2023

Market Assessment of Electrical Automation; Metering, Control and Protection Devices; Portable Test & Measurement Instruments; Solar String Inverters; and Aluminium High-Pressure Die-Casting: Global and India

SUBMITED TO RISHABH INSTRUMENTS

CREATED BY FROST & SULLIVAN

Catalog

DISCLAIMER

Given below is the content to be provided to you for your internal use by Frost & Sullivan as part of your subscription to its industry research:

"Market Assessment of Industrial Panel Devices, Portable Test and Measurement Instruments, Solar String Inverters, and Aluminium High-Pressure Diecasting: Global & India" (the "Report")

The study has been undertaken through extensive primary and secondary research, which involves discussing the status of the industry with leading market participants and experts and compiling inputs from publicly available sources, including official publications and research reports. The estimates provided by Frost & Sullivan (India) Private Limited ("Frost & Sullivan"), and its assumptions are based on varying levels of quantitative and qualitative analyses, including industry journals, company reports and information in the public domain.

Frost & Sullivan has prepared the study in an independent and objective manner, and it has taken all reasonable care to ensure its accuracy and completeness. We believe that the study presents a true and fair view of the industry within the limitations of, among others, secondary statistics, and primary research, and it does not purport to be exhaustive. The results that can be or are derived from the findings are based on certain assumptions and parameters/conditions. As such, a blanket, generic use of the derived results or the methodology is not encouraged forecasts, estimates, predictions, and other forward-looking statements contained in the report are inherently uncertain because of changes in factors underlying their assumptions, or events or combinations of events that cannot be reasonably foreseen. Actual results and future events could differ materially from such forecasts, estimates, predictions, or such statements.

In making any decision, the recipient should conduct its own investigation and analysis of all facts and information and the recipient must rely on its own examination. The recipients should not construe any of the contents in the report as advice relating to business, financial, legal, taxation or investment matters and are advised to consult their own business, financial, legal, taxation, and other advisors.

CHAPTER 1 - MACROECONOMIC OUTLOOK

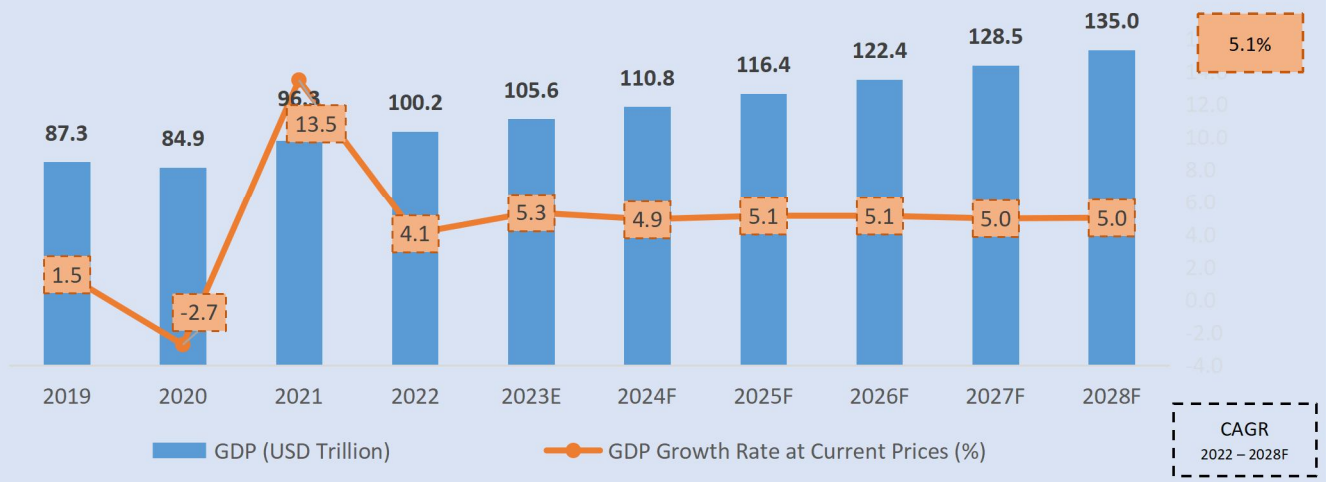
Overview of the Global Macro Economy

Global economic recovery following the COVID-19 pandemic has been hampered by the fallout of the Russo-Ukrainian war, elevated inflation levels, tighter monetary conditions, and dampened consumer and business sentiment.

The unprecedented rebound in economic activity globally in 2021 was supported by an influx of COVID-19 related economic stimulus and relief packages which led to a surge in consumer demand and improved investment inflows. However, there was a significant pullback in momentum during 2022, largely due to the Russo-Ukrainian war that exacerbated ongoing supply chain disruptions, and exponentially increased the prices of essential commodities such as food and fuel, thus leading to a cost-of-living crisis across the world. While inflation has moderated to some extent in 2023, restrictive credit conditions, sluggish Chinese economic recovery, and a deceleration in economic growth in major developed countries will lead to a slowdown in the real global annual growth rate in 2023.

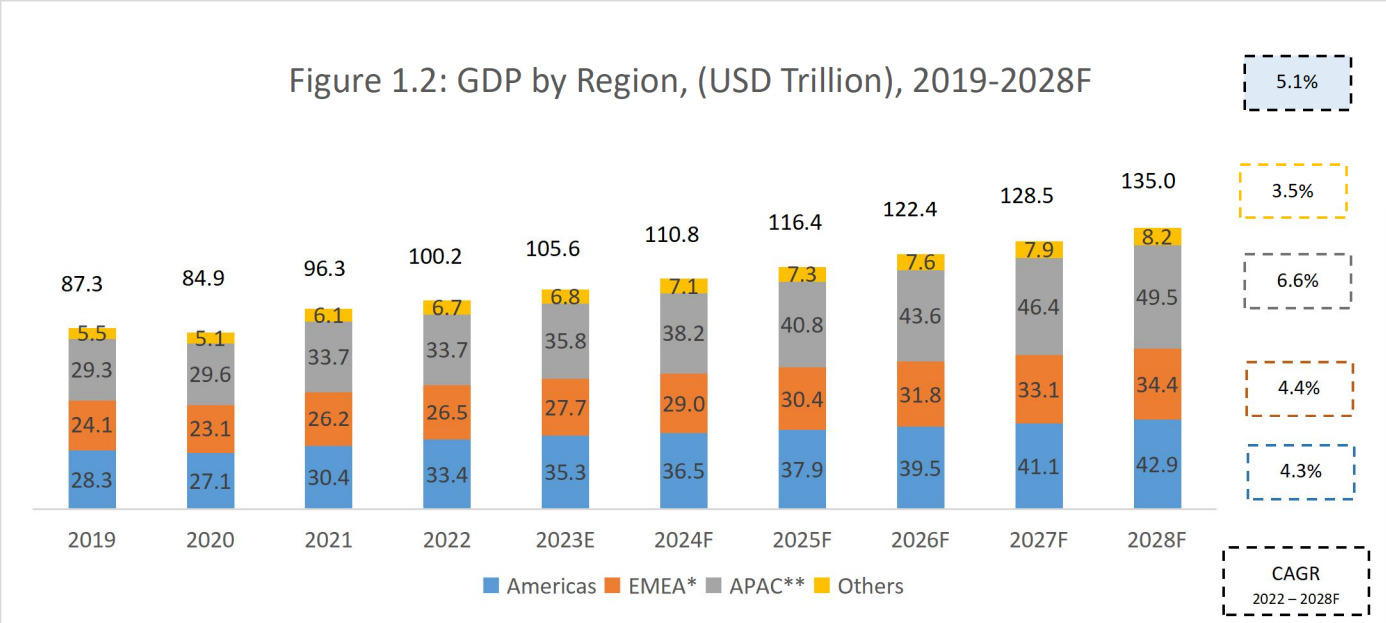
Meanwhile, growth beyond 2023 is marginally lower compared with pre-COVID-19 pandemic figures, mainly due to the economic issues that emerged in 2022. These issues have overall affected long-term growth prospects, albeit with a marginal impact. GDP growth at constant prices is expected to stabilize around 3.1% from 2024 to 2028.

Figure 1.1: GDP and Annual Growth Rate, Global, 2019-2028F



Source: International Monetary Fund (IMF), World Economic Outlook, April 2023; Frost & Sullivan

Note: E stands for estimate, F stands for forecast. GDP growth is calculated year-on-year. CAGR is calculated using current prices.



Source: IMF, World Economic Outlook, April 2023; Frost & Sullivan

Note: E stands for estimate, F stands for forecast. GDP is in USD trillion at current prices. GDP growth is calculated year-on-year. CAGR is calculated using current prices.

Note: *EMEA includes 27 countries of the European Union (EU) along with the United Kingdom (UK), and the Middle East and Central Asia, and Sub-Saharan Africa regions; **APAC includes 30 countries of emerging and developing Asia (including China and India), Japan, Australia, South Korea, and Taiwan. Others include countries that are not accounted for in *EMEA, and **APAC.

The repercussions of the Russo-Ukrainian war were felt across countries and industries in 2022.

War-induced commodity price increases and supply chain disruptions negatively impacted food security and trade of both developed nations such as the US and the EU as well as developing and under-developed nations in Asia, Africa, and Latin America.

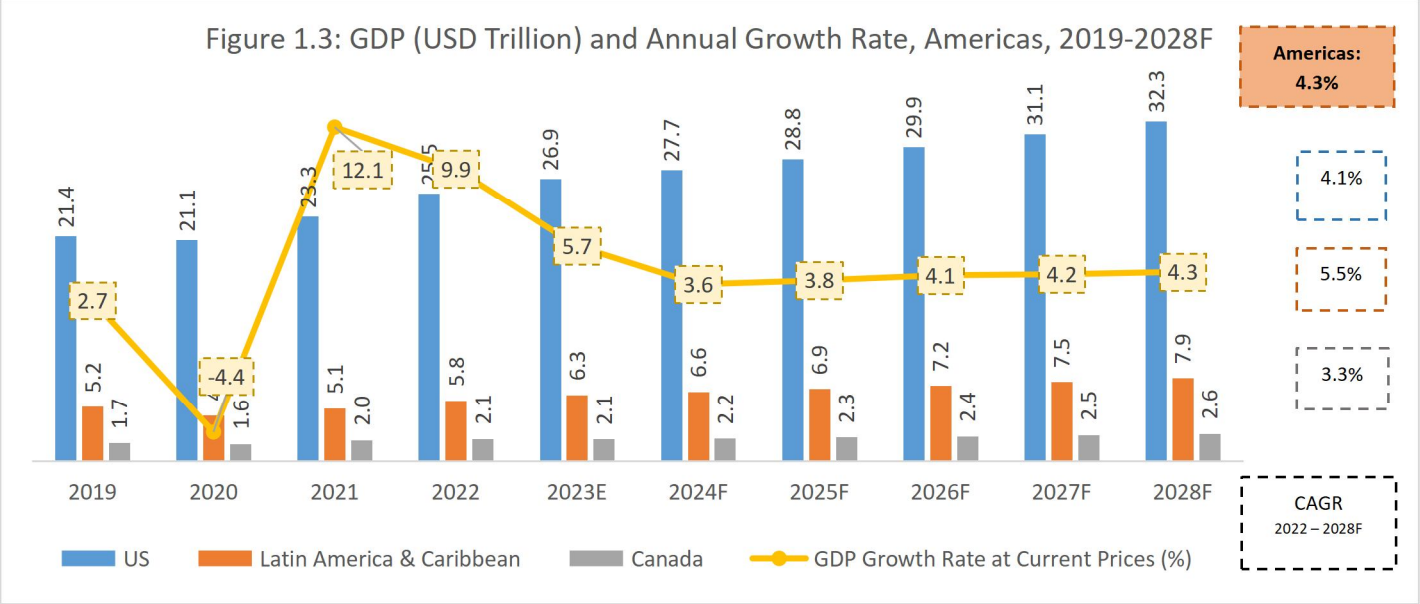
An expected normalization following the 2021 growth spurt, coupled with the war lowering consumer and business optimism, leading to a costly humanitarian crisis, and decreasing the supply of essential commodities such as wheat, corn, fertilizer, oil and gas, neon, and palladium, contributed to the significant contraction in global economic growth in 2022. Nevertheless, the outlook for the global economy is improving, albeit at a slow pace, as policymakers across countries focus on promoting competition, reviving investment, bolstering productivity, alleviating supply chain bottlenecks, and transitioning to a more digital and green future. Emerging economies will be at the forefront of this transformation, due to the availability of favorable economic, demographic, and monetary conditions.

.

Economic Outlook by Region

Americas

The Americas, which includes North and South America, is the second-largest regional economy. Its GDP was USD 33.4 trillion in 2022. The United States, the region's largest economy, contributed USD 25.5 trillion. Latin American countries' combined GDP for 2022 was USD 5.8 trillion, and Canada's was USD 2.1 trillion. The war has negatively impacted the growth potential of Americas, with disruptions to global energy and food markets squeezing supply and pushing up prices to unprecedented levels.



Source: IMF, World Economic Outlook, April 2023; Frost & Sullivan

Note: E stands for estimate, F stands for forecast. GDP is in USD trillion at current prices. GDP growth is calculated year-on-year. CAGR is calculated using current prices.

United States

The US economy grew by 2.1% in 2022, a significant slowdown compared with the previous year's growth rate of 5.9%. This can mainly be attributed to persistently high inflation, rising Federal Reserve interest rates, and battered financial markets due to the Russo-Ukrainian war.

Consumer confidence waned by a huge margin during 2022, amid increasing pessimism about the labor market, slower annual wage growth, high prices of essential commodities such as food and gas and increasing borrowing costs.

Moreover, the impact of the war was also seen on the business sector with the US Small Business Confidence Index consistently falling during the year. A decrease in output as well as new orders amid high inflation and reduced demand, worker shortages, and a deteriorating credit outlook dampened business conditions and led to a depressed growth momentum for small and medium-sized businesses.

Meanwhile, in its fight against inflation, the US Federal Reserve increased its interest rate seven times in 2022 – placing its benchmark rate in a range of 4.25% to 4.5%, its highest level in 15 years, at year-end.

While inflation has moderated, the US Federal Reserve has continued to hike its key interest rate in 2023, with median expectations of a funds rate of 5.6% by the end of the year. This, coupled with dampened commercial and industrial lending by banks, lower government spending due to the debt ceiling deal, and shrinking factory activity will lead to a 1.6% real GDP growth in 2023. Meanwhile, the US, over the medium term, will get a boost from the gradual recovery in real disposable income and stabilization in the country's housing market.

Latin America and Caribbean

Latin America and Caribbean comprises of Mexico, Central and South American countries, and Caribbean countries. Following the 6.8% contraction in 2020 amid the COVID-19 pandemic, the region's economy posted a robust rebound of 7.0% in 2021. However, momentum was impacted tremendously in 2022 following the onslaught of the Russo-Ukrainian war, with the region's economy recording just 4.0% GDP growth at constant prices during the year.

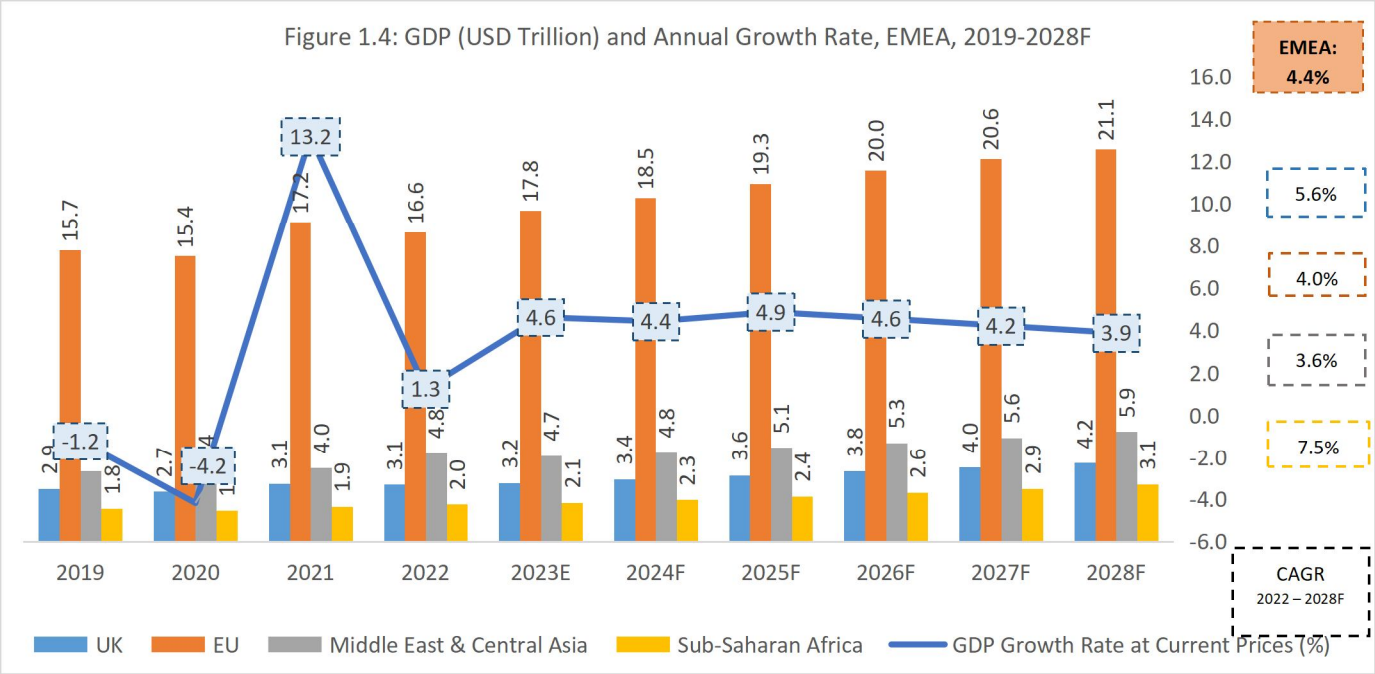
There is high socio-economic and political instability within the Latin American region. Most of the Latin American countries suffer from high income inequality, poor literacy rates, political volatility, and high poverty levels. These issues have been exacerbated in the last few years due to the COVID-19 pandemic and more recently due to the Russo-Ukrainian war. High inflation lowered disposable income levels of households, heightened income inequality, and increased poverty levels.

Going into 2023, growth is expected to further slow to 1.6% within the region, amid weaker global economic activity, slower labor market recovery, and tighter monetary conditions in the region. Moreover, most Latin American countries are highly dependent on export trade. The region's export potential will be hampered by sluggish Chinese economic recovery. Latin American countries are also a key destination for large-scale Chinese investments as part of the latter's Belt and Road Initiative. An uneven Chinese economic recovery will dampen investment inflows, thus hampering productivity across critical growth sectors such as infrastructure, transport, energy, and mining across Latin America.

Europe, the Middle East and Central Asia, and Sub-Saharan Africa

Europe

EU GDP stood at USD 17.2 trillion in 2021 but declined to USD 16.6 trillion in 2022, mainly due to the Russo-Ukrainian war.



Source: IMF, World Economic Outlook, April 2023; Frost & Sullivan

Note: E stands for estimate, F stands for forecast; GDP is in USD trillion at current price; GDP growth is calculated year-on-year. CAGR is calculated using current prices.

Note: EMEA numbers include 27 countries in the EU, Middle East (including Central Asia), and Sub-Saharan Africa

The EU and the UK have been the most affected due to the Russo-Ukrainian war, largely due to their geographical proximity to it as well as due to their heavy dependence on Russian oil and gas to meet their energy needs. Since the beginning of the war, the EU and UK have introduced unprecedented restrictive measures on economic relations with Russia which have also impacted the region's economic activity. Following a 3.7% growth in 2022, the EU's economy is expected to expand by a marginal 0.8% in 2023, with major European countries such as Germany, France, and Italy facing wide-spread socio-economic and political instability.

The EU's largest economy, Germany, entered a recession in the first quarter of 2023, amid high inflation, lower investment inflows, pullback in domestic consumer spending, and lower labor productivity due to lack of skilled workers. While gradually slowing inflation and strong wage growth will bring back some momentum later in the year, sustained demand weakening, and poor credit conditions will continue to negatively impact the country's manufacturing activity in 2023.

The UK is also facing a weak growth outlook for 2023. The economy is expected to contract by 0.3% in real terms over the year, as inflation eats into household incomes, coupled with a deteriorating housing market outlook, and soaring interest rates.

Shocks from the Russo-Ukrainian war will continue to impact the European economy in 2023 and beyond. The war has increased risk exposure for European capital flows, disrupted the region's trade routes, blocked a critical source of energy supplies, and led to a shortage in critical food products such

as wheat, and corn. For Eastern European countries, the costs of the war are in the form of a burgeoning humanitarian crisis which is exerting pressure on local resources.

Middle East and Central Asia and Sub-Saharan Africa

Following pandemic-induced 2.7% contraction in 2020, Middle East and Central Asia's economy grew sharply by 5.3% in 2022, supported by a rebound in global oil demand, elevated crude oil prices, and an increase in foreign investments within the region. The Middle East and Central Asia's GDP will grow at a 3.6% CAGR from 2022 to 2028, on account of business and market-oriented reforms and development of the non-oil economy.

Sub-Saharan Africa's GDP is expected to grow at a CAGR of 7.5% between 2022 and 2028 – one of the highest in the world – due to greater importance being placed on infrastructural investments, improving literacy rates, labor force development, and propagating the growth of technological innovation and digitalization. However, this region suffers from social upheaval. Wide-spread corruption, food insecurity, poor healthcare services, and the lack of strong political institutions are impacting the region's economic growth potential.

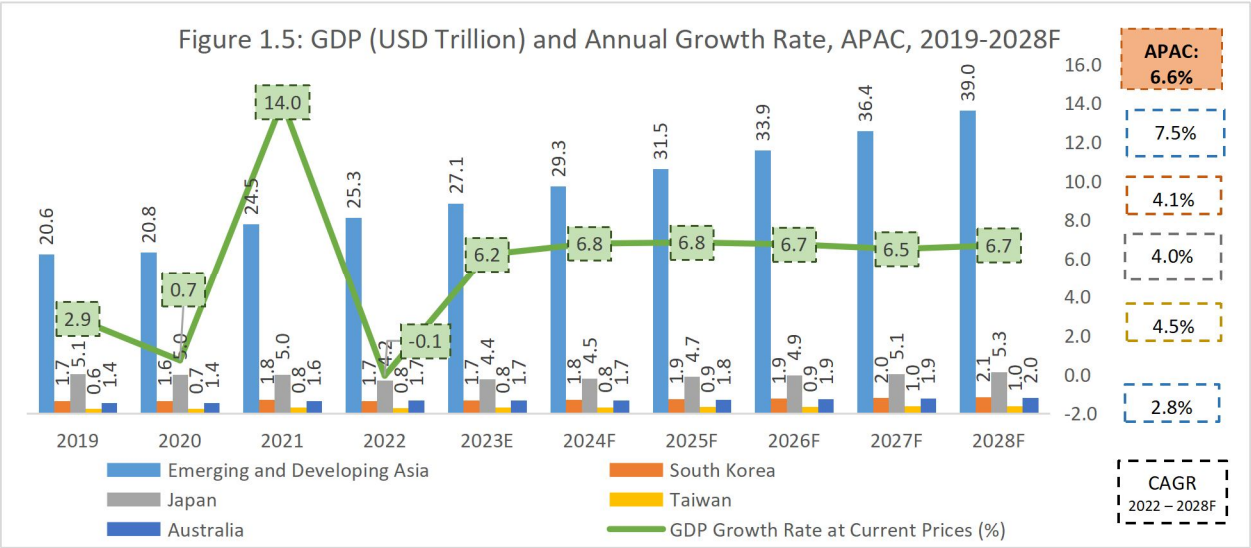
Middle Eastern and Central Asian and Sub-Saharan African countries were relatively insulated from the negative growth fallout of the Russo-Ukrainian war. While rising inflation heightened food insecurity, particularly within the African continent, and the resultant global monetary tightening led to constrained investment flows, the countries within these regions were largely shielded from the war, benefitting significantly from the rising oil prices which led to greater revenue inflows and improved trade balances.

Meanwhile, 2023 growth momentum within the Middle East and Central Asia and Sub-Saharan Africa regions will be sustained, amid robust growth in the non-oil sectors such as tourism, real estate, construction, transportation, and manufacturing, and improving business climate and competitiveness.

Asia-Pacific

The region includes 30 countries of emerging and developing Asia (including China and India), Japan, Australia, South Korea, and Taiwan. Its economy is poised to grow tremendously primarily because of the large and favorable population demographics, increasing urbanization, and digitalization initiatives. The APAC economy grew by 3.8% in 2022, despite the prevalence of the Russo-Ukrainian war, and the region is projected to grow by 4.4% in 2023, amid sound economic fundamentals such as rising disposable income, an expanding working-age population, and fiscal soundness. However, a slower-than-expected Chinese economic recovery can cause some spillover effects through trade and investment pullback.

Meanwhile, the war lead to new headwinds for the APAC region. Due to the region's high reliance on crude oil imports, increased oil prices led to higher import bills which negatively impacted the region's trade balances. Elevated food and fuel prices lowered consumer confidence. The war also dealt a blow to the region's poverty alleviation efforts, thus lowering living standards.



Source: IMF, World Economic Outlook, April 2023; Frost & Sullivan

Note: E stands for estimate, F stands for forecast; GDP is in USD trillion at current price; GDP growth is calculated year-on-year. CAGR is calculated using current prices.

Note: APAC numbers represented above includes 30 countries in Emerging and Developing Asia (including China and India), Japan, Taiwan, South Korea, and Australia.

Going ahead, the projected 2022-2028 GDP CAGR of 6.6% will be primarily driven by emerging and developing economies including China, India, and Southeast Asia (Thailand, Vietnam, Indonesia, Malaysia, Cambodia, and the Philippines). On the other hand, advanced economies of Asia including Australia, New Zealand, Japan, Taiwan, South Korea, & Singapore are anticipated to grow between 2.5% and 3.5% in the next 5 years.

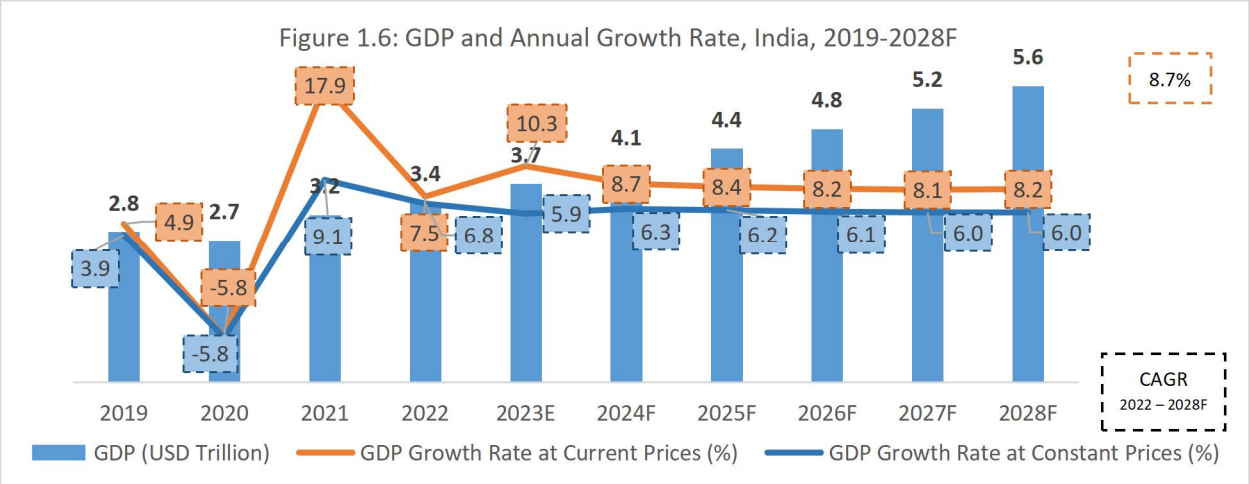
India

Following a 5.8% contraction in 2020, due to the COVID-19 pandemic, the Indian economy rebounded sharply by 9.1% in 2021, followed by 6.8% growth in 2022. The Indian economy is expected to grow by ~5.9% in 2023. These GDP numbers are in tangent with the country's long-term economic growth prospects, which will be supported by a resilient consumer base, strong government investments, cross-industry infrastructural projects, last-mile digitalization initiatives, and growing importance being placed on technological innovation.

India is largely considered as a bright spot in the current global economic scenario. One of the contributors to the economic strength is the country's manufacturing sector. Aided by resilient domestic demand, government incentives, a progressive tax structure, and the availability of skilled labor will contribute to the growth of this sector over the medium-term.

Digitalization is another growth driver for India's economy. Greater adoption of 5G services, increasing internet and smartphone penetration, availability of digital infrastructure facilities, and growing digital literacy is improving the scope of the country's digital economy and leading to the growth of emerging sectors such as FinTech, EduTech, AgriTech, and MedTech. Digitalization will also accelerate the growth

of India's cashless economy, which will help streamline financial services through better efficiency and productivity.



Note: E stands for estimate, F stands for forecast; GDP is in USD trillion at current price; GDP growth is calculated year-on-year. CAGR is calculated using current prices.

Source: IMF, World Economic Outlook, April 2023; Frost & Sullivan.

India has also stepped up its efforts to lower emissions and use more renewable energy. India aims to achieve 500 GW of non-fossil fuel capacity by 2030, with the goal to achieve net-zero greenhouse gas emissions by 2070. Out of the 500 GW, 300 GW is planned to come from solar sources with rooftop solar contributing about 40 GW. To achieve these targets, the Ministry of Renewable Energy launched several schemes and introduced policy measures such as renewable purchase obligations (RPOs) with mandates on increasing renewable sources' contribution to power distribution. The solar string inverters market is expected to grow from USD 778.14 million in 2022 to USD 1290.6 million in 2027 at a 10.6% CAGR.

The Indian automotive industry will join forces on sustainability initiatives. Automakers are creating separate electric vehicle (EV) business units to be prepared for higher demand. India will increase charging infrastructure and introduce more safety regulations and standards. Frost & Sullivan estimates that electric 4-wheeler sales will increase at a CAGR of 75.5% from 2019 to 2025, and electric 2-wheeler sales at a CAGR of 87.3% in the same period.

India also faced some near-term repercussions of the Russo-Ukrainian war. The immediate impact on India was rising inflation caused by higher petrol and diesel prices. Given that India imports about 80% of its oil, the increase in oil prices had an adverse effect on the entire economy. To tackle the issue, India has worked on various trade policies such as a rupee-ruble payment system for Russian oil and gas and adapting to digital currency to facilitate trade payments.
Sustained private consumption, particularly urban consumption, along with a sound external position and stable domestic financing base will contribute towards the growth of the Indian economy over 2023 and 2024.

CHAPTER 2 – OVERVIEW OF SEGMENTS

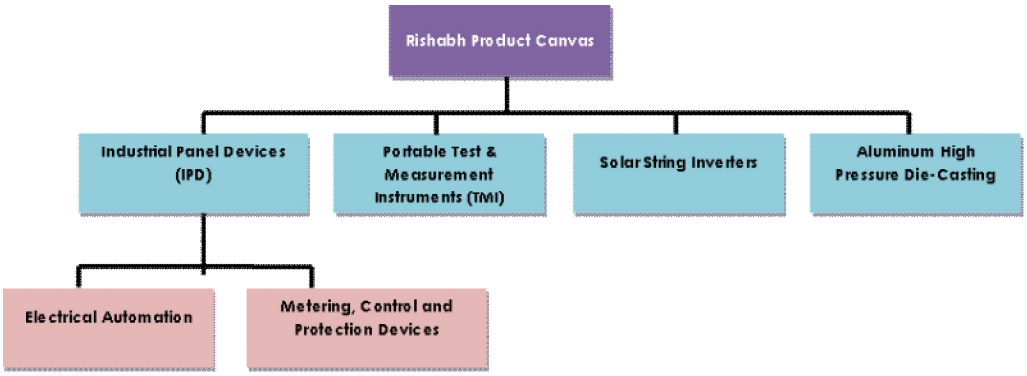


Figure 2.1: Rishabh Instruments' Product Segments

Industrial Panel Devices (IPD) are mainly used in different type of panels like PCC, MCC, Automation Panel, Power Factor Correction panel, Distribution Panel etc. to measure and control the standard signals like Electrical signals, Electro-mechanical signals, Digital and Analog type of signals, Process Signals etc., and protect the overall system. The various types of measured signals can be monitored via different devices like Analog/Digital Panel Meters, Multi-Function Meters, Current Transformers, Power Factor Controllers, Transmitters, Temperature Controllers etc. and the system protection can be ensured by devices like Protection relays. The main function of IPDs is to measure, record, analyze different type of signals and to protect and control the complete electrical system or processes. IPDs provide system transparency and integration, and remote system monitoring and control along with necessary protection to maintain the overall safety of the installation and operating personnel. IPD is categorized into two product segments.

a) **Electrical Automation** – A complex electrical network requires complete integration of various signals to build an intelligent system and to automate the overall operation. This integration and automation work is done by system integrators. The main function of system integrators is to collect the various types of signals from the multiple devices like Transmitters, Temperature Controllers, Electrical Transducers, integrate them, and automate the whole system. The electrical automation products are used by these system integrators mainly for collection of signals. The panels built by these system integrators are called "Automation panels." The Electrical Automation Market caters to a wide variety of customer segments like Processing industry (Cement, Chemicals), FMCG, Power utilities (Generation, Transmission, Distribution) etc.

b) **Metering, Control and Protection Devices** – The Metering, Control and Protection Devices, such as Analog/Digital Panel Meters, Multi-Function Meters, Current Transformers, APFC relays, Protection relays etc. are used in centralized system to measure, control, record, analyze, and protect the electrical system. The centralized system comprises of PCC (Power Control Centre), MCC (Motor Control Centre) and APFC (Automatic Power Factor Control Centre) etc. The system mainly monitors the Electrical Power Distribution Network, Performance of electrical Motors

and Power Factor Correction in the electrical network and provides necessary protections. These types of panels are mainly used in Power utilities (Generation, Transmission, Distribution), Railways, OEMs (Transformer, Motor, Cables, etc.), Processing industries, Manufacturing Industries, Pharmaceuticals Industries, DG Set Manufacturer etc. The Metering, Control and Protection Devices are mainly mounted on the front side of the panel or inside the panel to provide the necessary functionality.

Portable Test & Measurement Instruments (TMI) are used to measure the electrical parameters of wide-ranging industrial, utility, and consumer products. These instruments are used to test and measure the various electrical parameters, e.g., voltage, current, power, etc. onsite. Portable Test & Measurement Instruments largely include Hand-held as well as portable instruments such as Digital Multimeter, Clamp Meters, Insulation Testers, Earth Testers, Portable Power quality analyzers, etc. These instruments are basically used for maintenance and repairs by end users. They cater to a wide variety of customer segments like Power utilities (Generation, Transmission, Distribution), Railways, OEMs (Transformer, Motor, Cables, etc.) Defense, Processing industry, Service industries, Electrical Procurement and Constructions (EPCs), Electrical contractors, etc.

Solar string inverters refer to the inverters connected in string formation with each row of a solar panel equipped with an inverter box that connects to the main grid. Inverters are classified into micro inverters, string inverters, and central inverters. Micro inverters are typically limited to 300W-500W each and are suitable for only small installations of 1kW-2kW size. Central inverters are used for 105 MW scale ground mount PV projects but are now getting replaced by string inverters 175kW-255kW ratings because string inverters are easy to use, easy to service, and flexible in installing near to the PV array. String inverters can be used for residential and medium-sized commercial solar PV installations. It is smaller in size than central inverters. This market is dependent on the adoption of renewable energy across the globe.

Aluminium High-Pressure Die-Casting is the process of creating aluminium alloy-based products by forcing the molten metal into a die casted mold cavity. Aluminium Die Casting is usually done with a cold chamber under high-pressure as aluminium alloys have lower melting point. High Pressure Aluminium Die Casting is particularly employed for high volume manufacturing for automotive components. The high pressure die casting tooling (or die casting mold) is generally made of hardened steel to withstand high pressure and temperature. The die usually consists of two halves with negative geometry of the part to create the form factor. This segment mainly caters Automotive, Automation, Heating & Cooling, Lighting and Oil & Pumps industries.

CHAPTER 3 – OVERVIEW OF INDUSTRIAL PANEL DEVICES (IPD)

Value Chain Analysis of Industrial Panel Devices/Portable Test & Measurement Instruments

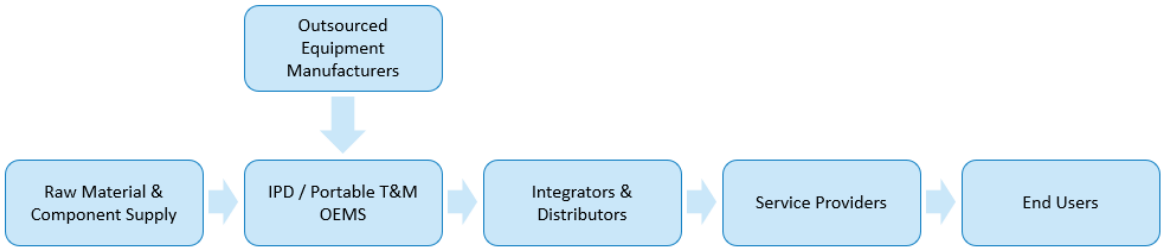


Figure 3.1: Value Chain of the Industrial Panel Devices/Portable Test & Measurement Instruments

The key players in the Industrial Panel Devices/Portable Test & Measurement Instruments industry value chain are:

- *Raw material and component supplier*: IPD/Portable T&M companies procure raw materials and components required for manufacturing the equipment. Components such as chip sets, cables, and other electronic components can be procured from local sources or imported.
- *Equipment Suppliers (Outsourced Equipment manufacturers)*: ESDM companies like Sanmina and Jabil support the design and manufacturing of components.
- *Original equipment manufacturers*: IPD/Portable T&M companies design and manufacture the equipment. Some outsourcing occurs. IPD/Portable T&M OEMs either directly sell to end users or sell through indirect sales channels consisting of integrators and distributors.
- *Integrators and distributors*: System integrators add more value and functionality for specific customer requirements. Distributors procure equipment from OEMs to provide last-mile sales to end users.
- *Service providers*: Examples include companies that provide Asset Management, Data analytics, Consulting, calibration and repair service, and financial solutions

In some product segments such as Electrical automation components; Metering, Control and Protection Devices; and Solar string inverters, Service providers may directly procure from OEMs for bulk requirements. In such a case, the OEMs supply to service providers in addition to integrators and distributors. Online and eCommerce sales are also emerging as a new form of distribution.

A. Electrical Automation

Overview

Note: As part of this study, the scope of Electrical Automation includes Sensors and Transmitters, Field Instruments, Human-Machine Interface, Temperature controllers, Chart Recorders, Electrical Transducers, and I/O Converters.

A complex electrical network requires complete integration of various signals to build an intelligent system and to automate the overall operation. This work is done by various system integrators whose main function is to collect the various types of signals from the multiple devices like Transmitters, Temperature Controllers, Electrical Transducers, integrate them, and automate the whole system. Rishabh Instruments supplies the products that are used in automating processes.

The market for electrical automation components is very mature globally. Electrical automation components are used to continuously monitor, analyze, and take control of real-time field equipment such as motors, pumps, and other manufacturing equipment. Digitization and Industry 4.0 initiatives are pushing every industry to transform their operations to become more efficient and flexible, thus positively affecting the electrical automation components market. The global electrical automation industry has experienced steady growth over the last 4 years. The global electrical automation market was valued at USD 147.5 billion in 2022 and is expected to grow at CAGR of 7.8% to reach USD 215.1 billion by 2027. India is forecasted to grow the fastest, driven by industrial end users.

The Indian market for industrial panel devices and electrical automation consists of end users from large, established automotive and food and beverage manufacturers and process industries such as oil and gas and steel mills. The rise of automation has been steady in the Indian market. Hence the demand for electrical automation components such as sensors, transmitters, field instruments, and Human-machine interfaces has been steadily growing as manufacturers embrace automation to deliver products of global quality. The concept of the Industrial Internet of Things is widespread in India and manufacturers are aware of the gains of digitization, accelerating growth for the Indian electrical automation market. Rishabh, with its products such as I/O converters, IoT enable Transmitters, Dataloggers, FTP & HTTP inbuilt webserver-based Chart Recorders, is well positioned to capitalise on this growth trend.

Evolution of Electrical Automation Industry

Years	Key Advancements
2011-present	• The last 11 years witnessed proliferation of sensors and transmitters at every stage in the industrial shop floor. With advanced communication protocols, cloud computing, and analytics, electrical automation has gone through a paradigm shift. • Multitouch technologies such as tablets and smartphones have changed the role of HMIs again. Cross-platform technology such as HTML5 has gained traction. Cloud Computing Servers now enable access to monitoring and control from any location.
2001-2010	• The late 1990s and early 2000s witnessed the move to PC systems, and the focus immediately turned from hardware to software. Wonderware and Intellution introduced control software for the PC, making HMI a software-rather than hardware-inclined

	technology. • The 2000s witnessed a steady growth in industrial sensors and small connected devices, leading to the inception of the IoT in 2009. • With wide adoption of DCS and PLC, HMI increasingly moved from control centers to the shop floor.
1991-2000	• The 1990s witnessed leading companies move into developing smaller handheld field devices and fully digital devices for measuring electrical signals (e.g., paperless Chart Recorders) • Simple push buttons and dials dominated the HMI market even in the 1990s because of their low cost. Electronic terminals were new but expensive innovations. It cost $100 to replace a single push button with electronic terminals. • The late 1990s witnessed movement from CRT to LCDs, making touch screens intrinsically safe.
1981-1990	• From the mid-1980s, PLC manufacturers gained traction and used proprietary Operator Interface terminals for control. • During the same period, semiconductors were becoming smaller, cheaper, and more reliable, enabling the design of complex field devices and other measuring equipment. • Because of the smaller form factor, companies started developing portable measuring devices for a wide range of applications.
1971-1980	• From the mid-1970s to mid-'80s, HMI predominantly consisted of a process flow diagram on a large wall that integrated gauges, indicators, and switches to provide an idea of the industrial process.

Overview of Global Electrical Automation Market

The global electrical automation market was valued at USD 147.5 billion in 2022 and is expected to grow at CAGR of 7.8% to reach USD 215.1 billion by 2027. Asia-Pacific is the fastest growing region and is expected to become the largest by 2027. The market push is expected to come from new building automation facilities, greenfield factories, and digitization initiatives in brownfield factories.

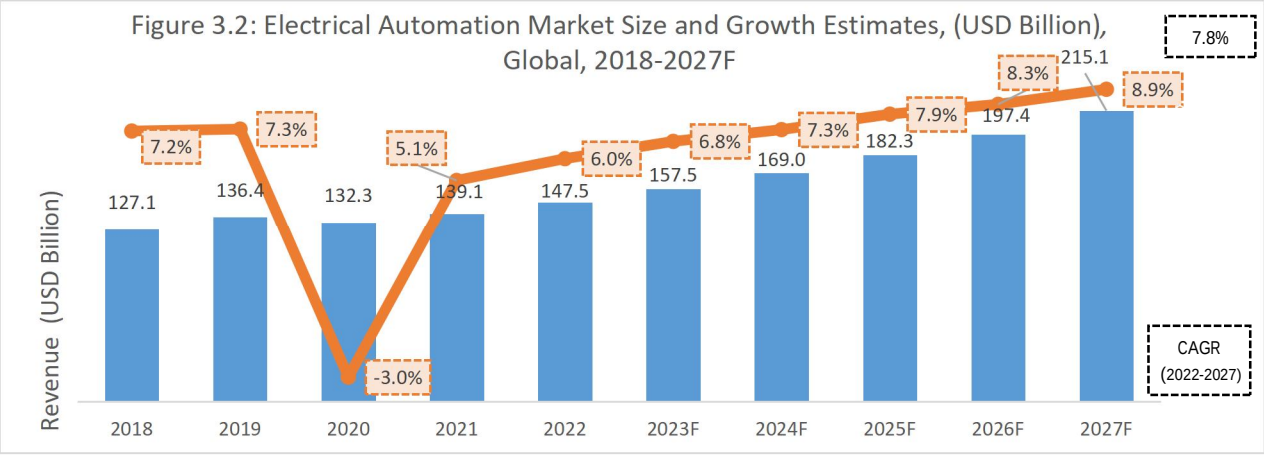


Figure 3.3: Electrical Automation Market Size and Growth Estimates by Region, (USD Billion), 2018-2027F

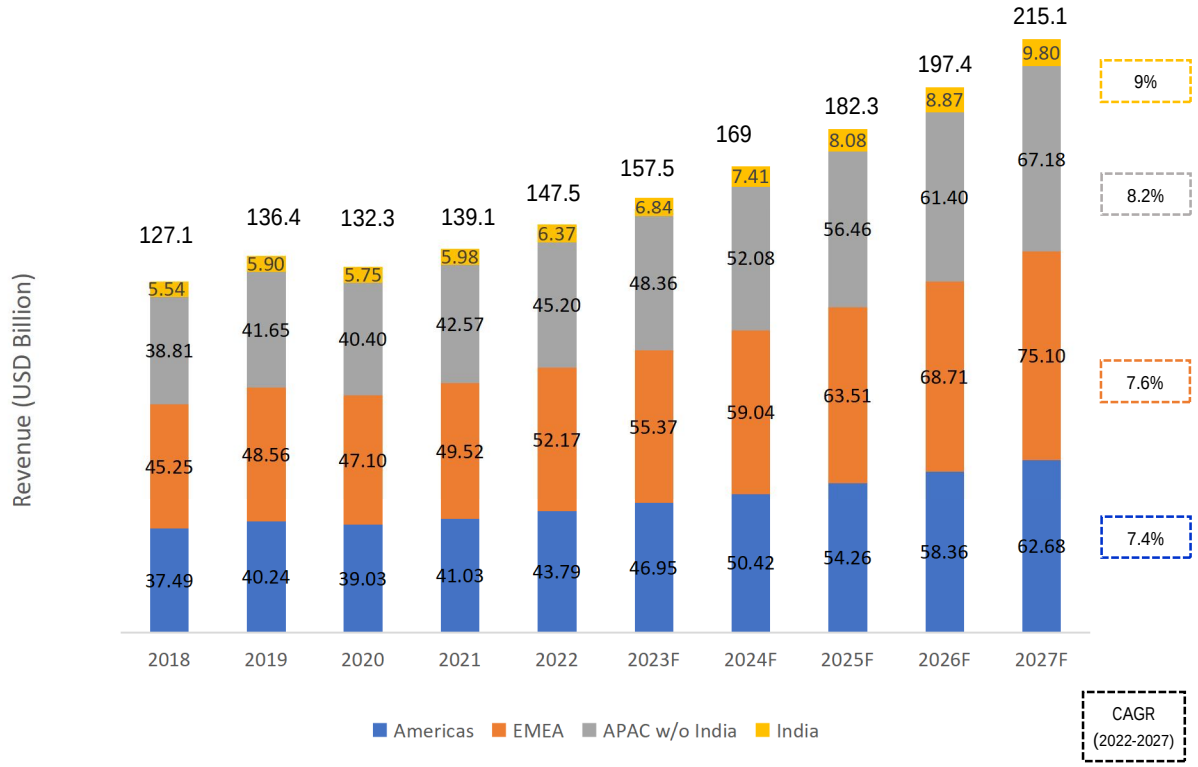
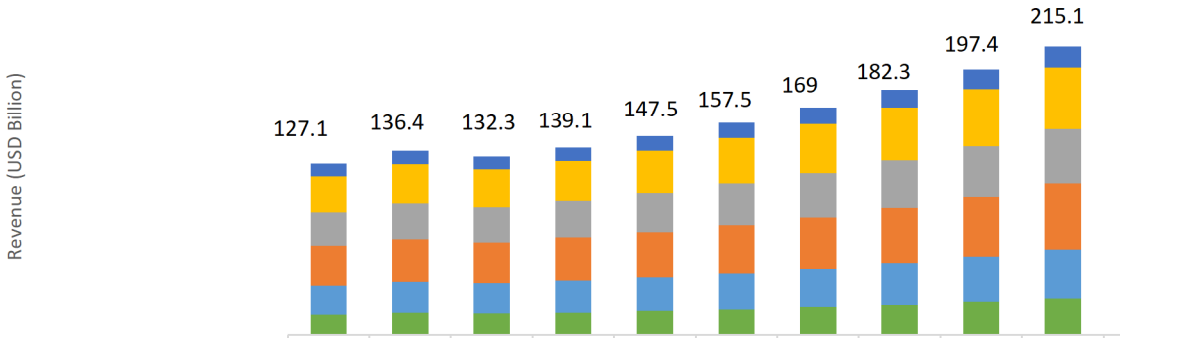


Figure 3.4: Electrical Automation Market Size and Growth Estimates by End User, Global, (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	9.38	10.06	9.77	10.26	10.86	11.60	12.43	13.40	14.49	15.7	7.6%
Pharma., FMCG	26.74	28.68	27.82	29.23	31.36	33.80	36.51	39.58	42.79	46.4	8.1%
O&G, PetroChem., S&C	24.98	26.79	25.99	27.32	29.00	30.87	32.94	35.22	37.76	40.6	7.0%
Comm., CE,Semicon,BA	29.21	31.34	30.40	31.95	33.61	35.56	37.95	40.93	44.49	48.8	7.7%
Auto,Transp.&Def.	21.43	22.99	22.30	23.44	24.86	26.57	28.44	30.66	33.18	36.2	7.8%
Others	15.37	16.48	15.99	16.80	17.84	19.13	20.69	22.51	24.62	27.16	8.8%

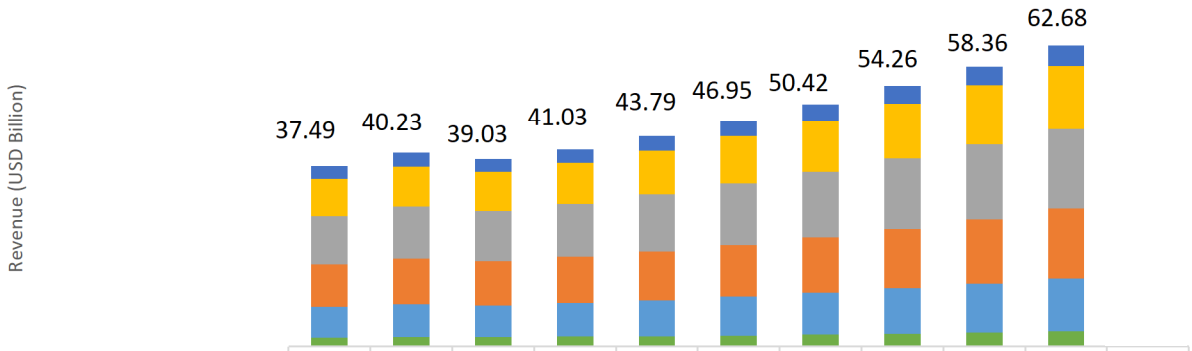
Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Regional Overview

The Americas was the third-largest market in 2022 with a 29.7% share. Electrical Automation market in the Americas is projected to grow from USD 43.79 billion in 2022 to USD 62.68 billion in 2027 at a CAGR of 7.4%. While the CAGR is lower than other regions, growth for electrical automation components remains constant as industries begin to invest in advanced technologies in preparation for a flexible, smart, and sustainable factory setup. With the Russo-Ukrainian war following trade sanctions, crude oil and natural gas prices have gone up. With demand picking up post COVID-19, and high gas prices, North America, is sensing an opportunity in the energy field. European countries are turning to the US as an alternative supplier of Oil and Gas. This is expected to boost its domestic production of crude oil and Natural Gas.

The Americas is forecast to record stable growth through 2027 with the restart of projects put on hold because of COVID-19. The region is seeing a shift from product- to service-based business models in process industries. Hybrid industry revenue is expected to increase, driven by the adoption of remote monitoring solutions, directly driving the demand for electrical automation products. Investments in smart factories in North America will boost market growth during the forecast period. The automotive industry will primarily drive the Americas market, with increasing investments in automation technologies. The Latin America market for digital technologies in industrial equipment is modest but set to experience incremental growth because of government initiatives, particularly in Mexico, to encourage their use.

Figure 3.5: Electrical Automation Market Size and Growth Estimates by End User, Americas, (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	2.66	2.86	2.77	2.91	3.03	3.20	3.40	3.64	3.91	4.2	6.8%
Pharma., FMCG	7.80	8.37	8.12	8.53	9.19	9.92	10.71	11.58	12.39	13.2	7.5%
O&G, PetroChem., S&C	10.01	10.74	10.42	10.96	11.79	12.71	13.64	14.58	15.59	16.6	7.0%
Comm., CE,Semicon,BA	8.81	9.46	9.17	9.64	10.16	10.77	11.51	12.38	13.39	14.6	7.5%
Auto,Transp.&Def.	6.34	6.80	6.60	6.93	7.47	8.06	8.70	9.41	10.16	10.8	7.7%
Others	1.87	2.01	1.95	2.05	2.15	2.28	2.46	2.67	2.92	3.22	8.4%

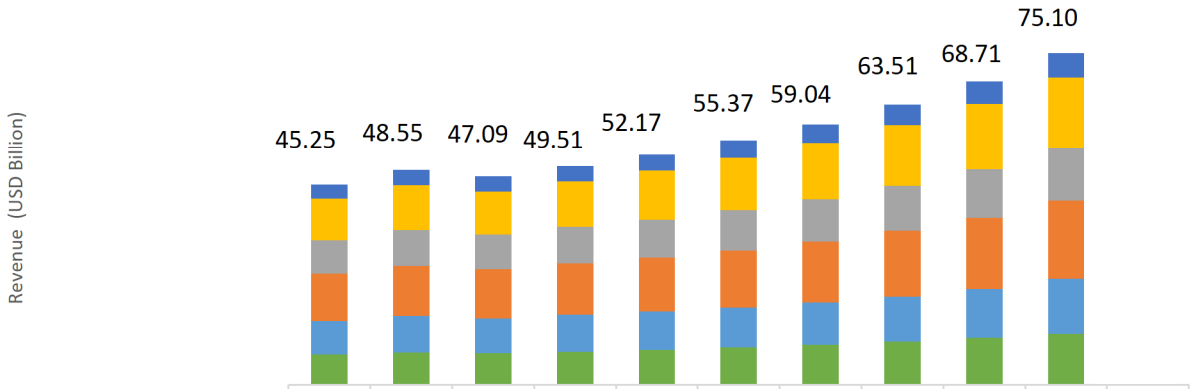
'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

EMEA, with a 35.4% market share, is the largest regional market. The market is estimated to grow from USD 52.17 billion in 2022 to USD 75.10 billion in 2027 at a CAGR of 7.6%. The region is at the forefront of industrial technology with Industry 4.0 initiatives. To tackle a lack of manpower, industries are turning to automation and digitization, which drives the demand for electrical automation components.

The Russo-Ukrainian war has negatively affected the automotive industry with OEMs and suppliers across Europe, discontinuing trade with Russia. This has led to a slowdown in production. Supply chain issues and raw material shortages are expected to decrease the overall year on year growth rate of the automotive industry during the forecast period.

The Oil & Gas industry has been impacted the most with the onset of Russo-Ukraine war. The Natural gas and coal prices rose by more than 90% in 2022. With US stepping up as a major alternative supplier, O&G activities are expected to witness a stable growth through 2027. Europe in particular anticipates an increase in extended service agreements for asset life cycles. The largest end user of electrical automation is Automotive and Transportation, followed by FMCG. Steel, Consumer electronics, and Pharmaceuticals also have considerable demand. Electrical automation in Building automation and data centers is fast growing, with CAGR of 7.8%.

Figure 3.6: Electrical Automation Market Size and Growth Estimates by End User, EMEA, (USD Billion), 2018-2027F



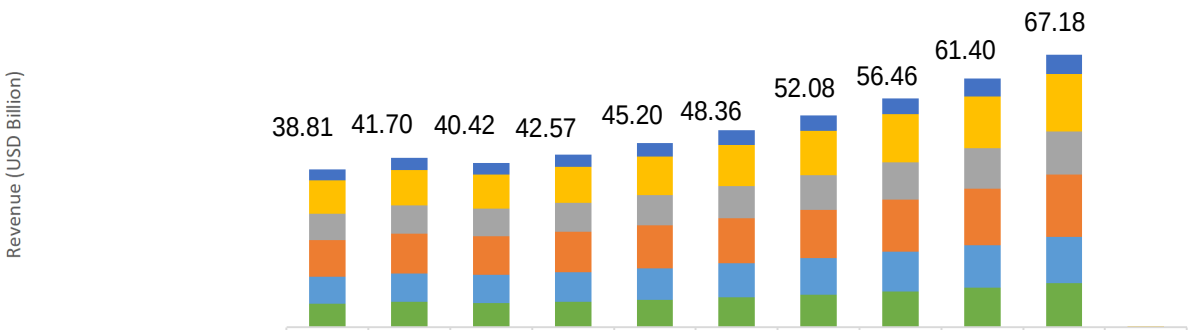
	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	3.21	3.45	3.34	3.52	3.72	3.96	4.24	4.57	4.95	5.4	7.7%
Pharma., FMCG	9.41	10.10	9.80	10.30	11.09	11.98	12.92	13.98	15.05	16.2	7.9%
O&G, PetroChem., S&C	7.56	8.11	7.87	8.27	8.67	9.09	9.58	10.18	10.90	11.9	6.4%
Comm., CE,Semicon,BA	10.63	11.41	11.07	11.64	12.19	12.89	13.73	14.82	16.14	17.7	7.8%
Auto,Transp.&Def.	7.65	8.21	7.96	8.37	8.65	9.06	9.54	10.20	11.09	12.4	7.5%
Others	6.79	7.28	7.06	7.43	7.85	8.39	9.03	9.76	10.58	11.52	8.0%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

APAC (without India) is the second-largest market, with a 30.6% share in 2022. Electrical Automation market in APAC w/o India is estimated to grow from USD 45.20 billion in 2022 to USD 67.18 billion in 2027 at a CAGR of 8.2% (the second-largest growth rate of any region). Volatile geo-politics have resulted in US imposing multiple sanctions on China, affecting Chinese semi-conductor market which relies heavily on technology from the US. Hence, its GDP growth is expected to be between 5.1% and 5.7% in 2023 instead of the predicted value of 5.5% to 6.3%.

Despite these factors, medium to high growth during the forecast period will be enabled by robust domestic demand from F&B and Pulp & paper. The region will gain a significant share in the digital manufacturing market, with steady growth from the automotive and power generation industries.

Figure 3.7: Electrical Automation Market Size and Growth Estimates by End User, APAC (excluding India), (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	2.76	2.96	2.87	3.02	3.25	3.51	3.78	4.09	4.43	4.80	8.1%
Pharma., FMCG	8.07	8.66	8.40	8.83	9.41	10.10	10.92	11.89	13.00	14.31	8.7%
O&G, PetroChem., S&C	6.48	6.96	6.75	7.09	7.48	7.95	8.51	9.16	9.85	10.60	7.2%
Comm., CE,Semicon,BA	9.12	9.79	9.49	9.98	10.52	11.10	11.85	12.79	13.93	15.31	7.8%
Auto,Transp.&Def.	6.56	7.04	6.83	7.18	7.73	8.35	9.01	9.74	10.48	11.30	7.9%
Others	5.82	6.25	6.06	6.37	6.82	7.36	8.01	8.79	9.71	10.86	9.8%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

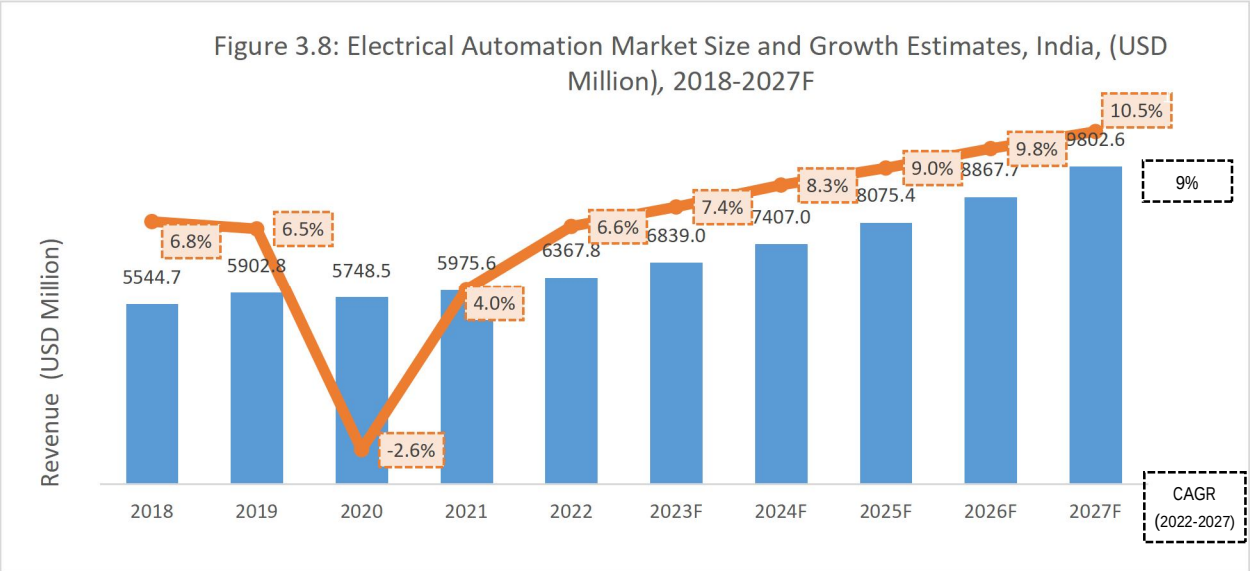
Total Addressable Market (TAM) for the Electrical Automation Market				
Region	*Total Market Size, 2022 (USD Billion)*	*Estimated TAM, 2022 (USD Billion)*	*TAM as % of Total Market**	*Comments*
Global	147.5	52.36	35.5%	The Global TAM is expected to be driven by organizational investments in sustainable, smart assets, facilities, and factories.
Americas	43.79	15.5	35.4%	Steady investments in sustainable factory setups will increase demand for temperature controllers, chart recorders, and electrical transducers in Americas.
EMEA	52.17	18.21	34.9%	A serious shortage of labor in EMEA is forcing companies to turn to automation and digitization, increasing demand for TAM products.
APAC excluding India	45.20	16.36	36.2%	Data centers and building automation are fast-growing end-user segments that are expected to increase demand for transducers, temperature controllers, chart recorders, and I/O converters.
India	6.4	2.27	35.5%	Automotive and transportation, food, and beverage, FMCG, chemicals, and textiles are major end users for Electrical Automation products like temperature controllers, recorders, transducer and I/O converters

*Note: Total market includes Sensors and Transmitters, Field Instruments, Human-Machine Interface, Temperature controllers, Chart Recorders, Electrical Transducers, I/O Converters. TAM calculated for the following products: Temperature controllers, Chart Recorders, Electrical Transducers, I/O Converters

Overview of Indian Electrical Automation Market

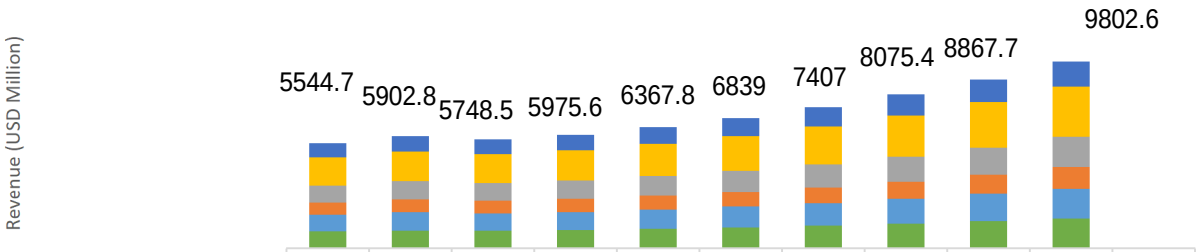
The Indian Electrical Automation market was valued at USD 6367.8 million in 2022 and is forecasted to grow at a CAGR of 9% to reach USD 9802.6 million by 2027. The market experienced a slowdown in 2020 due to the COVID-19 pandemic, but it has bounced back strongly and showcases a strong and positive outlook. China's weakening economic projections and ongoing trade wars will create opportunities for India to develop its cutting-edge technologies. By attracting investments from companies looking to diversify their manufacturing and supply chains away from China, India has more room to negotiate favorable trade agreements with other countries and strengthen its global influence.

With Indian Prime Minister's visit to the US in June 2023, both the countries are set to take a major step towards semi-conductors, defense and emerging technology (such as AI, 5G, 6G) supply chain market. This would promote semi-conductor manufacturing in India.



In India, Automotive and transportation, food and beverage, FMCG, chemicals, and textiles are major end users. Steel, semiconductor, and defense growth is less due to muted economic situation across the globe. Building automation and data centers are the emerging end-user segments. The push for localized manufacturing, development of IT infrastructure, and home automation systems can be seen as driving factors for electrical automation components.

Figure 3.9: Electrical Automation Market Size and Growth Estimates by End User, India, (USD Million), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	754.1	802.8	781.8	812.7	867.1	931.2	1006.5	1095.4	1197.4	1313.2	8.7%
Pharma., FMCG	1452.7	1546.5	1506.1	1565.6	1671.6	1799.4	1956.3	2138.7	2353.8	2613.5	9.3%
O&G, PetroChem., S&C	926.0	985.8	960.0	997.9	1053.7	1120.5	1205.7	1303.4	1420.6	1559.3	8.2%
Comm., CE,Semicon,BA	643.2	684.7	666.8	693.2	738.4	795.1	860.1	937.1	1030.7	1143.6	9.1%
Auto,Transp.&Def.	887.2	944.5	919.8	956.1	1019.5	1097.2	1193.1	1310.4	1450.6	1614.5	9.6%
Others	881.6	938.6	914.0	950.1	1017.5	1095.6	1185.3	1290.4	1414.6	1558.5	8.9%

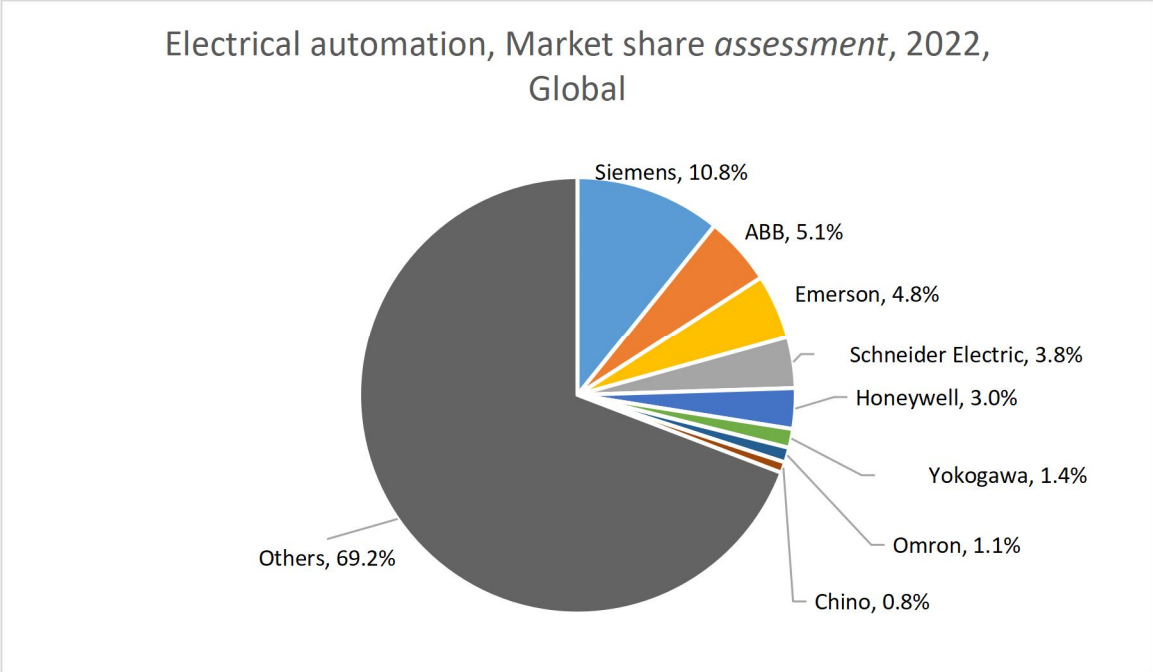
'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Total Addressable Market (TAM) for the Indian Electrical Automation Market			
Total Market, 2022, (Mn USD)	*Estimated TAM, 2022, (Mn USD)*	*TAM as % of Total Market**	*Product subcategories considered for TAM*
6367.8	2260.6	35.5%	Temperature controllers, Chart Recorders, Electrical Transducers, I/O Converters

*Note: Total market includes Sensors and Transmitters, Field Instruments, Human-Machine Interface, Temperature controllers, Chart Recorders, Electrical Transducers, I/O Converters.

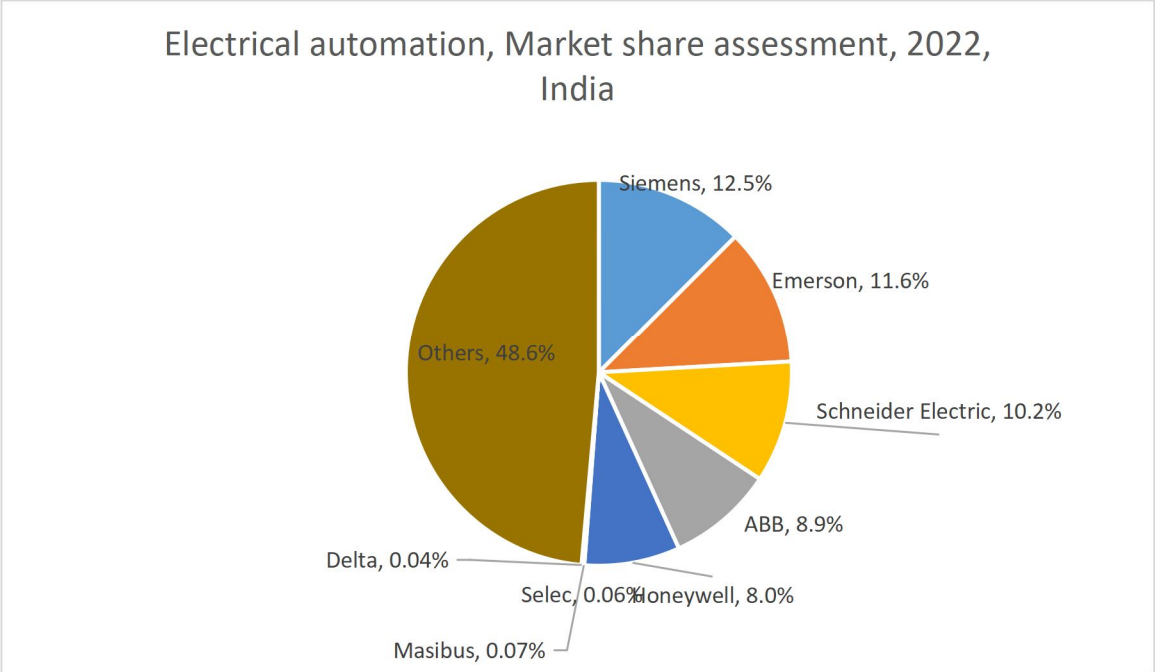
Competitive Landscape of Electrical Automation

Key Industry Players (Global and India)
Yokogawa, Chino, Omron, Phoenix, Masibus, Honeywell, Allen Bradley, Gefran, Waree, Baumer, Radix, Siemens, ABB, Schneider Electric, Selec, Delta, Emerson, Multispan & Rishabh



Note: Total Market Size = USD 147.5 Billion, 2022

Globally, the electrical automation component market has been dominated by international players like Siemens, ABB, Emerson, and others. The top 5 players occupy 27.5% of the global market share, followed by a long tail of regional and small players. The top companies have retained their market positioning by developing a strong product portfolio based on digitization. For example, Yokogawa with its Digital YEWFLO Sizing program provides customers easy means to product sizing and configuration, offering them the ability to generate flow-related calculations quickly and with high accuracy. Schneider Electric is integrating edge compute capabilities into its I/O modules as a part of its Ecostruxure portfolio. All the market leaders have infused digitization into their electrical automation products to provide added value to the customer and maintain market positioning. They also have a global presence and strong brand equity in this product segment that makes competition difficult.



Note: Total Market Size: USD 6367.8 MN, 2022

In **India**, the market is dominated by international players. The top 5 companies occupy approximately 50% market share. Local players compete with global brands on price points and customer service and are emerging competition. Industrial end users prefer a single vendor for all their needs, so international players have an advantage because of their wide product portfolio in this segment. Local players form a major part of others (48.8%) and in large part supply SMEs that make up the country's manufacturing base in India. Rishabh Instruments is the number one player in electrical transducers in India and holds ~37% of market share and it holds 0.07% market share in the electrical automation segment. (w.r.t the TAM).

Distribution Channel Assessment

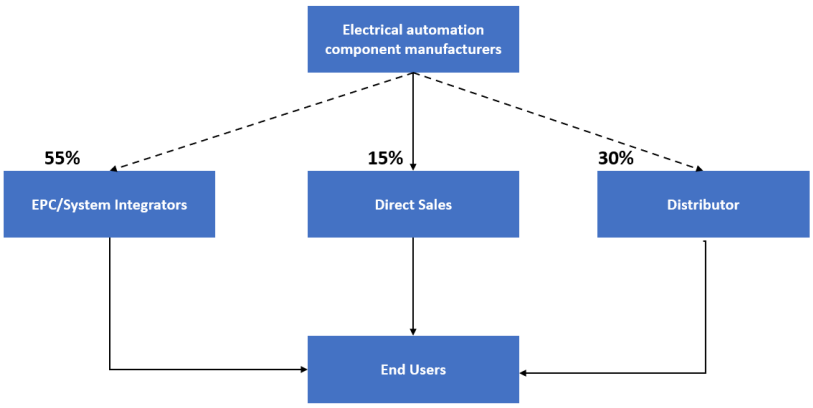


Figure 3.12: Electrical Automation Component Distribution Channels, India, 2023

There are three main distribution channels for Electrical automation components:

1. End users depend on EPCs and System integrators because most components are part of a larger project that EPCs and System integrators handle. About 55% of the sales happen through EPCs and system integrators.
2. Distributors account for 30% of sales in India.
3. Direct sales, at 15%, are the least preferred distribution method. Companies are using their own or third-party websites to improve traction here.

Technology Trends

Trend	Description
Direct-to-cloud connectivity in sensors	Sensors are being developed with inbuilt communication modules that can connect to the internet via gateway devices to automatically transfer data for remote monitoring.
Natural language processing and low-code user interfaces in HMI products	In order to simplify interface design and integration of HMI to controllers, low code and natural language processing is being used. Low code makes it extremely easy for operators to integrate HMI with controllers using a drag-and-drop interface. Natural language processing allows users to interact with HMI using verbal language, improving operational efficiency.
Wireless I/Os and converters offer better access to IoT capabilities	I/O modules are being developed with LPWAN technology, making them completely wireless and long lasting. These modules are particularly useful for transmitting data across a large factory area or remote sites.

Drivers & Restraints

Global Driver 1: Rising adoption of Industrial Internet of Things solutions

The electrical automation market had depended on CAPEX investments, but a shift to TOTEX (CAPEX + OPEX) is likely to encourage the adoption of Industrial Internet of Things (IIoT) solutions and increase the demand for electrical automation. With the rise of IIoT and as-a-service models, the investment focus is shifting to OPEX and TOTEX, which allows projects to progress without the burden of high CAPEX investments—an important factor especially for small and medium-sized companies. Products such as Sensors and Transmitters, HMI, Temperature controllers, Chart Recorders, and I/O Converters are expected to witness increased demand.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High**  **No Impact**

Global Driver 2: Rising integration of OT-IT shop floor data to business and enterprise systems because of COVID-19

The pandemic accelerated digitization initiatives around the world. The potential business benefits of the integration of operational and enterprise/business data steer the focus to customers adopting

digital solutions to bridge the divide and streamline integration. The integration process involves the procurement and commissioning of new and updated electrical automation components that enable data collection and transfer to the higher-level systems. While digital solutions seem to be more software-oriented, the realization of such integrations is inclined toward meticulously developed automation solutions that include robust hardware equipment such as sensors, transmitters and Chart Recorders, and I/O Converters.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High**  **No Impact**

India Driver 1: Make in India campaign

The Indian government has announced a string of policies focusing on the development of key industrial verticals. India has set up an Electronic Development Fund with a total target corpus of INR 150 Crores to foster R&D and innovation in technology sectors like electronics, IT, and Nanoelectronics. To position India as a global hub for Electronics System Design & Manufacturing, the government has proposed three schemes: Production Linked Incentive Scheme (PLI), Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS), and Modified Electronics Manufacturing Clusters Scheme (EMC 2.0). While large firms can tap into domestic production incentives to drive export growth, local MSMEs stand to gain from backward linkages from manufacturing growth. The logistics and connectivity push has created public-private partnerships across commercial infrastructure, transport & logistics, and manufacturing. These initiatives will result in new manufacturing facilities with state-of-the-art automation technologies, driving the demand for electrical automation components.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High**  **No Impact**

India Driver 2: Initiatives to lower factory costs

Manufacturers are looking for ways to lower operational and maintenance expenses and create more cost-effective solutions to embrace wide-scale digital transformation activities and initiatives. Brownfield projects such as plant modernization and upgrades with real-time monitoring and predictive maintenance capabilities, particularly in process industries, are set to increase demand for electrical automation equipment (the estimated CAGR for this market between 2022 and 2027 in India is 8.7%). OEMs are gradually moving toward as-a-service models that decrease CAPEX. After the COVID-19 outbreak, the requirement for electrical automation has expanded to enable the remote monitoring of plant facilities.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High**  **No Impact**

Global Restraint 1: Lack of a clear digitization roadmap

Whether to invest in digital is a 2-way equation for solution providers and customers. Companies are clear that the pivot to digitization is inevitable, but how much to invest, where to focus, whether it will be profitable, and what business models to pursue are questions that slow the scale of investments. The number of projects stuck in the pilot phase, a relatively low number of successful deployments, and a lack of industry benchmarks make the transformation a tough strategy for companies to embrace. Poor value proposition optimization and commercial model transformation are also reasons that digital solutions fail across industrial and energy markets, postponing investments. However, the impact of this restraint is expected to become low in the medium term and nil in the long term as large companies begin to invest and demonstrate digital leadership.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 2: Unclear ROI from digital technologies

Organizations are hesitant to invest in digital technologies such as edge analytics because they cannot define clear return on investment parameters and make a large resource commitment. All electrical automation components possess anomalies, especially sensors. Technological advancements such as sensor fusion exist to overcome these anomalies. Tier I companies and OEMs hesitate to adopt new technologies because of the lack of application evidence. The effect of this restraint is expected to be low in the medium term and nil in the long term.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 1: Higher initial investment

Small and medium enterprises suffer a lot when the investment requirements form a major chunk of their CAPEX investments. A higher initial investment cost and limited visibility into ROI impede investment. Additionally, cutting down CAPEX budgets due to economic uncertainties further delays investment in the short term. Companies like Rishabh Instruments have already incurred the CAPEX and hence are ahead of the curve.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Electrical Automation		

Impact of the trend on the product category: **Very High** **No Impact**

B. Metering, Control and Protection Devices

Overview

Note: As part of this study, the scope of Metering, Control and Protection Devices include Current Transformers, Electrical measuring & recording instruments like Analog Panel Meter, Digital Panel Meter, Multifunctional Instruments (multifunctional measurements like current, voltage, power factor, frequency…etc.), Selector & Rotary Switches, Power factor controllers, Power supplies & Battery Chargers and LV protection Relays, Shunt, Synchronizing unit, Genset Controller

The Metering, Control and Protection Devices, such as Analog/Digital Panel Meters, Multi-Function Meters, Current Transformers, APFC relays, Protection relays etc. are used in centralized system to measure, control, record, analyze and protect the electrical system. The centralized system comprises of PCC (Power Control Centre), MCC (Motor Control Centre) and APFC (Automatic Power Factor Control Centre) etc. The system mainly monitors the Electrical Power Distribution Network, Performance of electrical Motors and Power Factor Correction in the electrical network and provides necessary protections

Panel instruments are used not only in the electrical switch boards which are used for distribution of electricity, but also for industrial applications such as multiload monitoring, cloud and connectivity, and energy monitoring systems

The Metering, Control and Protection Devices market is well established globally. The components are used in applications such as electrical distribution, industrial panels, and process control, and their end users include residential buildings, commercial buildings, industrial buildings, and other industries such as Railways, Defense, Steel & Cement, Oil & Gas, and Utilities. The COVID-19 pandemic caused a slowdown in multiple industries in 2020 and most of 2021, notably delaying construction activities and new investments in retrofits of building systems. The market is expected to improve when economic investments gain momentum. The global Metering, Control and Protection Devices market is estimated at USD 34.08 billion in 2022 is expected to witness a 4.8% CAGR to reach USD 43.04 billion by 2027. Resumption of infrastructure development is expected to push adoption from commercial and utility applications across the globe.

The Indian Metering, Control and Protection Devices market witnessed growth mainly due to increased demand from the utility sector. The market is dominated by MNCs having domestic manufacturing facilities; imports, mainly those from China and South Korea, are less prevalent. Product availability influences panel builders' brand selection, resulting in a strong distribution network across growth markets. Global companies Schneider, Satec, and Janizta, and homegrown companies Rishabh Instruments, Elmeasure, and Selec are among the leading players in this segment. Product innovation that improves reliability and user safety during maintenance, and reduced installation time are the key

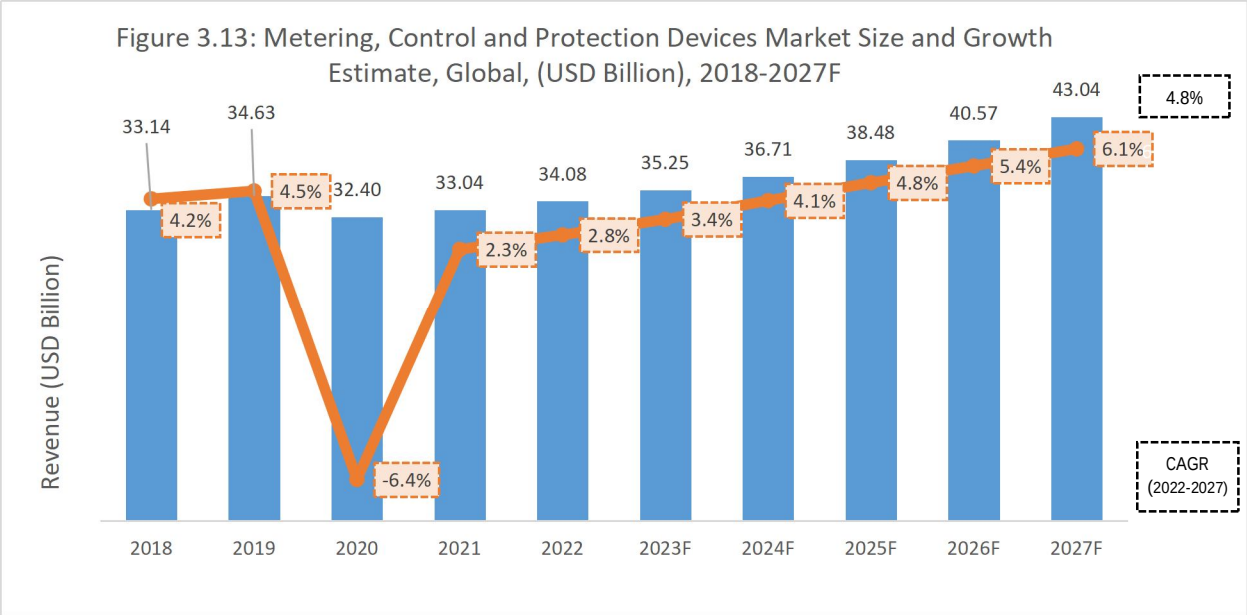
differentiating factors in the market. Rishabh Instruments has products with Ingress Safety feature, UL 94V-0 flame proof housing meters, meters with plug and play connection and modular/upgradable features.

Evolution of Metering, Control and Protection Devices Industry

Years	Key Advancements
2011-present	• In the last 11 years, digital panel meters have focused on increased functionality, lower cost, graphical displays, and HMI. New functionalities such as touch-screen display, programmability, cloud connectivity, Multi-Load Monitoring, and Integrated software platform are being developed.
2001-2010	• By 2000, digital panel meters had 5½ and 6 LED/LCD displays. Advanced electronics and surface-mounting capabilities enabled digital panel meters to display multiple functions in a panel instrument. New communication protocols such as Ethernet and USB became popular communication options.
1991-2000	• In the 1990s, measuring devices were developed with the capability to measure multiple parameters. • Digital panel meters witnessed increasing innovations such as using different-colored lights. Analog panel meters were increasing witnessing addition of electronic circuits to reduce mechanical complexities and cost and improve performance.
1981-1990	• In the 1980s, thanks to semiconductors, complicated electrical circuits became small, cheap, and reliable. • Measuring instruments that were used as stand-alone devices became part of a more complex system. Digital voltmeters, for example, progressed from being independent measuring instruments to being a part of an integrated electronic device. • Because of the smaller form factor, companies developed portable measuring devices for a wide range of applications. • A typical Digital Panel meter in the 1980s had 3½ or 4½ LED or LCD displays. Some meters could directly read from sensors such as thermocouples.
1971-1980	• By the late 1960s, rudimentary analog-to-digital converters existed to convert electrical signals to digital signals, but they were not widely used because of their impractically large form factor and cost. • In the 1970s, with increasing permanence of semiconductors, the cost and size of such A/D converters reduced, thereby finding widespread adoption. • The 1970s also witnessed the appearance of early digital panel meters with higher resolution and accuracy, but they were only for lower load signals, required an external power source, and were difficult to read.

Overview of Global Metering, Control and Protection Devices Market

Global Metering, Control and Protection Devices market was estimated at USD 34.08 billion in 2022 and is expected to witness a 4.8% CAGR to reach USD 43.04 billion by 2027. The market is expected to gain momentum post COVID-19 as construction and facility development activities resume.



The market registered a negative growth rate of -6.4% in 2020 with building projects delayed or shelved because of the pandemic. The market recovered in 2021 at a marginal growth rate of 2.3% before gaining momentum in 2022. Due to Russo-Ukraine war, rising iron and steel prices have impacted the Metering, Control and Protection Devices market negatively. Steel being a vital raw material, translated to higher production costs for manufacturers affecting the end products. The first wave of the war impacted US and Europe which relied heavily on Ukrainian steel plants. With an enhanced focus on Distributed Energy Resources, new Metering, Control and Protection Devices will be required to support changes in buildings' power systems. However, the market faces challenges resulting from end users' preference for lower-priced and substandard devices. It may be necessary to create awareness about device standards and safety among end users.

Figure 3.14: Metering, Control and Protection Devices Market Size and Growth Estimates by Region, (USD Billion), 2018-2027F

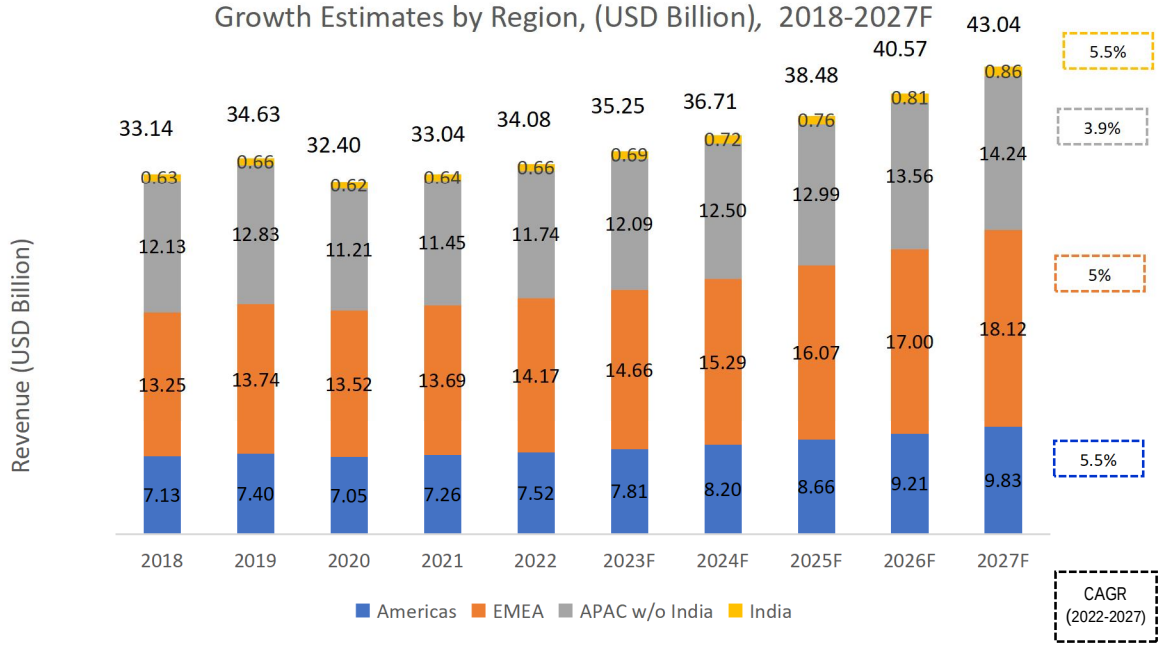
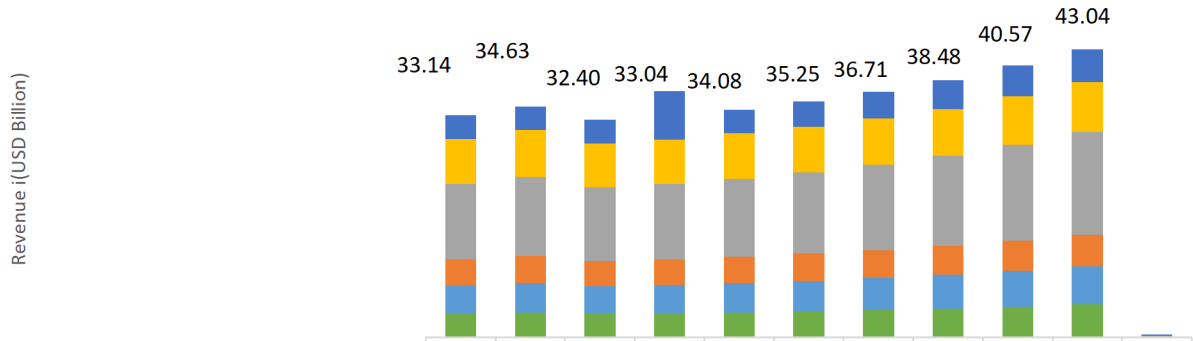


Figure 3.15: Metering, Control and Protection Devices Market Size and Growth Estimates by End User, Global, (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	3.17	3.32	3.12	6.61	3.33	3.48	3.66	3.87	4.12	4.4	5.8%
O&G, PetroChem., S&C, Pharma., FMCG	6.00	6.27	5.87	5.98	6.03	6.11	6.22	6.38	6.58	6.8	2.5%
Resid. & Comm	10.1	10.5	9.8	10.040	10.4	10.9	11.4	12.1	12.8	13.7	5.6%
Comm., CE,Semicon,BA	3.5	3.6	3.4	3.47	3.5	3.6	3.7	3.9	4.0	4.2	3.5%
Auto,Transp.&Def.	3.77	3.95	3.69	3.77	3.94	4.09	4.28	4.50	4.77	5.1	5.3%
Others	3.2	3.3	3.1	3.2	3.3	3.5	3.7	3.9	4.1	4.4	5.8%

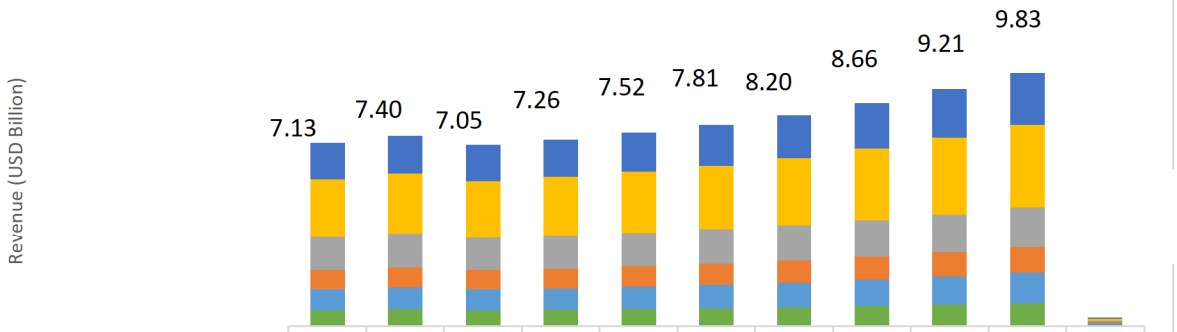
Others includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: data cent | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Regional Overview

In 2022, the Americas was the third-largest market with a 22% market share. Growth in the established region is expected to largely come from replacement and retrofit activities. The region is expected to grow from USD 7.52 billion in 2022 to USD 9.83 billion in 2027 at a CAGR of 5.5%. The US government announced a $1.30 trillion recovery plan in 2021, and hence the Metering, Control and Protection Devices market is likely to experience positive effect in the short to medium term. With the first wave of Russo-Ukraine war, the American steel industry witnessed a growth slump due to the initial disruption in supply chain. Though it is expected to stabilize over the next 5 years.

Latin America's demand for Metering, Control and Protection Devices is attributed to its pipeline of infrastructure projects including construction of transportation systems and hubs. Building construction, especially residential buildings, also contributes to the demand.

Figure 3.16: Metering, Control and Protection Devices Market Size and Growth Estimates by End User, Americas, (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	1.43	1.48	1.41	1.45	1.51	1.58	1.67	1.77	1.88	2.0	5.9%
Resid & Comm	2.24	2.32	2.21	2.28	2.37	2.47	2.61	2.78	2.98	3.2	6.2%
O&G, PetroChem., S&C	1.29	1.34	1.28	1.31	1.33	1.35	1.38	1.43	1.49	1.6	3.2%
Comm., CE,Semicon,BA	0.75	0.78	0.74	0.77	0.80	0.83	0.86	0.90	0.95	1.0	4.6%
Auto,Transp.&Def.	0.81	0.84	0.80	0.83	0.86	0.90	0.95	1.01	1.09	1.2	6.5%
Others	0.61	0.64	0.61	0.62	0.65	0.68	0.72	0.77	0.82	0.88	6.2%

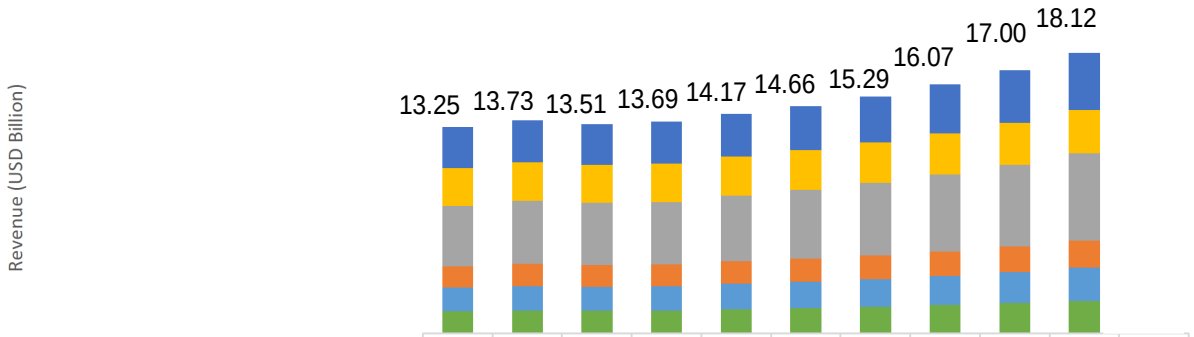
'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

EMEA remains a key region for Metering, Control and Protection Devices despite its relative maturity. The region is expected to have 5% CAGR during the forecast period, mainly because of construction activities of industries and commercial centers in the Middle East. The pandemic masked Brexit's impact on the market in 2020.

The market stood at USD 14.17 billion in 2022 for a 41.6% share of the global market share. The market size is expected to reach USD 18.12 billion in 2027 growing at a CAGR of 5% from 2022 to 2027. Europe is a mature market with moderate growth rates due to a slowdown in infrastructure projects. Both Europe and Middle Eastern automotive industry witnessed a supply crunch of automobiles in 2022 due

to global semiconductor shortage. This is expected to continue through 2023 and 2024 after which the situation is expected to ease.

Figure 3.17: Metering, Control and Protection Devices Market Size and Growth Estimates by End User, EMEA, (USD Billion), 2018-2027F

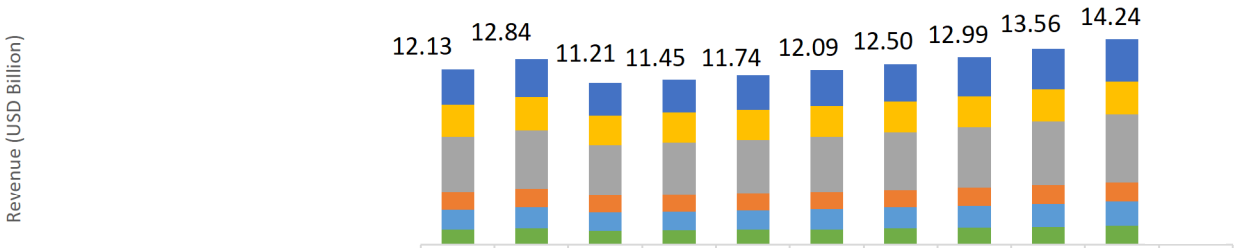


	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	2.65	2.75	2.70	2.74	2.81	2.90	3.03	3.21	3.42	3.68	5.5%
O&G, PetroChem., S&C, Pharma., FMCG	2.40	2.49	2.45	2.48	2.50	2.54	2.59	2.66	2.75	2.86	2.7%
Resid. & Comm	3.89	4.03	3.97	4.02	4.21	4.41	4.65	4.93	5.25	5.61	5.9%
Comm., CE,Semicon,BA,DC	1.39	1.44	1.42	1.42	1.46	1.49	1.53	1.58	1.65	1.74	3.6%
Auto,Transp.&Def.	1.51	1.57	1.54	1.54	1.64	1.70	1.78	1.88	2.00	2.15	5.6%
Others	1.41	1.46	1.44	1.46	1.55	1.62	1.71	1.81	1.93	2.08	6.0%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

APAC excluding India is the second-largest market and is expected to grow at a 3.9% CAGR. Most construction projects were halted in 2020 but resumed in 2021. This is expected to benefit all value chain participants including Metering, Control and Protection Device manufacturers. In 2022, market was USD 11.74 billion, which was 34.4% of the global market. The market size is expected to reach USD 14.24 billion in 2027, growing at a CAGR of 3.9%. Despite having the smallest CAGR among the regions, it will remain a large market. Due to the secondary trade sanctions imposed by the US, the Chinese consumer electronics and semiconductor industry witnessed a growth lag through 2022 and 2023. Though it is predicted that China will take efforts around self-reliance in the future. The Chinese government still hold strongly to their vision of smart city development. This will drive the demand for Metering, Control and Protection Devices in this region. For China, Japan, and South Korea, 2021 was largely a recovery year. Economic activities are steadily picking up with signs of new investments. Despite the challenges, China is the world's leading smart city market with the adoption of AI and other digital technologies.

Figure 3.18: Metering, Control and Protection Devices Market Size and Growth Estimates by End User, APAC (excluding India), (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	2.43	2.57	2.24	2.29	2.38	2.47	2.57	2.68	2.80	2.94	4.3%
O&G, PetroChem., S&C, Pharma., FMCG	2.20	2.32	2.03	2.07	2.08	2.10	2.13	2.16	2.20	2.26	1.7%
Resid. & Comm	3.79	4.01	3.50	3.58	3.67	3.80	3.96	4.15	4.39	4.67	4.9%
Comm., CE,Semicon,BA,DC	1.27	1.35	1.18	1.20	1.22	1.24	1.26	1.29	1.33	1.38	2.5%
Auto,Transp.&Def.	1.38	1.46	1.28	1.31	1.36	1.41	1.46	1.52	1.59	1.67	4.2%
Others	1.06	1.12	0.98	1.00	1.03	1.07	1.12	1.18	1.25	1.32	5.1%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

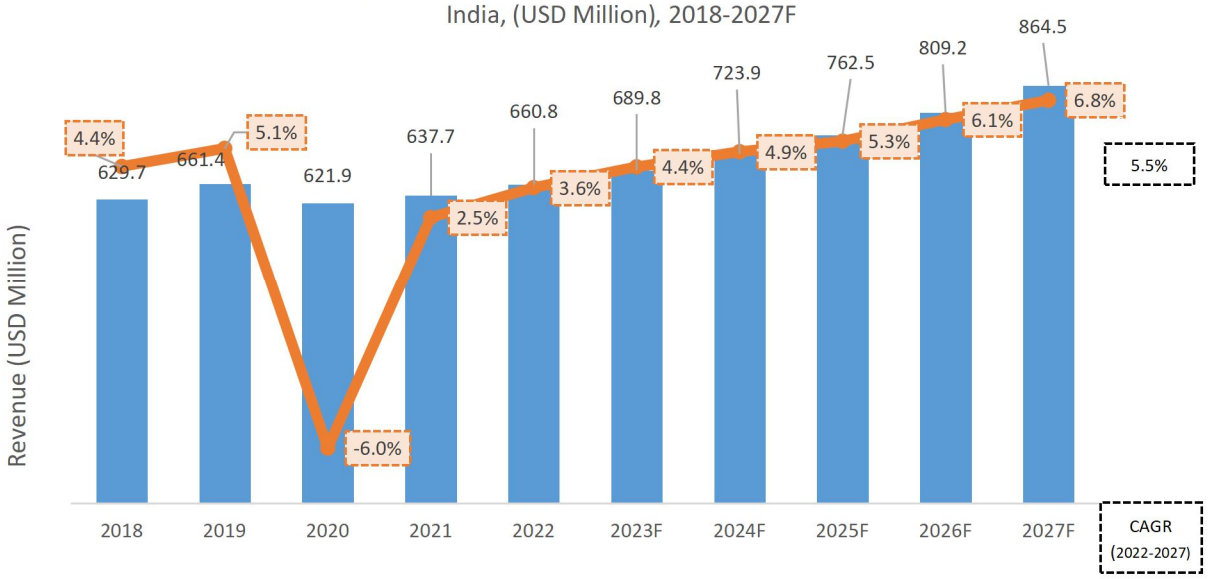
Total Addressable Market (TAM) for the Metering, Control and Protection Devices Market				
Region	*Total Market Size, 2022 (USD Bn)*	*Estimated TAM, 2022 (USD Bn)*	*TAM as % of Total Market**	*Comments*
Global	34.08	7.09	20.8%	The TAM is driven by the development of smart grids, EV charging stations, new data centers, and smart buildings that are focused on efficient energy management.
Americas	7.52	1.83	24.3%	Smart grid practices for better power management and more electric vehicle charging stations will drive demand for all TAM products in the Americas.
EMEA	14.17	2.39	16.9%	Investments in construction of utility infrastructure with better energy management practices will increase demand for all TAM Metering, Control and Protection Devices such as electrical measuring and recording instruments in EMEA region.
APAC excluding India	11.74	2.74	23.3%	Large-scale investments in new factories, commercial complexes that include smart buildings, and data centers is expected to drive demand for all TAM products in this region.
India	0.66	0.089	13.6%	The Residential and Commercial space is expected to witness increased demand especially because of rapid urbanization of Tier II and III cities, eventually demanding expansion of electrical utilities.

*Note: Total market includes Current Transformers; Electrical measuring instruments such as Analog Panel Meter, Digital Panel Meter, Multifunctional Instruments; Selector & Rotary Switches; Power factor controllers; Power supplies & Battery Chargers; LV protection Relays; Shunt; and Genset controller. TAM calculated for the following products: Current Transformers, Electrical measuring & recording instruments like Analog Panel Meter, Digital Panel Meter, Multifunctional Instruments, Selector & Rotary Switches, Power factor controllers, Power supplies & Battery Chargers and LV protection Relays, Shunt

Overview of Indian Metering, Control and Protection Devices Market

The Indian Metering, Control and Protection Devices market was valued at USD 660.8 million in 2022 and is forecasted to grow at a CAGR of 5.5% to reach USD 864.5 million by 2027. Expansion of power generation and distribution facilities, and construction of new factories would contribute to major revenues in the future.

Figure 3.19: Metering, Control and Protection Devices Market Size and Growth Estimates, India, (USD Million), 2018-2027F



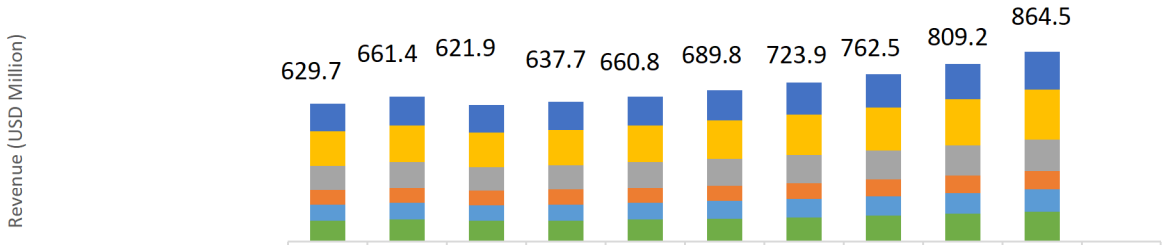
Investments in real estate, semiconductor industries, power generation projects, transmission & distribution, renewable energy projects, rural electrification programs, commercial infrastructure development, utility substation projects, and industrial projects are taken into consideration for forecasts. An uptick in demand in 2021 was mainly from utilities (aided by DDGJUY and Sau Bhagya programs) and real estate (which staged a recovery post RERA implementation).

The Indian government appears determined to reinvigorate growth and attract large investments from domestic and foreign sources, creating healthy demand from industrial and real estate (residential and commercial) end, which will help register healthy growth for industry-driven Metering, Control and Protection Devices. With the recent sanctioning of incentives worth $1.34 Billion for Micron plant, an American chipmaker company, Indian semiconductor industry is set to witness a high growth during the forecast period. Increasing awareness about the protection and metering devices, rising energy cost, and safety aspects among real estate (residential and commercial) end users continue to drive demand for such products.

The main end users of the Metering, Control and Protection Devices are broadly categorized as residential, commercial, industrial, and utilities. The industrial segment accounted for about 60% of market in 2022. Its share is expected to decrease a bit due to increased off-take from other segments such as utilities (Included in Residential & Commercial). Commercial and residential together accounted

for a 25.1% market share in 2022, mainly driven by increasing penetration of modular Metering, Control and Protection Devices in Tier II and Tier III cities.

Figure 3.20: Metering, Control and Protection Devices Market Size and Growth Estimates by End User, India, (USD Million), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	125.9	132.3	124.4	127.5	132.4	137.9	144.6	152.4	161.5	172.0	5.4%
Resid & Comm	157.4	165.4	155.5	159.4	165.5	173.6	183.4	194.8	208.4	226.3	6.5%
O&G, PetroChem., S&C	114.0	119.7	112.6	115.4	118.6	122.2	126.2	130.6	135.7	141.4	3.6%
Comm., CE,Semicon,BA	66.1	69.5	65.3	67.0	69.5	72.5	75.8	79.4	83.5	88.0	4.8%
Auto,Transp.&Def.	71.8	75.4	70.9	72.7	75.5	79.3	83.7	88.6	94.3	100.7	5.9%
Others	94.4	99.2	93.3	95.7	99.3	104.3	110.2	116.7	125.8	136.1	6.5%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

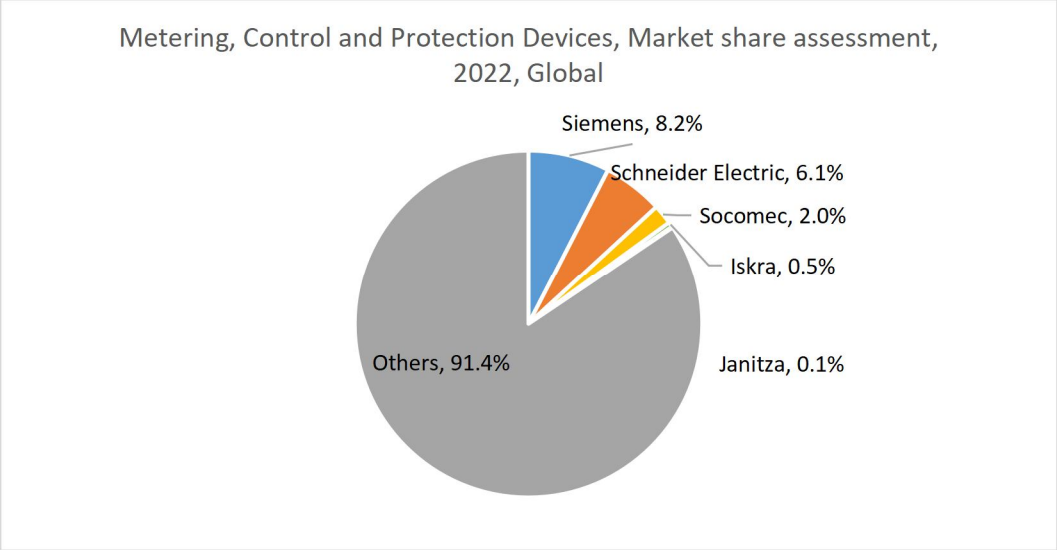
Total Addressable Market (TAM) for the Metering, Control and Protection Devices Market			
Total Market, 2022, (Mn USD)	*Estimated TAM, 2022, (Mn USD)*	*TAM as % of Total Market**	*Product subcategories considered for TAM**
660.8	89.9	13.6%	• Current Transformers, • Electrical measuring & recording instruments like Analog Panel Meter, Digital Panel Meter • Multifunctional Instruments • Selector & Rotary Switches • Power factor controllers • Power supplies & Battery Chargers and LV protection Relays, Shunt

*Note: Total market includes Current Transformers; Electrical measuring instruments such as Analog Panel Meter, Digital Panel Meter, Multifunctional Instruments; Selector & Rotary Switches; Power factor controllers; Power supplies & Battery Chargers; LV protection Relays; Shunt; and Genset controller.

Competitive Landscape of Metering, Control and Protection Devices Market

Key Industry players - Global & India

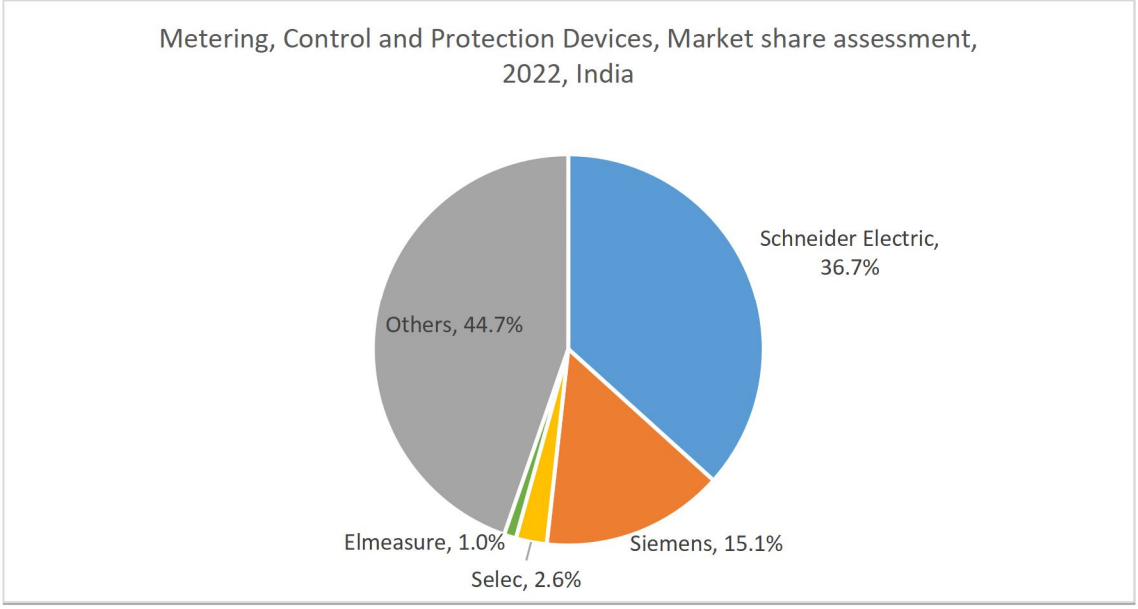
Schneider Electric, Socomec, Iskra, Janitza, MBS, Weigel, Kraus & Naimer, Entes, Rayleigh, Chint, Eastron, Hobut, Tyco, Satec, Siemens, Secure, Elmeasure, Selec, Salzer, Newtek Electricals, Nippen Electrical Instruments, AE, Multispan, Trinity, Accuenergy, & Rishabh



Note: Total Market Size = USD 34.08 Billion, 2022

Globally, the Metering, Control and Protection Devices market is highly fragmented. The players can be classified as Tier 1, Tier 2 and Tier 3 companies. Tier 1 companies such as Siemens & Schneider Electric have 4 – 8% market share each. These companies are large companies with international presence and possess the ability to deploy advanced Metering, Control and Protection Devices. Usually, these companies have multiple business units in the energy, grid and buildings segments beyond just Metering, Control and Protection Devices. Tier 2 companies consist of companies such as Weigel, Kraus & Naimer and Chint. They have an international presence, and offer products from more than one category, but smaller footprint than Tier 1 companies. Tier 3 companies are usually local manufacturers with limited geographical footprint, largely catering to local and regional country demands. The Metering, Control and Protection Devices market is pretty fragmented due to the numerous numbers of players, esp. in the tier 2 & tier 3 category. Even the larger global players have single digit percentage in market share. Rishabh instruments is a global leader in Analog Panel meters and is among the leading global companies in low voltage current transformers. Lumel is the most popular brand for meters, controllers, and recorders in Poland.

In **India**, the market is consolidating at the top and is dominated by a handful of players. Schneider Electric, with its inorganic growth strategy, is dominating the Indian Metering, Control and Protection Devices market following the completion of its acquisition of L&T's electrical business unit. Schneider Electric has the largest market share in India, with its wide product portfolio. Siemens is another leading company with ~15% market share. Rishabh Instruments is one of the top three players in digital panel meters in India and it holds 8.01% market share within digital panel meters (w.r.t the TAM)



Note: Total Market Size = USD 660.8 Million, 2022

Distribution Channel Assessment

Almost all Metering, Control and Protection Devices are manufactured in India. An estimated 70% to 75% of sales happen through the dealer/distributor channel, which also has a presence across B2B and B2C eCommerce sites. In select cases, for project sales, a supplier may prefer to route through a distributor while the billing is done directly with the supplier. The remaining 25% to 30% of sales are directly to EPCs/system integrators for large-value projects. EPC/system Integrators are major influencers of Metering, Control and Protection Devices brands and specifications. Compressor and generator OEMs are heavy users of Metering, Control and Protection Devices such as genset controllers, current transformers, and analog & digital panel meters. High-end customers (mainly in the commercial and industrial end-user segments) are ready to pay a premium for brand and reliability. Utilities, a price-sensitive segment, typically prefer semi-premium or basic products, which are mainly procured through a tender process.

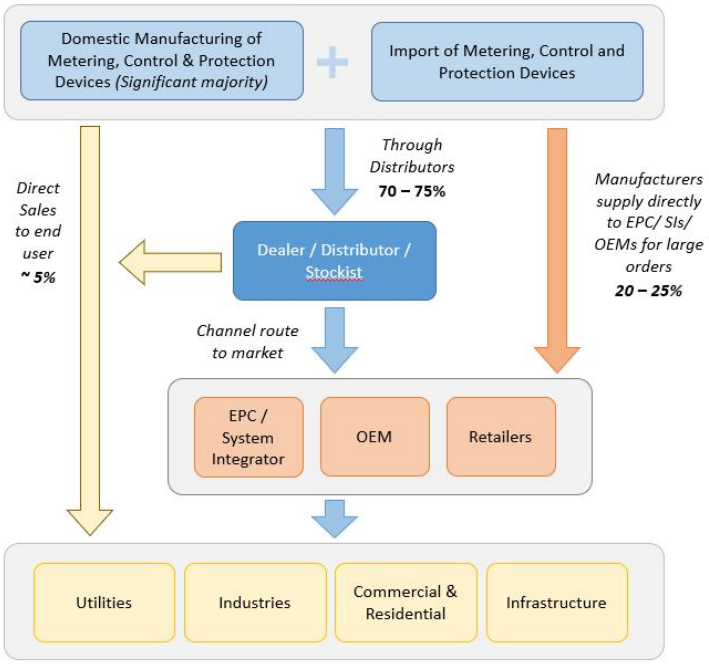


Figure 3.23: Metering, Control and Protection Device Distribution Channels, India, 2023

Technology Trends

Trend	Description
Metering, Control and Protection Devices transforming into intelligent energy management hubs	New-age Metering, Control and Protection Devices are becoming holistic energy management equipment. For example, low-voltage current transformers embedded with sensors and cloud connectivity can be used to control demand and monitor power consumption in buildings. They can also be embedded with transducers to diagnose the performance of electrical equipment to which they supply power.
Embedded connectivity features in panel meters	Panel meter manufacturers are embedding connectivity features so that the end user can connect multiple meters from the same vendor to a cloud platform to monitor, optimize, and control the complete electrical system.
Enhanced power management functionality and features provided through IoT platforms	Improved features such as remote monitoring, predictive maintenance, and performance tracking of diverse Metering, Control and Protection Devices are being delivered through IoT platforms.

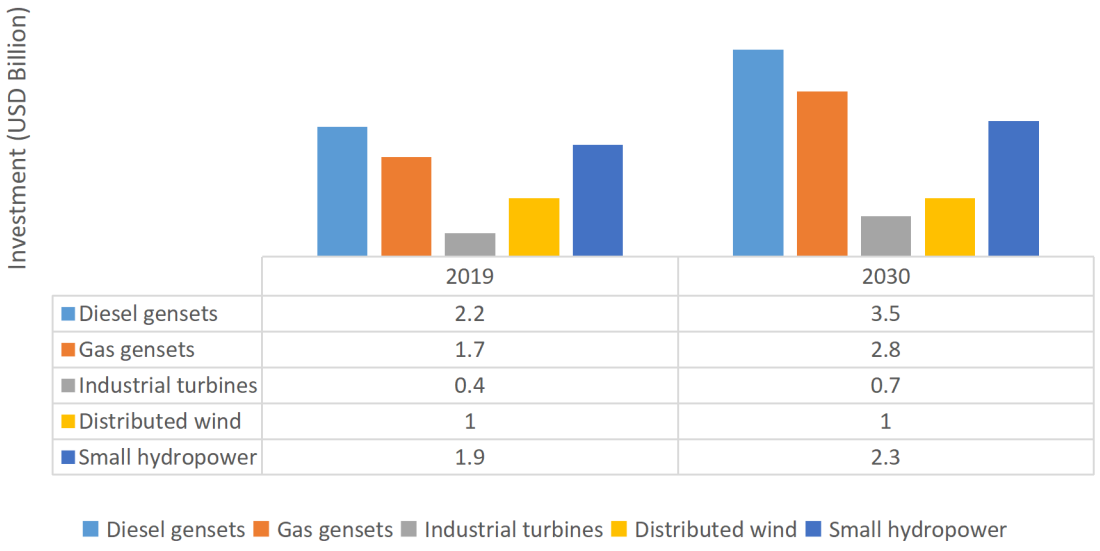
Drivers & Restraints

Global Driver 1: The continuous emphasis on distributed energy resources (DER) expands the need for Metering, Control and Protection Devices in new buildings, presenting retrofit opportunities in old buildings for newly installed DER systems.

Investments in distributed energy are expected to increase from USD 7.4 billion in 2019 to USD 10.4 billion in 2030 because of regulatory support, rural electrification goals, and decreasing project costs.

Distributed wind energy is the exception. The installed capacity of DERs is estimated to expand along with investments, requiring new Metering, Control and Protection Devices and other control systems in facilities and buildings. The continuous development of DERs will drive demand for new Current Transformers, Multifunctional Instruments, Selector & Rotary Switches, Power factor controllers, Power supplies & Battery, Genset controllers etc.

Figure 3.24: DER Market Investment Forecast by Selected Product Group, Global, 2019 and 2030F



	2019	2030
Diesel gensets	2.2	3.5
Gas gensets	1.7	2.8
Industrial turbines	0.4	0.7
Distributed wind	1	1
Small hydropower	1.9	2.3

Source: Frost & Sullivan Analysis

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High** **No Impact**

Global Driver 2: Building energy management systems (BEMS) and home energy management systems (HEMS) creates opportunities for new devices with monitoring and analytics capabilities. The growth due to BEMS and HEMS will largely come from retrofit activities.

Frost & Sullivan anticipates BEMS and HEMS market growth. The total global BEMS and HEMS market registered USD 6.77 billion in 2020 and is forecasted to reach USD 16.59 billion, growing at a 16.1% CAGR. Energy management will remain a key focus area for building owners. As energy costs are one-third of commercial buildings' OPEX, cost efficiency will be a priority as businesses begin to recover from the pandemic. Hospitals, educational institutions, factories, and malls will continue to have energy management improvements. The growth of BEMS will spur upgrades and new installations of Metering, Control and Protection systems with monitoring and analytics capabilities. The DER market also drives the use of BEMS in commercial and industrial buildings.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High**  **No Impact**

India Driver 1: Government's focus on infrastructure and rural electrification

Government spending on infrastructure projects will continue to be a key growth driver. Rural electrification projects/schemes (Sau Bhagya and DDUGJY) are expected to augment and expand the country's electricity distribution infrastructure wherein Metering, Control and Protection Devices are widely used. India required around USD 62 billion in infrastructure investments in 2022 to achieve sustainable economic development. To this end, the government is allowing 100% FDI through the automatic route and granting infrastructure status of affordable housing schemes. Metro, smart city, airport, railway, and road infrastructure projects also will accelerate the demand for Metering, Control and Protection Devices.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High**  **No Impact**

India Driver 2: Renewable energy and metro projects

The Indian government's push for renewable energy is ambitious but the government is confident and has set a target of 500 GW of renewable capacity by 2030. With such a clear long-term vision, global players are expected to step up investments. The solar sector is already witnessing a healthy revival after a slump in the early month of the pandemic. In 2021, 10 GW of new solar installations were completed, more than 300% jump from 2020, where it fell to 3.2 GW. The Metering, Control and Protection Devices market is expected to benefit considerably, especially through more demand for DC measurement solutions.

More than 700 metro stations and 800 kms of metro lines are expected to be commissioned during the next 5 years. The government also is planning to introduce an alternative mode of transport (LRT Metrolite) across 50 Tier I and II cities. It costs 40% less than conventional metro projects, making it attractive for private sector participation. These ongoing and upcoming metro projects will have significant demand for Metering, Control and Protection Devices.

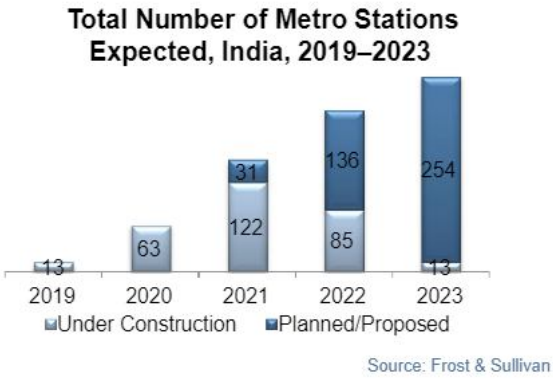


Figure 3.26: Number of Metro stations planned in India, 2019 - 2023

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 1: End users' preference for lower-priced and substandard Metering, Control and Protection Devices

Cheaper alternatives produced by smaller market participants usually do not adhere to standards and certifications IEC 61557-12 (for entire Power Monitoring Device PMD), IEC 62053-22/23 for energy monitoring devices, IEC 60529 IP standard, IEC 61869-2 for Current Transformers, IEC 60947 for Cam Switches, and many more.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

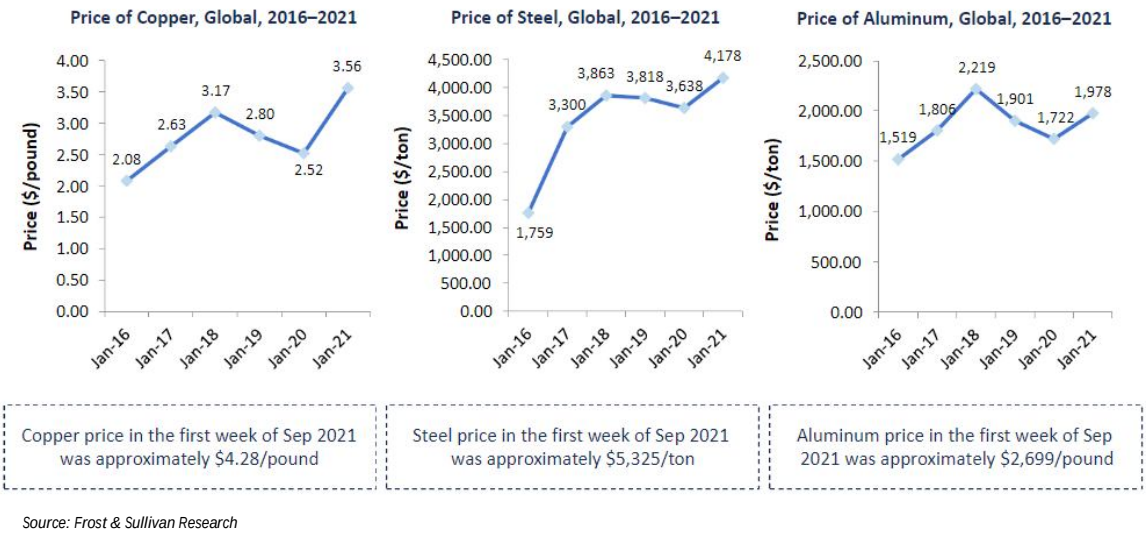
Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 2: Price volatility due to constrained availability of raw materials and limited skilled labor

Prices of copper, steel, and aluminium—key raw materials for the production of Metering, Control and Protection Devices —have been on the rise since 2020, with copper and steel reaching their highest prices to date in 2021. This trend may put cost pressures on market participants and affect the construction industry, which also requires these materials. With end users becoming increasingly price sensitive, device manufacturers may have to develop new pricing and business models.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High** **No Impact**



Source: Frost & Sullivan Research

Figure 3.26: Raw Material Price Trends, Global, 2016-2021

India Restraint 1: *Increasing pricing pressures due to high competition*

The Indian Metering, Control and Protection Devices market is well established with more than 40 participants including Schneider, Satec, Rishabh Instruments, and Elmeasure. The market is very competitive, especially for volume-driven products, making it difficult for large MNCs to sustain their market share. Factors inhibiting the market from realizing its true potential are fluctuating raw material prices, imports from other Asian nations, and the pressure on companies to reduce prices and sustain their business.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High**  **No Impact**

India Restraint 2: *Economic slowdown that could further delay private sector investments*

A liquidity crunch, weak consumer demand, and rising inflation are slowing the economy and affecting the country's industrial growth. This slowdown is expected to weigh on the Metering, Control and Protection Devices market, dampening its growth prospects.

Figure 3.27: GDP growth rate forecast, India, 2020 – 2030

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Metering, Control and Protection Devices		

Impact of the trend on the product category: **Very High** **No Impact**

CHAPTER 4 – OVERVIEW OF PORTABLE TEST & MEASUREMENT INSTRUMENTS (TMI)

Overview

Note: As part of this study, the scope of Portable Test & Measurement systems includes DAQ, Digital Multimeters, Electrical testers & Environmental testers, Logic analyzers, Network analyzers, Power meters, Clamp meters, electric signal isolators, Ohm meters etc.

Portable Test & Measurement Instruments (TMI) are used to measure the electrical parameters of wide-ranging industrial, utilities and consumer products. These instruments are used to test and measure the various electrical parameters, e.g., voltage, current, power, etc. onsite. Portable Test & Measurement equipment play a central role in enabling digital transformation, IoT, Industry 4.0, and autonomous living as the need for highly reliable and advanced electronic device increases. F&S estimates the Portable (TMI) market at USD 5.1 billion in 2022 and expects it to reach USD 6.6 billion by 2027 with a grow rate 5.1%. Growth will be led by APAC and India. End users that will drive demand includes the automotive and power industries.

The market in India is in the growth phase, bolstered by increasing urbanization, industrialization and consumerism, and favorable government policies. The competitive landscape consists of home-grown companies such as Rishabh Instruments and foreign companies such as Fluke, Megger, Hioki, and Kyoritsu. In Portable test and measurement market, where both Indian and Chinese players limit themselves to low-end maintenance and repair solutions, Rishabh has extended its offerings to professional, industrial TMI products capable of serving needs in modern laboratories and even aerospace. In terms of the utility sector, the products cover measurement and control of all vital electrical parameters in the power frequency range.

The demand for Portable Test and Measurement equipment in India stems from the automotive, industrial (process and discrete), defense, lab (research and educational), telecommunications, and consumer electronics industries. Rishabh has set of products such as Digital Multimeters, Digital Clamp meters, and Insulation testers along with earth tester to cater this demand.

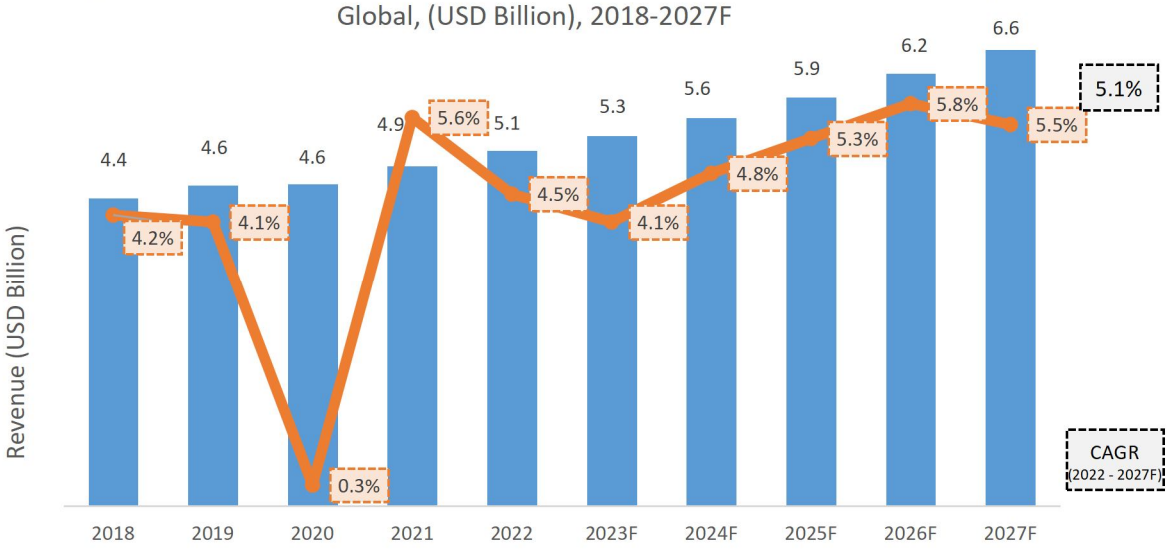
Evolution of Portable Test & Measurement systems Industry

Years	Key Advancements
2011-present	• T&M vendors started to focus on software to create more value. Software solutions are central to better acquire, analyze, and manage complex testing data. T&M vendors utilize software to remotely monitor testing, fix bugs, and improve equipment efficiency. • Vendors improve hardware ruggedness, user interface intuitiveness, and technical capabilities such as high operating frequency to support next-generation power, automotive, and communication end-user requirements. • Vendors add user-friendly features such as Bluetooth connectivity for operating and monitoring the system remotely, inbuilt logging of measured data, and mini testing facilities inside the meters with multi-scale display for easy diagnoses.
2001-2010	• Development of multi-function capabilities gained significance. For example, Fluke added thermal and frequency measurement capabilities in its multimeter. In the RF segment, some network analyzer functions were integrated in signal analyzers.
1991-2000	• Handheld and modular form-factor test instruments increased the addressable market. For example, Fluke introduced the first handheld meter for automotive end users. PXI and VXI-based modular test instruments found wide use in manufacturing.
1981-1990	• In the late 1970s, a new instrument interface called General Purpose Interface Bus (GPIB) was developed to replace instrument controllers. GPIBs were mainly used to connect PCs and measuring instruments. • T&M vendors began to integrate PCs in test and measurement. Digital technology allowed them to build more functionality and improve measurement reliability and ergonomics while reducing the footprint.
1971-1980	• Advancements in semiconductors and electronic physics dominated design and developments, but equipment was mainly analog. Instruments were bulky and had conventional box-type form factors for both bench-top and stand-alone automated systems, which restricted them to lab applications.

Overview of Global Portable Test & Measurement systems Market

Global Portable Test and Measurement market was estimated at USD 5.1 billion in 2022 and is forecasted to grow at a CAGR of 5.1% to reach USD 6.6 billion by 2027. Demand for digitization across industries, vehicle electrification, and the need for energy drives growth across regions.

Figure 4.1: Portable Test and Measurement Market Size and Growth Estimate, Global, (USD Billion), 2018-2027F



The market showed resilience to the pandemic despite the 2020 dip primarily because of CAPEX on development activities across end-user verticals. The 2021 rebound was due to scaling up of operations across all verticals. Growth will remain muted through 2023 because of the Russo-Ukrainian War and supply chain challenges affecting order backlogs, but digital transformation initiatives, electric vehicles and in-vehicle infotainment, and renewable energy projects will keep demand strong.

Figure 4.2: Portable Test and Measurement Market Size and Growth Estimates by Region, (USD Billion), *2018-2027F*

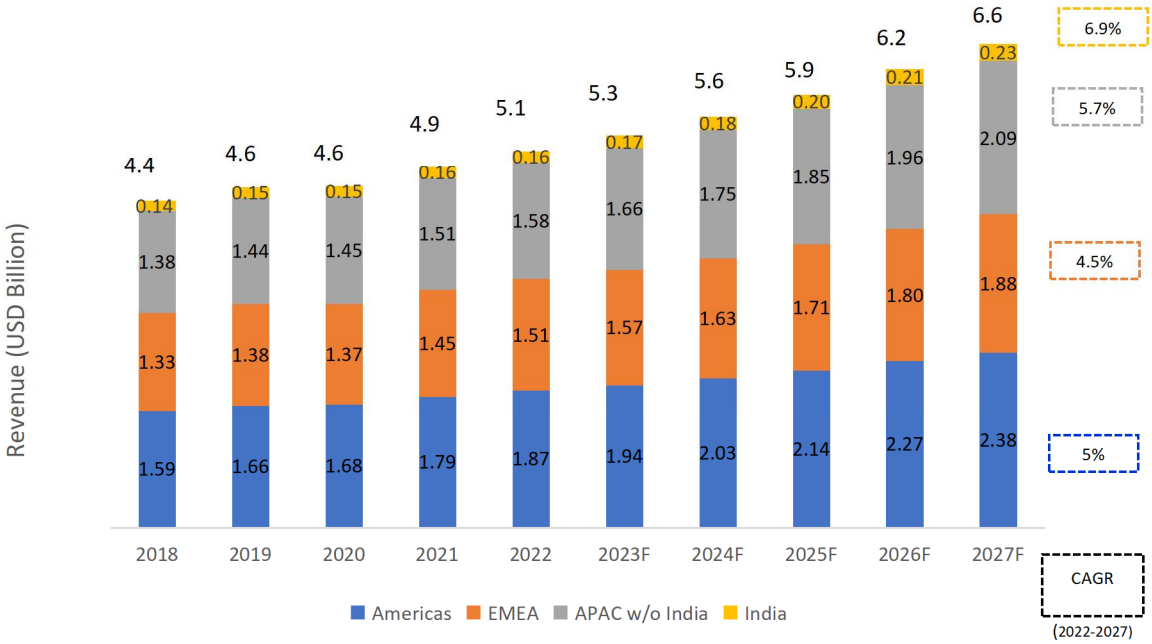
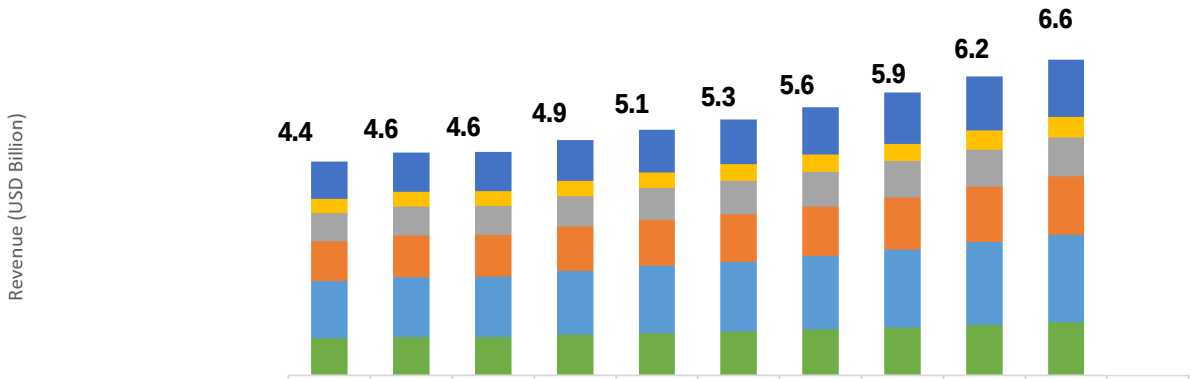


Figure 4.3: Portable Test and Measurement Market Size and Growth Estimate by End User, Global, (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	0.78	0.82	0.82	0.87	0.91	0.95	1.00	1.06	1.12	1.19	5.6%
Pharma., FMCG	0.29	0.30	0.30	0.32	0.33	0.35	0.36	0.38	0.40	0.42	4.9%
O&G, PetroChem., S&C	0.59	0.61	0.61	0.64	0.66	0.69	0.72	0.76	0.79	0.83	4.6%
Comm., CE,Semicon,BA	0.83	0.86	0.86	0.91	0.95	0.99	1.04	1.09	1.15	1.21	4.9%
Auto,Transp.&Def.	1.19	1.25	1.25	1.33	1.39	1.45	1.52	1.61	1.72	1.82	5.5%
Others	0.76	0.80	0.80	0.85	0.88	0.91	0.95	1.00	1.05	1.10	4.6%

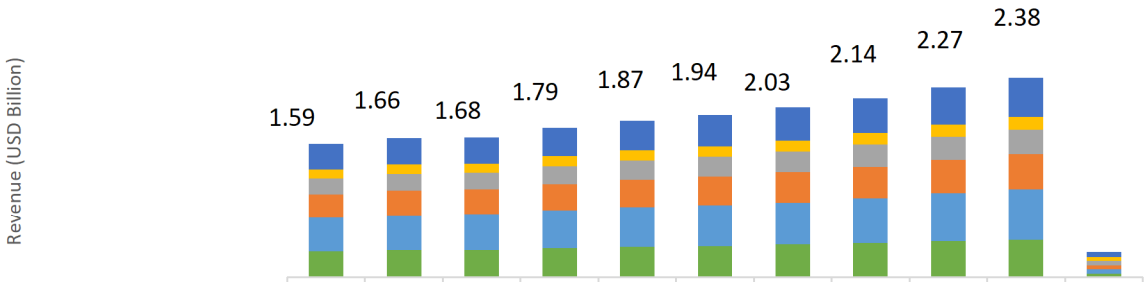
'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Regional Overview

The Portable Test & Measurement market in the Americas is estimated to grow from USD 1.87 billion in 2022 to USD 2.38 billion in 2027 at a CAGR of 5%. The Americas will remain the dominant region during the forecast period. In Americas, renewable sources, particularly solar and wind, is a strong focus enabled by falling installation cost and government support. Federal policies provide a 26% tax credit for solar and wind systems that were installed between 2020 and 2022, and installation costs are dropping. In North America, use of gas for electricity will remain flat (about 30%) during the forecast period. Increasing implementations of smart grids, growth in automotive manufacturing (especially in Latin America), electrification, development of connected cars, higher spend on defense, and development of medical devices are driving growth. The Russo-Ukraine war is expected to hamper the growth of American automotive and semiconductor industry through 2023. America's most of the supply of Neon gas comes either from Ukraine or Russia. Neon gas is used for powering the lasers that are required to make semiconductor chips further used in automobiles. The secondary trade sanctions on Russia have also negatively impacted the supply chain of nickel and palladium used in making lithium-ion batteries (essential for electric vehicles and gas or diesel-powered vehicles).

Power Generation, Distribution, Transmission and Labs segment is estimated to witnesses a growth at 5.6% between 2022 & 2027.

Figure 4.4: Portable Test and Measurement Market Size and Growth Estimate by End User, Americas, (USD Billion), 2018-2027F

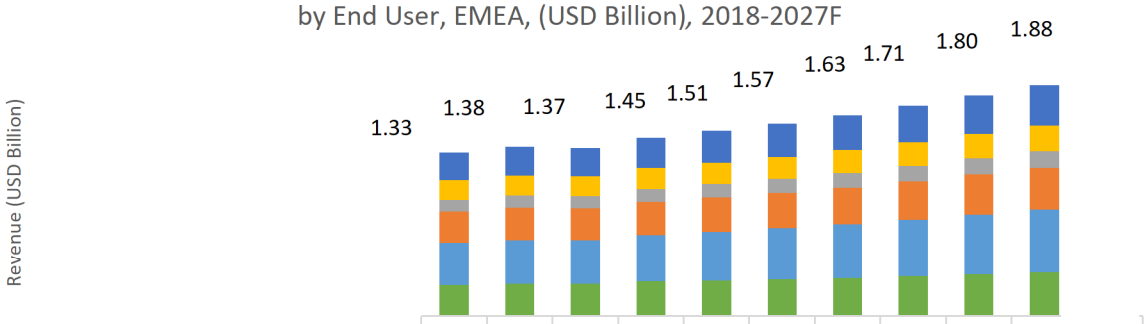


	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	0.30	0.31	0.32	0.34	0.35	0.37	0.39	0.42	0.44	0.47	5.6%
Pharma & FMCG	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.15	0.15	4.6%
O&G, PetroChem., S&C	0.19	0.20	0.20	0.21	0.22	0.23	0.25	0.26	0.28	0.29	5.3%
Comm., CE,Semicon,BA	0.28	0.30	0.30	0.32	0.33	0.35	0.36	0.38	0.40	0.42	4.9%
Auto,Transp.&Def.	0.40	0.42	0.43	0.46	0.48	0.49	0.51	0.54	0.58	0.61	4.9%
Others	0.31	0.32	0.32	0.35	0.36	0.37	0.39	0.40	0.43	0.44	4.3%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

In EMEA, Portable Test and Measurement market revenue was estimated at USD 1.51 billion in 2022. Demand for test and measurement products mainly is from automotive, aerospace & defense, power and industrial. At a CAGR of 4.5% between 2022 and 2027, the market is expected to reach USD 1.88 billion by 2027, representing a cumulative opportunity of USD 8.6 billion between 2022 and 2027. The Power Generation, Distribution, Transmission and Labs segment is estimated to witnesses a CAGR of 5% between 2022 and 2027.

Figure 4.5: Portable Test and Measurement Market Size and Growth Estimate by End User, EMEA, (USD Billion), 2018-2027F

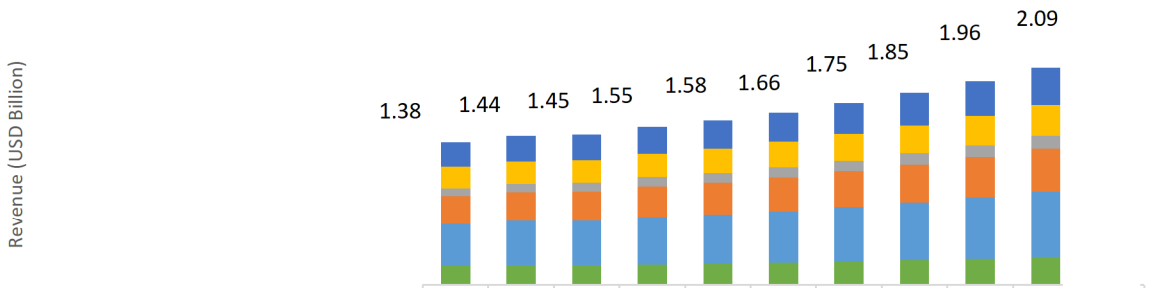


	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027	
Power Gen. & Dist., Labs	0.22	0.23	0.23	0.25	0.26	0.27	0.28	0.30	0.31	0.33	5.0%
O&G, PetroChem., S&C, Pharma., FMCG	0.16	0.16	0.16	0.17	0.17	0.18	0.19	0.19	0.20	0.21	3.5%
Pharma &FMCG	0.09	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.14	4.6%
Comm., CE,Semicon,BA,DC	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.34	3.8%
Auto,Transp.&Def.	0.35	0.36	0.36	0.38	0.40	0.42	0.44	0.46	0.49	0.51	5.1%
Others	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.36	4.1%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

APAC (excluding India) region's market stood at USD 1.58 billion in 2022. The region is expected to witness a CAGR at 5.7% between 2022 and 2027 to reach a market size of USD 2.09 billion. APAC witnessed high resilience after the 2020 decline, partly attributed to fast recovery in China. 5G deployments, increasing focus on EVs, and movement toward smart grids are the main drivers. The Chinese government is providing substantial support in terms of investments for R&D activities in EV market to expand their presence in the global market especially Middle Eastern consumers. The secondary trade sanctions by the US and its allies are expected to affect the semiconductor end user industry through 2023. The Power Generation, Distribution, Transmission and Labs segment is estimated to witness a CAGR of 5.9% between 2022 and 2027.

Figure 4.6: Portable Test and Measurement Market Size and Growth Estimates by End User, APAC (exclusing India), (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	0.23	0.25	0.25	0.26	0.27	0.28	0.30	0.31	0.33	0.36	5.9%
O&G, PetroChem., S&C, Pharma., FMCG	0.21	0.21	0.22	0.23	0.23	0.24	0.25	0.27	0.28	0.29	4.7%
Pharma &FMCG	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	5.5%
Comm., CE,Semicon,BA,DC	0.27	0.28	0.28	0.30	0.31	0.33	0.35	0.36	0.39	0.41	5.7%
Auto,Transp.&Def.	0.41	0.43	0.43	0.46	0.47	0.50	0.53	0.56	0.60	0.64	6.0%
Others	0.18	0.19	0.19	0.20	0.20	0.21	0.22	0.24	0.25	0.27	5.6%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Total Addressable Market (TAM) for the Portable Test and Measurement Market				
Region	*Total Market Size, 2022(USD Bn)*	*Estimated TAM, 2022 (USD Bn)*	*TAM as % of Total Market**	*Comments*
Global	5.1	2.69	52.7%	-
Americas	1.87	0.89	47.7%	Proportion of revenue from DAQ is higher in Americas (more than 40%), hence TAM for Rishabh Instruments is lower in the region.
EMEA	1.51	0.82	54.5%	-
APAC w/o India	1.57	0.89	56.7%	-
India	0.163	0.091	56.1%	-

*Note: Total market includes DAQ, Digital Multimeters, Electrical testers & Environmental testers, Logic analyzers, Network analyzers, Power meters, Clamp meters, electric signal isolators, Ohm meters etc. TAM calculated for the following products: Digital Multimeters, Electrical testers and Environmental testers (includes insulation testers, earth testers, installation testers, High Voltage Testers, Oil breakdown voltage testers), Clamp meters, electrical signal isolators, Network Analyzers and Power Quality Analyzers

Overview of Indian Portable Test & Measurement systems Market

Indian Portable Test and Measurement market was USD 163.46 million in 2022 — 3.6% of the global total. The market is estimated to grow at a CAGR of 6.9% between 2022 and 2027 and reach USD 228.6 million. The country's growth rate is highest among all regions. Manufacturing of EVs, increase in defense testing, a growing focus on solar PV installations, and electronics manufacturing activities pertaining to communications and consumer electronics are the primary drivers for the Indian market. Growth prospects are expected to be relatively high over the next 5 to 10 years owing to increasing investments in electronics and automotive manufacturing, government initiatives such as Make in India, and other financial incentives given to OEMs for setting up or expanding manufacturing capabilities across the value chain.

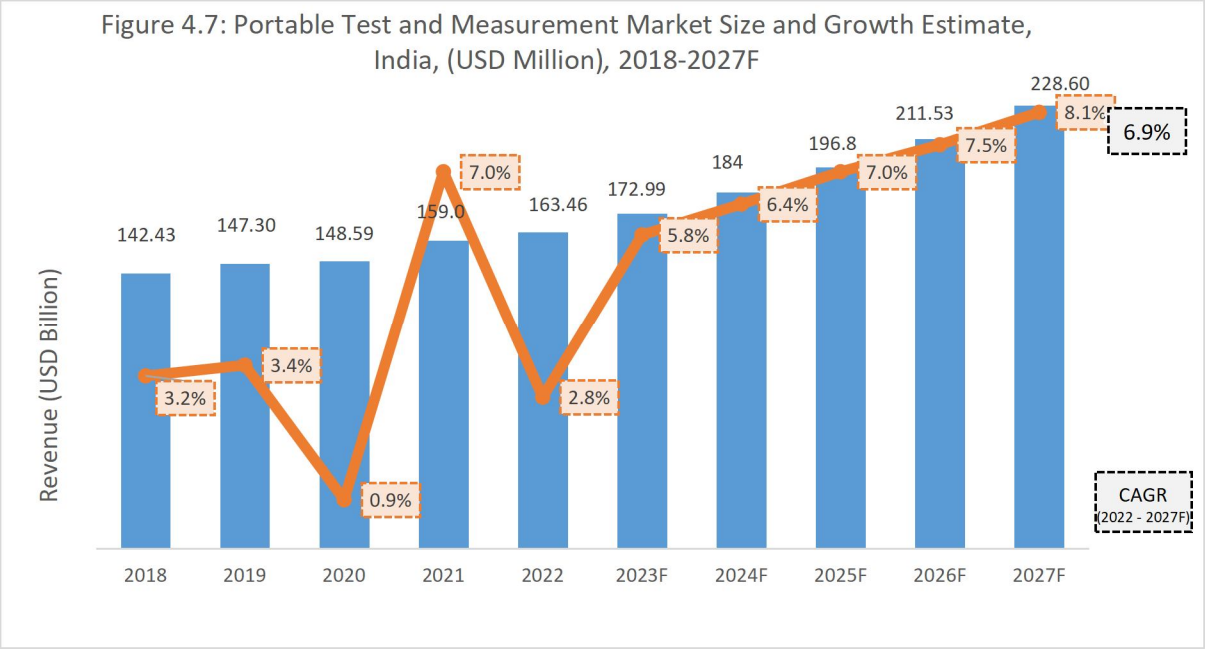
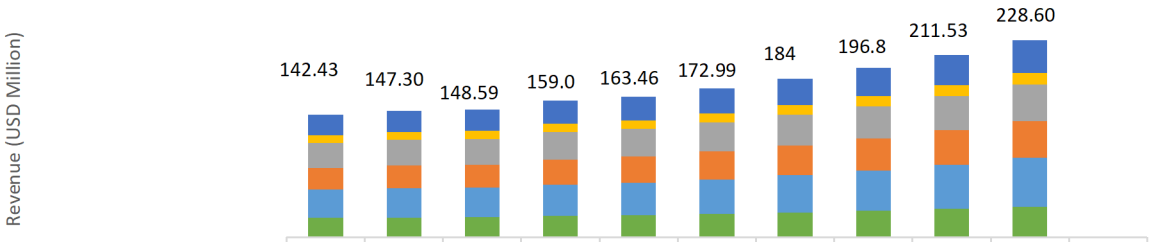


Figure 4.8: Portable Test and Measurement Market Size and Growth Estimates by End User, India, (USD Million), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Power Gen. & Dist., Labs	23.4	24.6	24.7	26.6	27.1	28.7	30.5	32.6	35.0	37.6	6.8%
Pharma & FMCG	8.9	9.2	9.3	9.9	10.1	10.6	11.2	11.8	12.5	13.4	5.8%
O&G, PetroChem., S&C	28.8	29.5	29.5	31.5	31.8	33.3	35.0	37.0	39.3	42.0	5.7%
Comm., CE,Semicon,BA	26.3	27.3	27.6	29.5	30.6	32.4	34.5	36.9	39.7	42.9	7.0%
Auto,Transp.&Def.	32.6	34.3	34.2	36.9	38.4	41.1	44.3	48.0	52.4	57.6	8.4%
Others	22.3	22.5	23.2	24.6	25.5	26.9	28.6	30.5	32.6	35.2	6.6%

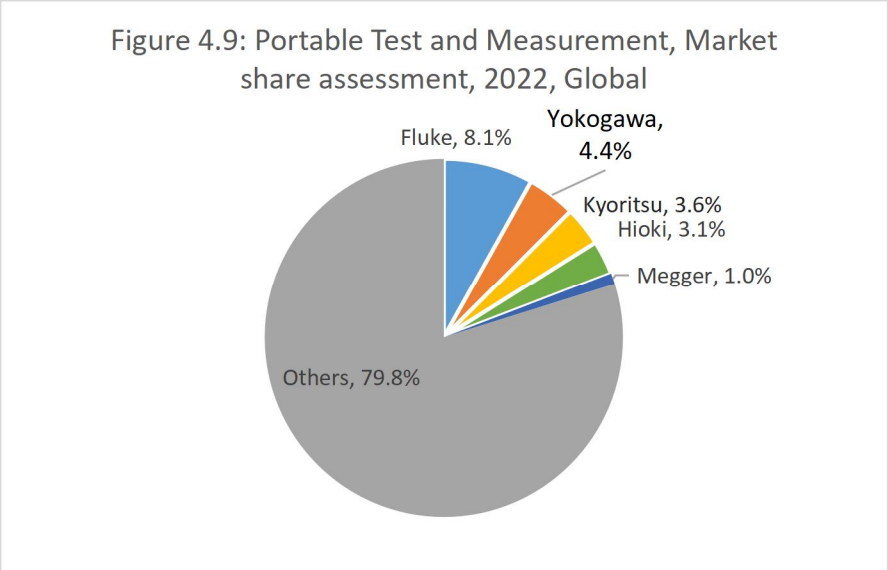
'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | S&C: Steel & Cement | Power Gen. & Dist.: Power Generation & Distribution | Pharma.: Pharmaceuticals | O&G: Oil & Gas | PetroChem.: Petro Chemicals | Comm.: Telecommunications | CE: Consumer Electronics | Semicon: Semiconductors: | BA: Building Automation | Auto, Transp. & Def.: Automotive, Transportation & Defense. | Food & beverages is included in FMCG

Total Addressable Market (TAM) for the Indian Portable Test and Measurement Market			
Total Market, 2022, (Mn USD)	*Estimated TAM, 2022, (Mn USD)*	*TAM as % of Total Market*	*Product subcategories considered for TAM**
163.46	91.7	56.1%	• Digital Multimeters • Electrical testers and Environmental testers (include insulation testers, earth testers, installation testers, High Voltage Testers, Oil breakdown voltage testers) • Clamp meters, electrical signal isolators • Network Analyzers and Power Quality Analyzers

* Total market includes DAQ, Digital Multimeters, Electrical testers & Environmental testers, Logic analyzers, Network analyzers, Power meters, Clamp meters, electric signal isolators, Ohm meters etc.

Competitive Landscape of Portable Test & Measurement systems Market

Key Industry Players (Global) & India
Fluke, Kyoritsu, Megger, Hioki, Agilent, Yokogawa, Sonel, Metrel, Meco Instruments, Motwane, Waco, Ideal Industries & Rishabh

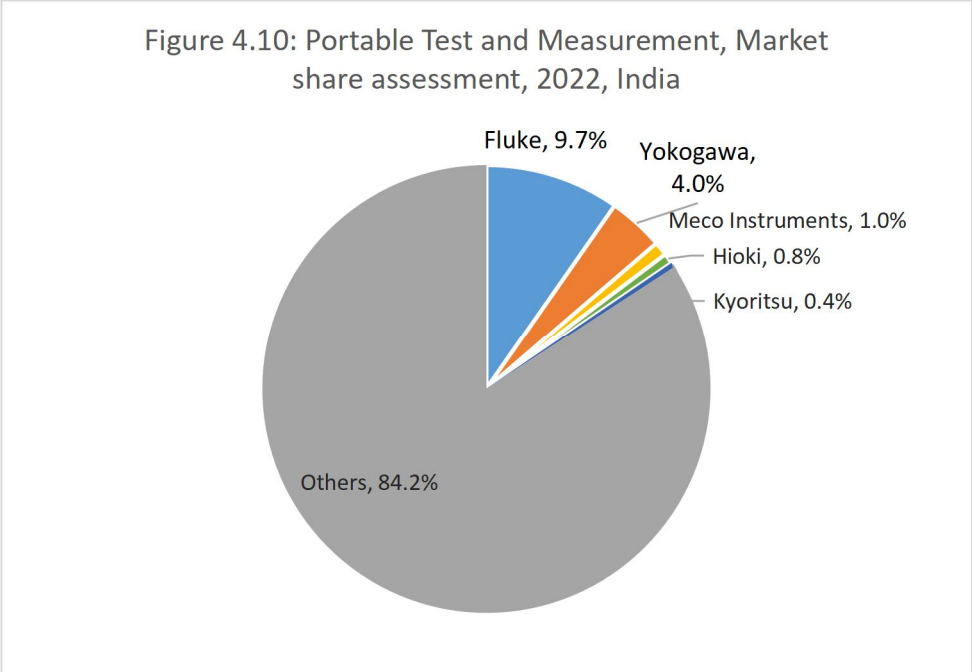


Note: Total Market Size, 2022 = USD 5.1 Billion

More than 100 global and regional companies operate in the Global Portable Test and Measurement market, characterized by a mix of global and regional players. Market is highly fragmented, and the top 5 companies hold only 20.2% revenue share.

- Fluke Corporation (a Fortive business) is a US-based company founded in 1948. It is a major global player in the electrical and environmental testers segments. Fluke's end market includes all major industrial sectors, buildings, and infrastructure segments.
- Kyoritsu Electrical Works (KEW), founded in 1940 and headquartered in Japan, is an electrical test and measurement equipment supplier specializing in portable instruments. Kyoritsu is a clamp meter pioneer. KEW has subsidiaries in the United Kingdom, Italy, India, China, Thailand, Singapore, and Japan.
- Megger is a UK company that was first registered in 1889. Megger, while well respected for its insulator testers, also provides end-to-end services to cater to electrical test & measurement requirements. It specialized in cable fault locating, protective relay testing, and power quality testing. Megger has grown through a series of acquisitions over the last 15 years. It predominantly focuses on Western Europe and the United States.

Product innovation, reliability, upgradeability, price-performance value, and ease of use are some of the factors that distinguish competitors. Market players focus on optimizing and broadening their product portfolio to witness organic growth. Nevertheless, mergers and acquisitions also are part of the growth strategy.



Note: Total Market Size: USD 163.46 MN, 2022

The Indian Portable Test and Measurement market is served by both overseas and homegrown companies, but overseas companies dominate. The market is led by overseas companies such as Fluke, Yokogawa, Agilent etc. A large number of regional players operate in this space making it highly fragmented. Indian companies include Rishabh Instruments, Meco Instruments, Kusam-Meco, and Crown Electronic Systems. Rishabh Instruments and Meco Instruments have in-house design, development, and manufacturing facilities and strong distributor networks. Rishabh Instruments is the Number 2 player for multimeter & clamp meter in India and is an emerging player for insulation testers. Rishabh Instruments holds 1.57% market share in the India Portable Test & Measurement segment (w.r.t the TAM). It was the first company globally to introduce selectable short circuit current along with touch screen insulation testers and Audio readout capability.

Distribution Channel Assessment

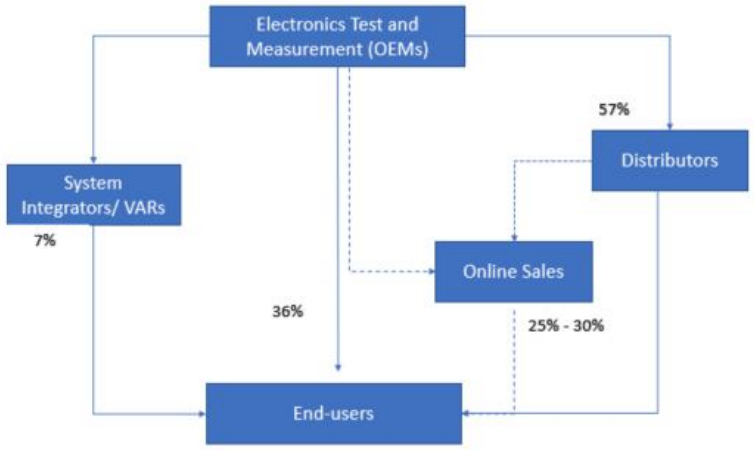


Figure 4.11: Portable Test and Measurement Component Distribution Channels, India, 2023

There are 4 main channels for distribution of Portable Test and Measurement equipment to end users.

1. Direct sales is the second-largest channel and contributes about 36% of sales. The route is preferred in high-value purchases or those that require consultation & services from the test instrument vendor. Both basic and advanced test instruments are sold through this channel.
2. Because the majority of test instrument vendors are global firms with headquarters outside of India, distributors play a pivotal role as gateways to reach large number of Indian customers and are responsible for about 57% of sales.
3. Online sales is gaining traction as familiarity with eCommerce increases in the country. Online sales account for 25% to 30% of sales, and that percentage is expected to grow.
4. System integrators are mainly used for DAQ-based instruments and contribute an estimated 7% of sales.

Technology Trends

Trend	Description
Connectivity and data Management for DMMs and Electrical testers	Handheld instruments that technicians use in the field are being upgraded to connected devices (e.g., inbuilt Bluetooth) that can transfer data to cloud platforms to enable continuous monitoring of assets in the industrial environment. Meters are coming with inbuilt memory to store data as a backup facility. This eliminates the manual data entry process and the possibility of human error.
Frequency coverage increase in Test & Measurement Instruments	As wireless technology advances toward utilizing higher-frequency waves, scalable, reliable, and higher-frequency analyzers will be needed. Increasing performance and ruggedness and making portable network analyzers as light as possible are among recent design and

	development trends.

Drivers & Restraints

Global Driver 1: Power management applications

Digitalization and the use of electronics increases the need for high-speed connectivity, advanced communication devices, and high-speed data transfer. Communication systems are transitioning to new technologies such as 5G, Wi-Fi 6, and 400 Gbe Ethernet that offer higher data bandwidth at lower latency. The new technologies consume more power, increasing the importance of power management. For the portable T&M market, this will translate into higher demand for power analyzers, RF test equipment for power amplifiers, electrical testers, and DMMs—especially for the automotive, A&D, communication, power, consumer electronics, and semiconductor industries and data centers. In addition, automotive OEMs' push for EVs will result in high demand for power analyzers, power meters, DMMs, and electrical testers. Urbanization, industrial growth, the need for energy efficiency, and growing electricity consumption are driving the demand for environmental testers and power analyzers worldwide.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

Global Driver 2: Growth in Electronics Content in Automotive

Growth in vehicle diagnostics, infotainment, and the development of autonomous vehicles, electric vehicles (EVs) and connected cars spur the adoption of electronics in the automotive industry. According to Industry experts, the cost of electronics as a percentage of total car cost will increase from 40% in 2021 to 50% in 2030. The increase in electronics content will directly drive the need for more portable test and measurement instruments for product development and manufacturing. RF test instruments such as network analyzers, power clamp meters, DMMs, electrical testers, and DAQ will be in demand.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

Global Driver 3: Product feature innovation and technology advancements

Price pressure is usually high in the fragmented Portable T&M market; therefore, market participants constantly invest in R&D to improve product features and performance. For example, in DMMs, market participants have introduced real-time data communication (using Bluetooth, Wi-Fi, and USB) to a

remote person through a mobile app/basic PC software, which enables faster response time and improves safety for on-field personnel. Market participants also are concentrating on software-centric value addition.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

Global Driver 4: Data center buildout

Projected exabyte-range data volume, increasing migration to cloud services, the need for efficiency, new forms of data modulation (e.g., PAM4), and the transition to 400Gbe Ethernet bandwidth drives data center buildout and generates growth opportunities for the portable test and measurement market. As more data centers are built, the need to verify the electrical performance for efficient and safe functioning also increases. Verification of UPS, ATS, Circuit breakers, cables, and transformers periodically for parameters such as Power factor, winding resistance, insulation resistance, connection resistance, earth testing, electrical operability tests are important to ensure that data centers are commissioned and operate at higher efficiency.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

India Driver 1: Make in India Initiative

The Government of India is encouraging domestic manufacturing through various policies and initiatives. In 2014, it announced the Make in India initiative to promote and develop India as a global manufacturing hub. The initiative reduced bureaucratic hurdles for both domestic and international companies to set up manufacturing bases in the country. The initiative, a part of the *Atmanirbhar Bharat Abhiyan* (Self-reliant India) provides a boost to the country's business operations by encouraging substitution of imports of low-technology products and generating demand for local manufacturing. Industries that benefit from include electronics, pharma, and steel. The country also introduced the modified Electronics Manufacturing Clusters Scheme (EMC 2.0), which aims to enhance the infrastructure base for the electronics industry and broaden the electronics value chain. The policies are expected to create more players across the semiconductor value chain (from design to service). At Rishabh Instruments, under all product segments, 99% of manufacturing operations are done in-house (in India) and only 1% of the total turnover is spent on outsourcing processes.

Product Category	*Impact-Medium Term (3 – 5 years)*	*Impact-Long Term (6 – 10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 1: Semiconductor supply constraints

The COVID-19 pandemic has created a supply-demand gap leading to shortage of semiconductors, the basic building block of all electronic components. Test equipment OEMs that cannot procure chips often lose revenue. Customers (e.g., automotive companies) also face production challenges that are halting or delaying expansion plans. Supply chain issues will ease gradually as semiconductor fabs add capacity.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 2: High Fragmentation and market maturity hampers growth

Portable Test and Measurement market has matured technologically, especially in the DAQ, DMM, and electrical and environmental tester segments. The current scope of innovation and product optimization lies in feature enhancements and design ruggedness rather than technology advancements. This has led to a decrease in Average Selling Price (ASP), hampering revenue growth. Intense competition among the many market participants also adds price pressure.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 1: Lack of government incentives

The Indian government has several policies to attract investments in manufacturing of electronics, but there are not enough policies and financial incentives to support the growth of the Portable Test and Measurement market. Companies often face higher GST on certain components required to manufacture the equipment.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 2: Cheaper imports from China

The Indian market is highly price sensitive. End users tend to procure low-priced equipment from China, creating price competition and resulting in lower Average Selling Prices of local products.

Product Category	*Impact-Medium Term (3–5 years)*	*Impact-Long Term (6–10 years)*
Portable Test and Measurement		

Impact of the trend on the product category: **Very High** **No Impact**

CHAPTER 5 – OVERVIEW OF SOLAR INVERTERS

Overview

Note: This report details on solar string inverters only. The TAM calculated focuses on on-grid type inverters (solar string) up to 100kW capacity.

Inverters are classified as micro inverters, string inverters, and central inverters. Micro inverters are typically limited to 300W-500W each and are suitable for only small installations of 1kW-2kW size. Central inverters are used for 10s MW scale ground mount PV projects but are being replaced by string inverters of 175kW-255kW ratings because they are easy to use, easy to service, and flexible in installing near the PV array. String inverters can be used for residential and medium-sized commercial solar PV installations. They are smaller than central inverters. This market is dependent on the adoption of renewable energy across the globe.

Solar String inverters convert direct current generated in Solar panels to alternating current. Multiple (typically 12 to 18) solar panels are connected to a single inverter in a series circuit. The global revenue for solar string inverters is expected to increase from USD 4.3 billion in 2022 to USD 6.6 billion in 2027 at a CAGR of 9.1%. Commercial and residential rooftop solar installations are driving the market's growth. APAC excluding India is the fastest-growing region.

India is a signatory to the Paris Agreement, which requires at least 40% of its energy to be from renewable sources by 2030. By the end of 2030, India targets 500 GW from renewable sources, out of which 300GW is expected to come from solar sources with rooftop solar contributing about 40GW, directly influencing the solar string inverters market. The Ministry of Renewable Energy has launched several schemes to achieve this target and introduced policy measures such as RPOs that mandate a certain percentage of distributed power to be from renewable sources.

The Central Government is also providing a financial subsidy on rooftop solar plant of capacity up to 10kW (Ref: MNRE Circular No. 318/331/2017-Grid Connected Rooftop Dy No. 580 dated 07.03.2019). Systems up to 3 kW will get 40% Central Financial Assistance (CFA) and from 3 kW to 10 kW, 20% CFA. The CFA is also being provided to Group Housing Societies/Residential Welfare Associations (GHS/RWA) etc. for common facilities up to 500 kWp (@10 kWp per house) with the upper limit being inclusive of individual rooftop plants already installed by individual residents in that GHS/RWA at the time of installation of RTS for common activity.

Evolution of the Solar String Inverters Industry

Years	Key Advancements
2011-present	• Hybrid inverters recently witnessed increased traction because of their ability to manage inputs from solar panels, battery banks, and utility grids. These inverters can decide which energy source to use and the way to tap into the sources.
2000-2010	• In 2008, Enphase introduced the world's first commercially available microinverter. Microinverters have numerous advantages over solar string inverters. Microinverters were expected to be pivotal to the solar industry, but cost and installation complexity were major roadblocks for widespread use.
1991-2000	• In 1999, solar PV systems were installed in Germany. Along with them, the world's first transformerless string solar inverter, the Kaco Blue Planet PVI 2600, was installed. These inverters lacked galvanic isolation between the DC and AC circuits, which could allow the passage of DC fault onto the AC side. This along with other challenges with transformerless solar inverters led to the rewriting of industrial standards around the world
Before 2000	• In the 1950s, Inverters moved from being mechanical devices to ones with solid-state circuits through power electronics.

Overview of Global Solar String Inverters Market

Solar string inverter market is expected to increase from USD 4.3 billion in 2022 to USD 6.6 billion in 2027 at a CAGR of 9.1%. Inverters account for around 5% of solar PV system costs and are considered indispensable as the "brain" of renewable energy systems. Solar string inverter segment growth is directly proportional to the increase in solar PV installations.

Growth at the GW level is expected to increase by the end of this decade as many countries, mainly in Asia, ramp up installations to meet renewable energy targets. Annual installations are expected to increase from 104.01 GW in 2021 to 130.51 GW in 2026. India has added 12 GW of solar power capacity till November 2022.

Revenue took a hit in 2018 as China introduced the restructuring of its financial incentive scheme for solar PV power, effectively halting support for utility-scale and distributed generation projects. China had been driving the global solar PV space in the previous few years, so the decline resulted in a contraction of the global market. After a period of subdued growth in 2018, the global solar PV market started to recover but was affected by the pandemic in 2020. The market is showing strong signs of recovery and is bouncing back as China completes its transition to a subsidy-free market and as emerging markets begin to grow. Falling prices of modules and inverters, mainly string inverters, are a result of increasing pricing pressures as Asian manufacturers supply cheaper products to Europe and North America from factories in low-cost locations. Lower prices, however, encourage more solar plant and inverter installations across the globe.

Import tariffs on solar PV components, such as 25% tariffs that the US government imposed on $200 billion in Chinese goods, could lead to a delay or cancellation of some utility-scale projects. However, geographic exemptions (from the US government) for countries like India, Turkey, Brazil, and South Africa may somewhat dampen the overall effect on the cost of solar PV power. The global solar PV

power market continues to become more geographically distributed, with the number of GW-level markets consistently increasing.

Figure 5.1: Solar String Inverter Market Size and Growth Estimates, Global, (USD Billion), 2018-2027F

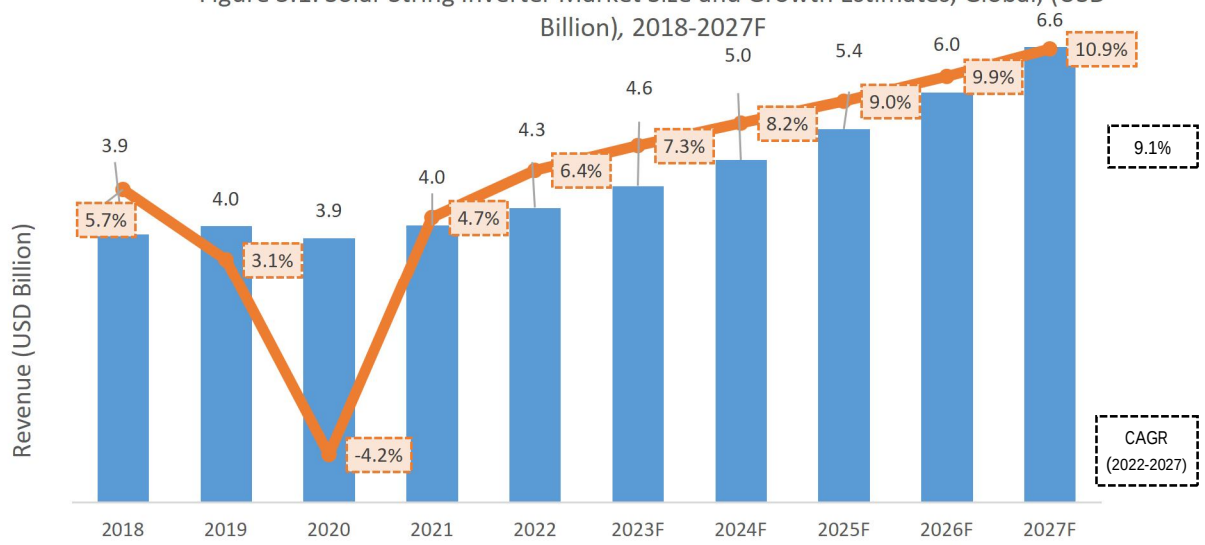


Figure 5.2: Solar String Inverter Market Size and Growth Estimates by Region, (USD Billion), 2018-2027F

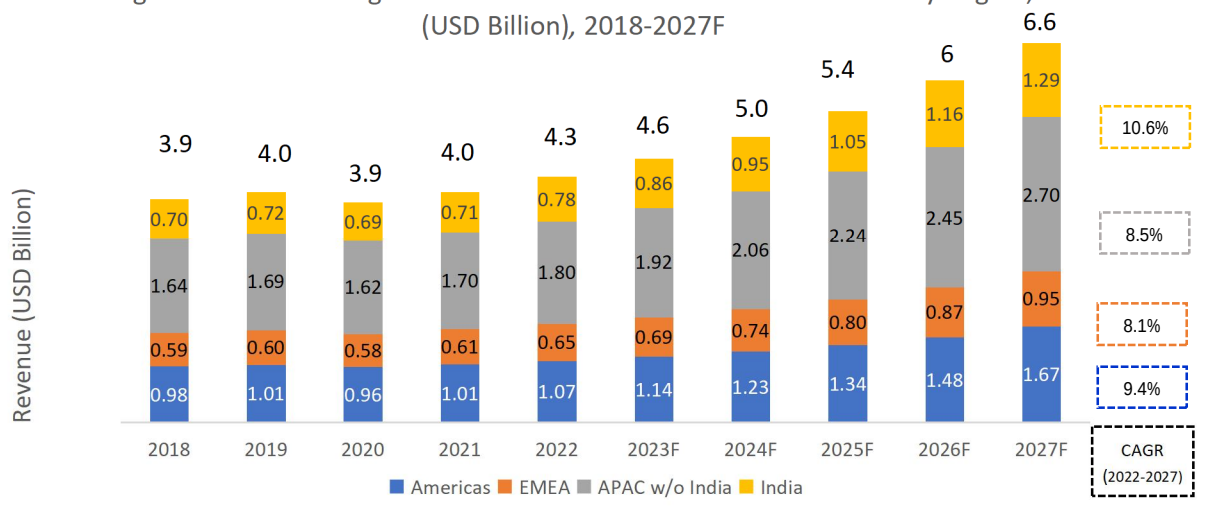
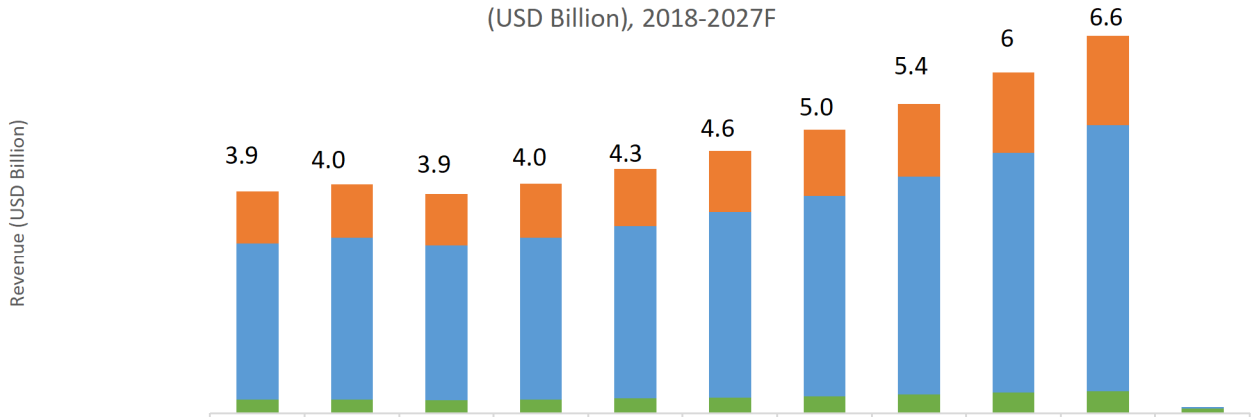


Figure 5.3: Solar String Inverter Market Size and Growth Estimates by End User, Global, (USD Billion), 2018-2027F



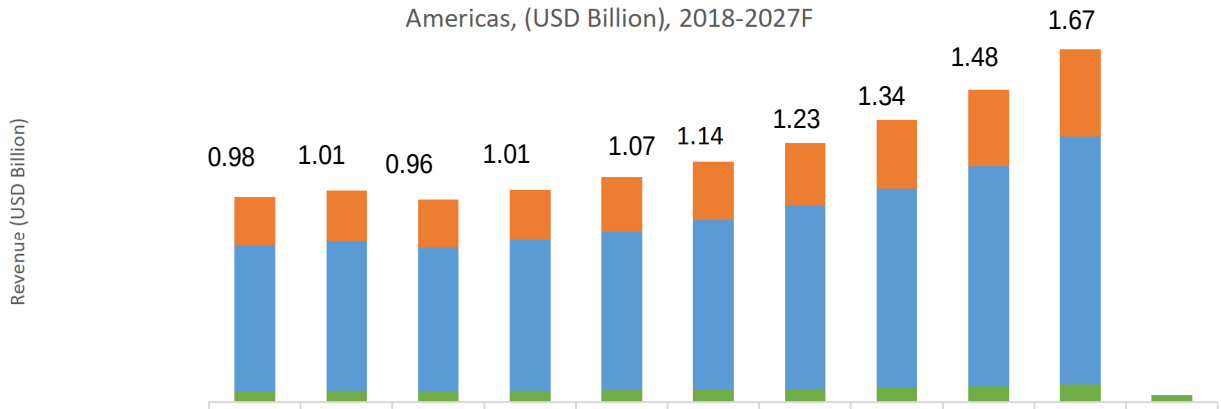
	2018	2019	2020	2021	2022F	2023F	2024F	2025F	2026F	2027F	CAGR
Resid. & Comm	0.91	0.93	0.89	0.94	1.00	1.07	1.16	1.27	1.40	1.56	9.4%
Industrial	2.76	2.84	2.72	2.85	3.03	3.26	3.52	3.83	4.21	4.66	9.0%
Others	0.24	0.24	0.23	0.24	0.26	0.28	0.30	0.33	0.36	0.39	8.4%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | Industrial includes Automotive, Transportation & Defense; Communications, Consumer Electronics, Semiconductors, Building Automation and Data Center; Oil & Gas, Petro Chemicals, Steel & Cement, Pharmaceuticals, Food & Beverages, FMCG; Power Generation & Distribution and Labs

Regional Overview

Americas solar string inverters segment is expected to increase from USD 1.07 billion in 2022 to USD 1.67 billion in 2027 at a CAGR of 9.4%. Subdued capacity additions in North American are mainly ascribed to the United States' introduction of import tariffs on solar PV inverters in 2018. This regulatory hurdle is expected to restrain market growth during the forecast period. Solar PV product price hikes attributed to import tariffs are partially offset by declining overall prices of solar power generation.

Figure 5.4: Solar String Inverter Market Size and Growth Estimates by End User, Americas, (USD Billion), 2018-2027F

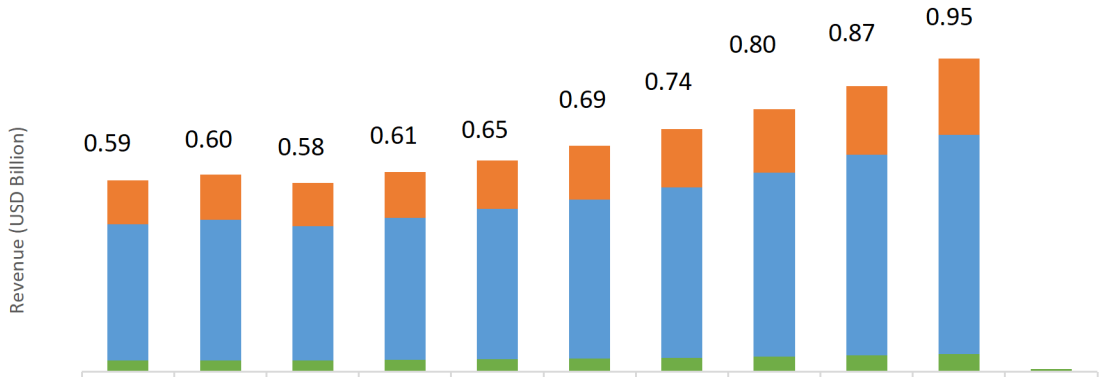


	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Resid. & Comm	0.23	0.24	0.23	0.24	0.26	0.28	0.30	0.33	0.36	0.41	9.9%
Industrial	0.69	0.71	0.68	0.71	0.76	0.81	0.87	0.95	1.05	1.18	9.3%
Others	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.08	8.4%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | Industrial includes Automotive, Transportation & Defense; Communications, Consumer Electronics, Semiconductors, Building Automation and Data Center; Oil & Gas, Petro Chemicals, Steel & Cement, Pharmaceuticals, Food & Beverages, FMCG; Power Generation & Distribution and Labs

EMEA is a mature region in terms of renewable energy installations. EMEA market is estimated to be USD 0.65 billion in 2022 is expected to reach USD 0.95 billion by 2027 at a CAGR of 8.1%. Germany, the United Kingdom, and Spain registered the largest GW installations during 2021 and 2022. The revised renewable energy target (32% of energy mix) by 2030 drives the demand for renewable energy inverters in the EU. Self-consumption and PPAs are core business models to be adopted to drive demand by counteracting the high initial investment costs of solar power projects. European countries offer tax certificates to encourage solar power production. Flexible energy demand and the prevalence of battery storage systems will bolster the growth of solar string inverters. Middle Eastern governments have set country-specific clean energy targets, with the United Arab Emirates attempting to fulfill 50% of its energy needs through renewable sources by 2050.

Figure 5.5: Solar String Inverter Market Size and Growth Estimates by End User, EMEA, (USD Billion), 2018-2027F

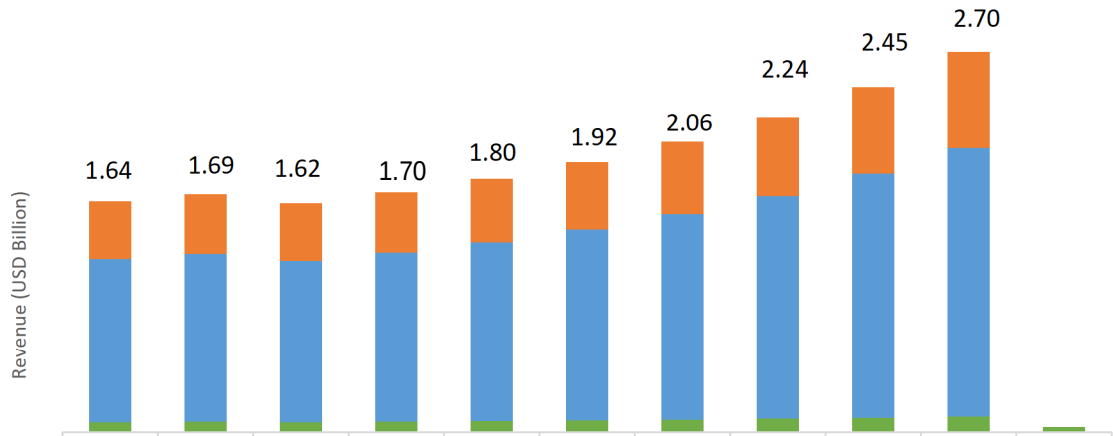


	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Resid. & Comm	0.14	0.14	0.14	0.14	0.15	0.16	0.18	0.19	0.21	0.23	8.7%
Industrial	0.41	0.43	0.41	0.43	0.46	0.49	0.52	0.56	0.61	0.67	8.0%
Others	0.03	0.04	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	7.2%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | Industrial includes Automotive, Transportation & Defense; Communications, Consumer Electronics, Semiconductors, Building Automation and Data Center; Oil & Gas, Petro Chemicals, Steel & Cement, Pharmaceuticals, Food & Beverages, FMCG; Power Generation & Distribution and Labs

APAC (excluding India) solar inverter segment is expected to increase from USD 1.8 billion in 2022 to USD 2.7 billion in 2027 at a CAGR of 8.5%. It is the largest market for solar string inverters. Inverter cost is the key deciding factor in Asia - lower prices may lead to lower overall market size. The market is dominated by installations in China, mostly by domestic manufacturers. Many Chinese manufacturers are venturing into overseas markets by diversifying supply chains and establishing manufacturing locations outside China to circumvent US import tariffs. String inverters are used in medium-sized installation across residential, commercial, utility, and industrial segments. It is imperative for inverter makers to have a local manufacturing facility to customize for the local requirements. Engineering requirements in each Asian country demand on-site and on-demand maintenance (a key restraint for inverter manufacturers trying to expand their global markets). Asian governments have initiated supportive policies and set renewable energy targets driving the market in the medium and long terms.

Figure 5.6: Solar String Inverter Market Size and Growth Estimates by End User, APAC (excluding India), (USD Billion), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Resid. & Comm	0.41	0.42	0.41	0.42	0.45	0.48	0.52	0.56	0.62	0.69	8.8%
Industrial	1.16	1.19	1.15	1.20	1.27	1.35	1.46	1.58	1.73	1.90	8.4%
Others	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11	7.7%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | Industrial includes Automotive, Transportation & Defense; Communications, Consumer Electronics, Semiconductors, Building Automation and Data Center; Oil & Gas, Petro Chemicals, Steel & Cement, Pharmaceuticals, Food & Beverages, FMCG; Power Generation & Distribution and Labs

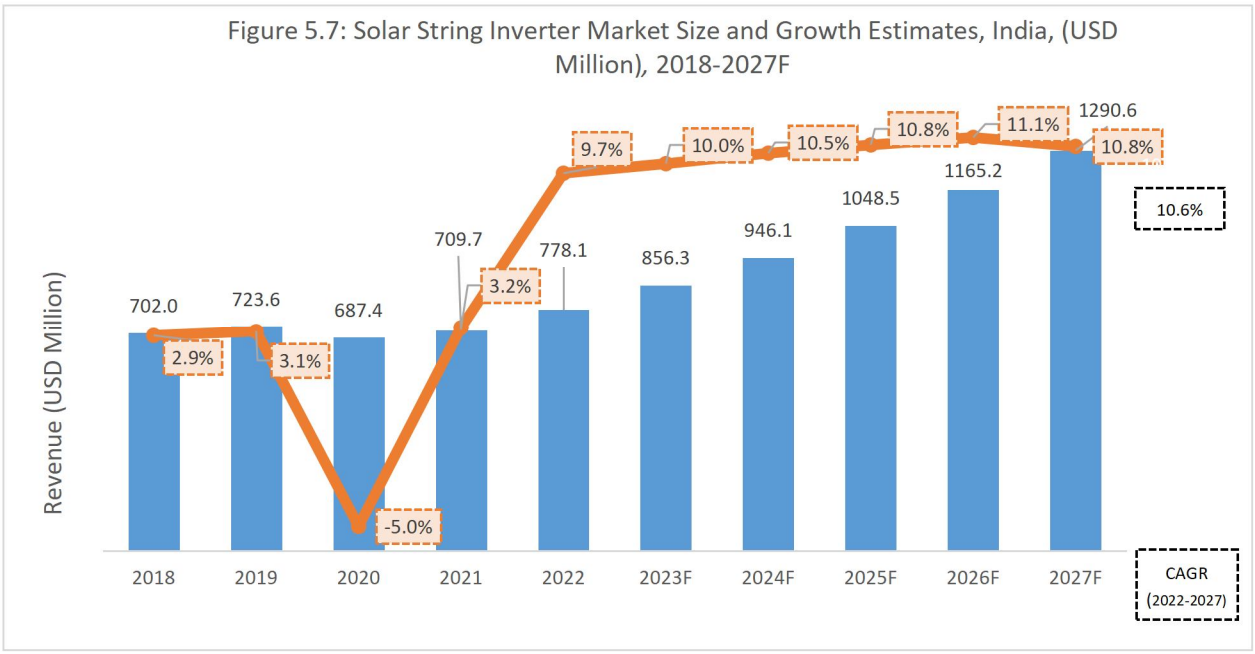
Total Addressable Market (TAM) for Solar String Inverters				
Region	*Total Market Size, 2022 (USD Bn)*	*Estimated TAM, 2022 (USD Bn)*	*TAM as % of Total Market*	*Comments*
Global	4.3	2.84	66%	The TAM for on-grid-type solar string inverters for up to 100 kW is driven by aggressive renewable energy practices pushed by government policies.
Americas	1.07	0.70	65.3%	The TAM market will be driven by installations in commercial complexes and EV charging stations in order to adopt renewable energy practices.
EMEA	0.65	0.43	66.9%	The market is very mature but offers potential for residential rooftop installations to handle peak power demand, which will drive demand for on-grid-type inverters of less than 100 kW.
APAC w/o India	1.80	1.23	68.4%	National renewable energy targets are expected to drive demand for on-grid rooftop solar, especially in residential and small commercial buildings in China and Japan (and India).
India	0.778	0.50	64%	Demand for solar string inverters is expected to come from commercial and industrial segments such as educational institutions, automotive and transportation, and power generation and distribution.

TAM calculated for the following products: on-grid-type inverters up to 100 kW

Overview of Indian Solar String Inverters Market

The Indian solar string inverter market was valued at USD 778.14 million in 2022 and is forecasted to grow at a CAGR of 10.6% to reach USD 1290.6 million in 2027. India is the second-largest market in Asia Pacific occupying more than 25-30% of the Asia pacific market for solar string inverters.

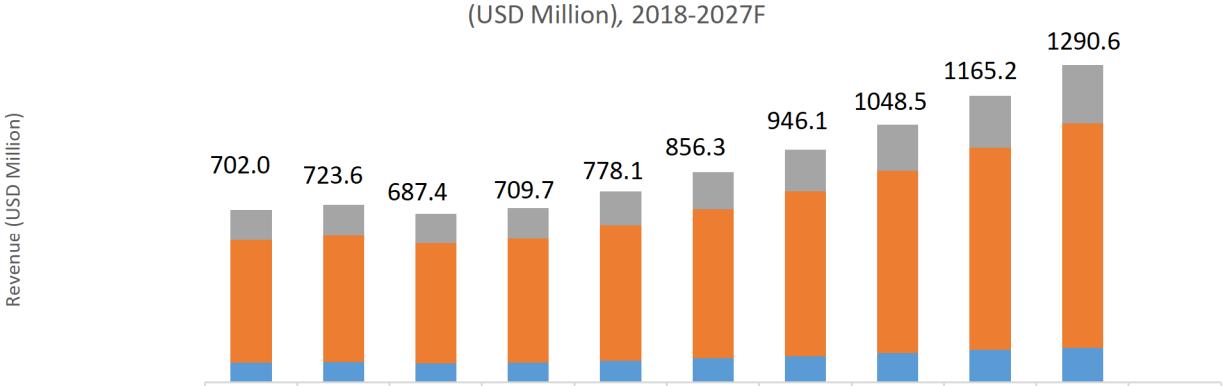
Figure 5.7: Solar String Inverter Market Size and Growth Estimates, India, (USD Million), 2018-2027F



India, the second-largest market in Asia, installed about 10 GW of solar PV capacity in 2019. The Indian solar PV market is expected to register strong growth as the country attempts to meet its revised target of 227 GW of PV installations by 2022. The Indian government focuses on proactive policies including subsidies, such as a 10-year tax holiday, to drive investment. About 77% of the solar capacity in 2021 was from grid-connected utility-scale projects, 20% was from grid-connected Solar rooftops, and 3% was from mini or micro off-grid projects. Industries can access solar power either by installing their own solar rooftops or through open-access solar installations. Open access solar installations witnessed year-on-year growth of 22% to 513 MW in Q1 2022.

String inverters dominate residential, commercial, and industrial installations, which are medium-size and mostly rooftop. The fastest-growing segments are commercial and industrial installations in educational institutions, automotive and transportation, and power generation and distribution. Customers prefer string inverters to central inverters because of their reliability, modular design, ease of installation, and low maintenance.

Figure 5.8: Solar String Inverter Market Size and Growth Estimates by End User, India, (USD Million), 2018-2027F



	2018	2019	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	CAGR
Resid. & Comm	125.5	129.3	122.9	126.8	138.7	152.0	167.8	186.7	209.2	235.8	11.2%
Industrial	496.3	511.6	486.0	501.6	550.7	607.1	671.2	743.6	824.5	914.8	10.7%
Others	80.2	82.7	78.6	81.3	88.7	97.2	107.1	118.2	131.5	140.0	9.6%

'Others' includes industries such as chemicals, textiles, pulp and paper, water that are not mentioned in the list | Industrial includes Automotive, Transportation & Defense; Communications, Consumer Electronics, Semiconductors, Building Automation and Data Center; Oil & Gas, Petro Chemicals, Steel & Cement, Pharmaceuticals, Food & Beverages, FMCG; Power Generation & Distribution and Labs

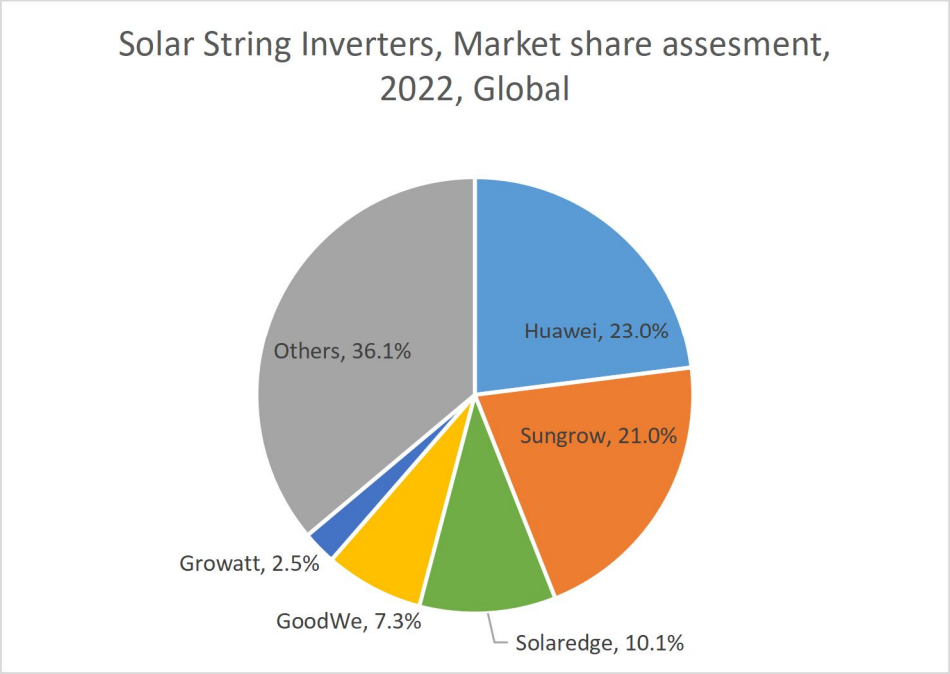
Total Addressable Market (TAM) for the Indian Solar String Inverters Market			
Total Market, 2022, (Mn USD)	*Estimated TAM, 2022*	*TAM as % of Total Market**	*Product subcategories considered for TAM**
USD 778.14	USD 498.0 Mn	64%	• on-grid type up to 100kW

* Note: The total market includes the entire Solar String Inverters market

Competitive Landscape of Solar String Inverters Market

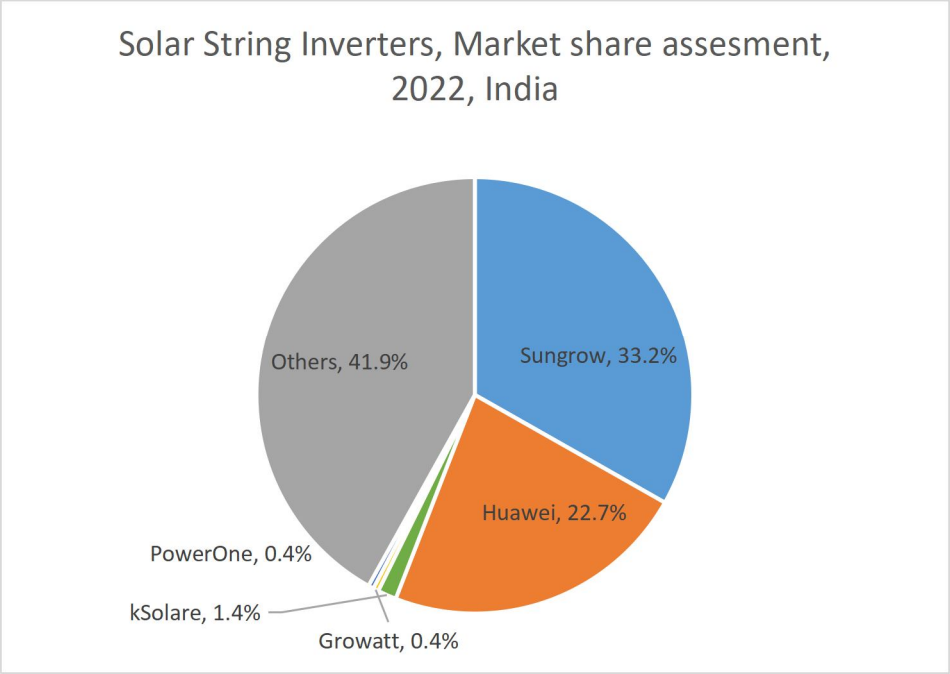
Key Industry players - Global & India
Huawei, Growatt, SolarEdge, Delta, SMA, Sungrow, Fimer, kSolare, PowerOne, GoodWe, ABB, TMEIC & Rishabh

Globally, the solar inverters market is dominated by Chinese manufacturers such as Huawei that have turned their focus on overseas markets after the domestic solar PV industry slowdown. These manufacturers have exclusive access to their home market, where high barriers to entry restrict other participants. The top 3 participants command 54.1% of the market. In the Americas, the market is dominated by residential, commercial and industrial installations and SolarEdge is the preferred brand for rooftop installations. In EMEA, string inverters are preferred for utility installations. Huawei and Sungrow are the major participants, followed by GoodWe. In Asia-Pacific, Sungrow and Huawei dominate, followed by Growatt and other players such as Solis and SMA solar.



Note: Total Market Size = USD 4.3 Billion, 2022

In **India** too, the market is dominated by Chinese players. Sungrow and Huawei are the market leaders. Huawei has gained access through its partnership with Waaree Energies Ltd and promoted its products through the sales and service network. Sungrow has been steadily gaining market share and topped the market in 2021. The company has bagged large utility projects and recently announced an increase in its Bengaluru factory capacity from 3 GW to 10 GW to cater to future demands. Rishabh Instruments is the first company in India to design, develop, and manufacture Solar String Inverters end to end and it holds 0.13% market share in the Solar String Inverters segment (w.r.t the TAM).



Note: Total Market Size = USD 778.1 Million, 2022

Others Include Delta, SMA, Fimer (ABB), Huawei, SolarEdge, Fronius, Statcon Energia, Kstar, Consul Neowatt, Havells, PowerOne, KACO, Enertech

Distribution Channel Assessment

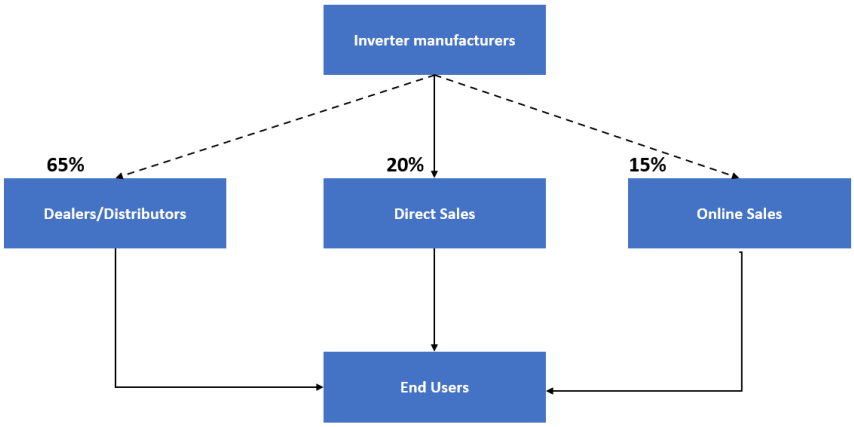


Figure 5.11: Solar String Inverter Distribution Channels, India, 2023

Solar string inverters have three main distribution channels.

1. Inverter manufacturers sell directly to end users in about 20% of transactions. This is preferred for high-value bulk or government orders.
2. Inverter manufacturers sell to dealers and distributors who then sell to end users. This is the dominant revenue-generating channel, accounting for 65% of sales.

3. Sales though self or third-party eCommerce websites is an emerging opportunity because it offers manufacturers a broader customer reach. About 15% of sales happen through this medium.

Technology Trends

Trend	Description
IoT-based energy management centers	String inverters are being equipped with sensors and cloud-based weather monitoring software tools to become intelligent energy management devices.
Smart inverters for smart grids	String inverters are being developed with autonomous features to accommodate smart grids. Autonomous features include reporting of grid abnormalities to utility operators and detection of arc fault circuit (interrupters that detect whether the arc fault is at the inverter or module level).

Drivers & Restraints

Global Driver 1: National and regional renewable energy targets

The prevalence of renewable energy sources and the need to convert DC to AC for these sources is expected to lead to higher inverter demand. The global commitment to sustainability and climate change will require focus on efficient energy utilization and shift towards sustainable and renewable sources of energy. This will drive the demand for energy solutions. Following the Paris Agreement, several developed and developing countries have adopted national RE targets to reduce their carbon emissions.

As of 2019, 85 countries have included unconditional renewable power pledges in their current nationally determined contributions (NDCs) while 135 countries have non-NDC domestic renewable energy targets. National governments are expected to update or enhance their NDCs in 2020. These national and regional renewable energy targets have led to the growth in renewables-based power generation in various regions of the globe.

Total Renewable Energy Inverters Market: Regulatory Environment, Global, 2019–2025

Region	Regulation	Target	Date
Global	Paris Agreement	Restricting the rise in global average temperatures to well below 2°C above pre-industrial levels. As of 2019, 195 member countries have signed the agreement, and 187 have become party to it.	-
	RE100	RE100 is a global corporate leadership initiative bringing together influential businesses committed to 100.0% renewable electricity by 2050 while achieving 60.0% by 2030.	2050
Europe	Renewable Energy Directive	Revised renewable energy target of 32.0% of the energy mix by 2030. This target is only binding for the EU as a whole and not at individual member state levels.	2030
US	Clean Power Plan	Sets target emission rates (or mass-totals) for each state and aims to lower total power sector emissions by 32.0% by 2030 from 2005 levels.	2030
	Renewable Portfolio Standard (RPS)	The RPS mechanism places obligations on electrical utilities to generate a specified fraction of their electricity from renewable energy sources. 29 states have adopted RPS programs, with each state designating its own renewable energy targets and end dates.	-
China	Renewable Portfolio Standard (RPS)	A minimum of 35.0% of total electricity consumed must be generated from renewable energy sources.	2030
India	Nation Action Plan on Climate Change	Renewable energy targets to develop 450.00 GW of renewable energy by 2030, with interim targets of 227.00 GW by 2022.	2030

Source: IRENA, Frost & Sullivan

Figure 5.12: Renewable Energy Inverters Market: Regulatory Environment, Global, 2019 – 2025

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters	●	●

Impact of the trend on the product category: **Very High** ● ◕ ◑ ◔ ○ **No Impact**

Global Driver 2: Falling renewable energy installation costs

Solar PV module prices are at their lowest ever, resulting in the commoditization of solar PV systems. The Levelized cost of electricity (LCOE) for solar energy sources is becoming comparable with conventional sources primarily because of technological advancements in solar PV power components such as solar modules. The costs of renewable energy systems are forecast to continue declining as further savings are made because of economies of scale, technological development, and production automation. The 31/5 Policy in which China cut support for and effectively halted utility- and distributed-scale PV projects in the country created an oversupply of solar PV products in the global market, leading to a further short-term decrease in prices and making more projects viable, resulting in higher demand for inverters. This driver is expected to have a high impact in the medium term and a medium impact in the long term.

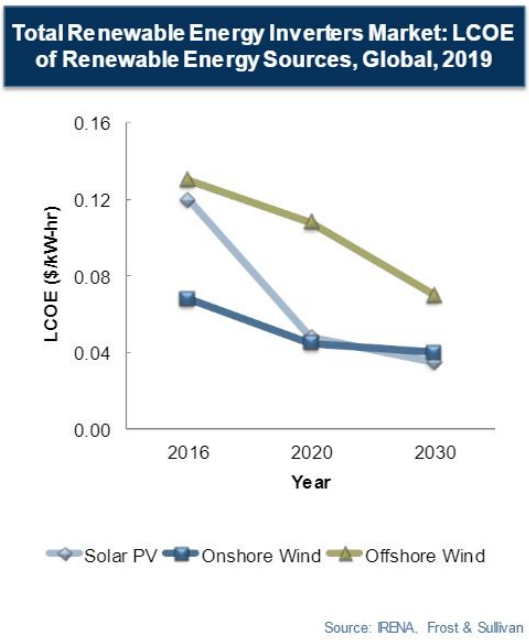


Figure 5.13: Renewable Energy Inverters Market: Levelized cost of electricity, Global, 2019

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters	●	◑

Impact of the trend on the product category: **Very High** ● ◕ ◑ ◔ ○ **No Impact**

India Driver 1: National renewable energy targets

India has been at the forefront in adhering to policies to reduce emissions and has a commitment to reduce GHG emissions by 33% to 35% below 2005 levels by 2030. The Intended Nationally Determined Contribution (INDC) aims to install 500 GW of renewable power by end of 2030 as per its submission to UNFCCC, in addition to setting a target of 40% of total energy production in renewable power by 2030. The National Solar Mission (NSM) was established in 2010 to turn India into a global leader in solar energy. The initial target to install 20 GW of solar power by 2022 increased to a target of 300 GW by 2030. India ranks 5th globally in solar power deployment. Given that the country has only achieved one-third of its 2022 target, there is plenty of growth potential in the short to medium term, which is increasing the demand for solar string inverters.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters	●	●

Impact of the trend on the product category: **Very High** ● ◕ ◑ ◔ ○ **No Impact**

The Government of India also is promoting smaller Solar plants up to 15 HP (11.2 kW) for farmers under the PM-KUSUM scheme, which will increase the demand for smaller string inverters (5 kW, 7.5 kW, 10 kW, and 12 kW). In addition, the Indian Government is supporting Make in India initiatives by proposing

to increase Basic Customs Duty (BCD) from 5% to 20% on imported Solar inverters, thereby driving indigenous manufacturing.

India Driver 2: Falling renewable energy installation costs

The declining prices of solar PV modules have resulted in increased adoption and commoditization of solar PV systems. While tariffs are influenced by multiple factors including financing and equipment costs, government incentives, and OPEX, falling equipment prices and increased competition have been the major factors in declining LCOE, which was as low as INR2.62 per KWh in 2017 ($0.036/KWh). Module costs account for approximately 20% of LCOE, while financing costs account for almost 56%. Declining module costs contributed to lower LCOE. Module costs fell from INR2.62/KWh ($0.036/KWh) in 2017 to ₹2.38/KWh ($0.033 per KWh) in 2019, declining by almost 10%. Maturing RE technologies have lowered risk premiums attached to the financing of projects further bolstered by policy support and increased competition that resulted in equity investors recalibrating return expectations, which has reduced financing costs.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters	●	●

Impact of the trend on the product category: **Very High** ● ◕ ◑ ◔ ○ **No Impact**

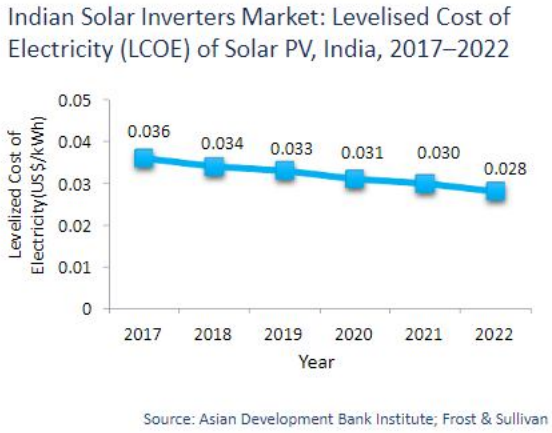


Figure 5.14: Cost of Electricity from Solar PV, India, 2017 – 2022

Global Restraint 1: Grid saturation

As the most mature market in terms of renewable energy installations, Europe has seen more than a decade of renewable energy development in Germany, Spain, Italy, and Greece. For instance, Germany generated approximately 43% of net electricity consumption from renewable energy sources in 2018. Solar PV power can cover as much as 45% of momentary electricity demand on sunny weekdays, with the coverage rate reaching as high as 60% on weekends and holidays. This places a heavy burden on grid networks, leading governments to cut back feed-in-tariff (FiT) schemes in order to prevent the oversaturation of renewable energy installations. This trend could extend to other parts of the globe as renewable energy sources become a significant part of the energy mix.

The high saturation rate compels governments to slow renewable energy uptake, which would reduce the demand for inverters.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 2: Restructuring and reduction of renewable energy incentive programs

Renewable energy, particularly solar power, is reliant on government support. FiTs, tax benefits, import duty exceptions, rebate programs, and fund allocations affect market dynamics. A cut in incentive programs reduces the growth potential of solar PV, at least during the time it takes for the market to adjust to the change. The Chinese solar PV market felt the effects of solar incentive program restructuring in 2018, and the contraction resulted in a significant slowdown in the global market. The reduction of investment tax credit (ITC) or federal solar tax credit in the United States, along with the migration from a tariff to a net metering scheme in Canada, restrains the growth of the North American solar PV market. The decline in FiTs for solar projects in Japan resulted in a considerable drop in the country's solar PV installations, directly translating into a decrease in demand for renewable energy inverters.

The effect of this restraint is particularly apparent in developing countries where policy support can reduce the cost of system financing and operational risks.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 1: *Risks associated with RE projects*

While the Ministry of Renewable Energy has taken several initiatives in de-risking RE projects to encourage investors, there still are challenges that decelerate the growth of solar projects. Utility-scale projects in India are marked by off taker risk, which refers to non-compliance of the PPA terms by an offtaker. This is usually in the form of payment delays of up to 12 months, which is much higher than the average of 30 to 60 days. This results in higher working capital requirements, thereby increasing tariffs. It also increases risk as investors demand higher returns causing higher financing costs.

The Ministry of Power recently issued an order mandating letter of credit for payments by DISCOMs, which, if implemented effectively, could be a solution for payment delays. Another major risk factor for developers is associated with land acquisition, which, when delayed, can impede the timely setup of solar parks. Government initiatives in facilitating land acquisition will expedite RE project development

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 2: *Restructuring of open access fees*

Most states in India announced amendments to open access regulations in 2018, including the withdrawal of benefits for open access transactions. To promote the use of renewable energy by corporates, most states had provided banking benefits that allowed accounting duration of longer than 15 minutes (as opposed to the 15-minute duration for other energy sources) facilitating banking of surplus that could be used during subsequent months in the same financial year. Indian states in the last few years have capped the duration at 15 minutes or restricted withdrawal of banked energy to a few months. Karnataka had been at the forefront in promoting renewable energy by issuing waivers on open access charges, but those were not extended beyond 2018. Maharashtra Electricity Regulatory Commission (MERC) recently reduced the flexibility of corporate PPA consumers by having more than one open-access supplier. Haryana withdrew its blanket 10-year open access charges waiver except for captive power projects. Such steps by state governments are expected to impede the growth of solar PV deployments.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*
Solar String Inverters		

Impact of the trend on the product category: **Very High** **No Impact**

CHAPTER 6 – OVERVIEW OF ALUMINIUM HIGH PRESSURE DIE CASTING (HPDC)

Overview

Note: In this report, Aluminium High Pressure Die Casting includes applications in automobile and automation industries only.

Aluminium Die Casting is the process of creating aluminium alloy-based products by forcing the molten metal into a die casted mold cavity. Aluminium Die Casting is usually done with a cold chamber under high pressure because aluminium alloys have a lower melting point. High Pressure Aluminium Die Casting is particularly employed for high-volume manufacturing for automotive components. The high pressure die casting tooling (or die casting mold) is generally made of hardened steel to withstand high pressure and temperature. The die usually consists of two halves with negative geometry of the part to create the form factor. Frost & Sullivan estimates Global Aluminium High Pressure Die Casting market at USD 83.9 billion in 2022. The market is estimated to grow at a 6.1% CAGR from 2022 to 2027 and reach USD 112.9 billion. Automotive will remain the highest revenue contributor across all regions. APAC will lead revenue growth in the next five years.

The High-Pressure Aluminium Die Casting market in India is mature and has continuously grown in production capability to meet both domestic and global requirements. Companies manufacture components including engine blocks, bed plates, and several other thin wall castings. The automotive industry is the largest revenue contributor for the high-pressure aluminium die casting market. India has a well-developed ecosystem of material suppliers, support services, skilled labor, and equipment suppliers for both global and domestic players to support the growing demands for high-pressure aluminium die cast parts.

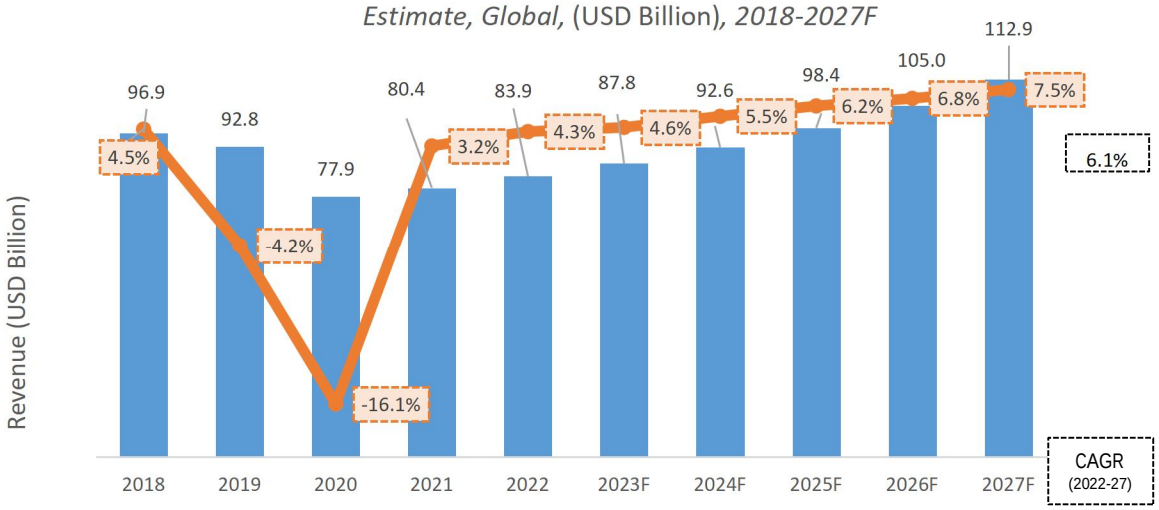
Evolution of Aluminium High Pressure Die Casting Industry

Years	Key Advancements
2011-present	• Digital solutions such as Monitizer and AMe continuously track processes and equipment condition to help customers optimize the process and learn about machine performance in real time to better react and predict downtime. • Gigapress machines emerge to cast larger aluminium components.
2000-2010	• The role of automation in Aluminium high pressure die casting gained significance to run the processes at a stable cycle time, which extends die life, reduces scrap, and lessens workers' repetitive tasks and heavy lifting.
1991-2000	• Simulation solution providers began to add more capabilities for comprehensive modelling of defects to optimize the process, thus helping aluminium casters reduce cost and time to market.
1981-1990	• The near-net shaping process brought lower cost and better process control, thus improving reliability of components produced by AL HPDC. • Early stages of CAD adoption for simulation of casting in two dimensions.
1971-1980	• Aluminium die casters focused on improving the process technology to solve issues such as sticking of aluminium to the die core. Several studies were conducted to analyze cooling rate and thermal stress to improve quality of cast components and extend die life.

Overview of Global Aluminium High Pressure Die Casting Market

High-Pressure Aluminium Die Casting is mainly used for fabricating components for automotive and industrial applications. The Global High-Pressure Aluminium Die Casting market was USD 83.9 Bn in 2022. The market is forecast to grow at CAGR of 6.1% between 2022 and 2027, to reach USD 112.9 Bn by 2027. The ratio of High-pressure Aluminium die casting market in automotive to that in industrial (the 2 sectors that are covered in this report) is ~ 4:1.

Figure 6.1: Aluminium High Pressure Die Casting Market Size and Growth Estimate, Global, (USD Billion), 2018-2027F



Demand for high-pressure aluminium die casting is high for automotive power train components such as cylinder heads, engine blocks, and transmission cases. Light weighting of vehicle structures such as longitudinal members, shock towers, and subframes are creating new opportunities. EV motor and battery housings generate demand. EVs require aluminium components to increase drive range, charging speed, and safety. Recovery in automotive production and growth in EV play a central role in growth of the Aluminium High Pressure Die Casting market in the next 5 years.

Figure 6.2: Aluminium High Pressure Die Casting Market Size and Growth Estimate by Region, (USD Billion), 2018-2027F

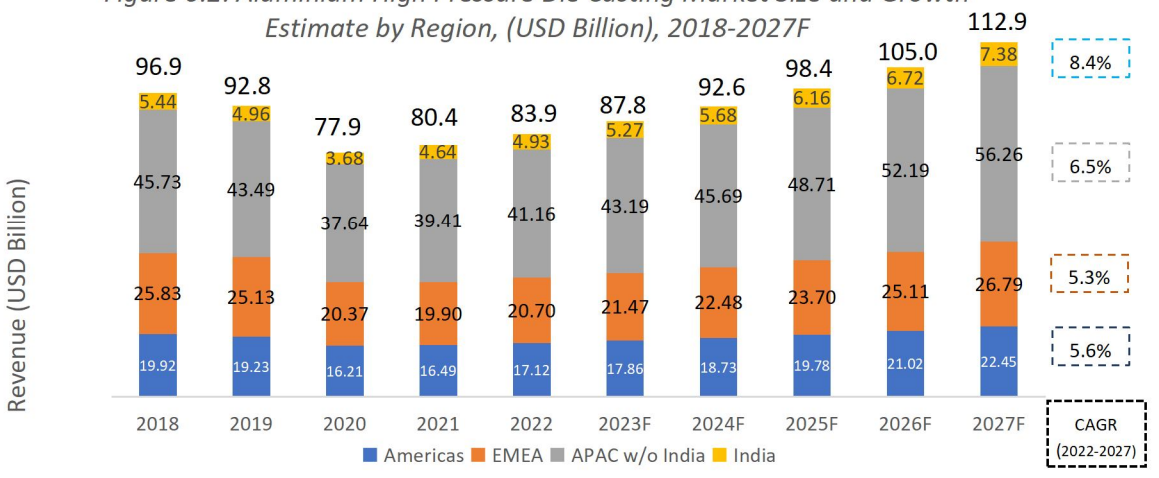
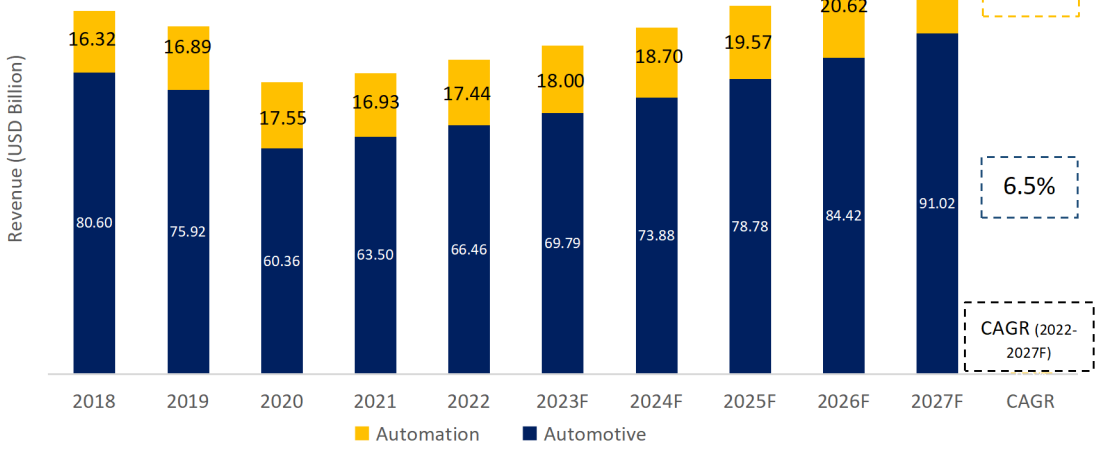


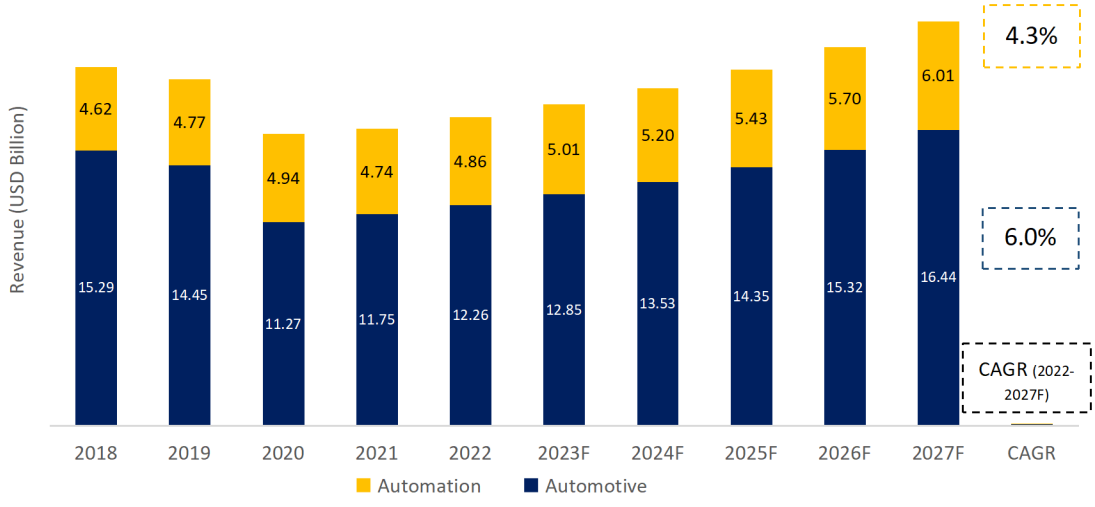
Figure 6.3: Aluminium High Pressure Die Casting Market Size and Growth Estimate by End User, Global, (USD Billion), 2018-2027F



Regional Overview

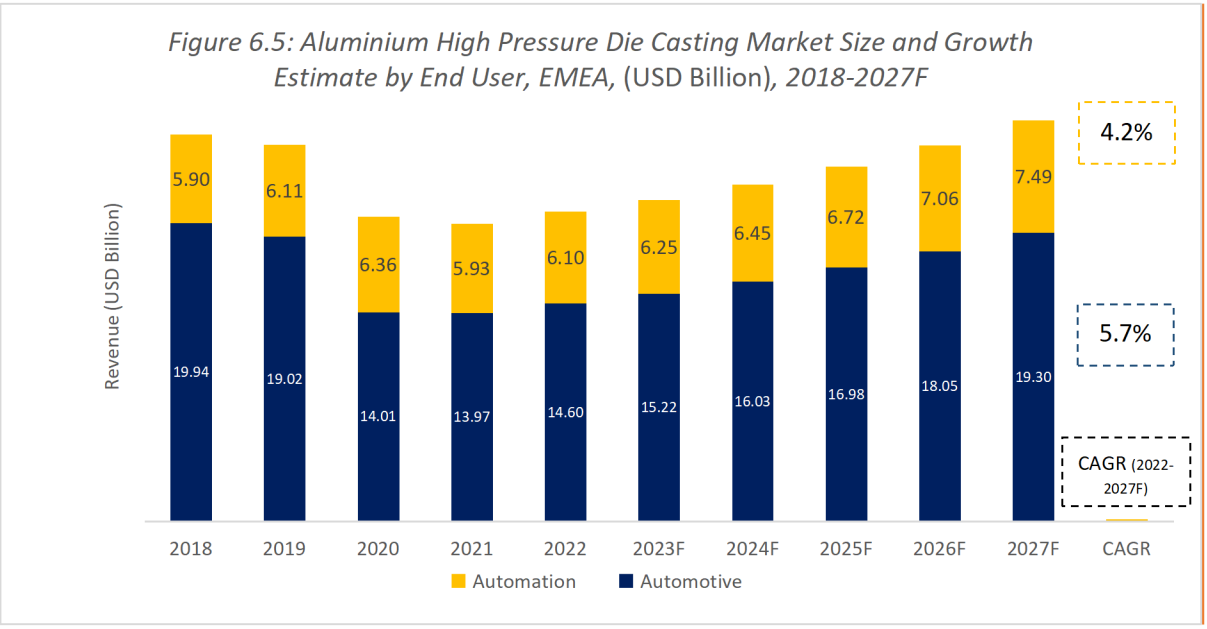
Recovery of the automotive industry in the Americas is driving the growth in short-term. Americas market is estimated to grow from USD 17.12 billion in 2022 to USD 22.45 billion in 2027 at a 5.6% CAGR. Light weighting is a major focus area for leading automotive OEMs such as Ford, Jeep, and Tesla. Many are investing in large giga press high-pressure die casting machines to produce large single-piece aluminium parts in body structures.

Figure 6.4: Aluminium High Pressure Die Casting Market Size and Growth Estimate by End User, Americas, (USD Billion), 2018-2027F



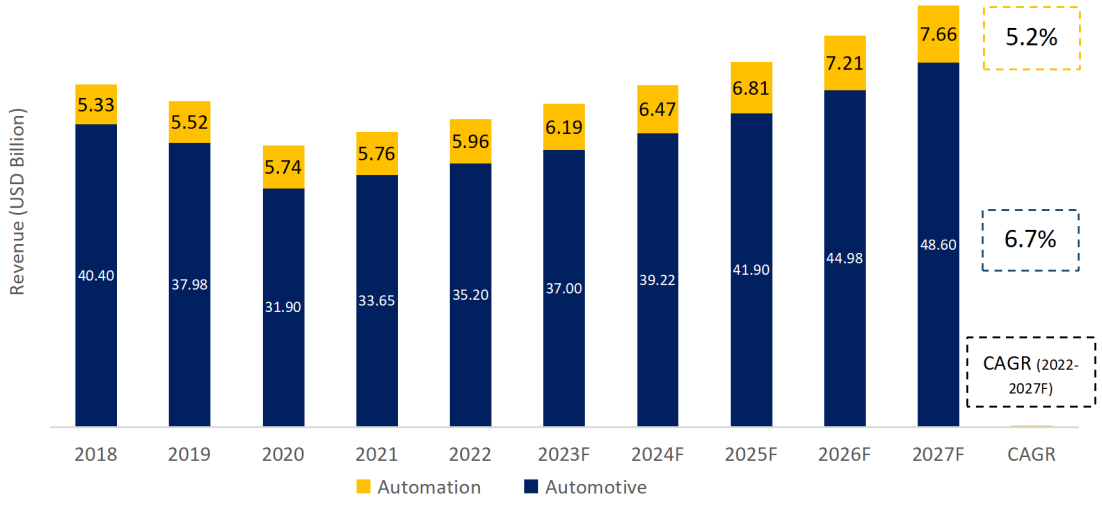
EMEA market is estimated to grow from USD 20.7 billion in 2022 to USD 26.8 billion in 2027 at a 5.3% CAGR. Major automakers BMW, Daimler, and Volkswagen are expected to achieve 20% electrification

(the percentage of EV cars sold) by 2025. Volvo Cars is leading the segment and aims to electrify 100% of its cars by 2030. In February 2022, Volvo Cars announced plans to invest in mega casting techniques similar to Tesla to build next-generation EVs that are lighter, stronger, and more efficient. Industrial demand for high pressure aluminium die casting is expected to experience steady recovery after 2020 until 2027.



Aluminium High Pressure Die Casting in APAC excluding India is estimated to grow from USD 41.2 billion in 2022 to USD 56.3 billion in 2027 at a 6.5% CAGR. APAC is characterized by large number of OEMs and suppliers and a competitive production cost. The region's high population, consistent demand for vehicles, low cost of production, and China's focus on EVs and its dominance in manufacturing are the driving forces. South Korea and Japan are other leaders in EV adoption. The region is the largest Industrial Automation market because of expanding industrialization and digitalization activities.

Figure 6.6: Aluminium High Pressure Die Casting Market Size and Growth Estimate by End User, APAC (Excluding India), (USD Billion), 2018-2027F



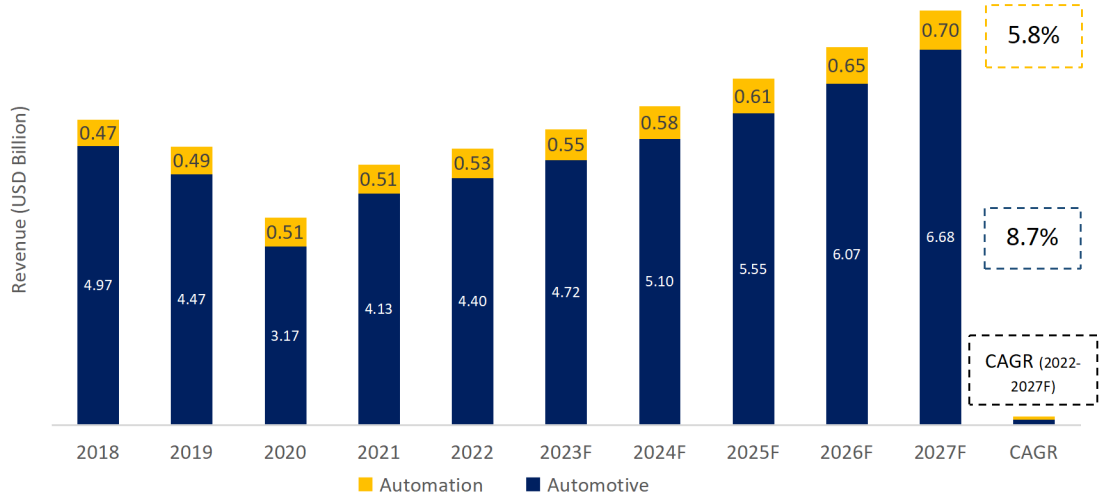
Total Addressable Market (TAM) for the Aluminium High Pressure Die Casting Market				
Region	*Total Market Size, 2022 (USD Bn)*	*Estimated TAM, 2022 (USD Bn)*	*TAM as % of Total Market*	*Comments*
Global	83.9	83.9	100%	TAM is 100% at global and all regional levels since the market size is assessed for automotive and industrial automation, the two sectors in scope
Americas	17.12	17.12		
EMEA	20.70	20.70		
APAC w/o India	41.16	41.16		
India	4.9	4.9		

TAM calculated for the following products: Applications in automobiles & automation industries

Overview of Indian Aluminium High Pressure Die Casting Market

Aluminium High Pressure Die Casting market in India is estimated to grow from USD 4926.8 million in 2022 to USD 7377.0 million in 2027 at a CAGR of 8.4%. Government incentives (FAME II), stringent emission standards, the push for cleaner fuels, and lower operating cost will drive EV adoption in India. This combined with the ongoing recovery of automotive sales indicates high demand for aluminium cast parts in the country for the next 5 to 10 years. Demand for Aluminium high pressure die casting for automation products is expected to be lower than in the automotive segment. The demand for aluminium enclosures and housings for automation products and electric motors will witness sustained growth during the forecast period.

Figure 6.7: Aluminium High Pressure Die Casting Market Size and Growth Estimate by End User, India, (USD Billion), 2018-2027F



Total Addressable Market (TAM) for the Indian Aluminium High Pressure Die Casting Market		
Estimated TAM, 2022	*TAM as % of Total Market*	*Product subcategories considered for TAM*
USD 4.9 Bn	100%	• Applications in automobiles & automation industries

Competitive Landscape of Aluminium High Pressure Die Casting Market

Key Industry players - Global & India
Consolidate Metco, Nemark, Faist Group, Alcast Technologies, Arconic, Dynacast International, Gibbs Die Casting, Bodine Aluminum, Martinrea Honsel, Leggett & Platt, Endurance, Sunbeam auto Pvt. Ltd., Rockmancycle, Endurance technologies, Kailas toolings, MRT Castings, Oswal Castings & Lumel

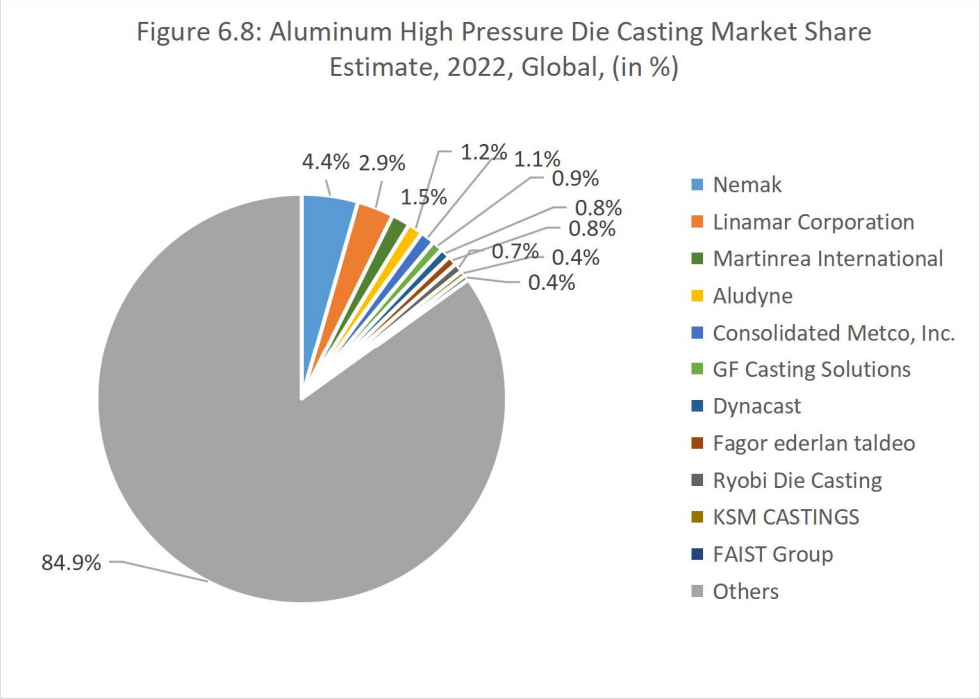
The Global Aluminium High Pressure Die Casting market is characterized by large, medium, and small-scale companies catering to the OEM and after-market requirements. With more than 1000 competitors, the market is considered highly fragmented. The market size estimates of leading global companies (having presence across major economies) indicate that 11 companies constitute a 15.1% market share. The United States alone has more than 200 companies in the small and medium-scale revenue category (below USD 200 million). Many other companies are based in China and Europe, given the strong presence of the automotive industry in these places. Lumel holds 0.09% market share in the overall EMEA Aluminium High Pressure Die Casting Market.

- Nemark, founded in 1979, has its headquarters in Mexico. It provides innovative light weighting solutions with a particular focus on the development and production of aluminium components

for power trains, e-mobility, and emerging structural applications. Products include engine blocks, cylinder heads, transmission components, and EV battery and motor housings for Ford, GM, Volkswagen Group, BMW, Hyundai-Kia, and other automakers. In 2021, the company generated more than USD 3.8 billion from 38 plants in 15 countries. Nemak generates 57% of its revenue from North America and 37% from Europe.

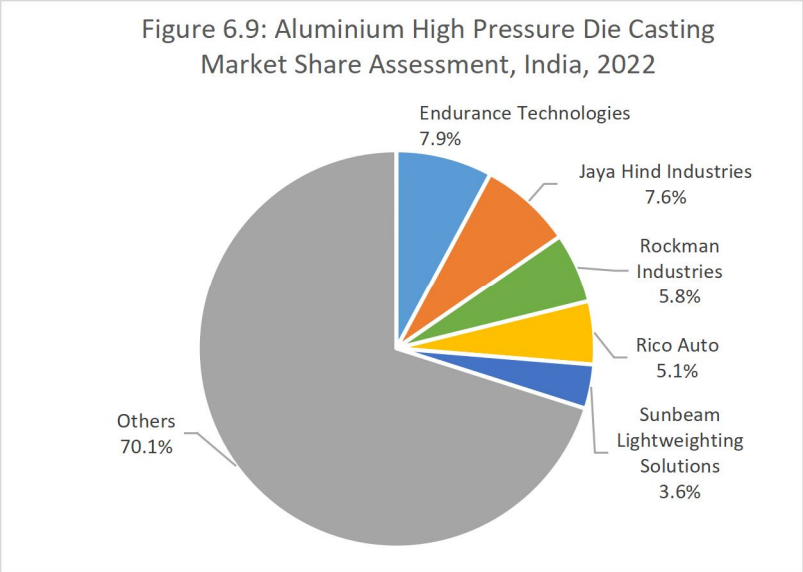
- Consolidate Metco: Consolidated Metco, founded in 1964, is an USA based components manufacturer for the commercial vehicle industry. The company specializes in production of lightweight and high-performance products such as Preset Aluminum Hub Assemblies. The company has 22 fully automated die cast cells from 450 to 800 tons complemented by in-house design and engineering team that performs product design, structural analysis, casting solidification simulation, and prototyping. Conmet has 13 manufacturing facilities located across USA, China and Mexico

- Faist Group: Founded in 1978, FAIST is an Italy headquartered company that specializes in production of components and assemblies to automotive, telecommunication, renewable energy, electronics and storage, and consumer products. The company has 32 sites operational worldwide. Some of the key product produced by FAIST in automotive includes ECU housings, transmission housings, Dual Clutch Systems, Oil & Vacuum pumps.



Note: Total Market Size = USD 83.9 Billion, 2022

The Indian market also is fragmented, with 100 to 200 companies operating in it. The top 3 companies hold a combined 21.3% market share. The majority of participants are home-grown, and most do not have manufacturing plants outside India though they serve both domestic and foreign clients.



Note: Total Market Size = USD 4926.8 Million, 2022

Distribution Channel Assessment

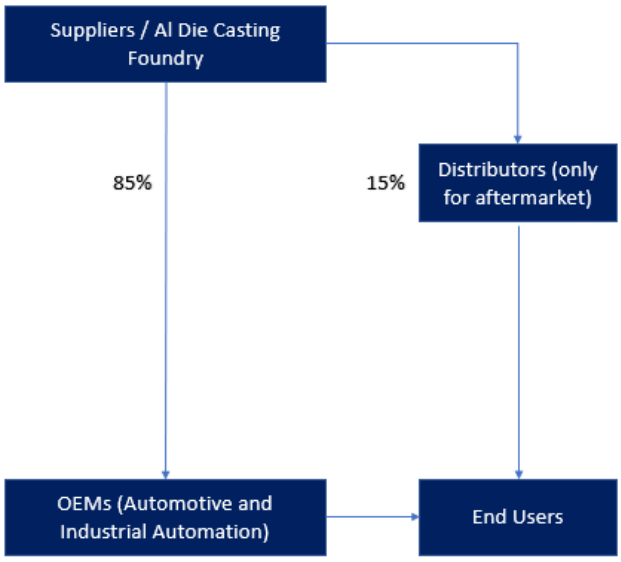


Figure 6.10: Aluminium High Pressure Die Casting Distribution Channels, India, 2023

The Aluminium High Pressure Die Casting market has 2 distribution channels.

1. Direct sales, in which the Component supplier (or Die Casting Foundry) directly supplies components to Automotive/Industrial OEM, is the dominant channel and contributes 85% of sales. Suppliers provide parts for new vehicles and for the aftermarket to OEMs.

2. Distributors' involvement is only for aftermarket products, amounting to 15% of sales.

Technology Trends

Trend	Description
Mega castings (large volume castings, high force application)	• Mega casting (also known as Giga-casting) is gaining popularity in the automotive industry to reduce the number of components and weight of the vehicles. • Italy-based Idra Group and LK Group are the only two suppliers of this high pressure die casting equipment. Idra's equipment can handle high clamping force of 55 kN to 61 kN and can push 80 Kg of molten aluminium into the casting mold. • Tesla pioneered the use of the Giga-press to produce chassis for its Tesla Y model.

Drivers & Restraints

Global Driver 1: Vehicle light weighting

Automakers are responding to climatic and environmental concerns about vehicle emissions by reducing vehicle body weight to make them more fuel efficient. Electric Vehicles must be lighter than vehicles with IC Engines to improve drive range and battery performance. To lower body weight by as much as 40% without compromising safety, automakers are resorting to aluminium die cast parts because the material has outstanding mechanical properties, high volume manufacturability at low cost, high dimensional accuracy, and higher stability of the formed part. Aluminium is only one-third the weight of steel and has high malleability, which makes it easy for rapid conversion of molten metal into a net shape-3D material.

Electric Vehicle sales is poised to grow at a 27% CAGR from 7 million in 2019 to 30 million in 2025. The shift to EVs (and Hybrids) will be significant in Europe, the United States, and China where IC engine vehicle account for more than 90% of sales. By 2030, more than 90% of vehicles sold in the United States and Europe, and more than 60% in China, will be Hybrids and EVs, for which average cast content of aluminium will be double that of ICE vehicles.

	ICE	Hybrid (PHEV)	EV (BEV)
Average Aluminium Content per vehicle (Kg)	99	189	180

Product Category	*Impact-Medium Term (3 – 5 years)*	*Impact-Long Term (6 – 10 years)*

Aluminium High Pressure Die Casting:		

Impact of the trend on the product category: **Very High** **No Impact**

India Driver 1: Favorable policy changes

The Government of India is promoting its Make in India initiative with the Production Linked Incentive (PLI) scheme, which attracted investment from Automotive companies worth USD 9480.3 million over a period of five years starting Apr 2022. The primary objective of the PLI scheme is to boost the domestic manufacturing of Advanced Automotive Technology (AAT) products by attracting investments across the manufacturing value chain. The PLI scheme is expected to overcome cost barriers and create a robust supply chain to support advancements in the industry including EVs. The overwhelming investment proposal that exceeds target combined with political stability and favorable policy will boost automotive manufacturing in the country and require aluminium die casting capability and capacity to meet those needs.

Product Category	*Impact-Medium Term (3 – 5 years)*	*Impact-Long Term (6 – 10 years)*
Aluminium High Pressure Die Casting		

Impact of the trend on the product category: **Very High** **No Impact**

Global Restraint 1: High cost

Aluminium Die Casting requires significant investment for initial equipment purchase and regular operation. Companies that provide Aluminium High Pressure Die Casting look for long-term commitments from customers before they invest in a new die. Because of the high cost of manufacturing, cannot commit to multiple suppliers.

Product Category	*Impact-Medium Term (3 – 5 years)*	*Impact-Long Term (6 – 10 years)*
Aluminium High Pressure Die Casting		

Impact of the trend on the product category: **Very High** **No Impact**

India Restraint 1: *High initial and operating costs*

The high cost involved in procuring and operating Aluminium Die Cast equipment hampers market growth opportunities. However, market participants are betting on growing demand for automotive and electrical products in the country backed by government initiatives to expand the domestic manufacturing value chain so the impact of this restraint will be low during the forecast period. Few players such as Rishabh Instruments have already incurred such costs and hence are ahead of the curve.

Product Category	*Impact-Medium Term (3 – 5 years)*	*Impact-Long Term (6 – 10 years)*
Aluminium High Pressure Die Casting		

Impact of the trend on the product category: **Very High** **No Impact**

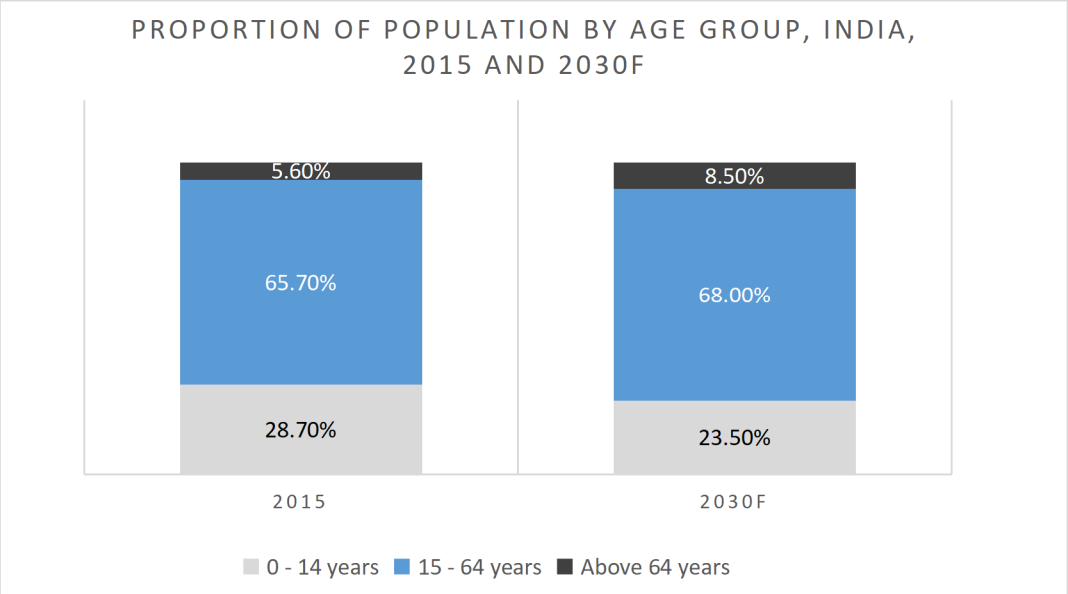
CHAPTER 7 – MEGA TRENDS AND CRITICAL SUCCESS FACTORS

Key growth drivers

1. Favorable demographics

India is one of the fastest-growing economies, driven by a large population and favorable demographics. A key reason behind its high growth is the large proportion of young working-class people that drives strong consumer demand. From the 5th-largest economy in 2022 (nominal GDP), India has the potential to become the 3rd-largest by 2030.

The working-age population is expected to grow from 65.7% in 2015 to 68% in 2030.



Source: UN; World Bank; Frost & Sullivan

Figure 7.1: Proportion of Population by Age Group, India, 2015 and 2030F

In 2014, India's median population age stood at 26.7 years (it was 37.0 in China, 45.9 in Germany, and 37.6 in the United States). India's median age represents a large young population in the working-age category, which fuels consumerism.

Working Age Population (15 – 64 years)	2015 (in Bn)	2030F (in Bn)	Trend
India	0.86	1.03	↑
China	1.01	0.97	↓

Source: UN; World Bank; Frost & Sullivan Research

Figure 7.2: Working Age Population, India and China, 2015 and 2030F

In India, more than 140 million middle-income households are expected to be added between 2018 and 2030. Middle- and high-income households are expected to boost India's incremental consumption spend by about USD 4 trillion by 2030F. In addition, the increase in working-age population boosts talent availability for technology and manufacturing companies. As a result of the growth in working-age population and formal employment, India's tax revenue will increase, and the government will use it to invest in infrastructure.

Therefore, India is expected to witness high demand for additional manufacturing capacity, infrastructure investments, and energy to meet the requirements of a growing working-age population and a booming middle class. A result is that Indian Electrical Automation and Portable Test and Measurement market is expected to grow at 7.8% and 5.1%, respectively, from 2022 to 2027F.

2. Urbanization

As of 2020, more than 4.3 billion people (more than half of world's population) lived in urban areas. A UN report estimates that people will continue to migrate from rural to urban areas to have a better standard of living. By 2050, more than 6.6 billion people will live in cities, representing 67% of the global population. Asia and Africa will witness the fastest urbanization rates. In India, the number of people living in urban areas will increase from 483 million in 2020 to 876 million in 2050—an increase from 35% to 52.9%. Between 2020 and 2030, India is expected to witness urbanization growth at 2%, while Africa will witness the fastest growth at 3.1%.

Urban Population (in Bn)	2020	2030F	2050F	CAGR (2020 - 2050F)
Global	4.4	5.2	6.7	1.4%
Americas	0.8	0.9	1.1	1.1%
Europe	0.5	0.6	0.6	0.6%
Asia	2.4	2.8	3.5	1.3%
India	0.4	0.6	0.9	2.7%
Africa	0.6	0.8	1.5	3.1%

Source: UN; Frost & Sullivan Research

Figure 7.3: Urban Population, 2020, 2030F, 2050F

Due to the overall growth in urbanization, governments across the world seek city-level solutions to address local problems, resulting in the development of new products and new business opportunities that bolster the industrial panel device and portable test and measurement equipment market. Product categories are expected grow between 4% and 8% over the next 5 years. Companies that have local presence in high-growth places such as India can capitalize on regional demand.

Urbanization in India will be driven by FDI in special economic zones, national affordable housing schemes, and development of 100 smart cities. Consequently, the number of Mega Cities in India

will increase from 5 in 2019 to 7 by 2030, with Hyderabad and Ahmedabad entering the fray. As metro cities reach saturation, rapid urbanization will begin in Tier II and Tier III cities. It is critical for companies to cater to the boom in demand from Tier II and Tier III cities as well.

- In India, *southern and western states* such as Tamil Nadu, Telangana, Kerala, Maharashtra, and Gujarat will see urbanization rates in excess of 50% by 2030.
- *Northern and eastern states* such as Bihar, Himachal Pradesh, and Assam will continue to have a sizeable rural population (greater than 75%).

3. Digital consumption

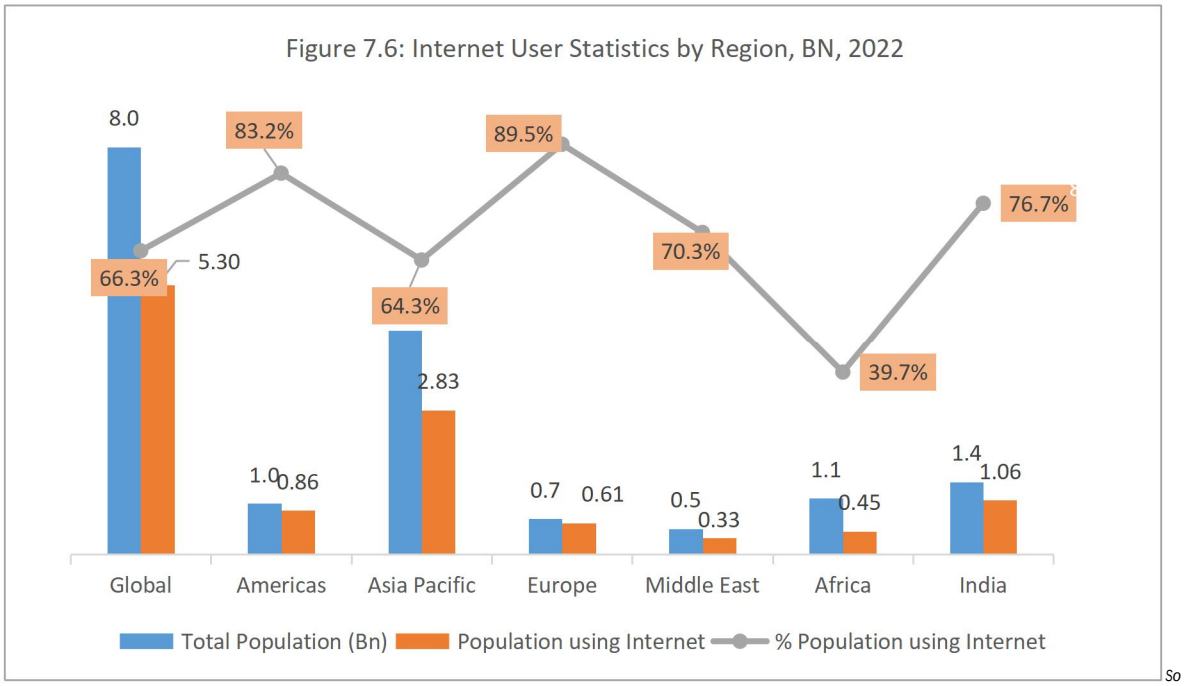
The internet user base (a key indicator for digital consumption) is growing every year due to increasing digitalization that reflects in the way we work, learn, and shop, and how businesses and governments operate. Globally, end users rely on digital solutions to make financial transactions and connect with people, for entertainment, and for other reasons that have a positive effect on lifestyle. The number of internet users globally is forecast to grow at 3.9% to reach 5.6 billion by 2025. The majority of growth will come from developing and underdeveloped nations.

	2018	2019	2020	2021	2022	Trend
Internet Users (in Bn)	3.7	4.1	4.6	4.9	5.3	↑↑
Annual Growth	9.4%	10.5%	11.4%	7.0%	8.2%	↑↑
Global Population (in Bn)	7.6	7.7	7.8	7.8	8	↑
Annual Growth	1.1%	1.1%	1.0%	1.0%	2.6%	↑↑
Internet Penetration	48.9%	53.5%	59.0%	62.5%	66.3%	↑↑
Population without Internet (in Bn)	3.9	3.6	3.2	2.9	2.7	↓

Source: UN; ITU; Frost & Sullivan

	2019	2025	Trend
Internet Users, India (in Bn)	0.65	0.94	↑
Credit & Debit PoS Growth, India (between 2019 & 2025)	400%		↑↑↑
Internet Penetration, India	45%	65%	↑↑

Figure 7.5: Internet User Statistics in Comparison to Population, Global & India, 2018-2022



Source: UN: ITU; Frost & Sullivan

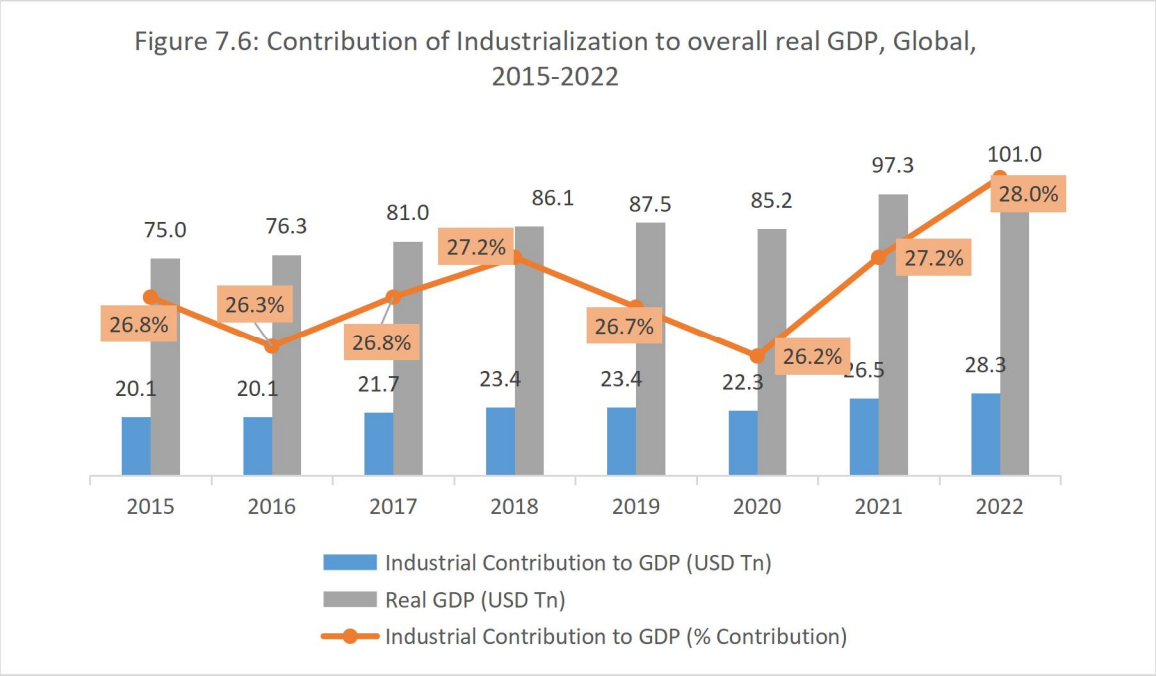
In India, the internet penetration rate is expected to increase to 65% by 2025. This is because a large portion of financial transactions will become digital, enabling India to transition from a cash-based economy to a digital economy. The number of cash payments is expected to decline from 4 in 5 transactions to 1 in 5 transactions between 2015 and 2025. The number of credit and debit card point-of-sale (POS) transactions in India is expected to grow 4.5x times between 2019 and 2025.

Digital consumption has also increased significantly in the B2B sector. For instance, Zoom, a virtual conference hosting software, grew its revenue more than 4X times in 2020 because the way companies interact with their employees and clients changed. Metaverse is gaining traction to monitor industry operations and to create virtual meeting rooms for clients and employees alike. B2B customer interaction is poised to transform to digital platforms in the coming years.

Digitization is expected to directly drive demand for Sensors and Transmitters; Digital meters including Multimeters, Panel Meters, and Multifunctional Instruments; and other industrial panel devices and portable test and measurement equipment that enable automated data collection, analysis, and decision-making.

4. Increasing industrialization

Industrialization is one of the pillars of growth for the Industrial Panel Devices and Portable Test and Measurement market. Though the industrial contribution to GDP has hovered around 27% since 2015, the absolute dollar value grew at a CAGR of about 10% between 2015 and 2020 (including the impact of COVID-19), indicating a continuous capacity expansion across industries.



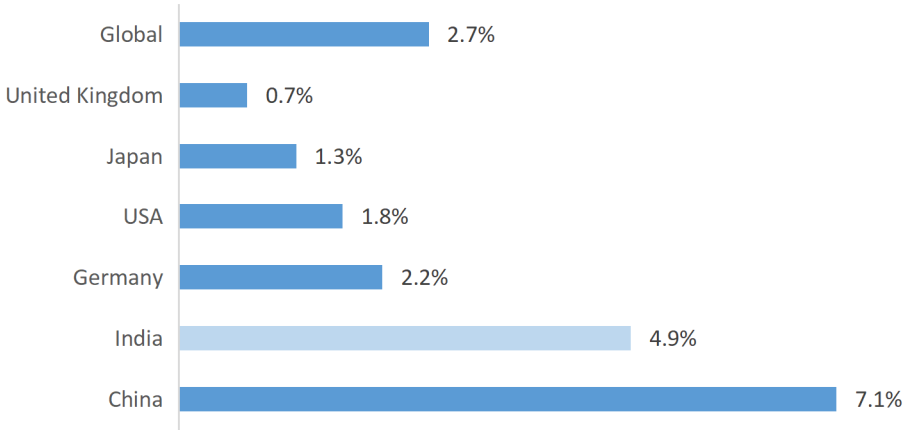
Source: World Bank, Frost & Sullivan

Industrial Contribution includes construction (physical infrastructure such as bridges and houses and all public infrastructure), manufacturing, mining, electricity, water, and gas. Sale of Real Estate and sale of constructed houses is not accounted.

Frost & Sullivan expects that the industrial contribution to GDP will grow beyond the average of 27% in the coming years due to the easing of supply constraints, enhanced operational efficiency, and growing consumer demand. Supply issues are exacerbated by the surge in demand for electronics and geopolitical issues surrounding the Russo-Ukrainian War and the US-China trade war. Industries and governments across the globe have developed new strategies to restrengthen the supply chain ecosystem.

An emphasis on improving industrial output through use of next-generation technologies is outlined in the United Nations' Sustainable Development Goals 2030. Initiatives to implement Industry 4.0 principles are gaining traction across all verticals as companies experience benefits such as lower labor dependency, enhanced efficiencies, better product quality, and increased agility to develop new revenue streams and business models. Leading companies have also started to conceptualize Industry 5.0 to enhance virtualization, better integrate value chains, and improve decision-making processes. The implementation of Industry 4.0 and 5.0 concepts require the integration of sensors, devices, digital platforms, and automation systems at various levels in the factory.

Figure 7.7: CAGR of industrial output contribution to GDP, global and selected countries, 2009 to 2022

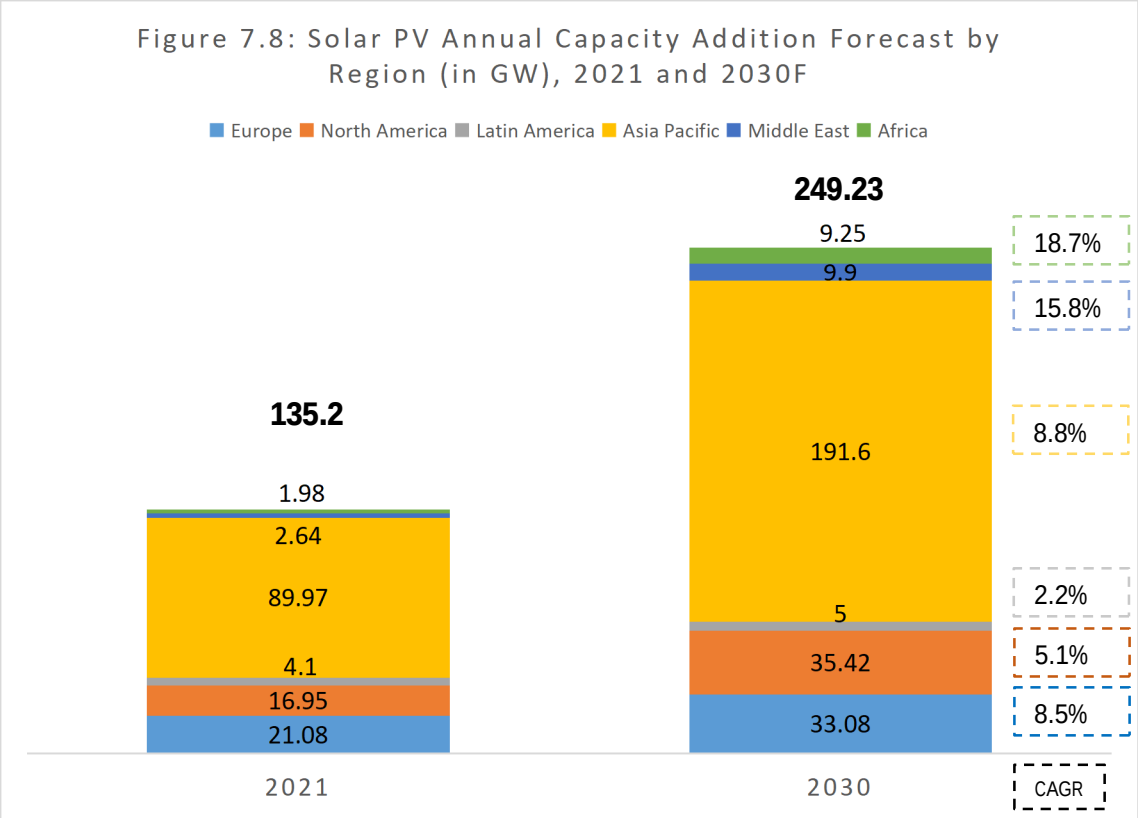


Source: World Bank, Frost & Sullivan

India in particular stands to gain from the easing of supply chain problems and the increased focus on manufacturing. Government initiatives such as Make in India and incentives for FDIs are attracting electronics and semiconductor manufacturers from around the world. India's industrialization contribution has been growing significantly over the last decade and is second only to China. Industrial output has grown approximately by 2.1% from 2009 to 2022, despite the impacts of a recession and COVID-19. Over the next five years, it is expected that higher labor costs and geopolitical issues in China will divert global industrial investment plans towards India and increase demand for all electronic products including Industrial panel devices and portable test and measurement instruments.

5. Rising infrastructure investments

Infrastructure investments are increasing globally, specifically in the water and energy sector to meet sustainability goals. Sustainability and Net Zero are key focus areas of this decade, and industries are developing strategies and making investments to reduce their carbon footprint. Governments across the globe are creating policies to support green infrastructure development. For instance, government agencies in India are implementing regulatory and funding mechanisms to open the water and wastewater treatment market for private investments. Investments in power infrastructure have increased with adoption of smart online sensors to enhance energy efficiency by optimizing asset performance.



Source: Frost & Sullivan Research

Across the globe, sustainability goals are pushing investments specifically in green energy such as Solar PV plants. The global solar PV capacity is expected to increase from 135 GW in 2021 to 250 GW by 2030 at a CAGR of 7%.

In summary, increasing investments in water, wastewater treatment, power distribution, and the renewable energy sector will boost growth opportunities for solar inverters, electrical automation systems and metering, and control and protection devices. Such infrastructure investments result in increased demand for Electrical Automation equipment such as Sensors and Transmitters, HMI etc.; Portable Test & measurement equipment such as Digital Multimeters, Electrical testers, Logic analyzers, Network analyzers, Power meters etc.; and Metering, Control and Protection Devices. These product categories are expected to witness a growth between 5% and 8% over the next 5 years.

Mega Trends

A. Autonomous World

Advancements in electronics, connectivity, and communication technologies have led to the rise of a digital-centric world and enabled the emergence of autonomy across multiple industries. Autonomous solutions are a combination of software and hardware entities that can function independently on behalf of the owner. The solutions, a part of the technical environment, sense a

system's current state and perform actions on it in pursuit of its preprogrammed or self-learned goals.

Autonomous solutions will become essential for end users and enterprises alike. Use cases are:

- ✓ *Personal use*, e.g., household tasks such as cleaning and lawn maintenance; transportation; healthcare
- ✓ *Professional applications*, e.g., updating inventory availability status; pricing based on demand forecasting; fraud detection etc.
- ✓ *Industrial applications*, e.g., managing inventory; helping workers carry out routine and high payload tasks; process and quality control; equipment maintenance etc.

Product Category	*Impact – Med Term (3 – 5 yrs.)*	*Impact – Long Term (6 – 10 yrs.)*	*Comments*
Electrical Automation			The demand for sensors, temperature controllers, electrical transducers, and I/O converters will increase for data generation, collection, and transmission needed to realize autonomous applications in industries and commercial setups. Automation will drive demand for products catering to autonomous solutions.
Metering, Control and Protection Devices			There will be a rise in demand for smart power measurement and management instruments such as power factor controllers and digital panel meters that enable autonomy of industrial, commercial, and utility systems.
Portable Test and Measurement			Test and measurement equipment is required to validate product performance in R&D, manufacturing, and certification stages of various electronic and electrical components that go into autonomous systems. DAQ, network analyzers, power clamp meters, electrical testers, and digital multi-meters will be required to validate the performance and functionality of the systems.
Solar String Inverters			As the shift to renewable energy such as solar power increases, inverters with autonomous smart features will be required for intelligent energy and grid management.
Aluminium High Pressure Die Casting			Growth in Autonomous Vehicles and the resulting need for lightweight structures (e.g., Connectors, Sensor and lidar housings) for the body will positively impact the Aluminium Die Casting market.

Impact of the trend on the product category: **Very High** **No Impact**

Source: Frost & Sullivan Analysis

Automation is expected to be the biggest driver for the Industrial Panel Devices and Portable T&M market. Sensors, Controllers, Test & Measurement systems, and electromechanical systems will be the building blocks for a world rich in automation.

B. Connected Living

By 2030, it is expected that there will be more than 20 connected devices per human. Over the last decade, we have been rapidly moving to an environment where all of us are always connected.

	2020	2030F	CAGR
Connected Device Sales (Bn)	30.4	200.0	20.7%

Source: Frost & Sullivan Research

Figure 7.9: Connected Devices Sales, Global, (Units in Bn)

An increasingly digital/connected way of living will have a profound effect on a wide range of applications at home, at work, across cities, and across industries. Consumers now expect fluid, personalized, and unified experiences that can be achieved only when devices seamlessly connect,

data flows, and networks work in perfect harmony. Connected living through connected cities, connected homes, and connected workplaces will lead to the emergence of new product applications, business models, technologies, platforms, and services. IoT devices, 5G/6G, AR/VR devices, connected cars, digital platforms, and automation and control systems will witness significant growth. As the world moves towards ubiquitous connectivity, the need for more data centers is expected to surge (data is set to increase to 163 ZB by 2025). The need to enable connectivity, test connected devices across various stages of the product life cycle and implement remote monitoring systems will be a key driver for the Industrial Panel Devices and Portable T&M market.

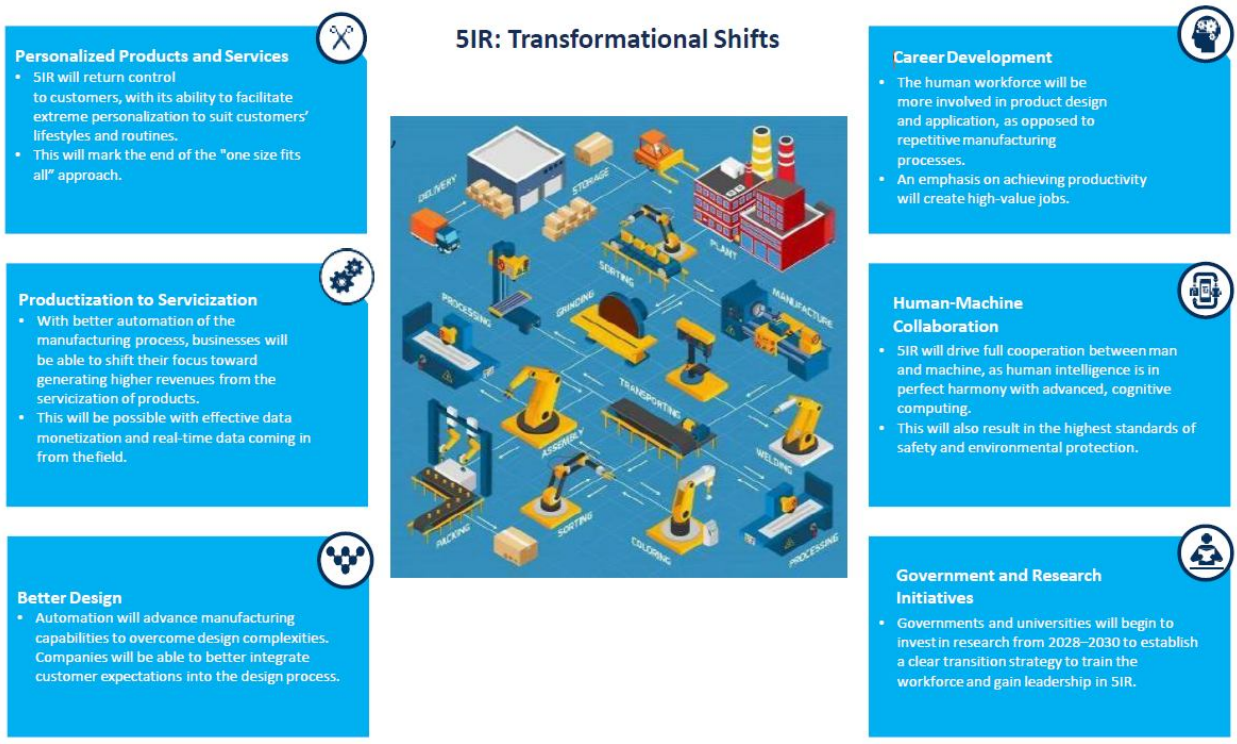
Product Category	*Impact – Med Term (3 – 5 yrs.)*	*Impact – Long Term (6 - 10 yrs.)*	*Comments*
Electrical Automation			The demand for sensors, transmitters, HMIs, and I/O converters will directly increase as a result of this Mega Trend to connect all assets, facilities, and personnel.
Metering, Control and Protection Devices			There will be a rise in demand for connected, smart power measurement and management instruments as cities, utilities, and residential buildings look to modernize their facilities.
Portable Test and Measurement			The need to develop and deploy electronic devices with continuous connectivity requires multidimensional testing including basic electronic and electrical parameters and RF and power parameters. Therefore, network analyzer, power clamp meters, DMMs, and electrical testers will witness increased demand.
Solar String Inverters			The need for sustainable living will increase the demand for solar string inverters that are connected to the cloud and can perform energy consumption analysis and inform the user accordingly.
Aluminium High Pressure Die Casting			High Pressure Aluminium Die Cast components will witness increased demand as it will find application in connected cars.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High**  **No Impact**

C. Industry 5.0

Automation and connectivity have percolated across all spheres of life including the manufacturing supply chain, and companies have gradually implemented Industry 4.0 principles over the last decade. Industry 4.0 primarily focuses on automation to improve efficiency and productivity. Interconnectivity between machines, Mass customization, intelligent supply chain, reducing human involvement, and manufacturing of smart products are the main themes.



Source: Frost & Sullivan Research

Figure 7.10: Key Aspects of Industry 5.0

As Industry 4.0 reaches maturity over the next 5 to 10 years, global leaders are looking at Industry 5.0, which is considered the next frontier in industrial revolution (5th Industrial Revolution or 5IR). Industry 5.0 will center on building smart and sustainable factories based on autonomy to develop solutions that enhance the customer experience. Design-centric product life cycle management, hyper customization, responsive and distributed supply chain, human-machine collaboration, and interactive products are its main characteristics. Industrial Panel Devices and Portable Test & Measurement equipment will play a pivotal role in this evolution.

In Industry 5.0, with better automation of the manufacturing process, businesses will be able to generate more revenue from the servicization of products. This will be possible with effective data monetization and real-time data coming in from the field. The number of connected sensors and systems that will enable advanced factory and industrial automation will grow from 3.7 billion in 2021 to 11.7 billion in 2026 at a CAGR of 22.8%.

Product Category	*Impact – Med Term (3 – 5 yrs.)*	*Impact – Long Term (6 - 10 yrs.)*	*Comments*
Electrical Automation			As factories invest in more automation and autonomous production, the demand for all electrical automation components (sensors and transmitters, HMI, temperature controllers, chart recorders, electrical transducers, I/O converters) will increase.
Metering, Control and Protection Devices			The focus on sustainable production and operation will increase demand for energy-efficient power management systems.

Portable Test and Measurement			Advancing factory automation requires product development in accordance with technologies that are fast, reliable and safe. Therefore, Digital Multimeter (DMM), and Electrical Testers will witness more demand to validate the performance during commissioning and operation of factory systems. Network Analyzers and Power meters will be required to validate RF-related devices in the Industry 5.0 ecosystem.
Solar String Inverters			As factories shift to renewable energy sources, demand will increase for solar string inverters that are the mainly found in rooftop installations.
Aluminium High Pressure Die Casting			Improved electrical performance of automation systems is required as Industry 5.0 implementation begins. It will require Aluminium High Pressure Die Casted electrical enclosures, housings, and heat sinks. Electric motors required in capacity expansion will further add demand for High Pressure Die Casting.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High** **No Impact**

D. Digital Reality

Digital Reality refers to the use of Augmented Reality, Virtual Reality, and Mixed Reality to enhance user experience. Digital Reality has value in industry (e.g., wide implementation of digital twins, improved guidance for equipment operation and maintenance, faster product innovation etc.) and consumer uses (e.g., games, social media, retail showcasing, connected cars etc.). While Digital Reality will accelerate the growth of hardware such as AR/VR headsets, gaming consoles, PCs and Laptops, it will also generate significant demand for data centers to sustain the software platforms that enable virtual worlds, virtual experiences, NFTs, and virtual meeting rooms. Connected cars is another attractive segment that will embed VR in ride sharing, retail experience, and for collaborative design efforts.

Automotive VR market	2023F	2030F	CAGR (2023F – 2030F)
Connected Cars with Built-in VR (Sales in Mn)	0.1	8.0	78.3%

Source: Frost & Sullivan Research

Figure 7.11: Automotive VR Market: Connected Cars with Built-in VR, Global, (Unit Sales in Mn)

Product Category	*Impact – Med Term (3 – 5 yrs.)*	*Impact – Long Term (6 - 10 yrs.)*	*Comments*
Electrical Automation			The demand for sensors, transmitters, electrical transducers, and I/O converters will increase in order to manufacture AR/VR headset and devices.
Metering, Control and Protection Devices			Metering, Control and Protection Devices will be used in power management of data centers that enable digital reality experiences.
Portable Test and Measurement			Portable T&M instruments will find demand to develop AR/VR headsets and verify operation of data centers that enable digital reality on a wide range of applications. DMMs, Electrical testers, Network analyzers, and power meters will witness a positive impact from this trend.
Solar String Inverters			This Mega Trend is not expected to affect the solar string inverters market in the medium or long term.
Aluminium High Pressure Die Casting			This Mega Trend has no direct impact on the market.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High** **No Impact**

E. Data as 21st Century Oil

Data as 21st century oil refers to the act of productizing data and trading it through bartering, brokering, and/or business intelligence models that analyze it to offer critical insights. The amount of data generated is witnessing a growth curve like never before. Businesses and economies are

looking into more and more ways to capture this raw data and analyze it using the latest data science methods to reveal powerful insights that shape future decisions.

	2020	2025F	CAGR
Global volume of data generated (in zettabytes)	64.2	180	22.8%

Source: Frost & Sullivan Research

Figure 7.12: Growth of data, Global

The electrical automation market consisting of sensors that collect data and data acquisition systems that aggregate and communicate data are expected to witness the highest growth. Data-driven business models for power management, test and measurement, and electrical automation products offer new growth opportunities based on this Mega Trend.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*	*Comments*
Electrical Automation			The demand for sensors and transmitters, electrical transducers, HMIs, and I/O converters will increase for data generation, collection, and transmission applications.
Metering, Control and Protection Devices			There will be a rise in demand for smart power measurement instruments such as digital panel meters and management instruments such as power factor controllers that enable companies to extract data from the field. Using this data, companies can create new data-driven business models.
Portable Test and Measurement			Growth in data consumption has triggered a continued investment in data centers, which are projected to grow at a CAGR of 11.1% from 2021 through 2031. DMMs, Electrical testers, Power analyzers, and power meters are expected to witness increased demand.
Solar String Inverters			As the shift to solar power increases, smart features can be embedded in inverters to collect, analyze, and monetize data.
Aluminium High Pressure Die Casting			Automation solutions, which are critical for collecting and monetizing data effectively, require high-performance enclosures and housings, thereby positively affecting the Al HPDC market.

Impact of the trend on the product category: **Very High** **No Impact**

Source: Frost & Sullivan Analysis

F. Smart Retail

Dynamic trends in consumer behavior and an increase in demand for personalized experiences have transformed the global retail industry. Physical retail stores are expected to become smart, automated, sustainable, and serve as a bridge to eCommerce to enhance the brand experience.

Smart retail refers to the use of IoT-based devices and technology to enhance the conventional customer experience and improve sales efficiency. This is achieved by implanting smart sensors and devices at the storefront to collect various types of data and offer customers a more personalized and seamless brand experience. In the backend, the store makes use of smart energy management systems and next-gen renewable power sources to enhance energy sustainability. New power management systems comprising current transformers, digital panel meters, and power factor controllers with improved safety and reliability will be vital to the realization of smart retail shops. In addition, rooftop solar systems for renewable energy harnessing will become a necessity for green facilities.

This Mega Trend will increase the demand for industrial automation components such as sensors and temperature controllers. Power management systems such as Metering, Control and Protection Devices and solar string inverters market are also expected to be impacted positively by this trend because of the demand for smart, energy-efficient, and sustainable retail chains.

	2019	2027F	CAGR
Global smart retail devices market size (USD Bn)	17.4	74.7	19.9%

Source: Frost & Sullivan Research

Figure 7.13: Smart retail devices market size, Global

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*	*Comments*
Electrical Automation			The demand for sensor and transmitters, electrical transducers, HMIs, and I/O converters will increase as new smart retail stores will require the basic equipment and IoT infrastructure.
Metering, Control and Protection Devices			There will be a rise in demand for power measurement and management instruments such as current transformers, digital panel meters, and multifunctional equipment as companies look to make their retail stores more energy efficient.
Portable Test and Measurement			Smart retail adoption will drive growth in validating performance of IoT devices and the operational verification of systems. DMMs and Electrical testers will find major adoption in verifying the automation and electrical systems deployed in smart retail.
Solar String Inverters			Retail stores will use renewable energy as the power source, especially in developing economies. As most will be rooftop solar PV installations, there will be a rise in demand for solar string inverters.
Aluminium High Pressure Die Casting			Die cast components may be used for some advanced autonomous machines.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High**  **No Impact**

G. Uberization of Industries

Uberization refers to the development of new business models that capitalize by connecting various kinds of service providers to customers over a digital platform. On-demand access to services, location-based services, mobile-based digital platforms, demand-based pricing, and removing the middleman are salient characteristics of an uberised business model.

Uberization unlocks value for customers and suppliers. For customers, it reduces costs extensively and ensures the highest level of service availability; for suppliers, it ensures enhanced asset utilization, higher revenue, and flexible work arrangements. Uberization is a digital-first approach that utilizes the power of data, IoT technology, and the internet to efficiently deliver and streamline complex services.

Examples are on-demand, app-based transportation services, healthcare and wellness services, educational services, home cleaning and maintenance services, and legal services.

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*	*Comments*
Electrical Automation			The demand for sensors and transmitters, HMIs, and I/O converters will increase slightly as the demand for new industrial machinery such as 3D printers increases.

Metering, Control and Protection Devices			The demand for Metering, Control and Protection Devices such as power supplies and battery chargers are expected to increase.
Portable Test and Measurement			Uberization of industries will lead to setting up of extensive networking capabilities in factories, which will result in demand for field test instruments to test network and operational conditions of equipment responsible for providing manufacturing services.
Solar String Inverters			This Mega Trend is inclined toward services and software rather than products, so the impact is low.
Aluminium High Pressure Die Casting			On-demand manufacturing of custom parts has a moderately positive impact on Aluminium High Pressure Die Casting parts.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High** **No Impact**

H. Towards Zero

Climate change is a global reality that governments and industries are taking steps to address without sacrificing economic growth. Towards Zero is a vision to build a world with zero carbon emissions, zero carbon, and zero pollution. The Paris Agreement also focuses on the mission of achieving net zero by the second half of the 21st century.

Implementation of sustainability principles has gained significant momentum primarily because of the increasingly stringent regulations imposed by governments across industry sectors and customer demand for sustainable practices. Sustainability is becoming a core business strategy for many companies. Access to cheaper capital, increased interest from investors, government incentives, and enhanced brand image have led companies to consider sustainability as a pillar of growth. The shift toward a green economy is influenced by the Sustainable Development Goals that the United Nations developed in 2012. The framework suggests two ways to realize net zero: decrease energy waste by adopting efficient energy management practices and reduce non-renewable energy usage by switching to sustainable power sources.

Both approaches have a very high impact on the Industrial Panel Devices and Portable Test & Measurement market. Renewable energy practices will increase demand for power management components such as inverters and power transmission components. Electrical automation and portable test and measurement also will benefit.

	2021	2025F	CAGR
Investment (USD Tn)	37.8	53	8.8%

Source: Frost & Sullivan Research

Figure 7.14: Investment in Environmental, Social, and Governance Assets, Global

Product Category	*Impact – Med Term (3-5 yrs.)*	*Impact – Long Term (6-10 yrs.)*	*Comments*
Electrical Automation			This is expected to be due to the rise in demand for electrical automation components such as temperature controllers, chart recorders, and I/O converters for integrating sensors into PLCs, driven by the need for facilities to become sustainable.
Metering, Control and Protection Devices			The trend is expected to increase demand for retrofitting old power management systems and increase need for energy-efficient power management and distribution systems for newer buildings.
Portable Test and Measurement			Surge in penetration of Electric Vehicles and renewable energy systems will drive demand for T&M instruments in R&D, manufacturing, and field applications.
Solar String Inverters			The global move toward renewable energy sources and sustainable energy practices will directly impact solar string inverters for solar PV installations.

Aluminium High Pressure Die Casting			Aluminium Die Cast parts will be required to manufacture low body weight vehicle structures for EVs.

Source: Frost & Sullivan Analysis

Impact of the trend on the product category: **Very High** **No Impact**

SWOT Analysis for the Indian Market

Electrical Automation

STRENGTHS	WEAKNESSES
• Strong demand in process industries such as oil and gas, petrochemicals and semi conductors, mainly because of digitization initiatives • Upcoming government investments in new smart city and smart building projects expand the market for sensors, transmitters, and other electrical automation components. • Government incentives to set up semiconductor manufacturing and fabrication ecosystem.	• Slow rate of digital transformation in Indian industry, especially among SMEs • Most electrical automation components are imported. A weak manufacturing base in India puts the industry at risk
OPPORTUNITIES	**THREATS**
• Upcoming demand in the automotive sector for sensors and transmitters, especially in the EV manufacturing segment • Building automation and energy management is a fast-growing consumer segment in India, and demand for electrical automation components will grow.	• Indian players risk of losing out to global players if manufacturing of electrical automation components is not strengthened in India. • Acquisition of Indian players by global players to capture market share.

Metering, Control and Protection Devices

STRENGTHS	WEAKNESSES
• Manufacturing base of India is very strong in this market segment. Almost all major market players have production facilities across India to cater to domestic demand. • The presence of global players in the	• The market is consolidating at the top in India. Major players are acquiring competitors' business to increase market share. This may lead to the top 3-4 players limiting market growth and restricting new entrants.

Indian market ensures high availability of high-quality products to cater to critical end-user industries.	• The market is still price sensitive and there is a tendency to buy lower-priced products, which may compromise quality.
OPPORTUNITIES • Upcoming government infrastructure projects in new metro stations and railway stations will present an opportunity for market expansion. • Retrofit and replacement activities in industries to ramp up energy efficiency will accelerate market demand.	**THREATS** • Global companies have a strong brand presence, brand equity, and distribution network, which will pose market entry and sustenance challenges for local players.

Portable Test & Measurement

STRENGTHS • Regulations set by government, industry, and standards bodies to ensure desired level of performance and safety of products mandate use of portable test and measurement equipment. • Favorable demographic growth drives consumerism, which results in the need to validate electronic, digital, and power systems.	**WEAKNESSES** • Low CAPEX allocation by end users for test instruments hampers revenue growth. • Demand for low-cost instruments increases competition and drives down revenue.
OPPORTUNITIES • The Make in India initiative will drive capacity expansion activities in end-user industries including electronics and automotive, which will present more demand for Portable T&M. • Emergence of Industry 4.0 emphasis on data-based decisions drives the demand for test instruments with advanced features. It enables test equipment OEMs to overcome technology maturity and price challenges.	**THREATS** • Geopolitical disruption causing supply chain and operational challenges

Solar String Inverters

STRENGTHS • High domestic demand for string inverters as residential, commercial, and industrial end users shift to sustainable energy practices • Technology advancements are making	**WEAKNESSES** • The market is driven by price, warranty, and after-sales service. • Inverters are all imported. A weak manufacturing base in India puts the industry at risk. Prices are determined by

string inverters preferrable over central inverters even for utility projects with bigger capacity designs.	Chinese players.
OPPORTUNITIES • String inverters are replacing central inverters because of their low LCOE. • Demand for renewable energy and sustainable practices in commercial buildings will present new opportunities for market expansion.	**THREATS** • The market is dominated by Chinese players, threatening entry and sustenance of Indian players.

Aluminium High Pressure Die Casting

STRENGTHS • A well-established automotive industry value chain (especially the presence of OEMs) in India • The growing purchasing power of consumers and the increasing demand for 2W and 4W vehicles will continue to drive the market.	**WEAKNESSES** • The highly fragmented nature of the market affects financial margins. • High barrier to market entry and capacity expansion due to the high capital cost of equipment
OPPORTUNITIES • EV is growing at a rapid pace globally. Given that Aluminium Die Casting companies export products to European and US customers, the opportunity should be capitalized through strategic partnerships with overseas OEMs and secure contracts. • The Make in India initiative to expand the automotive industry especially EV market will present more demand for Aluminium High Pressure Die cast components in the next five years. EV manufacturer Tesla expected to make a significant investment in India to explore opportunities in electric mobility and commercial space sector.	**THREATS** • The growing focus on securing local supply chains by governments globally may have an impact on the export market. • Global geopolitical disruption impacts the supply of semiconductors to the automotive industry. This reduces orders for aluminium die cast components as a chain reaction.

Critical Success Factors

Product Segment	Critical Capabilities	Key Technologies
Electrical Automation	• The electrical automation market is led by established players that already possess strong brand equity. To effectively compete, a strong	• IoT-based innovations in products, including cloud connectivity, edge

	brand equity is essential. • A wide portfolio of high-value products is important because end users prefer to use one vendor for all automation-related products. • After-sales service and maintenance support build trust and renewable business.	computing
Metering, Control and Protection Devices	• The mature market has large, established players, so competitive price positioning is important to gain market access. • Product availability through a deep dealer and distribution network is imperative to develop brand value and compete with international players.	• Advanced Metering, Control and Protection Devices based on IoT concepts provide better protection, measurement, and isolation features.
Portable Test and Measurement	• Competitive pricing of reliable products can win more customers. • Ease of use, advanced feature integration, and after-sales support are important to customers.	• Cloud connectivity and software-enabled remote data management capabilities for portable instruments is gaining significance to better manage a large number of tests. • Integration of multiple functions in one tester reduces the need to carry numerous devices.
Solar String Inverters	• Most market leaders are Chinese manufacturers. Local manufacturing infrastructure ensures reliable supply and reduces dependence on foreign manufacturers. • After-sales service and a long product warranty demonstrate vendor commitment and build trust with customers. • Partnerships with local renewable project developers and distributors open access to big-ticket commercial and utility orders.	• IoT-based energy management software and solutions • Easy-to-install and -maintain designs
Aluminium High Pressure Die Casting	• Reduction of scrap, high product quality, timely delivery, low cost, and faster returns on investment are competitive advantages. • R&D investments to advance production process capabilities and develop and manufacture new aluminium alloys are important, as is manufacturing flexibility.	• Investments in large die casting machines to produce large structures is gaining traction. • The degree of automation in machines is increasing to improve, production efficiency, traceability, and material handling capabilities.

Key Differentiators of Rishabh Instruments

Rishabh is a leading technology-driven engineering company engaged in the global manufacturing of electrical and electronic products and aluminium high pressure die castings catering to a variety of

industries. Rishabh is a global leader in manufacturing and supply of analog panel meters and is among the leading global companies in terms of manufacturing and supply low voltage current transformers. Lumel is one of the leading non-ferrous pressure casting players in Europe. With over 145 product lines and catering to over 3000 customers globally, Rishabh Instruments has undisputedly positioned itself as a leading player within the space.

Key market positioning of Rishabh Instruments, globally and locally:

Global

- Global leader in manufacturing and supply of Analog panel meters
- Leading global companies in terms of manufacturing and supply of Low voltage current transformers
- The most popular brand in Poland for meters, controllers, and recorders (Lumel).
- Lumel is a leading player in non-ferrous pressure casting in Europe. The Lumel Alucast factory melts 20 tons of aluminium per day and produce 35,000 castings per day. European car production is 9.9 million units/annum and Lumel produces 3 million of aluminium cast housing for the car compressor makes it one of the leading die-cast players in Europe.

India

- Number 1 player in Electrical transducers in India
- Number 1 player in Split Core Current Transformers in India
- Number 3 player in the Digital Panel Meters in India
- Number 2 player in Portable Test & Measurement (multimeter and clamp meter) and an emerging player in insulation testers
- First company in India to Design, Develop & Manufacture Solar String Inverters end to end.

Key strengths of Rishabh Instruments are

1. **Vertically integrated State-of-the-art operation facilities, backed by strong manufacturing capabilities:** Rishabh Instruments is currently operating 5 manufacturing facilities (of which 2 are in Nasik, India) spread across 3 countries: India, Poland and China. All facilities are vertically integrated with end-to-end product development capabilities from concept design to bulk manufacturing, with dedicated R&D units. Rishabh believes in extensive investments in infrastructure including plant, machinery and modern equipment's. The DNA of the organisation is to develop one product having global acceptance.
    - Rishabh has a product portfolio with over 145 product lines, 0.13 million product SKUs and 0.24million total SKUs including spares.
    - The company has total installed manufacturing capacity of 32.24 Mio products per annum
    - Having manufacturing facilities across the globe provides flexibility to seamlessly migrate production processes from different facilities in case of emergencies
    - In addition, it has 2 modification centers – one each in UK & USA.

- At Rishabh Instruments, under all product segments, 99% of manufacturing operations are done in-house (in India) and only 1% of the total turnover is spent on outsourcing processes.

This flexibility between manufacturing facilities has allowed Rishabh to plug gaps in product offerings across price and performance parameters

2. **Comprehensive Product Test Facility:** Rishabh operates a NABL-accredited testing lab that facilities EMI-EMC testing, Environmental testing, Safety testing, Life Cycle testing and Electro-technical calibration.

EMI-EMC Testing - EMI (Electromagnetic Interference) affects the functioning of an electronic device. Sources of EMI can sometimes occur naturally, but more often, the EMI source is another electronic device or electrical system. EMI (Electromagnetic Compatibility) is a measure of a device's ability to operate as intended in its shared operating environment while it should not affect the ability of other equipment within the same environment to operate as desired. These testing are extremely essential and critical part of any electronic device performance.

Rishabh has state of the art EMI-EMC (NABL accreadited) test facility with Radiated 3m Shielded Semi An-echoic Chamber. The facility is equipped with world-class infrastructure, high-end latest generation instruments to conduct accurate analysis and test for EMI / EMC compliance as per requirements of International standards. The testing is performed automatically and controlled through software

The EMI/ EMC laboratory provides below mentioned test facilities

- Radiated Immunity / Susceptibility Test
- Radiated Emission (Re) Test
- Electrostatic Discharge (Esd) Test
- Voltage Dips and Interruption Test
- Electrical Fast Transient/Burst Immunity Test
- Electrical Fast Transient/Burst Immunity Test
- Surge Immunity Test
- Radio Frequency Conducted Susceptibility
- Power Frequency Magnetic Field Test

The in-house NABL accredited EMI-EMC test facility provides Rishabh a unique leading edge over its competitors and brings down the cycle time of product development resulting into overall reduction in the Go To market time. The lab also provides an opportunity to test the products of other companies generating a separate business revenue model for the company.

3. **Strong and diversified Product Portfolio and Services:** Rishabh is an extremely customer centric organization which listens to customers regularly and develop/ modify products/services regularly,

resulting in strong and diversified product portfolio and services. Rishabh provides a wide range of products in each of the following product segments: Electrical Automation; Metering, Control, and Protection Devices; Portable Test and measurement, Solar String Inverters, High Pressure Aluminium Die Casting. The High-pressure Aluminium die casting business from Lumel also helps the company to bring new customers for the electronic and electrical products. As the Aluminium die castings are mainly used by big automotive, automation and other industrial customers, it eventually opens business doors for products from the other segments thus building synergy between the two business units. The diversified product portfolio helps Rishabh to retain its customers and strengthen cross-selling efforts across product portfolios

- Rishabh also provides strong software platform solutions (MARC) under ESL (Energy Solution Lab), which supports total integration of intelligent products supplied by all types of manufacturers.
- Key services that Rishabh provides are
  - **Electronic Manufacturing Services (EMS) -** Rishabh is an emerging player in one of the fastest growing EMS business segments which is currently lead by players like Syrma SGS Technology Pvt Ltd, Dixon Technologies India Ltd, Amber Enterprises India Ltd etc. providing huge future growth opportunity for the company. (The total addressable EMS market in India was valued at USD 36 in FY21, and is expected to grow to USD 135 Billion in FY26 with a CAGR of 30.3%)

  - **Mould Designing and Manufacturing**

  - **EMI/EMC Testing**

4. **Global Customer Base:** Serving over 3000 customers globally, Rishabh has an extremely wide customer base spread across the globe ensuring the avoidance of business risk due to concentration and dependency on a few big customers. At the same time, the product developed for these customers has wide applicability which avoids risk of ceasing any product line due to the loss of a particular customer. In the electrical segment, Rishabh's top 5 domestic customers account for 14.67% sales revenue and the top 5 overseas customers account for 6.30% sales revenue. In the High-pressure aluminum die casting segment, Lumel's top 5 customers in Poland account for 14.83% sales revenue and the top 5 International customers account for 49.61% sales revenue.

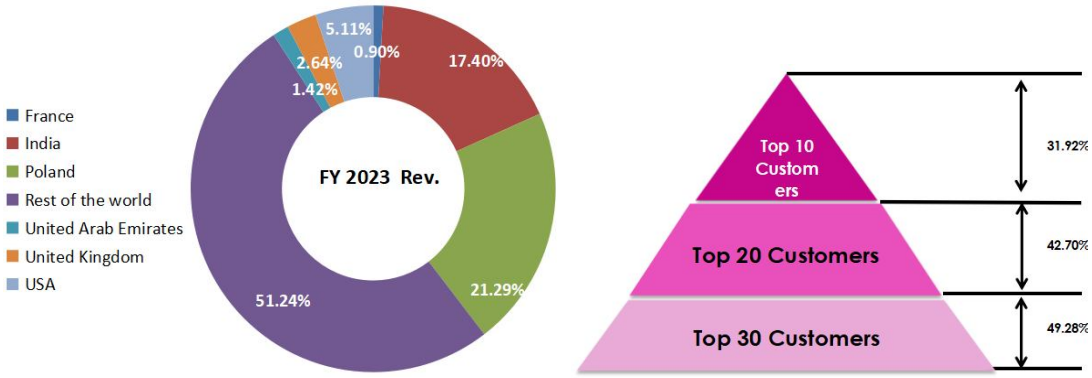


Figure 7.15 – Revenue contribution by region, and by customers, 2022-23

5. **Extensive network of sales partners in India and across the globe:** In India, Rishabh has an extensive network of 175 distributors across 81 districts with direct sales conducted through 8 sales and marketing offices which house 53 engineers and 24 sales personnel. 8 Sales and Marketing office locations in India are at New Delhi, Kolkata, Mumbai, Ahmedabad, Pune, Chennai, Bangalore, Hyderabad, and resident sales engineers in 10 cities.

   Globally, Rishabh has access to over 100 countries through 5 sales and marketing offices and a 339 strong global network of distributors as of May 31st, 2022. Rishabh has 164 stockiest to catering to international customers across 70 countries including Germany, USA, UK, Australia, Middle East, etc. Lumel has 15 stockists in Poland and 20 stockists outside Poland. Lumel resident sales engineers are in UAE, Hungary, Taiwan, Spain, Germany & Cyprus. This extensive network allows the company to provide an array of delivery options while servicing multiple delivery locations despite local-level sales or distribution disruptions.

6. **Strong R&D Focus:** Rishabh is technology-driven company, and its R&D centers are present across India (Nashik), Poland (Zielona Góra) and China (Shanghai), housing a team of more than 84 skilled engineers. Within India, Rishabh's R&D center is recognized by the Government of India's Department of Scientific & Industrial Research (DSIR)—a recognition that Rishabh has leveraged to enhance its R&D effort through Government incentives. In Poland, Lumel has a PCA (Polish Centre for Accreditation) accredited facility that has in-house engineering and manufacturing capabilities.

   The R&D team focuses on 3 core functions:

   - Electronic Design and Development for smart products
   - Mechanical design for Plastic components
   - Tool R&D for manufacturing of molds for plastic components

   - The R&D Centre in Poland focuses on design capabilities for trimming dies and CNC (Computer Numerical Control) tools.

- Rishabh holds 2 patents in India, Poland, and the United States, including for clamp meter rotary jaw (Patent No.: US 7,944,197 B2 since 2011), digital clamp meter safe trigger mechanism (Patent No.: US 8,120,350 B2 since 2012).
- Rishabh introduced Touch Screen Meters in innovative housing and easy plug-and-play connections with RJ12 CT's, setting the new benchmark in the Indian market.
- Rishabh was the 1st player to introduce a Transducer with display in the Indian market, which is completely modular on site and also the first one to introduce a panel-mounted multichannel/Multi-Load monitor meter with display (A device that can monitor 4x 3 phase and 12 single phase load at a time).
- Some of the key innovative and differentiating factors of Rishabh products are - compact housing in panel meters, meters with complete onsite programmability & upgradability, easy click fit mounting, scale interchangeability safety ingress protections ranging from IP 20 to IP67, automatic blocking system for Digital Multimeters, and smooth plug and play RJ 12 connection. The ethos of the company is not only to meet the customer expectation but also to surpass and exceed the same.
- Rishabh is the only player in the world to introduce a touch screen-operated Insulation Tester along with an audio readout feature and operating the meter with the help of Bluetooth technology. The device is capable to work even under extremely inductive environment event at 765kV substation.

7. ***Well-established and recognized brands:*** Rishabh brands Rishabh and Lumel are well-known and established in multiple countries with registration for "Rishabh" for over 40 years and "Lumel" for over 69 years. Lumel has brand recognition in both electronic files as well as Aluminum Die Casting fields with major Industrial Users and OEMs. Another subsidiary of Rishabh is Sifam Tinsley Inc. Under this brand the products are mainly sold in the US and UK markets and are very strong brands in both the markets. The brand name 'Sifam' has existed for over 75 years; and the brand name "Tinsley" has existed for over 118 years. Both in India and outside India through the Subsidiaries, company sells approximately half of our products in respective domestic market and export the rest

8. ***Cost Competitiveness:***
    - Rishabh has a widespread, efficient supply chain network across the globe that brings the cost competitiveness for all product segments.
    - In-house manufacturing and a strong global purchase team makes Rishabh very cost competitive and provides an additional advantage of quality consciousness due to in-house process control.
    - Redesigning of existing products not only cut down the development time (vis-à-vis complete development of a new product), but also brings the cost advantage due to adaptation of contemporary engineering and technology practices. This global business model allows the company to manage the costs well.

- The Government of India has always encouraged the export of Indian goods. The Foreign Trade (Development and Regulation) Act, 1992 (read with Foreign Trade Policy 2023) supports the export of Indian goods. Rishabh has always taken advantage of such policies and incentives schemes under section ATHSC, 10A, 10B (100% Export oriented unit of the Indian income tax act) of the income tax act and 35 2AB for development of R&D in India.
- Various incentive schemes provided by the Government of India under the foreign trade and Indian income tax act makes Rishabh product offerings the most cost competitive in the market. Some of the schemes are RoDTEP (remission of duties and taxes on export products), packing credit (low rate of interest from banks in dollars under export laws), DEPB - Duty Entitlement Passbook Scheme, and AEO – Authorized Economic Operator Programme.

9. *Automation Culture*:

Rishabh has a separate in-house Automation Department setup with the following business objectives:

- Design and develop automation facilities in order to reduce manufacturing cycle time
- Enhance the process efficiencies
- Optimize the worker efficiencies
- Deskilling critical manufacturing operations
- Optimum utilization of resources
- Enhance the product quality
- Increase the overall productivity

The major Automation Test setups include:

- Automatic Camera Detection Setup (ACS)
- Automatic Testing Setup (ATS)
- Auto Balancing System (ABS)
- Laser Marking/Printing
- Auto Screwing Machine
- Closed Loop Test Jig
- Automatic Box Packing Setup
- Temperature & Humidity Monitoring on Manufacturing Lines
- Automatic Test Setups

10. Global Certifications and Green Initiatives: As a strong quality objective, Rishabh has compliance for all its products with different types of certifications that include RoHS, REACH, CE, UK-CA UL, CSA, and ASTA. Rishabh also provides EMI-EMC reports along with Type Test Reports (TTR)—both internal report from Rishabh's NABL lab and external report from ERDA Lab—for all products.

- All Rishabh products follow important safety Standards (IEC 61010) that include level of operating voltage with proper creepage and clearance, Category Protection (CAT III or IV), level of transient and impulse handling, pollution degree, Enclosure protection (UL 94 V-0) self-fire extinguishing within 10 seconds, and non-drip property and HV test measurement.
- Each product goes with relevant product standards that include IEC 61557-12 (for entire Power Monitoring Device PMD), IEC 62053-22/23 for energy monitoring devices, IEC 60688 for Transducer, IEC 60529 IP standard, IEC 61869-2 for Current Transformers, IEC 60947 for Cam Switches, IEC 61557-1/2 for Insulation Tester, and many more.
- Rishabh Instruments has taken various GO Green Initiatives and started paperless documentation to save paper and eventually to support the environment. The major steps are E-TC (Electronic Test Certificate) & E-Manual (Electronic Manual) for all Meters.

Future Opportunities for Rishabh Instruments

Product Segment	*Opportunities in Key End-user Verticals*	*Opportunities in Customer Regions*
Electrical Automation	1. The unique demands of today's networked manufacturing plants rely on reliable strong connectivity solutions to optimize the available resources. It needs an end-to-end IoT-based solution to monitor real-time data like consumption of water, air, gas, electricity (WAGEs) and various types of analog signals with help of sensors, transmitters, transducers, and multi-function devices. Industry 4.0 clearly states transparency of the working systems that include simple switch operation to critical equipment working on a single platform (IoT-based software). 2. Automotive and electric vehicle manufacturing. Demand for Sensors, transmitters, temperature controllers, I/O converters that are embedded into various electric vehicle systems will provide new market opportunities. 3. Traction in smart lighting segment for building automation will provide new market opportunities for sensors, transmitters, and I/O converters for creating smart infrastructure. 4. Data centers and upcoming utility projects will increase demand for Field instruments, temperature controllers, and HMIs that are used in building automation projects.	Asia-Pacific markets especially China, Japan, and India are witnessing expansion of data centers, smart cities, and smart building projects initiated by the government.
Metering, Control	1. Retrofitting of old Metering, Control and	Post-pandemic recovery across the

and Protection Devices	Protection systems in industrial end-user verticals such as pharmaceuticals and FMCG will provide new opportunities for the overall metering, control and protection devices market. 2. New construction projects in development of transportation infrastructure, residential and commercial buildings will directly improve opportunities for current transformers, panel meters, and power factor controllers. 3. With new Make in India initiatives many manufacturing industries are establishing in India, providing opportunities for overall metering, control and protection devices. 4. Changing utility norms to maintain PF and kVAh billing will increase the opportunities for Current transformers, Power factor controllers, meters, and protection relays.	globe is leading to increasing construction activity in residential, commercial, and government projects in the Middle East, Europe, and Americas.
Portable Test & Measurement Equipment	1. The demand for energy generation is increasing day by day, which cannot be met without the extension of networks on substations. The impact of this will result in more and more products required for operation and maintenance in the T&M sector. When we bring extensions in the networks of substations, it warrants more devices, and more devices warrants more T&M products for testing of these devices. 2. One of the new trends in testing is the handheld and desktop instruments with Bluetooth technology to avoid physical contact with the devices under test. So, growth in demand for such products is inevitable. Even the testing of the devices with the help of mobile Apps of meters is started. Demand for portable test and measurement equipment enabled with wireless communication is going to increase. 3. Growing focus on reliable power will require continuous monitoring of equipment, systems, and power utilities, which will result in more demand for testing the power quality at various installation levels and would hike the demand for portable power quality	Electric vehicle uptake has already increased in the Western economies of Europe, the United States, and China, and is gaining high traction in the 2W vehicle segment in India. Renewable energy capacity expansion is gaining global significance, with higher focus in India, Europe, and the United States.

	testers/analyzers. 4. E-vehicle is the upcoming future. Testing of batteries for these e-vehicles is going to see high demand, for which many test and measurement devices would be required like Multimeters, clamp-on meters, battery analyzers, etc. 5. Similarly, upcoming electric trains would also result in an increase in testing of inverters, and motors in electric vehicle power trains will demand testing and measuring equipment	
Solar String Inverters	1. Increased adoption of renewable energy sources will drive demand for solar rooftop power systems in residential and commercial buildings. 2. Technologically better design will lead to implementation of string inverters in data centers and large renewable projects. 3. The Government of India is supporting Make in India initiatives by proposing to increase Basic Customs Duty (BCD) from 5% to 20% on imported Solar inverters, thereby driving indigenous manufacturing.	Large-scale utility projects are being set up in Africa, Middle Eastern, and Asia-Pacific countries especially India and China.
Aluminium High Pressure Die Casting	1. The aluminium content per vehicle is increasing due to the focus on light weighting to increase fuel efficiency. EVs use more aluminium content (at least 15% more) than IC engines. Hence, growth in EV (for applications in power train, battery housing, rear under structure) will gain significance.	Advanced economies of the United States, China, and Europe are purchasing more EVs than emerging economies in the 4W segment. In the 2W segment, India witnesses a large number of conventional and new OEMs venturing into the EV market.

CHAPTER 8 – COMPETITOR PROFILES

What follows is a snapshot of how Rishabh Instruments competes with top companies globally and in India across its 5 product categories.

	Comparative Analysis of Leading companies- India and Global									
	Electrical Automation		Metering, Control and Protection		Portable T&M		Solar String Inverters		Aluminium High Pressure Diecasting	
Domestic	Masibus	P	Schneider Electric	P	Meco Instruments	C	kSolare	C	Sunbeam auto pvt ltd	C
	Selec Controls	P	Secure Meters	P	Metravi	C	PowerOne	C	Rockmancycle	C
	Secure Meters	P	Elmeasure	P	Waco	C	GoodWe	C	Endurance technologies	C
	Delta	P	Selec Controls	P	Motwane	P	ABB	C	Kailas toolings	C
	Multispan	P	Automatic Electric	P	HTC	C	SMA	C	MRT Castings	C
Global	Yokogawa	C	Socomec	P	Fluke	C	Huawei	C	Consolidate Metco	C
	Chino	P	Janitza	P	Kyoritsu	C	Growatt	C	Gibbs Die Casting	C
	Omron	P	Entes	P	Megger	P	SolarEdge	C	Faist Group	C
	Phoenix	P	MBS	P	Hioki	C	Sungrow	C	Alcast Technologies	C
	Allen Bradley	P	Chint	P	Sonel	P	Fimer	C	Arconic	C

Complete Portfolio: C
Partial Portfolio: P
Source: Company Websites

Figure 8.1: Product map of top Global & India competition across product categories, 2023

Key Financial Performance indicators

All Value are in MINR									
Financial Parameters	Rishabh	Automatic Electric Ltd	Elmeasure India Pvt Ltd	Meco Instruments Pvt Ltd	Masi Bus Automation & Instrumentation Pvt Ltd	Hioki India Pvt Ltd	Siemens India Ltd	ABB India Ltd	Schneider Electric India Pvt Ltd
Net worth	3,461.0	328.9	225.5	82.6	455.0	21.4	1,20,760	49,390	91,537
Revenue from operations	4,702.5	621.8	1,287.4	170.1	838.5	251.8	1,77,880	90,100	1,03,606
EBITDA	826.3	57.6	105.1	20.2	77.4	22.1	25,480	12,740	19,396
EBITDA %	17.6%	9%	8.2%	11.9%	9.2%	8.8%	14%	14%	19%
PAT	496.5	3.6	45.3	15.1	48.5	13.8	16,190	9,010	5709
PAT%	10.4%	0.6%	3.5%	8.9%	5.8%	5.5%	9.1%	10.0%	5.5%
ROE	14.6%	1.0%	18.3%	18.3%	10.7%	64.7%	11.5%	22.8%	6.24%

Reference year: FY 2021-22
Source: https://www.mca.gov.in (AE, Elmeasure, Meco, Masibus, Hioki, Schneider India)
Source: Annual Report 2021-22 (Siemens India and ABB India)

Figure 8.2: Key Financial indicators, Rishabh Instruments vs Select Competition, 2023

Electrical Automation - Company Profiles

Company 1: Masibus Automation and Instrumentation Pvt. Ltd

Overview

Founded in 1975 in India, Masibus Automation and Instrumentation Pvt. Ltd. is an industrial automation solution provider. The company is headquartered in Gandhinagar, Gujarat, and has another office in the United Arab Emirates. The company is part of Sonepar, an independent, family-owned company that operates in the B2B distribution of electrical products and solutions.

Product Portfolio

The company's product portfolio includes controllers, indicators, signal conditioners, transmitters, vibration monitors, IR sensors, pyrometers, field interface boards, calibrators, power monitoring equipment, event and fault recording equipment, time synchronization equipment, converters, DC power supply, and data acquisition equipment.

Competitive Factors; Sales and Marketing Strategy

- *Strong competitive factor on cost and customer service:* Masibus Automation's strengths are cost competitiveness and customer service. The company's major customers are industrial OEMs. The company is known to have a very high customer retention rate because of proactive customer engagement.
- *A strong sales network to reach large-ticket end users:* The company's major sales are to industrial OEMs and followed by end-user industries in automotive, FMCG, and pharmaceutical manufacturing. The company primarily sells through dealers, distributors, and system integrators.
- *Expansion through parent company:* The company utilizes the widespread distribution network of Sonepar to reach end-user industries worldwide.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	11.2	10.1	10.6
India revenue for relevant products (in USD Mn)	4.48	4.04	4.24

Source: Frost & Sullivan Research

Company 2: Selec Control Pvt. Ltd

Overview

Selec Controls Pvt Ltd designs and manufactures various electrical measurement, protection, and automation products. The company was founded in 1981 and is headquartered in Navi Mumbai, Maharashtra.

Product Portfolio

Under electrical automation, Selec Controls Pvt Ltd has the following products:

- Industrial automation – Modular PLCs, HMI, drives, relay modules, and industrial communication accessories such as protocol adapters and cables
- Indicators and controllers – Digital timers, counters, temperature controllers, process indicators, speed monitoring relay, and solid-state relay
- Power supply and control – DIN Rail and open frame power supplies for industrial and medical applications

Selec Controls also has other products across categories as follows.

- Electrical measurements – Multifunction meter, energy meter, digital panel meter, current transformer, analog panel meter

- Electrical protection and control –Devices for Motor protection, pump protection, liquid level controller, time relay, time switches, alarm annunciator, earth leakage and earth fault, current protection, and line monitoring
- Power quality – Static voltage regulator, Automatic power factor controller, Advance Static Var generator, capacitors
- Solar – On-grid inverters

Competitive Factors; Sales and Marketing Strategy

- *Core manufacturing strength:* Selec Controls has inbuilt core competencies in the domains of manufacturing, design, tooling, and plastic manufacturing complying with global standards in its Indian manufacturing site.
- *Globally competitive pricing:* Due to its strong manufacturing base, Selec Controls is able to produce products at a price competitive with global brands.
- *Strong brand reputation for customer services:* The company has a good reputation for its maintenance services.
- *Global footprint:* The company operates through subsidiaries in the United States, Germany, and Australia and has presence in more than 75 countries through dealers and distributors.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	18.3	19.5	20.0
India revenue for relevant products (in USD Mn)	3.5	3.6	3.7

Source: Frost & Sullivan Research

Company 3: Delta Electronics

Overview

Delta Electronics is a global manufacturer of electrical automation components with a wide product portfolio. The company was founded in 1971 and is headquartered in Taiwan.

Product Portfolio

The company has products in 3 main business divisions: Power Electronics, Automation, and Infrastructure. In the Automation business division, the company provides drives, motion control systems, industrial control and communication, power quality improvement, human-machine interfaces, sensors, meters, and robot solutions.

Competitive Factors; Sales and Marketing Strategy

- *International brand with global presence:* Delta Electronics has a global presence and competes with market leaders based on price point. It is popular in Asia-Pacific, esp. in Southeast Asian countries.
- *Strong manufacturing and design capabilities:* The company's strengths are its wide automation component product portfolio has and its manufacturing bases in Taiwan, India, and across the globe to cater to its global customer base.
- *High focus on bettering brand equity:* Delta is increasing its brand equity through sustainability and renewable energy initiatives. The company recently joined RE100 initiative that requires companies to commit to 100% renewable electricity and carbon neutrality targets for global operations by 2030.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	8.73	9.74	11.26
India revenue for relevant products (in USD Mn)	1.8	2.1	2.5

Source: Frost & Sullivan Research

Metering, Control and Protection Devices - Company Profiles

Company 1: Schneider Electric

Overview

Founded in 1836 in France, the company provides products and services in building automation, home automation, energy and power systems, industrial control systems, critical power solutions, and data center cooling solutions. It has a global footprint of more than 100 countries. It is headquartered in Paris and has more than 128,000 employees. Schneider Electric is the market leader in India's Metering, Control and Protection Devices segment.

Product Portfolio

With the acquisition of L&T's electrical automation business, Schneider has the widest range of Metering, Control and Protection Devices.

- Low Voltage Protection relays – NEMA Contactors and Overload relays, Thermal Overload relays, and other circuit breakers and switches
- Power Metering and Energy Monitoring Systems – PowerLogic series of equipment that includes a wide range of analog, digital panel meters, and multi-functional power meters
- Power Quality and Power Factor Correction equipment
- Power Supplies and Transformers – includes the Square D transformers, low voltage transformers
- About 850 types of Selector & Rotary Switches

Competitive Factors; Sales and Marketing Strategy

- *Long-standing international player:* Schneider Electric is a global brand and market leader in Metering, Control and Protection Devices and enjoys high brand power for its quality products across the industrial automation and power grid segments.
- *Market expansion through acquisition:* The company has been in close competition with L&T in this space. With its acquisition of L&T's electrical automation business in 2020, Schneider Electric has cemented its leadership in the Indian market.
- *Focus on digitization product portfolio:* The company focuses on product innovation and R&D. It is marketing and promoting its EcoStruxure portfolio by testing its technology platform in its own manufacturing facilities across the globe.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, global (in USD Bn)	27.2	25.2	28.9
Global revenue for relevant products (in USD Bn)	1.9	1.8	2.0
Company revenue, India (in USD Mn)	1.5	1.4	1.6
India revenue for relevant products (in USD Mn)	220.1	203.9	233.8

Source: Frost & Sullivan Research

Company 2: Elmeasure India Pvt. Ltd

Overview

Founded in 2004, Elmeasure India Pvt. Ltd produces digital panel meters and energy management solutions for various industrial and commercial applications. The company is headquartered in Bangalore, Karnataka, and employs approximately 340 people. In the Indian Metering, Control and Protection Devices market, Elmeasure is an emerging player.

Product Portfolio

Elmeasure offers hardware products and solutions that comprise its IoT platform. Broadly, the company offers hardware in 4 categories:

- Smart monitoring – Transducer, Isolator, Digital panel meter, multifunction meter, branch circuit monitor, generator monitoring unit, dual source energy meter, DC energy meter
- Smart controlling – Automatic power factor controller, demand controller, earth leakage relay, energy and process monitor
- Smart resources – automatic transfer switch (ATS), manual transfer switch, solenoid ATS, prepaid meter, power quality analyzer
- Smart networking – split core current transformer (CT), converter, gateway

As a part of its solutions, the company offers Cloud-based IoT platforms that are pre-built for industrial applications in various sectors such as energy management, textile energy, process industry, prepaid metering, street light management, water management, and process automation.

Competitive Factors; Sales and Marketing Strategy

- *Focus on IoT-based products:* Among Indian companies, Elmeasure has a strong presence in digital panel meters and IoT-based solutions. The company's IoT-based energy management solution is a strong differentiator in this market, on par with international players.
- *Global product development team:* Elmeasure leverages the expertise of teams in the United States and European countries for developing its digitization product portfolio. The company claims that its Energy Management System can be tailor-made and customized for any industry, along with prepaid metering & Energy Billing Systems (EBS) for shopping/housing complexes.
- *Utilization of online/eCommerce channels for sales:* Elmeasure utilizes eCommerce channels to engage, sell, and distribute its products. The company exports to the United Kingdom, South Africa, Japan, and the Middle East.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	8.4	9.9	11.1
India revenue for relevant products (in USD Mn)	4.6	5.6	6.4

Source: Frost & Sullivan Research

Company 3: Selec Controls Pvt Ltd

Overview

Selec Controls Pvt Ltd designs and manufactures various electrical measurement, protection, and automation products. The company was founded in 1981 and is headquartered in Navi Mumbai, Maharashtra. The company has a long-standing presence in the Metering, Control and Protection Devices market, but is not among the top 10 in market share.

Product Portfolio

Under Metering, Control and Protection Devices, Selec Controls Pvt Ltd has the following product categories:

- Electrical measurements – Multifunction meter, energy meter, digital panel meter, current transformer, analog panel meter
- Electrical protection and control –Devices for Motor protection, pump protection, liquid level controller, time relay, time switches, alarm annunciator, earth leakage and earth fault, current protection, and line monitoring
- Power quality – Static voltage regulator, Automatic power factor controller, Advance Static Var generator, capacitors

The company has a wide portfolio across other categories:

- Industrial automation – Modular PLCs, HMI, drives, relay modules, and industrial communication accessories such as protocol adapters and cables
- Indicators and controllers – Digital timers, counters, temperature controllers, process indicators, speed monitoring relay, and solid-state relay
- Power supply and control – DIN Rail and open frame power supplies for industrial and medical applications
- Solar – On-grid inverters

Competitive Factors; Sales and Marketing Strategy

- *Well known India wide presence in electrical measurement category:* The company's major strength in the Metering, Control and Protection Devices product category consists of electrical measurement and protection equipment.
- *Core competence based on manufacturing strength:* Selec Controls has inbuilt core competencies in the domains of manufacturing, design, tooling, and plastic manufacturing complying with global standards in its Indian manufacturing site, allowing it to produce products at globally competitive pricing.
- *Global operation through subsidiaries:* The company operates through subsidiaries in the United States, Germany, and Australia and has presence in more than 75 countries through dealers and distributors. The company plans to expand its product portfolio in digitization through partnerships with other international companies.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	18.3	19.5	20.0
India revenue for relevant products (in USD Mn)	14.8	15.9	16.3

Source: Frost & Sullivan Research

Portable Test & Measurement - Company Profiles

Company 1: Meco Instruments

Overview

Founded in 1962, Meco Instruments Pvt. Ltd is an Indian company with headquarters in Navi Mumbai, Maharashtra. The company designs, develops, and manufactures Metering, Control and Protection Devices, and Electrical and Portable test instruments. Products are sold primarily through distributors.

Product Portfolio

- *Products offered*: Digital Multimeter, Digital Clamp meter, Insulation tester, Leakage current tester, Earth testers, Ground Resistance testers, Micro ohm meters, Power and Harmonics Analyzer, Industrial Infrared Thermometers, Temperature and Humidity meter, Handheld Thermal imaging camera, Clamp-on TRMS Power meter
- *Key end-user segments:* Power (includes Solar and other Renewable Energy), Automotive, Industrial equipment (motors, compressors, HVAC), buildings, consumer electronics, academics, and testing laboratories
- *Geographical presence:* India, and exports to more than 30 countries including Malaysia, Singapore, Philippines, Indonesia, the United Arab Emirates, France, Denmark, Germany, the United Kingdom, Kenya, and the United States
- *Clientele (non-exhaustive)*: Tata Power Limited, Mahindra and Mahindra, GE, TUV SUD, NTPC, L&T, TNEB, Central Institute of Mining and Fuel Research

Competitive Factors; Sales and Marketing Strategy

- *Large distributor network enables higher customer acquisition:* In India alone, the company has more than 60 Authorized Dealers and Distributors. Overseas, the company leverages local representatives to grow its business.
- *Strong in-house technical capability:*
    - Design and development: Holds more than 30 design patents (including test and measurement; and metering, control and protection products) with The Controller General of Patents, Designs and Trademarks, Government of India.
    - Manufacturing capability: State-of-the art Surface Mount Technology equipment including Pick and Place Machines, and Solder Reflow. Other equipment includes screw fitting machines, dial printing, pad printing, and other conventional machining equipment, quality control systems, and software tools.

  These factors enable Meco Instruments to continuously improve product performance, work closely with customers to build new products at shorter time to market and a lower development cost.

- *Sales focus:* Mumbai and Bangalore are focus areas for the company's sales and marketing strategy.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	1.7	1.5	1.9
India revenue for relevant products (in USD Mn)	1.4	1.2	1.6

Source: Frost & Sullivan Research

Company 2: Hioki India Private Limited

Overview

Hioki E.E Corporation, founded in 1935, is a Japanese-headquartered multinational corporation that primarily develops electrical and portable test and measurement equipment. Hioki has regional headquarters in India, South Korea, China, Taiwan, Singapore, Germany, and the United States. Hioki India Private Limited, a subsidiary of Hioki E.E Corporation, was established in 2010. The company went through transition in 2016 through 2019 to be re-established under the same name in 2019.

Product Portfolio

- *Products offered:* Data Acquisition Systems, Digital Multimeters, Electrical Testers (Insulation testers, Clamp meters, Clamp multimeters, Megaohmmeters, Insulation testers, LCR Meters, Capacitance meters, Resistance meters, Electrometers), Power Meters, Power Analyzers (Power Quality Analyzers), Environmental Testers (Temperature)
- *Key end-user segments*: Consumer electronics, Industrial equipment (including motors), Renewable energy, power, chemicals, pharmaceutical, medical, automotive, transportation, semiconductors
- *Geographical presence*: Americas, EMEA, and APAC

Competitive Factors; Sales and Marketing Strategy

- *High-mix, low-volume production facility:* Hioki's global manufacturing facility meets variable volume demand through a production setup that can deliver multi-model instruments in small lots at the required time.
- *Brand reputation:* With a market presence of more than 8 decades, HIOKI has built a reputation on its instruments' performance, which helps market penetration.
- *After-sales support:* Hioki 's subsidiaries (including those in India) provide after-sales support
- *Large distributor network:* Hioki has more than 280 distributors outside Japan. The company generates 58.6% of its revenue internationally.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, global (in USD Mn)	164.2	156.0	211.1
Global revenue for relevant T&M products (in USD Mn)	98.5	93.6	126.7
Company revenue, India (in USD Mn)	1.4	1.6	1.9
India revenue for relevant products (in USD Mn)	0.9	0.9	1.2

1USD = 0.0072 JPY; Source: Frost & Sullivan Research

Company 3: Kyoritsu

Overview

Kyoritsu Electrical Works (KEW), founded in 1940 and headquartered in Japan, is an electrical test and measurement equipment supplier specializing in portable instruments. Kyoritsu is a clamp meter pioneer. KEW's subsidiaries are present in the United Kingdom, Italy, India, China, Thailand, Singapore, and Japan, and its products are sold in more than 120 countries with help of a wide distributor network. In 2016, Kyoritsu Kew India Instruments Private Limited was incorporated to increase its sales and offer aftermarket services in the country.

Product Portfolio

- *Products offered:* Digital Multimeters, Electrical Testers (Clamp meters, Insulation testers, Earth testers, Voltage testers, multifunction testers), Power Meter, Power Quality Analyzer, IR Thermometer
- *Key end-user segment profile:* Industrial equipment and electrical infrastructure, Power plants, Renewable energy, Buildings, transportation
- *Geographical presence*: Americas, EMEA, and APAC

Competitive Factors; Sales and Marketing Strategy

- *Continuous update of product features to meet current and future market requirements*: Kyoritsu's recently launched products come with easy data transfer, logging, and data management facility through app and PC interfaces to improve technician efficiency. The company also pays attention to instrument ergonomics.
- *Broad portable electrical test instrument portfolio:* Kyoritsu develops and manufactures only electrical test instruments with a portable form factor. It allows the company to better track customers' emerging requirements and quickly develop high-quality, low-cost products for a large number of applications.
- *Sales focus:* Mumbai, Delhi, and Bangalore are the focus areas for the company's sales and marketing strategy.

Financial Performance

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, global (in USD Mn)	245.7	230.8	196.5
Global revenue for relevant T&M products (in USD Mn)	221.1	207.8	176.9
Company revenue, India (in USD Mn)	0.68	0.69	0.64
India revenue for relevant products (in USD Mn)	0.61	0.62	0.57

1USD = 0.0072 JPY; Source: Frost & Sullivan Research

Solar String Inverters - Company Profiles

Company 1: Ksolare Energy Private Limited

Overview

Founded in 2012, KSolare Energy Private Limited is a privately owned Indian manufacturing company with headquarters in Pune. The company does not have significant market share in the solar string inverters space. KSolare says it has implemented projects worth more than 805 MW with total installation of more than 175,000 inverters across the globe.

Product Portfolio

Ksolare offers energy storage and on-grid inverter solutions that include 1kw-60kw, 100kW-250kw Grid-tie inverters and hybrid inverters, Electric Vehicle charging units, custom designs, and after-sales service.

Competitive Factors; Sales and Marketing Strategy

- *Strong local manufacturing base:* KSolare's strength is its local manufacturing base, with an 1800-square-foot facility in Pune. Ksolare is one of the few Indian players that does not depend on manufacturing bases in other countries.
- *In-house R&D and product development*: The company has its own R&D unit for developing products of international standard. It also has an advanced automatic testing setup with certification facility.
- *Countrywide partner network for sales*: The company caters to its end users, mostly commercial and industrial, through a well-established national dealer and distributor network. Large projects are handled directly through its sales offices in Maharashtra and Gujarat.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	4.2	5.3	11.1
India revenue for relevant products (in USD Mn)	3.4	4.3	9.6

Source: Frost & Sullivan Research

Company 2: Growatt

Overview

Established in 2011, Shenzhen Growatt New Energy Co. Ltd (Growatt) is an international distributed energy solution provider headquartered in China. The company supplies to commercial, industrial, and residential end users across the globe. The company has 34 representative offices across key countries such as Germany, the United States, the United Kingdom, and Australia to provide customer services. In India, the company operates primarily through dealers and distributors and is emerging as a fast-growing competitor.

Product Portfolio

Growatt designs, develops, and manufactures PV inverters, energy storage products, and smart energy management systems that are used in residential, commercial, and industrial off-grid and on-grid applications. Its product portfolio includes single-phase and three-phase residential inverters, commercial rooftop inverters, large commercial and utility inverters, residential storage inverters, and off-grid storage inverters. The company also provides energy storage solutions tailored for residential and commercial end users and has after-sales service and warranty programs similar to other competitors in this space.

Competitive Factors; Sales and Marketing Strategy

- *Strength in residential inverter segment*: Growatt is considerably strong in the residential inverter segment for rooftop installations because of its feature-rich, easy-to-install products and better warranty terms.
- *Strong Research and Development team*: The company has a strong R&D team of more than 500 professionals to tailor products to customer needs quickly. Currently, 75% of Growatt's revenue is achieved through global markets.
- *Focus on Chinese and Indian markets:* The company plans to capitalize on the growth from China's 3060 Target and blanket rooftop solar program. Steady growth of rooftop solar across the globe and increasing adoption of string inverters is a growth strategy. In the Indian market, it competes with local companies on price. By offering a lower price than competition, Growatt is slowly capturing Indian market share.
- *Market expansion through subsidiaries:* Across the globe, the company has established multiple subsidiaries that act as regional headquarters. In India, the company operates through Growatt New Projects Pvt Ltd, located in Hyderabad.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	149.7	283.1	432.8
India revenue for relevant products (in USD Mn)	125.7	239.2	367.8

Source: Frost & Sullivan Research

Company 3: Power-One Microsystems Pvt. Ltd

Overview

Power-One Micro Systems Pvt. Ltd. is a manufacturer of power conversion technology in India. The company was started in 1992 and is headquartered in Bangalore, Karnataka. The company began as a manufacturer of UPS systems and has evolved to the renewable energy space. In India, Power-One is an emerging provider but does not hold enough market share in comparison to other major players.

Product Portfolio

The company's product portfolio includes online UPS, Line Interactive UPS, Solar inverter, Isolation transformer, servo-controlled voltage stabilizer, frequency converter, and EV charger. In the solar inverter space, the company also offers solar on-grid inverters, solar hybrid inverters, and solar off-grid Inverters.

- Competitive Factors; Sales and Marketing Strategy *Local factory setup:* The company has a manufacturing facility in Bangalore where all products are assembled and tested.
- *High brand strength in UPS segment:* The company's competitive strength is in UPS, which it is trying to leverage for its solar portfolio. The company also claims that it offers the fastest customer service in the sector.
- *Sales through dealer, distributor, and EPC network:* The company operates mainly through a network of dealers and distributors across the country for its UPS product portfolio. The company utilizes EPCs to widen the reach of solar inverters. Its major sales network is in metro cities such as Delhi, Mumbai, Bengaluru, Chennai, and Hyderabad.

Sales Revenue

Revenue estimate	FY2019	FY2020	FY2021
Company revenue, India (in USD Mn)	15.9	15.1	12.6
India revenue for relevant products (in USD Mn)	4	3.75	3.12

Source: Frost & Sullivan Research

Aluminium High Pressure Die Casting - Company Profiles

Company Profile 1: Endurance Technologies

Overview

Endurance Technologies Limited., founded in 1985, is a leader in the Aluminium Die Casting Components market. The company has grown from one manufacturing facility (Aurangabad, India), to 27 plants (17 in India, 7 in Italy, and 3 in Germany). In Aluminium Die Casting the company manufactures components for the automotive industry with high pressure, low pressure and gravity die casting methods. The company's other business segment includes suspension, transmission, and braking systems in which it is primarily involved in design, development, and manufacturing of proprietary products. The company generates 27% of its revenue from overseas markets. From Europe, the company produces casting and machining products for mainly four-wheeler OEMs.

Product Portfolio

- *Key end users:* Components are produced for 2W, 3W and 4W automotive segments in domestic and overseas markets.

- *Components manufactured:* Passenger Vehicle Cam Cover, Two-wheeler swing arm, three-wheeler crank case and cylinder block, passenger vehicle transmission case, two-wheeler crank case, commercial vehicle gear box housing, commercial vehicle clutch housing, passenger vehicle oil cooler housing, passenger vehicle clutch housing, mounting bracket, two-wheeler magneto cover, passenger vehicle rack pinion housing, among others.
- *Other services/value additions:* In Aluminium High Pressure Die Casting, the company has in-house design Finite Element Analysis (FEA), casting simulation, tooling manufacturing, test labs, and aluminium alloy development capabilities.
- *Key domestic clientele:* Bajaj Auto, Hero MotoCorp, Honda Motorcycle and Scooter, Mahindra & Mahindra, PIAGGIO, Royal Enfield and more.
- *Key overseas clientele:* Porsche, Daimler, Stellantis, Volkswagen

Competitive Factors; Sales and Marketing Strategy

- *Strong financial position:* Endurance closed FY2021-2022 with zero net debt
- *Immense focus on innovation*: The company has 4 R&D centers for higher value-added products. The company has a multifaceted approach that includes utilization of new technologies, cross-learning from R&D centers in India and Europe, development of products with a first-time-right approach, and close engagement with customers.
    - The company's continuous investments in R&D to enhance product value and quality accelerate new customer acquisitions.
    - In HPDC, the company's innovation focus is on developing comprehensive die-casting solutions to help customers with light weighting of complex parts.
- *Long-standing relationship with key OEMs* such as Bajaj Auto, Royal Enfield, and India Yamaha. The company also is increasing its business with OEMs like Honda Motorcycles and Scooters India Ltd, TVS Motor Company Ltd, and Hero MotoCorp.
- *Renewed focus on securing orders from new technology and high-growth EV market*: In FY2021-2022, the company started supply of casting, brakes, and suspension for 2W and 3W EVs.
- A diversified product and geographic base help the company be more resilient and sustainable in terms of growth.

Sales Revenue

Revenue estimate	FY 2019	FY 2020	FY 2021
Company revenue, India (in USD Mn)	905.4	855.1	986.7
India revenue for relevant products (in USD Mn)	266.1	251.2	289.9

Source: Frost & Sullivan Research

Company Profile 2: Sunbeam Lightweighting Solutions Private Limited

Overview

Founded in 1986, Sunbeam Lightweighting Solutions Pvt Ltd is one of the leading suppliers of automotive Aluminium Die Casting components in India. The company initially supplied components to India's 2W market but expanded and forayed into the 4W market and evolved its standard through R&D

and investments to meet demands of overseas markets. In 2018, the company was acquired by private equity firm Kedaara. Its manufacturing footprint in India is spread across four states: Rajasthan, Punjab, Haryana, and Gujarat. Sunbeam produces automotive components through high pressure, low pressure, and gravity die casting.

Product Portfolio

- *Components manufactured*: Transmission case, crank case, cylinder block, crank case cover, throttle housing, cover cylinder head, gear box, rear grip, cylinder head cover, among others.
- In-house tool design and simulation, and tool manufacturing facilities.
- *Key domestic clientele:* Hero MotoCorp Ltd, Maruti Suzuki India Ltd, Suzuki Powertrain India Ltd, Munjal Showa Ltd, Rane NSK
- *Key overseas clientele:* Ford, GM, Continental, Bosch, Valeo

Competitive Factors; Sales and Marketing Strategy

- *Location of manufacturing facility*: Proximity of manufacturing plants to OEM facilities provides a cost advantage and timely delivery of components.
- *Enhanced focus on exports for sustainable growth:* A broad overseas client base keeps business stable. The presence of large overseas OEMs in its client base can be leveraged to build more customers.
- *Investment in futuristic solutions:* Investments in advanced solutions such as automation and robotics boost cost efficiency and quality of components.
- *Constant focus on R&D:* Continuous investments in Research and Development of new die casting technologies.

Financial Performance

Revenue estimate	FY 2019	FY 2020	FY 2021
Company revenue, India (in USD Mn)	143.4	144.8	147.5
India revenue for relevant products (in USD Mn)	114.8	115.9	118.0

Source: Frost & Sullivan Research

Company Profile 3: Rockman Industries

Overview

Founded in 1966 as a bicycle chain manufacturer, the company has grown to supply components for 2W and 4W automotive OEMs. The company began high pressure die casting operations in 1999, and now has Low Pressure and Gravity Die Casting capability as well. Rockman has 8 in India, in Ludhiana, Haridwar, Bawal, Mangli, Chennai, Tirupati, Halol and Surat. Rockman can process more than 140,000 Tons of Aluminium annually.

Product Portfolio

- *Installed capacity:* More than 103 HPDC machines in 250T – 1250T specification and expanding in 1650T - 1800T specification. The consolidated capacity can produce more than 180,000 components every day.
    - Annual processing capacity for Aluminium high pressure die casting is 45,000 Tons.
- *Components manufactured*
    - 2W products: Crank case, Crank case cover, cylinder head, bottom case, and 2W assemblies
    - 4W products: Cylinder head cover, fuel rail assembly, chain tensioner housings, tensioner rail, ECU housings, engine mounting, EPS motor housing, among others
- *Key domestic clientele:* Hero MotoCorp, Hyundai, KIA, TATA, Royal Enfield, Mahindra, Ather, Revolt, OLA Electric, Honda
- *Key overseas clientele:* Magna, IWIS, Ford, KSPG Automotive

Competitive Factors; Sales and Marketing Strategy

- *Increasing focus on customer diversification:* Currently, HMCL is its major customer, but the company is focusing on acquiring more customers.
- *Capacity expansion:* In 2019, a new plant was commissioned in Gujarat to be in proximity to its OEM customer HMCL. Proximity to customers has cost and product delivery advantages.

Financial Performance

Revenue estimate	FY 2019	FY 2020	FY 2021
Company revenue, India (in USD Mn)	308.3	282.1	307.3
India revenue for relevant products (in USD Mn)	176.6	161.6	176.0

Source: Frost & Sullivan Research