ASSESSMENT OF ELECTRONICS SYSTEM DESIGN & MANUFACTURING, SKILL DEVELOPMENT (ESDM) IN INDIA

SUBMITTED TO

KAYNES TECHNOLOGY INDIA LTD.

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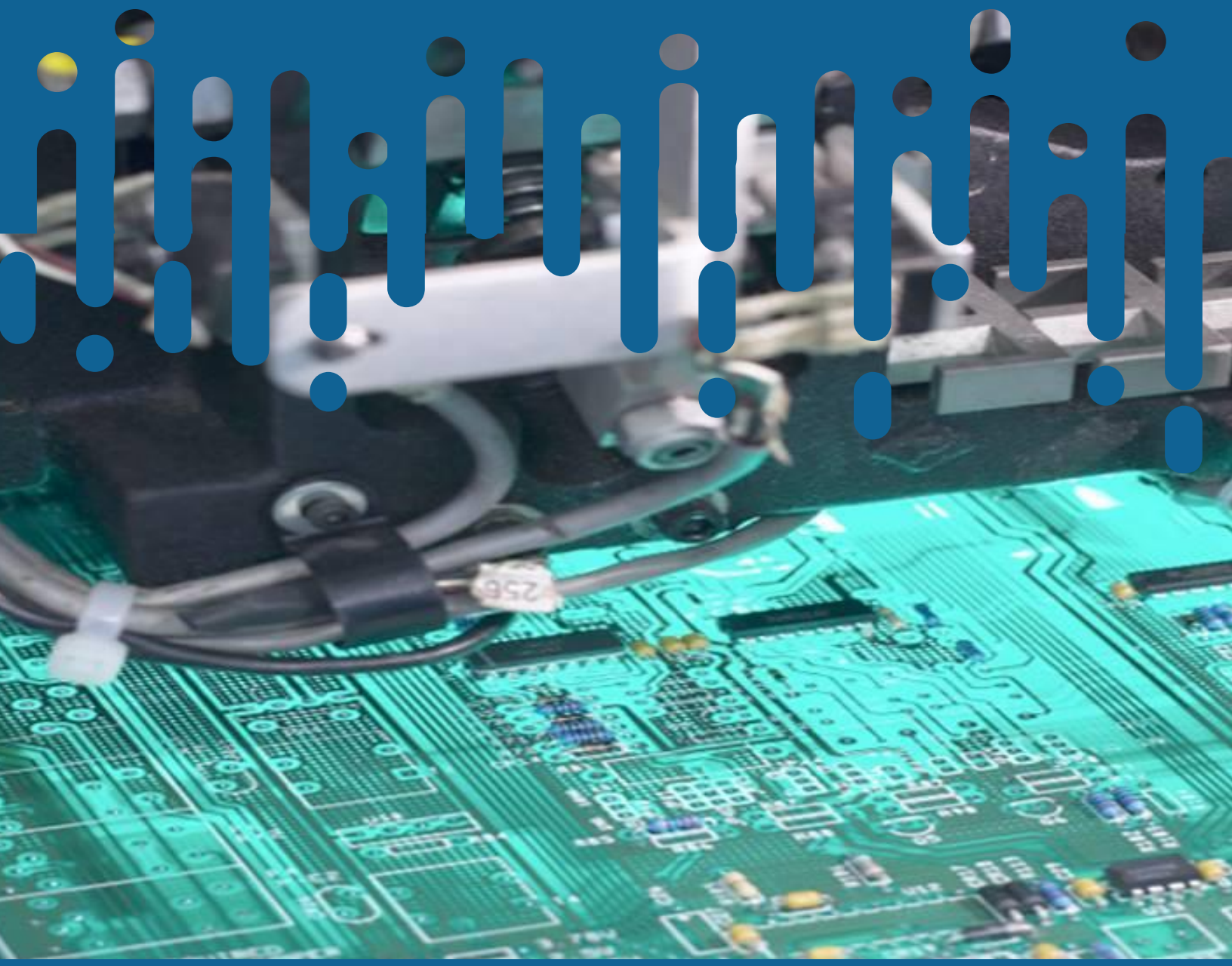

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Contents

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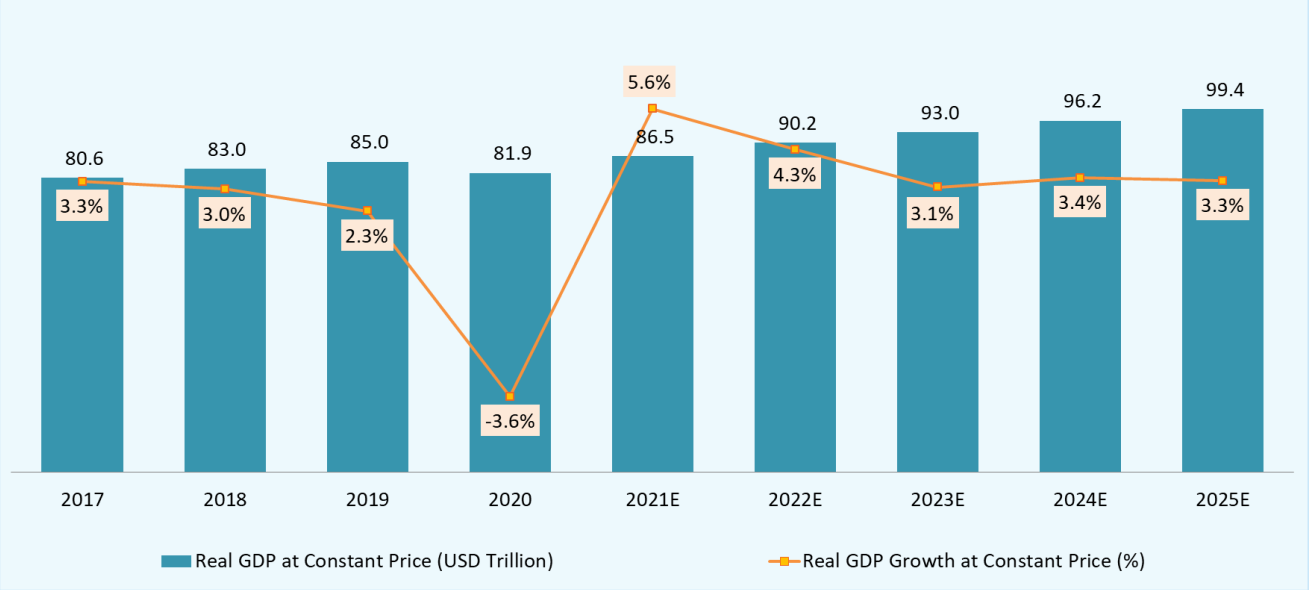
CHAPTER 1 - GLOBAL MACROECONOMIC OVERVIEW

Global Real GDP and Growth Outlook

The Global economy (real GDP), which is now in the path of steady recovery, has undergone significant stress in the last few years due to extended trade conflicts, slowdown in investments across the world and then a novel virus. Global economy was showing signs of slowdown since CY2018 and then entered into a recession in CY2020 owing to the unprecedented crisis caused by COVID-19 pandemic. The pandemic started from China around December CY2019 and then had spread across the continents with alarming speed, infecting millions and bringing economic activity to near standstill in Q2 and Q3 of CY2020 as many countries had to impose strict restrictions to curb the spread of the virus. This novel virus has seen multiple variants in the past two years and the most recent one is the Omicron variant which is causing the third wave of COVID-19. Omicron is expected to be more transmissible than the past variants. With this the pandemic is also expected to become an endemic. World now has vaccines to fight this disease and companies have developed innovative business models including adoption of digital measures to continue with their businesses. Pent up demand, caused by economic stagnation and improvement in the supply situation are now fuelling the recovery of global economy which is poised to stage its most robust post-recession recovery in 80 years in CY2021. The global GDP is expected to grow at a CAGR of 3.9% by CY2025.

Chart 1.1: Real GDP and Real GDP Growth (Annual percentage change), Global, Value in USD Trillion , Growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

The pandemic, in its peak, had created several issues for the manufacturing industries such as supply chain disruptions, labour issues, sluggish demand and fall in exports. In order to survive, companies across the globe had to adopt drastic measures such as employment and wage cuts. This had a circular effect on the global economy. Job losses coupled with salary reductions and delayed payments resulted into significant

decline in consumer spending which in turn affected the economy and further job losses. Travel, hospitality, banking, construction and manufacturing were among the worst-affected industries.

Impact of the Pandemic was severe among the weaker economies in CY2020. Most of the African countries faced severe economic downturn especially the countries with large energy exports such as Algeria, Angola and Nigeria. Fluctuations in the oil prices, cold war among major Oil & Gas producers coupled with the impact of the global economic slowdown had affected the Middle Eastern economies adversely. The Latin American region, which has been grappling with many socio-economic issues such as poverty, inequality, debt crisis, low economic growth etc., the pandemic had further worsened the situation. Latin America has also been one of the worst hit regions due to the COVID-19 pandemic.

However, the situation was lot better and brighter in CY2021 and the global economy has made a strong recovery after a doom performance in CY2020. Global economy is likely to grow by 5.6% in CY2021, largely on the inherent strength of the major economies such as the United States, China, Japan, Germany, United Kingdom and India. While global economic bodies have made upward revisions in their growth projections for most of the economies, many weaker and developing economies will continue to grapple with COVID-19 for the next few years.

Impact of COVID-19 pandemic on different economies in 2020 and 2021

The outbreak of COVID-19 pandemic has thrown the entire world into an unforeseen crisis in terms of both public health and economy. Protecting people's lives and supporting public health have become the highest priorities for countries across the world. The global economy, which was already slowing down, plunged into a deep depression in 2020 causing severe impact on spending and employment.

With increasing spread of the virus, most of the economies had to enforce desperate measures such as lockdowns, travel restrictions, social distancing etc. Various containment measures including closure of offices and factories, slowdown of public services etc. were taken which resulted in significant drop in investments during 2020.

Business scenario has significantly improved since then and most of the economies are hoping to bounce back to 2019 levels by 2021 or beginning of 2022. Governments across the world have created necessary healthcare infrastructure to deal with any future outbreak, more than 7.7 billion vaccine doses have already been administered, and public at large have learnt to live with this menace.

The global economic recovery is jeopardised by high freight charges. Container freight charges have risen across nearly all trade routes due to increased demand for commodities. According to recent estimates, the current increase in container freight rates could increase global import prices by 11% and consumer prices by 1.5% by 2023. The economic impact of COVID-19 containment measures, coupled with a general shrinking of shipping capacity and equipment, has severely impacted maritime freight operations. The implementation of COVID-19 protocols resulted in a steep increase in freight costs, which resulted in depressed margins in FY21. Once the pandemic gets under control, this may ease out.

Similarly, restrictions on air travel were gradually lifted, including those that had hampered the provision of crucial health products in several countries since the outbreak of COVID-19. The impact on air travel depends on the duration of the current pandemic's duration and severity, containment measures' efficacy,

consumer trust in air travel, and future economic conditions. The latest indicators from India show the country is progressively recovering from major operational disruptions and moving towards normalisation. Globally, the market is expected to stabilise as more flights open and reschedule as European and international borders reopen.

United States of America - USA became the epicentre of the pandemic with highest number of reported casualties in the world with a devastating impact on the country's economy. As per U.S. Bureau of Labour Statistics, unemployment rate almost tripled between Q4 CY2019 to Q2 CY2020, from 3.6% to 13%. Over thirty million Americans had filed for unemployment benefits due to job losses during this period. However, unemployment rate fell to 6.7% by Q4 CY2020 due to slew of economic measure taken by the Government. The U.S. economy has been strengthened by massive fiscal support and widespread vaccination and the economy is expected to grow by 6.4% in CY2021, the fastest pace since 1984. While small businesses are expected to have a longer road to recovery, the services sector, construction, retail trade, management companies & enterprises, real estate, technical services and healthcare are driving economic recovery in the country.

Europe - The situation was no different in Europe. Post China, Italy was the second country to experience massive casualties in the initial months of the pandemic outbreak. While the pandemic triggered sharp declines in job opportunities and millions of job cuts, the region was also at the forefront in easing down economic lockdowns and opening up economic activities.

Compared to the global economy, the euro area suffered a bigger hit in 2020 and likely to experience comparatively slower recovery in CY2021. The real GDP is likely to reach pre-crisis levels only by mid-2022. Manufacturing industries were impacted by short-term supply shortages, but most of them recovered relatively quickly during Q3 CY2020. Sectors which thrive on human contact and interactions, such as the cultural and creative industries and the aerospace industry, have experienced substantial hits by the crisis, and likely to have longer recovery path. Pharmaceuticals and Digital sectors were the least impacted sectors.

South East Asia - Even though health, economic and political impact of COVID-19 has been significant across South East Asian nations, the virus has not spread as rapidly in this region as compared to other parts of the world. Although the region could not match fiscal incentives of many of the western world countries, fiscal policy in Southeast Asia has still been more generous and this has played a crucial role in limiting the economic and social fallout from the pandemic.

Asian Development Bank, in one of its latest reports, mentioned that Southeast Asian economies will recover at "a much slower pace" than previously thought due to recurring waves of Covid-19. ADB downgraded economic growth projections for all Southeast Asian economies — except Singapore and the Philippines. Major Southeast Asian economies including Indonesia, Thailand, Malaysia and Vietnam reported a sharp rise in daily COVID-19 infections and deaths in the recent months. The spike in cases and deaths was attributed to the highly infectious delta variant. Southeast Asia plays a major role in the global manufacturing supply chain. Lockdowns and social-distancing measures in the region, primarily in Taiwan, have prolonged a global shortage of semiconductors, and constrained the supplies of goods such as coffee and clothing.

China - Covid-19 outbreak started with China and then rapidly spread into other parts of the world. Before the pandemic, China was already grappling with slower growth and rising unemployment along with trade conflicts with economic giants like USA. Impact of the Pandemic was severe on the country's economy in Q1 CY2020. The Govt. had to adopt strict containment measures and as China is the biggest exporter to many countries in the world, there were supply chain disruptions in the first few months of 2020 which impacted the manufacturing sector globally. However, the country could restore its operations within next few months and was one of the leading suppliers of medical consumables and equipment globally in CY2020. China's economy, which did not contract in CY2020, is expected to grow at 8.5% in CY2021 and moderate as the country's focus shifts to reducing financial stability risks.

India - India, one of the potential superpowers in the world and one of the emerging manufacturing destinations, could not decouple itself from this global disaster. Indian manufacturers had to face supply side bottlenecks as there was no supply from China in Q1 2020. India is the second most populous country and population density of the cities are one of the highest in the world. Due to this, India Govt. had to impose strict country-wide lockdown much faster than most of its western counterparts. Indian manufacturing sector could not withstand this double blow – first from the supply side and then from the demand side and its economy contracted the most (-23.9 %) globally in Q2 2020.

However, the country has shown strong resilience since then. The Govt. had called for 'Atmanirbhar Bharat' or 'Self-Reliant' India and the industries have responded to that call. India has not only become self-reliant on medical supplies, it is now one of the largest producers of Covid-19 vaccines globally. The demand scenario has improved and Indian economy has grown by record 20.1 % in Q2 2021 compared with the corresponding period last year.

Manufacturing has emerged one of focus area for the Govt. with policies such as 'Make in India' and 'Atmanirbhar Bharat' and series of schemes such as Phased Manufacturing Plan (PMP), Production Linked Incentive (PLI) etc. India has emerged as the second most sought after manufacturing destination across the world indicating the growing interest shown by manufacturers in India as a preferred manufacturing hub over other countries, including the U.S and those in the Asia-Pacific region, showed Cushman & Wakefield's 2021 Global Manufacturing Risk Index.

Other countries - The economic impact of the COVID-19 pandemic has been different across different countries. Iran had the highest number of corona cases in Middle East, followed by Iraq and UAE. Countries such as Saudi Arabia and UAE were conservative in allowing tourists, which has badly affected the region's tourism revenue. Tourism is one of the biggest revenue generators of the region especially for GCC countries like the UAE. GCC governments have taken swift measures to reduce the impact of the virus in the region. Africa is one of the most affected regions globally due to COVID-19 pandemic. It is one of the most susceptible regions in terms of controlling the pandemic due to lack of proper health care services and basic infrastructural amenities.

For many countries, economic recovery is being driven by the private sector. The Small & Medium Enterprises are expected to play a key role in economic and employment recovery in these countries. Digitalization is also playing a key role in economic rebound across Africa as healthcare apps, payment

platforms, e-commerce portals and micro-insurance systems are witnessing positive traction across end users.

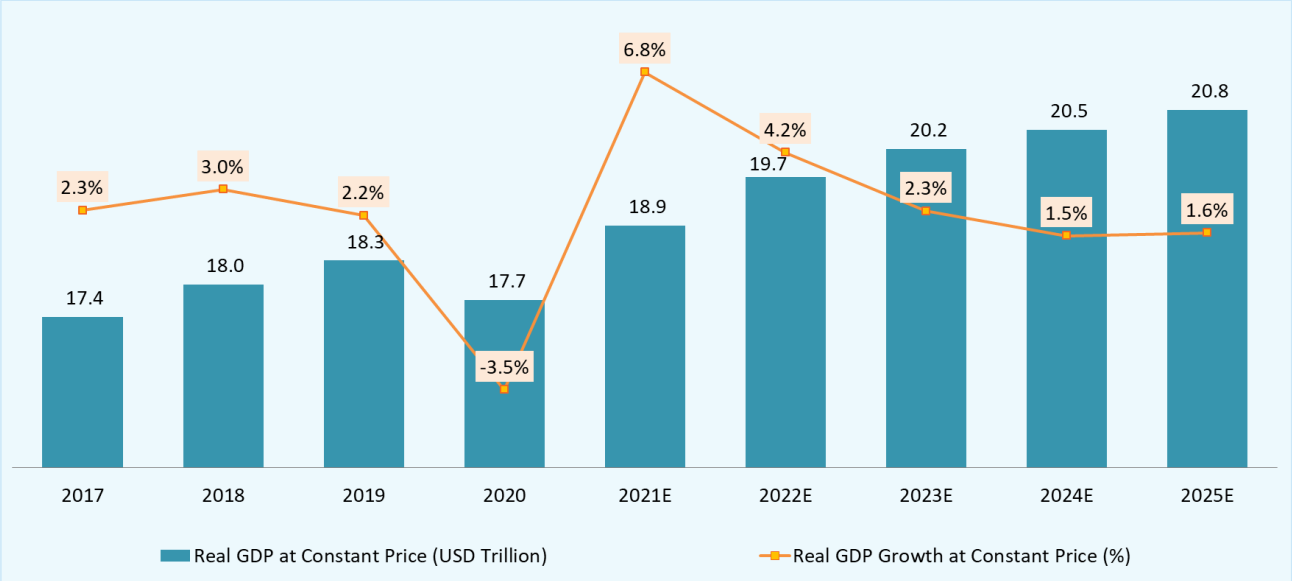
Real GDP for key regions and growth outlook

A) United States of America (USA)

USA economy was progressing well with more than 2.0 % growth between 2017 and 2019 before it experienced the biggest decline in 2020 when the economy contracted by over 3.5%. This was worse than the 2.5 % decline witnessed during the economic recession of 2009. A positive recovery of 6.8% in 2021 is anticipated to be followed by subdued growth and saturation in economic activity where the market is expected to grow between 4.2% in 2022 and 1.6% in 2025.

The US policy makers have taken proactive decisions to protect lives and businesses. The stimulus announced by the government has given the nation some additional relief. Few of the economic indicators like employment are showing significant improvement in 2021. Household expenditure has now been rising gradually since April 2021. Retail sales and housing sales has also gathered pace and also exceeded pre-crisis levels.

Chart 1.2: Real GDP and real GDP growth (annual percentage change), USA, value in USD trillion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

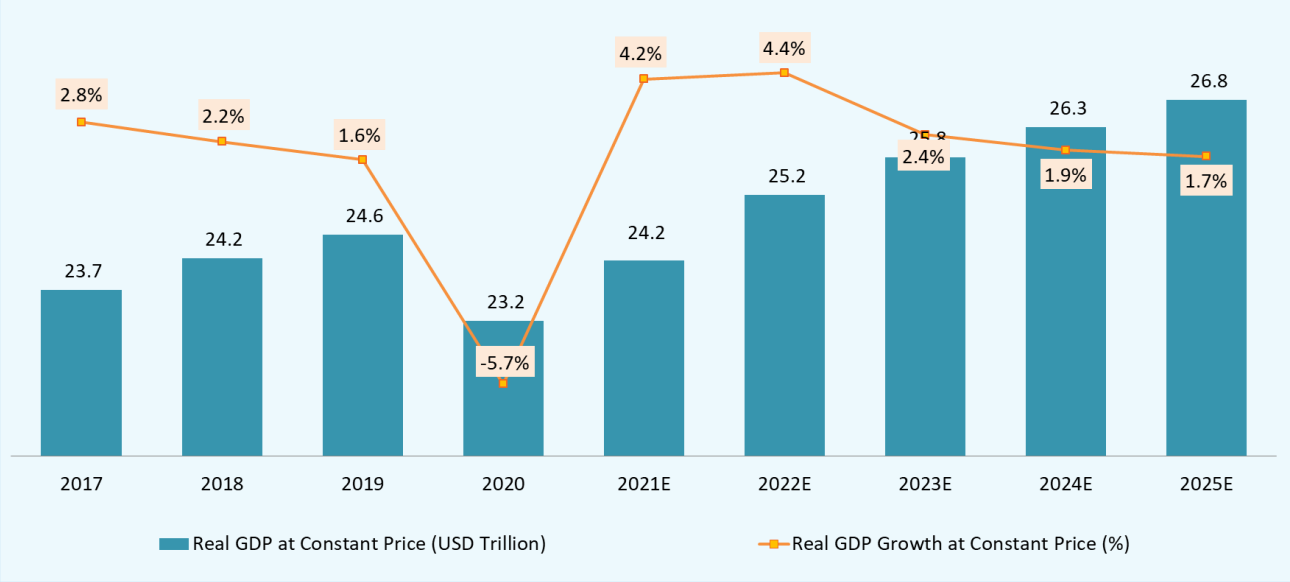
B) Europe

The European Union (EU) economy has shrunk by 5.7 % in 2020 with a recovery anticipated at 4.2% in 2021. Spain, UK, Italy, Greece and France are the worst affected economies, experiencing a GDP decline of 10.8 %, 9.1 %, 8.9 %, 8.2 % and 8.1 % respectively.

After the pandemic, EU and the United Kingdom have adopted various trade control measures to ensure the availability of essential items, medicines and medical equipment. In addition to this, EU member countries introduced export bans, notification requirements for exports, power to seize goods etc. The entire EU nations are experiencing a low production crisis. European companies have started redesigning production to revive from the current situation. Companies across Europe are embracing innovative business models to survive the crisis and continue doing business.

While the recurrence of COVID-19 looms large, economic experts have predicted that economic recovery of EU region will happen at a slower pace and the region will reach to pre-crisis level only in 2022 as many economies depend heavily on tourism. Most of the economies are now operating normally and a positive sentiment prevailing buoyed by a landmark agreement forged by the European Union to raise a 750 billion euro (USD 883 billion) relief fund through the sale of bonds backed collectively by all members. Countries are now looking towards more sustainable growth with resilience and cohesion.

Chart 1.3: Real GDP and real GDP growth (annual percentage change), Europe, value in USD trillion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

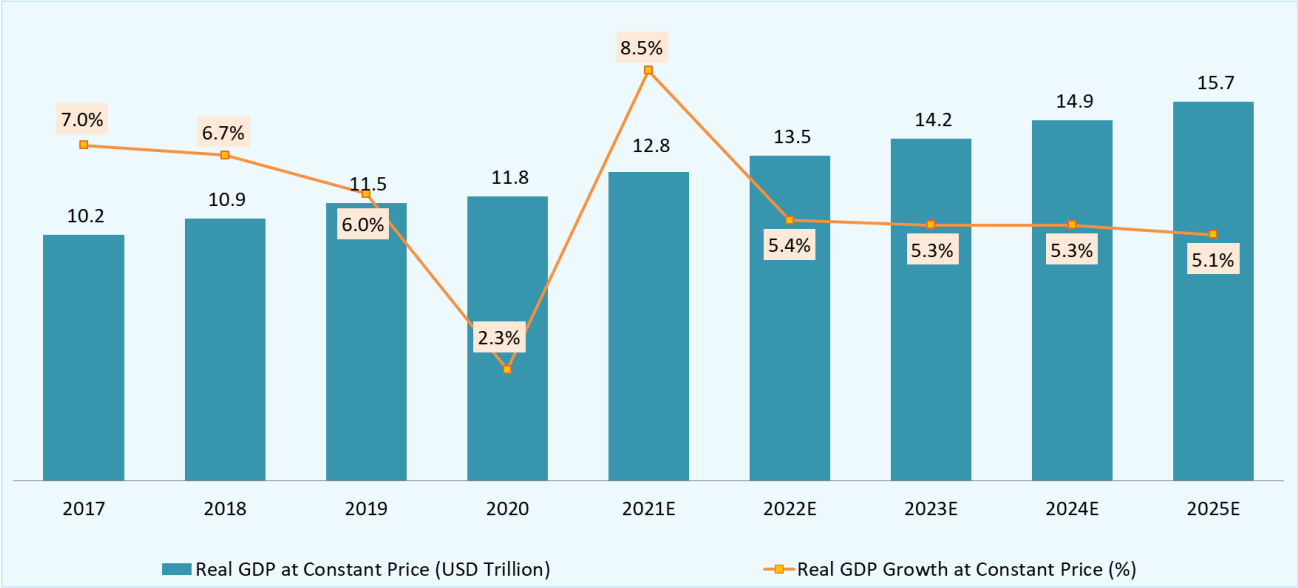
C) China

China is the only large economy to register a positive GDP growth in a year when the global economy contracted by 3.3 %. China's economy had a positive growth of 2.3% during 2020. The country has shown its resilience during the pandemic year and expected to register 8.5% GDP growth in 2021. China's economy has recovered well with the government focusing on supporting Small and Medium Enterprise (SME's) and allowing delay of loan repayments. Though China's industrial economy showed positive signs, retail and investment industry remained weak and challenging.

As the recovery gains traction, the composition of aggregate demand is likely to shift toward private domestic consumption. Real consumption growth is expected to eventually return to pre COVID-19 levels, aided by continued labour market recovery, growing household incomes, and increased consumer

confidence. Despite recent increases in imported raw material prices and an increase in local demand, consumer price inflation is projected to stay below target. Given the on-going uncertainty, the authorities are expected to remain flexible and modify the level and nature of macroeconomic policy assistance.

Chart 1.4: Real GDP and real GDP growth (annual percentage change), China, value in USD trillion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

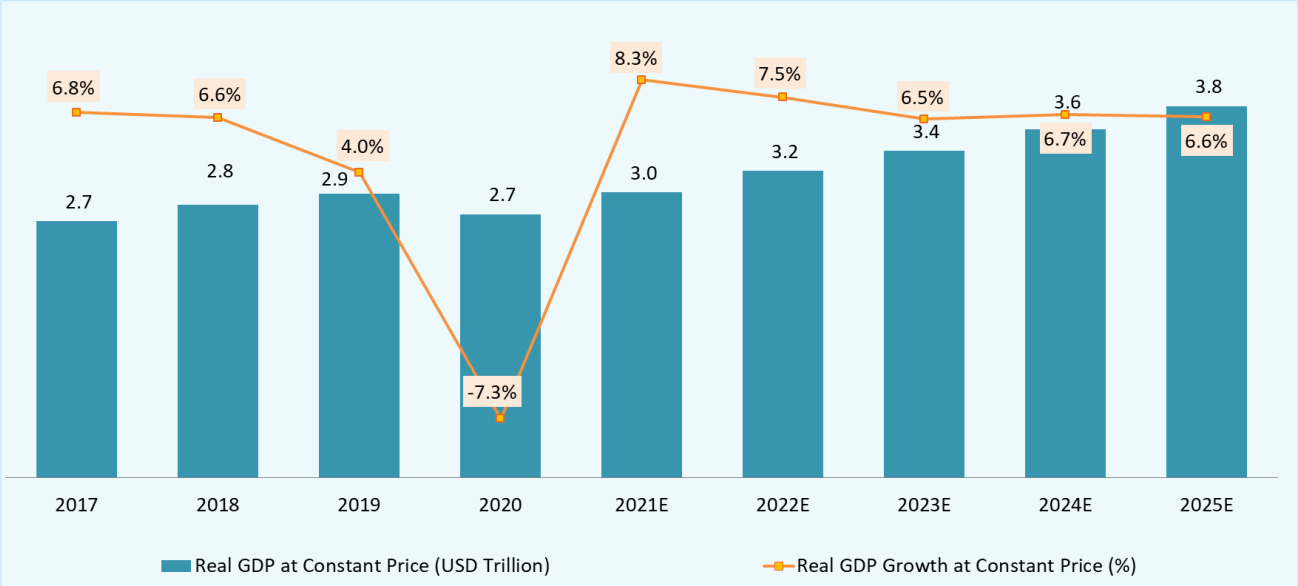
Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

D) India

The Indian economy continued to grow between 2017 and 2019. However, there was a moderation in the growth rate during these years. As the Government was taking various measures to counter this slowdown, Covid-19 created havoc in 2020 which resulted in 7.3% contraction of the country's economy. This was worst ever economic performance by India, worst year in terms of economic contraction in the country's history and much worse than the overall contraction in the world. Unemployment rate was more than 20% in April and May 2020 and individual income dropped by more than 40% during this period. Private consumption, the mainstay of aggregate demand, was severely affected by the pandemic. As per NSO estimate, Private Final Consumption Expenditure (PFCE) contracted by 9.0 per cent in 2020-21, reflecting impact of the stringent nation-wide lockdown and social distancing norms, heightened uncertainty as a result of transitory and permanent job losses, closures of small, micro and unincorporated businesses and wage resets.

However, the country has shown tremendous resilience in these difficult times and macroeconomic indicators started improving gradually since Q3 2020. The medium term growth outlook is very positive and country is likely to record a growth of 8.3% in 2021 and 7.5% in 2022, on account of strong macroeconomic fundamentals including moderate inflation, implementation of key structural reforms and improved fiscal and monetary policies. Among all large economies, India is likely to demonstrate a rapid and sustainable growth post COVID-19, driven by strong manufacturing-led industrial expansion and consumption demands from the private sector.

Chart 1.5: Real GDP and real GDP growth (annual percentage change), India, value in USD trillion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

One of the key reasons for the anticipated growth of Indian economy is the country's focus on the manufacturing sector. Indian manufacturing sector's contribution has increased from 16% to over 18% in the past 10 years buoyed by initiatives like the "Make In India" and sector specific initiatives that aim to make India a global manufacturing destination.

For the Electronics industry, The National Policy on Electronics (NPE 2019) aims to position India as a global hub for Electronics System Design and Manufacturing (ESDM) by encouraging and driving capabilities in the country for developing core components, including chipsets, and creating an enabling environment for the industry to compete globally. The NPE 2019 also envisions the creation of a vibrant and dynamic semiconductor design ecosystem in the country by way of incentivizing the start-ups and making design infrastructure accessible to them. Towards this, the Govt. has promoted entire ecosystem of the Indian electronics industry through incentive schemes such as;

- Incentive support to companies / consortia that are engaged in Silicon Semiconductor Fabs, Display Fabs and Compound Semiconductors / Silicon Photonics / Sensors (including MEMS) Fabs Semiconductor Packaging (ATMP / OSAT) and Semiconductor Design (Design Linked Incentive or DLI);
- Production Linked Incentive (PLI) for IT hardware and large scale electronics manufacturing

These incentive schemes will boost investment in the entire value chain of the Indian electronics industry include designing and ensure local availability of components (Integrated Circuits (ICs), Chipsets, System of Chips (SoCs), Systems or IP Core etc.) and enable Indian Electronics industry more self-reliant and export oriented. Development of local manufacturing ecosystem will strengthen the local supply chain thereby

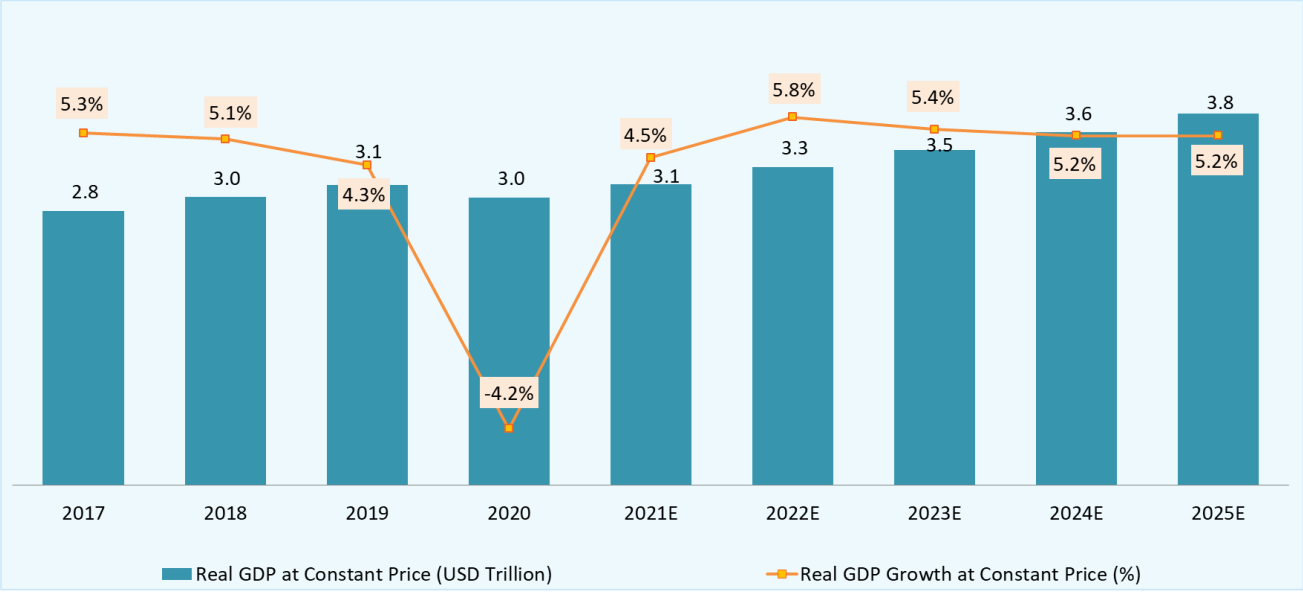
improving time to market, reducing lead times, saving precious foreign exchange, reducing component and logistics costs, and making electronics products more affordable in the coming years.

The pandemic has also created unique growth opportunity for India. Supply chain disruption during the pandemic has forced many countries and organization to re-think on their sourcing strategy and reducing dependency on one country for the entire supplies. These large companies are now looking for alternate low-cost manufacturing locations in South East Asia and South Asia and India is emerged as one of the sought after investment destinations for many of these organization. As there would be re-alignment of global supply chain in the coming years, India is likely to benefit immensely from these strategic decisions and likely to become a manufacturing powerhouse in the coming years. Huge investment are likely to flow into Electronics manufacturing segment with possibilities of backward and forward integration becoming more attractive. Favourable business environment, liberal FDI norms, constantly improving 'Ease of Doing Business' rankings, enormous consumer base and rapidly improving digital infrastructure are some of the key factors that will drive investment in India in the coming years.

E) South East Asia (SEA)

For the first time in 20 years, due to the economic downturn, the poverty rate in South Eastern Asia is expected to increase. Trade and other sectors are experiencing a sharp decline in the region and likely to recover at a much slower rate due to recurring waves and imposition of multiple lockdowns.

Chart 1.6: Real GDP and real GDP growth (annual percentage change), South East Asia, value in USD trillion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: IMF, World Economic Outlook, 2021; World Bank; Frost & Sullivan Analysis

Following the Covid-19 pandemic, South East Asia went through socioeconomic crises, with GDP falling by 4.2 % in 2020. Declining tourism and businesses have caused sharp downturn in the overall economy of the region. Low material movements and lockdowns are affecting countries dependent on trade and tourism

especially Singapore, Vietnam, Cambodia, Malaysia and Thailand. Also, reduced remittance has negatively impacting the economic growth of countries such as Philippines and Taiwan. According to the recent International Monetary Fund projections, GDP per capita in the region will stand at 4.5, 5.8 and 5.4 % in 2021, 2022 and 2023. Although the outlook is shadowed by uncertainty, three major elements have shaped Southeast Asia's experience with the crisis thus far and will be critical in the following years (a) Controlling the virus through vaccine drives (b) Role of international trade (c) Responsiveness of the macroeconomic policy.

With the US China trade war and the economies are now gradually recovering from the impact of COVID-19, the focus of global growth is shifting towards South East Asia. With a rapid growth in urbanization and industrialization, high proportion of young population, digitization, and growing access to education and employment, South East Asia is set to emerge as one of the manufacturing hotspots in the coming years.

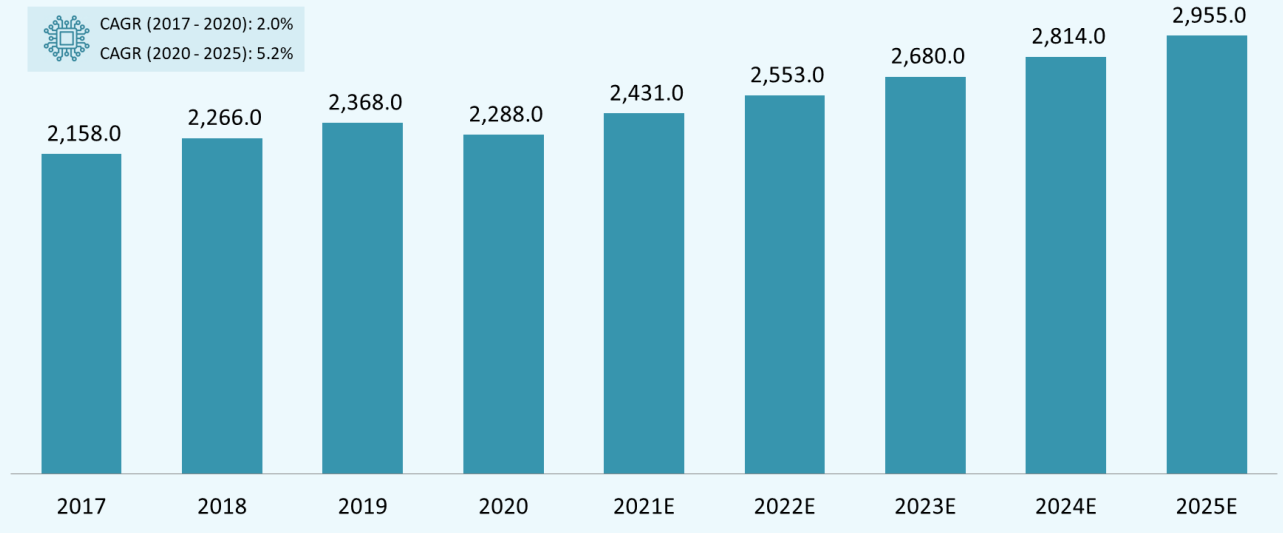
CHAPTER 2 - GLOBAL ESDM INDUSTRY OVERVIEW

Global Electronics industry

Over the last 60 years, the global electronics industry has evolved tremendously. Emerging and multiple disruptive technologies drive global demand for the electronics industry. Electronics products, electronics design, electronics components, and electronics manufacturing services are all part of the overall electronics market. The electronics industry, which has historically been a strong growth market, decreased by 3.4 percent in CY2020, owing primarily to a decrease in private expenditure caused by the COVID-19 pandemic.

The global Electronics industry has been valued at USD 2,288 billion in CY2020. As per Frost & Sullivan analysis, the industry is expected to grow at a CAGR of 5.2 % to reach USD 2,955 billion by CY2025. Some of the critical factors driving this growth are increasing disposable income, improved acceptability of audio and video broadcasting, higher internet penetration, inclination of the youth towards next gen technologies, emergence of e-commerce etc.

Chart 2.1: Overall Electronics industry, global, value in USD billion, growth in %, CY2017-CY2025E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

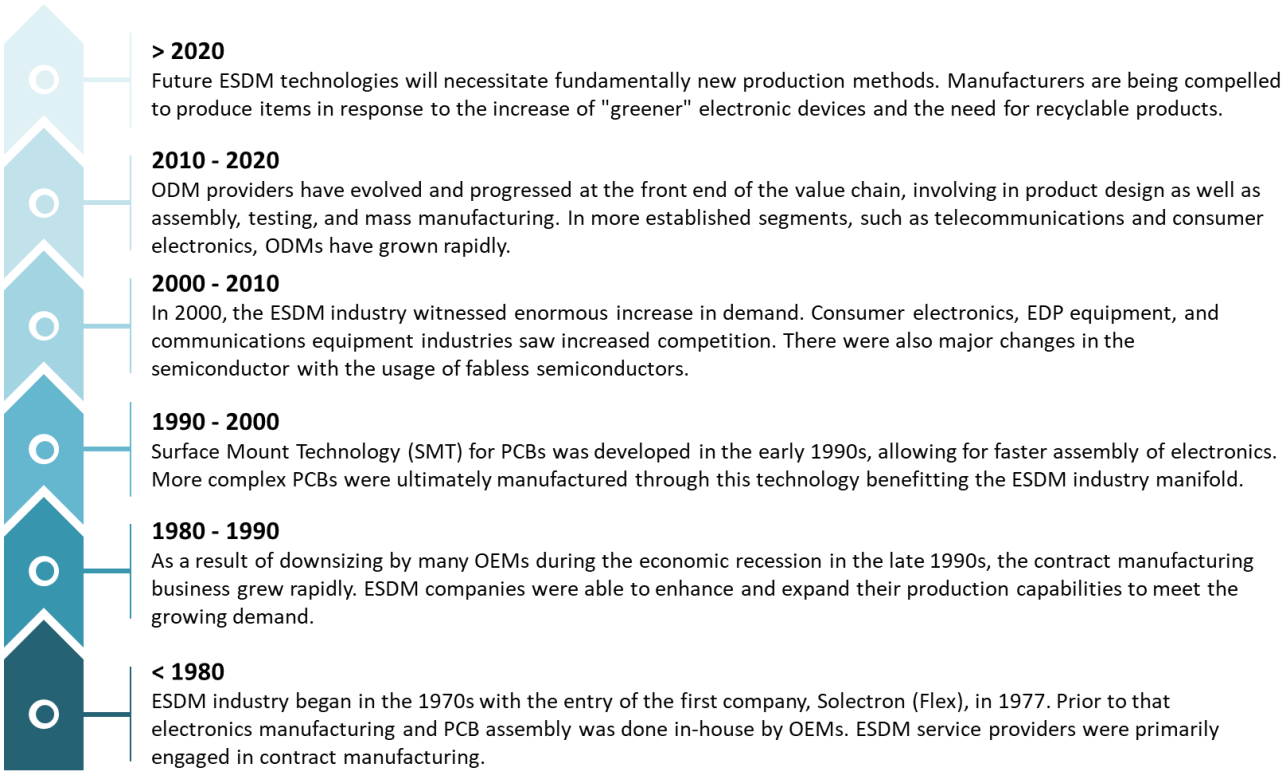
Introduction to Electronic System Design and Manufacturing (ESDM) Industry

Traditionally, the global ESDM market has been dominated by the companies that manufacture electronic products, primarily through the assembling of components on printed circuit boards (PCBs) and box builds for original equipment manufacturers (OEMs) and OEMs used to take care of the designs. However, the scenario is changing fast and OEMs are increasingly realising the capabilities and contribution of the ESDM companies, which have resulted in their involvement expanding beyond manufacturing to encompass product design and development, testing, and after-sales services such as repair, re-manufacturing, marketing, and product lifecycle management. Some of the key design-related activities include product designing, chip designing, very large-scale integration (VLSI), board designing, and embedded systems.

The transformation of the Global ESDM industry

The ESDM market was established more than five decades ago to execute manufacturing designs from government, defence, and research institutions. As the years passed, the ESDM market expanded to meet demand that surpassed OEM manufacturing capacity. By the mid-1990s, the industry's benefits had become abundantly clear, and OEMs began outsourcing PCB assembly on a large scale. By the late 1990s and early 2000s, several OEMs had divested themselves of their assembly plants to the ESDM companies, which were aggressively pursuing market share. A wave of partnerships unfolded as the more cash-rich ESDM companies began purchasing existing plants and the smaller ESDM companies sought to consolidate their global market position.

Chart 2.2: The transformation of ESDM industry, Global, CY2020



Source: Frost & Sullivan Analysis

Since the 1990's, the introduction of digital computers and their subsequent advancement and integration into the mainstream have played a critical role in popularising electronic usage. Modern electronic devices have long outperformed their predecessors' capabilities, gradually becoming more cost-effective, available, and diverse over the last few decades. As component miniaturisation and electronic assembly become more complex, need for specialized ESDM services will increase in the coming years. ESDM is the overall procedure for design, assembly, manufacturing, and testing of electronic components and products for original equipment manufacturers (OEMs).

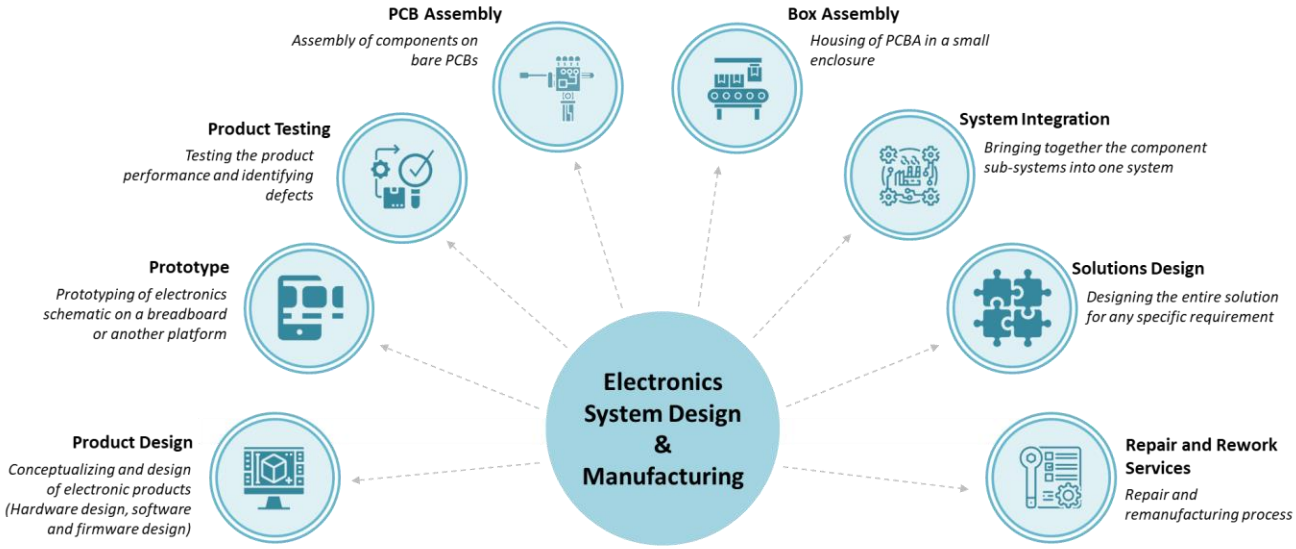
As technology advances, the size of the components and the circuits will become smaller. On the other hand, with digital revolution, electronics has become an integral part of our life and overall penetration and coverage of electronics is increasing more rapidly than the miniaturization. Manufacturers are resorting to

more complex technologies to expedite their manufacturing operations as the demand for unique features and products are increasing. Artificial intelligence (AI) is also creating disruptions in the ESDM industry, transforming functionality of operations. OEMs, ESDM companies and other stakeholders are increasingly forming strategic alliances, mergers, and partnerships to adapt to the rapid changes in designing and manufacturing.

Range of services offered by ESDM companies globally

ESDM companies are equipped to provide a gamut of services which includes design, assembly, manufacturing and testing of electronic components for the original equipment manufacturers (OEMs). These companies can be contracted at different stages of the designing and manufacturing processes. While large companies have the capability to offer entire range of services starting from design, sourcing of components, assembly and testing (also known as ODM), smaller companies offer primarily assembly and testing services.

Chart 2.3 Range of services offered by ESDM companies, Global, CY2020



Source: Frost & Sullivan Analysis

Design services and solutions: Design services include multiple associated actions that occur after determining the customer's specifications or product requirements and before manufacturing or at the beginning of an assembly. OEMs generally conduct research with the product users, experts and market participants to understand needs and expectations of the market and then set out broad specifications / feature requirements for the products to be designed. The ESDM Company based on inputs from the OEMs creates conceptual design and the same is shared with the OEMs for inputs and approvals. Certain ESDM companies may also have capabilities to design a complete solution that meets needs / expectations / requirements of its customers

Prototyping: The next step is to create a Proof of Concept (POC) to demonstrate that concept of design, actually functions. Post that, once design for manufacturability, design for testing and design for servicing

are established, prototypes are made to make sure that the product will serve its proposed purpose after it is manufactured as a part of a bigger production run. Prototyping may happen at different stages in the design and planning stages of a project and there could be several revision changes

Testing services: Testing is an essential element across the entire ESDM value chain. ESDM companies which are capable of designing test solutions for both at PCBA level and end of line product testing, including functional testers and fixtures are preferred by the OEMs. It is critical for the ESDM companies to have sound testing capabilities so that they can consistently create high-quality products.

PCB Assembly: At the heart of the electronics industry is Printed Circuit Board or PCB. A PCB with components mounted on is called an assembled PCB and the manufacturing process is called PCB assembly or PCBA for short. The copper lines on bare board, called traces, electrically link connectors and components to each other. PCB assembly is a major activity and normally outsourced to ESDM companies. Out of overall PCBA demand in India, approx. 80% demand is met through importing or domestic manufacturing of Bare PCBs and then local assembly in India. Rest of the PCBA demand is met through imports.

Box Assembly: In this, OEM outsources complete product manufacturing to an ESDM company and the ESDM company, manufactures the final product, puts in the OEM logo and dispatched to the OEM warehouse for selling. This model is largely used in HVLM type of products such as Mobiles, Computer Hardware and industrial segments. Box-Build Assembly requires availability of integrated infrastructure for doing major processes in-house by the ESDM companies. The objective is to produce products in high volume with best possible economics and least interruptions.

Overall manufacturing capabilities: This includes manufacturing of diverse types of electronic products as per the design. Companies in the ESDM sector those have design capabilities, can provide faster turnaround in technology absorption and manufacturing development than those that are into purely manufacturing. ESDM companies desiring larger manufacturing presence should be able to have domain skills in electronics, testing, moulding tools, magnetics, and cable harness and product integration to deliver the complete product to the OEMs.

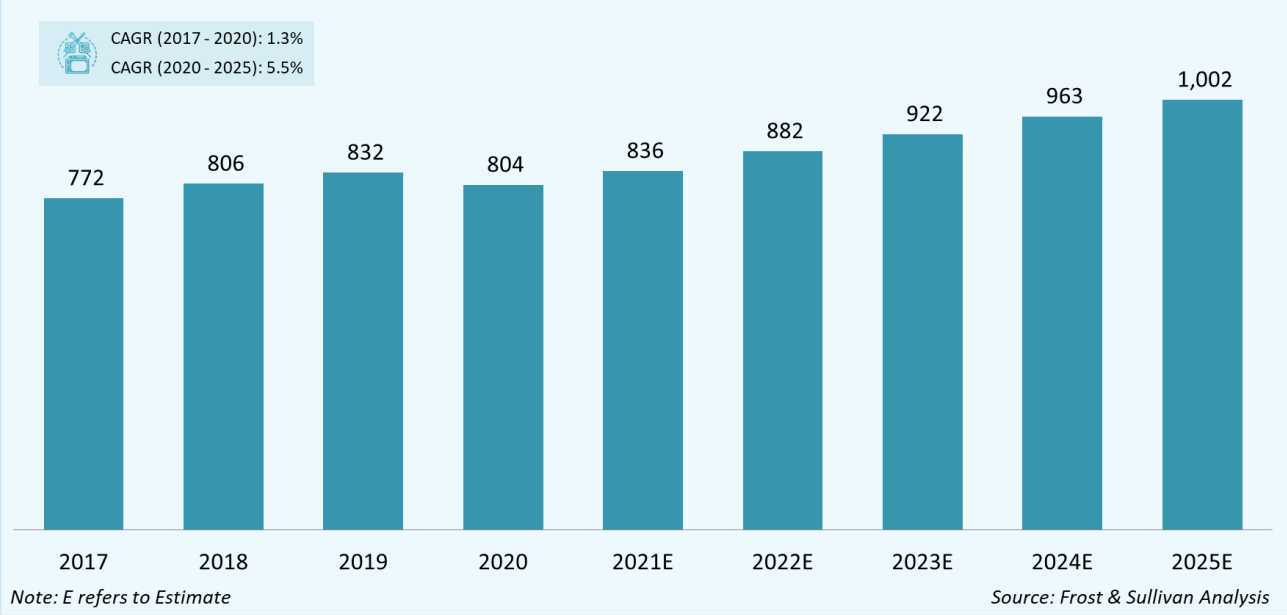
Aftersales Service (Repair and Rework): Aftersales currently accounts for 7.1 % of the ESDM market revenue. The demand for repair and remanufacture is not high, because the majority of electronic products (such as mobile phones, tablets, computers, and laptops) do not necessitate repair or remanufacturing activities. Since the end-user mind-set is focused on replacement rather than repair, overall demand for this service is low. Niche verticals like Aerospace & Defence, Railways and high end electronics segment is opening up to accept third-party repairs due to high cost of equipment and re-design. This relatively new service segment has immense potential due to its natural barriers to entry and certifications involved.

Global ESDM industry and outlook

The global ESDM market was estimated at USD 804 billion in 2020 and is expected to reach USD 1,002 billion in 2025 at a growth rate of 4.5%. The global ESDM market witnessed a period of steady growth till 2018, riding on the wave of increased outsourcing activities from OEMs and increasing electronics content. However, in 2019, the opportunities started stagnating due to a multitude of factors - firstly, due to decline

in global automotive sales and saturation of consumer electronics sales, and secondly, due to supply chain restrictions as a result of heightened trade tensions between the US and China.

Chart 2.4: ESDM Industry, Global, value in USD billion, CY2017-CY2025E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

While the industry was still coming to terms with these shocks, a bigger blow was waiting for the industry in the form of the COVID-19 pandemic. The pandemic-induced lockdown created an even more complicated environment for the industry, affecting demand, supply, and manufacturing activities. Despite growing demand, the ESDM industry recorded a 3.4% decline in 2020. The impact on the industry was expected to be higher, but certain factors worked in favour of the industry. These are:

- The pent-up demand created by the need for life-sustaining medical devices
- The work-from-home economy, which created demand for smartphones, tablets, and laptops
- The China +1 strategy which resulted in the USA and Japanese companies shifting focus to India and Southeast Asian countries
- Government of India's focus on increasing local content in manufacturing
- Increasing investments in infrastructure projects
- Increasing use of data has resulted in the need for data privacy and this is creating demand for large domestic servers. Growth in data analytics is also contributing to the growth of data serves, which in turn creates demand for electronics
- Adoption of Industry 4.0 across manufacturing segments
- Growth in 4G/ 5G networks
- Increasing adoption of clean energy/ renewable energy
- The push for climate change, which created demand for digitalization or digital software, products, or solutions that can track, monitor, measure, and verify sustainability initiatives.

Moving ahead, the ESDM industry is anticipated to grow rapidly over the next few years, surpassing the pre-COVID-19 revenue level by 2021 or 2022. According to Frost & Sullivan analysis, the ESDM market has faced

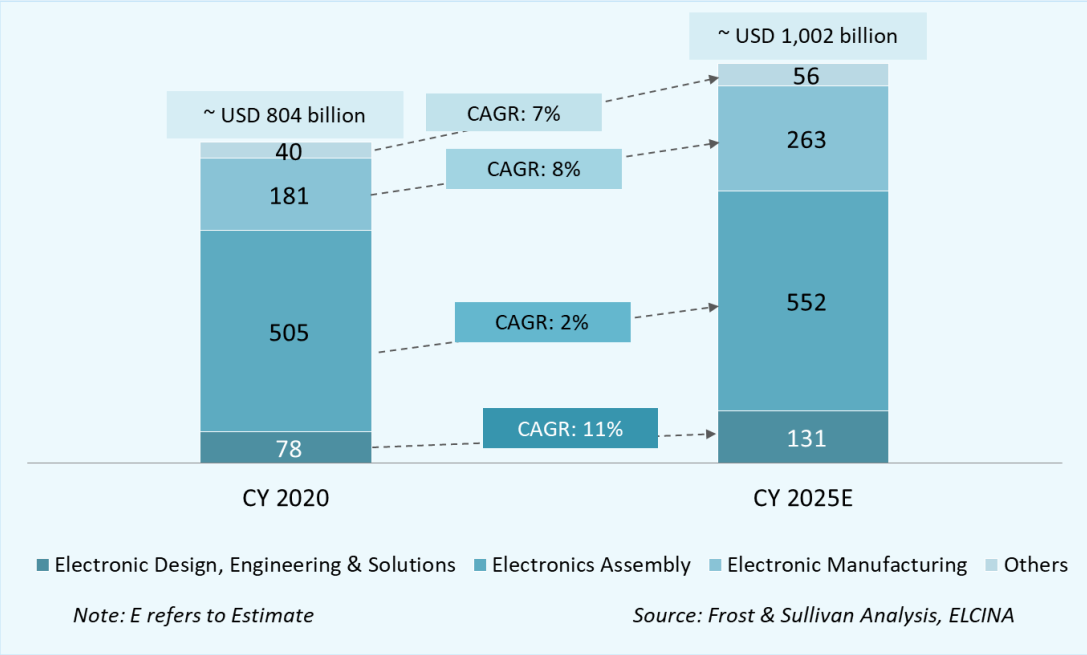
challenges with the supply chain in 2021, which had medium restraining effect. The problem is expected to be resolved by early 2022 through a combination of measures, including part localization. Additionally, as the electronic content increases, the demand for electronic components will also increase in the future, which will drive the ESDM industry. ESDM providers are increasing their focus on the design aspects, which would also add to their revenue stream going forward. According to market participants, technological expertise would add to the competitive advantage of ESDM providers and increase their revenue opportunities.

Global ESDM market dynamics

A. By services

The global ESDM market is defining the force in the production of electronics products and now accounts for a sizable portion of the electronics market. While outsourcing continues to be the most anticipated model for the manufacturing / assembly of advanced electronics products, OEMs are increasingly outsourcing the design activities to the ESDM companies. Extensive experience in manufacturing and assembly has enabled large ESDM companies to advance up the value chain by providing other services such as design, testing, and component procurement. The industry is evolving away from Original Equipment Manufacturing (OEM) toward Original Design Manufacturing (ODM), to put it succinctly (ODM). By 2025, it is predicted that the share of ODM business would have increased from 10% to 13%

Chart 2.5: ESDM market break-up by services, Global, value in USD billion, CY2020 and CY2025E



Note: E refers to Estimate

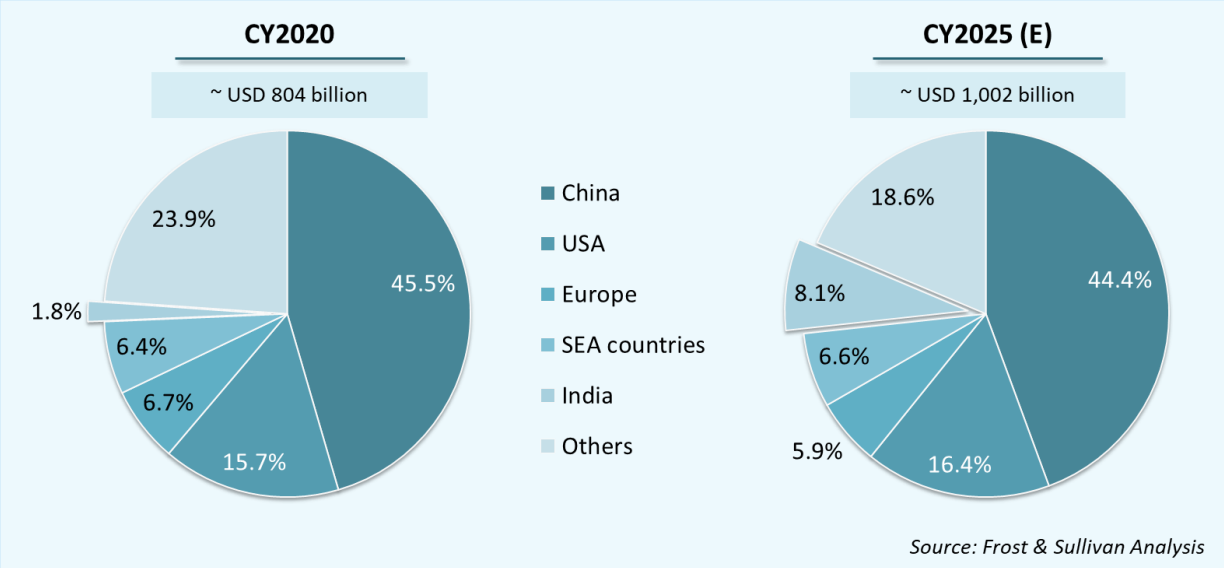
Source: Frost & Sullivan Analysis, ELCINA

B. By geography

China leads the global ESDM business with almost 45.5% share. Its dominance in the global market is attributed to a blend of cost effectiveness and technological leadership in electronics manufacturing. On-

going digitalization, IoT, and urbanization are some mega trends that are driving the growth prospects. It is a high growth region due to operational cost benefits, availability of a large number of highly skilled personnel, infrastructure, logistical advantages, and proximity to the largest end-user base across all end-user verticals. However, post COVID-19 pandemic, many global electronics manufacturers are contemplating on China + 1 strategy and looking for alternate manufacturing locations for exports business. This is creating tremendous investment potential for countries like Vietnam, India, and Philippines etc.

Chart 2.6: ESDM market break-up by select countries, Global, value in USD billion, in %, CY2020



Source: Frost & Sullivan Analysis

North America is a leader in adopting next-generation technologies and devices. For instance, the USA is one of the first countries to start commercialization of 5G. On the device front, the demand for IoT-based devices is expected to accelerate at a CAGR of 15.0% till 2025. In the next five years, demand for ESDM will be driven by a rise in electronic device demand, a well-established ESDM infrastructure, and evolving government policies that encourage local production. Linking the region's quantum of R&D activities to the total available market, ESDM companies can expect good growth opportunities from product development if ESDM companies can solve scalability and time-to-develop challenges.

Advanced technologies provide huge market potential for European ESDM companies. Manufacturers in the region are expected to aggressively adopt Smart Factory capabilities to compete on price and secure more contracts. Also, the ESDM companies in the region are looking to diversify their portfolio of end-user verticals to create sustainable growth opportunities. Due to the economic slowdown, some ESDM companies in the region that rely heavily on the automotive or aerospace and defence (A & D) verticals will be significantly impacted in 2020.From a growth perspective, the presence of leading network equipment OEMs, emerging medical device start-ups, regulations forcing auto OEMs to shift to EVs, reshoring, and upgrading of manufacturing facilities will improve growth prospects for ESDM companies in the region.

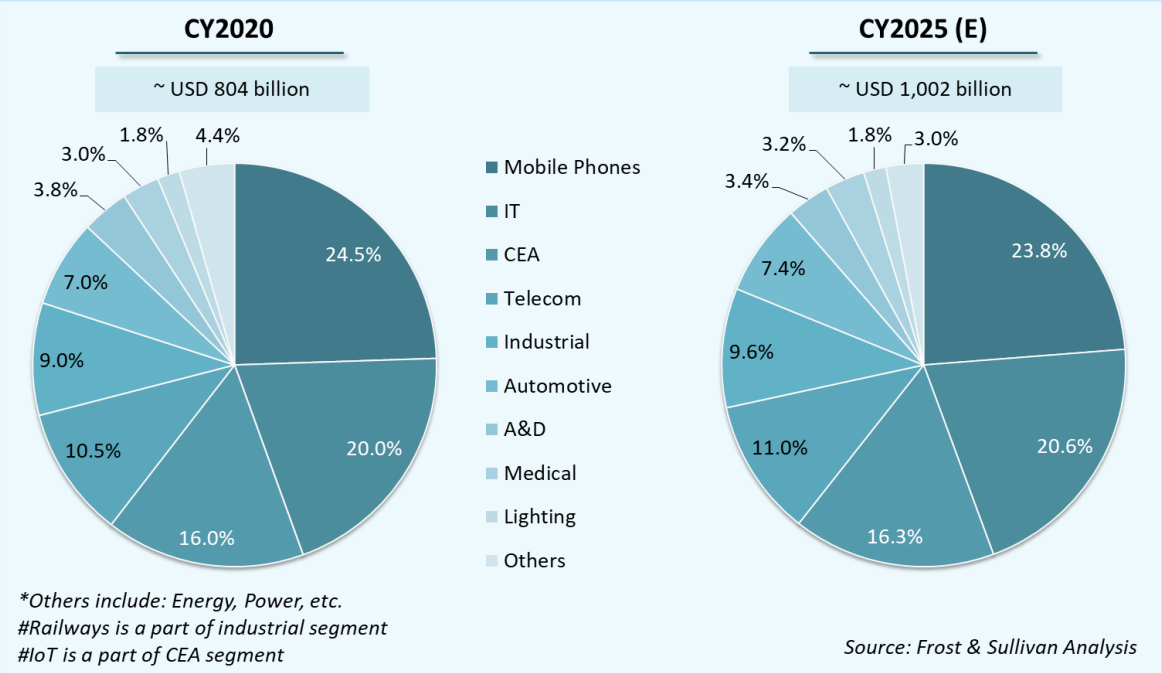
India contributes to approximately 1.8% of the global ESDM market in 2020. However, there is a strong push from the government to make India an ideal location for electronics manufacturing in the region. Under the National Policy on Electronics (NPE), India announced various programmes in 2019, including EMC 2.0, to enhance the infrastructure of electronics manufacturing and offer incentives to manufacture more products

that promote the industry in India. The PLI programme, which benefits electronics manufacturing firms, was introduced in 2020. In the southern state of Tamil Nadu, in Chennai, an electronic manufacturing corridor is being built. The EMC Smart City investment in Greater Noida is planned at USD 162.7 million. Kaynes, Jabil, Dixon, Flextronics, SFO, Elin, Rangsons, and Centum are among the companies that have invested in manufacturing capacity as a result of 'Make in India policy' efforts. The Govt. has recently come up with incentive scheme for the development of semiconductors and display manufacturing ecosystem in India – this includes Semiconductor Fabs and Display Fabs, Semiconductor Laboratory (SCL), Compound Semiconductors / Silicon Photonics / Sensors (including MEMS) Fabs and Semiconductor ATMP / OSAT Units and Semiconductor Design companies (Design Linked Incentive / DLI).

Industry experts in South East Asian countries have acknowledged the increased interest among large ESDM providers to relocate from China. There are country-level investor programmes initiated by governments, such as the Philippines, Vietnam, and Thailand, to capitalise on the situation and evolve into the next ESDM manufacturing hubs of the region. Asian countries like China, India, and Japan will further strengthen their shares in the global electronics market over the coming years. The requirement for low-cost manufacturing within closer proximity of the end market will be the driving factor.

C. By end-user segments

Chart 2.7: ESDM market break-up by industry applications, Global, value in USD billion, CY2020



Consumer electronics and appliances have had a consistent performance in the last few years, which is aided by growth in advanced economies and developing countries. ESDM companies have also profited from rising consumer spending and technological improvements. Rising demand for smart solutions will fuel future growth. Furthermore, OEMs and ESDM manufacturers are progressively supplying both premium and mid-range appliances in order to meet the growing demand for both product categories and increase revenue.

Mobile phones, IT hardware, and CEA (Consumer Electronics and Appliances) are the key segments with a significant share of the global ESDM market. The Internet of Things (IoT), which is part of CEA, is gaining in popularity as the number of internet users and smart device use rises. Similarly products such as BLDC motors, inverters and other specific product categories are also gaining importance. Another important market in which electronics are used is industrial, which is divided into a number of sub-segments. Railways are considered to be part of the industrial sector. Leading manufacturers are looking to add new applications into their portfolio by partnering with niche application providers.

Mobility (Automotive and Railways/Metro) is one of the key growth opportunity verticals for ESDM providers in the next 5 years, due to the technology transformation currently underway with autonomous cars development and electric car commercialization activities. Moreover, the rapidly growing electronics content will accelerate the growth of ESDM revenue from this vertical. The Aerospace & Defence industry is predicted to be a promising market, with a considerable supply-demand mismatch. In the long term, the industry is likely to benefit from the global market.

Medical devices electronics manufacturing services are a key revenue opportunity in the others segment. Though the COVID-19 pandemic has created a surge in demand for ESDM in this vertical, it is important to carefully assess the demand level for the mid and long terms. LED lighting has grown from strength to strength over the last decade driven by energy efficiency regulations, widespread manufacturing and reduced prices of LED light sources.

Drivers and challenges for the growth of Global ESDM industry

Key drivers for the growth of Global ESDM industry
▪ China +1 strategy
▪ Growing emphasis on renewable energy
▪ Global increase in infrastructure spending
▪ Technological advancements and acceptance of smart home devices
▪ Greater emphasis on Electric Vehicles
▪ Growing demand for electronics
▪ Technological upgrade of facilities
▪ Product development activities
▪ Continued outsourcing of manufacturing to Contract Manufacturers (CM) and Original Design Manufacturers (ODMs)
▪ COVID-19 induced pent-up demand

China +1 strategy: China was the epicentre of global supply chains in the last decade due to favourable manufacturing environment and a strong business eco-system. But recently several factors such as higher

labour costs, adoption of stringent environment regulations and compliance costs have impacted Chinese manufacturing competitiveness and this resulted in a trend of diversifying global supply chains around 2017. The global pandemic which started in late 2019 has accelerated the adoption of this strategy, which is called as China +1. Today many MNC companies are in the process of adding new manufacturing operations in other developing Asian countries such as India, Vietnam, Thailand, Bangladesh and Malaysia and Mexico. Global ESDM industry is also in the process of diversifying their global supply chains and countries such as India, Vietnam and Mexico are expected to witness high growth as a result this diversification.

Growing emphasis on renewable energy: Global renewable electricity capacity is forecast to reach over 4,800 Giga Watts (GW) by 2026. This is an increase by more than 60% from the 2020 levels. Strong policies and climate change goals and targets are driving the demand for renewable energy across the globe. China is expected to remain the largest market for renewables with an anticipated 1200 GW of capacity for wind and solar by 2026. The other major markets are India, Europe and the USA. These four markets are expected to be the major contributors for renewable capacity additions globally. Solar PV is expected to the dominant renewable technology across these markets. The growth in renewable energy market would have a direct implication on the electronics demand and create opportunities for ESDM.

Global increase in infrastructure spending: As the global economy recovers from the pandemic, a synchronized infrastructure investment is expected to drive the future economic growth. Investments in infrastructure are critical for economic and social development. Many countries in Africa, Europe and Asia are investing heavily in infrastructure development. For example recently the EU announced a Euro 300 billion global infrastructure plan named “Global Gateway”. Such investments in developing the global infrastructure is expected to drive the demand for ESDM,

Technological advancements: The development of new manufacturing technologies and the emerging end-use sectors, such as the Internet of Things, are expected to boost demand for the ESDM industry. Major manufacturers are strengthening their R&D investment in order to differentiate their products and attract new end-use applications. The rising popularity of smart home devices in developed nations such as the United States and European countries raises very high expectations for ESDM companies. In the United States, companies provide electronic manufacturing services that include developing optoelectronics, radio frequency and wireless devices, and microelectronics devices for the rapidly growing smart home sector. Key market participants are focusing on increasing production volumes by combining cloud computing, artificial intelligence, big data analysis, and 3D printing to produce connected devices for smart homes.

Greater emphasis on Electric Vehicles: The Electric Vehicle market will be the most lucrative in the automotive industry over the next decade. With an ever-increasing electronic content in each car, energy-related modules and sub-assemblies, as well as charging infrastructure, which requires an overall ecosystem; it is a paving out major potential for ESDM companies to enter this fast developing industry and serve the leading EV manufacturers. Across the world, incentives are provided by the respective government to encourage people to purchase electric vehicles. For instance grants are highly popular in the United Kingdom, China, the United States, Germany, and even Norway, among other places, in order to reduce air pollution and promote a more sustainable way of life. As the number and complexity of PCBAs in electric vehicles are significantly higher than in typical ICE vehicles, this growth represents a huge potential for ESDM businesses to offer electronic manufacturing and mass production services to automakers.

Growing demand for electronics: Several factors have contributed to the growth of the electronics market across the globe. The most prominent ones are

- Increasing demand for consumer electronics and FMCD across developing countries such as India, China, Brazil, and Africa.
- COVID-19 has accelerated the shift to "future-of-work" hybrid model that includes a majority of the manpower working from remote locations/ homes. This has driven the sales of consumer electronics such as laptops, tablets and smart phones. Adoption of 5G services will facilitate connected devices and result in accelerated adoption of IoT ecosystem. This is also expected to contribute to the increasing demand for electronics.

Technological upgrade of facilities: ESDM companies are investing in the technological up gradation of their facilities by adopting digitization and industry 4.0 concepts. This will improve productivity and capacity, thus acquiring the capability to get more contracts. A majority of the market participants are progressing in this direction; hence, this factor will evolve into a significant driver in the mid to long-term.

Product development activities: The dependence created by electronics in product development activities across all verticals will turn out to be a significant driver for ESDM, especially in consumer electronics and automotive segments, where new devices and systems are being developed. As the electronic content increases, the volume of manufacturing will increase, driving the market.

Continued outsourcing of manufacturing to Contract Manufacturers (CM) and Original Design Manufacturers (ODMs): Outsourcing of design and manufacturing of electronic components have been adopted in the industry for more than three decades. This trend is expected to continue among OEMs and most of the design and manufacturing is expected to be outsourced to CM and ODMs in the long-term. This would contribute to the growth of the ESDM.

COVID-19 induced demand: Covid-19 has currently increased the requirement for ESDM industry. The onset of the pandemic has created a spike in demand for medical devices such as pulse oximeter, thermometers etc. and this demand is expected to subdue in the mid to long-term once inventory is created. Major medical devices companies are very keen to design & manufacture smaller and smarter medical devices that integrate new technologies like IoT and other electronics-embedded features. There is also a growing demand for the wearables and the smart medical devices is pushing the need for smaller, flexible, and light-weight products in the healthcare business. As COVID-19 virus is expected to remain in a milder and manageable form in the future, the demand for smart medical devices and wearable would witness high demand, thereby driving the potential for ESDM

Challenges / market restraints hindering the growth of Global ESDM industry

- **Increasing competitions in the industry**
- **Shrinking operating margin**
- **Complex structure and delay in supply chain**

- **Shortened product lifecycles and uncertain demand**
- **Regulations and Violations of IP**

Increasing competitions: Due to its strong growth potential, many companies are entering into ESDM industry which is causing stiff competitions in the market. While this is good from the consumer point of view, flip side of this issue is competitive pricing / price war and finally reduces revenue potential of the market.

Shrinking operating margin: This is primarily true for the HVLM segment such as Mobile, Consumer Electronics etc. These segments run the risk of reducing margin due to increase in labor costs, addition of features costs and overheads. However this does not completely apply to products in other verticals which is more skill oriented and the product can absorb the costs as the end customer could be OEMs in Automotive, Railways, A&D and Industrial Verticals.

Complex structure and delay in supply chain: Manufacturing businesses must adhere to global standards since they rely on a wide range of suppliers, both local and international. The operational constraints are compliance with rigorous government and industry regulations, as well as the concern of traceability. The biggest challenge in the recent past has been the shortage of semiconductors. As Indian ESDM companies rely largely on global supplies for semiconductors, this has resulted into increase in lead time and prices and also impacted revenue of the ESDM companies in the short term. Govt. of India has now come up with incentive schemes for the development of semiconductors and display manufacturing ecosystem in India. This will resolve the supply chain issues in the long run.

Shortened product lifecycles and uncertain demand: Customer preferences and interests continue to evolve at a breakneck pace. An active new product launch procedure is required for ESDM companies. To launch the items on schedule while fulfilling quality and volume objectives, a collaborative effort across difference sections is required. Production is always based on the customer demand, which can be both unstable and cyclic. The industrial sector should be able to handle the rise in demand if it reaches exceptional heights. If demand falls, companies must have a strategy in place for the idle raw materials or machinery.

Regulations and Violations of IP: Local stringent laws and trade pricing are having an influence on the ESDM sector. ESDM companies due to their scale of purchase and efficiencies in manufacturing are able to offer better alternatives and pricing to OEMs to increase their outsourcing. China now accounts for 13 % of global exports and 18 % of global market capitalization, and is one of the world's two corporate giants in terms of economic supremacy. However, as a result of the China+1 strategy and the US-China trade dispute, China is gradually losing its global partners. According to a recent global survey, 20-30 % of industrial firms will leave China in the next few years. Around USD 4 trillion in manufacturing took place in China in 2020, and it is the world's largest exporter and the US is its top importer, posing a huge challenge for the World Trade Organization to regulate trade under its current rules and regulations. India as a destination for manufacturing would be more attractive due to this fact when compared to China in the long run.

Government incentives and Programs to support Electronics Industry by Select Countries

Across nations, there is a strong government push to broaden the operations and revenue from the electronics industry.

India: The government of India has been proactively building a base for electronics manufacturing in India and it has launched numerous incentive schemes, which have allowed manufacturing growth, reduced dependence on the imports, and promoted the exports. The GOI has launched numerous policies over the last few years to increase the innovation, protect the intellectual property, and develop the best-in-class electronics manufacturing set-up to build a favourable environment and invite the investment in the electronics hardware manufacturing. India's production of electronics has more than doubled in the past five years in between the time period 2015 to 2020 depending on such favourable incentive schemes. Some of the key schemes/ policies include: Product Linked Incentive (PLI) Scheme, Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS), Modified Electronics Manufacturing Clusters Scheme (EMC 2.0), Merchandise Exports from India Scheme (MEIS), Design Linked Incentive Scheme (DLI).

Chart 2.8: Key government incentives, policy / schemes and programs by select countries, Global, 2020

Key government incentives, policy / schemes and programs by select countries, Global, 2020	
India	PLI Scheme, SPECS, EMC 2.0, MEIS, DLI, Scheme for ATMP/ OSAT units
China	China Standards 2035;Made in China 2025
United States	National Defense Authorization Act of 2021 (NDAA)
Europe	Industry 4.0 Policies; Digital Single Market Strategy; Industrial Policy Strategy
Vietnam	National industrial Development policy through 2030
Thailand	Thailand 4.0 strategy
Indonesia	National Industrial Policy
Singapore	Electronics Industry Transformation Map (ITM)

China: The Chinese economy is locally driven and has grown rapidly in recent years as a result of rapid expansion of its consumer market, deep localization of supply chains, and a strong emphasis on local innovation. As a result, China's revelation to the rest of the world in terms of people, technology, and capital has decreased. As a result of COVID-19, a number of foreign government leaders have called for reshoring of supply chains. Hence, a number of initiatives and policies recently launched by the Chinese government highlight the importance of attracting international companies to conduct business and invest in the country. In April, 2020, the Ministry of Commerce issued the 'Circular on Further Expanding Reform & Opening up to Stabilize International Investment,' which includes 24 various steps to encourage foreign investment into China.

At the 2020 National People's Congress, the Chinese Communist Party announced that along with doubling down on its China Standards 2035 and Made in China 2025 initiatives, it is also going to spend roughly USD 1.4 trillion on the digital infrastructure public spending initiative. The new structure includes seven crucial areas: Industrial internet, 5G networks, inter-city transportation & railway system, Artificial Intelligence, data centres, ultra-high voltage power transmission, and new-energy vehicle charging station. Originally pushed as a way-out for China to attain the domain independence and speed up its industrial up gradation, the new infrastructure plan has transformed into a very long-term nationwide economic strategy.

United States of America: The United States Congress enacted the yearly policy law as part of the National Defence Authorization Act of 2021 (NDAA) in January 2021, and it has made a strategic move toward Onshore Electronics Manufacturing. The national defence bill encourages the establishment and expansion of cutting-edge foundries. The provisions authorise financial incentives for the construction or modernization of semiconductor fabrication, assembly, testing, advanced packaging, or advanced research and development facilities.

In addition to financial incentives, the NDAA authorises microelectronics-related R&D, the development of a "provably secure" microelectronics supply chain, the establishment of a National Semiconductor Research Technology Centre to assist in the transition of new technology into industrial facilities, and the formation of committees to develop strategies for increasing cutting-edge capacity. It also gives the go-ahead for quantum computing and artificial intelligence programs.

Europe: Industry 4.0 Policies in the European Union is a significant trend in the region, and the European Commission sees the introduction of Industry 4.0 as an opportunity to boost productivity and re-shore industrial operations. Recognizing the obstacles that the European Union has in fully leveraging Industry 4.0, the European Commission has advocated for bold industrial policy initiatives. The two most relevant policy strategies are the Digital Single Market Strategy for Europe (2015) and a renewed EU Industrial Policy Strategy (2017).

Vietnam: Vietnam's electronics industry is one of the fastest-growing and the most vital industries in Vietnam. Largely dominated by the multinational companies, electronics industry has considerably boosted country's trade volume and contributed to the Vietnam's GDP in the preceding decade. With evolving opportunities because of trade liberalization, labour quality enhancement, corporate tax discount and the government restructurings, Vietnam has become one of the most favourable alternatives for the foreign investors who are considering relocating their electronics industry investment in Asia Pacific.

Thailand: In the perspective of the 4th Industrial Revolution, the Royal Thai Administration has launched "Thailand 4.0" strategy in the year 2016, classifying the Electrical & Electronics industry as the strategic sector within its industrial advancement and human capital growth plans. This capacity growth plan is expected to boost the industry going ahead for Thailand.

Indonesia: The Indonesian government has selected electronics as one of the six manufacturing priorities with the Presidential Decree on the National Industrial Policy, which offers a road map of industrial development and long-standing development goals. It has set a long-term industrial development vision for Indonesia to be a strong industrialized nation by 2025. The Ministry of Industry has taken a two-pronged approach to set the Policy into effect. The first is a top-down strategy, with the central government planning

to establish 35 key industrial clusters, which will be followed by municipal and regional participation. The second is a bottom-up approach that involves identifying local industries that will become core competences in each region, followed by the establishment of province, regency, or municipal excellence industries.

Singapore: The country has a robust electronics industry that accounts for a quarter of the country's manufacturing GDP. With the Electronics Industry Transformation Map (ITM), the Singapore government has outlined plans to improve the electronics industry, with the goal of increasing the electronics sector to SGD 22.2 billion. The plan aims to transform the current installed base of companies through productivity, automation, and upgrading the manufacturing product mix.

Geopolitical situation and their positive impact on the Indian ESDM industry

US-China Trade War: Beginning in the early 2017, the Trump government began making threats of tariffs on the Chinese imports. In the month of March of 2018, the administration endorsed its first of three rounds of tariffs which ultimately covered a varied range of Chinese exports comprising many manufactured by the country's 4,500+ ESDM companies. The imports are transferred to other countries due to the trade war between these 2 major economies. Asian countries especially India, Vietnam and Indonesia, are likely to benefit more than the rest of the world due to lower wages and their geographical proximity to China.

Rising labour cost in China: The aspiration level of Chinese workers has increased and they are focusing on high-tech jobs, leaving gaps in the low end of manufacturing value chain. This has led to scarcity of the labour and a higher cost due to lack of availability of the manpower. The average cost of manufacturing labour per day is USD 6.2 in India and USD 28.2 in China, which make manufacturers to move out of China.

Threat on ESDM industry in China: Over the past few years, China has realized its stake of challenges, and what some individuals recognize as the potential threats to China's current position as the world's biggest ESDM host country. Trade tensions, allegations of currency manipulation, and a resurrection of economic patriotism in the US, UK and some other western nations have all formed a new level of emphasis and scrutiny on the China's ESDM business. On top of these challenging concerns, none of which have been fully resolved, the COVID-19 pandemic has caused major supply disruptions around the world. All of the above issues have been exacerbated by allegations and blame games, resulting in a perfect storm for China's ESDM industry. OEMs' need to diversify their supply chain to reduce risk has fuelled the expansion of the ESDM industry in countries like India, Vietnam and Mexico. Mobile phones from brands such as Apple, Xiaomi, Vivo, Oppo etc., which were earlier imported from China, are now manufactured in India. ESDM partners of these companies such as Foxconn, Wistron, Pegatron, etc. have all invested in manufacturing facilities in India which have given huge boost to the Indian ESDM industry.

COVID-19 driven disruption in supply chain: The COVID-19 pandemic has disrupted the manufacturing supply chain and curtailed the commodity demand. Although manufacturing of mobile phones is boosted through 'Make in India' initiative, India is heavily dependent on China for supply of raw materials, components and accessories. Such high dependency on imports with some critical components being produced in China is expected to have significant impact in the future if there is reoccurrence of any similar

outbreak. Hence, OEMs based out of India are planning to develop local supply chain in order to follow 'China + 1' strategy and become 'Atmanirbhar (Self Reliant)'.

Impact of Global chip shortage on ESDM industry: The global chip supply shortage has intensified in 2021 after the COVID-19 pandemic, as major companies across industries have failed to meet the rising demand for electronic goods and components. Supply chain disruption due to pandemic, rising demand for electronic products as more people work from home, and a lack of investment in chip production capacity have all contributed to the global chip shortage. As a result, the prices of household appliances and electronics have increased. The supply of finished electronic products and components necessary for local manufacturing has been delayed due to prolonged congestion at Chinese ports and a lack of containers. Analysts predict the chip shortage may not end until 2022, since supply delays caused by current COVID limitations are expected to last at least a year.

Global vendor diversification: Global ESDM players have presence in a number of countries and have a diverse range of products and services. Given the magnitude of manufacturing, global companies are expanding their product offerings across countries, through partnerships with multiple vendors rather than depending solely on a single vendor for electronic manufacturing services. As a result, there is tremendous potential for market expansion and the entry of new players into this industry.

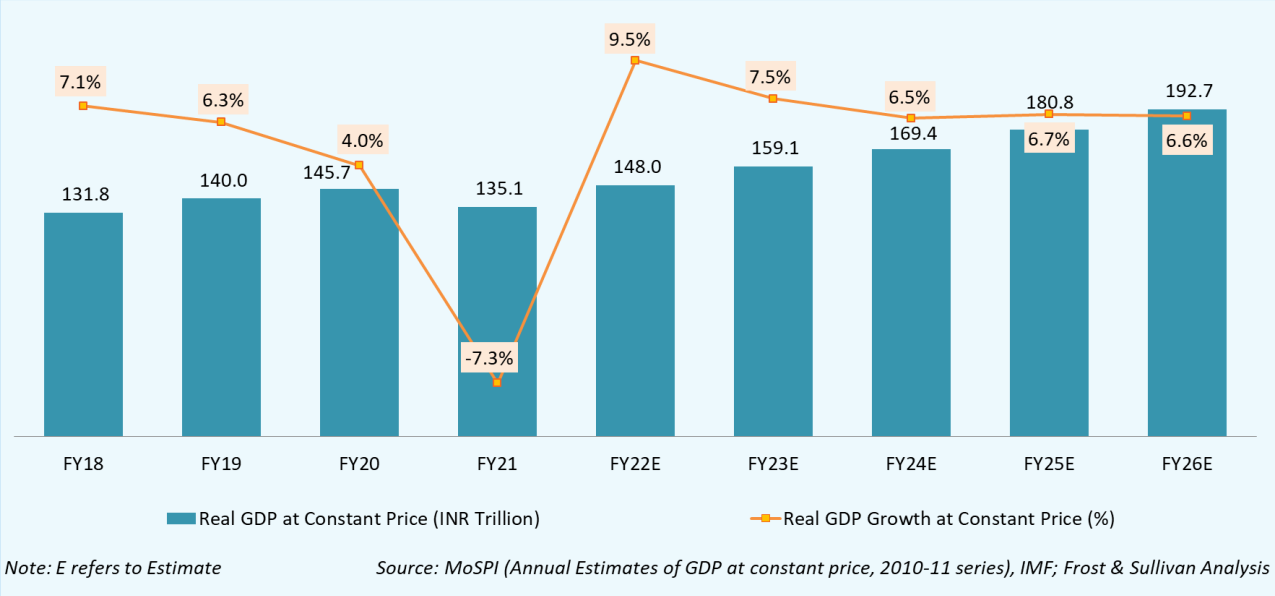
Manufacturers have an opportunity to diversify their production bases in order to tap into the domestic market, given the rising population. Furthermore, manufacturers would benefit from rising domestic demand for consumer electronics. Several large brands have announced capacity diversification in India with an aim to expand their manufacturing operations. This helps to upscale their benefits and also to help maintain a certain level of control over production quality.

CHAPTER 3 - OVERVIEW OF INDIAN ELECTRONICS INDUSTRY

India real GDP

Since 2010, India's GDP growth has swung back and forth between the trends that continued until 2020. Indian real GDP growth has steadily increased from 5.5% in FY13 to 8.3% in FY17. Growth was strong, and the fundamentals were stable. However, growth has been slowing since FY18, reaching a low of 4.0% in FY20. Eminent economists have cited demonetization and the implementation of the GST as the primary reasons for this moderation in growth.

Chart 3.1: Annual real GDP and real GDP growth (annual percentage change), value in INR trillion, growth in %, India, FY18-FY26E



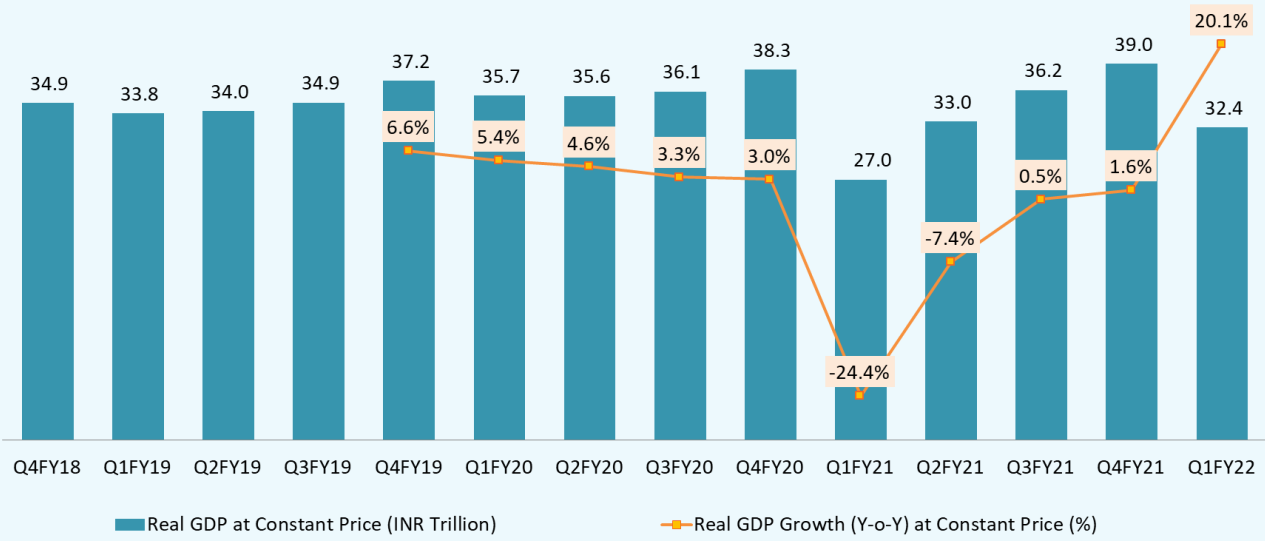
Note: E refers to Estimate

Source: MoSPI (Annual Estimates of GDP at constant price, 2010-11 series), IMF; Frost & Sullivan Analysis

As the government was implementing corrective measures, the economy was rattled by the COVID-19 pandemic at the start of FY21. During the first wave (March 2020 onwards), the Indian government was forced to impose a four-phase countrywide lockdown until May 2020 in order to prevent the virus from spreading. The economy has started to bounce back from Q3 FY21 on the back of huge pent-up demand and festive season. While industries such as travel & tourism, aviation, hospitality, construction were impacted heavily, some of the industries such as healthcare, pharmaceuticals, e-commerce, and electronics products experienced phenomenal growth during this period.

The outlook for FY22 is positive, with the Indian economy expected to grow by 9.5% this fiscal year. The government has implemented a slew of measures to get the economy back on track. Through various policy initiatives such as Atmanirbhar Bharat, PLI schemes, and so on, there is a strong emphasis on the growth of the domestic manufacturing sector. These initiatives will assist the economy in achieving medium-term stable growth of approximately 6.5%.

Chart 3.2: Quarterly real GDP and real GDP growth (quarterly percentage change), value in INR trillion, growth in %, India, Q4FY18-Q1FY22

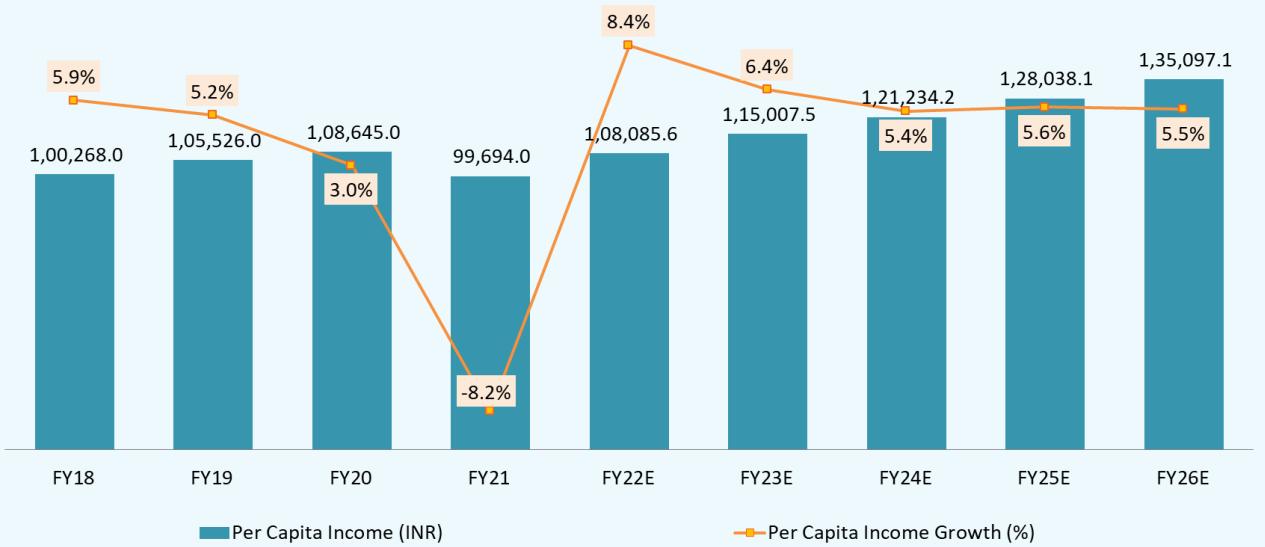


Source: MoSPI (Annual Estimates of GDP at constant price, 2011-12 series), IMF; Frost & Sullivan Analysis

Similar to FY21, FY22 also started on a sour note as the second wave of the pandemic swept across the country. However, the economy showed extreme resilience and recorded 20.1% growth in April – June quarter of this financial year. Outlook for FY22 is strong and the economy is expected to grow by 9.5% in this financial year.

Per capita income

Chart 3.3: Per capita income and growth (annual percentage change), value in INR, growth in %, India, FY18-FY26E



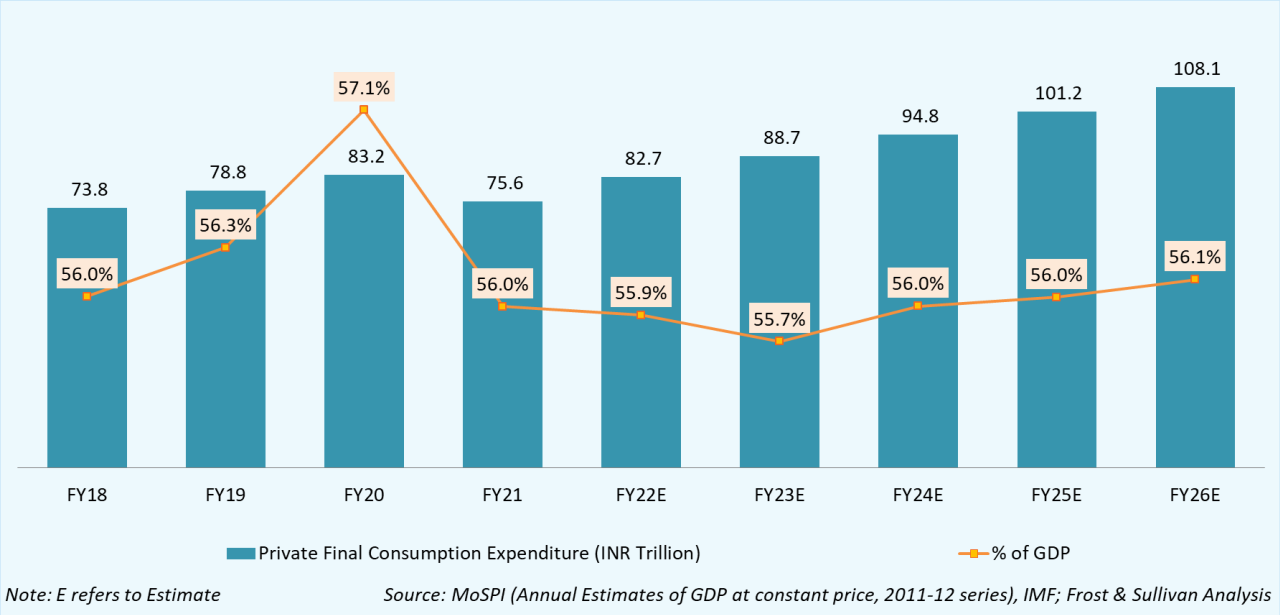
Note: E refers to Estimate

Source: MoSPI (Annual Estimates of GDP at constant price, 2011-12 series), IMF; Frost & Sullivan Analysis

The per capita income is a broad indicator of prosperity of an economy. India's per capita income, calculated in correlation to Real GDP, was INR 99,694 during FY21 compared to INR 108,645 in FY20, an approximate decline of 8.2%. As the economy is reviving, it is expected that the per capita income will increase by around 8.4% during FY22 to touch INR 108,085. Post that, the growth is likely to be stable at approximately 5.5% CAGR over the medium term.

Private Final Consumption Expenditure (PFCE)

Chart 3.4: Private Final Consumption Expenditure and contribution to Real GDP, Value in INR Trillion, % of GDP, India, FY18-FY26E



Note: E refers to Estimate *Source: MoSPI (Annual Estimates of GDP at constant price, 2011-12 series), IMF; Frost & Sullivan Analysis*

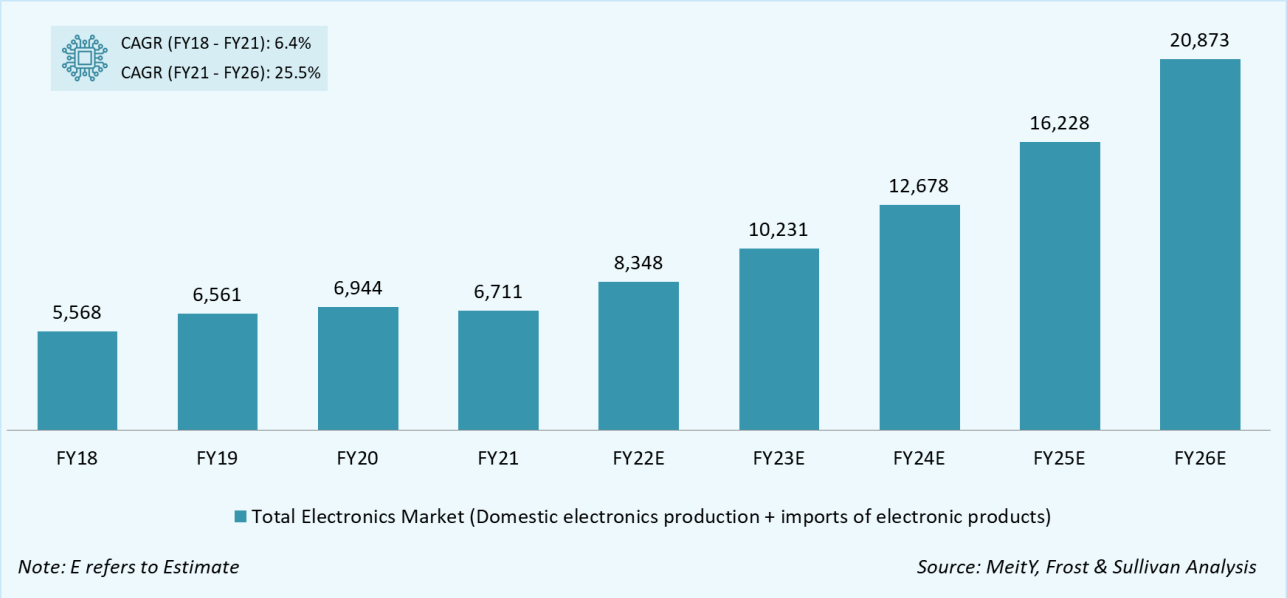
India's Private Final Consumption Expenditure (PFCE) has declined by 9.1% in FY21. Consumption expenditure growth has been slowing through the last decade. Due to COVID-19 pandemic, the FY21 PFCE was not only 9.1% lower than FY20; it was also 4.1% lower than FY19. This shrinking of consumption expenditure had a direct impact on the intermediate industries that feed India's consumption engine. As the threat and uncertainty around COVID-19 has significantly declined in the last few months, consumer confidence is coming back and PFCE is expected to catch-up with pre-COVID levels within this financial year. After that, the PFCE is expected to be stable at approximately 56% in the medium term. The PFCE is expected to grow at a CAGR of 7.4% from FY20 to FY26.

Indian Electronics market - historical trends and outlook

Electronics is one of the fastest growing industries in the country. The total electronics market (which includes domestic electronics production and imports of electronic finished goods) in India is valued at INR 6,711 billion (USD 91 billion) in FY21, which is expected to grow at a CAGR of 25.5% to reach INR 20,873 billion (USD 282 billion) in FY26. Domestic production accounts for approximately 74% of the total electronics market in FY21, valued at INR 4,975 billion (USD 67 billion), and is expected to grow to approximately 96% by FY26, valued at INR 20,133 billion (USD 272 billion), owing to various government initiatives and the development of India's electronic ecosystem. Also, the global landscape of electronic

design and manufacturing is changing significantly, and revised cost structures have shifted the attention of multinational companies to India. At present, the Indian government is attempting to enhance manufacturing capabilities across multiple electronics sectors and to establish the missing links in order to make the Indian electronics sector globally competitive. India is positioned as a destination for high-quality design work as well as a cost-competitive alternative. Many multinational corporations have established or expanded captive centres in India. Increasing penetration of consumer electronics in semi-urban and rural markets, a shift in lifestyle among the Gen Y population, and the adoption of smart devices are some of the key drivers that are assisting the rapid expansion of this industry.

Chart 3.5: Total Electronics market, value in INR billion, India, FY18-FY26E



Note: E refers to Estimate

Source: MeitY, Frost & Sullivan Analysis

Per capita electronics consumption in India

Globally, per capita electronic consumption is increasing. In comparison to the global average, India's per capita electronic consumption is currently low. The global per capita consumption of electronics is 4.7 times that of India. While the Indian government has taken many steps to improve the domestic electronics manufacturing industry in India, the country has also seen a 12.5% increase in electronics consumption between FY17 and FY20. The industry's long-term growth outlook is quite optimistic, owing to the fact that market penetration for many electronics items is still very low when compared to the global average.

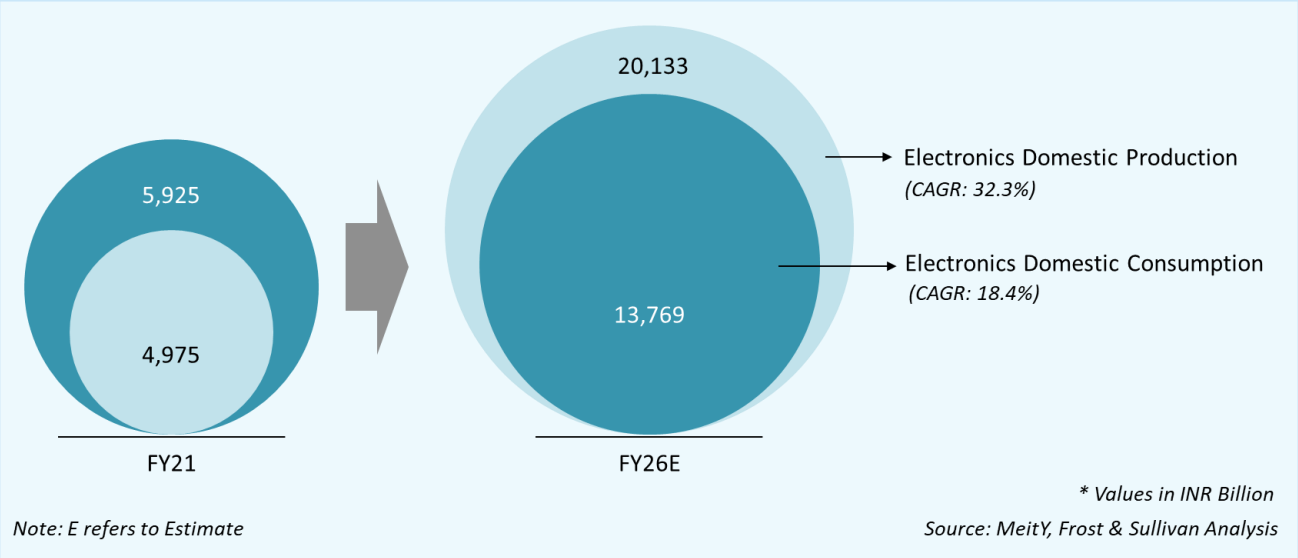
Apart from the economy's stable growth outlook, the Digital India initiative, rising disposable incomes (the proportion of middle- and high-income earners is expected to increase from 64% in FY21 to 85% in FY30), changing lifestyles, the emerging work-from-home culture, the expansion of organised retail into tier 2 and tier 3 cities, improved electricity and internet infrastructure, and improved logistics infrastructure will all provide additional impetus to the industry. With these strong underpinnings in place, numerous global electronics brands and their supply chain partners have invested in electronics manufacturing facilities in recent years, positioning India to become a significant electronics manufacturing hub in the coming years.

Analysis of domestic Electronics production vs. consumption

Electronics is one of the country's fastest growing sectors. At the moment, the Indian government is working to strengthen manufacturing capabilities across several electronics industries and to establish the missing links in order to make India's electronics sector globally competitive. India is positioned as a low-cost alternative as well as a source of high-quality design work. Many global firms have established or expanded captive operations in India.

The government's stated goal of improving manufacturing capability in India has been supported by the creation of a favourable environment. Whether it is the removal of customs duties on certain products, the removal of duties on components, or encouraging local component manufacturing, there has been significant movement to drive domestic manufacturing. The government has also taken several steps to improve the ease of doing business, which has resulted in increased manufacturing setups in the country by multiple foreign manufacturers. As electronics brands/OEMs continue to push for collaboration and partnership, this environment has certainly encouraged the ESDM market.

Chart 3.6: Overview of Electronics industry - domestic consumption vs. manufacturing, value in INR billion, India, FY21 and FY26E



In recent years, India's demand for electronic products has increased significantly, owing primarily to the country's progress in the ESDM sector. Some of the driving forces behind the development of India's electronics ecosystem are low manufacturing costs, a skilled workforce, and a large geographical area. India is now the world's second largest mobile phone manufacturer, and the Indian start-up ecosystem is still expanding, with the potential that Indian start-ups have demonstrated to be a massive opportunity for India.

A. Indian Electronics consumption

The Indian electronics consumption market is estimated to be INR 5,925 Billion (USD 80 Billion) in FY21, with a growth rate of 18.4% expected to reach INR 13,769 Billion (USD 186 Billion) by FY26. India has one of the largest consumer bases in the Asia-Pacific region, and its electronics industry is one of the fastest growing in the world.

- **Industrial -** The transition to smart manufacturing practises will result in intelligent machinery built on the foundation of electronic systems. The vast majority of electronics applications are concerned with the control and operation of heavy machinery. Energy meters/smart metres, machine tools (CNC), and industrial machineries are key products in this segment, accounting for a sizable market share. Furthermore, by adopting energy efficiency measures, India holds a potential to reduce about 550 MtCO2 by 2030. The proposed change to the Energy Conservation Act is expected to boost the adoption of clean technologies. The provisions would facilitate promotion of the green Hydrogen as an alternate to the existing fossil fuels used by the Industries. The increasing usage of automation and instrumentation systems is driven by the demand for process optimization, energy efficiency, M2M, asset management, machine and process safety.

- **Automotive:** Environmental sustainability and digitalization are at the forefront of the automotive industry's innovation and development. The global automotive industry is being transformed by four megatrends: connected, autonomous, shared, and electric (CASE). Electric vehicles are already a reality, and their growth and domination in the automotive mix will be considerable this decade. Customer demand for a digital in-vehicle experience, along with a growth in integrated linked services, will continue to transform the industry. This progression would be centred on digitalization, which would lead to increased use of electronics components in the automotive industry.

- **Railways and Metro -** The transportation sector, including railways, requires zero defect electronic assemblies due to their high level of reliability. ESDM companies in the railway industry have demonstrated their ability to design and produce control systems and electronics, particularly for railways and rolling stock. ESDM companies contribute to the development of innovative, safe, dependable, and simple-to-install solutions and equipment for the Railways market. ESDM companies contribute to the increased efficiency of railway equipment and provide support across the traction chain's full life cycle, particularly in the areas of service, maintenance, upgrades, and retrofit project works.

- **Medical/ Healthcare** - The Indian medical electronics market is undergoing rapid transformation as a result of the emergence of advanced technologies, evolving clinical and administrative needs, and the implementation of new policies and regulations, all of which are compelling industry participants to innovate in order to maintain their competitive edge. The Indian medical device sector has grown tremendously in recent years. India has developed into a key centre for high-end diagnostic services as a result of massive capital expenditure, therefore serving to a large population. The Indian government's PLI programme for medical devices intends to stimulate

investment and production in order to create enterprises capable of expanding and scaling through the use of cutting-edge technologies and so penetrating global value chains.

- **IT (including IoT and related products)** - Availability of broadband in remote areas of the country is a key demand driver for entry level notebooks and desktops. Due to the pandemic, the work-from-home lifestyle for office workers and online education for school children have created a lot of opportunities for the IT hardware market in India. Short- to medium-term development will be fuelled by the government of India's plans such as Digital India and greater internet penetration. Emerging technologies, for example, IoT, AI, and the introduction of robotics and analytics in the industrial and strategic electronics segment, have all led towards the overall development of numerous electronic products, which has given a lift to local demand. Utilization of IoT/sensors, 5G, artificial intelligence, and machine learning are providing stimulus for the creation of advanced multi-utility electronic products. Increased Cloud Storage of data will expand server requirement exponentially going forward.

- **Aerospace & Defence** - India is the world's seventh largest aerospace and defence market. India wants to decrease its reliance on imports while simultaneously modernising its aerospace and defence capital equipment base. The indigenous manufacturing base, which was previously centred on Defence Public Sector Undertakings and Ordnance Factories, is only now expanding, with private sector companies concentrating on establishing significantly sized and capable facilities. As the Aerospace & Defence business advances, the critical influence is on platform capabilities, a large percentage of which comes from electronics. Thus, electronics is a critical component of the Indian Aerospace & Defence industrial strategy that must be addressed. In FY 2020, the Indian government spent an approximate of INR 1.3 trillion on the space sector. There was a continuous rise in the amount of money allocated to the space sector. The Indian Space Research Organisation (ISRO) is turning into a facilitator as it looks for the private sector to play a major role in space technology in the second space age. In spite the COVID-19 cash crunch, the Budget 2021-22 did not deprioritise the space sector with a 3.48% increase in the expenditure allocation. There are many companies exporting as well and now Indian manufacturing companies in this area, with certifications such as NADCAP, can access US and other foreign markets.

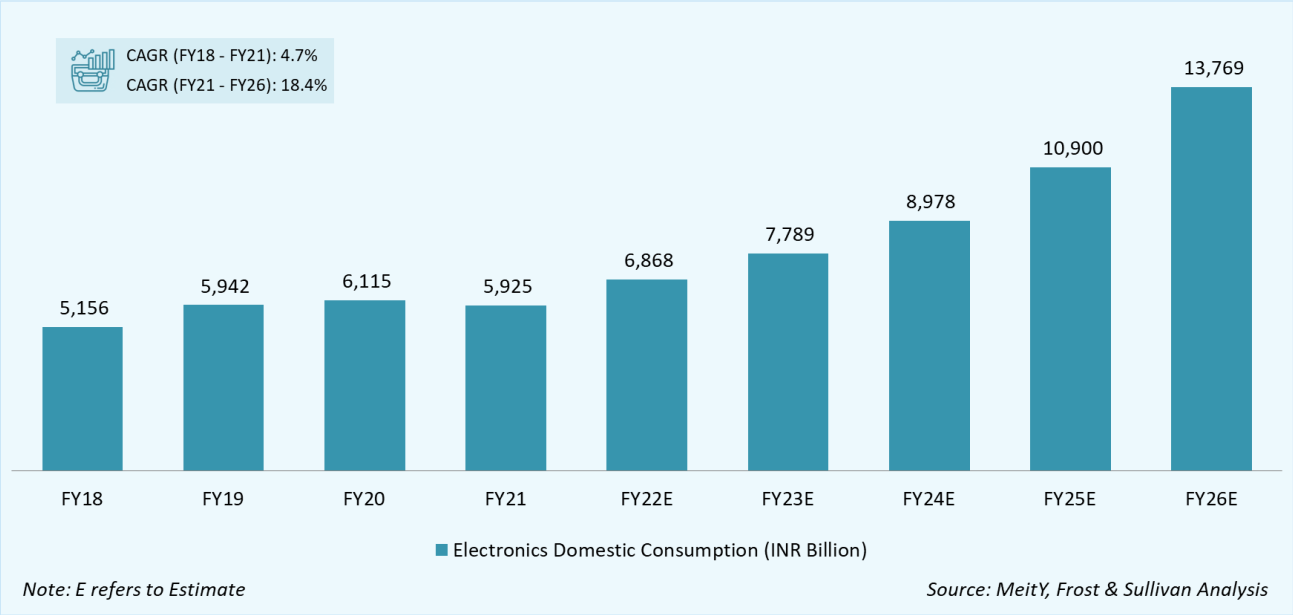
- **Consumer electronics & appliances -** is one of the largest segments, with a diverse range of electronic products such as televisions, cameras, audio players, and a variety of other household items. The key drivers are increased awareness, increased access, changing lifestyles, higher discretionary incomes, and lower per unit prices.

- **Telecom -** To propel the Telecom and Networking Products sector, there is a need for deep penetration of broadband networks as well as the availability of mobile telephony. The government's push for broadband availability in rural areas of the country is a key demand driver for the telecom segment. This segment is also being driven by the increased focus on the 5G sector. 3G/4G will remain strong in the coming years, and 5G will make an impact relatively soon.

- **Mobile phones**: With the introduction of new smartphone models, better availability, declining prices, and increased customer spending across Tier1/2/3 cities, India's mobile phone penetration is

increasing. As a result of the proliferation of mobile data networks, a widespread distribution network, and support from e-commerce websites, mobile phone penetration in India has increased even further.

Chart 3.7: Electronics domestic consumption market, value in INR billion, India, FY18-FY26E

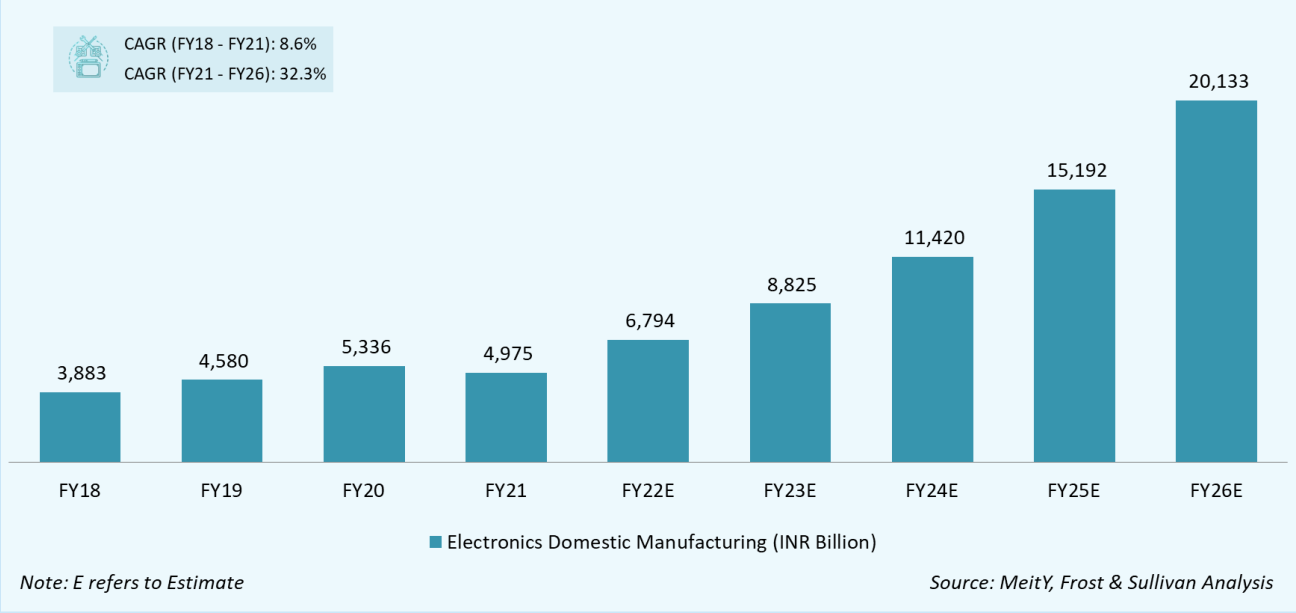


Note: E refers to Estimate

Source: MeitY, Frost & Sullivan Analysis

B. Indian Electronics production

Chart 3.8: Electronics domestic production (including components), value in INR billion, India, FY18-FY26E

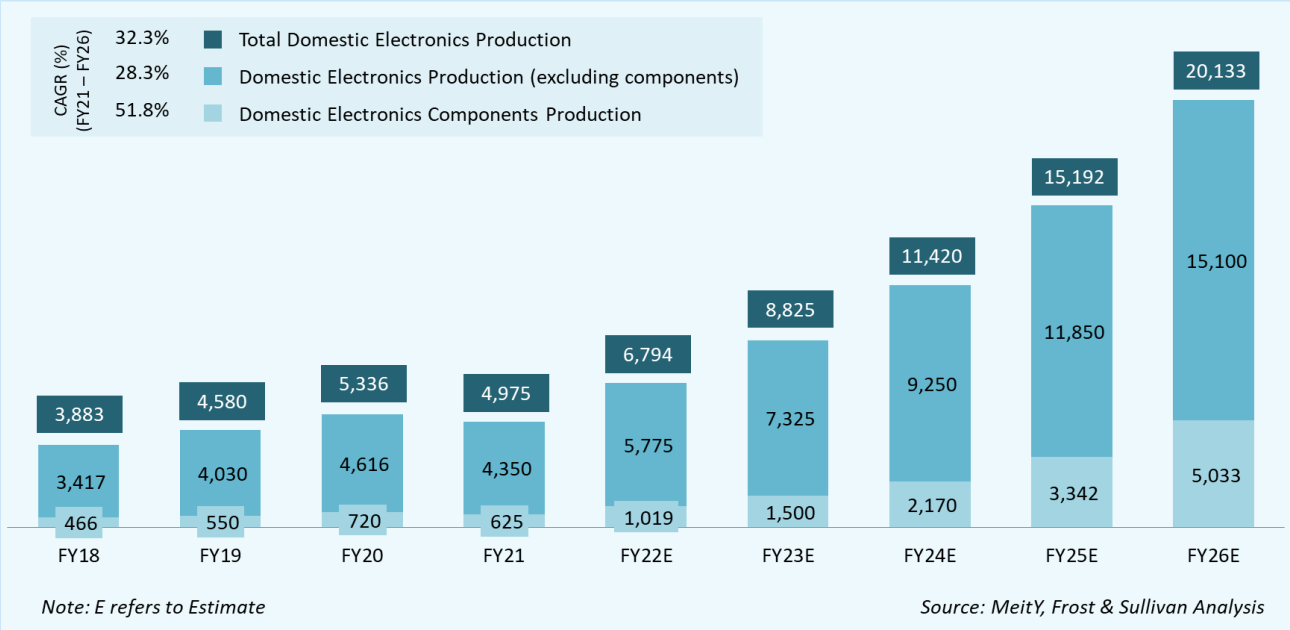


Note: E refers to Estimate

Source: MeitY, Frost & Sullivan Analysis

Electronics production in India is estimated at INR 4,975 Billion (USD 67 Billion) in FY21, and is expected to grow at a CAGR of 32.3% to reach INR 20,133 Billion (USD 272 Billion) by FY26. India has the potential to be one of the most attractive manufacturing destinations and support the objective of 'Make in India for the World'. Government and Industry needs to collaborate and drive initiatives to help India move among top 5 countries in electronics production and among top 3 in electronics consumption. To improve the manufacturing capability in the electronics industry, the Government of India has taken several initiatives and developed a series of policies that would be implemented in the short to medium term. The policies must be reviewed at regular intervals in order to determine their efficacy in achieving the intended objective of increasing the manufacturing capability.

Chart 3.9: Total domestic Electronics production market split by finished goods vs. components manufacturing, value in INR billion, India, FY18-FY26E



Note: E refers to Estimate

Source: MeitY, Frost & Sullivan Analysis

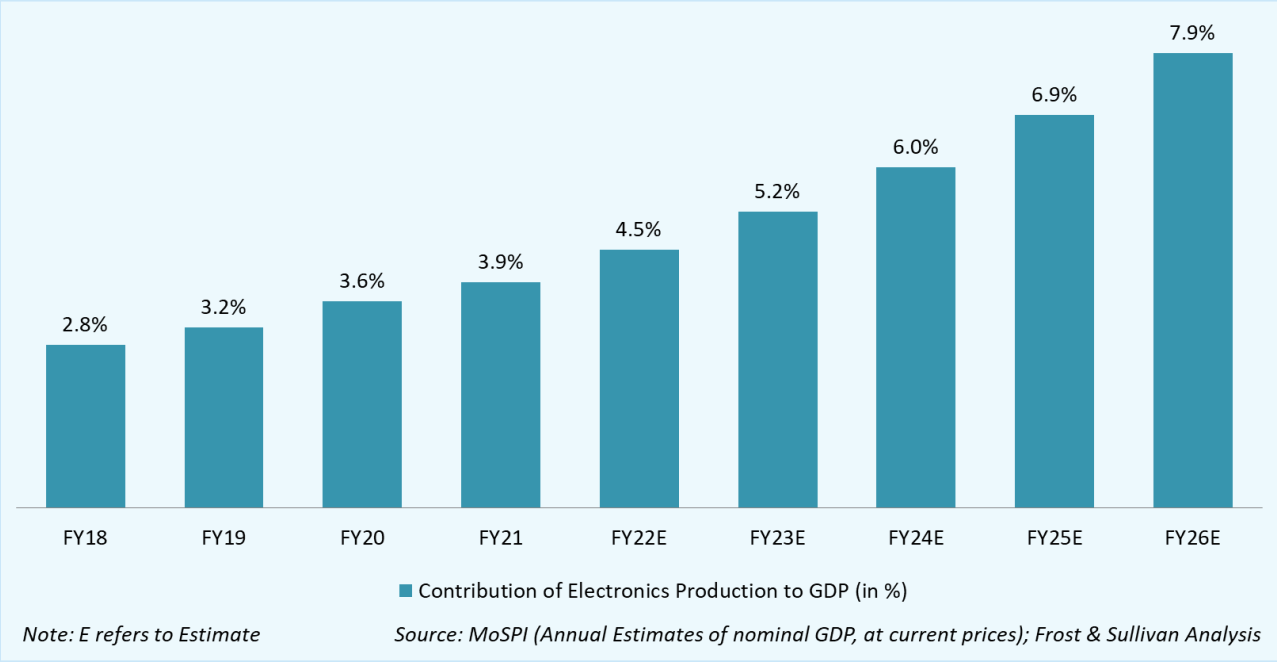
The success of the PLI scheme for the electronics segment in large-scale manufacturing of electronic products is being viewed with great confidence. Similarly, the National Policy on Electronics (NPE) aims to make India a global hub for electronic system design and manufacturing and has fixed some aspirational targets. Excellent opportunities for increasing electronics manufacturing are estimated to come from consumer electronics and appliances, the automotive sector, lighting, electronic components, and the medical electronics sector. India is finding its way to be a part of the global value chain to increase production and exports.

The biggest challenge before India is to make a fast transition to the manufacturing of high-technology electronics. Electronic products do need continuous design modifications, as end-users expect creativity and continuous innovation. Consequently, the design and development of electronics products is often undertaken by ODMs. The earlier a brand engages an ODM for product design and development services, the sooner the product enters high-volume production.

C. Indian Electronics production as a % of GDP

In FY21, the electronics production in India contributed to 2.5% of the nominal GDP (at current prices), which is expected to increase to around 6.8% by FY26. The Government's objective is to provide domestic manufacturers with a better facility to make them competitive with imports into the industry by simplifying the tariff system, simplifying the procedures, giving incentives and improving the infrastructure. Considerable high value added manufacturing takes place in the consumer electronics and appliances segment and most products command high brand equity globally, offering an excellent opportunity for ESDM companies to export.

Chart 3.10: Contribution of Electronics domestic production (incuding components) to Indian GDP, in %, India, FY18-FY26E



Note: E refers to Estimate

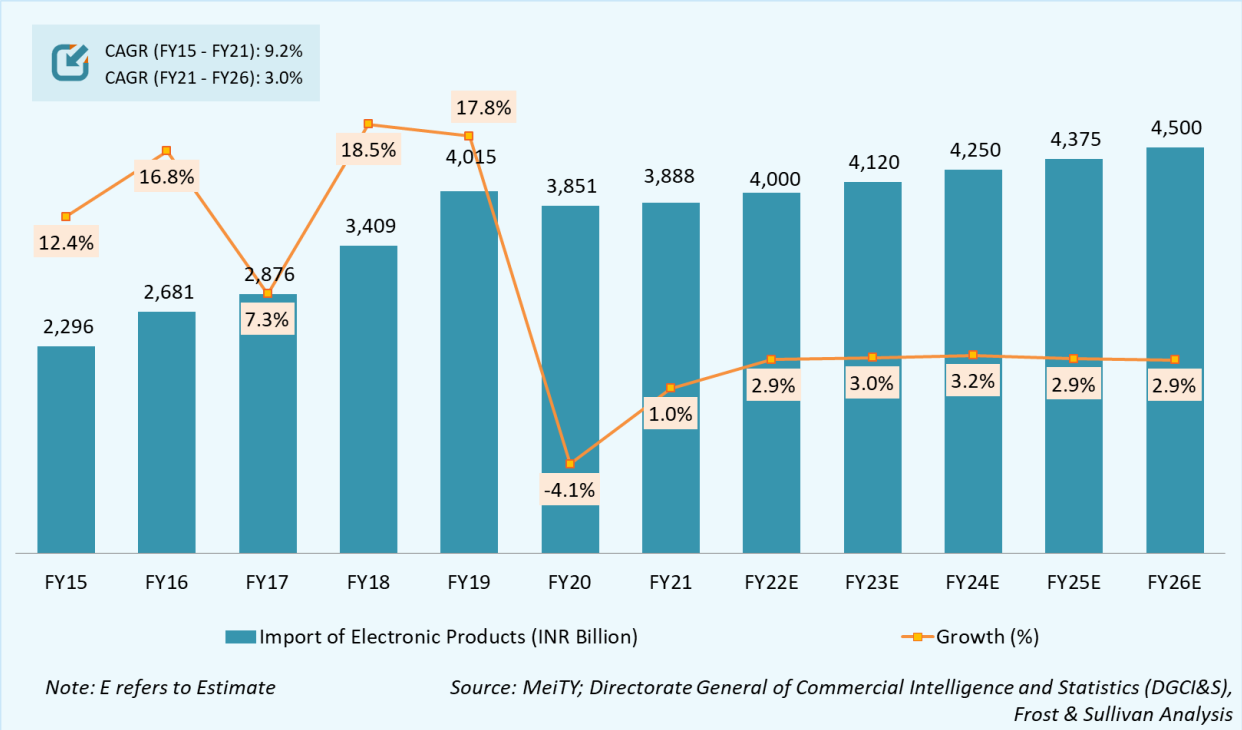
Source: MoSPI (Annual Estimates of nominal GDP, at current prices); Frost & Sullivan Analysis

D. Import of Electronic products in India

The total import value of electronics products was INR 2,296 billion (USD 38 billion) in FY15 and INR 3,851 billion (USD 54 billion) in FY20.The import value decreased by 4.1 percent in FY20 compared to FY19, when it was valued at INR 3,888 billion. In FY20, China and Hong Kong accounted for ~ 70 percent of India's total electronic imports. The majority of semiconductor demand is now fulfilled by imports from the United States, Japan, and Taiwan. The government is developing electronics manufacturing clusters (EMCs) around the country to provide world-class infrastructure and facilities in order to minimise reliance on imports.

The electronics industry relies extensively on Chinese suppliers, especially consumer electronics, industrial electronics, computer and IT hardware, strategic electronics, light-emitting diodes, etc. The top 3 leading products in the import category are laptops & desktops, FPD (Flat Panel Display) televisions, and storage devices. In the laptops and notebooks segment, almost all the components used in building notebooks are completely imported or as semi-knocked down units from China and Thailand.

Chart 3.11: Import of Electronic products, INR billion, USD billion, India, FY15-FY26E



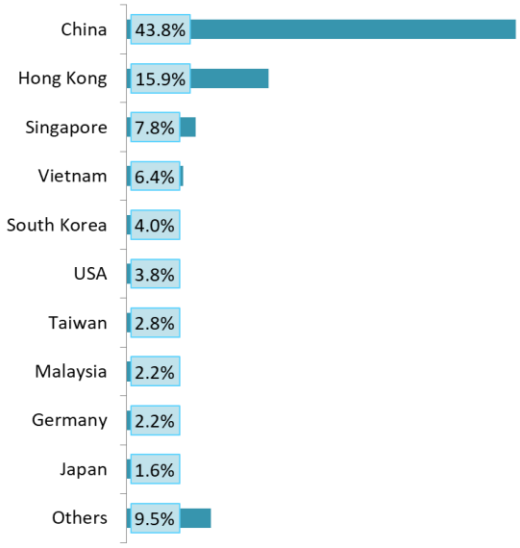
Note: E refers to Estimate

Source: MeiTY; Directorate General of Commercial Intelligence and Statistics (DGCI&S), Frost & Sullivan Analysis

Chart 3.12: List of top 10 imported Electronic products by value, India, FY20

Source: Export-Import Data Bank, Frost & Sullivan Analysis

Chart 3.13: Import of Electronic products by key countries, value in %, FY20



Source: Ministry of Commerce & Industry, Govt. of India

Mobile phones contribute to around 2.5% of the total import value. In GPON (Telecom and Networking Products) and CCTV segments, the components are still imported from China and Taiwan. Despite the government's efforts to build India's electronics ecosystem, domestic manufacturers' reliance on China for

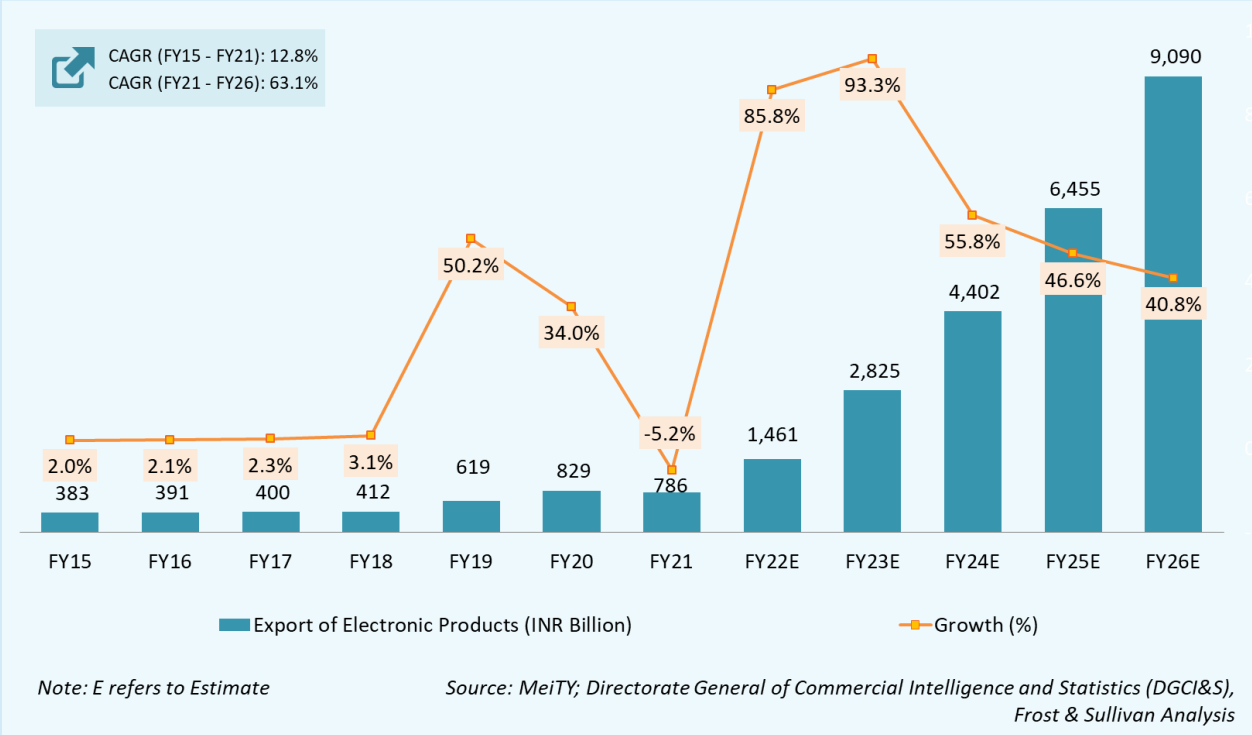
components persists, which is expected to improve slowly as the localization of production for these products is increased with the opening of new manufacturing facilities.

The CAGR of import in between FY21-FY26 is expected to remain 3% while the Indian electronics consumption CAGR is expected to remain 14% during that same time period. This shows less reliability on import and increasing dependability on domestic production and electronics manufacturing.

E. Export of Electronic products in India

The total export value of electronic products in FY15 was INR 383 billion (USD 6 billion) and in FY20 it was INR 829 billion (USD 12 billion). The value of exports increased by 34% percent in FY20 compared to FY19, which was worth INR 619 billion (USD 9 billion). The export market is expected to grow substantially in next five years at a CAGR of 63%, owing to various government initiatives such as PLI scheme, Atmanirbhar Bharat which facilitates the domestic manufacturing.

Chart 3.14: Export of Electronic products, INR billion, USD billion, India, FY15-FY26E



Note: E refers to Estimate

Source: MeiTY; Directorate General of Commercial Intelligence and Statistics (DGCI&S), Frost & Sullivan Analysis

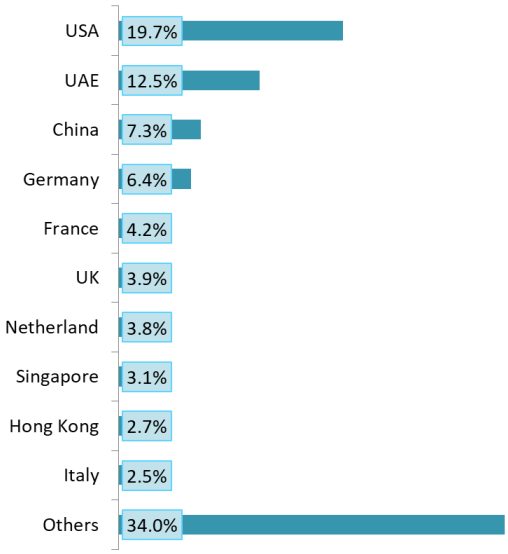
The top 3 leading products in the export category are mobile phones, engine control units, and industrial machinery. India holds superior design competence and the availability of a talented workforce at lower wages compared to China, which fortifies its position as the futuristic, domestic-cum-export-oriented manufacturing destination for the globe. Cost-effectiveness, a talented and affordable workforce, a burgeoning domestic electronics market, and export opportunities will drive the market for EMS/ODM in India. Globally, India ranks second in mobile phone manufacturing, which involves design of the handset, assembly of components, and manufacturing of the device. India has a strong base with the automotive industry, including component suppliers, in the engine control unit. India has emerged as the global hub for

auto component sourcing. As more players are setting up bases in India, auto component manufacturers need to up-skill their technology know-how to remain in the lead.

Chart 3.15: List of top 10 exported Electronic products by value, India, FY20

Source: Export-Import Data Bank, Frost & Sullivan Analysis

Chart 3.16: Export of Electronic products by key countries, value in %, FY20



Source: Ministry of Commerce & Industry, Govt. of India

Increase in design and manufacturing capabilities have led to export opportunities for some products and is a key driver for other segments as well. Global players use local companies for contact manufacturing as local companies have their in-house plants, R&D and testing facilities. In Energy Meters/ Smart Meters segment, India has a strong base of manufacturing/ assembly; however many components like LCD, Relay, Communication Module, PCB, Passive Components and Microcontrollers are imported. Components like Mechanical Components, Terminals, Brass Terminals and Screws are locally sourced. With a strong foothold in the electronics sector, Kaynes is one of the key players in the market, with a significant growth potential in the global market.

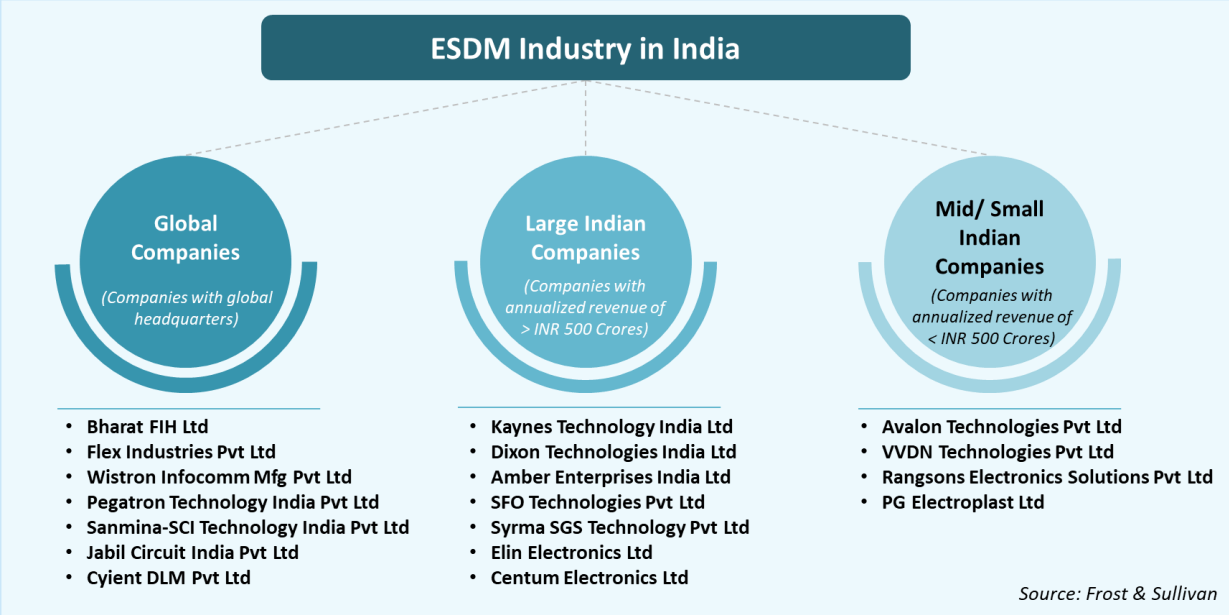
CHAPTER 4 - OVERVIEW OF INDIAN ESDM INDUSTRY

Overview of ESDM industry in India

The Indian ESDM industry is relatively young, with nearly three decades of experience. The ESDM industry has grown in prominence over the last decade, particularly in the last five years. Indian ESDM industry, which was traditionally a domain of the PSU's, saw participation of few MNCs and many private sector Indian companies post liberalization of Indian economy. These companies were addressing requirement of Consumer Electronics OEMs and some of them were manufacturing for their global requirement.

The period of 2005-07 saw the first big ticket investment in ESDM operations in India with entry of Jabil Circuits and Nokia. This triggered a series of large / medium scale investments in Indian ESDM sector. Period of 2013-14 was a dampener as Nokia wound up its India operation however, this was short-lived. By 2015, global ESDM giants have started showing interest in India. Indian ESDM industry has since then embarked on an upward journey. Now with most of the global Mobile Phone manufacturers and their supply chain partners are investing in manufacturing, Indian ESDM industry is well poised to unlock its true potential in the coming years.

Chart 4.1: Industry structure of ESDM market in India



As per ELCINA, there are nearly 700 companies offering services related to design and manufacturing of electronics products. While most of the companies offer pure play manufacturing / assembly services (also known as EMS companies), there are specialized companies such as Kaynes which offer services across the value chain including conceptual product design, components, products and solutions (also known as ESDM companies). EMS companies offer 'Build to Print' of either PCBA only or complete Product, whereas ESDM companies leverage their conceptual 'Embedded Design' capabilities to add value in electronics manufacturing such as Kaynes.

Market participants have been categorized under three categories namely, Global Companies, Large Indian Companies and Mid/Small Indian Companies. Major global companies present in the Indian market are Bharat FIH, Flex, Wistron, Pegatron, Jabil etc. Large Indian companies include Kaynes, Dixon, Amber, SFO, Syrma, Elin, and Centum among others and mid-size Indian companies include companies such as Avalon, VVDN, Rangsons and others. Mobile Phones, Consumer Electronics and Industrial Electronics contribute to more than 75% of the total ESDM market in India. Few EMS providers are slowly evolving to offer complete design services apart from contract manufacturing. This acts as a win-win situation for both ESDM players as well as OEMs; ESDM players obtain higher margins through this model, and OEMs benefit by outsourcing manufacturing and design activities, enabling them to focus on other expansion activities. Embracing the ODM model of partnership coupled with venturing into new product segments is propelling OEMs to pursue this engagement. High volumes will influence ESDM companies to bring in the component ecosystem locally and enhance domestic capabilities for component sourcing, making the electronics ecosystem stronger.

Ambitious expansion plans and capacity augmentation of indigenous players to capitalise on favourable policy initiatives ensure that the ESDM sector in India will witness heightened growth in coming days. Also, India has done well in electronic design and has established itself as the design hub of the world. The next phase of growth in the design sector will be characterised by the growth of indigenous design companies creating their own IPs as against the erstwhile growth of outsourced captive design services companies. This, together with impressive expected growth in the ESDM market, presents an opportunity for design-led manufacturing.

Kaynes was one of the first companies to offer design led electronics manufacturing to the OEMs using its mature embedded design capabilities. It has now evolved into an ODM player in the fields of Smart Devices, IoT Solutions, Brushless Drive Technology, and Gallium Nitride (“GaN”) Technology. Kaynes is among the leading companies in the ESDM space to offer optimised product realization solutions to customers in flexible volumes and higher complexity products across industry verticals. Kaynes caters to more industry verticals than any of its peers.

Development of ESDM industry in India

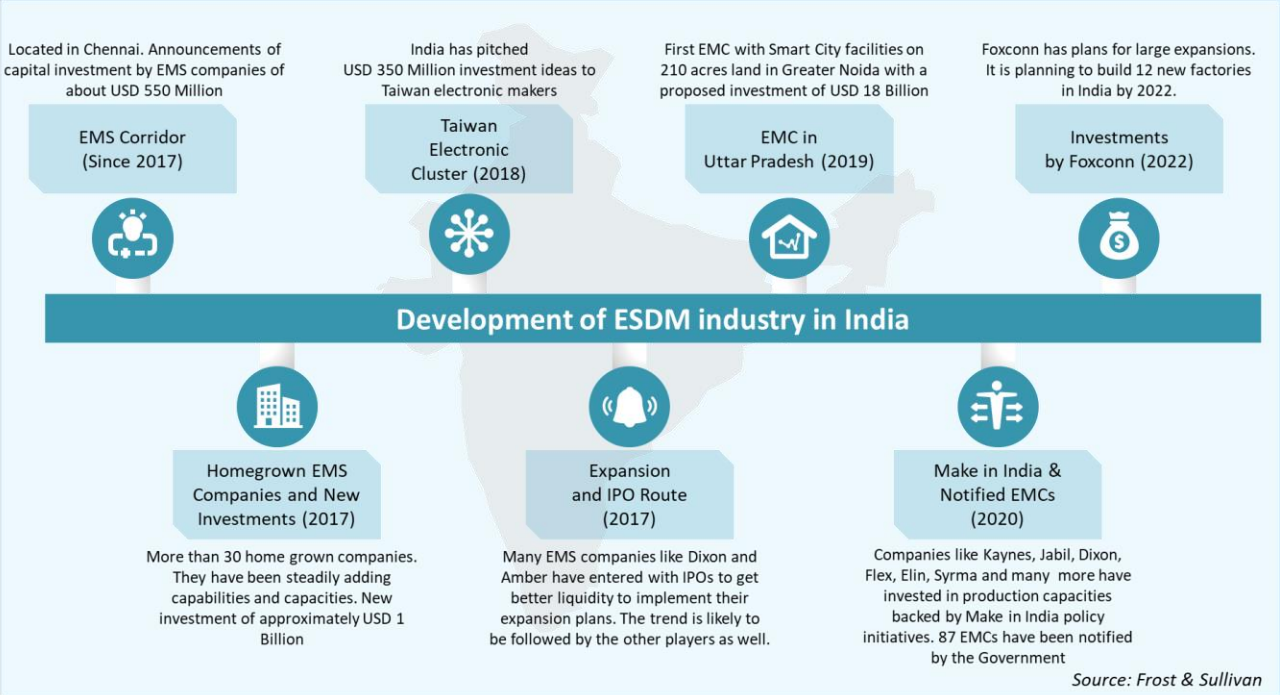
The Indian electronic market, which is large, complex and highly competitive, requires OEMs to focus on marketing and after-marketing services, thus leaving manufacturing to electronic manufacturing service providers. The extensive financial costs involved in setting-up manufacturing, capacity additions/expansions, R&D, manpower, etc. influence OEMs to leverage on ESDM services. An ESDM player with economies of scale is better positioned to accommodate frequent technology changes as it allows for better price negotiations with raw material suppliers. Post warranty servicing support provided by ESDM companies also give OEMs a viable component in deepening their presence.

In highly commoditized markets such as Semi-Automatic Washing Machines, Direct Cool Refrigerator, Window Air Conditioners, CFLs, UPS and Energy meters, where the scope for design is not high, OEMs prefer to engage in ODM partnership with their ESDM partners. Embracing ODM model of partnership with ESDM partners coupled with venturing into new product segments is propelling OEMs to pursue ESDM engagement.

Ambitious expansion plans and capacity augmentation of indigenous ESDM players to capitalize favourable policy initiatives will ensure that the Indian ESDM sector realizes heightened growth in coming days. Also,

India has done well in Electronics design and has established itself as design hub of the world. The next phase of growth in the design sector will be characterised by growth of indigenous design companies creating their own IPs as against the erstwhile growth of outsourced captive design services companies. Also getting into designing of Integrated Circuits (ICs), Chip Sets and others, will ensure shifting of core designing capabilities. This, together with impressive growth expected in the ESDM market, presents an opportunity for Design-led manufacturing for Kaynes.

Chart 4.2: Development of ESDM industry in India



Indian ESDM industry value chain analysis

Business models of Indian ESDM companies can broadly be classified under four categories[1].

1. ODM model
2. EMS model
3. Job work
4. After-sales service

ODM (Original Design Manufacturers) model

Under this, ESDM companies design products as per the specifications provided by the OEMs. ESDM companies then source components, carry out fabrication and assembly, test the final product, and also undertake logistics and after sales services related activities. ODM model helps the ESDM companies to have deeper and long term business relations with the OEMs. Although, the ODM model of business

[1] *Source: ELCINA EMS Task Force report, Frost & Sullivan analysis*

requires additional investment in research and development as well as working capital, it results in higher margins, recurring business with high customer retention, as compared to the OEM model.

EMS (Electronic Manufacturing Services) model

At present, this model is widely followed in India. Under this, OEM provides designs and specifications to the ESDM companies. ESDM companies source components manufacture / assemble components and supply the finished product back to OEMs.

ESDM companies are gradually adding capabilities to offer ODM or JDM (Joint Design Manufacturers) services. Increasingly, OEMs are preferring engagement on ODM / JDM basis. This is win-win situation as EMS companies can earn higher margins while OEMs can focus on expansion activities.

Job Work

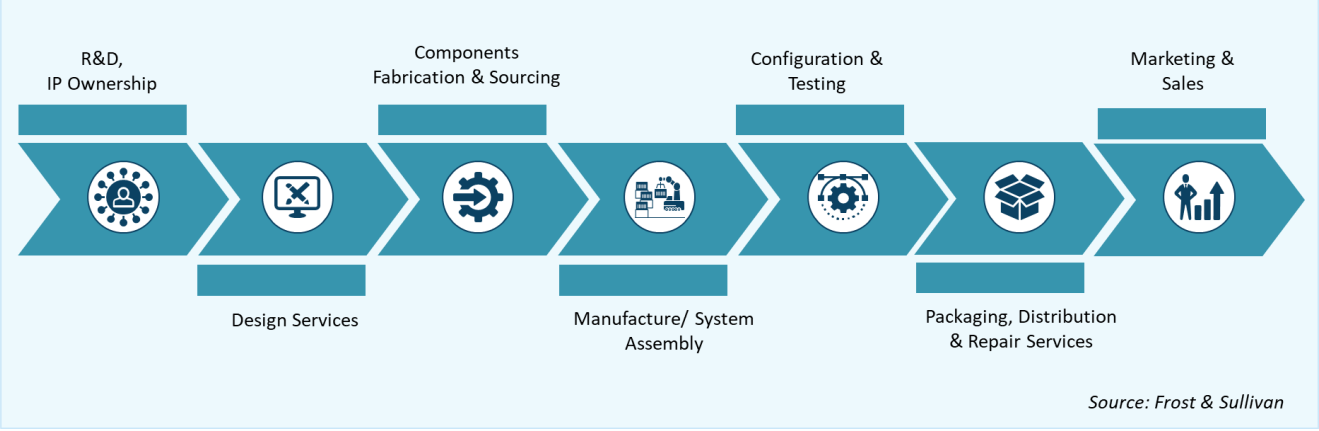
Job Work is the start of any long term engagement. Qualification process can take the Job Work route. Even, new product design may be done thru Job Work. In such a scenario, Job Work yields good margin but is for a limited period till Turnkey manufacturing commences.

Smaller EMS companies, who do not have any engineering or sourcing capabilities, undertake this business with OEMs in a fragmented or Price sensitive market. Large OEMs and Overseas companies generally like to have one point solution with their EMS / ESDM provider.

After-sales service

After-sales service is an important activity which helps the companies to build long-term brand image and brand loyalty. Globally, ESDM companies are offering end-to-end services including after-sales service. This is a nascent business for Indian ESDM companies, however gaining traction in the recent times.

Chart 4.3: Value Chain of ESDM Industry in India, FY21



Source: Frost & Sullivan

ESDM market Break-up by ODM vs. EMS model

In the total ESDM market, EMS model accounts for approximately 80%, while ODM model accounts for the remaining 20%. Most of the electronics manufacturers in India lack mature R&D set-ups due to large capex investments and long gestation periods. Europe and the US continue to dominate R&D and IP ownership of

related work. This has also been a factor that has restrained OEMs and EMS providers from investing. Most MNCs hold their IP in the headquarter location (mostly located in the USA and Europe) and do not prefer to invest in local R&D. However, India has a competitive edge in design services, since most such work is outsourced to cost-effective destinations. In terms of manufacture/ system assembly, India has an established set-up. Many EMS providers are slowly evolving to offer complete design services apart from pure play manufacturing (ODM model). This acts as a win-win situation for both ODM players as well as OEMs; ODM players obtain higher margins through this model and OEMs benefit by outsourcing manufacturing and design activities enabling them to focus on other expansion activities.

The country also has high maturity levels in packaging, distribution, repair, sales and marketing functions to meet geographical standards and cater to local requirements. After-sales services which include repair and maintenance are fairly important for the Indian buyer as the use-and-throw perception is still not acceptable in the Indian electronics ecosystem. EMS/ODM companies having an extra ability to provide the reverse logistics will get additional business from the OEMs at the same time they would also be playing a very significant role in the e-waste management which is a huge concern globally. Many players like Bharat FIH, Dixon, Flextronics, Kaynes, etc. are offering after-market services like repair, refurbishment, vendor management etc.

Benefits of ODM model over EMS model

Of late, the increase in demand for electronic products has not been met by a corresponding increase in investment by OEMs in their production facilities. This is due to the fact that they have the choice of outsourcing to ESDM companies and focus on their core activities. The ODM companies, with their versatile capabilities in system designs, plastic moulding, PCBA, software engineering, and more importantly, manufacturing, encourage OEMs to increase the width of their partnership. Instead of investing in R&D, Tier-II players collaborate with ODMs to select and develop specific models based on existing models. The secondary benefit for ODMs from such collaborations is the improvement of capabilities to handle fresh clients. This has created additional business opportunities for the ODM players such as Kaynes who has the capability to offer services across the ESDM value chain.

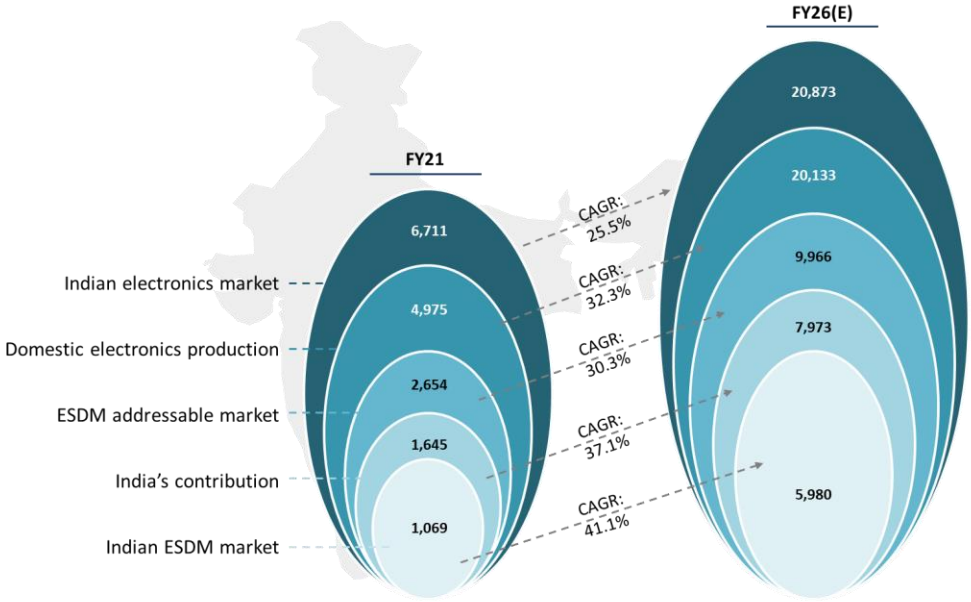
Kaynes is a leading end-to-end and IoT solutions enabled integrated electronics manufacturing player, having capabilities across the entire spectrum of ESDM services with strong credentials in concept co-creation followed by product realization and lifecycle support. Kaynes has the capabilities to conceptually design simple to complex electronic devices and IoT enabled solutions across industry verticals. It operates a de-risked business model with a wide ranging ESDM portfolio having applications across industry verticals that range from mission critical verticals to industrial and include verticals such as railways, aerospace and defence, outer-space and nuclear, industrial, medical, automotive, IoT and IT.

Kaynes is present in the entire spectrum of ESDM services which includes design services (product development, rapid prototyping, etc.), industrialisation services (supply chain design, value stream mapping, etc.), manufacturing services (prototype manufacturing, OEM manufacturing, turnkey electronic manufacturing, etc.), product maintenance services (repair and refurbish, face lifts, etc.) and end-of-life services (spare part handling, product maintenance, etc.). Kaynes has nearly 3 decades of expertise and experience in ESDM, with 350+ man years of management experience, 210,000 square feet of infrastructure across 7 cities in India and 250+ customers spread across 19 countries. The company has best in class tech

infrastructure with 7 SMT lines, 57 THD lines, 11 cable harness lines and an annual capacity for 3 billion components, along with well establish testing facilities. Also, Kaynes is one of the few players with multiple certifications, and industry specific clearances and approvals creating a significant moat in a highly quality sensitive industry.

Indian ESDM industry size and growth forecast

Chart 4.4: Indian ESDM addressable market vs. Contribution of ESDM companies for goods made in India, Value in INR Billion, FY21 and FY26E



Source: MeitY, ELCINA, Frost & Sullivan Estimates

The total addressable ESDM market in India was valued at INR 2,654 billion (USD 36 Billion) in FY21, and is expected to grow to INR 9,963 Billion (USD 135 Billion) in FY26 with a CAGR of 30.3%. However, the contribution of Indian ESDM companies is around 40%, which is valued at INR 1,069 Billion (USD 14 Billion) in FY21, which is expected to grow at 41.1% CAGR to reach INR 5,978 Billion (USD 81 Billion) by FY26. India is positioned as a destination for high-quality design work, not merely as a low-cost alternative. Many multinational companies have established and expanded captive centres in the country. Although it aided the economy by creating domestic infrastructure and jobs, the intellectual property rights were held by the global headquarters. Most OEMs prefer engaging ESDM partners for contract manufacturing, but the ODM model is slowly gaining traction in India, where OEMs collaborate with ODMs on product development. Many ESDM players are gradually expanding to provide complete design services in addition to contract manufacturing. This acts as a win-win situation for both the ESDM players as well as the OEMs; ESDM companies obtain higher margins through this model, and OEMs benefit by outsourcing manufacturing and design activities, enabling them to focus on other expansion activities. Embracing the ODM model of partnership with ESDM partners, coupled with venturing into new product segments, is propelling OEMs to pursue ESDM engagement.

A strong consumer economy with increasing demand for consumer and industrial electronics has driven the Indian ESDM sector into the forefront. Domestic electronics production in India has received a lot of attention from both industry and the government, owing to the necessity for import substitution. Favourable policy initiatives in recent years, as well as changes in the global manufacturing environment, have drawn attention to India as a preferred destination for electronics manufacturing investments.

The Indian ESDM industry has benefited from a greater focus on manufacturing and an overall growth in the usage of electronics in many aspects of life. Domestic demand for mobile phones, PCs, consumer electronics, medical products, strategic and automotive electronics and offers a huge growth potential. Because of the 5G rollout, there is an increase in demand for telecom infrastructure projects, as well as a necessity to build them locally. Furthermore, growing labour costs in other parts of the world have led major OEMs to favour India, which is a practice of large OEMs to outsource manufacturing rather than to create their own infrastructure. ESDM market in India enjoys unique benefits of an explosive domestic demand and the migration of manufacturing from other manufacturing havens driven by multiplicity of factors. These reasons have resulted in the Indian ESDM market growing at a higher rate than average global market and are expected to intensify in the next decade.

Growth drivers for Indian ESDM industry

Key growth drivers for Indian ESDM industry
▪ Domestic cost competitiveness in manufacturing
▪ Competitive exports
▪ Import substitution
▪ Enhancing local value-add
▪ Supply chain realignment
▪ China+1 strategy
▪ Export focus on USD 5 Trillion GDP
▪ Component manufacturing / lead time
▪ Indian Government policies/incentives
▪ Investment by local and global players
▪ Increasing demand from sunrise industries

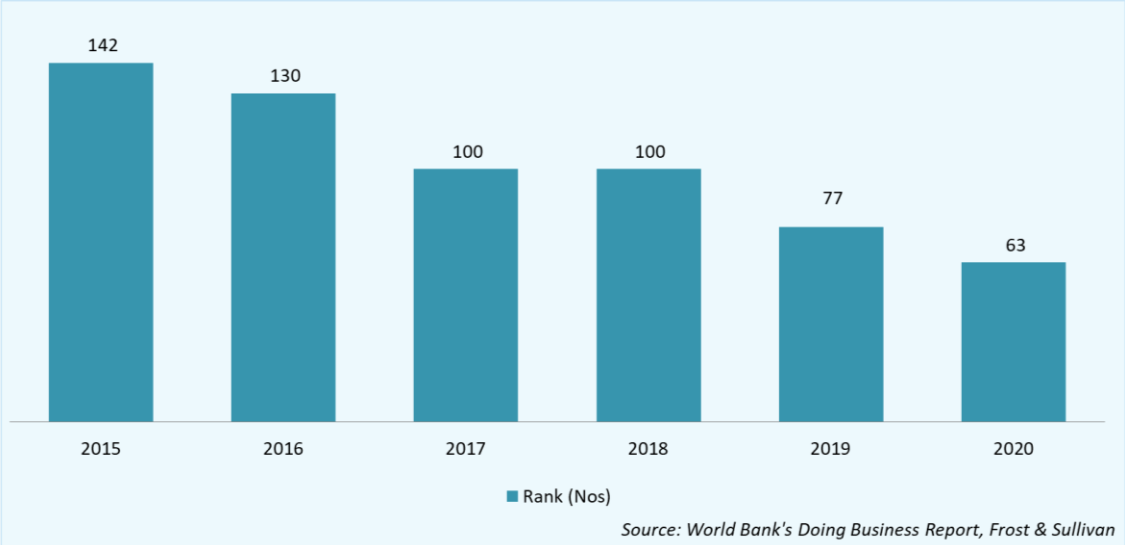
Domestic cost competitiveness in manufacturing: India has one of the lowest labour costs and overheads giving it a considerable advantage over China and most of the other Southeast Asian countries. A 'Disability Analysis' carried out by Invest India and ELCINA shows wages in India is 46% cheaper than the wages in China. This is expected to make India an attractive market for investments and drive the demand for ESDM.

Competitive Exports: Cost competitiveness in domestic manufacturing in India contributes to growth of exports in electronics from the country. This is supported by the favourable policies such as the ASEAN-India Free Trade Agreement coupled with the depreciating value of Indian Rupee (INR), which makes Indian exports competitive.

Import substitution: As per MeiTY, electronic imports accounted for INR 3.9 Trillion (USD 56 Billion) in FY1, which is 21% of the total electronics market in India. The top products contributing to the highest electronics imports are the Engine Control Unit, FPD TV, Refrigerator, Set Top Box, Machine Tools, CCTV Camera, Notebooks, Servers, Storage Devices, Home Automation Modules, Mobile Phones, Media Gateways, Enterprise Routers, Defence, Medical Devices Smart Cards & Readers, low voltage power switchgear segment, among others. Imports are expected to reach USD 68 Billion by FY25, accounting for 12.6 % of total electronics market demand.

Enhancing local value-add: India's business environment can be improved by simplifying procedures involved in setting up and conducting business. To position India as an attractive business destination, the government must reduce the burden of additional taxes on start-ups and strengthen the IP protection framework. India is evolving as an innovation-driven R & D destination for global companies. The government, academia, industry players and industry associations need to make concerted and coordinated efforts to help the industry reach its potential. India is registering increasing EV investment in the country. Companies such as Ola and Triton are investing in setting up manufacturing plants in the country. Likewise, ESDM companies in the country, including the likes of Wistron, are ramping up investments, which indicate a robust EV market for ESDM in the next 5 years.

Chart 4.5: Ease of doing Business in India, Rank in Nos., FY15 to FY20



Source: World Bank's Doing Business Report, Frost & Sullivan

Sub-assembly modules and the finished goods assemblies are things that are happening currently in India and are very lucrative opportunities given in the Indian ecosystem. Current Indian wages stand at roughly 20 % of the Chinese average wages, and India offers a 500 million plus workforce in the age bracket of 15 to 39 years, which is 15 % larger than that of China. Even though component manufacturing is currently being dominated by China, Japan, and South Korea, India has showcased strong potential in this part and is on the

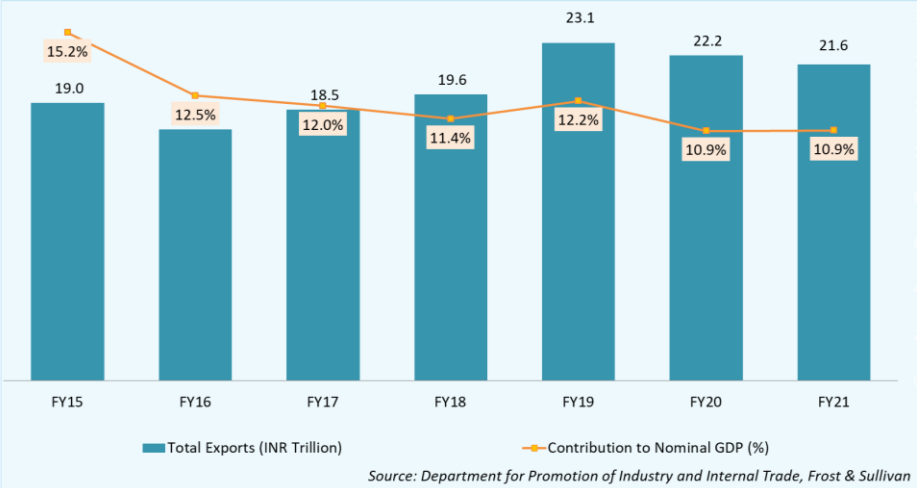
path to developing a strong component manufacturing base. The opportunities in India ominously offset the hurdles. It is also clear from the World Bank report's improvement in rank of ease of doing business in India, which has risen from 142nd in 2015 to 63rd in 2020.

Supply chain realignment: Local availability of components and chip fabrication are primary activities that determine the strength of a country's electronics manufacturing ecosystem. India has a very limited component supplier base; a majority of the high-value and critical components are imported. Components that are predominantly imported include ICs, PCBs, and other active components. As supply-chain resilience and localization are becoming more significant, India has had to take the necessary steps to improve the domestic value chain capability for long-term benefits.

The introduction of the PLI scheme to promote component sourcing; FDI policies relaxing companies' ability to set up bases in India, allowing them to drive product development, research and development (R & D), and other knowledge-intensive activities in collaboration with Indian companies; and the establishment of dedicated freight corridors that help in the advancement of transportation technology and increase in productivity are some of the key initiatives taken by the government of India. Freight corridors are high-speed, high-capacity railway lines designed solely for freight traffic, requiring the seamless integration of improved infrastructure. The Bhaupur-Khurja segment of the Eastern Dedicated Freight Corridor (EDFC) in Uttar Pradesh was recently inaugurated by the government.

China + 1 strategy: As the Chinese electronics contract manufacturing cost structure continues to be on the rise, so has the OEM customer's interest been amplified in moving the electronics production to other countries having similar prices, quality, and receptiveness. There is a new urgency now to examine practical alternatives to manufacturing in China given the tariff conflicts and the COVID 19 pandemic. Though, transferring production decisions is not very straightforward. Sub-tier vendor incorporation of metal fab, plastics, and other mechanical components all in China improves the product cost, efficiency, and time-to-market. The gigantic size of the China market itself for the end-products should also be considered. These factors and other factors have OEM clients thinking more in terms of adding one more nation for additional production rather than replacing China entirely. Kaynes, with its strong OEM and ODM capabilities, is a strong contender for China+1.

Chart 4.6: Total exports from India and Contribution to GDP, INR Trillion, %, India, FY15-FY20



Source: Department for Promotion of Industry and Internal Trade, Frost & Sullivan

China now accounts for 13 % of global exports and 18 % of global market capitalization, and is one of the world's two corporate giants in terms of economic supremacy. However, as a result of the China+1 strategy and the US-China trade dispute, China is gradually losing its global partners. According to a recent global survey, 20-30 % of industrial firms will leave China in the next few years. Around USD 4 trillion in manufacturing took place in China in 2020, and it is the world's largest exporter and the US is its top importer, posing a huge challenge for the World Trade Organization to regulate trade under its current rules and regulations.

Export focus on USD 5 Trillion GDP: With a larger focus on CAPEX and R&D, Budget 2021 has given a strong push to the domestic marketplace, which is very significant to India's economic growth. Presented encouragingly at the tail-end of the COVID 19 pandemic and at the inauguration of the vaccination drive, Budget 2021-22 lived up to the hope of being an exercise to push growth. In the following two-three years, high real GDP growth rates are going to be rare in the majority of the economies as they gradually recover from the impact of the COVID 19 pandemic.

India has the potential to be one of the most attractive manufacturing destinations and support the objective of 'Make in India for the World'. The government and industry need to collaborate and drive initiatives to help India move among the top 5 countries in ESDM production and the top 3 in ESDM consumption. Many policy-level initiatives are hoped to be implemented quickly. The effect of policies should be measured and evaluated against the desired objectives to re-check and refine at regular intervals.

Component manufacturing/ lead time: Companies in the industry should take initiative to jointly locally source a minimum quantity of key components that are currently imported (fully or partially). Criteria on minimum quality standards and sourcing price should be set up for such an engagement. This will help component manufacturers plan and develop scale advantage.

India has limited capacity in local manufacturing of PCB with significant gaps with flexible, HDI and multilayer PCBs. Indian manufacturers find strength in rigid multilayer range and are limited by their scale. OEMs, at present, are importing already designed and manufactured PCBA from third party suppliers. However, the need is to invest resources in in-house PCBA design and assembly. Investing in Printed Circuit Board Assembly design and (Surface Mount Technology) SMT-level PCBA assembly are important steps towards full-scale manufacturing. Some ESDM companies are building capabilities for PCBA and are actively scouting for PCB suppliers to reduce cost and lead time. There are numerous benefits for adopting the in-house design and assembly. Firstly, it will guarantee more control over the entire product design, selection of crucial components, better buying power, building Intellectual Property portfolio and ensuring several in-house quality checks and testing In comparison to importing a readymade PCBA from a third party ODM from the overseas. PCBA design and assembly will further help in development of component ecosystem.

Investments in PCBA by ESDM companies as well as OEMs with the objective of high value adding manufacturing is expected to drive the demand for PCB in the country. Reduction in lead times from 4 weeks to 1 week by discrete local sourcing of PCB is a significant driver for PCBAs to source their bread boards locally than import. PCBA design and assembly with local sourcing of some passive components alone will drive the total local value addition and will make a strong case to attract foundry players to manufacture the high-cost silicon based PCBA sub-components locally. This could alone grow the total value addition for Make in India program substantially.

Indian Government policies/incentives

The Government in India is encouraging domestic manufacturing through supporting policies and initiatives that are likely to lead to overall development in the ecosystem and will open up gates of opportunities for companies, vendors, and distributors in the market. Incentives for local manufacturing, demand side support through Government procurement, import barriers via duties and favourable steps like GST that reduced complexity of operations, are pull factors for MNCs to invest in India.

Some of the key initiatives/ schemes/ programs introduced by the government in boosting the ESDM market in India include:

a) **Make in India:** In 2014, the government of India announced this initiative to make India a global manufacturing hub, by facilitating both domestic as well as International companies to set-up manufacturing bases in India. As per the scheme, government released special funds to boost the local manufacturing of mobile phones and electronic components. It has also introduced multiple new initiatives, including promoting foreign direct investment, implementing intellectual property rights and developing the manufacturing sector. The Make in India initiative, a part of the 'Atmanirbhar Bharat Abhiyan' (Self-reliant India), would provide an additional boost to country's business operations by encouraging substitution of imports of low-technology products from other countries and generating demand for local manufacturing. Atmanirbhar Bharat Abhiyan is planned to get carried out in two phases:
   - Phase 1: The emphasis will be on segments like medical, textiles, electronics, plastics and toys
   - Phase 2: For products like gems and jewellery, pharma and steel, etc.

Chart 4.7: PLI scheme in 13 key sectors for enhancing India's manufacturing capabilities and enhancing exports, Atmanirbhar Bharat, FY21-FY22

Sectors	Implementing Ministry/Department	Approved financial outlay over a five year period (INR billion)
Mobile manufacturing and specified electronic components	Ministry of Electronics and Information Technology	409.5
Critical key starting materials/ drugs intermediaries, APIs	Department of Pharmaceuticals	69.4
Manufacturing of medical devices	Department of Pharmaceuticals	34.2
Advance Chemistry Cell ACC Battery	NITI Aayog and Department of Heavy Industries	181.0
Electronic/Technology Products	Ministry of Electronics and Information Technology	50.0
Automobiles & Auto Components#	Department of Heavy Industries	259.4
Pharmaceuticals drugs	Department of Pharmaceuticals	150.0
Telecom & Networking Products	Department of Telecom	122.0
Textile Products	Ministry of Textiles	106.8
Food Products	Ministry of Food Processing Industries	109.0
High Efficiency Solar PV Modules	Ministry of New and Renewable Energy	45.0
White Goods (ACs & LED)	Department for Promotion of Industry and Internal Trade	62.4
Speciality Steel	Ministry of Steel	63.2
Total		1,661.9

 # Financial outlay for Automobiles & auto components was revised on September 2021 from INR 570.4 billion to INR 259.4 billion

Source: MeitY (Ministry of Electronics and Information Technology), Invest India

a) **Production Linked Incentive (PLI) Scheme:** The scheme was initially announced in the year 2019 by the Government of India considering the incremental investment and sales of manufactured goods specifically to mobile phones and components market in India. It is expected to promote exports in the next few years. As per the scheme, a total production of INR 11,500 Billion is expected including INR 7,000 Billion exports in the next five years. Production Linked Incentive Scheme (PLI) for large scale electronics manufacturing was notified in April 2020.

As per the 2021-22 budgets, under the PLI scheme the government has allotted INR 1,970 billion for 13 sectors. However, the financial outlay for the auto sector was revised in September 2021, bringing the total allotment down to around INR 1,661.9 billion. Initially introduced in mobile phone production, this policy is being expanded to other sectors as well. The scheme is also extended to white goods (Air conditioners and LED lighting) and select few electronic/ technology products. The allocation for Mobile Manufacturing and Specified Electronic Components is around INR 409 billion, which is significantly higher than any other scheme. It has different thresholds of investments required for domestic and international companies. Fully integrated manufacturers are going to be the biggest beneficiary of this scheme. This scheme will definitely help India Inc. to be an integral part of the global supply chain.

b) **Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS):** The aim is to strengthen the manufacturing ecosystem of electronic components and semiconductors. Target manufacturing of electronic components and semiconductors through the scheme will help meet domestic demand, increase value addition and promote employment opportunities in this sector. Incentives of up to INR 32.85 Billion will be awarded under the Scheme over a period of 8 years.

c) **Merchandise Exports from India Scheme (MEIS):** The scheme falls under foreign trade policy of India, replacing five other similar incentive schemes in the past. As per this scheme the government of India provides benefits up to 4% depending on the country of exports and the products. Rewards under the scheme are payable as percentage of realized free-on-board value and, MEIS duty credit scrip can be transferred to the company for working capital needs or used for payment of various duties such as basic customs duty.

d) **Modified Electronics Manufacturing Clusters Scheme (EMC 2.0):** The scheme is aimed to strengthen the infrastructure base for the electronics industry and deepen the electronics value chain in India. The scheme provides financial incentives for creating quality infrastructure as well as common facilities and amenities for electronics manufacturers. Financial Incentives of up to INR 37.62 Billion will be disbursed over a period of 8 years.

e) **Semiconductors and Display Fab Ecosystem**

In furtherance of the vision of Atmanirbhar Bharat and positioning India as the global hub for Electronics System Design and Manufacturing, Govt. of India has approved the comprehensive program for the development of sustainable semiconductor and display ecosystem in the country

with an outlay of INR 76,000 Crore (>10 billion USD). The programme will usher in a new era in electronics manufacturing by providing a globally competitive incentive package to companies in semiconductors and display manufacturing as well as design. This shall pave the way for India's technological leadership in these areas of strategic importance and economic self-reliance.

The programme aims to provide attractive incentive support to companies / consortia that are engaged in Silicon Semiconductor Fabs, Display Fabs, Compound Semiconductors / Silicon Photonics / Sensors (including MEMS) Fabs, Semiconductor Packaging (ATMP / OSAT) and Semiconductor Design. Following broad incentives have been approved for the development of semiconductors and display manufacturing ecosystem in India:

- **Semiconductor Fabs and Display Fabs:** The Schemes for Setting up of Semiconductor Fabs and Display Fabs in India shall extend fiscal support of up to 50% of project cost on pari-passu basis to applicants who are found eligible and have the technology as well as capacity to execute such highly capital and resource intensive projects. Government of India will work closely with the State Governments to establish High-Tech Clusters with requisite infrastructure in terms of land, semiconductor grade water, high quality power, logistics and research ecosystem to approve applications for setting up at least two Greenfield Semiconductor Fabs and two Display Fabs in the country.

- **Semi-conductor Laboratory (SCL):** Union Cabinet has also approved that Ministry of Electronics and Information Technology will take requisite steps for modernization and commercialization of Semi-conductor Laboratory (SCL), Mohali. MeitY will explore the possibility for the Joint Venture of SCL with a commercial fab partner to modernize the brownfield fab facility.

- **Compound Semiconductors / Silicon Photonics / Sensors (including MEMS) Fabs and Semiconductor ATMP / OSAT Units:** The Scheme for Setting up of Compound Semiconductors / Silicon Photonics / Sensors (including MEMS) Fabs and Semiconductor ATMP / OSAT facilities in India shall extend fiscal support of 30% of capital expenditure to approved units. At least 15 such units of Compound Semiconductors and Semiconductor Packaging are expected to be established with Government support under this scheme.

- **Semiconductor Design Companies:** The Design Linked Incentive (DLI) Scheme shall extend product design linked incentive of up to 50% of eligible expenditure and product deployment linked incentive of 6% - 4% on net sales for five years. Support will be provided to 100 domestic companies of semiconductor design for Integrated Circuits (ICs), Chipsets, System on Chips (SoCs), Systems & IP Cores and semiconductor linked design and facilitating the growth of not less than 20 such companies which can achieve turnover of more than INR 1500 Crore in the coming five years.

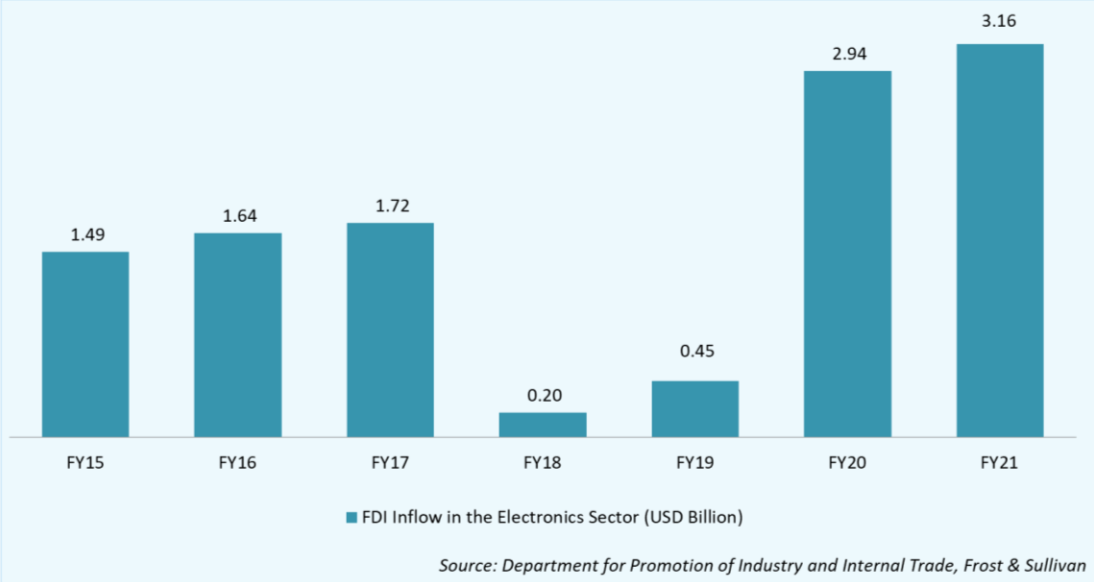
- **India Semiconductor Mission:** In order to drive the long-term strategies for developing a sustainable semiconductors and display ecosystem, a specialized and independent "India Semiconductor Mission (ISM)" will be set up. The India Semiconductor Mission will be led by global experts in semiconductor and display industry. It will act as the nodal agency for efficient and smooth implementation of the schemes for setting up of Semiconductor and Display Fabs.

All the above mentioned policies and initiatives, 'Make in India', PLI, DLI, Scheme for development of Semiconductor and Display Fab ecosystem, SPECS, MEIS, and EMC, have provided necessary impetus to the domestic electronics manufacturing industry and India is now on path to become a global manufacturing hub for electronics products.

Investments by local and global players: The higher growth rate in India vis-à-vis the Global market is because of multiple factors: consistent local demand for Electronics products, Government's focus on domestic manufacturing, programs like Make in India and Digital India, which have led to increasing manufacturing investment in the country.

The Make in India initiative, tax and duty support and Government support through policies, most notably, MSIPS, have been instrumental in encouraging new investment from ESDM companies. Electronic manufacturing services player Dixon Technologies is spending over INR 6 Billion to build the new capacity in India in the mobile devices, laptops & tablets, telecom equipment, & LED components segment to cater to the domestic and the global market in the coming year. Dixon is currently positioning itself as India's largest home-grown 'universal champion' for the electronics manufacturing, one of the important goals of the government's PLI scheme which Dixon is currently leveraging for its overall growth.

Chart 4.8: FDI Inflow in the Electronics Sector, Value in USD Billion, FY15-FY21



Source: Department for Promotion of Industry and Internal Trade, Frost & Sullivan

European telecom dealers Ericsson and Nokia have conveyed their intention to increase existing manufacturing operations in India to support their worldwide supply chain. Local telecom component

manufacturers VVDN Technologies, HFCL, Dixon, Coral Telecom and the Sterlite Technologies have also expressed interest in the PLI scheme of Government. India is expected to run a widespread outreach program with the support of "Invest India team" for the Production Linked Incentive scheme. Nokia and Ericsson is also going to target the BSNL big ticket 4G contract expansion after GOI dropped few clause which was earlier prohibiting them from bid participation.

Increasing demand from Sunrise industries: Sunrise industry is a colloquial term for a burgeoning sector or business in its infancy stage showing promise of rapid growth in the coming years. Sunrise industries are typically characterized by exponential growth, numerous start-ups, and flurry of funding / investment. Globally, proliferation of digitalization and Industry 4.0 drives across industries has prompted origination of many sunrise industries namely, IoT and embedded systems, augmented and virtual reality, 3D printing, block chain, smart factories, industrial IoT, smart and advanced manufacturing , HealthTech, SpaceTech etc. Industry 4.0 is a holistic automation solution for integration and efficiency improvement of all value chain elements including, product designing, supply chain, manufacturing process, sales, and customer experience.

Digitalization initiatives will give fillip to demand of sensors, IT & automation hardware and solutions, application & platforms and networking products. Kemsys (a subsidiary of Kaynes) possesses Canvas to Cloud IIoT engineering capabilities and is well poised to meet the requirements of the sunrise industries. It offers services such as device engineering, digital engineering, and firmware engineering and solutions such as sensors & IO, edge processing, connectivity, remote device monitoring, and application software.

Comparative Analysis of industry in India, China and Vietnam

A. Economic comparison on favourable manufacturing parameters

Chart 4.9: Economic comparison on favourable manufacturing parameters, India, China & Vietnam, 2020

PARAMETERS		INDIA	CHINA	VIETNAM
Population (Million)		1,379.0	1,414.0	97.40
Annual GDP (USD Trillion)		2.66	14.86	0.34
GDP Growth (%)	2020	-7.3	2.3	2.9
	2025	6.6	5.1	7.0
Inflation (%)		6.2	2.4	3.2
Manufacturing Value Added (% of GDP)		13.0	26.1	16.7
Export (USD Trillion)		0.47	2.73	0.28
Imports (USD Trillion)		0.48	2.35	0.27
Manufacturing Risk Index (Rank)		3	1	4
FDI Investments (USD Billion)		64	163	17

Source: World Bank, IMF, Frost & Sullivan

Economic development in India is gaining support as a result of the continuing expansion of private consumption and investments some industries following the liberalisation of foreign ownership. The projected government expenditure expansion would further enhance growth by focusing on social infrastructure, making the best use of technology, digital India, make in India, job creation in Micro, Small, and Medium Enterprises (MSMEs), and heavy investment in infrastructure.

China is now the world's second-largest economy. The growth rate is impressive when compared to the size of the economy. The primary difficulties for its expansion are excess capacity issues, labour costs, and financial market weaknesses. India and Vietnam are gaining ground as the second-best destinations after China. The IMF estimates that India's GDP is improving, and projects that GDP will be around 6.6% by 2025. Various government initiatives and tax regimes are expected to stimulate India's domestic manufacturing sector.

India has the potential to become a global manufacturing powerhouse, competing with China, which now produces one-fifth of the world's commodities. With a relatively young population, India boasts the world's second largest population. India's median age is 28.7 years, lower than China's median age of 37.4 years and Vietnam's median age of 31.9 years (CIA's World Fact book, 2020). Chinese employees' aspirations have risen, and they are increasingly focused on high-tech jobs, leaving gaps in the industrial value chain. Due to a lack of manpower, this has resulted in a labour shortage and increased costs.

B. Labour market comparison

In comparison to other Asian countries, India and Vietnam benefit from lower labour costs. Vietnam, with a population of less than one-tenth that of China, is experiencing skilled labour shortages as global manufacturers rush to set up shop here to avoid US tariffs. It is also hampered by a scarcity of specialised supply chains. India is expected to fill this void due to its advantage in skilled and semi-skilled labour. With nearly 500 million people of working age, India has one of the world's largest workforces, next to China. Each year, tens of millions of students across the country graduate from colleges and enter the workforce. Apart from a favourable labour environment, India has an abundance of design talent (hardware and software).

Chart 4.10: Labour market comparison, India, China & Vietnam, 2020

PARAMETERS	INDIA	CHINA	VIETNAM
Total Labour Force (Million)	471.68	750.6	56.54
Total Labour Force, Female (% of Total population)	26.2	63.7	62.2
Labour force participation rate (% of total population)	51.1	71	68.6
Employment in Industry (% of Total Employment)	26.18	28.18	28.36
Wage and salaried workers (% of Total Employment)	23.9	53.5	44.38
Average Daily Wages - Manufacturing (USD)	~6	~35.5	~10.48

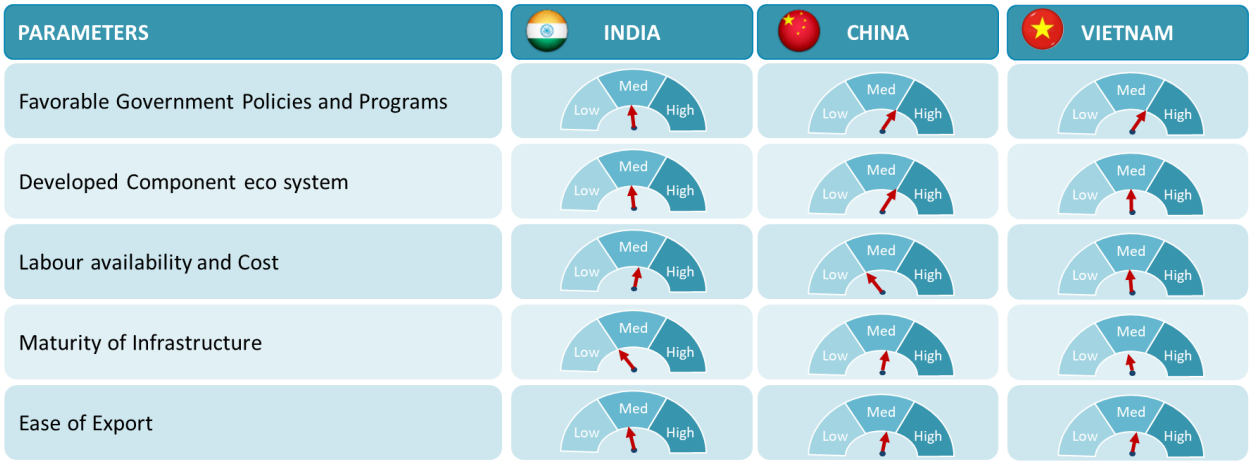
Source: World Bank, IMF, Frost & Sullivan

C. Manufacturing eco-system comparison

China has been the most ideal manufacturing destination due to its long history and supremacy in electronics manufacturing. The electronic sector in China has expanded at three times the rate of the country's GDP. Exports account for a large portion of China's electronics manufacturing, including notebooks, mobile phones, and flat panel displays. The current uncertainty in China's manufacturing favourability has stemmed from the global economic crisis and years of rapid expansion. Vietnam benefited significantly from the US-China trade war. Vietnam is aggressively investing in infrastructure to facilitate the strong inflows of FDI. Economic zones, industrial parks and clusters, hi-tech parks, and agri-tech zones are among the sectors targeted for investment. Vietnam has introduced new incentives to attract high-tech investment.

The position of the Indian electronics sector is changing, and electronics is recognised as a key segment for policy focus. The National Policy on Electronics (NPE), 2019 has highlighted the local value addition and a supportive environment has been developed. The government is rapidly attracting the eye of global and domestic companies with an unimpeded focus on manufacture through Make-in-India policies. The favourable developments leave India with great aspirations to dominate electronics manufacturing in the region. The Product Linked Incentive (PLI) Scheme was announced in the years 2020 by the Government of India considering the incremental investment and sales of manufactured goods. The PLI scheme, which was first introduced for mobile phones and was later expanded to IT Hardware, White Goods, and Telecom and Networking Products, is now being expanded to other sectors in the coming years.

Chart 4.11: Manufacturing eco-system comparison, India, China & Vietnam, 2020



Source: Frost & Sullivan

Indian electronics manufacturers are heavily dependent on imports for raw materials sourcing. The phased manufacturing programme of the Government of India involves a mix of local assembly import levies and incentives. Since plastic components are driven by international prices, there is no noticeable disadvantage for Indian producers. As a large number of electronic manufacturing units are anticipated to undertake greater value addition, the component cost is likely to go down over the next 3 to 4 years. Various PLI schemes across sectors are expected to address this challenge by bridging the cost gap in between India and China.

Advantage India: A favourable destination for Electronic Manufacturing

India has long been seen as a destination with plenty of low-cost skilled and semi-skilled labour however grappled with poor infrastructure and challenging business environment. The scenario has changed a lot in the last few years. Among 190 countries, India ranked 63rd in 'Ease of Doing Business' in 2020. A 63rd rank meant India has improved its ranking by 79 positions in the five years between 2014 and 2019. With the recognition of electronics sector as one of the key growth drivers for the Indian economy, the sector has received significant attention from the government in the last 6 – 7 years through various policies, schemes and incentives. The National Policy on Electronics (NPE) emphasised local value addition and created an enabling environment. Shift in government in 2014, and its unwavering focus on manufacturing through Make-in-India policies, attracted the interest of both global and domestic companies.

India has been able to take advantage of its demographic dividend while also introducing much-needed flexibility in its manufacturing policies. The conscious efforts to attract global investors have resulted in a growth in FDI as well as investor confidence. The following factors will contribute significantly towards India becoming the next Electronics manufacturing hub of the world.

- Stable political government that assures global investors on consistency in policies
- Rising cost of labour in China while India is still at a lower end of this cost
- Creation of National Manufacturing Zones (NMZ), Electronics Manufacturing Clusters (EMC), close coordination between centre and states for investment promotion
- High domestic demand for products and services; local needs
- Investment by ESDM companies
- Duties and tariffs to discourage imports and encourage domestic value addition
- Digitalization that accentuates demand for select products

Below are some of the underlying factors that will help Indian ESDM industry in this journey.

a. Manufacturing ecosystem

To offset the disabilities faced by industries for quality infrastructure and to develop a robust electronics manufacturing ecosystem in the country to make India an Electronics manufacturing hub, Indian government has notified Electronics Manufacturing Clusters (EMC 2.0) scheme in 2020. Objective of the scheme is to address the disabilities, by providing support for creation of world class infrastructure along with common facilities and amenities, including 'Ready Built Factory (RBF)' sheds / 'Plug and Play' facilities for attracting major global electronics manufacturers along with their supply chain to set up units in the country. Besides, Production Linked Incentive (PLI) schemes have also been launched for the sector in order to boost manufacturing of electronics products, assemblies and components in India. Towards this, Indian government has also launched The Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) in 2020. This scheme will help offset the disability for domestic manufacturing of electronic components and semiconductors in order to strengthen the electronics manufacturing ecosystem in the country. The scheme will provide financial incentive of 25% on capital expenditure for the identified list of electronic goods that comprise downstream value chain of electronic products, i.e., electronic components, semiconductor/ display fabrication units, ATMP units, specialized sub-assemblies and capital goods for manufacture of aforesaid goods, all of which involve high value added manufacturing.

MeitY has developed a component supply ecosystem as part of the modified electronic cluster scheme. Mysuru, which had an early start in the ESDM industry, was chosen to establish such a cluster named 'Lahari'. Lahari is a government initiative to establish a Product Reliability Lab with the goal of meeting the testing, quality, and regulatory needs of the regional electronic industry. It is a fast-track project and the first of its kind in India, undertaken jointly by the Central and State Governments at a cost of INR 29 crores. It facilitates companies' access to better technology and allows them to climb up the product value chain. It provides necessary technical facilities for various electronics manufacturing companies located in and around the region, thereby reducing production lead time, production costs (including transportation and logistics costs), increasing export and income creation. Lahari has a state-of-the-art ISO 17025 2017 NABL recognised infrastructure that allows it to test in accordance with national and international standards. Kaynes is one of the key promoters of Lahari to facilitate growth in electronics design and manufacturing.

b. Availability of talent and resources

The Ministry of Skill Development and Entrepreneurship implemented the Pradhan Mantri Kaushal Vikas Yojana through the National Skill Development Corporation in 2015-16, with a target of covering 24 lakh youth in the country. The scheme is being implemented with the goal of enabling a large number of Indian youth to pursue industry-relevant skill training, which will enable them to earn a better living. Individuals with prior learning experience or skills were also evaluated and certified in the category of Recognition of Prior Learning.

The Pradhan Mantri Kaushal Vikas Yojana (2016-2020) is divided into two parts: the Centrally Sponsored, Centrally Managed scheme and the Centrally Sponsored, State Managed scheme. With a budget of INR 12,000 crore, nearly 1 crore people were brought under this scheme to be provided with industry-ready skills. The Pradhan Mantri Kaushal Kendra programme provides financial assistance in the form of a soft loan up to INR 70 lakhs for the purpose of creating training infrastructure, and it supplements the delivery of the Pradhan Mantri Kaushal Vikas Yojana, the Government of India's flagship skill development programme, at the district level.

c. Stability in supply chain

The Indian electronics industry is likely to suffer in the short term as a result of supply disruptions from China and other nations, given the country's reliance on them to meet its raw material requirements. Due to the COVID-19 pandemic, certain key suppliers across the country temporarily suspended manufacturing, while logistics providers were also unable to deliver goods effortlessly, particularly across borders, due to pandemic-related limitations. On the other side, the pandemic has created an once-in-a-lifetime chance for India. During the epidemic, supply chain disruption caused many governments and organisations to reconsider their sourcing strategy and lessen their reliance on a single source for all of their goods. These huge corporations are now exploring for alternative low-cost manufacturing areas in South East Asia and South Asia, and India has emerged as one of the most sought-after investment destinations for many of them.

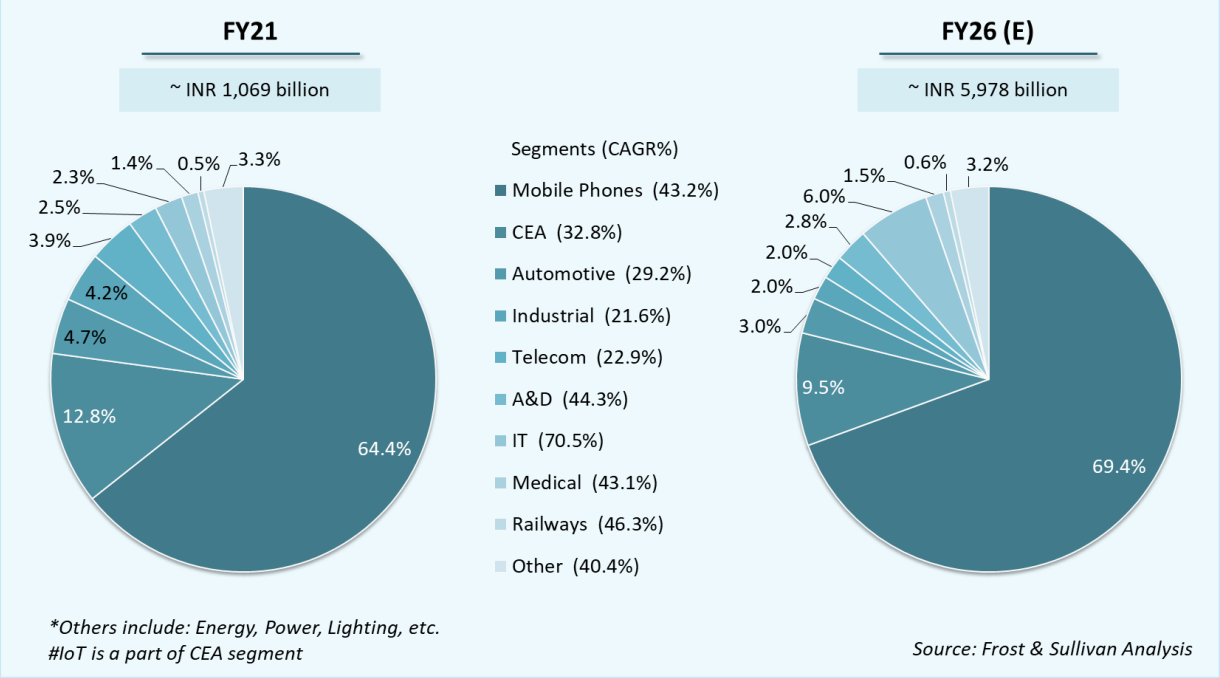
As the global supply chain re-aligns in the future years, India is set to profit greatly from these strategic decisions and will become a manufacturing powerhouse in the coming years. A favourable corporate environment, open FDI norms, ever-increasing "Ease of Doing Business" rankings, a massive consumer base,

and quickly improving digital infrastructure are some of the important drivers that will fuel investment in India in the future years. On December 15, 2021, the Indian government authorised an INR 76,000-crore scheme to develop the country's semiconductor and display manufacturing companies in an effort to promote India as a worldwide hub for hi-tech production and attract multinational chip makers. This initiative will help India's ambitions to become self-sufficient in the electronics manufacturing industry by attracting major investments and creating 35,000 specialised jobs, in addition to indirectly employing one lakh others.

As India is aiming to become self-reliant, the government has announced industry-friendly measures for the development of semiconductors and display manufacturing ecosystem in the country. The Union Cabinet has approved a financial outlay of INR 76,000 Crore for the semiconductor manufacturing ecosystem in India, announcing incentives for every part of the supply chain including electronic components, sub-assemblies, and finished goods. Under the scheme for holistic development of semiconductor and display manufacturing system, the policy will support silicon semiconductor fabs, display labs, compound semiconductors/ silicon photonics/ sensors fabs, semiconductor packaging, semiconductor design, and modernisation and commercialisation of the Semiconductor Laboratory (SCL) at Mohali.

ESDM market break-up by industry applications

Chart 4.12: ESDM Market break-up by Industry Applications, India, in %, FY20



*Others include: Energy, Power, Lighting, etc.
#IoT is a part of CEA segment

Source: Frost & Sullivan Analysis

A) Industrial

Industry Overview

India's industrial sector has seen a revival from the lows of the first wave of COVID 19 of the pandemic last year in 2020 but the revival is being majorly led by the commodity producers like metals & oil & gas

companies while the manufacturers like auto firms and producers of the consumer goods continue to struggle here.

The Make in India initiative is designed to strengthen India's manufacturing sector, boosting essential industries including power, metals and minerals, and chemicals. Some of the key ESDM players operating in industrial space include Kaynes, Amber, SFO Technologies, Syrma SGS, Avalon, and VVDN Technologies among others.

Electronics manufacturing in Industrial sector

- Most of the large manufacturing companies are investing heavily in the technological up-gradation of their facilities by adopting digitization and industry 4.0 concepts. This will increase demand for Industrial electronics products which in turn will boost the ESDM industry
- Huge potential in smart metering in electricity/water/gas
- Home grown companies will be preferred than Chinese

Key Drivers

- Several initiatives by Government of India to promote a healthy environment for the growth of the industrial sector in the country in form of approving PLI schemes and improving the electronics supply chain and assembly industry
- A strong consumer economy with increasing demand for consumer and industrial electronics has driven the Indian EMS sector into the forefront

Future outlook of Industrial sector

- Industrial electronics likely growth rate till 2025 will be around 9%, in which the Industrial ESDM is predicted to grow at 21.6% to reach INR 120 billion in FY26, from an estimated market of INR 45 billion.
- The manufacturing industry of India has got the potential to reach USD 1 trillion by 2025. The implementation of the Goods and Services Tax is going to make India a common market with a GDP of USD 2.5 trillion
- With an allocation of INR 1.97 lakh Crore for the next five years starting FY22, the production-linked incentive (PLI) was established to build global manufacturing hub across 13 industries.
- Samsung completed construction of its display production plant in Noida, Uttar Pradesh, in June 2021, as part of the company's goal to move manufacturing capacity away from China.
- In March 2021, the government offered incentives worth US$ 1 billion in cash to each semiconductor company that develops production units in the nation as part of its attempts to boost its smartphone assembly sector and enhance its electronics supply chain.
- Amazon India has declared that it would begin producing electronic products in India in 2021. The company intends to begin production with contract manufacturer Cloud Network Technology (a subsidiary of Foxconn in Chennai)

B) Automotive

Automotive industry overview

In the Automotive Electronics industry, the top 5 products, namely, Engine Control Unit (ECU), EV/HV, HVAC, Infotainment and Lighting account for 95% of the demand. Government Initiatives such as the Automotive Mission Plan which targets production of 940 million vehicles by FY26 with an annual output value of INR 19.7 Lakh Crore bodes well for the market. Statutory requirements on emissions and safety are expected to generate significant demand for many products, which will boost local manufacturing

Domestic automobiles production increased at a CAGR of 2.36% in between FY16 to FY20 with 26.36 million vehicles being manufactured in India in FY20. Total, domestic automobiles sales augmented at a CAGR of 1.29% in between FY16 to FY20 with 21.55 million vehicles being sold in FY20. In FY21, the overall passenger vehicles production reached the value of 22.65 million. In the month of October 2021, the overall production volume of the passenger vehicles (except for BMW, Mercedes, and Tata Motors & Volvo Auto), three wheelers, two wheelers and quadricycles reached 2,214,745 units.

Electronics manufacturing in the automotive segment

- Engine Control Unit has a major contribution in the overall Automotive Electronics. The growing concern among end-users about vehicle performance and fuel consumption are the primary drivers of Engine Control Unit. Furthermore, due to regulatory compliance, even entry-level vehicles are equipped with ECUs. In Engine Control Unit, India has a strong base with automotive industries, including the component suppliers
- Electrification will penetrate cars and last-mile connectivity modes like 2W by 2030. Frost & Sullivan expects more electrification in the fleet segment due to a combination of lower ownership costs and regulatory intervention.

Key drivers

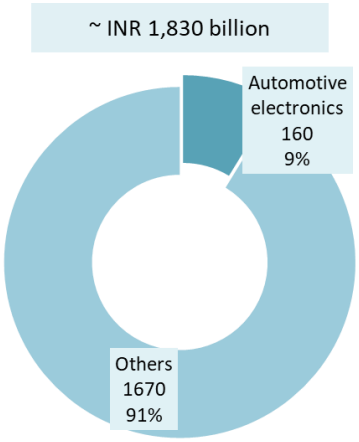
- **Support infrastructure and rising investment by foreign companies:** India is transforming into a global automotive R&D hub, as more players entering the automotive sector. The Indian government estimates the automobile sector to attract USD 8,000 to 10,000 million in domestic & foreign investments by 2023.

- **Strong growth momentum in automotive electronics:** Automotive electronics development is linked to automotive technologies in the creation of solutions that improve safety, fuel efficiency, consumer comfort, infotainment, and related applications.

- **Cloud based infotainment:** Consumer demand for increased safety, comfort, and aesthetic elements has prompted substantial technological advancements in the automotive industry. One of these developments is cloud-based infotainment which has increasing adoption among end-users.

Localisation of automotive electronics in India

Chart 4.13: Contribution of automotive electronic imports, India, by value in INR billion, FY20



Source: Localisation of auto electronics, SIAM and ACMA

There is a significant level of local value addition in India's automotive electronics industry. However, there is a high reliance on imported components. In FY20, overall automotive electronics imports accounted for 9% of total automotive imports, totalling around INR 16,000 crore. The share of electronics has been increasing across vehicle segments due to regulatory changes and consumer trends. China contributes for around 53% of the total auto electronic imports, followed by Vietnam, Korea, and Japan. Sensors, ECUs, PCBs, and electronic components make up roughly 65% auto electronics imports. Some of the key reasons for imports are lack of technology, shortage of raw materials, lack of fab production, and relatively low quantities to justify an investment in India in comparison to the global market. Moreover, Tier 1 global suppliers have production facilities outside of India and prefer to import components from those facilities.

Some of the key demand drivers supporting a significant increase in auto electronics include: (a) increasing customer preference for safety, comfort, and infotainment; (b) evolution of C.A.S.E. mobility; (c) increasing regulatory standards on safety, emission, fuel consumption, and performance; and (d) strong government policies to shift India's value chain dependency.

OEMs are being pushed to enhance their localization of auto electronics, focusing on procuring components from domestic suppliers in order to avoid high import duties and save on logistics costs. OEMs are interested in collaborating with Indian suppliers on automotive electronics to provide solutions that demonstrate their capabilities while also improving system-level understanding. Suppliers intend to increase the scale and quality of their products, as well as to establish a long-term value chain. The Indian auto industry's bodies, SIAM and ACMA, are collaborating on a road map for self-reliance, including increasing localization of market-relevant components.

Electric Vehicle market outlook in India

The Indian Electric Vehicle (EV) sector is still in its infancy, but there have been recent developments from both the government and OEMs. Electric two-wheelers (e2Ws), electric three-wheelers (e3Ws) and e-rickshaws, electric four-wheelers (e4Ws) (BEV, PHEV, and HEV), eCarts, and electric buses are all part of the EV market. Currently, e3Ws are the most popular EVs in India, followed by e2Ws. Premium carmakers traditionally dominate the e4W segment, while compact, low-cost EVs are steadily developing. Government policies and incentives have been a major driving force in the EV market. Also, battery swapping is witnessing a huge success in the country and, in turn, is driving the EV market, especially in smaller vehicle segments. There have been initiatives to set up public charging stations in order to promote the growth of the electric mobility segment. However, there are still ample gaps to be filled in the EV infrastructure area.

EVs are steadily gaining traction, owing to favourable government policies and the participation of global players. Emerging financial solutions, the huge growth of last-mile services, government policy revisions,

and increased availability of affordable models drive market expansion. While a few OEMs control a sizable market share in India, new entrants are increasingly striving for market share and competing with existing OEMs with improved models. The EV industry requires sizeable investments to promote EV technology, product R&D, and the development of tech-enabled platforms. Rising investments of start-ups in e2W and e3W segments, and investments by established OEMs in e4W segment play a crucial role in driving industry growth. The OEMs' requirements in this industry are quick and high-quality manufacturing, supply chain management and prototype development.

Future outlook of automotive industry

- The Automotive ESDM segment is expected to grow at a 29.2 % CAGR, from an estimated INR 50 billion in FY21 to INR 180 billion in FY26.
- Automotive is one of the key growth opportunity verticals for ESDM providers in the next 5 years, due to the technology transformation currently underway with autonomous cars development and electric car commercialization activities. Moreover, the rapidly growing electronics content will accelerate the growth of ESDM revenue from this vertical.
- India's passenger vehicle industry is estimated to post a growth of 22% - 25% in FY22
- Going forward OEMs will partner with more and more digital platforms for launching new vehicles as customers are now doing majority of their shopping for a new vehicle digitally
- In September 2021, the Indian government announced a PLI plan for automobiles and auto components totalling INR 25,000 Crore. This scheme is expected to attract investments more than INR 40,000 Crore by 2026.
- Under a new strategy to boost the development and export of clean technology cars, the Indian government has budgeted US$ 3.5 billion in incentives over a five-year period until 2026.
- Under the FAME (Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India) initiative, the Ministry of Heavy Industries, Government of India, has nominated 11 cities in the country for the adoption of EVs in their public transportation systems. The government will also establish an incubation centre for EV start-ups.
- The government intends to make India a worldwide manufacturing centre as well as a research and development (R&D) powerhouse. The Government of India intends to establish R&D centres under NATRiP (National Automotive Testing and R&D Infrastructure Project) at a total expenditure of US$ 388.5 million in order to bring the sector up to global standards.

C) Railways

There are currently a number of global OEMs in signalling innovations such as moving block technology, which allows trains to travel in order of braking distance, increasing capacity on multiple lines by over 20% and operating fully automated segments with complete safety. These OEMs include Siemens, Thales, Hitachi, Alstom and Bombardier.

The Indian market is controlled by global OEMs, as they all have Indian subsidiaries to meet the required need of local production. Kaynes has been the market leader in this vertical, working with most of the major global OEMs such as Siemens, Hitachi, Frauscher Sensor Technology, and others to manufacture Electronic Interlocking, Audio Frequency Track Circuits (AFTC), Axle Counter systems, and Passenger Information

Systems (PIS) for both Indian Railways and Metro. Before being included into the Indian Railways/Metro, these mission-critical electronic signalling and communication systems must be authorised by an RDSO or Metro authority. Kaynes is one of the few companies approved by RDSO and Metro authorities for onsite Factory Acceptance Testing. Similarly, Kaynes has been allowed to supply Audio Frequency Track Circuits to SNCF (French Railways) through one of the OEM. As the sole local producer for major Global OEMs, Kaynes is in a unique position to leverage on its connection with them.

Kaynes is currently a leading electronics manufacturer of signalling system for both Indian Railways and metro railways through number of multinational corporations. Besides being a manufacturer of Passenger Information Systems for a Canadian-based OEM, Kaynes is also an authorised vendor for repairs for Delhi Metro Rail Corporation. Kaynes has also created a Metro Door opening and shutting Light module, which is marketed to OEMs, using its ODM capabilities. Apart from Kaynes, Kyosan has a production and supply agreement with Avalon, a Chennai-based EMS company. Kaynes is also approved by Chittaranjan Locomotive Design centre for restoration of Three Phase Locomotive electronics. Other prominent include Cyient and Avalon. Some of the other key organisations supporting Indian railways include RVNL, Railtel, DFCC and Concor. RVNL is helping in building engineering works required by the Indian Railways and Railtel is helping modernizing the train control operation and safety system of the railways.

Growth Drivers

- **Increasing private sector participation:** Global players having presence in rail infrastructure and ecosystem
- **Government focus on infrastructure:** Emergence of High Speed Rail Projects for faster connectivity
- **Rising demand for urban mass transportation:** Increase in urbanisation and rise in income for both urban and rural sectors is driving growth in this segment
- **Improved safety and modernisation:** Increase in automation of Urban Railway Infrastructure and importance of Safety
- **Growth of freight traffic due to industrialisation:** India is projected to account for 40% of the total Global share of Rail activity by 2050

Electronics manufacturing in Railway sector

- Major areas of usage of electronics in Railway industry is signal safety related electronic system, safe communication and processing system among others
- Electronic components without asymmetric faults and unsafe communication channels are also being used in the railway signalling system.

Future outlook of Railway sector

- The Railways ESDM segment is expected to grow at a 46.3 % CAGR, from and estimated INR 5 billion in FY21 to INR 35 billion in FY26.
- The Indian Railway has launched the National Rail Plan, Vision 2024, to accelerate the implementation of the critical projects, like multi-track congested routes, achieving 100%

electrification, upgrade the speed to 160 km/hr on Delhi-Howrah & Delhi-Mumbai routes, upgrade the top speed to 130 kmph on all other golden quadrilateral-golden diagonal routes and remove all level crossings on the golden quadrilateral-golden diagonal route, by 2024.

- Indian railways plans to invest INR 500 billion to enhance the metro network across major cities
- Metro requirements in next five years is expected to go up
- To boost the rail infrastructure and make Indian Railways network future ready, Indian Railways has recognized 56 projects across the nation in numerous zones to be completed by FY22.
- Indian Railways is developing & creating technology in areas like signalling & telecommunication to be tailored with 'KAVACH', the locally developed Train Collision Avoidance System.
- The key signalling and telecom Upgrades on Indian Railways by 2026 include (a) Train collision avoidance system for a target of 37,000 km (b) Automatic block signalling for a total route of 15,500 km (c) Electronic interlocking across 1551 stations (d) 4G/LTE Based Wireless Communications for entire railway network (e) centralised traffic control for 11,000 km.

D) Medical

The Indian Medical Devices, market is experiencing dynamic changes with the emergence of advanced technologies, evolving clinical and administrative needs, and the introduction of new policies and regulations, which is forcing industry participants to innovate to maintain their competitive edge.

The healthcare & medical device sectors have grown ominously in the last decade. There is a huge gap in between the current market demand and supply of the medical devices in India and this actually provides a substantial opportunity for the manufacturing devices market to grow in India.

At present, numerous medical device manufacturers (domestic & international) are chasing this huge under penetration of the medical devices in India as a substantial growth opportunity.

Growth Drivers

- Population growth and an increase in the number of healthcare initiatives are projected to fuel the growth in medical devices. Growing health consciousness, shifting attitudes toward preventive healthcare, and an increase in lifestyle diseases all serve as further catalysts.
- The increased pace of technological advancements and an access to advanced equipment to address patient s' needs, as well as increasing affordability of diagnostic devices by users is expected to dominate the market.
- Government setting up innovation centres for medical diagnostics products
- Rapid growth and demand in remote diagnostics and patient monitoring

Electronics manufacturing in Medical sector

- Nearly 65% of the manufacturers in India are typically domestic players operating in consumables segment & catering to the local consumption with limited exports. Big MNCs lead the high technology end of Medical Devices market in India with widespread service networks.

- Major electronics in medical business includes MRI, X-Ray, Ultrasounds, etc. and Patient Aids include hearing aids and pacemakers, etc.
- Kaynes is a major manufacturer of Ventilators, Respirators, and Diagnostic Devices for OEMs. Kaynes is manufacturing complex diagnostic and lab testing equipment's for both domestic and exports market.

Future outlook of Medical sector

- The Medical ESDM segment is expected to grow at a 43.1 % CAGR, from and estimated INR 15 billion in FY21 to INR 90 billion in FY26.
- The Government has approved 100 % FDI in the sector, including Brownfield and Greenfield projects, which is expected to boost the industry. Strong FDI inflows also suggest that foreign companies are optimistic about the Indian medical devices market.
- The department of pharmaceuticals launched the PLI scheme for domestic production of medical devices, with a total expenditure of funds worth INR 34.2 Billion for the period FY21-FY28, to increase domestic manufacturing of medical devices and attract significant investments in India.
- The medical devices market in India has the potential to increase at a 37% CAGR till 2025
- To boost the domestic manufacturing of the medical devices has attracted huge investments in India; the department of pharmaceuticals launched a PLI scheme for the domestic manufacturing of medical devices, with a total outlay of funds worth INR 3,420 Crore for the time period FY21-FY28.
- In January 2020, the government set up a National Medical Devices Promotion Council to promote the local manufacturing of high end medical devices and attract the investments in the sector, which is expected to create more investments in next 5 years
- In September 2021, the government approved a medical devices park in Oragadam (Tamil Nadu) which is expected to attract an estimated investment of INR 3,500 Crore and offer direct and indirect employment to nearly 10,000 people.
- Hyderabad is emerging as the medical devices hub in the country. Establishment of the country's largest medical devices park in Sultanpur in 2017 has attracted more than 40 companies to set up units till 2020.
- In May 2020, AiMeD invited Japanese investors who were interested in setting-up a manufacturing base for the medical devices in India. As a part of the initiative, India is targeting 1200 technical collaborations with the Indian investors for USD 5746.7 million and above, 200 JVs with the foreign investors for USD 1903.8 million and above and 50 MNCs for USD 1903.8 million and above.

E) IT

Industry Overview

Government's digitization programs like Digital India will continue to drive this segment. Key products in the IT segment include Notebooks, Servers, Storage Devices and Tablets. These top products occupy majority of the market in terms of volume.

AI printed circuit board designs & engineering processes bring further flexibility and create a new generation of products, like the connected objects, smart home devices, and IoT devices. Printed Circuit Boards (PCB) for the connected devices have been reinvented in order to add the AI aspects.

In FY21, demand for IT hardware increased as a result of work-from-home opportunities and the need to be connected remotely. Individuals purchased computers and tablets; businesses invested in data centre infrastructure (to service work from home and online B2B dealings). IT/computer hardware is a highly competitive market both globally and in India. The market's leading players include Dell Technologies, HP, and Lenovo, which collectively hold 74% of the market and are increasing their shipments year over year. The other key players include Acer, Apple, and Asus among others.

The IT and business service industry's revenue was estimated at USD 6.96 billion in H1 of 2021, an overall increase of 6.4% Y-o-Y. IT spending in India is estimated to reach USD 93 billion in 2021 a 7.3% Y-o-Y growth and it is expected to further increase to USD 98.5 billion in the year 2022.

Electronics manufacturing in IT sector

- The IT hardware market encompasses all physical components that includes computing hardware (desktop PCs, notebook PCs, tablets, adaptors and workstations), all of which are produced by global companies such as Samsung, Apple, Acer, and Lenovo, with the majority produced in China. Challenging macro-economic outlooks, along with the rising demand for PCs has slowed down the PC sales in India. Notebook PCs saw very high level shipments in the year 2019 to 2021.
- The OEMs' requirements in this industry are PCBA, testing and packaging and box build capabilities, as well as supply chain management

Key Drivers

- **Faster adoption of virtual lifestyle:** The rapid adoption of the virtual lifestyle by large enterprises, small and medium businesses, and start-ups is cited as the primary driver of increased PC demand. In addition, millions of students purchased personal computers to use for online learning. As the amount of time spent on screens increased, a large number of millennial and youth who previously used mobile phones and laptops for computing began to prefer PCs. Increasing adoption of tablets and notebooks in the Gen Y population especially in the 25-to-45-year-old demographic will help the sales grow.
- **Notebooks and tablets leading the growth path:** Falling prices and subsidies relationships with carriers are set to drive sales of tablet devices. Rising demand from the enterprise segment gives notebooks and tablets a place in schools, offices, and in the field.

Future outlook of IT sector

- The IT ESDM segment is expected to grow at a 70.5 % CAGR, from and estimated INR 25 billion in FY21 to INR 360 billion in FY26.

- Supply remains relatively lower than current demand in the country. Also, supply constraints for entry-level CPUs and panels restrained growth, due to which, allowing vendors to have an opportunity to capitalise on missed forecasts in 2020.
- Consumer demand does not appear to be slowing down anytime soon, and businesses continue to place new orders. Additionally, government education arrangements are being discussed, which might lay the groundwork for a very prosperous year in 2022. If the current supply constraints persist for a few more months, it can partially offset the ongoing demand. Not only will device availability be crucial for category growth, but it will also be critical for the market expansion.
- IT hardware segment is expected to maintain a growth rate of around 8% till 2025
- In FY21, computer software and hardware topped the FDI investments, accounting for nearly 44% share of the total FDI inflows of USD 81.72 billion. Japanese investments in the Indian IT sector grew 4 times between 2016 and 2020. Investments stood at USD 9.2 billion in the same period.
- Adoption of the new technologies is estimated to accelerate the growth of the BFSI vertical. The need for undertaking the investment in IT will also be required for gaining the competitive advantage instead of only reducing the operational costs
- In February 2021, Yotta Infrastructure announced that by leveraging company's state-of the-art Yotta NM1 data centre at Navi Mumbai, Essar Capital Ltd., with investments worth nearly USD 14 billion has undertaken a very large-scale digital transformation initiative.
- With digital transformation accelerating across the sectors, the pandemic has driven the demand for the cloud services globally, and the Internet has become the lifeline for the people both for work and also for entertainment. This move towards the cloud services has accelerated the hyper-scale data centre investments, with global investments estimated to surpass USD 200 billion every year by 2025.
- The combined investments in the data centres in India are expected to reach USD 28 billion between 2019 and 2025, having a CAGR of nearly 5% in between 2019 and 2025, and 2x faster than the global average.

F) Aerospace & Defence

In India, the aerospace industry is growing ominously with rising activities from both defence & civil aviation segment. With the increasing demand for the large aircraft from the Indian carriers like SpiceJet & Indigo, and focus on the Powered by Hour Contracts, many of the India's aerospace services & manufacturing activities are anticipated to be carried out. Likewise, as country's defence capital expenditure spending is constantly growing, there are also numerous opportunities in the defence aerospace. This offers opportunities for the start-ups as well as further expansion for the existing players.

Some of the prominent players operating in Indian A&D space include Kaynes, Cyient and Centum. Additionally, Kaynes is also an approved supplier for ISRO. Kaynes possesses prestigious NADCAP certification, which gives it access to the global A&D market, especially US and Europe. Kaynes is the first company in the ESDM industry to be NADCAP accredited for aerospace products and among the few Indian companies maintain this accreditation.

Growth Drivers

- India ranked 19th among the world's defence exporters in attracting the foreign investments. India's defence exports augmented 700% in two years from INR 1,521 crore in 2016-17 to INR 10,745 crores in 2018-19. In August 2020, the Union Ministry of Defence formulated the Defence Production & Export Promotion Policy 2020 as an essential guidance document to fast-track the government's commitment for the 'Atmanirbhar Bharat' and provide a streamlined, guided and significant boost to country's defence production capabilities for self-reliance & exports.
- As India is speedily modernising its military segment, the aerospace & defence industry is anticipated to consume electronics worth INR 70-72 billion over the coming decade in agreement with two industry associations—NASSCOM and IESA.
- Strong A&D ecosystem and increasing defence budget will drive the A&D market in India

Electronics manufacturing in A&D sector

- Within the defence sector, Defence electronics have emerged as a key market.
- IESA, along with the Nasscom have put together draft recommendations on a "Defence Electronics Policy" they hope the GOI is going to implement in a well-timed manner in order to enhance the development of the sector
- The Defence electronics & system design policy recommendations signifies the recommendations made to the Ministry of Defence. The policy references indicate that India not only needs to form world-class companies, but it is vital to bring them in the global value chain of the OEMs.

Future outlook of A&D sector

- The A&D ESDM segment is expected to grow at a 44.3 % CAGR, from and estimated INR 27 billion in FY21 to INR 170 billion in FY26.
- The Indian A&D market is anticipated to reach USD 70 billion by end of 2030, driven by burgeoning demand for the advanced infrastructure & government thrust.
- ISRO looking for EMS partners as they are scaling up
- Strategic electronics segment has a growth potential of around 8% till 2025
- In 2021, the government of India eased constraints on defence expenditures to boost development of military purchases. As a consequence, the Ministry of Defence may spend within its quarterly budget, which includes over 100 emergency procurement contracts at INR 500 crore each.
- Tata, Airbus signs INR 20,000 crore deals to make military aircraft in India. It will enable to build a robust aerospace ecosystem in the subcontinent by encouraging MSMEs to produce aircraft components and spares.
- As many as 34 aerospace and defence firms have shown interest in investing in Karnataka to spur aviation business in the Karnataka at a total investment of around INR 2,500 crore.
- The government announced measures under the 'Make in India' initiative, including raising the foreign direct investment (FDI) limit from 49% to 74% via automatic route; this resulted in significant FDI inflows in the defence and the aerospace sector.
- Also the government is in plans to revise the State FDI policy, with FDI up to 100 percent being allowed in satellite establishment and operation, subject to the Department of Space/ISRO sectoral

guidelines. It will open up a lot of opportunities for foreign companies to collaborate with Indian companies in order to compete with global space players. There is a lot of interest from other countries in collaborating.

- In the month of November 2021, Defence Acquisition Council (DAC) boosted the 'Make in India' initiative by according Acceptance of Necessity — to capital acquisition proposals worth INR 7,965 crore for the purpose of modernisation and operational needs of the armed forces.
- Defence ministry plans to put 101 defence items under the import embargo to offer the potential military hardware manufacturing opportunities to the Indian defence sector.

G) Consumer Electronics & Appliances (CEA)

Industry Overview

Low penetration levels of most of Consumer Electronics & Appliances categories leaves large headroom for the CEA industry to grow. This opportunity is further pronounced in large semi-urban and rural markets of India. The sharp focus by government in improving infrastructure, especially electrification and roads, has resulted in reducing the gap between rural and urban. Today consumers are value conscious and do detailed research before buying a product. Therefore, companies are forced to provide features that differentiate them from others. Designing and making products that meet the aspirations of today's consumers is what is the order of the day. After-sales service is a crucial component as it helps in building brand value and customer loyalty, which triggers repeat purchase and helps in word-of-mouth publicity.

A growing Indian economy, rising purchasing power of consumers and better access to quality products at affordable prices has revolutionized the consumer electronics and appliances (CEA) industry in India. The rapid pace of urbanisation, a large emerging middle class and easy digital access have further aided the growth of CEA products. ESDM is essential for consumer electronics and appliances industry since many manufacturers outsource their CEA manufacturing to ESDM companies

Consumer goods industry is India's fourth-largest sector with household & personal care accounts for nearly 50% of the consumer goods sales in India. Growing awareness, changing lifestyles and easier access have been the major growth drivers for this sector. The urban segment is the biggest contributor to the total revenue generated by the consumer goods business in India. However, in the last couple of years, the consumer goods business has grown at a much faster pace in the rural India while compared to the urban India. Semi-urban & the rural segments are growing at a fast pace and the consumer goods products account for nearly 50% of the overall rural spending. Electric fans, one of the key appliances having highest penetration in CEA market at around 74%. Kaynes has a good offering and connects to a new generation of fans through its own BLDC design. Refrigerators, washing machines, and other white goods have a significant market share in the Indian CEA market. Kaynes is an upcoming firm with differentiated product offerings that is gaining traction in these markets. Kaynes is delivering excellence with larger focus in IoT solutions. It is the only ESDM company with strong focus on IoT solutions capabilities.

Electronics manufacturing in CEA segment

- Modern technology has paved the gateway for the multi-functional devices like the smart watch and the smartphone. Computers are much faster, more portable, and higher-powered than it was

ever before. With all of these uprisings, technology has also made our lives easier, better, faster and more fun.

- The advent of IoT and artificial intelligence (AI) in the consumer appliances segment opens a wide array of possibilities, given the massive size of the market in India.
- Introduction of wide serving automation and robotics in production lines, inspection cycles, maintenance and logistics is becoming a new trend.

Key Drivers

- Demand for the consumer electronics in India has been growing depending on the rising income of consumers; this particular trend is all set to continue even as the other factors like the rising rural incomes, a growing middle class, increasing urbanization and changing lifestyles aid the demand growth in the sector.
- E-commerce platform is fast capturing the commodity requirement of customers and is becoming popular among a large section of customers. Internet transactions in consumer electronics and appliances have grown tremendously over the past couple of years. The expansion of internet access, the growing usage of smartphones, and the increased number of internet retailers have aided in growth.
- Advancement in the technology and the higher competition are driving the price reductions across numerous consumer appliances product segments like television, refrigerators, washing machine and RACs. With the “Make in India” initiative, numerous domestic and the foreign manufactures are investing in India to set up their production plants which is going to produce more affordable products.

Future outlook of CEA industry

- The CEA ESDM segment is expected to grow at a 32.8% CAGR, from and estimated INR 140 billion in FY21 to INR 565 billion in FY26.
- Low penetration levels of most Consumer Electronics and Appliances categories leaves large headroom for the industry to grow. This opportunity is further pronounced in large semi-urban and rural markets of India. The sharp focus by government in improving infrastructure, especially electrification and roads, has resulted in reducing the gap between rural and urban.
- The Indian consumer electronics and appliances market is expected to grow more than two-folds in the next five to six years, helped by the growth of the economy and domestic market. The market is expected to grow at a CAGR of in between 11 to 12 percent till FY25.
- Today consumers are value conscious and do detailed research before buying a product. Therefore, companies are forced to provide features that differentiate them from others. Designing and making products that meet the aspirations of today’s consumers is what is the order of the day.
- In September 2021, FICCI mentioned that nearly 52 companies have applied for availing the PLIs for the white goods makers, proposing an investment of nearly INR 6,000 crore in manufacturing components for the air conditioners (ACs) and the LED lights. Most of these investments are estimated to happen in the coming 2 to 3 years; following this, local production for the components for the ACs and the LED lights is estimated to start.
- Dyson, is going to invest around USD 200 million in the Indian consumer durables sector by 2023.

- Godrej Appliances made an announcement of an investment of INR 100 crore across two of its manufacturing facilities— Shirwal in Maharashtra & Mohali in Punjab—to expand company's production capacity for the air-conditioners to a volume of 800,000 units by the year 2025.
- Foxconn plans to invest up to USD 1 billion to expand a factory in the southern India where it assembles iPhones.
- Blue Star Climatech, the wholly owned subsidiary of the Blue Star, plans to invest INR 550 crore, over the coming few years, to set up the new manufacturing facility at Sri City, in Andhra Pradesh's Chittoor district.

H) Telecom

Industry Overview

India is currently the world's second largest telecommunications market. Over the next five years, increased mobile phone penetration and reduced data prices will add 500 million additional internet users in India. The advancement of direct and indirect competition in the telecommunications market has had an influence on conventional operators' revenue growth rates and profit margins. While penetration of telecommunications services is high, infrastructure on information technology (IT) and value-added services (VAS) is in the growth stage. Moving away from the traditional sources of revenues to cloud offerings is critical for long-term growth.

The new technology provides the advantages of massive connectivity and low power consumption and boasts of download speeds and capacity that can enable autonomous vehicles, drones, remotely assisted surgeries, and traffic control. 5G connectivity will be used in emerging technologies and technology-enabled markets such as IoT, smart cities, and smart agriculture. 5G, due to its greater speed, would also enable next-generation IoT and machine-to-machine (M2M) applications such as autonomous vehicles and virtual or augmented reality. The OEMs' requirements in this industry are technical expertise in the manufacturing of large and complex PCBAs and quick ramp-up capabilities.

ESDM companies provide a variety of core manufacturing and ancillary activities, allowing OEMs to focus on their core competencies while improving overall efficiencies. The technologies allow for the efficient manufacture of telecom equipment, and India aspires to become a major manufacturing hub. The ecosystem is an important and strategic component of constructing a secure telecom infrastructure. India aspires to be a major original equipment manufacturer of telecommunications and networking products. Syrotech, Netlink, Alcatel Lucent, Bharat FIH, Syrma SGS, Tejas Networks, Speech & Software Technologies, and Alphion India are key telecom and ESDM players.

Electronics manufacturing in Telecom sector

- A lot of growth potential exists for telecom electronics products like GPON, IP PBX and Media Gateway as well as Router and Modems. Routers, GPONs, and modems are going to remain key revenue contributors within the Telecom and Networking Products business in the forecast period.
- India plans to roll out state-of-the-art 5G telecom services in 2022. The new technology provides the advantages of massive connectivity and low power consumption and boasts of download speeds

and capacity that can enable autonomous vehicles, drones, remotely assisted surgeries, and traffic control.

- 5G connectivity will be used in emerging technologies and technology-enabled markets such as IoT, smart cities, and smart agriculture. 5G, due to its greater speed, would also enable next-generation IoT and machine-to-machine (M2M) applications such as autonomous vehicles and virtual or augmented reality. The OEMs' requirements in this industry are technical expertise in the manufacturing of large and complex PCBAs and quick ramp-up capabilities

Growth Drivers

- **Removal of duty exemption on imported products:** In line with the 'Make in India' initiative, exemption from the basic customs duty, special additional duty and countervailing duty has been removed on select components. This is intended to benefit domestic manufacturers by increasing the cost of imports. Import tariffs on inputs that contribute to the manufacture of such parts and components have also been removed to encourage local production.
- **Capex Optimization:** Spend on Capex in the Telecom and Networking Products industry is very high. Nearly 40 % to 60 % of the Capex is being utilized for setting up and managing the telecom infrastructure. As revenue per tower and ARPU is declining over a period of time, sharing of the telecom tower and other types of infrastructure is imminent. By sharing the infrastructure, operators can actually optimize their capex, and focus more on providing new and advanced services to their subscribers.
- **4G and 5G Infrastructure in India**: While Airtel, Vodafone and Jio have concluded the roll out of its 4G services on pan-India basis, service providers are gearing up for 5G roll out in India, which will boost the customer utilization of high-end data products. 5G is required to create new economic value in India and globally. The business opportunity for 5G in India is huge and it will encourage investors to participate, manufacture, sell and export to the global market.
- **Increased telecom coverage and capacity:** Having innovation at the core, Indian telecom tower business has carved a world-wide niche in terms of infrastructure sharing. By focusing on right mix of competencies & business opportunities, the tower industry is expected to drive the next infrastructure revolution & recognize the vision of broadband for all in India. The telecom tower business has remained a pivotal force in routing the connectivity revolution in India. Between 2007 & 2020, total number of towers has grown over two-fold having a CAGR of more than 7% to reach 606K in 2020.

Future outlook of Telecom sector

- The Telecom ESDM segment is expected to grow at a 22.9% CAGR, from and estimated INR 42 billion in FY21 to INR 118 billion in FY26.
- The Indian Telecom market, which has over 900 million mobile subscribers, has grown at a breakneck pace over the last decade. While much of this development has been driven by voice, the next wave of growth will be data-driven.
- Increased potential will result from a focus on customer experience and network quality, as well as growing demand for wireless data services, 4G, and broadband wireless access networks, as well as development into new circles and rural areas. As the importance of coverage and capacity grows,

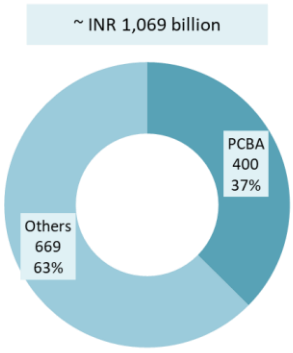
telecom infrastructure service providers have expanded potential to assist Telco's. Services are becoming crucial for everything from network deployment to network benchmarking and optimization.

- The market is expected to grow at a CAGR of 18%, from FY21 to FY26.
- In October 2021, Dixon Technologies announced plans to invest INR 200 crore under the telecom PLI scheme; this investment will include the acquisition cost of the Bharti Group's manufacturing unit.
- In September 2021, Bharti Airtel announced an investment of INR 50 billion in expanding its data centre business to meet the customer demand in and around India.
- Bharti Enterprises Ltd. and Dixon Technologies (India) Ltd. created a joint venture in April 2021 to take advantage of the government's PLI plan for telecom and networking device manufacture.
- In March 2020, the government approved the Production Incentive Scheme (PLI) for the Large- scale Electronics Manufacturing. The scheme proposes production-linked incentive to boost the domestic manufacturing and attract the large investments in the mobile phone manufacturing and specified electronic components which includes Assembly, Testing, Marking and Packaging (ATMP) units.

ESDM Market Break-up by Select Product Segment

PCBA (Printed Circuit Board Assembly)

Chart 4.13: Break-up of PCBA in the ESDM Market, India, by Value in %, FY20



The PCBA is the core of an electronic device, which includes Flash Memory, Application Processor, Graphics Processor, other semiconductor-based active and passive sub-components. All these assembly parts are not locally sourced considering a lack of semiconductor foundry and PCB sub-components supplier ecosystem in India. All electronic devices derive their intelligence and functionality from the PCBA. PCBAs are used in several sectors such as consumer electronics, mobile phones, automotive, and medical. It supports most electronic products and continues to expand into new sectors and applications.

The National Policy on Electronics 2019 predicts positioning India as the global hub for the ESDM by concentrating on the size and the scale, endorsing the exports and enhancing the domestic value addition by creating a facilitating environment for the industry to compete on global level, which is an important policy objective. Building PCBA manufacturing capabilities is going to be the key to India's desire to become the leading electronics manufacturing hub for the universe. Investing in Printed Circuit Board Assembly is not only critical for maintaining the domestic manufacturing impetus but also India's emphasis on reducing its dependency and trade deficit on China. There is now a very strong realization among the multinational companies that supply chains must be de-risked and these establishments are now looking at diversifying to the other countries.

Some of the key drivers of PCBAs include growth in value addition and increasing demand for electronic products globally, requirement for high-speed assembly and miniaturization. It is very important for India to

encourage the contract manufacturers and increase their manufacturing operations in India. This is expected to speed up the export of PCBA, position India as the source of the global supply and further strengthen India's hold on the electronic manufacturing.

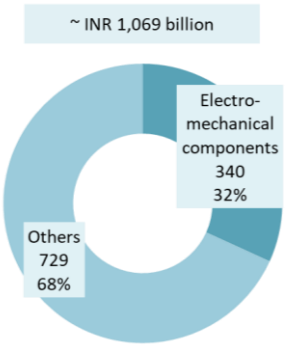
Electro mechanical components

Electro-mechanical components are those that utilise an electrical signal to create a mechanical change. The electronic components market can be largely categorised as follows:

- Passive components - capacitors, resistors, wound components and crystals
- Active components - diodes, transistors, ICs and LEDs
- Electromechanical components - PCBs, switches, relays, cables and connectors
- Associated components - optical discs, magnets, RF tuners, heat-sinks, magnetrons, etc.

The electromechanical components dominate the ESDM market, contributing to 43 % of the total ESDM market. China, Taiwan, Japan, South Korea, and a few European countries are the key import destinations for India. The amount of value added in electronic components is quite restricted because the majority of the raw materials are imported. Imports of specialised components such as chip components, ICs, LEDs, PCBs, and so on have a greater percentage share of imports. India has strong production capability for components that do not require complex manufacturing.

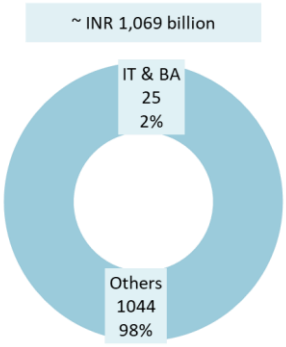
Chart 4.14: Break-up of Electro-mechanical components in the EMS Market, India, by Value in %, FY20



Consumer durables and the telecommunication which includes mobile phone account for the major demand for the electronic components in India. This is being followed by the information technology and office automation and the automotive industries. Other major application industries like industrial and medical electronics, strategic electronics and the lighting industry contribute to the balance of the market. Industries like lighting and the strategic electronics are anticipated to witness the substantial growth in the near future. Rising local demand, adoption of high-end technology devices, technological advancements such as 4G/LTE network rollouts and the Internet of Things (IoT), along with government policies and incentives will drive the growth for electro mechanical components in India.

Some of the leading electro-mechanical component player in India include, Vishay Components India Pvt Ltd, Epcos India Pvt Ltd, Deki Electronics Ltd, Globe Capacitors Ltd, Keltron Component Complex Ltd, Victor Component Systems Pvt Ltd. Kaynes is a major participant in this category since it designs and manufactures its own magnetics and has an in-house magnetics facility with a continuing emphasis on backward integration. It also provides cable harness and assembly.

Chart 4.15: Break-up of IT & BA in the EMS Market, India, by Value in INR Billion, FY20



IT & BA

Government's digitization programs like Digital India will continue to drive this segment. Additionally, rising security concerns (primarily deployment of video surveillance systems), demand from upcoming infrastructures projects as well as growing awareness amongst consumers is driving the Building Automation market in India.

The top 5 products in the IT and Building automation segment include CCTV cameras, Notebooks, Servers, Storage Devices and Tablets. These top 5 products occupy 90% of the market in terms of volume.

India is one of the largest exporter of IT and this trend is expected to increase and there is an increased outsourcing that is happening to the companies with design, logistics and after sales support services.

High opportunity segments for ESDM companies especially for Kaynes

Industrial, Consumer electronics and appliances, Automotive, Lighting and Mobile phones are the high opportunity segment for ESDM companies in India. The mobile phone has become the dominating sector in the ESDM industry. Additionally, as India is a global leader in the automotive sector, with various OEMs active in the market, Engine Control Units (ECU) have a stronger focus. The growing concern among end-users about vehicle performance and fuel consumption are the primary drivers of ECU growth. The government has classified LED lighting as one of the products with a strategic focus. In the coming years, the biggest applications are expected to be residential, street lighting, and commercial lighting. Kaynes is a pioneer in excellence, with a particular emphasis on new technology. Kaynes with its focus on Smart Metering Technology, Smart Street Lights, Brush Less Direct Current Technology, GaN Technology, Dispensing Technology and IOT solutions with its own sensors for cloud based asset tracking/ monitoring is poised for substantial growth in the ODM space. Their hardware/ solutions are being used increasingly by the OEMs in consumer electronics to make their products SMART and even energy efficient.

CHAPTER 5 – COMPETITION OVERVIEW

Company profiles

1. Kaynes Technology India Ltd

Company Overview

- Kaynes, headquartered in Mysore, is a prominent domestic player in the Electronics System & Design Manufacturing Services, having a strong worldwide presence.
- Kaynes is the only company in the world to hold ten global certifications, making it the most certified ESDM Company in the country. It is also one of the biggest companies that have been certified by Global Standards for Social Accountability Standards.
- The company has a cutting-edge Design and Development Centre in Bangalore that provides Embedded Design and Engineering services to customers from Concept to Manufacturing.

Key Business Segments

- Industrial
- Automotive
- Railways
- Medical
- Medical electronics
- IT
- Aerospace & Defence
- IoT and Others

EMS Products Manufactured

- **Industrial** – Engine control panel, Biometric add-on, Surge protector, Accelerometer, Street light controller, BLE module, Precision bridge, Strain gauge instrument, Single Phase and three phase Smart Meter, Test equipment, Industrial UPS, Temperature controllers, Controllers for renewable energy etc.
- **Automotive** – Cluster PCBA, All types of electronics for Automotive lighting (including LED head lamp PCBA (2W & 4W), LED tail lamp PCBA, LED position lamp PCBA, DRL PCBA, Headlamp level switch PCBA, Headlamp level actuator PCBA etc.), Passenger Entry Passenger Exit (PEPS), Electronic Control Unit (ECU), Switches for steering control, doors, windows, HVAC and lumbar support etc.
- **Railway** - Audio Frequency Track Circuits (AFTC), Short Distance Track Circuits (SDTC) cubicle, electronics for Interlocking, Axel counter, Passenger Info System (PIS), Train safety and traction, UM71 Receiver, ETCS On board Cubicle etc.
- **Medical (Healthcare)** – Ventilators, Respirators, Controller units for dental chairs, Smart glucometer, Single & multiple-bed PMS, Endoscopy cart, Fetal monitoring system, X-ray machine with display, Tube sealers, incubators and agitators, VAP care, Flip device, Specific protein analyzes & clinical chemistry analyzers, Controller units, Foreign body extractors, diagnostic devices etc.

- **Aerospace and Defence** – Electronics for navigation & sensors, Airborne radio communication systems, Thermal imaging systems and LRUs for power supplies, HH Sonar, Negotiator, etc.
- **IoT & Others** – Bar code scanner, RFIG gateway, Industrial tablet, Industrial HMI, PLC Gateway, Gateway – Asset condition monitoring, AIIoT gateway, Differential air pressure, RTD temperature, Liquid pressure, Vibration, Magnetics, Relays, Plastic Moulding, High Complex & High Mix PCBAs, etc.
- **Non-automotive** – PCBAs, IT Tech & Semi-conductor, High end test instruments, IC card readers, BLE modules, Streetlights, Energy meters, Controllers, Harness, Night vision cameras, etc.
- **Wearables** - Wired Headsets, Wireless Headsets, Accessories, TWS, Smart watch, Bluetooth speakers, etc.

Manufacturing Facilities

- Mysore, Karnataka - Unit 1 (Railways, Defence and Aerospace, Medical and Industrials)
- Mysore, Karnataka - Unit 2 (Railways, Defence and Aerospace, Medical and Industrials)
- Parwanoo, Himachal Pradesh (IT, Telecom, Industrial, Medical and Automotive)
- Selaqui, Dehradun (IT, Industrial)
- Bengaluru, Karnataka - Unit 1 (Automotive, Medical, IOT, IT and Industrial)
- Bengaluru, Karnataka - Unit 2 (Automotive and Industrial)
- Chennai, Tamil Nadu (Automotive, Medical and Industrial)
- Manesar, Haryana (Industrial, Medical and Automotive)

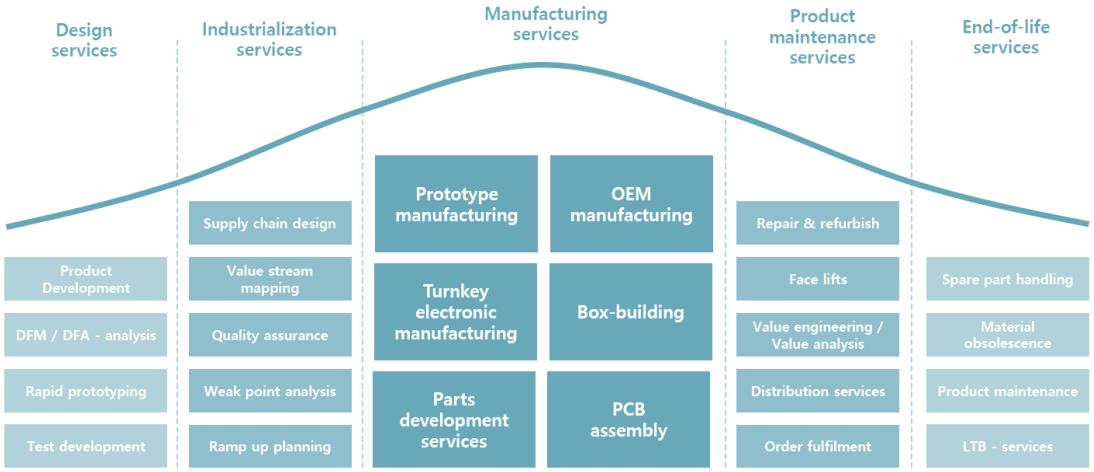
Service Centers

- Kochi, Kerala (Aerospace and Defence)
- Mumbai, Maharashtra (Railway, Aerospace, Defence and Industrial)

Global certifications

- ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018
- IRIS certification Conformity assessment: 2020 and based on ISO/TS 22163:2017
- ANSI ESD S20.20-14
- IEC 61340-5-1:2016
- SA 8000:2014
- IATF 16949
- ISO 13485:2016
- BS EN ISO 9001:2015, EN 9001:2018
- NADCAP

Capabilities offered by Kaynes in the entire spectrum of ESDM



Key Strengths

- Kayne's capabilities in Design, Manufacturing, Infrastructure, Systems, Skill Sets, and TQM techniques allow it to provide High Tech, High Mix, Low and Medium Volume Production, as well as Value Engineering and Product Data Management throughout the product's life cycle.
- Kaynes is a market leader in high mix flexible volume product management, with a presence in nearly every industrial vertical. The company focuses on highly complex products & demanding regulatory environments.
- Kaynes provides conceptual design, production, and testing of high reliability PCBAs, Box Build, Products, and Systems Integration Services in addition to products required by various industry segments.
- It features a cutting-edge production and testing facility as well as a contemporary infrastructure, including a unique line for green manufacturing.
- Kaynes has robust manufacturing systems and processes. It has the best-in-class infrastructure with 7 SMT lines, 57 THD lines, 11 cable harness lines, annual capacity for 3 billion components. The company also has 2 exclusive RoHS compliant lines for green manufacturing.
- Kaynes has continued emphasis on customer centric process with strong entry barriers, given the stringent on boarding process, quality audits & protocols established (over 6 18 months period), involving significant investments by both clients & Kaynes.
- Kaynes has a diverse and global customer base with a low customer revenue concentration. Also, it has a long standing relationship with customers, an opportunity for increased wallet share.
- The company has a diversified and balanced geographic and sectoral portfolio catering to 250+ customers in 19 countries.
- Growing through consolidation, and partnership models – For example, Kaynes International Design and Manufacturing Pvt Ltd (JV with Mohlenhoff Gmbh)
- R&D is at the heart of Kaynes' strategic agility and competitiveness. It's one of the few Indian companies with a broad range of competencies, including design, and offers end-to-end solutions.

- Kemsys (a Kaynes company), from canvas to cloud IIoT engineering, provides one stop IoT solution. The firm provides solutions in device engineering, manufacturing, digital engineering and firmware engineering.
- Kaynes has deep connects with the start-up ecosystem that can help partner with the next generation companies early on.
- Kaynes is growing through consolidation, acquiring, and partnership models.

2. Bharat FIH (formerly Rising Star Mobile India)

Company Overview

- Bharat FIH, the subsidiary of the FIH Mobile Ltd, a Foxconn Technology Group Company, is currently India's leader in manufacturing and services of handset and the wireless communications. The company have been a part of the Indian growth story since 2015, leading an unmatched manufacturing revolution. Bharat FIH is one of the largest EMS providers in the country serving the local and the international brands.
- Formerly known as the Rising stars Mobile India, the company entered and established their presence in India in the year 2015 at Sri City, Andhra Pradesh. By 2017, the company had expanded their capacity to Sungavarchatram and Sriperumbudur near Chennai, with added capabilities.

EMS Products Manufactured

- Mechanical components (metal & plastic) of mobile phones
- PCBA
- Assembly of both Smart Phones and the Feature Phones categories

Key Business Segments

- Mobile phones (Communication devices)
- Telecom
- Television

Key Services Offered

- Design & Engineering
- New Product Development
- PCB Assembly
- Complex machining
- SMT
- Final assembly

Manufacturing Facilities

- The company has 3 manufacturing campuses and 12 factories in overall
- 50+ mobile assembly lines
- Company's manufacturing operations are spread over three campuses in at Sri City, Andhra Pradesh, at Sriperumbudur and Sungavarchatram with on-going R&D center at IIT Research Centre, Chennai.

Key Strengths

- To enhance the value chain, Bharat FIH is continually ramping up their production architecture from L1 to L10 capabilities. These operations are being supported by developing an environment of world class local suppliers to support the value chain.
- The company also offer direct-order fulfilment & configure-to-order services for delivery of the final products.

3. Dixon Technologies India Ltd

Company Overview

- Dixon Technologies, located in Noida, is an Indian Electronics Manufacturing Services Company that was founded in 1993 and has been leading this space in India. Initially, the company began production of colour televisions.
- Dixon has now expanded its activities to numerous electronic sub-segments. The company offers design-focused solutions in consumer durables, home appliances, lights, mobile phones, and security systems, as well as repairing and refurbishing services for a wide range of products.
- Since its initial public offering in 2017, the company has been listed on the BSE and NSE.

EMS Products Manufactured

- LED TVs
- Washing Machines
- LED bulbs, LED Drivers
- Feature Phone and Smart Phone
- CCT and DVR
- Micro PCR Analyser and Thermometer
- Set-Top-Box

Key Business Segments

- Consumer Electronics
- Home Appliances
- Lighting Solution
- Mobile Phones
- Security surveillance system
- Medical Electronics
- Reverse Logistics

Key Services Offered

- Product Design
- Prototyping
- System Integration
- Quality & Testing
- Supply & Logistics
- After market

Manufacturing Facilities

- The company operates in ten production facilities in Noida, Dehradun, and Tirupati / Chittoor District

Key Strengths

- Core Competence: Provides design focused products and solutions, along with repairing and refurbishment services of a wide range of products
- Diversified Product portfolio covering multiple electronic segments
- Largest television, washing machine and bulb assembly plants in India.
- Integrated Business model has helped derive greater operating efficiencies

4. Amber Enterprises India Ltd

Company Overview

- Amber Enterprises was established in 1990 and was converted to a public limited company in 2017.
- The company is a prominent solution provider for Air conditioner OEM/ODM Industry in India. It has a dominant presence in RACs complete unit and deals in major RAC components.
- The company provides greater energy efficiency as well as experience in indoor, outdoor, split, and window air conditioners. It also sells both AC and non-AC components.
- Amber is well-positioned to extract the core deliverables in terms of quality, pricing, and delivery due to its backward integration.

EMS Products Manufactured

- Room Air Conditioners (Window ACs, Indoor & Outdoor units of split ACs, Inverter Split ACs)
- Room Air Conditioner Components (Heat exchanger, Electric motor, Copper tubing, Sheet metal components)
- Non-AC Components (Plastic extrusion, Vacuum forming, Sheet metal component)
- Mobile Air Conditioners (Railway, Metro, Bus, Defence & Telecommunications)

Key Business Segments

- Consumer Electronics
- Home Appliances
- Industrial
- Automotive

Key Services Offered

- Conceptualize & Design
- Product Development
- Prototyping
- Product Assembly
- Testing
- Supply Chain

Manufacturing Facilities

- The company has ten manufacturing facilities across seven locations in India – Rajpura, Jhajjar, Faridabad, Pune, Kala amb, Dehradun and Noida

Key Strengths

- Amber Enterprise is a market leader in the Indian OEM/ODM industry for room air conditioners. It has a diverse product range and a long approval cycle. Because of the company's high degree of backward integration and excellent R&D skills, it has a large share of ODM.
- Their growth strategy continues to focus on product expansion, customer expansion, and overall profit within the customer. Amber Enterprises is constructing two new Greenfield factories in Pune and South India.

5. SFO Technologies Pvt Ltd

Company Overview

- SFO Technologies, a subsidiary of the NeST Group of Companies, was founded in 1990 and is headquartered in Kochi, Kerala.
- It has evolved from a single manufacturing facility to a diversified corporation with a global footprint and multi-domain competence in EMS, ODM, SI, and ADM.
- SFO Technologies has a global presence with front end operations in all continents and the products and services are targeted at technology fields across diverse domains.
- SFO can provide turnkey solutions, product development and maintenance, R&D support, and customised services across a wide range of domains and technologies.

EMS Products Manufactured

- Digital electronics, power supplies & RF
- Optronics & Magnetics
- Cables & Harness
- Tool Making & Sheet metal fabrication
- Plastic injection & Moulding

Key Business Segments

- Healthcare/ Medical Diagnostics
- Automobile/ Transportation
- Communications
- Aerospace & Defence
- Energy
- Industrial

Key Services Offered

- Hardware Design Services
- Hardware Testing
- Software Services
- Manufacturing Services
- Testing & Certification
- After market support

Manufacturing Facilities

- SFO Technologies has manufacturing units, robust software development centers and R&D cells spread over Kochi, Trivandrum and Bangalore

Key Strengths

- The company offers unique ODM plus solutions in a variety of areas and specialises in IoT, Analytics, GIS, and Mobility. SFO Technologies' Quality Is a Key Differentiator
- SFO has prioritised organisational quality or quality entrenched in its goods and services.
- The Group currently comprises development centres, manufacturing, and front-end offices in 32 different countries, including the United States, Canada, Europe, the Middle East, South East Asia, Japan, Australia, and India.

6. Syrma SGS Technology Ltd

Company Overview

- Syrma SGS Technology, founded in 1978 by industry pioneers (Tandon family), is located in San Jose (California), and Chennai (India), developing quality technology products. It is one of India's leading exporters of electronics, providing a high-value integrated design and production solution for internationally recognized OEMs.
- Syrma SGS is one of the leading ESDM company with a focus on technology based solutions and ODM business. Unlike the traditional OEM or ODM business model, which only focuses on certain stages of the production process, the company's business model starts from product concept design and focuses on every segment of the overall industry value chain.
- Syrmas' business approach leads to continuous advancements in product technology, structure, and functional design to meet customer requirements and lead the industry in development.

EMS Products Manufactured

- PCBA (Printed Circuit Boards)
- ZAC (Zone of Autonomous Creation)
- RFID (Radio-Frequency Identification)
- Magnetics (Mechanical Parts)
- Others (motherboards, DRAM modules, SSD and USB drives, copper wire coiling, induction devices, chokes, transformers)

Key Business Segments

- Industrial
- Consumer Electronics
- Automotive
- Computer
- Medical
- Railways

Key Services Offered

- Product Design
- Prototyping
- Product Assembly
- Quality & Testing
- Supply & Logistics
- After market

Manufacturing Facilities

- The company currently operates through 11 manufacturing facilities spread across four states in Chennai, Bargur, Bengaluru, Baddi, Bawal, Gurugram and Manesar

Key Strengths

- Manufacturing facilities in Tamil Nadu are placed in SEZs, allowing them to take advantage of specific tax and other incentives in relation to the products manufactured at these facilities.
- All of the manufacturing facilities are certified, including ISO 14001 and ISO 9001. Syrma SGS is recognized as leader in people development as in the company is one of the great places to work. Also, it has key focus on women empowerment, where more than 80% of employee base is women workforce. The company was the first in India to manufacture RFID products.

7. Elin Electronics Ltd

Company Overview

- Elin Electronics Ltd, founded in 1969 in Delhi/NCR, is the flagship company of the Elin Group.
- Initially, the company produced switches, relays, and cables for Philips. Later, as a backward integration, the company started producing motors and audio heads.
- In the late 1990s, the company expanded into the manufacturing of small appliances and diversified into different motor categories.
- Elin now provides a variety of goods and services to its OEM clients and serves as a one-stop solution provider.

EMS Products Manufactured

- Motor (Universal , Induction, Other range of motors)
- Fans (Ceiling, Fresh Air)
- Components (Sheet metal, plastic)
- Small appliances (Mixer Grinders, Juicer Mixer Grinders, Flash Lights, Dry & Steam Irons, Pop-up Toasters, Bar Blenders, Hair Dryers, Trimmers & Hair Straightener)
- LED Lighting

Key Business Segments

- Lighting
- Small Appliances
- Personal Care
- Motors

Key Services Offered

- Development & Engineering
- Motors & Tools Manufacturing
- Injection Moulding
- PCB Assembly
- Die Casting

Manufacturing Facilities

- Elin has three manufacturing plants, located in Ghaziabad, Baddi and Goa

Key Strengths

- In India, Elin is a prominent manufacturer of electric motors. It is also India's leading manufacturer of fractional horsepower motors.
- Research and development, as well as end-to-end design and development, are among the company's core competencies.
- The firm has a high degree of backward integration, which results in higher profits.

8. Avalon Technologies Pvt Ltd

Company Overview

- Avalon Technologies, a division of Sienna Group, has been a preferred vendor for large global MNCs operating in a wide range of industries.
- Avalon, founded in 1995 in Fremont, California, is a vertically integrated manufacturing company that offers service to a wide range of industry segments.
- In the year 2000, the company established its EMS manufacturing facility in Chennai, India.

EMS Products Manufactured

- Sheet Metal Fabrication & Machining
- Manufacturing of Solar Modules, Hybrid Power Systems and Inverters
- Network Routers, Switches, Communication Systems, BTS Antenna Systems and ATM Machines
- Digital Radiography Systems, Ultrasound Equipment, Patient Monitoring Devices
- Electronic Control Units and Telematics Solutions

Key Business Segments

- Transportation
- Aerospace
- Power & Energy
- Communication
- Healthcare
- Automotive
- Industrial

Key Services Offered

- PCBA Design & Assembly
- Wire Harnesses, Magnetics
- Electro-Mechanical Integration (EMI)
- Sheet Metal Fabrication
- Machining
- Injection Moulded Plastics
- Complete system integration
- Product testing

Manufacturing Facilities

- The Company has manufacturing facilities in Chennai & Bengaluru (India) and Atlanta & Fremont (USA)

Key Strengths

- Avalon Technologies meets industry-specific quality criteria by adhering to ISO 9001:2008, ISO 9100C (Aerospace & Defence), ISO/TS 16949:2009 (Automotive), and ISO 13485 (Medical).
- Avalon Technologies provides a complete turnkey solution that is "all under one roof" and ideally located in LCR (low-cost region).
- Avalon has distinct benefits in terms of manufacturing capabilities, such as supply chain integrity, existing infrastructure, and incoming and outgoing logistics managed by skilled employees.
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9. VVDN Technologies Pvt Ltd

Company Overview

- VVDN's India headquarters' is located in the Global Innovation Park in Manesar, Gurugram, India, while its North America HQ is in San Jose, CA, USA.
- It is a global leader in product engineering and manufacturing with clients in a range of technical domains.
- The company supports its global customers across several regions including US, Canada, Europe, India, Vietnam, Korea, and Japan.

EMS Products Manufactured

- PCB Assembly
- 5G NR Products
- Cloud network management system
- Industrial IoT, E-mobility, Hearable & Wearables
- Smart Medical
- Power & Utilities

Key Business Segments

- Communications (5G, Networking & Wi-Fi, VISION, IoT, Clouds & apps)

Key Services Offered

- Embedded Product Design and Manufacturing
- Hardware Design, Software Design, Mechanical Design, QA & Testing, Prototyping and Manufacturing

Manufacturing Facilities

- VVDN has five manufacturing centers located in Gurugram and ten design centers

Key Strengths

- VVDN has over a decade of expertise in Product Engineering & Manufacturing electronic solutions, and it provides end-to-end design, development, and manufacturing support.
- In the Communication segment, the company intends to make a significant investment in electronics manufacturing services, including CKD Manufacturing in India.
- VVDN has recently announced the establishment of a Global Innovation Park in Manesar, Gurugram, India. This announcement is part of the company's goal to improve its engineering service offerings while also boosting production capacity through infrastructure expansion.

10. Sanmina-SCI Technology India Pvt Ltd

Company Overview

- Sanmina was founded in 1980 and is located in San Jose, California (USA); the company entered the Indian market in early 2000 with its head office in Chennai.
- Sanmina manufactures some of the world's most sophisticated and inventive optical, electrical, and mechanical devices.
- Sanmina, a technological leader, offers end-to-end design, manufacturing, and logistics solutions, as well as exceptional quality and support to OEMs.

EMS Products Manufactured

- PCB Circuit Boards & Assembly
- SMT capability
- Medical devices
- RF products & enclosures
- LED Lighting
- Cables

Key Business Segments

- Communications networks
- Computing and storage
- Healthcare
- Defense and Aerospace
- Industrial
- Automotive
- Clean technology sectors

Key Services Offered

- Design & Engineering
- Prototyping
- Test Services
- New Product Development
- Systems Manufacturing
- Global Services and Logistics
- PCB Assembly
- SMT

Manufacturing Facilities

- The company has global operations in 21 countries.
- In India, Sanmina has a complete end-to-end design service and a high-tech manufacturing facility located in Chennai

Key Strengths

- Key certifications held by the Sanmina's Chennai manufacturing facility include TL 9000, EN/AS9100, ISO 13485, and IATF 16949.
- Sanmina became India's first tier EMS Company to get FDA certified in 2018.
- Sanmina has been granted Domestic Tariff Area (DTA) status at its manufacturing facility, allowing the company to support the Make in India initiative, a government-led initiative to encourage the domestic production.
- With SEZ and DTA status, Sanmina is able to manufacture and distribute products for both local and export markets with zero customs duty.

Comparative Analysis of Leading ESDM companies in India

Summary

Chart 5.1: Comparative Analysis – Revenue, EBIDTA and PAT, India, FY20-9MFY22

	Revenue (INR million)			EBIDTA (INR million)			EBIDTA (%)		
Name of the ESDM Company	**FY20**	**FY21**	**9M FY22**	**FY20**	**FY21**	**9M FY22**	**FY20**	**FY21**	**9M FY22**
Kaynes Technology India Ltd *	3,682.4	4,206.3	4,677.8	413.3	408.9	536.5	11.2%	9.7%	11.5%
Bharat FIH Ltd	2,66,355.5	1,58,548.6	NA	6,932.7	3,869.3	NA	2.6%	2.4%	NA
Dixon Technologies India Ltd	44,001.2	64,481.7	77,443.2	2,230.6	2,865.9	2,609.0	5.1%	4.4%	3.4%
Amber Enterprises India Ltd	39,627.9	30,305.2	22,700.0	3,092.7	2,202.9	1,630.0	7.8%	7.3%	7.2%
SFO Technologies Pvt Ltd	17,889.7	NA	NA	1,251.3	NA	NA	7.0%	NA	NA
Syrma SGS Technology Ltd	8,656.5	8,874.0	NA	1,309.6	999.1	NA	15.1%	11.3%	NA
Elin Electronics Ltd	7,855.8	8,623.8	NA	552.4	674.7	NA	7.0%	7.8%	NA
Avalon Technologies Pvt Ltd	3,271.5	NA	NA	311.0	NA	NA	9.5%	NA	NA
VVDN Technologies Pvt Ltd	3,090.9	6,659.9	NA	-198.9	782.3	NA	-6.4%	11.7%	NA
Sanmina-SCI Technology India Pvt Ltd	861.5	908.5	NA	226.9	289.1	NA	26.3%	31.8%	NA

NA - Required data is not available with RoC

Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis

EBIDTA is calculated as Profit before tax plus depreciation and amortization expense plus finance cost less finance income and other income

Chart 5.2: Comparative Analysis – Export sales and RoCE, India, FY20-9MFY22

	PAT (%)			Export sales (%)			RoCE (%)		
Name of the ESDM Company	**FY20**	**FY21**	**9M FY22**	**FY20**	**FY21**	**9M FY22**	**FY20**	**FY21**	**9M FY22**
Kaynes Technology India Ltd *	2.5%	2.3%	4.7%	20.5%	25.6%	21.5%	14.4%	13.5%	14.8%
Bharat FIH Ltd	1.5%	1.0%	NA	0.0%	0.0%	NA	19.1%	8.1%	NA
Dixon Technologies India Ltd	2.7%	3.4%	1.6%	0.1%	0.1%	NA	30.5%	27.1%	17.6%
Amber Enterprises India Ltd	4.1%	2.7%	2.3%	0.9%	0.7%	NA	20.6%	9.9%	NA
SFO Technologies Pvt Ltd	4.2%	NA	NA	57.4%	NA	NA	21.4%	NA	NA
Syrma SGS Technology Ltd	10.6%	7.4%	NA	60.0%	45.0%	NA	31.2%	17.1%	NA
Elin Electronics Ltd	2.4%	3.1%	NA	1.0%	0.9%	NA	13.3%	14.0%	NA
Avalon Technologies Pvt Ltd	1.7%	NA	NA	53.8%	NA	NA	7.7%	NA	NA
VVDN Technologies Pvt Ltd	-5.4%	6.5%	NA	51.5%	NA	NA	-5.8%	19.5%	NA
Sanmina-SCI Technology India Pvt Ltd	20.8%	22.2%	NA	78.7%	NA	NA	15.0%	15.0%	NA

NA - Required data is not available with RoC

Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis

ROCE is calculated as EBIT divided by capital employed. EBIT is calculated as restated profit before tax plus finance cost. Total capital employed is calculated as tangible net worth plus non-current borrowings plus current borrowings.

Tangible net worth is calculated as total assets less total non-current liabilities (except non-current lease liabilities and deferred tax liabilities), total current liabilities (except current lease liabilities), intangible assets, intangible assets under development, goodwill and right of use asset.

Comparative Analysis - Application segments & Revenue

Chart 5.3: Comparison of presence of key ESDM companies in the Application segments, India, FY21

Name of the ESDM Company	Mobile Phones	CEA*	Automotive	Industrial	Telecom	A&D**	IT	Medical	Railway	Others#
Kaynes Technology India Ltd		✓	✓	✓	✓	✓	✓	✓	✓	✓
Bharat FIH Ltd	✓	✓	✓		✓	✓	✓			✓
Dixon Technologies India Ltd	✓	✓						✓		✓
Amber Enterprises India Ltd		✓							✓	✓
SFO Technologies Pvt Ltd			✓	✓	✓	✓		✓		✓
Syrma SGS Technology Ltd		✓	✓	✓	✓			✓		✓
Elin Electronics Ltd		✓								✓
Avalon Technologies Pvt Ltd			✓	✓	✓	✓		✓	✓	✓
VVDN Technologies Pvt Ltd			✓	✓	✓		✓			✓
Sanmina-SCI Technology India Pvt Ltd			✓	✓	✓	✓	✓	✓		✓

**CEA – Consumer electronics and appliances; **A&D – Aerospace & Defence*
#Others include: Energy, Power, Lighting, etc.; ##IoT is a part of CEA segment

Source: Company websites; Frost & Sullivan Analysis

Chart 5.4: Revenue Comparison of key ESDM companies, India, Value in INR Million, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd *	2,874.7	3,794.3	3,642.3	3,682.4	4,206.3	4,677.8
Bharat FIH Ltd	1,13,766.9	2,37,620.2	3,43,453.8	2,66,355.5	1,58,548.6	NA
Dixon Technologies India Ltd	24,987.2	28,533.9	29,844.5	44,001.2	64,481.7	77,443.2
Amber Enterprises India Ltd	17,358.1	21,715.1	27,519.9	39,627.9	30,305.2	22,700.0
SFO Technologies Pvt Ltd	12,366.1	12,746.7	16,696.5	17,889.7	NA	NA
Syrma SGS Technology Ltd	NA	NA	7,947.4	8,656.5	8,874.0	NA
Elin Electronics Ltd	4,381.2	4,943.2	8,285.4	7,855.8	8,623.8	NA
Avalon Technologies Pvt Ltd	3,048.1	2,952.3	3,669.6	3,271.5	NA	NA
VVDN Technologies Pvt Ltd	764.9	1,515.1	2,632.2	3,090.9	6,659.9	NA
Sanmina-SCI Technology India Pvt Ltd	778.2	873.9	888.8	861.5	908.5	NA

Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis

**Kaynes technologies India Ltd - is expected to generate a revenue of INR 7,000 million in FY22*
NA - Required data is not available with RoC

Comparative Analysis - EBIDTA & PAT

Chart 5.5: EBIDTA Comparison of key ESDM companies, India, Value in INR million, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd *	203.2	367.1	350.4	413.3	408.9	536.5
Bharat FIH Ltd	1,310.8	1,424.5	-592.5	6,932.7	3,869.3	NA
Dixon Technologies India Ltd	911.6	1,126.9	1,348.7	2,230.6	2,865.9	2,609.0
Amber Enterprises India Ltd	1,305.3	1,835.4	2,128.6	3,092.7	2,202.9	1,630.0
SFO Technologies Pvt Ltd	961.4	737.6	1,070.7	1,251.3	NA	NA
Syrma SGS Technology Ltd	NA	NA	903.7	1,309.6	999.1	NA
Elin Electronics Ltd	354.0	222.6	424.1	552.4	674.7	NA
Avalon Technologies Pvt Ltd	322.4	299.7	345.4	311.0	NA	NA
VVDN Technologies Pvt Ltd	76.3	132.5	259.0	-198.9	782.3	NA
Sanmina-SCI Technology India Pvt Ltd	196.0	273.1	218.2	226.9	289.1	NA

NA - Required data is not available with RoC *Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis*

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Chart 5.6: EBIDTA Comparison of key ESDM companies, India, Ratio in %, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd	7.1%	9.7%	9.6%	11.2%	9.7%	11.5%
Bharat FIH Ltd	1.2%	0.6%	-0.2%	2.6%	2.4%	NA
Dixon Technologies India Ltd	3.6%	3.9%	4.5%	5.1%	4.4%	3.4%
Amber Enterprises India Ltd	7.5%	8.5%	7.7%	7.8%	7.3%	7.2%
SFO Technologies Pvt Ltd	7.8%	5.8%	6.4%	7.0%	NA	NA
Syrma SGS Technology Ltd	NA	NA	11.4%	15.1%	11.3%	NA
Elin Electronics Ltd	8.1%	4.5%	5.1%	7.0%	7.8%	NA
Avalon Technologies Pvt Ltd	10.6%	10.2%	9.4%	9.5%	NA	NA
VVDN Technologies Pvt Ltd	10.0%	8.7%	9.8%	-6.4%	11.7%	NA
Sanmina-SCI Technology India Pvt Ltd	25.2%	31.2%	24.5%	26.3%	31.8%	NA

NA - Required data is not available with RoC *Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis*

Chart 5.7: PAT Comparison of key ESDM companies, India, Ratio in %, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd	5.2%	4.7%	2.7%	2.5%	2.3%	4.7%
Bharat FIH Ltd	1.6%	0.3%	-0.6%	1.5%	1.0%	NA
Dixon Technologies India Ltd	1.9%	2.1%	2.1%	2.7%	3.4%	1.6%
Amber Enterprises India Ltd	1.3%	2.9%	3.4%	4.1%	2.7%	2.3%
SFO Technologies Pvt Ltd	3.3%	1.6%	1.7%	4.2%	NA	NA
Syrma SGS Technology Ltd	NA	NA	6.6%	10.6%	7.4%	NA
Elin Electronics Ltd	4.5%	4.1%	3.0%	2.4%	3.1%	NA
Avalon Technologies Pvt Ltd	3.2%	1.8%	1.3%	1.7%	NA	NA
VVDN Technologies Pvt Ltd	8.0%	3.9%	-4.4%	-5.4%	6.5%	NA
Sanmina-SCI Technology India Pvt Ltd	15.7%	21.3%	19.6%	20.8%	22.2%	NA

NA - Required data is not available with RoC *Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis*

PAT = Profit after tax

Comparative Analysis - Export Sales & RoCE

Chart 5.8: Export Sales Comparison of key ESDM companies, India, Ratio in %, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd	24.0%	35.5%	15.8%	20.5%	25.6%	21.5%
Bharat FIH Ltd	0.0%	0.0%	0.0%	0.0%	0.0%	NA
Dixon Technologies India Ltd	2.4%	2.6%	0.9%	0.1%	0.1%	NA
Amber Enterprises India Ltd	0.2%	0.2%	0.2%	0.9%	0.7%	NA
SFO Technologies Pvt Ltd	61.1%	64.7%	62.7%	57.4%	NA	NA
Syrma SGS Technology Ltd	47.3%	51.4%	56.0%	60.0%	45.0%	NA
Elin Electronics Ltd	0.4%	0.5%	1.1%	1.0%	0.9%	NA
Avalon Technologies Pvt Ltd	64.7%	55.2%	63.5%	53.8%	NA	NA
VVDN Technologies Pvt Ltd	81.3%	80.2%	16.6%	51.5%	NA	NA
Sanmina-SCI Technology India Pvt Ltd	81.3%	75.7%	76.2%	78.7%	NA	NA

NA - Required data is not available with RoC *Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis*

Chart 5.9: RoCE Comparison of key ESDM companies, India, Ratio in %, FY17-9MFY22

Name of the ESDM Company	FY17	FY18	FY19	FY20	FY21	9M FY22
Kaynes Technology India Ltd	13.2%	21.2%	12.9%	14.4%	13.5%	14.8%
Bharat FIH Ltd	42.7%	8.3%	-9.4%	19.1%	8.1%	NA
Dixon Technologies India Ltd	32.7%	20.0%	22.6%	30.5%	27.1%	17.6%
Amber Enterprises India Ltd	37.7%	19.7%	16.0%	20.6%	9.9%	NA
SFO Technologies Pvt Ltd	8.7%	14.3%	20.1%	21.4%	NA	NA
Syrma SGS Technology Ltd	NA	NA	27.8%	31.2%	17.1%	NA
Elin Electronics Ltd	13.7%	5.2%	12.4%	13.3%	14.0%	NA
Avalon Technologies Pvt Ltd	8.9%	7.7%	10.0%	7.7%	NA	NA
VVDN Technologies Pvt Ltd	14.2%	40.6%	28.8%	-5.8%	19.5%	NA
Sanmina-SCI Technology India Pvt Ltd	12.8%	16.3%	16.2%	15.0%	15.0%	NA

NA - Required data is not available with RoC

Source: Annual Reports of Companies published in RoC, MCA; Frost & Sullivan Analysis

CHAPTER 6 – FUTURE OPPORTUNITIES IN THE ESDM MARKET

Summation of opportunities from select business segments for Kaynes business in India

INDUSTRY	MARKET DYNAMICS	ESDM ADDRESSABLE MARKET (INR BILLION)		
		FY21	FY26E	CAGR (%)
Telecom and Networking products	• India is one of the largest exporter of telecom equipment and this trend expected to increase • Increased outsourcing to companies with design, logistics and after sales support services	42	118	23%
Electric Mobility	• Electric mobility is in a growth phase and India is equally competing with the global leaders • The Indian government's strict measures in response to rising levels of vehicular emissions will boost demand for electric vehicles.	4	23	43%
Medical Electronics	• Rapid growth and demand in the remote diagnostics, cardiovascular, neurology and other medical products • The huge gap between demand and supply of medical devices in India creates a huge opportunity for manufacturers.	15	90	43%
IoT and Embedded Systems	• India's IoT ecosystem is likely to flourish, opening up new revenue sources for IoT providers • The rapid expansion of the IOT market is driven by increased customer demands, cloud computing, and analytics	65	311	37%
Strategic Electronics (Aerospace)	• Despite only 2% of the global space industry, India has one of the world's most successful and cost-effective space programmes • New policy initiatives have allowed private firms and start-ups to establish and operate	15	93	44%
Green Energy (LED Lighting)	• Regulations on energy efficiency, widespread manufacturing, and reduced prices of LED light have propelled India's LED lighting market • Proliferation of IoT devices has further paved way for the growth of the smart LED lighting market	30	109	29%
Wearables	• India is currently world's third largest wearable market • Gaining popularity due to features such as internet connectivity and data exchange between a network and a device	4	36	53%
Smart meters	• India ranks third in global electricity production. India's utility sector is changing with advanced metering solutions. • Government initiatives on energy saving, smart cities, and modernization of electricity grid are expected to drive the industry.	10	21	17%

Note: E refers to Estimate

Source: Frost & Sullivan Analysis

A) Telecom and Networking Equipment

Industry overview

The Telecom and Networking Products industry primarily comprises of telecom service providers, telecom equipment manufacturers and suppliers, and passive infrastructure providers. India is currently the world's second largest telecommunications market with a subscriber base of around 1.16 billion. Over the next five years, increased mobile phone penetration and reduced data prices will add 500 million additional internet users in India. The Government has eased market access for telecom equipment and provided a fair and proactive regulatory environment to ensure consumer access to affordable telecom services. The growth of direct and indirect competition in the telecommunications market has impacted revenue growth and profit margins. While telecommunications penetration is high, IT and VAS infrastructure is still developing. Long-term growth requires a shift from traditional revenue streams to cloud alternatives.

Growth drivers

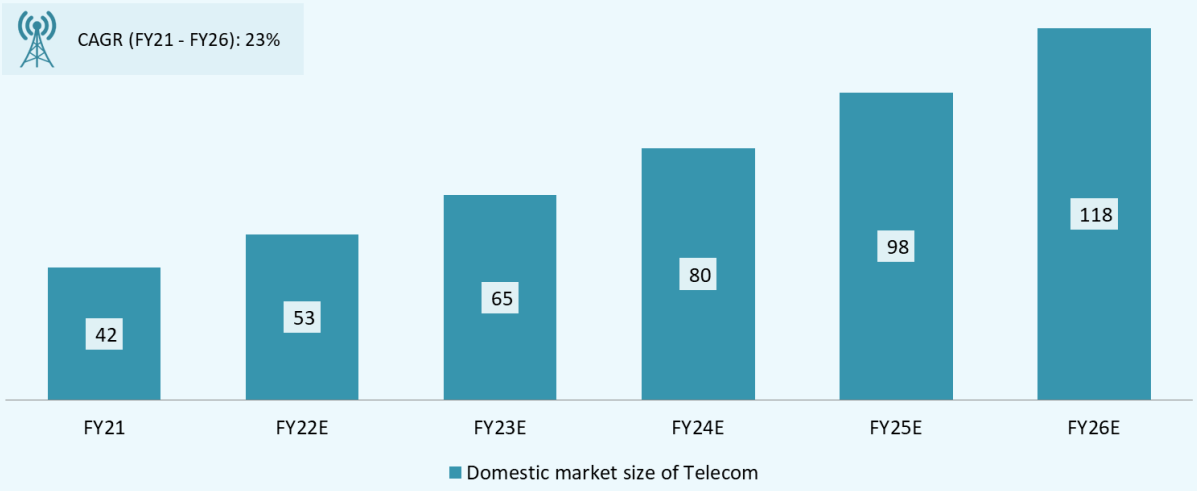
- **4G and 5G Infrastructure in India**: While Airtel, Vodafone and Jio have concluded the roll out of its 4G services on pan-India basis, service providers are gearing up for 5G roll out in India, which will boost the customer utilization of high-end data products. 5G is required to create new economic value in India and globally. The business opportunity for 5G in India is huge and it will encourage investors to participate, manufacture, sell and export to the global market.
- **Increased telecom coverage and capacity:** Having innovation at the core, Indian telecom tower business has carved a world-wide niche in terms of infrastructure sharing. By focusing on right mix of competencies & business opportunities, the tower industry is expected to drive the next infrastructure revolution & recognize the vision of broadband for all in India. The telecom tower business has remained a pivotal force in routing the connectivity revolution in India. Between 2007 & 2020, total number of towers has grown over two-fold having a CAGR of more than 7% to reach 606K in 2020.

Key market trends

- **Optical fibre connectivity:** India’s current market penetration in optical fibre connectivity is not more than 30% of the mobile towers and 7% of the total households. Significant fabrication and infrastructural improvements are required to bring in 5G and high-speed connection, and this will be a key focus area in 2021 and beyond.
- **Adoption of emerging technologies:** Industrial Internet of Things (IoT), smart homes, connected mobility and autonomous appliances and gadgets are all deeply reliant on the hyper connectivity. This trend is expected to continue to rule in 2021 and beyond. Smart cities would also need a robust digital neural network for the purpose of functioning seamlessly.
- **Hyper connectivity:** The year 2021 and beyond can be seen as an era of hyper connectivity (anything, anywhere and at any time). This is going to create huge security challenges, and henceforth, security is going to become tremendously important. There will be imminent threats, and henceforth, the complete device, application, and the network infrastructure eco-system require developing security mitigation strategies.

Market size and outlook of Telecom and Networking Products industry in India

Chart 6.1: Domestic market size of Telecom and Networking Products, value in INR billion, India, FY21-FY26E



** Products considered for analysis: Base Transceiver Station (BTS); Digital Subscriber Line Access Multiplexer (DSLAM); Gigabit Passive Optical Networks (GPON); Internet Protocol Private Branch Exchange (IP PBX); Media gateways; Modems; Enterprise routers; Synchronous Transport Module (STM)*

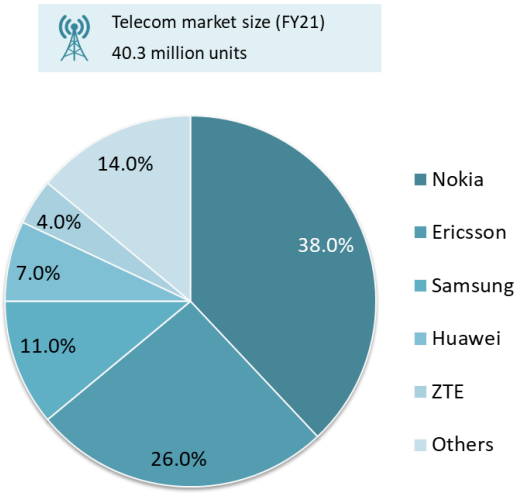
Note: E refers to Estimate *Source: Frost & Sullivan Analysis*

In FY21, the Indian Telecom and Networking products market was estimated grow at a CAGR of 23%, from INR 42 billion in FY21 to reach INR 118 billion in FY26 by sales value. A lot of growth potential exists for telecom electronics products like GPON, IP PBX and Media Gateway as well as Router and Modems. Routers, GPONs, and modems are going to remain key revenue contributors within the Telecom and Networking Products business in the forecast period. India plans to roll out state-of-the-art 5G telecom services in 2022. The new technology provides the advantages of massive connectivity and low power consumption and boasts of download speeds and capacity that can enable autonomous vehicles, drones, remotely assisted surgeries, and traffic control. 5G connectivity will be used in emerging technologies and technology-enabled markets such as IoT, smart cities, and smart agriculture. 5G, due to its greater speed, would also enable next-generation IoT and machine-to-machine (M2M) applications such as autonomous vehicles and virtual or augmented reality. The OEMs' requirements in this industry are technical expertise in the manufacturing of large and complex PCBAs and quick ramp-up capabilities.

Competitive landscape of OEMs and ESDM players

Global players like Ericsson, Nokia, Samsung, ZTE and Huawei dominate the telecom equipment market. Other players may be trying to build their capabilities and do some trials with the operators, so it will be interesting to see how that eco-system develops in the country over time. To maintain a competitive Telecom and Networking Products market, the Telecom Regulatory Authority of India (TRAI) and the government must encourage new entrants and prevent unnecessary exits.

Chart 6.2: Telecom market size by major OEMs, Volume, million units, India,



Source: Frost & Sullivan analysis

ESDM companies provide a variety of core manufacturing and ancillary activities, allowing OEMs to focus on their core competencies while improving overall efficiencies. Syrotech, Netlink, Alcatel Lucent, Kaynes, Bharat FIH, Syrma SGS, Tejas Networks, Speech & Software Technologies, and Alphion India are the key ESDM players in telecom and networking products segment. The incentive scheme such as the PLI, for Telecom and Networking Products will boost manufacturing in the midst of the 5G construct. STL or Sterlite Technologies is one of the first Indian companies to publically come out with its home grown 5 G Portfolio catering to the needs of the leading network creates across the Globe.

The Department of Telecommunications (DoT) on October, 2021 approved total 31 proposals, garnering an investment of INR 3,345 crore over four-and-a-half years under the PLI scheme for telecom gear. Akashastha Technologies, Dixon Electro Appliances, HFCL Technologies, ITI, Neolync Tele Communications, Syrma SGS, Tejas Networks, and VVDN Technologies are some of the winners of the PLI scheme.

Future opportunities

The Indian telecom market, home to more than 900 million mobile subscribers, has witnessed a relentless growth during the past decade. This growth has been largely driven by voice, but the next wave of growth will be data-centric. Focus on customer experience, network quality, and the growing demand for wireless data services, 4G, and broadband wireless access networks, along with roll-out to newer circles and rural expansion, will result in increased opportunities.

As coverage and capacity become increasingly important, telecom infrastructure service providers have increased opportunities to help the Telco's. From the roll-out of new networks to network benchmarking and optimization, the services are becoming critical.

B) Electric Mobility

Industry overview

Automotive industry is rapidly evolving in terms of technology as well as tackling environmental issues. Electric vehicles have been introduced as a clean energy initiative, as they have low or zero emissions and have come a long way to become an integral part of OEM's business strategies. Automakers are creating separate EV business units to be prepared for the expected EV boom in the future. However, the surge in EV demand will create a huge need for charging infrastructure and safety regulations and standards.

India is expected to aggressively push itself toward electrification, especially in the automotive and transportation sector. Stringent emission regulations, liberal incentives and subsidies for consumers and

manufacturers, high level of localization, concrete safety standards, and established technology roadmaps are few key steps that must need to be given a lot more focus by the government to ensure the success of electric vehicles in the coming years.

OEMs can partner with charging infrastructure operators, aggregators, and manufacturers to set up networks of normal and fast chargers across the country. The cost of setting up a charging infrastructure varies depending on the level and type of the infrastructure that is required - slow, medium, or fast charging. The rise of digitalization, along with increased connectivity and mobility demand, is increasing the complexity of electronics, resulting in an increase in component demand from ESDM suppliers. Increased automotive electronics usage is driven by increased consumer demand for electric mobility solutions. The domestic ESDM players supplying to the automobile industry, see an entirely different opportunity coming up in terms of supplying to the electric mobility sector. There is considerable possibility for new technologies in terms of charging, battery management, associated software, and advanced motors, as well as new business opportunities for component manufacturers. Electric vehicles of the future will have a greater proportion of electronic components than electrical components. Motors, controllers, harness, and converters are critical for localization on modes that will provide suppliers and OEMs with the desired scale in India. ESDM companies are working closely with OEMs and product companies to indigenize technology in Electronic Cluster, Battery Management System, DC-DC converter, BLDC Motor Controller, Power Distribution Unit, Positive temperature coefficient (PTC) controller etc.

Growth drivers

- **Incentives and Subsidies:** As part of the Make in India initiative, the government is providing incentive schemes and subsidies (FAME I and II) for domestic companies, and they can utilize this opportunity to partner with foreign companies and set up manufacturing facilities to drive local market growth and decrease the final cost of the vehicle. Key state level subsidies include:
    - **Karnataka:** In the state budget announced in March, 2020, the government announced allocation of INR 100 million to establish an electric vehicle & energy storage manufacturing cluster in the state. With this, Karnataka has become the first state to have an electric vehicle and energy storage policy in India.
    - **Haryana:** Haryana government has offered a capital subsidy of 25% of the value of the EV charging station equipment/ machinery for the first 100 charging stations/battery banks which will be provided up to a maximum subsidy of INR 10,00,000.
    - **Gujarat:** As per 'Gujarat Electric Vehicle Policy 2021', the state government is providing a subsidy of up to INR 20,000 on electric two-wheelers, INR 50,000 on electric three-wheelers and INR 1.50 lakh on electric four-wheelers.
    - **Tamil Nadu:** The "Tamil Nadu Electric Vehicle Policy 2019" has a strategy to attract 50,000 crore in investments, including 100% road tax exemption for all types of EVs, capital subsidies, and State GST reimbursement. The government intends to update the EV policy with particular elements that will aid in the growth of manufacturing.
- **Reducing carbon emission:** Increase in fuel cost will be a key factor to drive higher adoption of electric vehicles, starting from e2Ws in India. The electric vehicle with its zero-emission assurance is the future of the transportation. For a country having a population of 1.3 billion, ease of

transportation is a requisite. Indian transport contributes to about 10 % of country's carbon emissions. India is prepared to branch out into a new sustainable mode of transportation through the means of an electric vehicle. Stringent emission norms to improve the air quality and reduce carbon emissions are mainly forcing OEMs to launch more electric vehicles. The government has committed to cut down on the air pollution concentration. The higher cost of compliance for BS VI emission norms will dent the demand for IC engines in the Indian market and provide scope for electrification, primarily in the 2W and 3W segments.

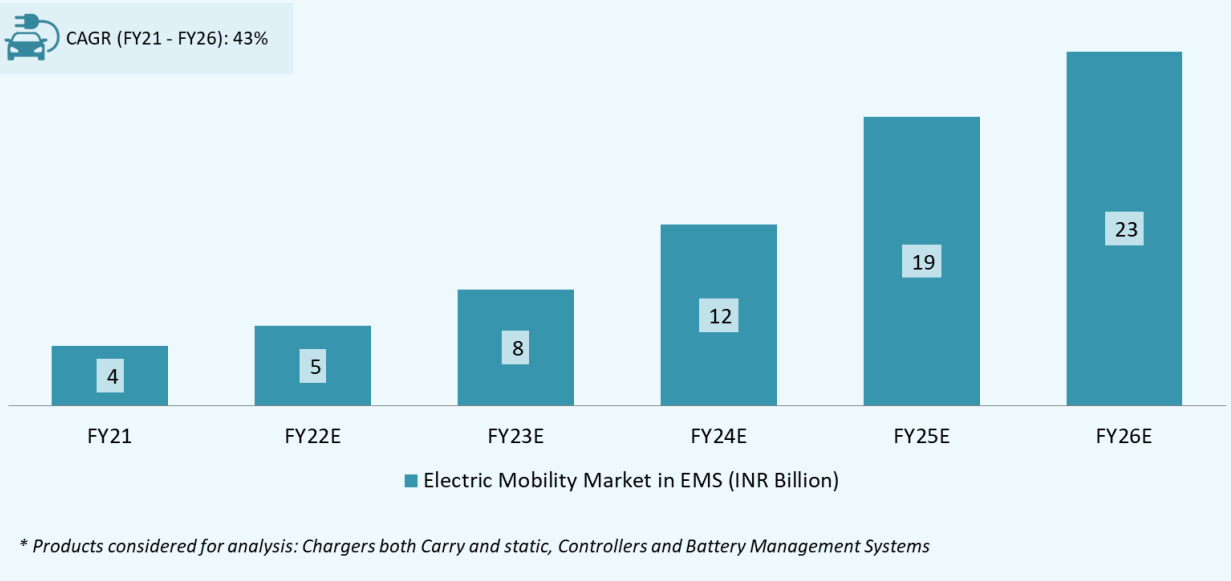
- **Localisation of EV components:** Electric vehicles are now subsidised, resulting in negative government income and a low import cost. As net localisation levels are currently quite low, there is a need to localise the supply chain. Localisation levels on motor controllers, batteries, and other components are likely to rise as a result of government support for domestic manufacturing and incentives such as the FAME-I & II schemes. Within the next few years, EVs will begin to provide benefits in terms of import bill reduction.

Key market trends

- **The installation of EV public charging stations** may reduce concern among users about achieving comparable performance to IC engine vehicles. Hence, charging infrastructure needs to be established on the high-transit routes with an in-depth survey of the availability of all the required essentials within its vicinity.
- Innovations like **light EV charge points, streetlight charger and other low-cost Electric Vehicle Supply Equipment solutions** are providing inexpensive solutions for the charging infrastructure in India.

Market size and outlook of Electric mobility products industry in India

Chart 6.3: Domestic market size Electric mobility products, value in INR billion, India, FY19-FY26E



** Products considered for analysis: Chargers both Carry and static, Controllers and Battery Management Systems*

Note: E refers to Estimate

Source: Frost & Sullivan Analysis

The EV segment is in a growth phase and India is equally competing with the global leaders. The electric mobility market, specifically for products such as carry and static chargers, controllers, and battery management systems (BMS), has very good potential. The Electric mobility market was worth INR 4 Billion in FY21, and it is expected to grow at a 43% CAGR to INR 23 Billion in FY26.

Chargers, controllers, and BMS are going to play a very crucial role in the overall EV ecosystem in India and will grow rapidly in the forecast period. As of 2020, there were 293 community charging stations in India, of which 22 were fast-charging points. The Department of Heavy Industry has plans to incentivize 1,000 charging stations with 6,000+ chargers under 3 incentive categories. Incentives will be distributed in three installments: 20% as an advance at the time of approval, 40% after charging station commissioning, and 40% after 6 months of successful commercial operation.

Competitive landscape of OEMs and ESDM players

Some of the key OEMs / Auto makers in EV market include Maruti Suzuki India Limited (MSIL) and Mahindra & Mahindra (M&M), which hold approximately 67 % of India's total EV market share. Mahindra & Mahindra focuses on battery electric vehicles, while Maruti Suzuki India Limited focuses on plug-in hybrid electric vehicles and hybrid electric vehicles. OEMs such as Hyundai and Tata Motors are expected to join the bandwagon as volumes increase. Due to their high penetration of hybrid vehicles, MSIL and M&M will have the maximum market share in terms of eMotors. India is on a continuous growth path in the EMS market in the EV / Electric mobility segment. All leading companies are looking for India as an option. There are also Indian companies who are into this segment. Kaynes, Sanmina, Solectron, Flextronics, Syrma SGS and Frontline are some of the most prominent players in the EMS market in the E mobility category. Kaynes is one of the key players in electric mobility, working with 24 odd product companies on 8 different technologies for 2, 3, 4 Wheeler segment.

The electric vehicle (EV) segment in India is likely to witness investments of INR 94,000 crore, across the automotive value chain in next five years. Tamil Nadu is the frontrunner in this space, accounting for nearly 34% share in the total planned investments for EVs, followed by Andhra Pradesh & Haryana, having a share of 12% & 9%, respectively. The investments are most likely to benefit the real estate industry in the form of setting up new or expanding manufacturing units, industrial parks & clusters with focus on the last-mile delivery by the e-commerce firms and the 3PL companies, government push for the electrification of public transport, tax benefits and incentives for first-time buyers, among others.

Future opportunities

Growth in charging infrastructure is a must for the growth of electric passenger cars in India. Localization of EV components will lead to a decrease in the cost of vehicles, improving the demand from drivers in the country. At present, e-Rickshaws have little or no penetration in Maharashtra and all southern states. However, these states could be potential markets for e-Rickshaws in the future due to increasing metro rail connectivity and the need for pollution-free last-mile connectivity services. Most of the growth is in the e2W segment, eRickshaws, and electric auto rickshaws. e4Ws are picking up pace and are expected to occupy a significant share by 2025.

C) Medical Electronics

Industry overview

Indian Healthcare sector is incessantly growing due to its strengthening coverage, services and growing expenditure by public and private players. Medical Devices play a role through the entire spectrum of healthcare ranging between diagnosis to aftercare. The quality, awareness, and, affordability of these devices directly impacts the accessibility of health care services in a country. The Indian Medical Devices market is experiencing dynamic changes with the emergence of advanced technologies, evolving clinical and administrative needs, and the introduction of new policies and regulations, which is forcing industry participants to innovate to maintain their competitive edge. There has been an increased innovation in the handheld portable medical devices like blood pressure monitors, oximeter, glucometer, portable ECG monitors, etc. The innovations have prompted an increased demand for the medical electronics. Most of the innovative startups are looking at ESDM companies who are adequately certified with advanced Infrastructure, to support them in the difficult stage of product realization and mass manufacturing.

Growth drivers

- **High Healthcare expenditure**: The medical devices industry in India is poised for noteworthy growth in the next five years, with the market size expected to reach USD 50 billion by 2025. Hence, the future of the medical device industry in India is quite promising. Continuously rising healthcare expenditure acting as a growth catalyst for the market in Indian economy.
- **Medical infrastructure along with growing adoption rates of advanced equipment's**: With a potential for strong domestic demand and other supporting factors, India is set to emerge as an ideal destination for the purpose of setting up manufacturing facilities, especially for the global companies looking to align their global manufacturing footprint with shifting consumption patterns. A shorter lead-time as well as the opportunity to significantly enhance service levels indicates well for increasing healthcare penetration in India.
- **Emergence of advanced technologies:** Electronic medical devices are gaining appeal across all age groups. Advanced technology appeals to younger people and makes self-care easier for older patients. Increasing technology advancements such as advanced telemedicine, novel drug discovery methods, data-driven healthcare, and nanomedicine, among others, will propel the medical electronic devices market forward in the future years.
- **Introduction of new policies and regulations:** As healthcare infrastructure improves, new policies and schemes will continue to enhance local medical device manufacturing capacity, eventually supporting medical device exports. Incentives for domestic manufacturing of medical equipment have the potential to attract substantial investments and a sizable total outlay in support of a market-encouraging strategy.

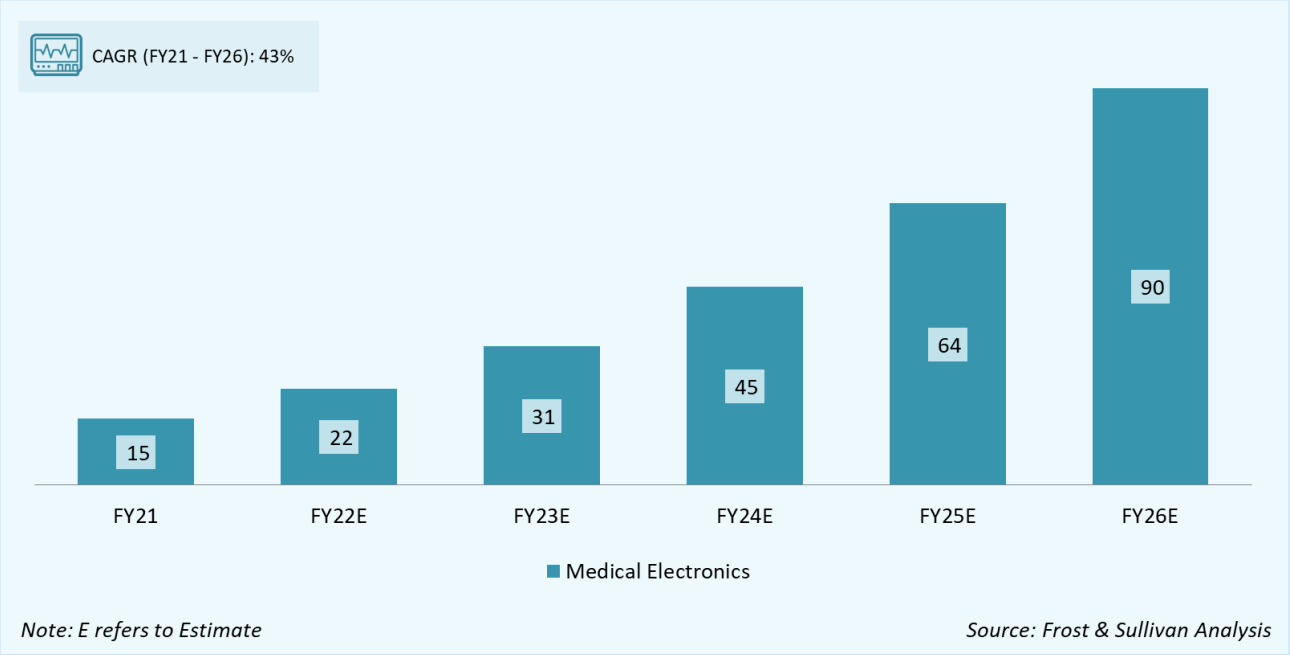
Key market trends

- **Government healthcare schemes**: The sector gains importance because of an increasing thrust of the Indian government on ensuring universal health care with schemes like Ayushman Bharat.

- **Government schemes focused on medical equipment manufacturing:** The Indian government is also focused on developing medical electronics as a popular manufacturing stream in the country through its initiatives like IIPME i.e. Industry Innovation Programme on Medical Electronics. Some of the clusters that have emerged in India include Bangalore & Mangalore (Karnataka) with companies like GE Healthcare, as well as Vishakhapatnam (Andhra Pradesh) with companies like B Braun, St. Jude Medical, and Medtronic. AMTZ (Andhra Pradesh MedTech Zone) is India's premier medical technology park with dedicated manufacturing and scientific facilities that include specialized laboratories, warehousing, and testing centres such as the Centre for Electromagnetic Compatibility and Safety Testing, Centre for Biomaterial Testing among others. It is one of the world's largest medical technology manufacturing clusters, with over 100 companies engaged in the research, development, and manufacturing of medical devices.

Market size and outlook of Medical electronics industry in India

Chart 6.4: Domestic market size of Medical Electronics, value in INR billion, India, FY21-FY26E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

The ESDM market for the Medical electronics was around INR 14 Billion in FY21 and is expected to reach INR 82 Billion in FY26, at a CAGR of around 43%.

The Indian Medical device market is dominated by diagnostic imaging because of increasing awareness amongst people about the benefits of diseases getting diagnosed early. There is a direct link between the electronics component industry and the medical electronics industry. The existence of medical electronics manufacturing would not be feasible without a firm presence in the electronics component industry. Reliability and faster Product Realization is the key to success in medical electronics.

Competitive landscape of OEMs and ESDM players

Large multinationals and small and medium businesses (SMEs) exist in India's medical device industry, which is expanding at an unprecedented rate. Around 65% of Indian manufacturers are domestic operators in the consumables sector, catering mostly to domestic consumption with little exports. With vast service networks, large multinational corporations lead the high-tech end of the Medical Devices industry. Increased demand for healthcare and medical products as a result of rising medical tourism is anticipated to boost local production at a rate of 21% over the next 5 years.

Domestic OEMs typically operate in the low-cost, high-volume market segment, where demand is high. Global players do not operate in the low-tech device segment, which is mostly driven by imports. On the positive side, some manufacturing firms are now focusing their efforts on developing market niche products. Some of the key OEMs in this industry include global players such as GE Healthcare, Johnson & Johnson, Siemens, Philips, etc. and domestic players include Molbio diagnostics, Opto Circuits, Allied Medical, Trivitron Healthcare, etc. Key ESDM players addressing medical electronics market in India include Jabil, Dixon, and Kaynes, SFO Technologies, Sanmina-SCI, Flex and Avalon.

Over the last five years, the Indian government has taken various initiatives to support the creation of a strong ecosystem for medical device manufacturing in India. Under the automatic procedure, 100 percent FDI has been permitted in both brownfield and greenfield establishments. The high level of FDI inflows reflects the global firms' trust in the Indian market. Around % of manufacturers in India are domestic firms mostly engaged in the consumables sector and focused on domestic consumption with negligible exports. With extensive service networks, huge multinational corporations dominate the high-tech segment of the medical device industry in India. The medical equipment business has attracted about USD 2.2 billion in FDI since April 2000.

Future opportunities

There are vast opportunities for investment in healthcare infrastructure in both urban and rural India further fuelled through the massive adoption of technology in the sector. The current demand and supply side dynamics provide a significant opportunity and rationale for manufacturing medical devices in India. The Government of India’s ‘Make in India’ initiative presents a platform for the sector to revisit the operating model, identify key imperatives for growth and explore possibilities for creating a step change in the medical devices sector. Existing ESDM companies who are having design capabilities are globally certified for manufacture of Medical Devices and are having advanced infrastructure will benefit immensely in the years to come.

For MNC players, India presents a good opportunity to simultaneously de-risk their business from regional or global risks and the growing domestic market. India is set to become a major consumption location, with high potential to become an export oriented country. While China is an example of a location that provides enormous domestic demand as well as low cost manufacturing, countries like Ireland, Singapore and Puerto Rico are successful examples of markets that have become major export hubs.

D) IoT and Embedded Systems

Industry overview

India's thriving economy and potential to play a larger role in global manufacturing position it to be a centre for internet of things deployments. Industrial sectors such as health sciences, energy, and core manufacturing will utilise IoT use cases such as supply chain monitoring and asset maintenance to accelerate IoT adoption. In the consumer segment, the desire for a more personalised customer experience and improved after-sales support will motivate retailers to deploy IoT. Similarly, the Indian government's emphasis on smart cities would generate significant opportunities for IoT spending in areas like as public safety, traffic control, and energy management.

The Government of India launched the Smart Cities Mission in 2015. Under this program, the Government of India and State governments have identified 100 smart cities, to be developed by the year 2024 to address the challenges associated with India’s fast population growth and massive urbanisation in the coming years. These smart cities will be developed with an aim to promote inclusive cities with a sustainable approach to promote better quality of life to the citizens in a very sustainable environment through the application of the smart information and communication technology (ICT) solutions, wherever required.

Under Union Budget 2021-22, the Smart Cities Mission in India was allocated INR 6,450 crore as compared to INR 3,400 crore in FY21. The total allocated investment for Smart City Mission stood at INR 205,018 crore as of March 2021. Of the total investments, 5,614 projects worth INR 173,018 crore have already been tendered, work orders have been issued for total 4,912 projects worth INR 139,851 crore and 2,420 projects worth INR 40,152 crore have been completed as of March, 2021.

Embedded systems, on the other hand, have become a fundamental feature of consumer electronics gadgets such as smartphones, computers, lighting, and game consoles. The rising standard of life, growing awareness of technology, and lowering prices of consumer electronics devices have all contributed to an increase in the penetration of consumer electronics with embedded computing across end-user verticals. The Internet of Things has enhanced the importance of embedded systems in the consumer electronics industry.

Despite the fact that India started its Internet of Things journey far later than established economies, the installed base of connected products in India is likely to increase at a much faster rate than in developed economies. The adoption of IoT solutions for Digital Utilities/Smart Cities, as well as industries like Manufacturing, T&L, and Automotive, will fuel demand for Industrial IoT applications in the future. In India, consumer IoT applications are being driven by the development of the tech-savvy customer, as well as increased smartphone and mobile internet usage. Players from all parts of the value chain are gearing up to take advantage of the IoT industry. In addition, start-ups that provide novel solutions are assisting in the expansion of IoT in India.

IoT Application development vendors which are also known as machine -to- machine application developers are predicted to capture a 50% share of the Indian IoT market, presenting potential for firms across the value chain. Top IoT development companies present in India are Mphasis, TCS, Tech Mahindra, Mindtree, Wipro, LTI, Hyperlink Infosystem and Infosys among others. Manufacturing, automotive, utilities,

healthcare, and retail are among the industries that have embraced the Internet of Things. The Indian government has proposed a multifaceted approach to developing the IoT sector. To enable the successful deployment of IoT by the workforce, cross-functional skill sets and specialised training are required. The Internet of Things (IoT) is a network of interconnected gadgets that is rapidly expanding.

Growth drivers

- **IoT in home automation:** End-users desire for smart homes has increased in recent years, making IoT the most popular home automation technology. Home automation has given IoT a lot of much-needed exposure. Smart remotes, smart locks, smart lighting, smart doorbells, smart AC controllers, etc. are few examples.
- **IoT in Manufacturing:** IoT provides better automation, analytics, and data collecting, and is propelling the Industry 4.0 movement toward automation for optimised workflows and analytics. Manufacturing gets easier with IoT, as machines can be configured to work in concert to optimise production. The concept of smart factories is only conceivable with the assistance of the IoT.
- **IoT in Smart City:** The solution encompasses smart transportation, buildings, utilities, streetlights, security, and smart citizen services making it one of the top growth segments for IoT. The key growth drivers include rapid urbanization, better management & utilization of public resources, public safety, rising environmental concern, and efficient consumption of energy to name a few. The current Indian Government initiative to push 100 cities to adopt smart solutions shall further add traction to this segment's growth locally.
- **IoT in other sectors:** Healthcare is one of the sectors that has recognised the IoT's potential and prepared itself to reap the benefits of connectivity. IoT has disrupted the healthcare business by transforming it from a time-consuming process of physicians collecting and accessing patients' data to an automated and efficient process of sampling, collecting, and remotely accessing data via IoT-enabled operations. The energy utility sector was a pioneer in adopting IoT, and with the advent of smart metres, the energy utility business has been able to more precisely track energy consumption. Additionally, it enables enterprises in the area to bill clients for use more efficiently.

Multiple IoT related initiatives by Indian Government

- **Draft IoT Policy 2015:** Ministry of Electronics and Information Technology launched India's first draft of IoT Policy Document in 2015 – a strong governance framework for the holistic implementation and the execution of the IoT-related policies
- **National Digital Communications Policy (NDCP) 2018:** Futuristic goals & policy initiatives undertaken by the NDCP to address the problem of communications and to have access of digital services in India
- **Smart Cities Mission (SCM) 2015:** Smart City Mission was launched in the year 2015 to drive the economic growth and to improve the quality of life by using the technology as a means to create smarter outcome
- **IoT Centre of Excellence (CoE) by NASSCOM, MeitY and ERNET:** CoE is particularly designed to help the Indian IoT Start-ups to create the market-leading products. CoE is India's largest deep tech innovation ecosystem.

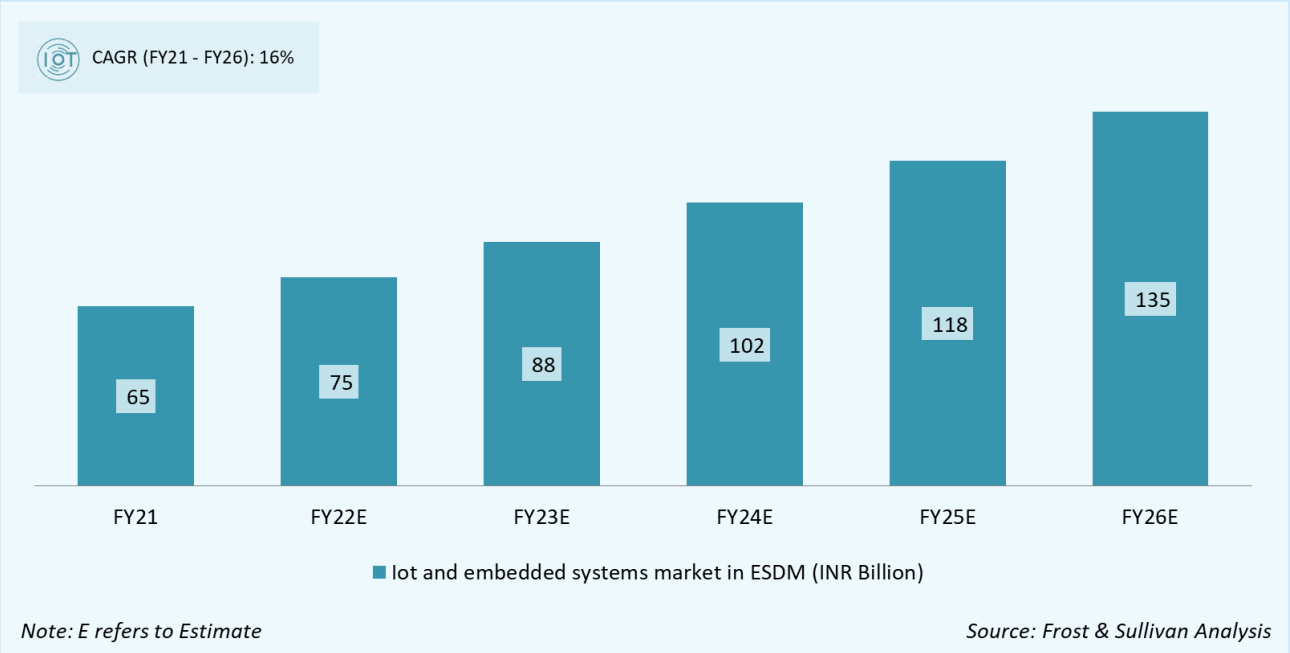
Key market trends

- **Advent of blockchain technology:** The distributed ledger of a blockchain is tamper-proof. Blockchain encryption prevents anyone from overwriting existing data records. Using blockchain to store IoT data offers another layer of security to prevent unwanted attacks. The combination of IoT and blockchain opens up new opportunities for all individuals involved, reducing inefficiencies, increasing security and transparency, and enabling secure machine-to-machine transactions. The combination of these technologies allows a physical asset to be tracked from the time it is mined through every step of the supply chain to the ultimate user.
- **Increasing focus on big data analytics:** that track and analyse the performance of machines, fuel consumption, etc.
- **Emergence of wireless connectivity:** The extensive use of Wi-Fi and Bluetooth on smartphones, as well as the general availability of cell towers and public Wi-Fi access points, makes it easier for IoT devices to connect to the cloud. With the advent of 5G, data-transfer speeds will increase significantly going forward. 5G will be 10 times faster than the current LTE networks. This increase in speed will allow the IoT devices to communicate & share data faster than ever earlier.

Market size and outlook of IoT industry in India

The IoT market in India is expected to continue expanding at a CAGR of 16% from 2021 to reach INR 135 billion in 2026, backed by strong connectivity and coverage, rising internet penetration, surge in smart applications adoption, new business models, and government initiatives such as smart city projects.

Chart 6.5: Domestic market size of IoT industry, value in INR billion, India, FY21-FY26E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

Competitive landscape of OEMs and ESDM players

Some of the major players operating in the Indian IoT market include Kaynes, Ecoxys, HCL Technologies, Ennovasy, and others. These players adopt various organic and inorganic growth strategies such as merger and acquisition and product launch to strengthen their presence in Indian market. Kaynes through Kemsys is one of the key market participants in the IoT space in India.

Companies such as HCL, Kemsys Technologies, Wipro, among others, that have end-to-end IoT Solution capabilities including Hardware/System Engineering, Digital Engineering, and Data Engineering are better placed to benefit as IoT use cases across industries are getting into the mainstream deployment. Kemsys Technologies which is a part of Kaynes offer multi-year experience in the key domains where IoT and the Digital Transformation adoption are taking place very fast. The company offers comprehensive and industry compliant solutions across industries via innovative engineering practice. Kemsys has its own suit of sensors, gateways and connectivity providing IoT solutions over the cloud, enabling penetration of digital technology in all business segments it is operating.

IoT is disrupting the consumer market, government, and industrial sectors at the same time. Companies like Kemsys are providing a range of customizable sensor products, multi-protocol gateway solutions, low-power wireless connectivity modules, Industry 4.0 and Smart City compliant cloud platforms, and vertical analytic applications. Such companies are better equipped to target a wide range of growing IoT use cases both locally and globally. India IoT based start-ups comprises of the following companies: MangoMan Consumer Electronics, Sensara, Lycos Internet, Altiux, Altizon Systems, Cooey, EcoAxis, Entrib, SPAN, Maven System, Nexiot, SenseGiz, Yuktix.

Kaynes strength in IoT segment

Kemsys, a wholly owned subsidiary of Kaynes, has been delivering IoT product design services for more than two decades. Kemsys offers IoT hardware, software, and smart product development. It also offers embedded design, which allows a product to be brought to life right from the concept stage. As a major player in IoT, Kemsys provides business value creation for clients ranging from Fortune 500 companies to start-up firms. It has eight labs and facilities and has completed nearly 100 projects globally. Its end-to-end IoT development architecture enables the rapid, smooth, and cost-effective execution of complex projects.

Key service offerings of Kemsys include:

1. Device engineering: providing turnkey solutions for product companies across verticals requiring custom embedded system development
2. Digital engineering: service offerings leverage new technologies including IoT, Big Data, Machine Learning, Cloud, Media, etc.
3. Quality engineering: providing quality assurance services across the entire Connected Product Lifecycle spectrum
4. Manufacturing: providing product certifications, mechanical casing design, BOM optimization, and mass manufacturing services

Kemsys is primarily focused on OT/IT integration and serves a diverse client base in industries such as industrial, healthcare, and infrastructure (smart cities). The IoT solution is horizontally integrated, delivering digital automation throughout the manufacturing value chain, from research and development to production and distribution. Kemsys' technologies enable clients to create their own applications and combine them with the suitable devices. Industrial IoT products and accelerators include differential air pressure, RTD temperature, liquid pressure, vibration, 3P power sensor, LTE BLE gateway, M4 gateway, RFID gateway and AIIot gateway.

As production activities are also becoming automated via the use of digital tools, Kemsys provides a strong support through IoT solutions across key segments. Use cases in the key segments include:

1. Manufacturing segment: (a) operations management (b) predictive maintenance (c) productivity (d) inventory optimization
2. Smart city: (a) waste management (b) commercial infra compliance (c) water infra monitoring (d) fleet management (e) STP monitoring and maintenance (f) air quality monitoring

Future opportunities

With initiatives like smart manufacturing, industry 4.0 and smart cities gaining traction, we can estimate that India will be one of the most vibrant IoT ecosystems in the world. IoT is emerging as one of the fastest-growing tech fields in India and with its widespread following the digital revolution. It is already catapulting various industries and India is at the cusp of transforming and hybridizing jobs as per the future's demand. Therefore, IoT is triggering the next big digital revolution and paving the way for it through automation.

IoT technology creates an opportunity to re-think business models at a fundamental level and to harness new ways to create, deliver, and capture value. As a strategic tool, it helps in business scalability by enabling enterprises to generate new and innovative user experiences through a customer centric approach. In India, The best place where IoT will be transformative will be in smart cities in areas such as control centres, transportation management, utilities, and water supplies.

E) Strategic Electronics (Spacetech)

Industry overview

Strategic electronics production in India has developed rapidly, as concern about indigenization and Make-in-India has increased the significance of strategic electronics. Aerospace and defence is one of the most complex and specialised industries in electronics manufacturing. Increased research and development expenditure, quick approval on clearances, better public-private partnerships (PPP) models, and higher customer acceptance rates are required for the industry to fulfil its full potential. Electronics have emerged as a strategic and lucrative field as the segment powered by increased aerospace and defence budgets achieves unprecedented growth. There are around 350 private companies in India's space tech sector. The sector is increasing due to investors backed by government initiatives.

The Indian space industry accounted for only two per cent of the global space industry having a market size of nearly USD 8 billion in 2020. Late in 2020, the Department of Space, Indian Government, came up with a draft outlining the new space policies. The draft reduced the regulations related to the private players in the

space tech industry, opening the doors for the independent space tech players to grow and flourish in the Indian space ecosystem. In the annual budget released by India's Finance minister on February 1, 2021 the Department of Space was allocated INR 139.4909 billion rupees. The newly established NewSpace India Limited — the commercial arm of the ISRO that seeks to increase the government-industry cooperation — has been allocated INR 7 billion rupees. The Company is expected to spearhead the commercialization of the space products including the "productionisation of the launch vehicles, transfer of the technologies and marketing of the space products".

Government Initiatives

- Indian National Space Promotion & Authorization Centre (IN-SPACe) created for the purpose of developing the link between the ISRO and the private companies
- SATCOM and remote sensing policy under revision
- Formulated new navigation policy

Key Drivers

- **Increasing need for satellite manufacturing:** the rising space-based needs of security agencies, ISRO will not only have to continue the routine development of remote sensing and telecommunications missions but also need to deliver for national security requirements.
- **Digitalization** is the key driver of commercial success in NewSpace; it also underscores the lower maturity of adoption of digital tools and resources by the Indian space businesses. Potential integration into the global value chains of local OEMs acting as a growth catalyst for the industry

Key market trends

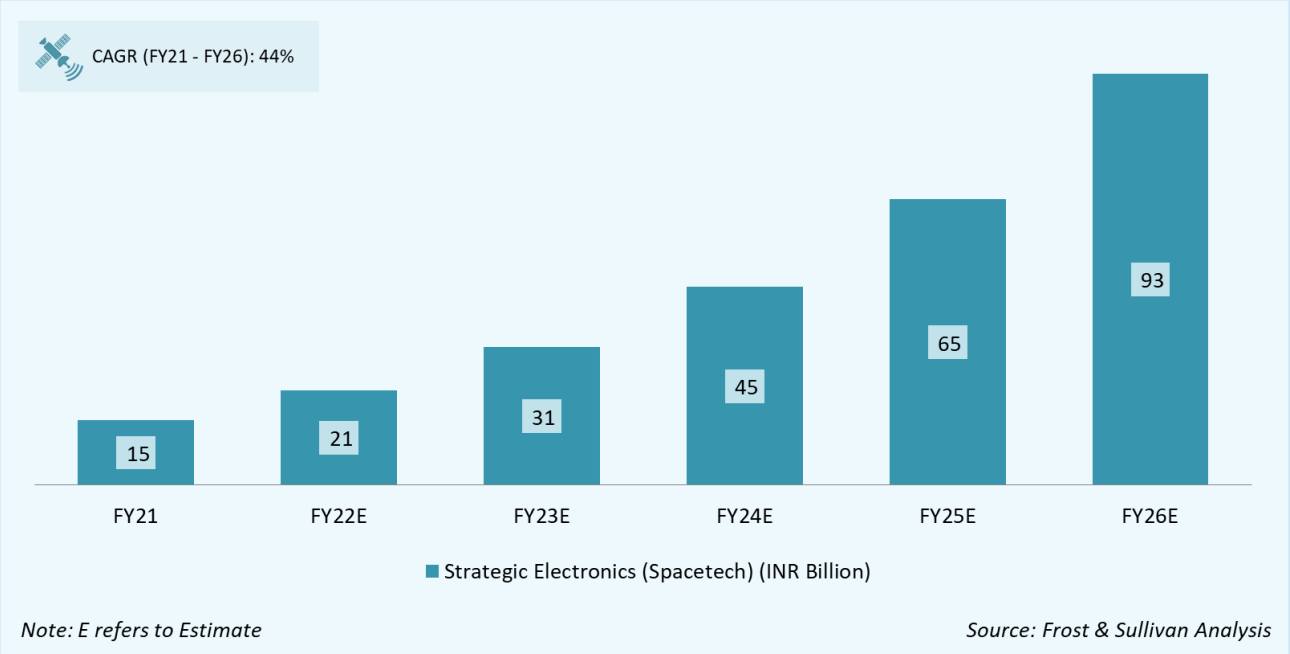
- **Entry of private sector in the Indian Space Industry:** In India, many Non-Government-Private-Entities (NGPEs) have started engaging in space activities for commercial gains. Many start-ups and industries have started making launch vehicles and satellites and are eager to provide space based services.
- **Development of new applications:** Space based applications/ services over the years have grown remarkably. Many new applications are being developed to meet the growing needs. The activities are on a growth trajectory with huge commercial potential. Major applications include developing the highest resolution hyper-spectral satellite constellation, developing a 3D printed semi-cryogenic rocket engine, working on cluster of earth-observation nano-satellites to mention a few.
- **Government initiatives:** The aerospace segment looks very promising because of the increasing trend in the budget allocation, modernization and the procurement of state of the art electronic equipment & technology. Strong government support to the start-ups in the aerospace industry in India is showing promising trend in the market

Market size and outlook of Strategic Electronics industry in India

The market size of strategic electronics (spacetech) currently projected at INR 15 billion in FY21, and there is enormous potential due to a significant supply-demand mismatch. The spacetech industry, which has the

ability to connect global value chains of OEMs, is another set of prospects that have grown within strategic electronics. The Indian government has sanctioned the participation of private players in the space industry and established an autonomous body IN-SPACe(Indian National Space Promotion and Authorization Centre), as an extension of ISRO, to assist private firms. This is being fuelled in part by India's expanding technical capabilities.

Chart 6.6: Market size and outlook of Strategic Electronics industry in India



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

The Indian space agency, ISRO, intends to reuse rocket-launch technology and begin developing reusable rockets in the coming decade. With the unexpected admission of several firms, this sector has grown. ISRO has 18 centres dedicated to expanding capabilities in ground stations, human spaceflight, satellite platforms, and other areas. The Vikram Sarabhai Space Centre is active in the development of launch vehicles for heavy-lift capabilities by attaining partial reusability and scramjet engine research.

So far, the domestic ESDM sector has been unable to meet expanding demand because it has majorly been driven by the government entities and now as slowly as the deeper value unlocking is happening in this sector going forward large ESDM participation can also be seen. Despite its image as a software giant and a worldwide hub for IT and outsourcing, India lacks a single business that builds powerful end-to-end aerospace and defence software solutions. As a result, India remains reliant on foreign companies.

Increasing trend of outsourcing design, R&D and the manufacturing will open up opportunities for ESDM players going forward. Most of the orders are high tech low volume orders that can be seen in Indian space ecosystem currently. Indian Defence spending due to efforts for modernization and increased threat perception is increasing the potential for the Indian defence manufacturing sector. ISRO is looking for EMS partners as they are scaling up currently and have long term goals going forward.

Competitive landscape of OEMs and ESDM players

The ISRO has already been working with private firms for a substantial period of time. First-generation private players include Godrej and Andhra Sugars, which formed collaboration with the Indian Space Research Organization (ISRO). A group of businesses that was proud to be part of the country's effort to develop its space programme. The liquid propulsion engines for PSLV and GSLV rockets, the thrusters for satellites, and antenna systems have all been developed in collaboration with ISRO by Godrej Aerospace over the course of the past 30 years .

About 165 SMEs in India are working in space sector and key spacetech startups are Pixxel, Bellatrix Aerospace, Vesta Space, Grahaa Space, Dhruva Space, Manastu Space Technologies, Kawa Space, and Parampara. The other segments are state-run institutions, academic institutions, publicly traded companies and large private companies which constitute list of 281 in the space ecosystem. Companies like Space X, Blue Origin, Virgin Galactic and Agnikul are among of the most prominent participants in the business. Several major private firms, including Reliance, L & T, Tata Power SED and Mahindra Aerospace, are investing heavily in this sector. However, these private sector companies are only expected to hold a 5% market share. Additionally, in the last several years, companies with the capability of manufacturing PSU component parts have expanded their reliance on domestic sourcing. But it will take 3 to 5 years for development to reach a point where there will be a range of suppliers for one single constituent. Key ESDM players operating in this segment include Kaynes, Cyient, Centum, Ananth technologies and Avalon.

F) Green Energy (Solar inverter and LED Lighting)

Industry overview

Indian renewable energy sector is the 4th most attractive renewable energy market in the world with 4th in wind power and 5th in solar power. Recently, India had 101.53 GW of renewable energy capacity and represent about 38% of the overall installed power capacity.

As of October 2021, India’s renewable energy capacity stood at 1.49 GW representing nearly 38.27% of the total installed power capacity and providing a great opportunity for the expansion of green data centres. India set to achieve 500 GW renewable energy installed capacity by 2030. Solar will constitute about 450 GW and hydro about 70 GW to 100 GW.

The wind energy potential would be about 70 GW of off-shore. And expect to add 10 GW of solar PV manufacturing capacity over the next five years. India is targeting initially approximately 1 million tonnes of annual green hydrogen production by 2030.

Key drivers

- As per the Global Trends in Renewable Energy Investment 2020 study, India has attracted investments worth INR 4.7 lakh crore in renewable energy projects in between 2014 to 2019. Investments in the sector stood at INR 45,000 crore in FY21 and INR 46,000 crore in FY22 (till July 2021).

- In April 2021, the Ministry of Power released a draft of the National Electricity Policy 2021 and invited suggestions from all the stakeholders to map the growth potential in renewable energy sector in India.

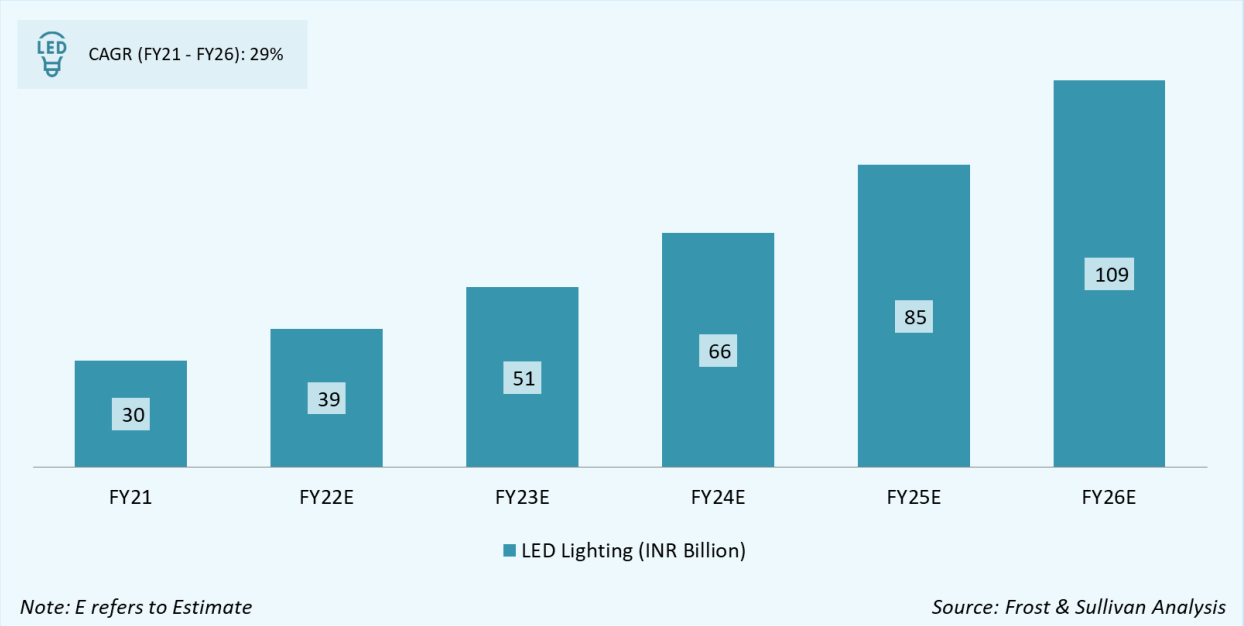
Key market trends

- India's foreign investment policy permits 100% FDI in renewable energy sector.
- To promote domestic production and boost domestic capacity under 'Atmanirbhar Bharat', the government is estimated to notify a phased manufacturing plan for solar cells and solar panels.
- To encourage domestic production, customs duty on solar inverters has been increased from 5% to 20%, and on solar lanterns from 5% to 15%.

Market size and outlook of Green energy in India

The wind energy potential would be about 70 GW of off-shore. And expect to add 10 GW of solar PV manufacturing capacity over the next five years. India is targeting initially approximately 1 million tonnes of annual green hydrogen production by 2030. According to Department for Promotion of Industry and Internal Trade (DPIIT), FDI inflow in the Indian non-conventional energy is about USD 10.28 Billion between April 2000 and June 2021. India Solar Inverter market is projected to grow at CAGR of 14.4% during 2020-26. The key drivers are increasing environmental awareness, financial support from the government in the form of subsidies, new initiatives, and targets for renewable energy launched by MNRE. The key segments for solar invertor business are educational institutes, offices, factories, hospitals, and warehouses. The untapped residential segment looks promising in years to come.

Chart 6.7: Domestic market size of LED Lighting, value in INR billion, India, FY21-FY26E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

Indian LED lighting market is about USD 2.9 Billion and is expected to grow at a CAGR of 30% and may reach USD 12 Billion by 2026. The major reason for increase in demand for LED lights is driven by government

initiatives, increased awareness and higher socio-economic growth. Rural India and Tier- II cities have also contributed to an increased demand based on requirements from the street lighting and industrial lighting domains.

Competitive landscape of OEMs and ESDM players

The solar inverter market is largely consolidated with some large players in the fray. R&D for product innovation and product development is the focus of prominent players in the solar inverter market. Sungrow is leading players, followed by Sineng Electric and TBEA Energy. Other key players include Waaree Energies, Delta, SMA India, GoodWe, ABB, TMEIC, Fronius, Huawei and Sofar.

In LED lighting, with a combined market share of 57%, prominent brands such as Signify (Philips), Havells, Wipro, Syska LED, and Bajaj dominate the majority of the market. Surya Roshni, Orient Electric, Eveready, Halonix, and MIC are some of the other major competitors in the industry. Major LED lighting EMS player present in the Indian market include Dixon, Elin and RK Lighting hold the major market share. The other key players present in the EMS space are Century LED, Compact Lamps and Goel Lighting to name a few.

Future Opportunities

- Power generation from solar and wind projects are likely to remain cost-competitive relative to thermal power generation in India in 2025-2030.
- The NTPC is expected to commission India’s largest floating solar power plant in Ramagundam, Telangana by May-June 2022. The anticipated total installed capacity is 447MW
- A new hydro power policy for 2018-28 has been drafted for the growth of hydro projects in the country

G) Wearables (Earwear, Smart band and Smart watch)

Industry overview

Wearable technology is an emerging trend that integrates electronics into daily activities and addresses changing lifestyles. Wearable technology is gaining popularity due to features such as internet connectivity and data exchange between a network and a device. India is currently the world's third largest wearable market. In 2020, India's wearables market grew more than 100% YoY. This increase was primarily driven by more people purchasing earphones as a result of the need to work from home during the lockdown. This growth was majorly driven by increasing acceptance of the earwear devices and upgrades to watches from the wrist bands, both of these recording their highest annual shipments in the year 2020.

Key drivers

- **Income growth and rising purchasing power** has led to an increase in sales of consumer electronics. With aesthetic design, improved battery life and better connectivity wearables are evolving from a nice to have device to one that positively impacts in the lifestyle.

- **Favourable demography with a large young population base** has resulted in the adoption of wearables. The growing trend toward the adoption of technology gadgets by the tech-savvy Indian youth population will drive the wearables market during the forecast period.
- **Increasing internet penetration and sales through eCommerce** will augur well for market growth: Wearables are preferably purchased online by consumers due to the high discounts provided by eCommerce platforms. High discounts and festive sales will boost the growth of wearables market in India.

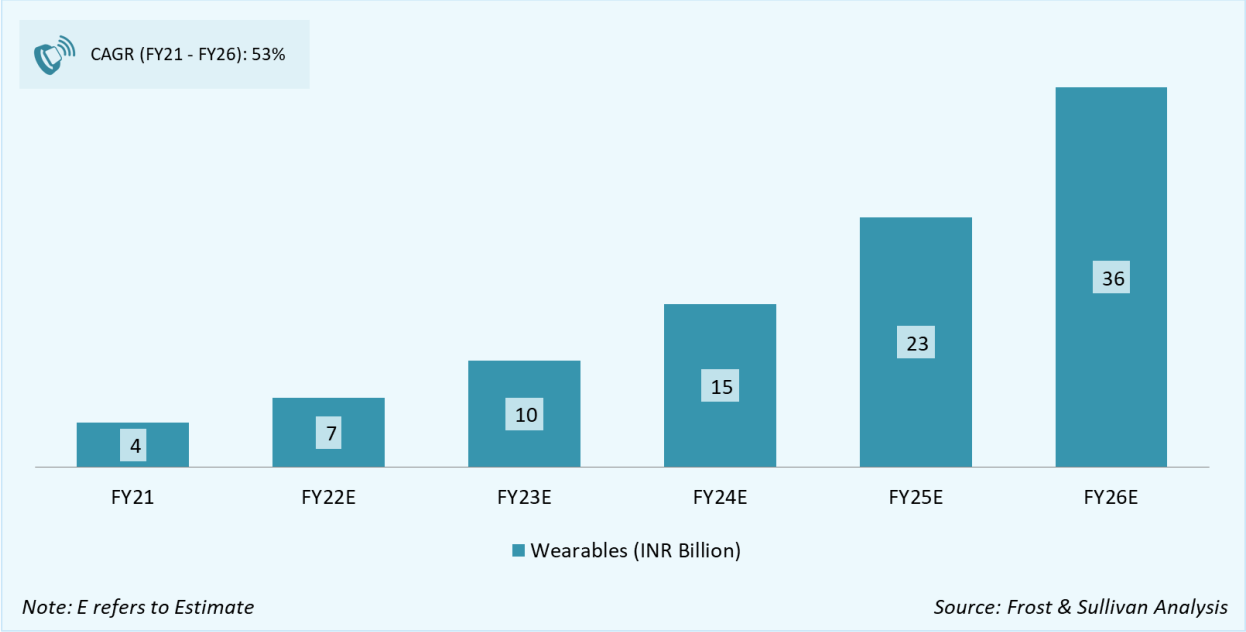
Key market trends

- **Increasing urbanization:** With increasing urbanization and more adoption among the Gen Y population, the demand for aesthetically appealing advanced featured products such as TWS has driven the market for wearables.
- **Connected homes:** The advent of Internet of Things (IoT) and the increase in connectivity features in consumer appliances and electronics present an opportunity for suppliers.

Market size and outlook of Wearables in India

In FY21, the Indian wearables market was estimated to grow at a CAGR of 53%, from INR 4 billion in FY21 to reach INR 36 billion in FY26 by sales value. The latest version of the wearables is much better in terms of improved aesthetic and design of the wearables also made them the trendsetter. The wearables market will continue to see technological advancements such as AI-enhanced utility and user experience, and noise cancellation features for improved audio quality during voice calls in hearables segment. The OEMs' requirements in this industry are localized/domestic manufacturing, speedy and high-quality manufacturing, as well as cost-effective solutions.

Chart 6.8: Domestic market size of Wearables, value in INR billion, India, FY21-FY26E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

Competitive landscape of OEMs and ESDM players

BoAt, One Plus, RealMe, Noise, and pTron are the prominent brands within wearables segment in India. Xiaomi and Apple are the other leading players in the market. Affordability has been the key for Indian brands, and these brands have been immensely successful in gaining a significant portion of the market. The wearable market grew nearly 99% in Q3 2021 in comparison to Q3 2020. This was mainly due to affordable options becoming available, and also because demand for such devices rose as virtual meetings and e-learning became the rule in COVID-19 times. The entry of new players and frequent new model launches has resulted in a phenomenal change in India's wearables market, with more than 40 brands entering this market since 2017. More new brands across all price tiers are expected to be launched going forward in order to capture a larger share of the market. Low-cost offerings have given this segment a much-needed boost.

Till late 2020, wearables were imported into India by companies such as Boat, Noise, and others from their facilities in China and other overseas locations. Companies have begun to look for opportunities in the domestic market via EMS providers. In India, the leading EMS providers in the wearables segment are Bharat FIH, Kaynes, and Optiemus. BoAt, which is the fifth largest hearables brand globally, is an Indian consumer electronics brand that previously manufactured all of its products in China, is gradually shifting manufacturing to India with the support of EMS providers. Over 15% of their current products are manufactured in India, and they intend to manufacture more than 40% of their products in India by 2024. Aiwa, the most recent entrant, is also looking into a similar opportunity in India.

Future opportunities

- Smart bands are expected to have a higher growth in the next few years due to increase in adoption of wearables technology and more focus on health and fitness. The segment is expected to dominate the overall wearables market by volume and revenue for next 4 years. Age group between 25-45 years are the majority users in this segment.
- The smart watches segment has seen tremendous growth, especially in the last 3 years, leading to a huge spike in its revenue growth. Smart watches will present a large opportunity by value and are expected to have a higher growth rate backed by greater functionality spread and penetration of smartphones in India.
- Wearables technology is anticipated to be integrated into additional product categories, such as smart glasses, smart clothing (t-shirts), smart helmets, and smart shoes, all of which have a negligible presence at the moment. Although these devices are primarily focused on technology, many users place a premium on design. Increased emphasis on aesthetics is likely to be a key role in these products.

H) Smart meters

Industry overview

India is the world’s third largest producer of electricity after China and US. Government has introduced various schemes to boost the market such as National Smart Grid Mission and Ujwal Discom Assurance

Yojna among others. Utility sector of India is embarking on a new journey through advanced metering solutions and custom made technology. This smart metering technology is expected to benefit both the consumers and the utility sector of the country by allowing providers to increase operational efficiency, reduce energy theft and avoid revenue losses, while giving customers more stable electricity service and the ability to control their usage and expenses.

Smart meter is used in the industrial, commercial, and residential sector. This is mainly used to measure the energy consumption of the consumers. Industrial sector accounted for the majority share of the total domestic demand market of the smart meter. The government has planned to purchase around 50 lakhs smart meters for the two of the northern states.

The government initiatives on energy conservation, smart cities and modernization of electricity grid are expected to drive the Smart meters market. To overcome challenges including billing inefficiencies, unauthorized power consumption, and reduce DISCOMs' financial woes, the government is accelerating adoption of smart meters. Smart meter technology is critical to India's on-going power sector reforms. The Smart Meter National Programme aims to retrofit 250 million conventional meters with smart variants. However, there is absence of proper standards and distribution companies are following different technical specifications which impact the quality and price of energy meter. India has strong manufacturing capability of energy meters with some players exporting heavily to other countries

Growth drivers

- **Government initiative:** Government initiatives including Deen Dayal Upadhaya Gram Jyoti Yojna and Integrated power development scheme likely to boost the meter market. Ministry of Power have introduced Ujwal DISCOM Assurance Yojna (UDAY) which would inject a growth in the power sector.
- **Growth of key industrial sectors:** The Make in India campaign is expected to boost the manufacturing economy in India, which in turn will drive core industries including Power, Metals and Minerals, and Chemicals. The growth in industry is built on the foundation of reliable and continuous flow of power supply which is likely to boost the market for meters in India since it is the key component to monitor the consumption of electricity
- **Development in Infrastructure and Construction industry:** Projects including development of 100 smart cities and 500 cities under AMRUT (Atal Mission for Rejuvenation and Urban Transformation) are expected to attract investments of INR 2,00,000 Cr in the subsequent years, which bodes well for the market

Key market trends

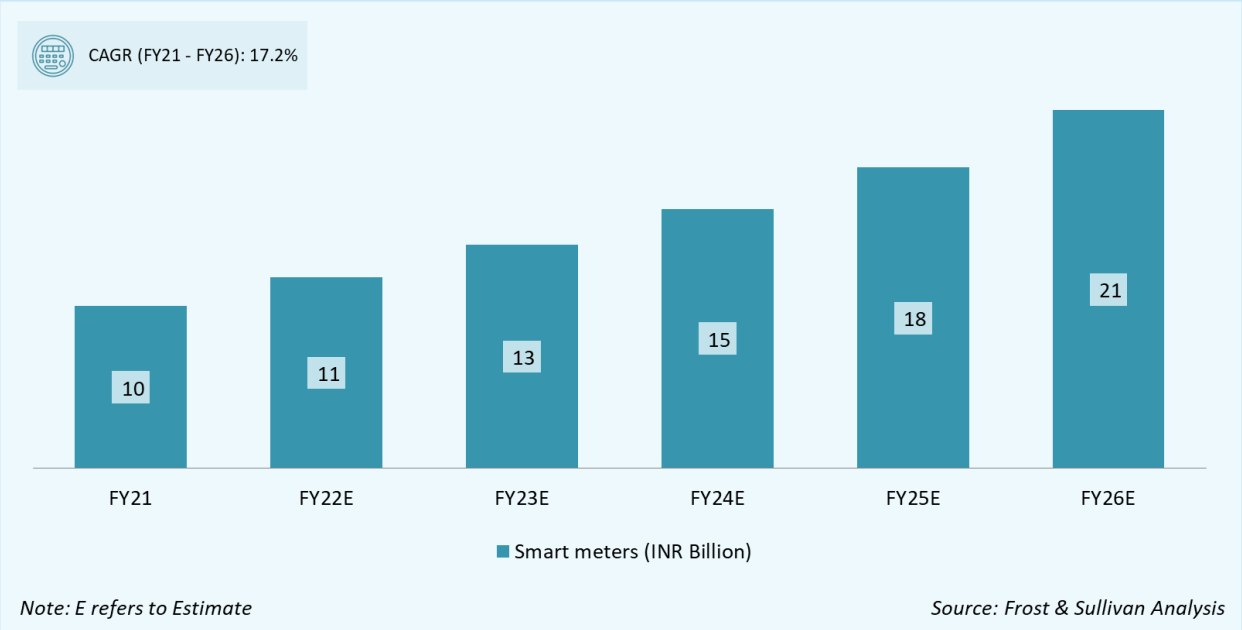
- **Higher adoption of mobile read communication enabled meters:** India is the next most important market, with shipments forecast to increase from 2 million in 2015 to 5 million by 2024. However, most of these meters are likely to be of very low specification, in many cases only fitted with mobile read communications.

- **Price sensitivity:** Price competition will continue to increase, particularly as Chinese meter manufacturers start aggressively targeting the international market once the Chinese rollout completed in 2015

Market size and outlook of Smart Meters industry in India

The Smart Meter market in India is expected to continue expanding at a CAGR of 17% from 2021 to reach INR 21 billion in 2026, backed by strong connectivity and coverage, rising internet penetration, surge in smart applications adoption, new business models, and government initiatives such as smart city projects.

Chart 6.9: Domestic market size of Wearables, value in INR billion, India, FY21-FY26E



Note: E refers to Estimate

Source: Frost & Sullivan Analysis

Competitive landscape of OEMs and ESDM players

Some of the major players operating in the Indian Smart Meters market include HPL, Intelli Smart which is among the leading players followed by Genus power and L&T. Other major companies include Itron India Pvt Ltd, Schneider Electric India Pvt Ltd, Secure Meters Ltd, Superior Products Industries and Towa Engineering Works among others

Future opportunities

Smart metering has been in India for more than two years now, but the industry is at a very early stage in India currently. Primarily, there was an issue around the acceptance with resistance from the consumers, but slowly, developments have started to rise, thanks to EESL, which took the initiative with numerous states. The government's plan is to install nearly 250 million smart meters in the upcoming three to four years across all the states in India. For that, several tenders are out based on the model document prepared by the government.

Third party servicing and repairs as a business opportunity

India has a huge market for electronic products. From laptops, smartphones, televisions, speakers, appliances, etc. the list continues to grow, and each product requires its own eco-system of repair and service assistance. India's increasing emphasis on domestic electronic production, combined with its desire for digitalization, is scaling new heights, and has paved the way for the third party servicing and repair sector, which is currently an untapped market. Repairing in-service electronic equipment almost often extends its life, lowering the amount of e-waste generated.

As a result of India's advancement in engineering skills and cost-effectiveness, the electronics third-party servicing and repair market is gaining traction. Several service and repair activities are currently underway in India for locally available devices. It is the pre-existing custom processes and the resulting logistical friction for repair that discourages large companies from outsourcing repairs of electronic. India has a significant advantage over China and Europe in terms of labour costs. Additionally, it boasts world-class service infrastructure that is owned by both Indian and foreign companies that have established operations in India. As per recent estimates, the third party electronic servicing and repairs market is projected to generate revenues of USD 20 billion per annum[2] in the next four years (from 2025 onwards), making it one of the fastest growing segments. The demand for electronic components will increase as the service and repair industry grows. Strategic component stock is expected to be created, which the industry desperately needs in times of global supply chain disruptions.

OEMs are often best positioned to capture the service and repair market because they have a better understanding of their products and the ability to form partnerships within their channels. Also, service and repair is a highly labour-intensive industry with large profit margins and it has the potential to become an emerging sector for employment growth in India.

[2] *Report on 'Electronic Hardware Repair Services Outsourcing', Manufacturer's Association of Information Technology (MAIT), 2021*

CHAPTER 7 – BACKWARD INTEGRATION OPPORTUNITIES – BARE PCB

Background

Printed Circuit Boards (PCBs) constitute the base of most electronic circuits and enable connecting electronic and electrical components without the use of wires. They find application in a wide range of industries which includes electronic products, automotive, electric vehicles, IoT, medical, defence, aerospace, lighting, solar, broadcasting, and more. It is hard to imagine an electronic product without a PCB and as it continues to evolve into new industries and applications, the size of this sector as well as its technology are advancing rapidly.

PCBs, being the backbone of electronics, are in a huge demand from the Indian electronics manufacturing industry. Demand for PCBs in FY'20 was approx. INR 20,000 Crore which includes both bare PCBs worth INR 16,000 Crore, as well as PCBs that form part of a module. All populated PCBs and more than 92 per cent of Bare PCBs were imported into India in FY'20.

Going forward, the demand for PCBs is likely to touch approx. INR 50,000 Crore in FY'26. This represents a huge growth in demand for PCBs within a short span of time, which cannot be left solely to be catered by the foreign suppliers. The Indian PCB manufacturing industry needs to develop capabilities to produce new technology PCBs and scaling up in the medium term in order to cater to such huge domestic demand.

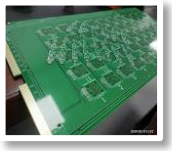
This brings attention to some of the critical challenges for development of Indian PCB industry. PCB manufacturing process requires a very robust supply chain and efficient as well as reliable infrastructure including abundant water supply, power, logistics and effluent treatment. Their manufacturing is characterised as one of the highest value added processes with very high capital output ratio ranging between 1:1 and at best 1:2. Thus need for technology and capital is very high and so is the disability cost vis à vis global competition (source: ELCINA). This chapter highlights Indian PCB industry value chain, hurdles for investment in domestic manufacturing, current market size, capabilities of Indian PCB manufacturers and growth outlook.

Types of bare PCBs

a) Classification by layer:

Single sided PCB - Printed circuit boards or the PCBs, are used for the purpose of connecting electronic components and these boards are regularly used in a wide range of electronic devices. Single sided PCBs are a type of circuit board that has the conductive copper and the components mounted on one side of the board and the conductive wiring connected on the other side. These PCBs usually have a rigid laminate with a woven glass epoxy base and have the circuit printed on one of its faces. These are used for simple circuits such as power supplies, remote controls, LED lamps etc.

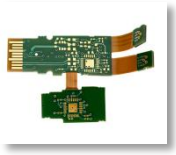
Double side PCB - Double sided PCBs are very much similar to the single sided PCBs, except the fact that they have two sided traces with a top & bottom layer. These boards can mount conductive copper & components on both the sides of the circuit board, which permits the traces to cross over each other. These PCBs have conductive copper layers on both sides of the substrate, which can be connected using vias. These are used in slightly complex circuits such as cameras, industrial control system, Automobiles etc.



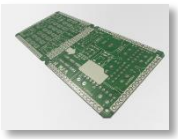
Multilayer PCB - These are PCBs that contain three or more conductive layers, which are used for designing complex circuits in compact from factors, common application include computers, medical devices, aerospace etc.

b) Classification by material/ substrate:

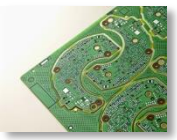
Flexible PCB - Flexible PCB is manufactured by using flexible substrate like polyamide and polyester. Flexible circuits are usually used in Printers, Mobile Phones, Keyboards and SMT machines. Due to the flexible nature of the connection, its firmness, and high density of electrical connections which can be achieved, the solution based on the flexible PCBs allows to attain a substantial reduction of space, weight & costs compared to an equivalent solution based on the rigid PCBs.



Rigid Flexible PCB - Rigid flexible board help connect multiple rigid PCBs while allowing flex capabilities. Rigid FPCBs are used in mobile phones, cameras, pacemakers and automobile. Rigid FPCBs are boards using a combination of flexible & rigid board technologies in an application. Most rigid flex boards comprise of multiple layers of flexible circuit substrates attached to one or more rigid boards externally or internally, depending upon the design of the application.



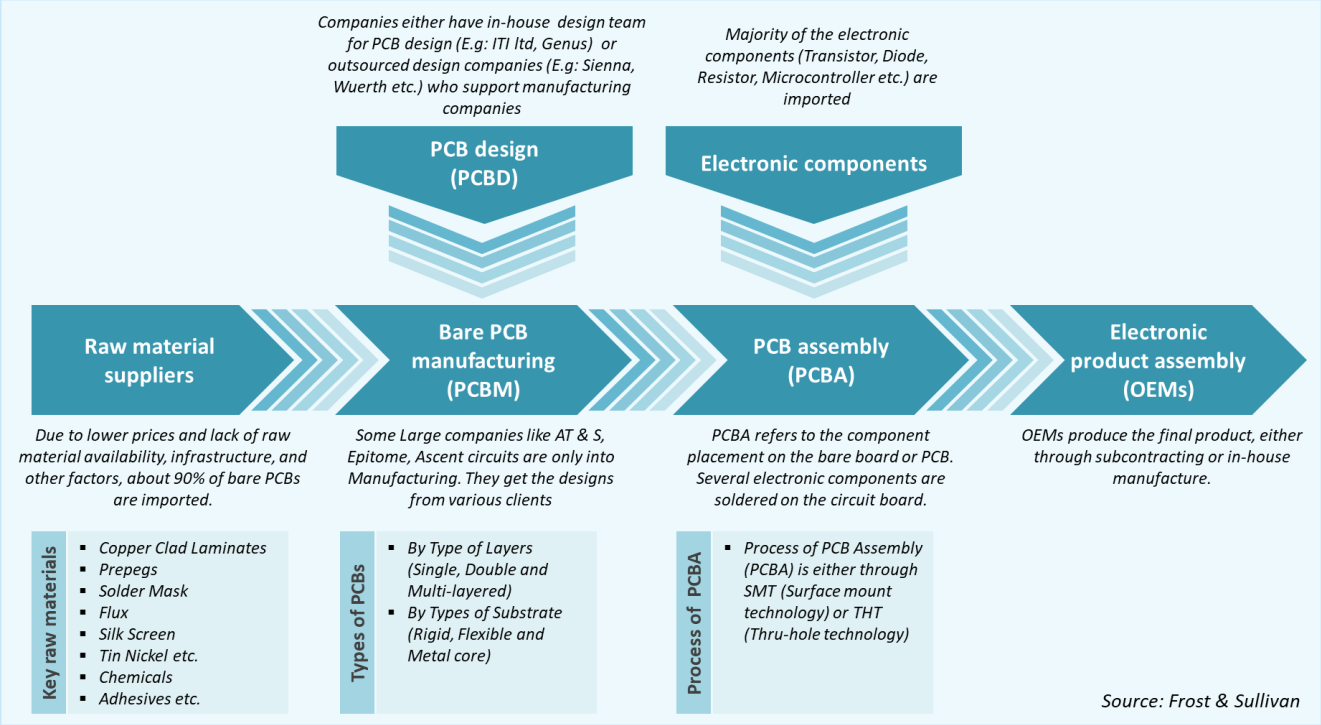
Metal Core PCB - Metal Core PCB made of thermal insulating layer, metal plate and metal copper foil, which has special magnetic conductivity, excellent heat dissipation, high mechanical strength and good processing performance. For metal core base material, there are aluminium and copper base materials.



HDI- High Density Interconnect - In High Density Interconnect, these PCBs have a higher wiring density than the traditional PCBs. Manufacturing of these boards require two and more lamination processes and micro via, blind via, buried via and through holes. Used in mobile phones, digital cameras and note books.

PCB industry value chain

Chart 7.1: Value chain of PCB industry, India



As per ELCINA's report on Indian PCB industry, India has about 200 operational PCB manufacturing units which includes about 15 organised PCB manufacturers, including AT&S, Epitome Components, Shogini Technoarts, Ascent Circuits, Sahasra Electronics, CIPSA-Tec, Micropack, Vintek and Genus, among others. These organised players have recorded revenue of more than INR 25 Crore in FY'20, going up to INR 100 - 500 Crore for some of the largest manufacturers.

The below table highlights PCB manufacturing capability of some of the leading domestic manufacturers:

Chart 7.2: Capabilities of the leading PCB manufacturers in India

Company Name	Year of establishment	Manufacturing Location	PCB Offering	Type of PCB manufacturing	Segment Focus
AT&S India Pvt. Ltd.	1999	Nanjangud, Karnataka	Double Sided PTH PCBs, Metal Core PCBs , Multilayer PCBs, HDI any layer PCBs, Flexible & Rigid Flexible PCBs	Single Sided Double Sided Multi Layer	Smart Phone, CE, Tablets, Ultrabook, Watches / Wearables item and Automotive, Industrial and Medical
Epitome Components	1997	2 units in Ahmednagar, Maharashtra	Single Sided PCBs, Double Sided PCBs and Rigid Flexible PCBs	Single Sided Double Sided Multi Layer	Consumer Electronics, IT Hardware, EMS and Others
Ascent Circuits Pvt. Ltd.	1999	Hosur, Tamil Nadu	Single Sided PCBs, Double Sided PCBs, Multilayer PCBs, Rigid Flexible PCBs	Single Sided Double Sided Multi Layer	EMS, CE, IT Hardware, Strategic Electronics and Mobile
Shogni Technoarts Pvt. Ltd.	1979	Pune, Maharashtra	Single Layer PCB, Double Layer PCB, Multi Layer PCB, Metal Clad PCB	Single Sided Double Sided Multi Layer	EMS, Consumer Electronics, IT Hardware and Others

Company Name	Year of establishment	Manufacturing Location	PCB Offering	Type of PCB manufacturing	Segment Focus
Cipsa-Tec India Pvt. Ltd.	2005	Tumkur, Andhra Pradesh	Double Layer PCBs, Multi layer PCBs, Metal Clad PCBs	Double Sided Multi Layer	EMS, Consumer Electronics, IT Hardware and Others
Vintek Circuits (India) Pvt. Ltd.	1990	Gurgaon, Haryana	Single Sided PCBs	Single Side	Consumer Electronics, EMS and Others
Micropack Ltd.	1984	Bangalore, Karnataka	Copper Rigid PCBs and Rigid Flex PCBs	Double Side Multi Layer	Defence, Space & Avionics, Telecom & Medical Electronics and Industrial Electronics
Meena Circuits Pvt. Ltd.	2006	Vadodara, Gujarat	Single Sided, Double Sided, Multi layer	Single Sided Double Sided Multi Layer	Consumer Electronics, Energy & Utility, Automotive & Medical

Source: Company websites

Challenges affecting investment in the domestic PCB manufacturing

Key challenges in development of domestic PCB manufacturing industry

- Technical capability
- Very high dependency on import for the raw materials
- Lack of physical infrastructure
- High capital investment
- Requirement of skilled human resource
- Inability to compete with Chinese and Taiwanese suppliers

a) **Technical capability:** Majority of the domestic PCB companies are engaged in manufacturing of single sided / double sided PCBs and don't have capability to produce multilayer and HDI PCBs required in manufacturing of mobile phones, computer hardware, telecom and defence electronics. Indian Government's PLI and SPECS initiative will help the Industry improve its technical capability, but it would still be difficult to compete with China on price.

b) **Import dependency for the raw materials:** Majority of the raw materials required for PCB manufacturing such as Laminates, Dry Film, Solder Mask, Copper Balls, Tin balls, Plating Chemicals, Copper Foil, and Prepreg etc. are all imported, mainly from China and other far-east countries. This indicates vulnerability of the domestic manufacturers against price and foreign exchange fluctuations, higher lead time and shortage of raw materials and results in higher manufacturing cost and longer turnaround time.

c) **Lack of physical infrastructure:** PCB manufacturing process requires uninterrupted supply of power. Even though power supply scenario has drastically improved in the past few years, there are instances of unplanned shutdowns. The process also requires huge amount of water while many stakeholders have reported challenges with consistent water supply, even with their relatively small water requirement. Due to the industry's dependency on import for raw materials, access to

highways and sea port airport facilities also play a crucial role. Lack of paved roads in some parts of the country and delay in clearance of cargo has also been minor challenge for the industry in the past.

d) **High capital investment:** In India, capital investment required for setting up of a bare PCB manufacturing factory (SS/DS) with an annual capacity of 5,000 SQM per month is approximately INR 25 Crore As most of the domestic PCB manufacturing companies are MSMEs, it is difficult for them to invest such huge capital and expand quickly.

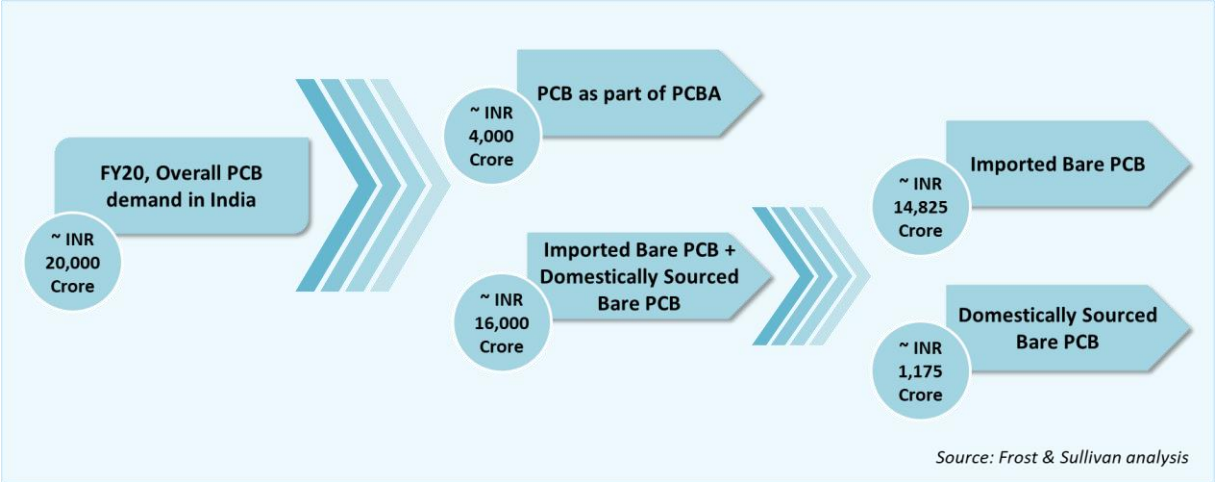
e) **Requirement of skilled human source:** It would be a daunting task for the industry to recruit and train employees to cater to the projected growth in demand. Without any structured training programme or diploma course for the PCB manufacturing industry, the industry would be forced to invest heavily, both in terms of time and money to train these employees. On the contrary, setting up of training infrastructure without the corresponding expansion of the job market could also spell disastrous for the industry.

f) **Inability to compete with Chinese and Taiwanese suppliers:** All the above mentioned challenges faced by the Indian PCB industry ultimately lead to the fact that the Indian PCB manufacturers are unable to compete against companies from China and Taiwan in terms of price. Import of expensive capital equipment and raw materials, lack of economies of scale and lack of trained human resource contribute significantly to the higher cost of manufacturing of PCBs in India. Even after the imposition of trade tariffs, PCB imports from China were 20-25% cheaper. This explains inability of the Indian manufacturers to cater to the high volume segments such as mobile phones, tablets, TVs and computers. This vicious circle of high manufacturing cost and low volumes has remained the key obstacle in development of domestic PCB manufacturing industry.

A large technology driven ESDM Company such as Kaynes as the capability to mitigate most of the above mentioned challenges and play an important role in development of domestic PCB industry through backward integration.

Indian Bare PCB market

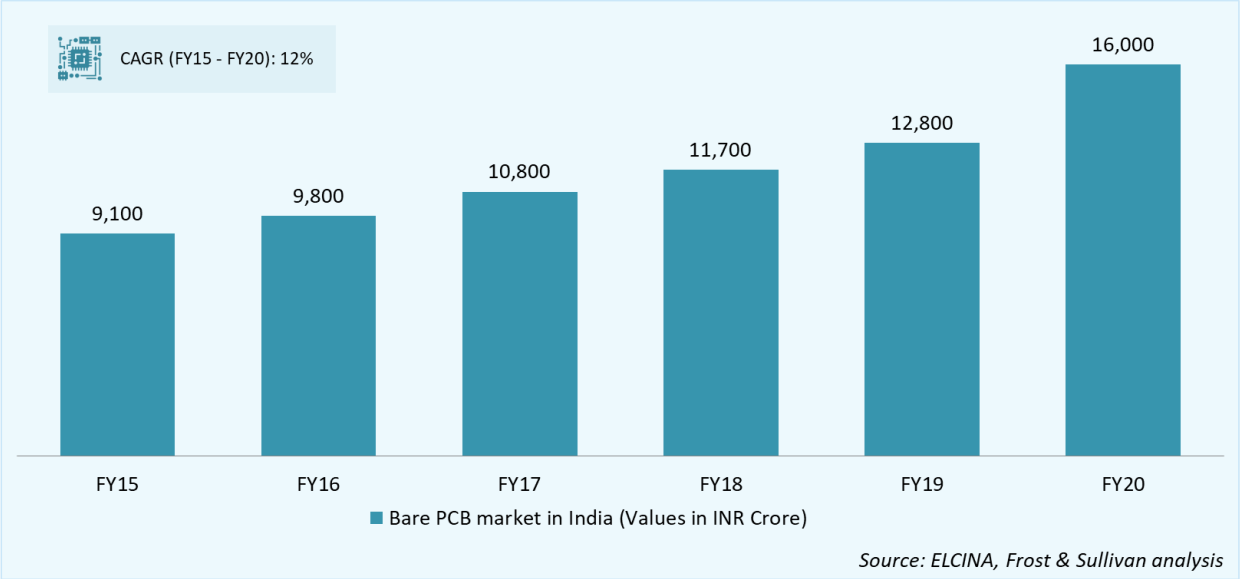
Chart 7.3: Overall PCB demand in India, FY20



As it can be seen from the above chart, approximately 94% of the PCB demand in the country had been met through import in FY'20. Bare PCB accounted for approximately 80% of this PCB demand i.e., INR 16,000 Crore. Going forward, Bare PCB demand in the country may touch INR 50,000 Crore by FY'26.

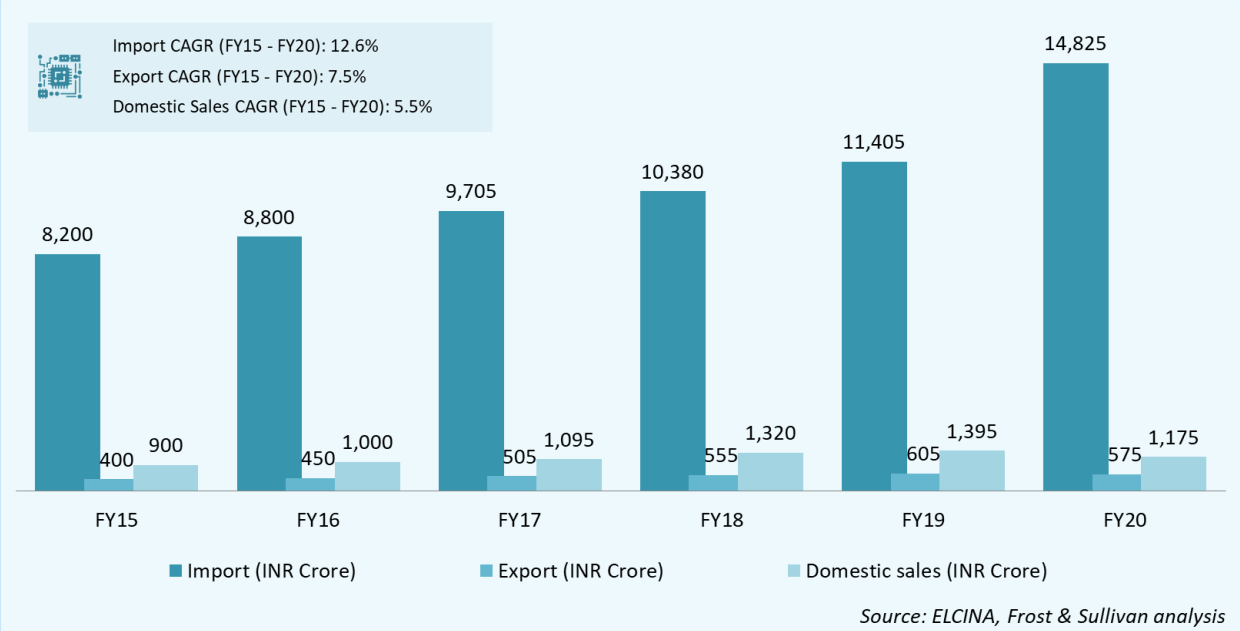
This represents a huge growth in demand for PCBs within a short span of time, which cannot be left solely to be catered by the foreign suppliers. The Indian PCB manufacturing industry needs to develop capabilities to produce new technology PCBs and scaling up in the medium term in order to cater to such huge domestic demand.

Chart 7.4: Bare PCB market in India, Value in INR Crore, FY15 to FY20



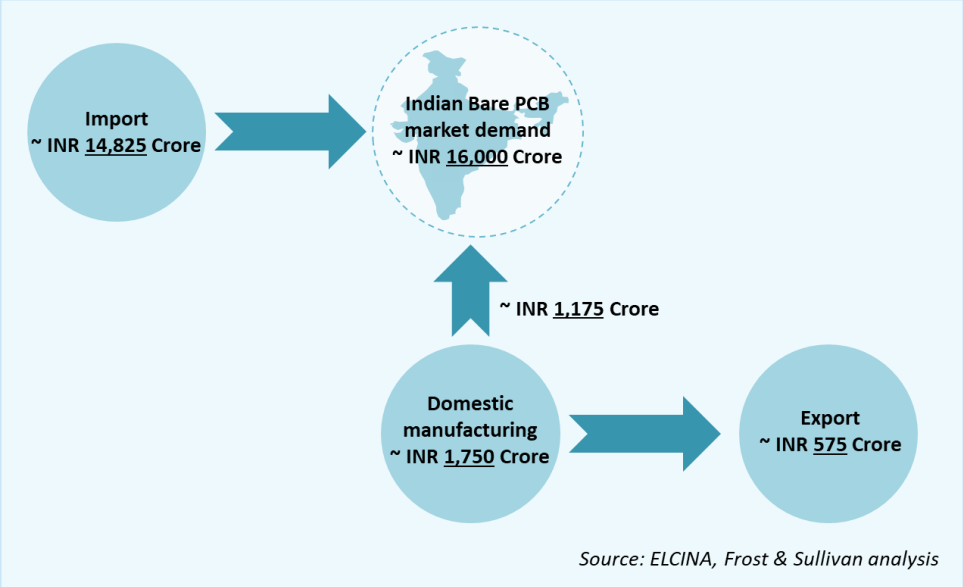
Source: ELCINA, Frost & Sullivan analysis

Chart 7.5: Bare PCB import, domestic sales and export trend, Value in INR Crore, FY15 to FY20



Source: ELCINA, Frost & Sullivan analysis

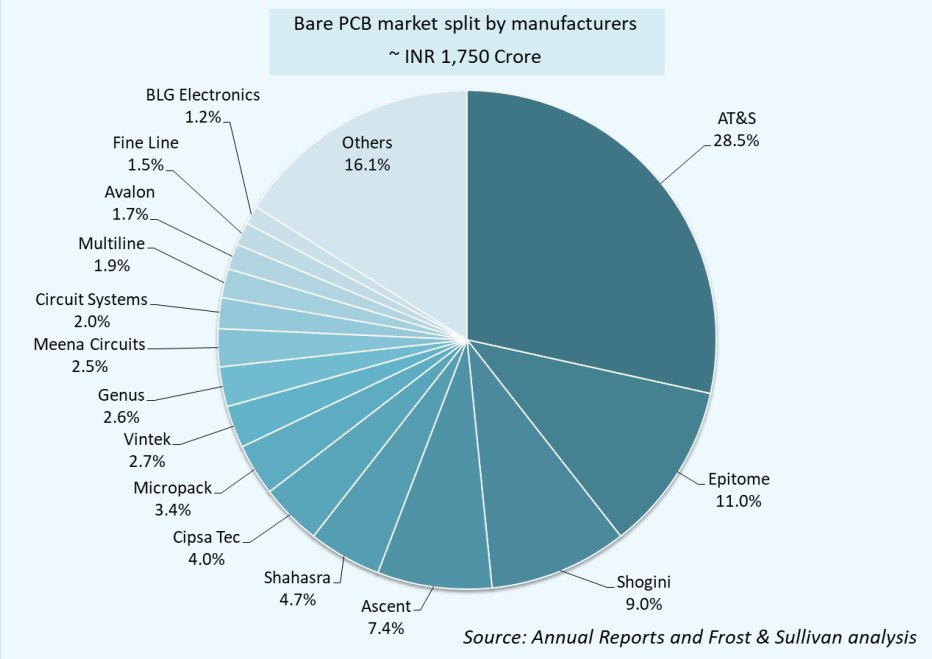
Chart 7.6: Indian Bare PCB market composition, Value in INR Crore, FY20



Indian PCB manufactures have sold PCB worth INR 1,750 Crore in FY'20. Apart from meeting the domestic demand, the industry has also generated decent revenue of INR 575 Crore through exports albeit through select suppliers namely, AT&S, Sahasra Electronics, Meena Circuits etc. In spite of the steady growth in electronics manufacturing, domestic PCB manufacturing scenario has not changed much in the recent past. The country is yet to see any major investment in the domestic PCB manufacturing sector.

Indian Bare PCB market split by domestic manufacturers

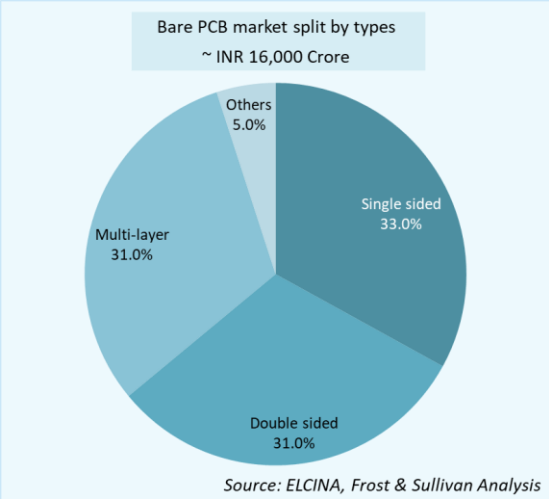
Chart 7.7: Bare PCB market split by domestic manufacturers, India, Value in INR Crore, FY20



AT&S is the largest manufacturer of PCBs in India and approximately 89% of its revenue came through exports in FY'20. AT&S manufactures multi-layer PCBs for many segments such as Smart Phone, CE, Tablets, Ultra book, Watches / Wearables, Automotive, Industrial and Medical equipment. Epitome is the largest PCB supplier to the domestic electronics industry and had 11% market share in FY'20.

Indian Bare PCB market split by types of PCBs

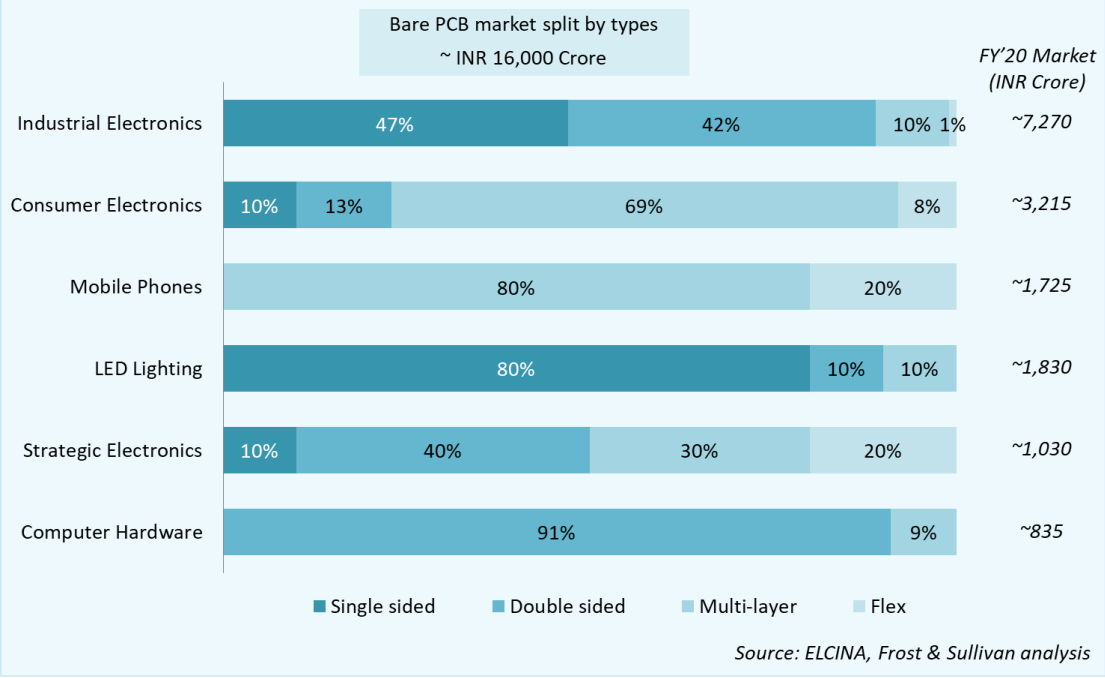
Chart 7.8: Bare PCB market split by types, India, Value in INR Crore, FY20



Single Sided (SS) and Double Sided (DS) PCBs accounted for approximately two-third Bare PCB usage in India in FY'20. This highlights the fact that most of the complex electronics assembly work is still done outside of India or it is being imported as PCBAs into the country. Industrial electronics products and most of the Consumer Durables (excluding Television) still use SS & DS PCBs. However the scenario is now changing and there could be growth in Multi-Layer (ML) PCB usage in these segments in the coming years. ML PCBs accounted for nearly 31% market share in FY'20 which is a significant growth of 6% in the market share over FY'19. ML PCBs are widely used in Mobile Phones, Televisions, and Medical Electronics and to some extent in the Strategic Electronics segment.

Indian Bare PCB market split by end-user industry

Chart 7.9: Bare PCB market split by end-user industry vs types, India, Value in INR Crore, FY20

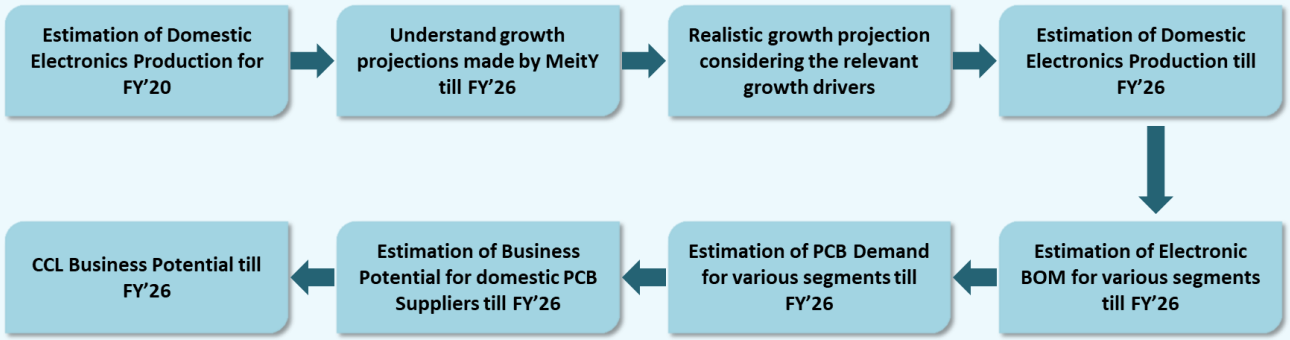


Industrial Electronics and LED Lighting segments accounted for more than 90% consumption of SS PCBs in FY'20. On the other hand, Industrial Electronics and Computer Hardware segments accounted for approximately 90% consumption of DS PCBs in FY'20. Mobile Phones, Consumer Electronics (primarily TVs), & Medical Electronics are the top three consumption segments for ML PCBs in FY'20. Flex PCBs were consumed by Mobile Phones, Consumer Electronics & Strategic Electronics segments in FY'20.

Expected growth in PCB and Bare PCB demand in India

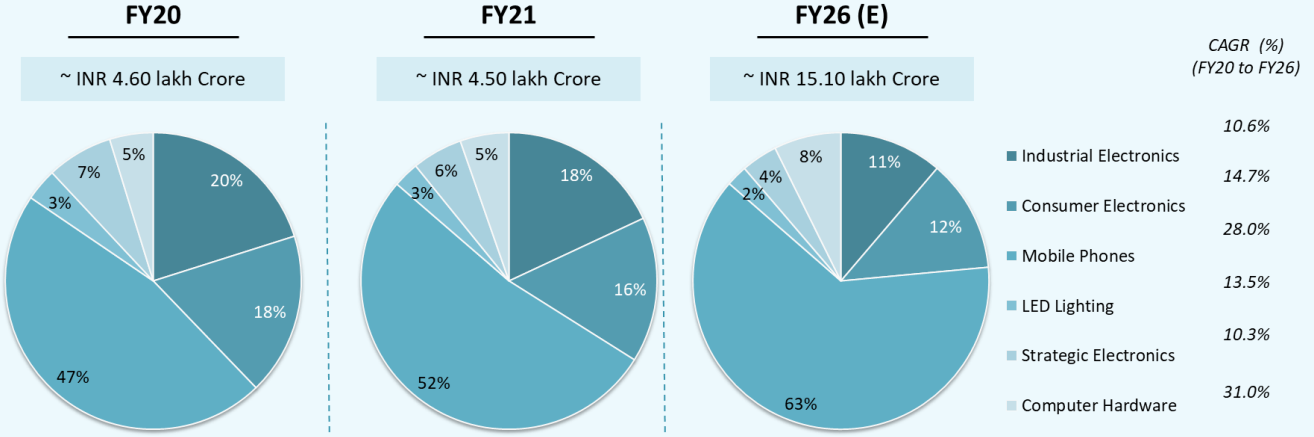
Indian electronics manufacturing industry (excluding components) is likely to witness a sharp growth of 22% CAGR between FY'20 and FY'26 and expected to touch INR 15.1 Lac Crore by FY'26. As PCB is the backbone for any electronics products, this will create significant demand for PCB in India. As Indian electronics industry is maturing, majority of this PCB demand will be in the form of Bare PCB and assembly will happen locally in India. Frost & Sullivan has adopted the following methodology to estimate demand of PCB and Bare PCB in India between FY'20 and FY'26.

Chart 7.10: Methodology adopted for estimation of future PCB demand in India



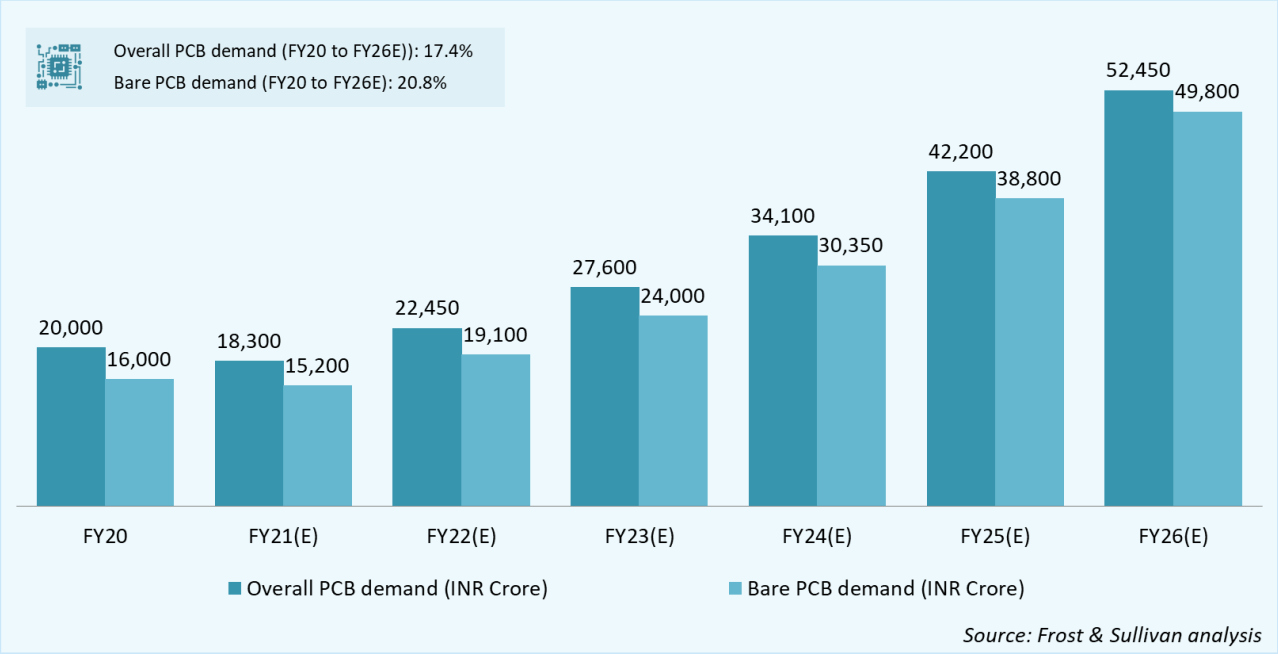
Source: Frost & Sullivan analysis

Chart 7.11: Electronics manufacturing split by segments, India, FY20, FY21 and FY26E



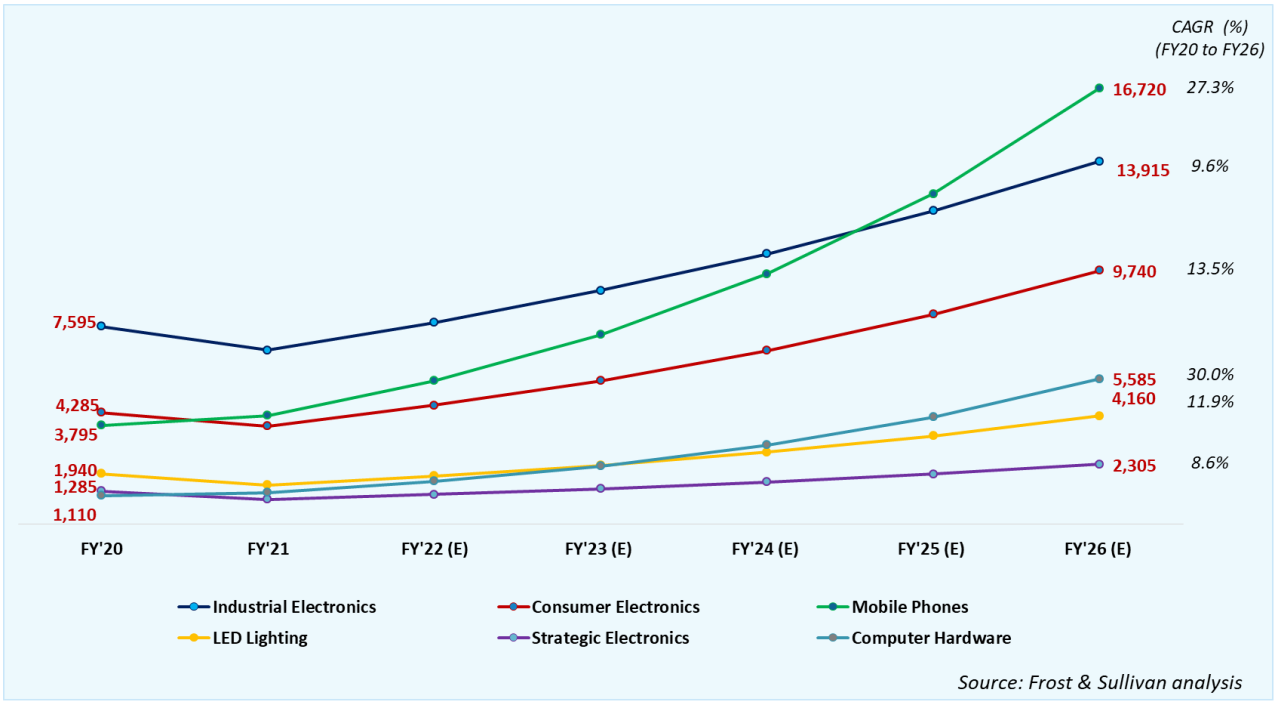
Source: Frost & Sullivan analysis

Chart 7.12: Overall PCB and Bare PCB demand in India, FY20 to FY26E



Overall PCB demand is likely to grow at a CAGR of 17.4% to touch approximately INR 52,500 Crore by FY'26. Bare PCB will account for more than 96% of this demand. Bare PCB demand is expected to grow at a CAGR of 20.8% to become approximately INR 50,000 Crore in FY'26.

Chart 7.13: Segment-wise growth in domestic PCB demand



Going forward, advancements in PCB functionalities and manufacturing along with miniaturisation of the semiconductor devices are anticipated to drive the demand for more complex PCBs with higher number of layers. The Government of India is strongly encouraging end to end manufacturing of electronics products in India including PCBs and components. Many policies and schemes have already been launched in this regard which has been detailed in the previous chapters of this report. All these initiatives coupled with strong demand are expected to result in significant investment in the domestic PCB manufacturing industry in the coming years.