

Atmanirbhar Bharat
Making India the global
hub for Printed Circuit
Board Assembly (PCBA)

Market opportunity and key imperatives
to drive export-led growth



ICEA
INDIA CELLULAR
& ELECTRONICS
ASSOCIATION



Building a better
working world

Executive summary

India has witnessed unprecedented growth in electronics manufacturing in the past five years on account of strong policy initiatives by the Government of India. The flagship program of 'Make in India' coupled with 'Atmanirbhar Bharat' is expected to further accelerate the trajectory.

The NPE 2019 has set a target of achieving production of US\$ 400 billion by 2025. This includes production of 1 billion mobile handsets valued at US\$ 190 billion, with an export target of US\$ 110 billion.

The National Policy on Electronics (NPE) 2019 envisions positioning India as a global hub for Electronics System Design and Manufacturing (ESDM) by focusing on size and scale, promoting exports and enhancing domestic value addition by creating an enabling environment for the industry to compete globally¹.

The Economic Survey of India published in January 2020 introduced and advocated the concept of "Assemble in India for the World" which may enable India to forge an export trajectory similar to China.² This major shift acknowledges job creation and India's aspiration to participate in global value chains.

This is a significant policy objective. Building Printed Circuit Board Assembly (PCBA) manufacturing capabilities will be the key to India's ambition to become a leading electronics manufacturing hub for the world. PCBA is a Printed Circuit Board (PCB) with all components mounted and soldered and has the functionality it was designed for. All electronic devices derive their functionality and intelligence from the PCBA.

“

Industry has reposed its faith in India's stellar progress as a world class manufacturing destination and this resonates strongly with Prime Minister's clarion call of Atmanirbhar Bharat – a self-reliant India.

Ravi Shankar Prasad,
Minister for Communications,
Electronics & Information
Technology and Law & Justice

¹ https://www.meity.gov.in/writereaddata/files/Notification_NPE2019_dated25.02.2019.pdf

² <https://www.indiabudget.gov.in/economicsurvey/doc/echapter.pdf>



Global market
for electronics:
US\$2.1 trillion

PCBAs constitute up to
50% of the BoM of an
electronic product

Global PCBA
market size:
US\$ 600B

It is the core of every electronic device such as mobile phones, tablets, computers, routers, televisions, washing machines, refrigerators, air conditioners etc.

The average contribution of PCBA to the Bill of Materials (BoM) is at around 40% and presents a US\$ 600B global PCBA market³. The four key electronic products segments that are estimated to witness growing consumer adoption in the forthcoming years – 1) Mobile phones; 2) Tablets, notebooks and desktop PCs; 3) Smart TVs, audio devices, video and music streaming devices; 4) Consumer appliances (washing machine, refrigerator, AC and heaters) – constituted US\$971 billion market of the US\$2.1 trillion global electronics market in 2018-19⁴. The total global PCBA market across these product categories is expected to be US\$358 billion by 2025-26⁵.

To develop India as an electronics manufacturing hub, it may be important to bring in as many manufacturing operations as possible and PCBA is a key manufacturing activity. The large scale of operations is estimated to positively influence the manufacturing environment and help in backward integration by attracting vendors supplying components and raw materials to PCBA manufacturing. Over a period of about five years, India is expected to be able to boast of a credible electronics manufacturing ecosystem. If the scale gets sufficiently large, it could trigger the design and manufacturing of multi-layer PCBs in India and production of semiconductor chips (ATMP) could also become a reality. At the start of PCBA operations, value addition is expected to be about 3-5% and it could climb to 15-20% within three years⁶.

³ ICEA estimates

⁴ Source: IDC, India Cellular & Electronics Association ('ICEA') and Allied Market Research: weblinks part of Annexure-1

⁵ ICEA estimates

⁶ ICEA estimates

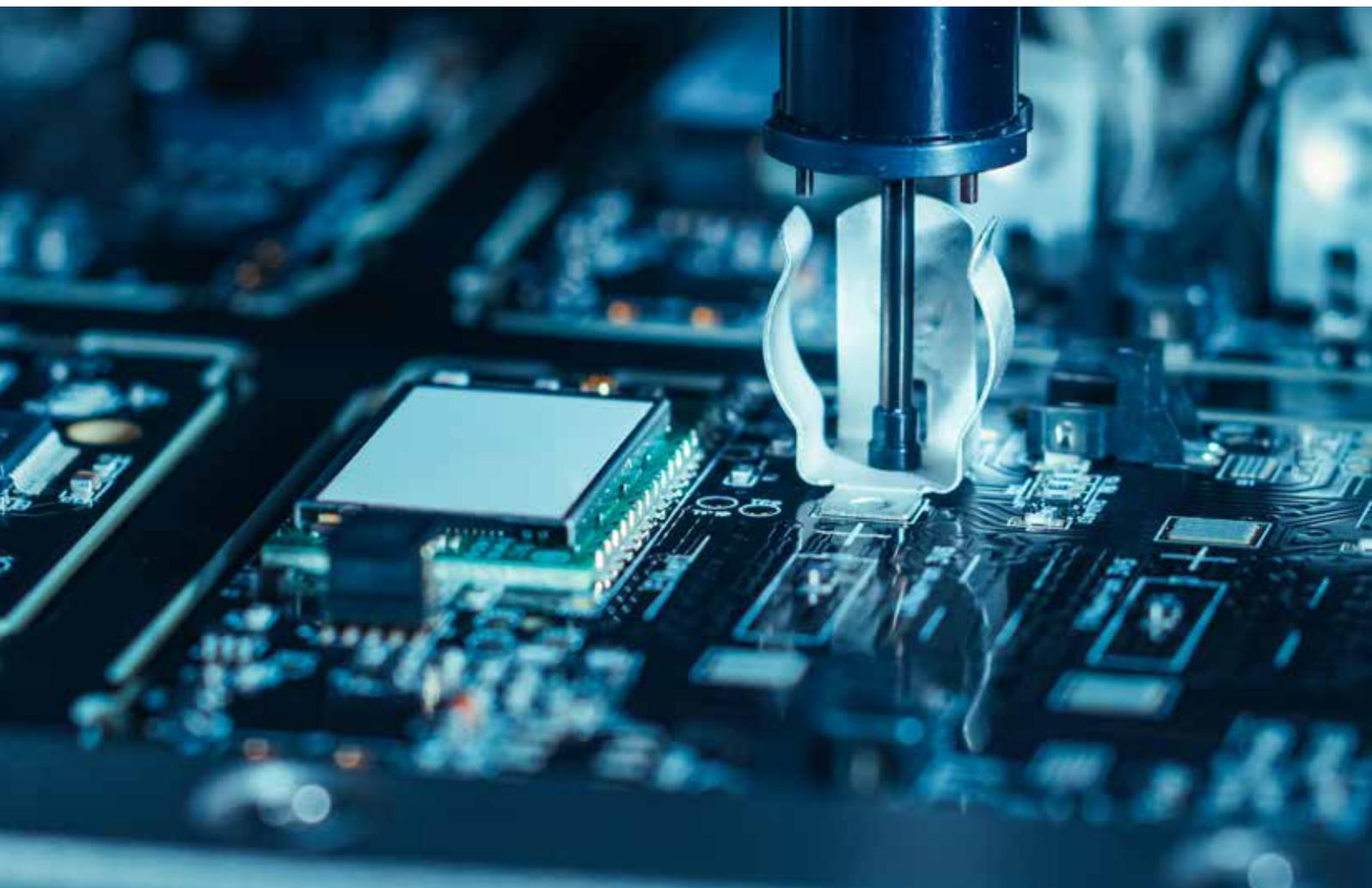
Investing in PCBA is not only critical for maintaining domestic manufacturing momentum but also fundamental to India's focus on reducing its trade deficit and dependency on China.

Mobile phone manufacturing has had a ripple effect on PCBA manufacturing capabilities in India. Leading contract manufacturers such as Foxconn, Flex, Hi-Pad, Wistron and OEMs such as Samsung are investing and expanding in this segment. This is just the tip of the iceberg and majority of the leading companies have their manufacturing bases in China and other South East Asian countries.

One of the most important factors driving the shift of manufacturing hubs is the pursuit of low-cost manufacturing. The US-China trade war has set off tremors in global value chains. Disruptions caused by COVID-19 has highlighted the risk of being dependent on a

few geographies. There is now a strong realization among multinational companies that supply chains must be de-risked and these companies are looking at diversifying to other countries. It is important for India to attract and encourage contract manufacturers to set-up or expand their manufacturing operations in the country. This might speed up the export of PCBA, position India as a source of global supply and strengthen India's hold on electronic manufacturing

The Indian electronics hardware manufacturing sector suffers serious disability compared to other nations. In a study done for mobile phones by ICEA, industry in India suffers a disability of 17.32 - 18.3% compared to China and 7.52-9.8% compared to Vietnam, due to inadequate availability of quality power, infrastructure and logistics; lack of domestic supply chain; high cost of finance; limited R&D; design capabilities and inadequacies in skill development⁷.



⁷ Report titled "Making India a global hub for handset manufacturing", by ICEA

The dream of becoming the global electronics manufacturing hub cannot be realized unless the government provides support to mitigate the disabilities faced by the PCBA industry. If support of 4-6% on exports of PCBAs can be provided, by 2025-26, the cumulative PCBA export for India can be about US\$ 109 billion. However, if no support is offered, the export is estimated to dwindle to a US\$ 4 billion⁸.

Accordingly, it is recommended that support for 6% may be provided for a period of five years. This may be instrumental for deepening the manufacturing ecosystem and making the electronics industry in India globally competitive. Currently, the Indian Government provides 2% benefit on Free on Board (FOB) value of exports under the Merchandise Exports from India (MEIS) Scheme for specified products, which includes PCBA. The scheme will end by 31 December 2020.

PCBA exports is a US\$ 100B+ opportunity during 2021-26:
 a. US\$ 109B (if 6% export incentive support)
 b. US\$ 4B (if zero export incentive support)

Assembling PCBA is a core manufacturing technology requiring high degree of specialization and precision. Surface Mount Technology (SMT) and other automated machines are required to mass produce PCBA. SMT technology offers significant advantages including automation, high-speed assembly, miniaturization, enhanced mechanical and electrical performance.

Manufacturing PCBAs requires high-technology, capital intensive SMT and other machines which need to work round-the-clock. This require uninterrupted and clean power supply; else, expensive machinery can suffer damage and cause production losses.

The industry calls for allowing import of used plant and machinery without any restrictions or conditions which will ease the high capex burden as well as supply of uninterrupted and stable power. As the PCBA manufacturing industry works on the principle of Just in Time (JIT), it requires unconstrained access to components and raw materials. Hence, prioritization of import/export of the products and priority clearance at airports and ports would be required to ensure uninterrupted supply chains and efficiency of operations.

Given the present geo-political situation, India has a strong opportunity to become a significant part of the global supply chain in electronics. This strategic objective may be achieved by becoming the hub for PCBA manufacturing and attracting manufacturers to Make in India for the world. Implementing this strategy may ensure the following key benefits accrue to India:

1. Atmanirbhar Bharat
2. Decoupling from China
3. Reduced trade deficit with China
4. Significant part of the global value chain
5. Deepening of the manufacturing eco system
6. Increased value addition

⁸ ICEA estimates

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PCBA - heart of electronics

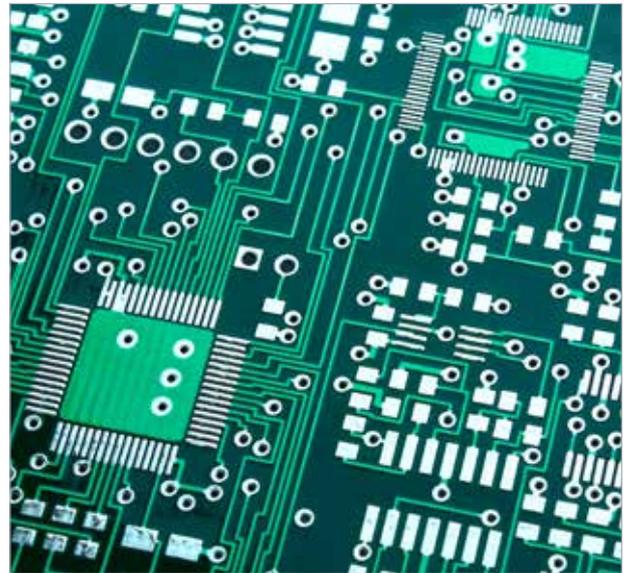
Electronics industry growth driven by consumer adoption and technological advancements

The US\$2.1 trillion global electronics industry is one of the largest and fastest growing industries in the world. The growth in electronics is expected to be fueled by the middle class aspiring for a higher standard of living. Rising disposable income, rapid urbanization and education is likely to drive this aspiration higher. It may stimulate growth in electronic products such as smartphones, tablets and wearable electronics such as smartwatches. Internet of Things (IoT) are estimated to connect billions of devices, vehicles and household appliances. Coupled with technologies such as big data analytics, artificial intelligence, robotics, and smart automation that will deeply embed electronics in everyday life, the electronics industry is estimated to be a strong pillar of economic growth in the foreseeable future.⁹

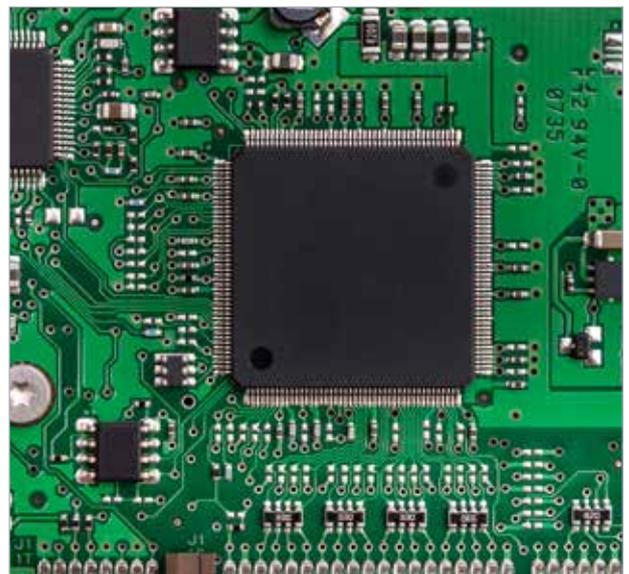
Importance of PCBA¹⁰

PCBA is the backbone of all electronic products. PCBAs are required to operate a wide variety of electronic products such as mobile phones, tablets, laptops, desktops, gaming consoles, televisions, washing machines, microwave ovens, air conditioners, refrigerators, automobiles, medical equipment and industrial products.

PCBA is a Printed Circuit Board (PCB) with all components mounted and soldered and has the functionality it was designed for. The PCBA is connected to other components such as displays, sensors etc. and is housed in an enclosure. It is at this point that the electronic device gets its identity, functionality and is recognized as a mobile phone, color television etc. Thus, the PCBA is the heart of any electronic device/appliance.



Bare PCB



PCBA

⁹ <https://www.jeita.or.jp/english/topics/2018/1218.pdf>

https://www.business-standard.com/article/pti-stories/india-s-electronics-production-on-accelerated-path-but-accounts-for-3-3-pc-of-global-mkt-prasad-119071800671_1.html

¹⁰ <https://www.electronicshobby.com/eb-specials/industry-report/where-is-the-indian-pcb-industry-headed/>, ICEA

PCBA is a generic term and denotes all types of PCBs with components mounted and soldered, ready to be used in a product. Depending on the application, PCBA can have a rigid, rigid-flex, flexible, or a high frequency PCB. PCBAs may also be referred to by the material of the PCB used, such as FR4 (Flame Retardant fiber glass epoxy), PTFE (Teflon / Polytetrafluoroethylene), or metal.

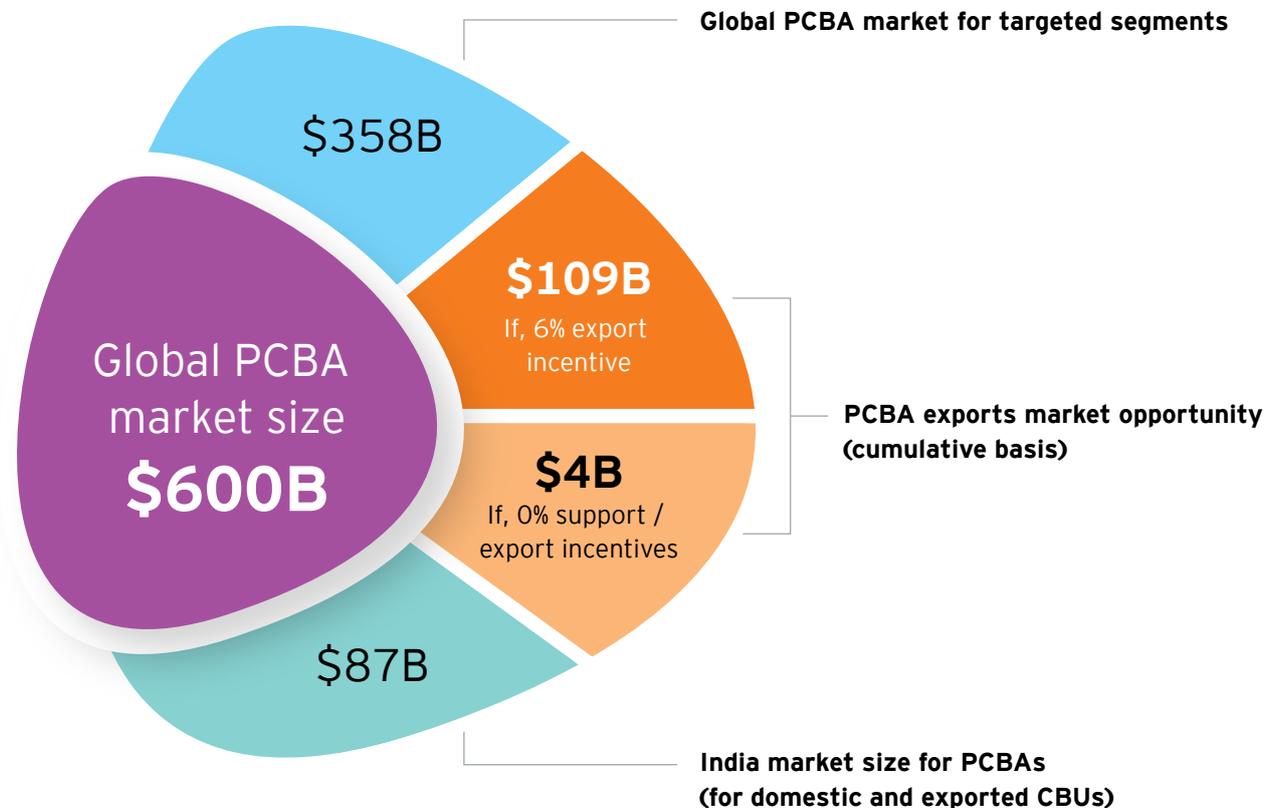
PCBs may be single, double or multi-layered. Single layered PCB is the first generation of PCB used in simple electronic devices. As the products became complex, so did the PCBs. Multilayer PCBs are the rule rather than the exception. Smartphone PCBs can have up to sixteen layers while military electronic equipment may even have a hundred-layer PCB. Components may be mounted on one side of the PCB, referred to as single sided PCBA, or both sides of the PCB, referred to as a double sided PCBA.

S. No.	Electronic product	PCBA as % of BoM*
1	Mobile phones	45-50
2	Tablets, notebooks and desktop PCs	40
3	Smart TVs, audio devices, video and music streaming devices	20
4	Consumer appliances (washing machine, refrigerator, AC and heaters)	10

Source: ICEA

BOM - Bill of material

The business opportunity



*(during 2021-26)

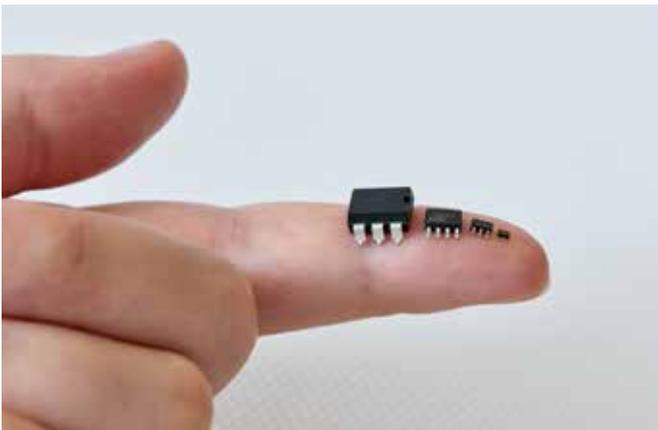
PCBA is the key assembly for electronic devices; forms an appreciable part of BoM especially for Mobile phones and Tablets, notebooks and desktop PCs among others.

There are four critical stages in the manufacturing process of a PCBA - Design of PCB, manufacturing of laminates, manufacture of PCB and mounting components on PCB. It is noteworthy that each stage is an industry by itself.

Depending on the type of components, the PCB Assembly is done using Surface Mount Technology (SMT) or Thru hole Technology (THT). The SMT technique is an automated process to mount Surface Mounted Devices (SMD) components on the bare PCB. THT is used for mounting axial and radial components on the PCB. Most of the axial and radial components are mounted by thru hole machines, although odd shaped and large components are mounted manually.

Surface Mount Technology: a technological marvel¹¹

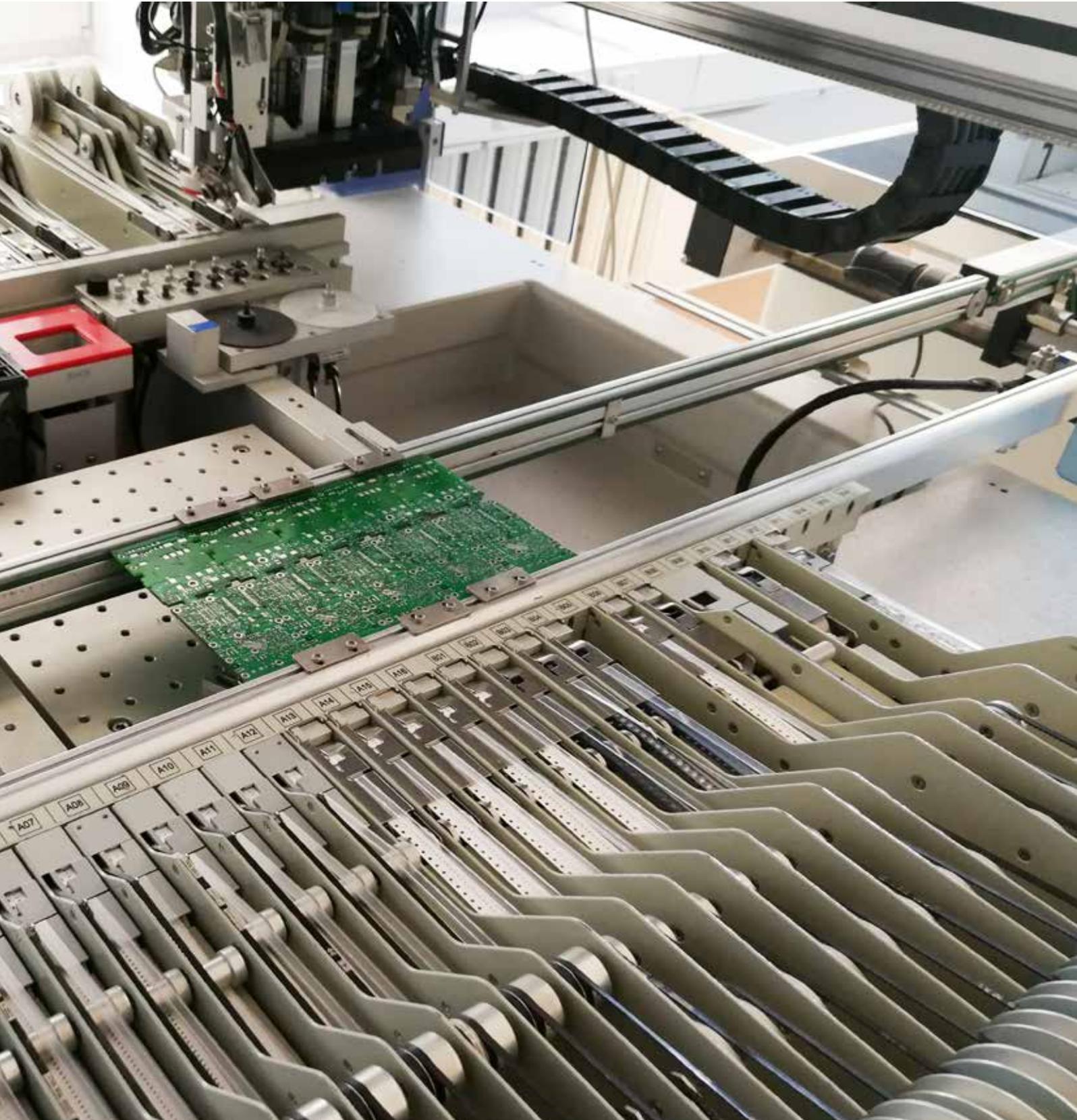
SMD components are generally rectangular/square in shape and are mounted flat on the PCB. The SMT machines can mount SMD components ranging from 1.0 x 0.5 mm to chips of 90x90 mm. The SMT machines can mount up to 86,000 components an hour and a smart phone PCBA can be produced in about 5 seconds.



SMD components



¹¹ ICEA, <https://www.pcbcart.com/article/content/pcb-assembly-process.html>, http://mirteceurope.com/images/products/pdf/product_details_18_28.pdf, https://globalsmtseasia.com/articles_&_papers/smt-solder-paste-printing-process-description/, <https://www.cmlaser.com/industrial-applications-for-lasers/pcb-marking/>, <https://eitpl.com/the-process-and-significance-for-pcb-assembly-services/>



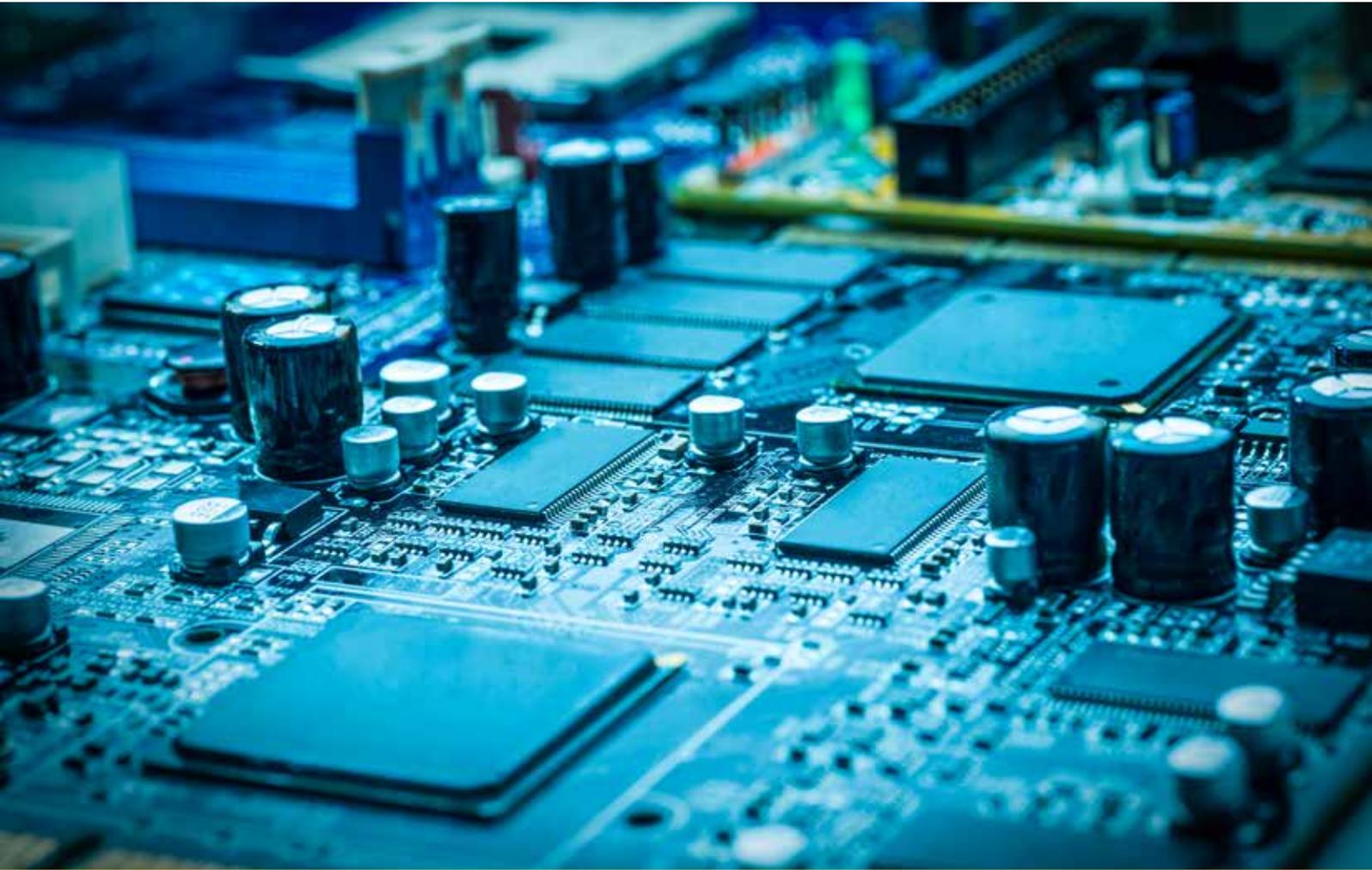
Pick and place machine mounting SMD components

A typical SMT line configuration is as follows:

- 1. PCB Loader** - for automatically loading PCB on the SMT line. The machine loads the production line automatically by pushing PCBs out of a magazine onto the conveyor of the down-stream machine.
- 2. Laser Marker** - for bar coding PCB, including etching codes, numbers and logos onto circuit boards, which is necessary for inventory control and tracking.
- 3. Solder Paste Printer** - for applying solder paste on the PCB. A solder paste is a mixture of tin and copper (can also be a mixture of other metals) used in PCB assembly to make conductive joints between the components and the PCB. It also provides the necessary mechanical bond to hold the components on the PCB.
- 4. Pick and Place Machines** - for precision placement of large components such as Quad Flat Package (QFP), Quad-Flat No-Leads (QFN), Plastic Leaded Chip Carrier (PLCC), Small Outline Integrated Circuit (SOIC) on the bare PCB. These machines have fine pitch capability of 0.3mm. (pitch is the center-to-center spacing between conductors, such as pads and pins, on a PCB). Mounting QFP is a difficult job and requires high precision. A square QFP may have 256 pins which translates into 64 pins on each side. The distance between the pins (pitch) of the QFP can be as small as 0.3mm. It means that the Pick and Place must align 256 pins, each pin separated by pitch of 0.3mm. It is for this reason that Pick and Place machines can mount with an astounding accuracy of ± 0.025 mm/chip. Some of the smaller QFPs may have pin counts of 32 pins, i.e. 8 pins on each side, assuming the package is a square.
- 5. Chip Shooter** - is a machine that can typically mount smaller SMD chips at very high speeds. Rated speeds can be up to 86,000 components/hour. Chip shooter pumps up the through-put of the SMT line. A Pick and Place Machine can take up to 2 seconds to mount a 256 pin QFP, while a chip shooter may take only 0.041 second to mount a flat chip. Pick and Place machine is aligning 256 pins, with a pitch of 0.3mm, while a / chip), chip shooter is aligning only 2 points and hence, is extremely fast.
- 6. Reflow oven** - for automatic soldering of components placed on the PCB. The pick and place machine, chip shooter place the components on the PCB which are held in place due to the viscosity of the solder paste. The PCB board passes through the reflow oven. The reflow oven provides a suitable temperature profile to melt the solder and join the components to the PCB.



- ▶ Takes 5 seconds to produce a mobile phone PCBA
- ▶ Mounts 86,000 components/hour



In addition, there are other machines such as x-ray inspection machines (for inspecting solder quality), in-circuit tester (for board functionality test), PCB cleaning machines, reflow profiler, dehumidifier, Ball Grid Array (BGA) rework station, test and quality control equipment. The SMT line uses dedicated equipment, has high through-put, is capital intensive and requires few, but highly trained equipment operators, together with trained technicians/engineers (for maintenance, repairs and calibration of the equipment) along with line supervisors.

SMT is the preferred process in mass produced electronics such as smartphones, tablets and laptops, color televisions, set-top boxes etc. This technology offers significant advantages including automation, high-speed assembly, miniaturization, and enhanced mechanical and electrical performance. SMT machines are a marvel of technology, represent the best in precision engineering and robotics.

Thru-Hole Technology: a waning concept

This technology works well on components with leads or wires that have to be mounted on PCB board by plugging them through holes on the PCB. The extra lead part has to be soldered on the other side of the board. This technology is applied on PCB assemblies containing large components such as capacitors, resistors, coils to be assembled.

Thru-Hole Technology usage is fading as density of components on the PCB is getting higher and miniaturization is the norm.

PCBA exports - A US\$100B+ opportunity during 2021-26

PCBA manufacturing is the soul of electronic manufacturing. Creating capability and capacity to manufacture PCBA is estimated to be the key to India's ambition of becoming an electronics manufacturing hub for the world.

The NPE has set an objective of encouraging domestic manufacturing and exports in the entire value-chain of Electronics System Design and Manufacturing (ESDM) and to achieve a turnover of US\$400 billion by 2025.¹²

Investing in PCBA is critical for maintaining domestic manufacturing momentum and reducing trade deficit. As PCBA manufacturing picks up pace, backward integration is expected to be a natural outcome and the country may witness electronic components manufacturing. Investing in this critical assembly can enable India to build a designed manufacturing ecosystem.

Based on market trends, the following four electronic products segments ('target segments') are estimated to witness healthy growth in the forthcoming years:

- ▶ Mobile phones
- ▶ Tablets, notebooks and desktop PCs
- ▶ Smart TVs, audio devices, video and music streaming devices
- ▶ Consumer appliances (washing machine, refrigerator, AC and heaters)

In 2018-19, the target segments constituted US\$971 billion market, which was 46% of the global electronics market. By 2025-26, they are expected to grow to more than US\$1.2 trillion¹³. Global and domestic market projections for the target product segments are provided in Annexure-1.

Growth drivers for consumer demand in select segments

01

Mobile handsets

Increasing need for anytime, anywhere access to information and innovative mobile applications
Smartphones offering new form factors and functionality

02

Tablets, notebooks and PCs

Continued competition in the PC market from large-screen smartphones, phablets and convertibles
Thinner form factors such as ultraslim notebooks and 2-in-1 options
(portable computer with features of both tablets and laptops)

03

Consumer electronics and appliances

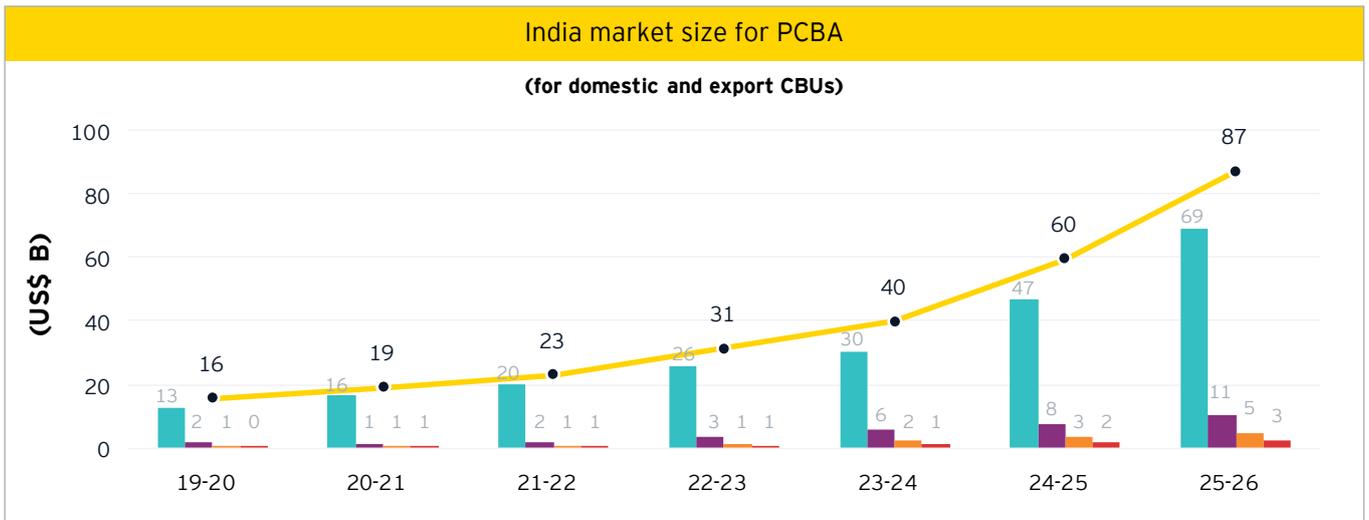
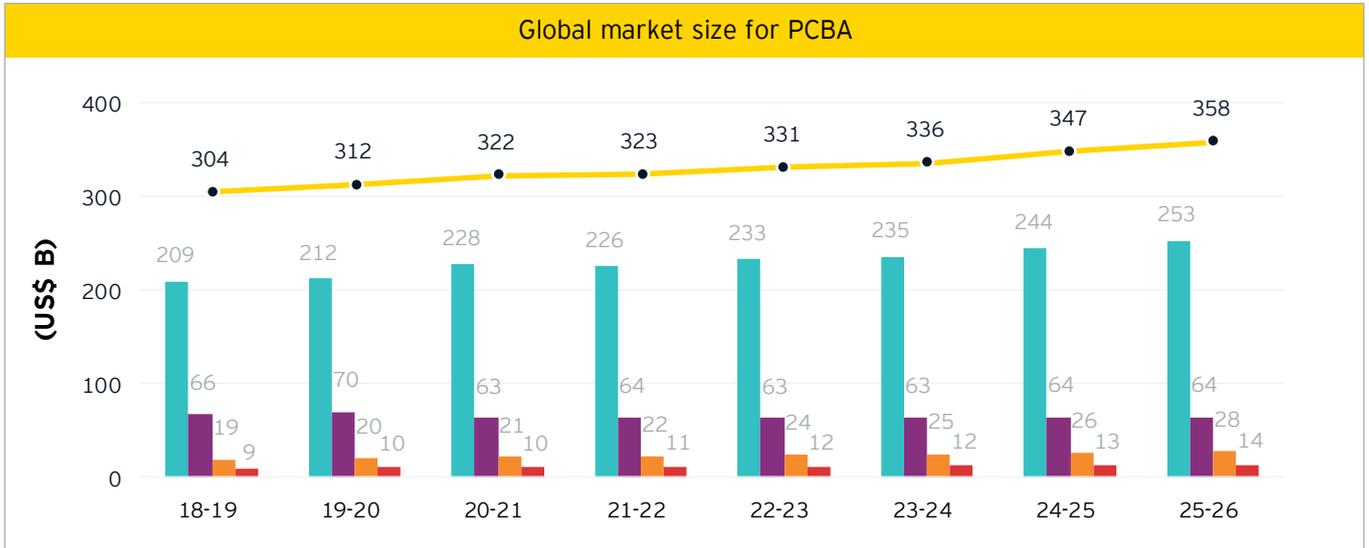
Rapid urbanization, improvement in living standard and consumer's need for comfort and smart home appliances with connectivity, voice control features and energy-efficient technology

¹² https://www.meity.gov.in/writereaddata/files/eGazette_Notification_NPE%202019_dated%2025022019.pdf

¹³ Source: IDC, ICEA and Allied Market Research: weblinks part of Annexure-1

By 2025-26, the Global PCBA market size for the target segments is expected to touch US\$358 billion¹⁴. The PCBA opportunity for India can be split into three segments:

1. PCBA used in completely built unit ('CBU') sold in India
2. PCBA used in CBU exported from India
3. PCBA for exports



■ Mobile phones
 ■ Tablets and PCs
 ■ Smart TVs, audio devices, etc.
 ■ Consumer appliances
● Total

Source: ICEA

Note: PCBA market size includes four product segments - mobile phones; tablets, notebooks and desktop PCs; Smart TVs, audio devices, video and music streaming devices; and Consumer appliances (washing machine, refrigerator, AC and heaters)

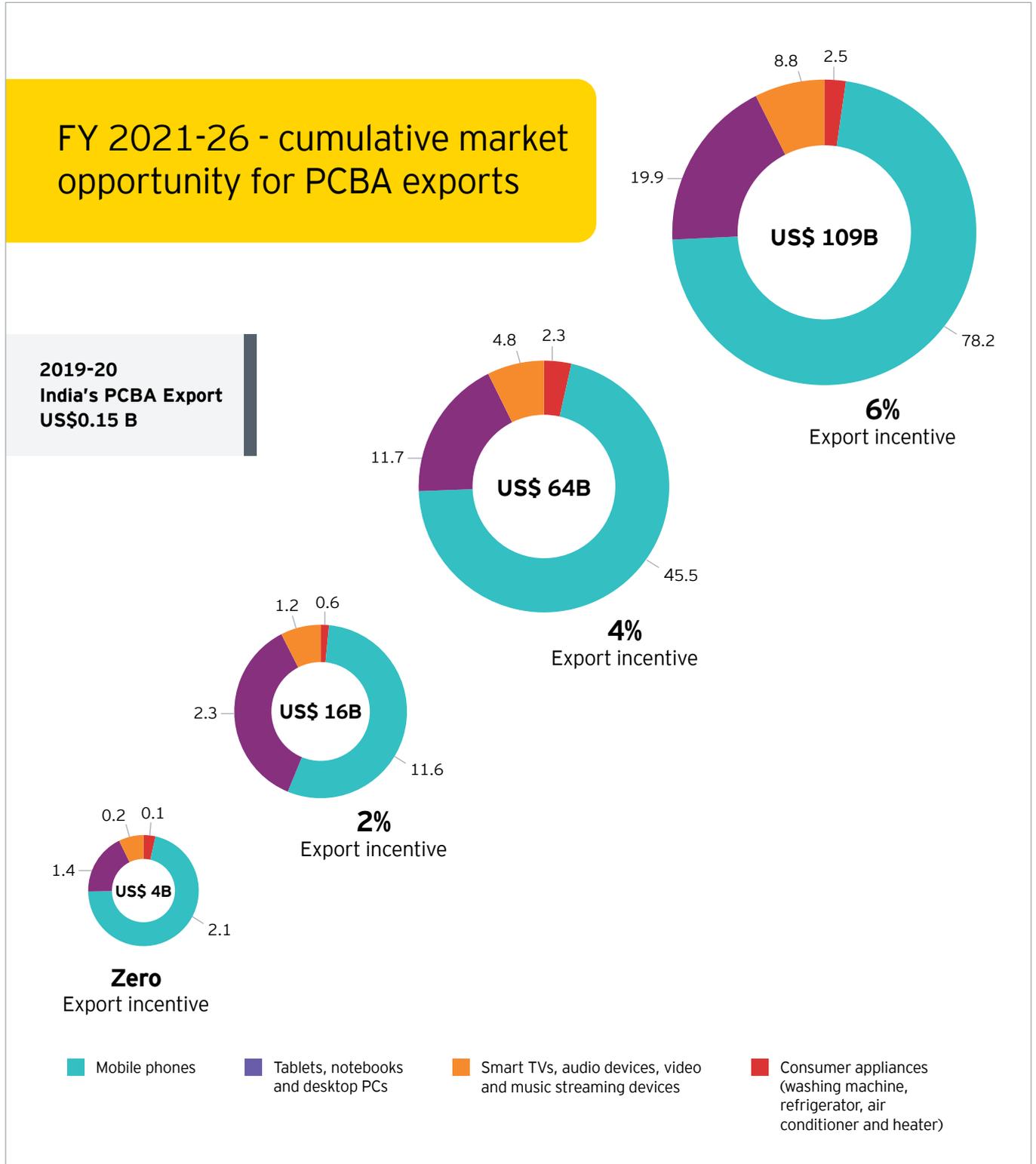
Given the existing PCBA manufacturing capacity in the country and the manufacturing plans over the next five years, especially for mobile phones under schemes such as Production Linked Incentives (PLI), India is expected to meet 90-99%¹⁵ of the PCBA demand for domestic market and CBU products exports from India across these product categories.

¹⁴ ICEA estimates

¹⁵ ICEA estimates

India has an opportunity to export US\$ 109 billion¹⁶ worth of standalone PCBAs to the world over the period from 2020-21 to 2025-26, provided the industry is

suitably incentivized. This would be the key to decide the manufacturing investments by global manufacturers/ electronics manufacturing services companies in India.



¹⁶ ICEA estimates

Standalone PCBA exports from India face cost disabilities against well-established manufacturing hubs, with large manufacturing capacities, such as China and Vietnam. In addition, China offers various incentives for R&D activities, tax benefits on exported goods, policies to promote an export culture, significant investments across the value chain and technology transfer from global players.

Currently, the Indian Government provides two-percent benefit on Free on Board (FOB) value of exports under the Merchandise Exports from India (MEIS) Scheme for specified products, which includes PCBA. However, the benefit will continue only until 31 December 2020 and thereafter, the benefit will be based on rates decided under the Remission of Duties or Taxes on Export Products (RoDTEP) scheme.

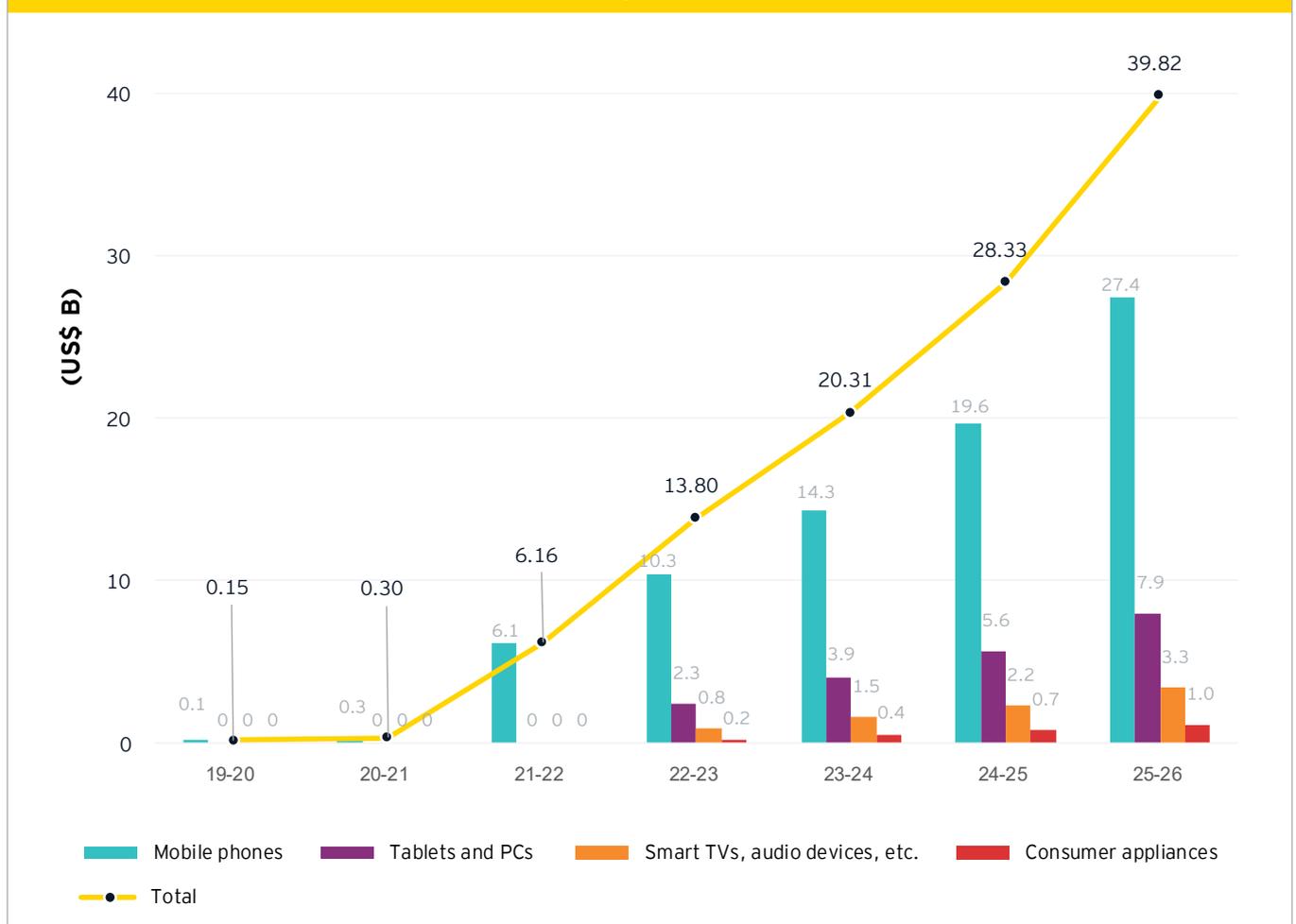
India's exports of standalone PCBAs for mobile phones were US\$0.15 billion in 2019-20¹⁷ and are expected to be US\$0.30 billion in 2020-21¹⁸. For other electronic

products, standalone PCBA exports are estimated to begin only from 2022-23 as manufacturing capacities increase in the country.

If there is an incentive of 6%, the cumulative market opportunity for standalone PCBA exports across the four product segments during 2021-26 is estimated to be about US\$ 109 billion. However, if there is zero support offered, the market opportunity is estimated to dwindle to a mere US\$4 billion¹⁹.

In such a scenario, the country may be able to export only a miniscule of standalone PCBAs, as manufacturing capacities will largely be built to meet PCBA demand for domestic and exported CBU products. This calls for proactive policy actions by the government to attract and encourage exports of standalone PCBAs from India. The advantages for doing so are substantial and have been discussed in greater detail in next section.

Export opportunity for PCBAs from India



¹⁷ Department of Commerce, Exports of HSN 85177010 <https://commerce-app.gov.in/eidb/>

¹⁸ ICEA estimates

¹⁹ ICEA estimates

Benefits of transforming India into a PCBA exports hub

Government policies aim to increase exports and build an ecosystem

It is pertinent to point out that the NPE shifted the focus from import substitution to exports. The Economic Survey of India (January 2020) also introduced and strongly advocated the concept of “Assemble in India for the World” which can enable India to forge an export trajectory similar to China.²⁰

This is a major shift which acknowledges that job creation and participating in Global Value Chains, even at initially small value additions is a significant policy objective.



India's Economic Survey 2019-20 states: “By importing components and assembling them in China for the world, China created jobs at an unprecedented scale. Similarly, by integrating “Assemble in India for the world” into Make in India, India can raise its export market share to about 3.5% by 2025 and 6% by 2030, which is highly feasible”.

The volumes under the “Assemble in India” concept may create a cumulative value which can be unprecedented over the next five years. This strategy is estimated to make India's manufacturing industry competitive, increase the scale dramatically and help to reduce the massive outflow of foreign exchange. As per ICEA, in 2019-20, India's electronics exports were a mere US\$11 billion (smartphones being the largest category at US\$3.6 billion), while imports were high at approximately US\$50-51 billion.

Government of India (‘GoI’) notified the PLI scheme on 01 April 2020²¹. The PLI scheme specifically aims to achieve ‘Make in India for the World’ for specific products such as mobile phones, and specified components which include SMD components, semiconductor devices, PCBs, sensors, and Assembly, Testing, Marking and Packaging (ATMP) units.

²⁰ <https://www.indiabudget.gov.in/economicsurvey/doc/echapter.pdf>

²¹ https://www.meity.gov.in/writereaddata/files/production_linked_incentive_scheme.pdf

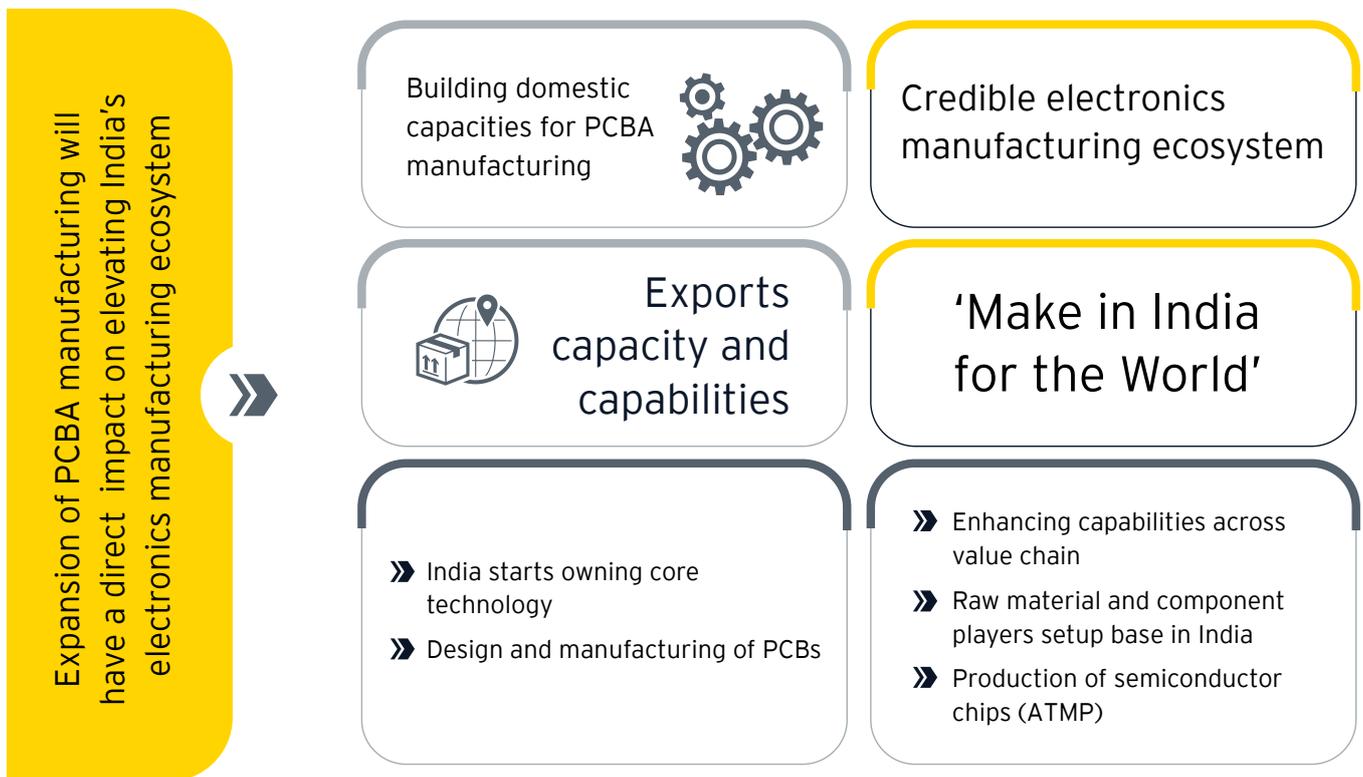
The PLI scheme is expected to bring additional investment of around INR 110 billion to the electronics manufacturing sector and promote exports significantly. Out of the total production of INR 11.5 trillion in the next 5 years, more than 60% (INR 7 trillion) is expected to be contributed by exports.²² These investments are just the direct

investments in the sector and expected to have a further rub-off effect on the overall ecosystem as there will be additional investments required to feed these primary manufacturing units. It is almost a certainty that India will be scaling up the production which may lead to substantive electronic products exports.

Focus on PCBA exports

To develop India as the electronics manufacturing hub, it is important to bring in as many manufacturing operations as possible. Catalyzing manufacturing of PCBAs would be a step in the right direction. Once the capacity is built for import substitution, it could become a big export category from India, provided suitable support is provided by government.

Assembling PCBA is a core manufacturing technology and requires high degree of specialization. Among others, it requires precision automated machines, intricate knowledge of the soldering process, extremely high-quality standards, ability to operate 24x7 and produce Just in Time (JIT).



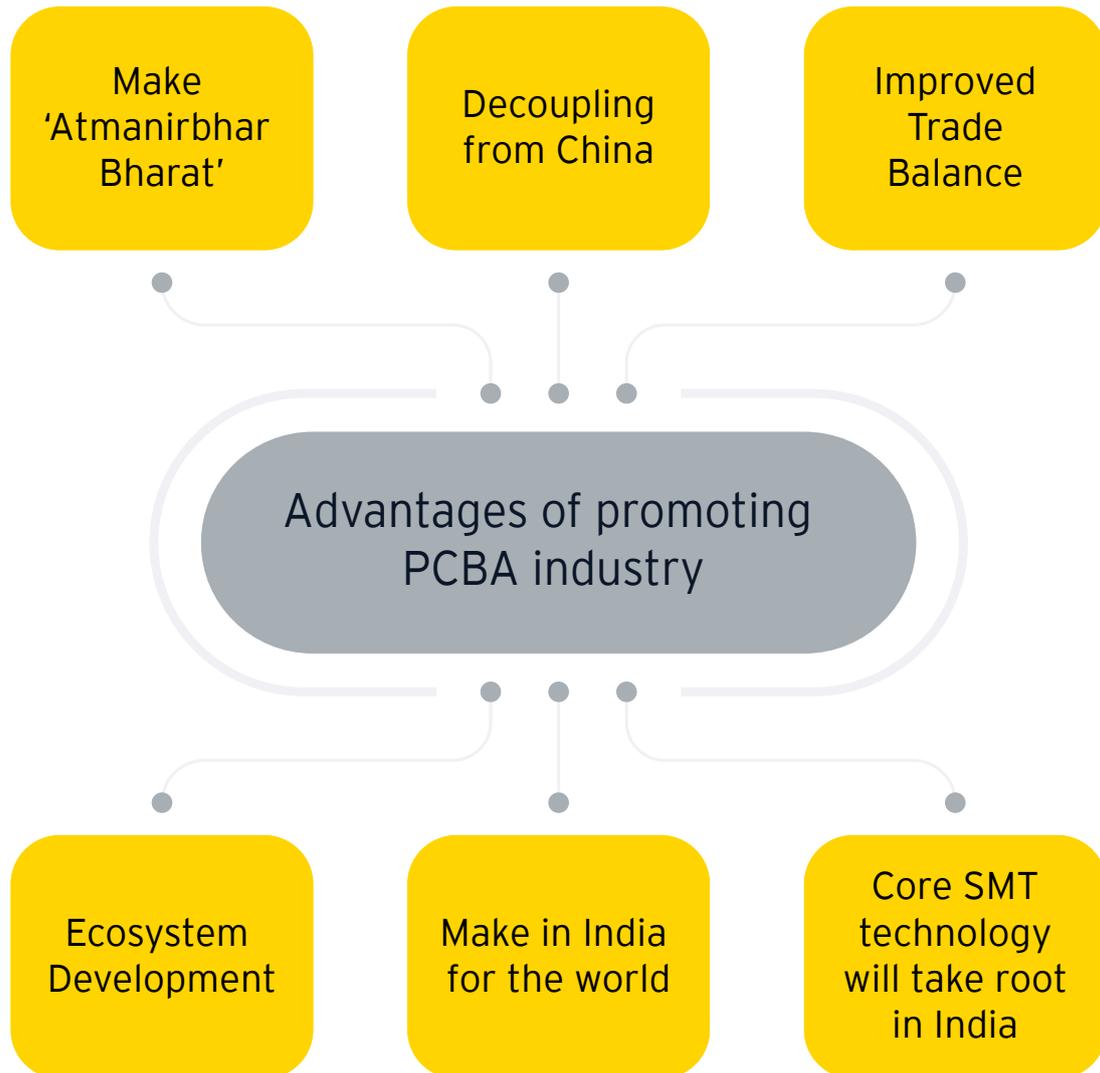
Such a production facility, in turn, would raise the bar for developing a complete ecosystem for employees, vendors, logistics, customs, as well as other infrastructural factors such as electricity, water supply, ease of doing business etc. The large scale of operations will positively influence the manufacturing environment and will help to bring in vendors supplying inputs to PCBA manufacturing, such as components, PCB, solder paste, cleaning agents and other raw materials.

As more electronics manufacturing is set up in India - this may in turn, bring in more vendors and players. Over a period of about five years, India might be able to boast of a credible electronics manufacturing ecosystem. If the scale gets sufficiently large, it could trigger the design and manufacturing of multilayer PCBs in India. Production of semiconductor chips Assembly, Testing, Marking and Packaging ('ATMP') could also become a reality. This is how it had panned out in China.

²² <https://pib.gov.in/newsite/PrintRelease.aspx?relid=213362>

Historically, the electronics industry had moved in search of lower manufacturing costs from the US to Japan to Korea to Taiwan to China. In 2018, China had the largest share of 28.4% of the global manufacturing output²³. In 2017, China produced US\$682.5 billion worth of electronics²⁴, while the domestic electronics production in India was US\$70 billion in fiscal year 2018-19²⁵. China was able to achieve this by starting assembly factories and expanding the scale of manufacturing rapidly and

consistently. Once an appreciable assembly volume was established, China started PCBA operations. As the PCBA started scaling global volumes, it was necessary for the component and design industry to shift to China to support the mega production volumes. Thus, PCBA became the trigger for the next step of backward integration and China became the leader in electronics manufacturing.



²³ <https://www.statista.com/chart/20858/top-10-countries-by-share-of-global-manufacturing-output/>

²⁴ <http://www.koreaherald.com/view.php?ud=20180126000750>

²⁵ https://www.meity.gov.in/writereaddata/files/Presentation-Electronics_Manufacturing_Schemes.pdf

Promoting the PCBA industry is estimated to have the following benefits:

1 India can be an option for de-risking the global supply chain

Owning supply chain of one of the largest traded commodities globally, i.e., smart phones, and expanding that to 20-30% of the global market may have geopolitical advantages and upside. US, Europe, Japan and Australia would start looking at India, as a country that can safely own core technologies and de-risk the global supply chain. It increases India's trade leverage with developed economies and China. It will be a firm step in making 'Atmanirbhar Bharat'.

2 Decoupling from China

The Indian electronics manufacturing industry is heavily dependent on China and imports finished goods, components and PCBAs. India imports US\$ 7 billion worth of integrated circuits (semiconductor chips) from China, which is 70% of its total import of semiconductor chips²⁶. On the other hand, China imports semiconductor chips from Korea, Singapore, USA Japan and Germany²⁷. Should the PCBA operations start on a global scale in India, semiconductor chips can be imported by India directly from Korea, Singapore, USA, Japan and Germany and there may be no need to import from China. It will help to achieve the strategic objective of reducing dependence on China.

3 Reduced trade deficit with China

As per ICEA, India will be able to export to nations such as Ethiopia, Nigeria, Kenya, Egypt, Indonesia who are aspiring to set up electronic assembly operations, which is the first step in reducing the import of completely built units. Such assembly units will provide a robust opportunity for exports

thereby strengthening India's manufacturing and exports. Starting PCBA operations will cut down the import of semiconductors and PCBA from China and India will be able to reduce its US\$19 billion electronics trade deficit with China²⁸.

PCBA manufacturing and exports would assist making of Atmanirbhar Bharat.

Imports of semiconductor chips - CY 2019

	Total electronics import of India	Import by India - HS 8542
China and Hong Kong	29.10	7.00
South Korea	2.40	1.30
Singapore	4.00	0.90
USA	2.20	0.20
Japan	1.00	0.10
Germany	1.20	0.03
Rest of the World ('RoW')	10.80	0.47
Total	50.70	10.00

	Total electronics import of China	Import by China - HS 8542
China and Hong Kong	-	-
South Korea	83.00	53.00
Singapore	49.00	36.00
USA	31.00	12.00
Japan	38.00	12.00
Germany	17.00	2.00
Rest of the World ('RoW')	182.00	76.00
Total	400.00	191.00

²⁶ UN Comtrade data for 2019 <https://comtrade.un.org/data/>

²⁷ ICEA estimates

²⁸ UN Comtrade data for 2019 <https://comtrade.un.org/data/>; Chapter 85 products as a whole



4 India - contract manufacturing and export hub

India is estimated to transform into a contract manufacturing and export hub as companies look to expand their manufacturing set up in the country and reduce the dependency on China.

5 Component and ATMP units can be set up

Mega volume of PCBAs can trigger the setting up of component ecosystem and Assembly Testing Marking and Packaging (ATMP) of semi-conductors units over the next four to five years. China is testimony for this phenomenon.

6 Core SMT technology will take root in India

Global scale electronics manufacturing requires automated SMT lines, allied machinery and deep understanding of surface mount technology. As the manufacturing of PCBA is scaled up, the population of SMT lines will increase sharply. To run these lines, skilled and intelligent manpower is required. Improvement in the quality of manpower might be a natural outcome. It is estimated, India has about 900 SMT lines while China has about 15,000 SMT lines.²⁹

²⁹ ICEA estimates



7 Multi-layer PCB manufacturing and PCB design can be a reality

Eventually, like smartphones, only a handful of countries and companies will lead in the global supplies of PCBAs. By 2025-26, India is projected to achieve US\$190B of mobile phone production (US\$110B exports and US\$80B domestic market) which will be about 25% of the global mobile phone market³⁰. The large volume will be a trigger for setting up PCB manufacturing, design, especially high-speed design, necessary for PCB of mobility electronics.

8 Testing lines and facilities will be a natural outcome

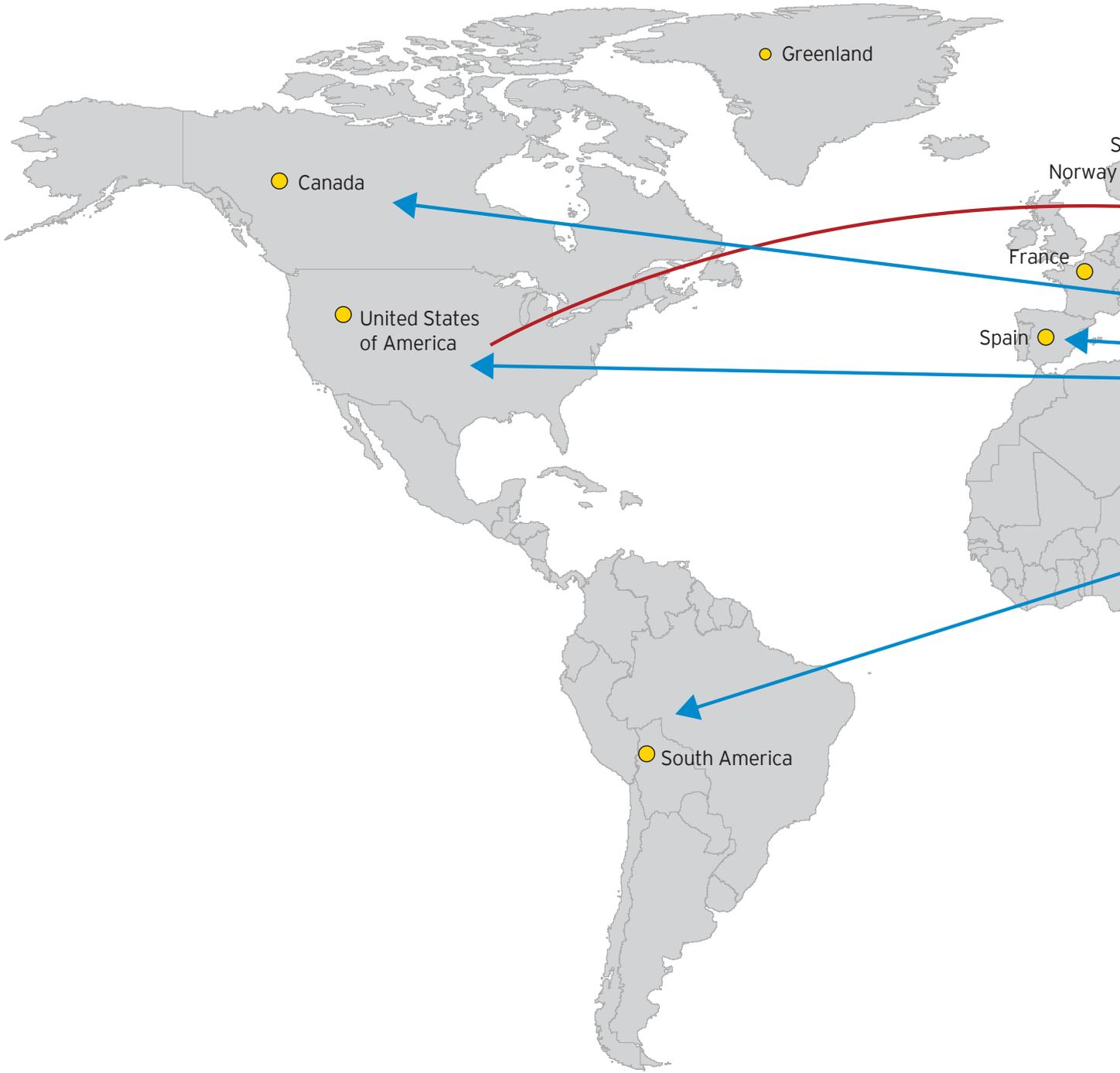
Production of large volumes of PCBA would require testing lines, which will further improve the manufacturing ecosystem.

9 Factory automation and system integration industry will get a boost

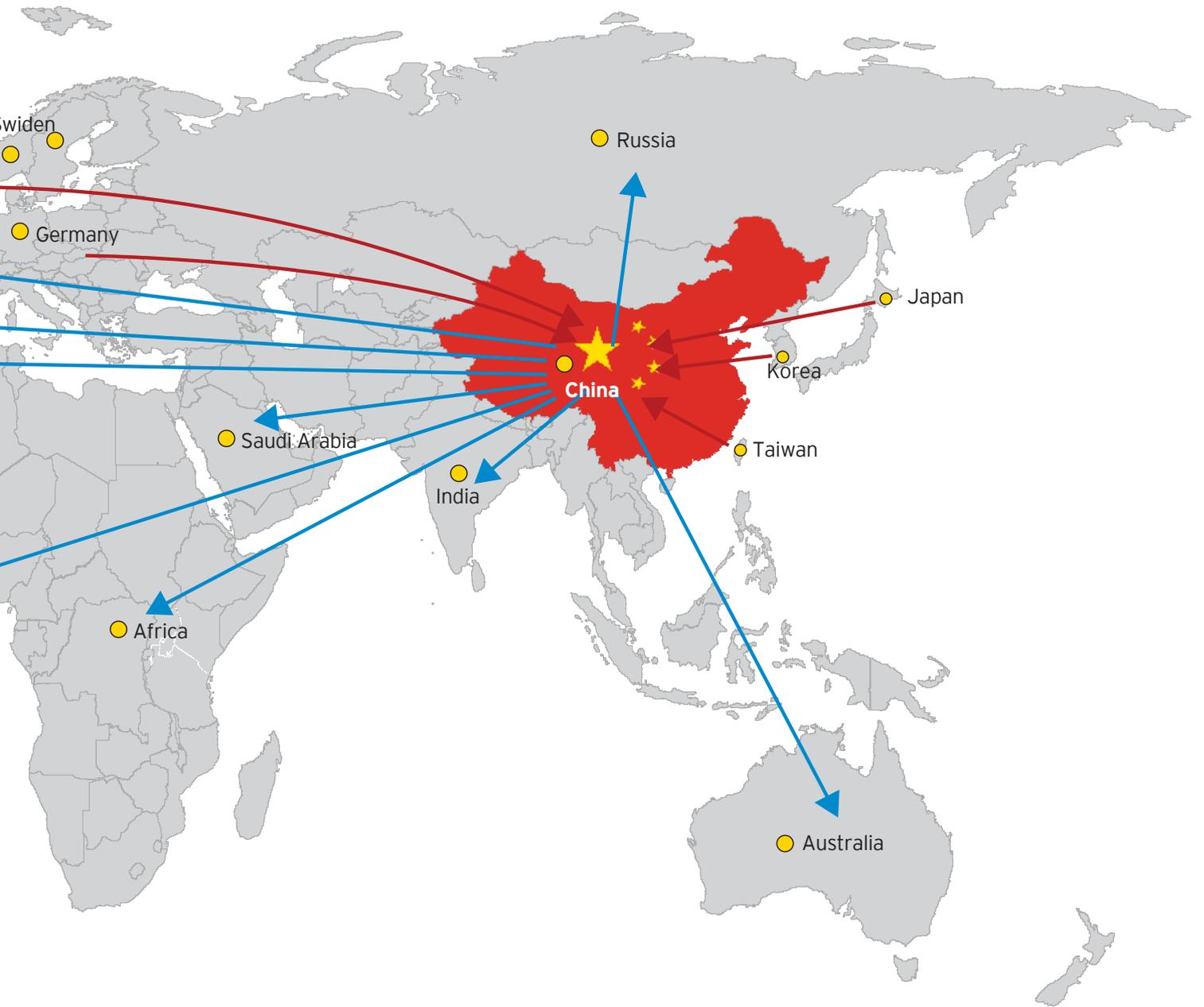
Large scale automated production will open the door for factory automation and system integration, as there will be a need to integrate new plant and machinery with the existing machines in the factory.

³⁰ ICEA, https://www.meity.gov.in/writereaddata/files/eGazette_Notification_NPE%202019_dated%2025022019.pdf

Present: China dominates global supply chain

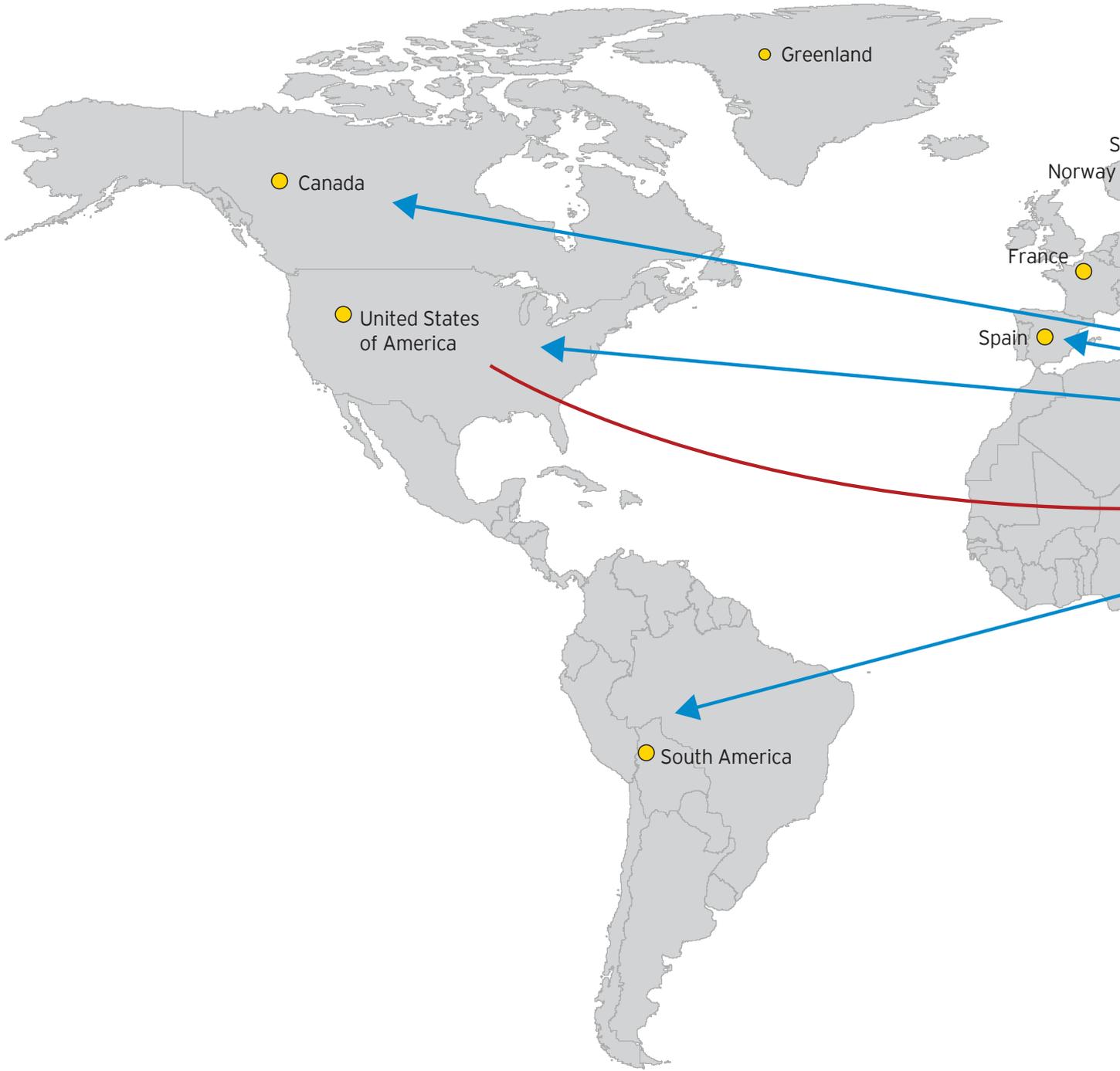


PCBA exports from China ←

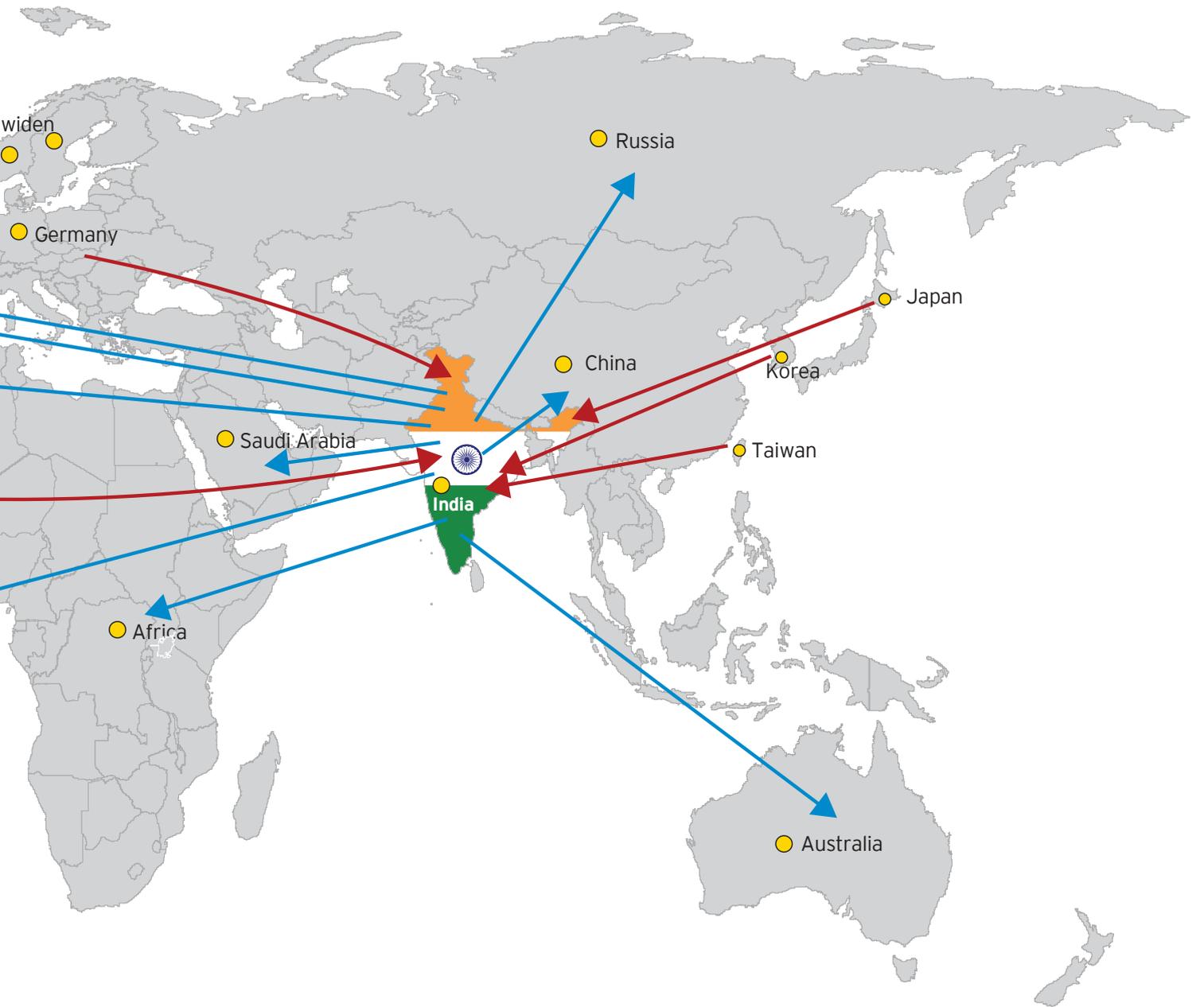


Imports by China →

Future: India emerging as a viable alternative in global supply chain

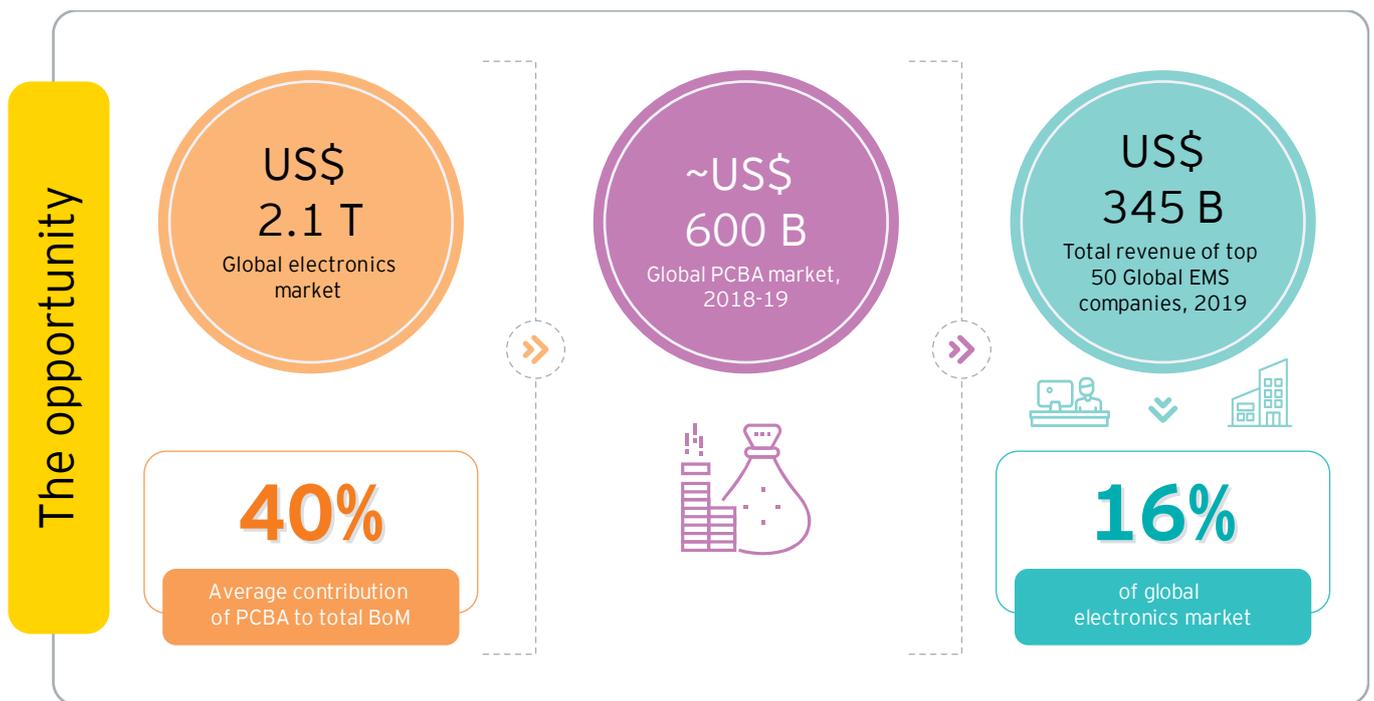


Potential exports destination for India ←

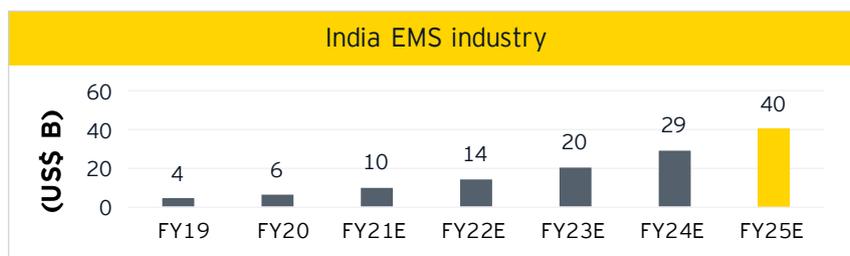


Imports by India →

Contract manufacturers can propel PCBA exports



The contract manufacturing industry has played an integral role in the development and growth of manufacturing and assembly industries worldwide. Contract manufacturing companies function as strategic partners to Original Equipment Manufacturers (OEM) by providing a full range of services which include design, testing, manufacturing, final assembly, order fulfillment, and repair and aftermarket services. By using the services of contract manufacturing companies, OEMs gain access to the design and engineering capabilities, process knowledge and manufacturing know-how without making heavy capital investments.



Source: ICEA, <https://www.eenewsanalogue.com/news/global-top-50-ranking-ems-providers-2019>

- ▶ To grow at CAGR 7.5%
- ▶ Share in global electronics assembly to increase from 42% in 2018 to 52% in 2023

Key growth drivers for Indian contract manufacturing industry include:

- ▶ Favorable government policy initiatives for 'Make in India'
- ▶ Large exports opportunity
- ▶ Contract manufacturing provides ready platform for manufacturing

The top 50 Contract Manufacturing/Electronics Manufacturing Services (EMS) companies recorded a revenue of about US\$344 billion in 2019³¹. This is about 16% (by value) of the global electronics market. It is apparent that if the manufacturers / EMS companies were to set up an export base in India, the country could catapult its electronic exports.

Major OEMs and contract manufacturers are looking to relocate production from China wherein India could be one of the favored destinations. Some of the top contract manufacturers are already present in India.

The leading global EMS providers³³ are listed in Annexure-2 and most of them have their manufacturing bases in China and other South East Asian countries. Only a few have presence in India currently. It is important for India to attract and encourage contract manufacturers to set-up/expand the manufacturing operations in the country. This will speed up the export of PCBA and strengthen India's hold on the electronic manufacturing and become a source of global supply.

Global contract manufacturer	Global market share	Number of SMT lines
Flex	7% (in 2018)	30
Foxconn	63% (in 2018)	30
HiPad	12% (in 2018)	6
Jabil	NA	-
Pegatron	NA, Company registered in July 2020. Planning manufacturing plant in India	-
Sanmina	NA	7
Wistron	NA	6

OEM	Products	Number of SMT lines
Lava	Mobile phones	4
Oppo	Mobile phones	13
Samsung	Mobile phones and colour TV	60
Vivo	Mobile phones	10

Source: ICEA, Press articles ³²



Source: Ambit Capital report ("All hands on 'electronic' deck," Ambit Capital report, 8 June 2020, via ThomsonONE.com)

³¹ <https://www.eenewsanalog.com/news/global-top-50-ranking-ems-providers-2019>

³² <https://www.mixindia.com/huawei-smt-line-near-chennai-goes-in-full-swing/>; <https://www.thehindubusinessline.com/info-tech/foxconn-emerges-top-smartphone-ems-in-india-report/article28085759.ece>; <https://economictimes.indiatimes.com/tech/hardware/foxconn-local-printed-circuit-boards-push-to-give-make-in-india-a-boost/articleshow/63552812.cms?from=mdr>; <https://www.indiatvnews.com/technology/news-wistron-assemble-apple-iphone-pcb-in-india-585576>; <https://economictimes.indiatimes.com/tech/hardware/xiaomi-sets-up-3-units-for-assembling-printed-circuit-boards/articleshow/63690249.cms>; <https://swarajyamag.com/news-brief/pegatron-apples-second-largest-contract-manufacturer-in-talks-with-many-indian-states-for-setting-up-a-factory-report>; https://www.sanmina.com/wp-content/uploads/2016/05/5678_chennai_pcba.pdf; <https://www.electronicshb2b.com/eb-specials/leading-electronics-manufacturing-service-providers-of-india/jabil-intends-replicate-global-success-india/>

³³ <https://newventureresearch.com/the-mmi-top-50-for-2018/>; <https://www.eenewsanalog.com/news/global-top-50-ranking-ems-providers-2019>;

Impediments to scaling up PCBA manufacturing

India suffers from disabilities that affect the competitiveness of the country versus its Asian peers viz. China and Vietnam. In order to attract PCBA manufacturing, these impediments need to be analyzed and mitigated.

Cost disability³⁴

In order to ascertain factors that impede creation of a sizable manufacturing ecosystem in India, it becomes imperative to analyze the disabilities faced by Indian manufacturers vis-à-vis China and Vietnam. As per a report published by ICEA³⁵, the table summarizes the disabilities for Indian mobile phone industry arising due to lack of incentives and other support policies.



“

The Indian electronics manufacturing sector suffers from a disability of around 8.5% to 11% on account of lack of adequate infrastructure, domestic supply chain and logistics; high cost of finance; inadequate availability of quality power; limited design capabilities and focus on R&D by the industry; and inadequacies in skill development.

MEITY report

³⁴ https://www.meity.gov.in/writereaddata/files/production_linked_incentive_scheme.pdf

³⁵ Report titled “Making India a global hub for handset manufacturing”, by ICEA

S. No.	Factor resulting in cost-reduction	India	Vietnam	China
1	Corporate income tax exemption/reductions	0.73 - 0.95%	1.5 - 2%	2%
2	Subsidy for machinery and equipment	Nil	0.20%	3%
2A	State subsidies in India for capital investments	0.6 - 1.2%	NA	NA
3	Cost of power	0%	1%	1%
4	Interest subvention on working capital	0%	1.5 - 2%	3 - 3.5%
5	R&D subsidy	0.15%	0.4 - 1%	2%
6	Incentive for supporting industry	0%	0.5 - 1%	0%
7	Exemption/reduction of land rental	0%	0.50%	0.60%
8	Industrial land development support	0.40%	0.50%	0.60%
9	Building (or plug and play)	Negligible	0.30%	1%
10	Labor subsidy	Negligible	0.50%	2%
11	Logistics	0%	0.50%	1%
12	Factors affecting "Ease of doing business"	-	1.5 - 2.5%	2 - 3%
13	Duty free imports for creating fixed assets, and of inputs not available domestically	0%	0.50%	-
14	Incentive schemes	-	0%	1 - 2%
Total		1.88 - 2.7%	9.4 -12.5%	19.2 -21.7%

Some of the key speed breakers for the PCBA industry are:

Focus on PCBA exports

- ▶ As per Economic Survey, India needs to spend 7-8% of its GDP on infrastructure every year, translating into an annual infrastructure investment of US\$200 billion. However, the country has been able to spend only about US\$100-110 billion.³⁶
- ▶ The basic infrastructure for any industry comprises good roads, ports and logistics. Logistics delays due to road infrastructure and state border check-points, increase costs and inventory requirements. There is port congestion for both exports and imports due to unavailability of containers and long cumbersome documentation process.

Polluted and erratic power supply

- ▶ PCB assembly (PCBA) is a process that involves various high-tech machines such as chip shooters, pick and place machines, solder printer systems, reflow ovens, soldering systems and inspection systems, which require uninterrupted, spike free and stable frequency power supply. Any interruption, spikes, or variation in frequency can damage the expensive equipment. This leads to production loss and adversely affects the competitiveness of the manufacturing unit.

³⁶ <https://economictimes.indiatimes.com/news/economy/infrastructure/budget-2019-india-must-spend-200-billion-on-infra-annually-harnessing-private-investment-a-challenge-says-economic-survey/articleshow/70073382.cms?from=mdr>

Capital intensive nature of business

- ▶ The **high cost of capital** is a major challenge faced by domestic manufacturers, since it increases the overall cost of finance.
- ▶ The cost of capital at ~12%-14% in India is much higher than the global average of ~5%-7%.³⁷
- ▶ Elevated cost of manufacturing (conversion costs) due to inadequate availability/reliability of power (resulting in its high blended cost), high cost of real estate, etc.

Costs of importing components

- ▶ Manufacturing requires seamless supply of imported components and smooth exports of PCBA which requires world class logistics and supply chain. Freight from major component destinations such as the US, Taiwan, China, Korea, Japan and Germany, to India is high and increases the manufacturing cost. On the other hand, Vietnam is connected to China by a world class highway and can import components speedily and without incurring exorbitant freight costs.
- ▶ China follows differential pricing wherein it offers cheaper component pricing for local Chinese industry compared to the industry based in India. For example, 2.4" display is priced at 6-7 RMB for the local Chinese industry whereas Indian companies have to pay 11 RMB³⁸.
- ▶ VAT refunds for local Chinese industry is processed expeditiously while it is delayed for the exports to India. Such an action increases the price of the components for the industry in India and makes it uncompetitive.³⁹

Increasing competition from China and South-East Asian countries

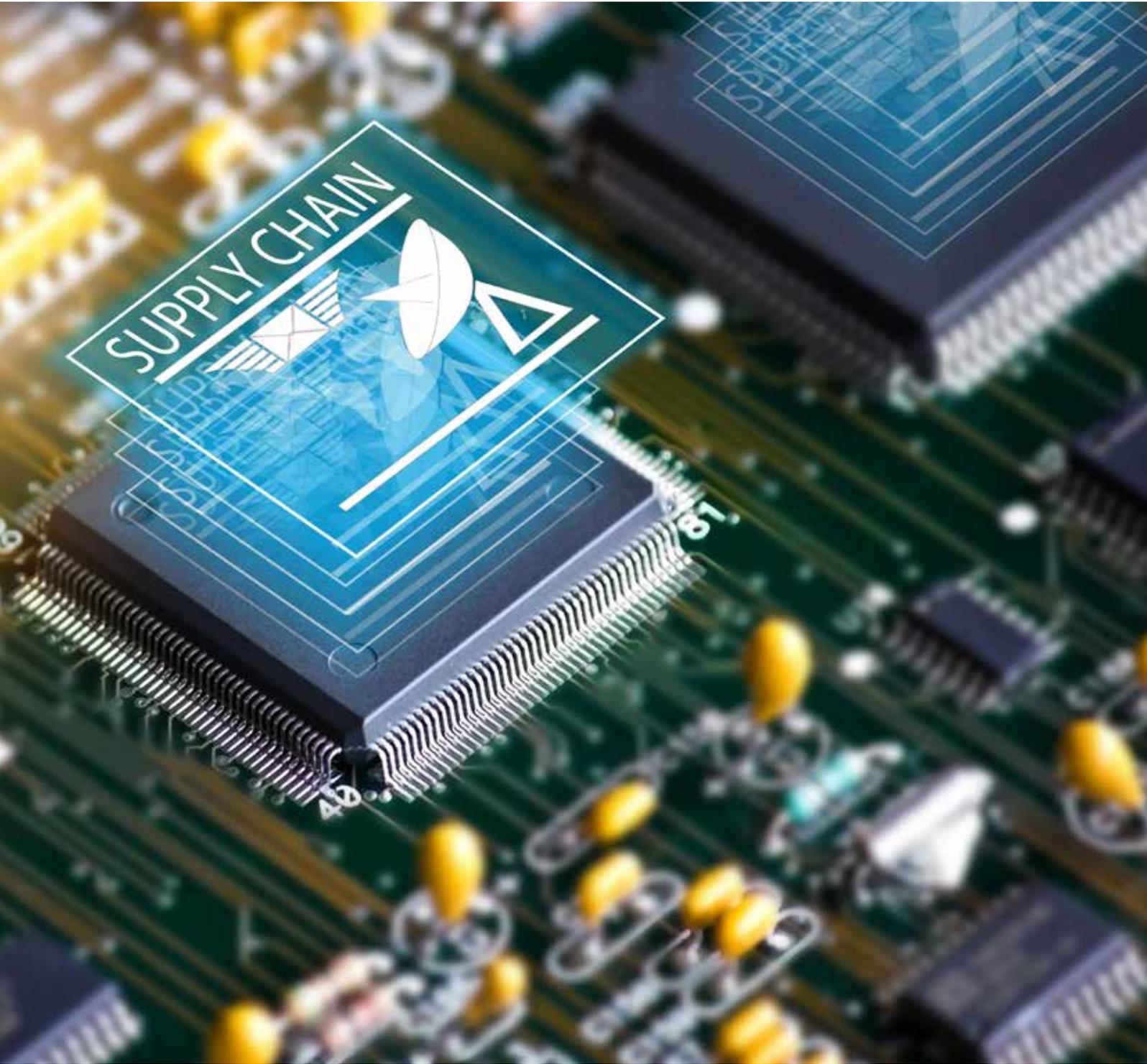
- ▶ Indian manufacturers face strong competition from Chinese and other SE Asian counterparts such as Thailand, Malaysia, Indonesia and Vietnam. These countries have well-developed infrastructure for manufacturing and several incentives for promotion of electronics manufacturing.



³⁷ "Turning the "Make in India" dream into a reality for the electronics and hardware industry," EY-ASSOCHAM report, April 2016

³⁸ ICEA estimates

³⁹ ICEA estimates



Government's role in enabling the PCBA industry

Right policy initiatives would attract lead firms, incentivize production and unveil measures that provide cost competitiveness to industry and help offset the disabilities suffered by Indian firms vis-à-vis Vietnam and China. Based on the analysis of trade practices of our Asian peers, policy measures that may catalyze manufacturing and export of PCBAs have been recommended.

Supply of uninterrupted and consistent power

Manufacturing PCBAs involves high-tech machinery and is viable only if round the clock operations are undertaken. The primary enabler for this is the supply of uninterrupted and consistent power supply that is free from voltage spikes and frequency fluctuations.

Even a minor fluctuation may disrupt the entire operations and trigger heavy losses thereby discouraging investments in the segment. Therefore, supply of uninterrupted and stable power is a pre-requisite for the segment.





Freely allow import of used Plant and Machinery for use in the PCBA industry

Manufacturing PCBAs requires high-technology, capital intensive SMT and other machines such as x-ray inspection machines, in-circuit tester (for board functionality test), PCB cleaning machines, reflow profiler, dehumidifier, Ball Grid Array (BGA) rework station, test and quality control equipment.

It is recommended to allow import of used plant and machinery without any restrictions or conditions. This will ease the high capex burden and serve as an incentive for companies looking to shift out of China or Vietnam.

Ability to import/export components freely and speedily

Similar to allowing import of SMT machines for manufacturing set-up; import of components and other raw materials of a PCBA are equally important. The industry works on the principle of Just in Time (JIT) manufacturing which requires unfettered access to components and raw material to cater to domestic demand as well as exports.

Any delay would be counter-productive to the business environment and adversely affect investments in the sector. Prioritization of import/export of the products would be required to ensure uninterrupted supply chains and efficiency of operations.

Infrastructure improvements

Infrastructure is a key enabler for any industry and availability of better roads, ports and logistics greatly enhances the competitiveness of doing business in the country. This is especially relevant for electronics sector in general and PCBA segment in particular. Since most of the components would be imported from across the world (to start with) and the PCBA would be exported, priority clearance at airports and ports would greatly enhance the ability of firms to adopt JIT manufacturing.

**6% export incentive
will build global scale
PCBA industry in India**

As mentioned earlier, the value chain of Printed Circuit Board Assembly (PCBA) manufacturing can be divided into four segments:

- ▶ Design of PCB
- ▶ Laminator Manufacturers - Laminates and Prepregs are building blocks for manufacturing PCB.
- ▶ Board Manufacturers - Manufacture bare PCB
- ▶ EMS/OEM - Manufacture PCBA / Finished product

It is noteworthy that each of the above segments is an independent industry by itself.

At the start of PCBA operations, say in 2021-22, the value addition is estimated to be 3-5 % as there is hardly any availability of good quality, multilayered PCB, laminates and prepregs in India⁴⁰. As manufacturing volumes of PCBA increase, it has the potential to trigger the manufacturing of the bare board and PCB design ecosystem in India. It is noteworthy that central government schemes such as Production Linked Incentive (PLI) scheme and Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECES) seek to promote manufacturing of PCB, laminates, prepregs in India. Thus, PCBA operation in India complements the objectives of the central government.

Given the business dynamics and the policy intervention by the Government of India, it is expected that global quality multi-layered PCB may be manufactured in India by the end 2021-22. This may ensure that PCBA manufacturers source the bare PCB from India and by 2022-23, the value addition in PCBA may climb to about 15%. The value addition can touch 18-20% as the PCB manufacturing ecosystem deepens and is made for higher end products⁴¹.

The current Merchandise Export from India (MEIS) Scheme provides incentive of 2% on FOB value of export of PCBAs (HSN 85177010)⁴². MEIS benefits shall be available only up to 31 December 2020⁴³. Till date, the MEIS incentive has proven to be inadequate for boosting exports of PCBA. In 2019-20, a mere US\$ 145.88 million of PCBAs were exported.

We recommend an incentive of 6% for a period of 5 years. This shall assist in offsetting the disabilities vis-à-vis China and Vietnam and encourage industry players to set-up manufacturing facilities in India. It may ensure that PCBAs generate strong interest among contract manufacturers and ride the wave of mobile manufacturing triggered by the PLI scheme. It will be instrumental to achieve 'Atmanirbhar Bharat' and 'Make in India' for the world and reduce dependency on China.

Post 2025-26, the support on PCBA may not be required as the manufacturing ecosystem would have deepened, scale of production would have increased significantly, component ecosystem would have come into being, power and infrastructure would have stabilized .

⁴⁰ ICEA estimates

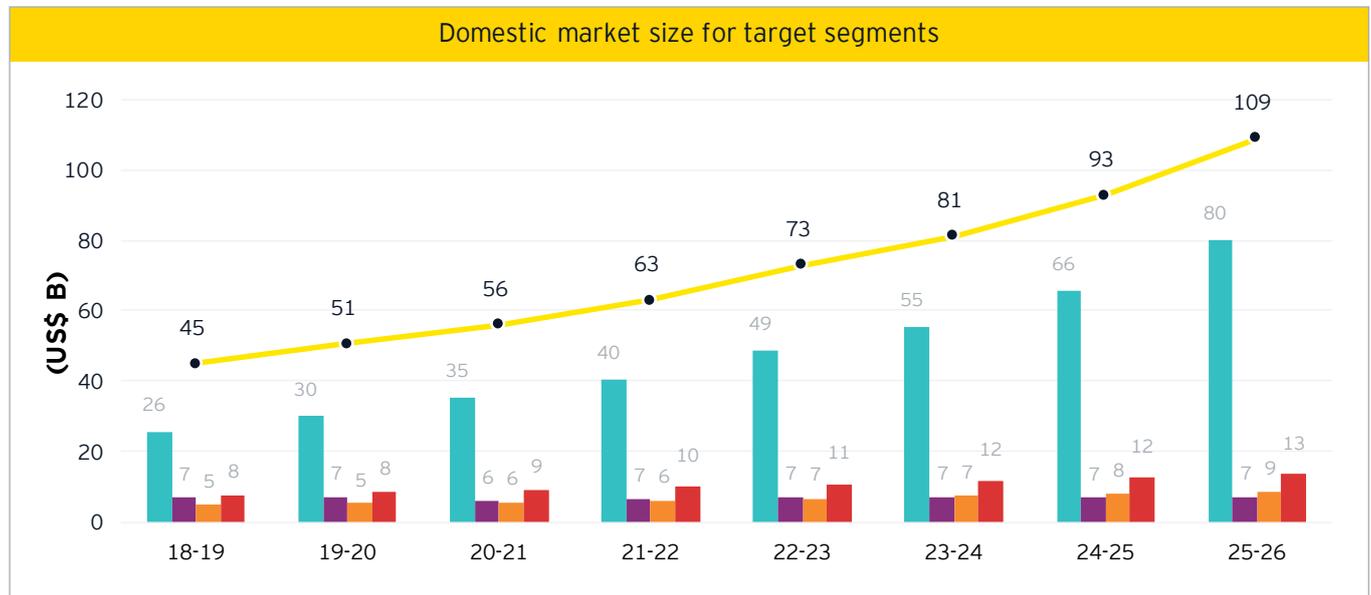
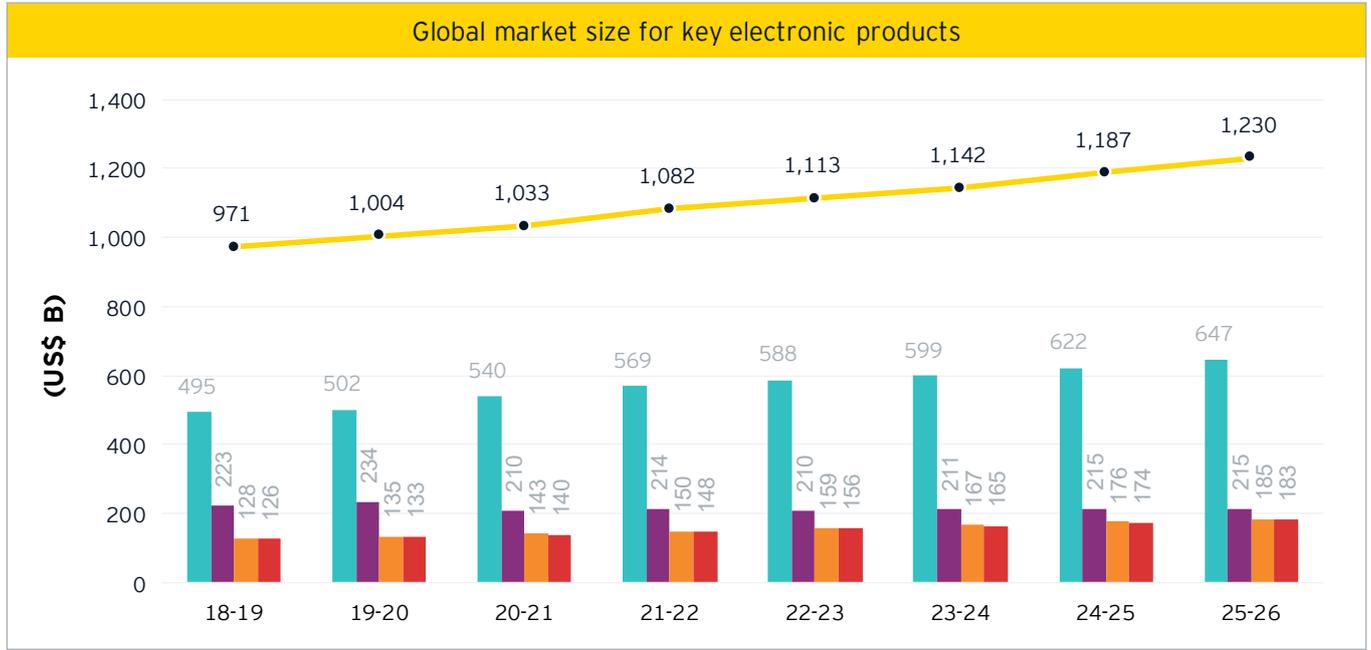
⁴¹ ICEA estimates

⁴² <http://dgftcom.nic.in/licasp/MEIS/meisitemdetail2016.asp>

⁴³ <https://content.dgft.gov.in/Website/Trade%20Notice%2003%2015%20April%202020.pdf>

Annexure -1

Market size for the target segment



Sources: ICEA, IDC Tracker, Allied Market Research⁴⁴

Note: The market numbers for smart TVs, audio devices, video and music streaming devices; and consumer appliances are on a conservative side.

⁴⁴ "Global household appliances market - Opportunity Analysis and Industry Forecast, 2018-2025," Allied Market Research report, Ja 2019, via EMIS <https://www.idc.com/getdoc.jsp?containerId=US44916519>

Annexure -2

List of leading global contract manufacturers

S. No.	Company name	Headquarter	Manufacturing locations	Revenues (US\$ million)
1	HonHai Precision (Foxconn)	Taiwan	China, India, Japan, Vietnam, Malaysia, U.S.	1,78,600
2	Pegatron	Taiwan	China, Indonesia, US, Europe, India	45,672
3	Wistron	Taiwan	US, Europe, China, Taiwan, India	29,358
4	Jabil Inc.	US	US, China, Malaysia, India, Europe	25,282
5	Flex	Singapore	US, China, India, Malaysia, Indonesia	24,210
6	Sanmina	US	China, Canada, Europe, India, Malaysia, Thailand, US	8,234
7	BYD Electronic	China	China	7,616
8	Celestica	Canada	Canada, US, China, Malaysia, Europe, Thailand	5,888
9	Universal Scientific Industrial	China	China, Taiwan, Mexico, Poland	5,343
10	New Kinpo Group (parent - Kinpo Electronics)	Taiwan	US, China, Thailand, Malaysia, Brazil, Mexico, Philippines	4,598
11	Kaga Electronics	Japan	Japan	4,123
12	Plexus Corp.	US	US, China, Malaysia, UK	3,164
13	Venture Corporation	Singapore	Singapore, US, China, Malaysia	2,702
14	Benchmark Electronics	US	US, China, Malaysia, Netherlands, Romania	2,268
15	SIIX Corp.	Japan	Japan, China, Thailand, Indonesia	2,052
16	Shenzhen Kaifa	China	China, Malaysia, Philippines	1,899
17	Fabrinet	Cayman Islands	China, Thailand, Japan, US	1,584
18	UMC Electronics	Japan	Japan, China, Vietnam, Thailand	1,310
19	Integrated Micro-Electronics	Philippines	Philippines, China, Europe, Japan, US	1,250
20	Kimball Electronics	US	US, Thailand, China, Poland	1,182
21	PC Partner Group	Hong Kong	Hong Kong, China	970
22	V.S. Industry Berhad	Malaysia	Malaysia, China, Indonesia and Vietnam	964
23	Pan International	Taiwan	China, Taiwan, Malaysia, Thailand	856
24	Global Brands Manufacture Ltd.	Taiwan	Taiwan, China	730
25	Ducommun Inc.	US	US	721
26	ATA IMS Berhad	Malaysia	Malaysia	713

List of leading global contract manufacturers

S. No.	Company name	Headquarter	Manufacturing locations	Revenues (US\$ million)
27	Hana Microelectronics	Thailand	Thailand, China, US, Cambodia	697
28	WKK Technology (parent - Wong's Kong King International)	Hong Kong	China, Hong Kong	675
29	Scanfil	Finland	Finland, China, Germany, Poland, Sweden, Estonia, US	650
30	Neways Electronics	Netherlands	China	599
31	Orient Semiconductor Electronics	Taiwan	Taiwan, China, US	586
32	LACROIX Electronics	France	France, Germany, Poland, Tunisia	525
33	SVI Public Company	Thailand	Cambodia, Europe	508
34	Wong's International Holdings	Hong Kong	China, Vietnam	485
35	Shenzhen Zowee Technology	China	China	480
36	Key Tronic	US	US, China, Vietnam	464
37	Computime Group	Hong Kong	Malaysia	421
38	DBG Technology	China	China, Hong Kong	315
39	Zollner Elektronik	Germany	Germany, China, Hong Kong, US, Europe	NA
40	Sumitronics	Japan	Thailand, Indonesia, Cambodia, Mexico	NA
41	Asteelflash	France	China, Europe, US, Tunisia	NA
42	VTech Communications	Hong Kong	China, Malaysia	NA
43	NEO Tech	US	US, China	NA
44	Enics AG	Switzerland	China, Estonia, Finland, Slovakia, Sweden, Switzerland	NA
45	VIDEOTON	Hungary	Hungary, Bulgaria	NA
46	Katolec	Japan	Japan	NA
47	3CEMS Group	China	China	NA
48	ALL CIRCUITS	France	France, US	NA
49	GPV Group	Denmark	Thailand, Sri Lanka, China, Hong Kong, Denmark, Switzerland	NA
50	Katek SE	Germany	Germany	NA

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EYIN2010-003

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