



TIFAC Building

Technology Information, Forecasting & Assessment Council (TIFAC), an autonomous organization under the Department of Science & Technology (DST), Government of India was established in 1988. TIFAC is a think tank within government setup which looks up to technologies on the horizon, assesses the technology trajectories and supports technology innovation in select areas of national importance.



## TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL

(Autonomous body of Department of Science and Technology, Govt. of India)

A-Wing, Vishwakarma Bhavan, Shaheed Jeet Singh Marg

New Delhi - 110016

[www.tifac.org.in](http://www.tifac.org.in)



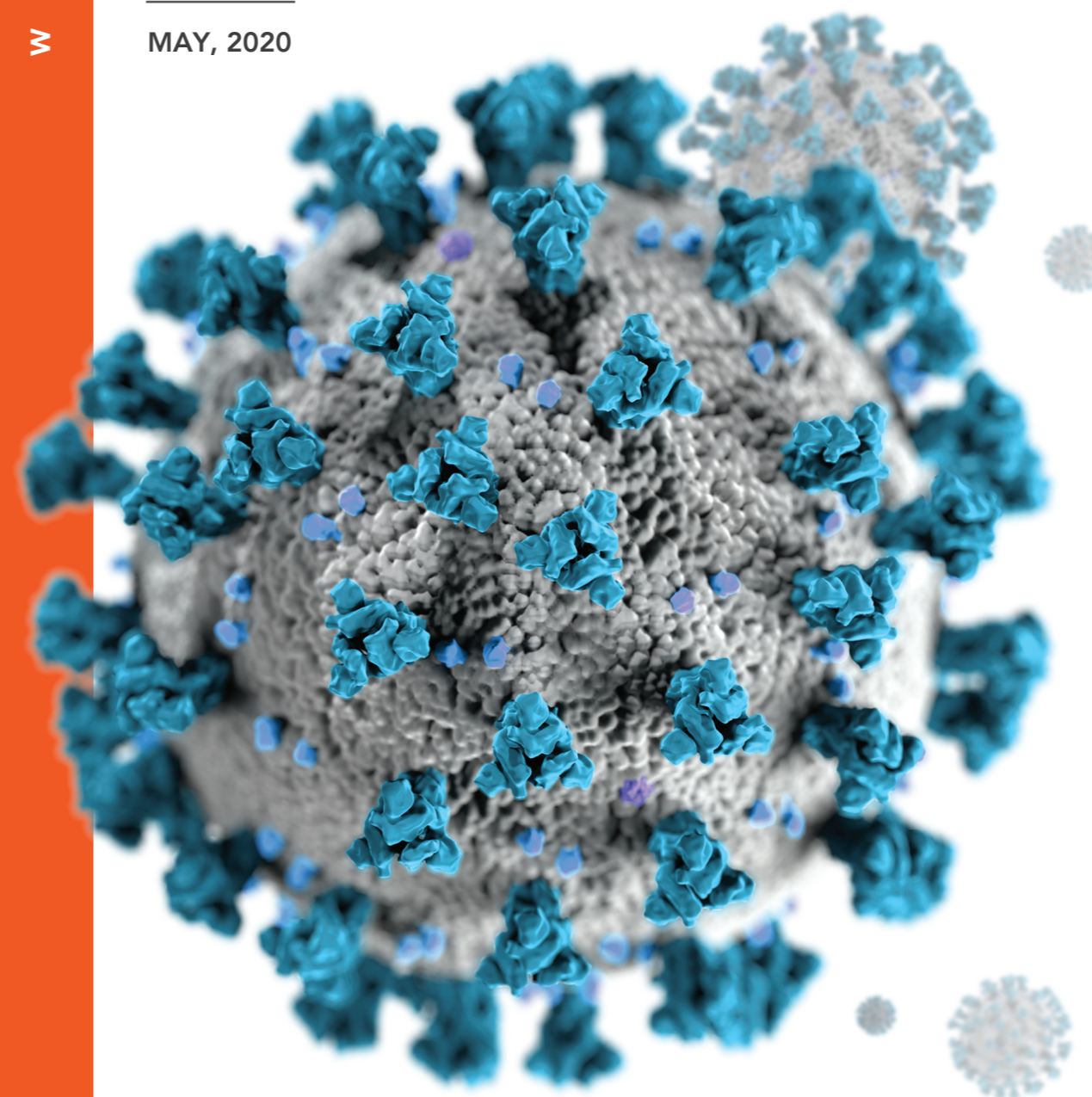
W H I T E P A P E R

# FOCUSED INTERVENTIONS FOR 'MAKE IN INDIA'

## *POST COVID-19*

LOCAL SOLUTIONS TO GLOBAL CHALLENGES  
POLICY AND TECHNOLOGY IMPERATIVES

MAY, 2020



TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL  
(AUTONOMOUS BODY OF DEPARTMENT OF SCIENCE AND TECHNOLOGY, GOVT. OF INDIA)

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The report has been prepared for Policy Makers primarily as inputs for decision making. This is not a priced document. The information contained in this report is of general nature and collated from various secondary sources including available reports, websites, discussion with experts and inputs from TIFAC scientists.

Information has also been sourced from the KPMG report: "Potential impacts on the Indian economy" as available on website.

The policy part has been finalized in consultation with Innovant India and Sapio Analytics.

Any specific follow up action by any industry etc to be done only after professional advice and assessment of the situation.

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Technology Information, Forecasting and Assessment Council (TIFAC)

Department of Science and Technology (DST)

'A' Wing, Vishwakarma Bhavan, Shaheed Jeet Singh Marg,  
New Delhi 110016, India.

Email: [tifac.foresight@gmail.com](mailto:tifac.foresight@gmail.com) | Web: [www.tifac.org.in](http://www.tifac.org.in)

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WHITE PAPER

FOCUSED INTERVENTIONS FOR  
**'MAKE IN INDIA'**

*POST COVID-19*

*Local Solutions to Global Challenges  
Policy and Technology Imperatives*



TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL

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MAY 2020







## डॉ हर्ष वर्धन Dr Harsh Vardhan

स्वास्थ्य एवं परिवार कल्याण, विज्ञान और प्रौद्योगिकी  
व पृथ्वी विज्ञान मंत्री, भारत सरकार

Union Minister for Health & Family Welfare,  
Science & Technology and Earth Sciences  
Government of India

सबका साथ, सबका विकास, सबका विश्वास  
Sabka Saath, Sabka Vikas, Sabka Vishwas



### MESSAGE


In our lifetime, the world had never seen an outbreak of the scale of COVID-19. Consequently, it is also true that India has not only exhibited able leadership and resoluteness in facing this outbreak, but has also shown remarkable tenacity in quickly ramping up the medical and health infrastructure of the country. In response to the crisis, India has launched a host of medical research initiatives including for diagnostics, treatment options and development of vaccines. This crisis has also given our society an opportunity to reorient our lifestyles and undertake holistic thinking process. These imbibed values will help us face better any such crisis in future.

Post - COVID, World is staring at a major transformational change with altered global order and alignments and changed supply chains. While this may present some problems in the short term, this crisis also presents a silver lining. It has presented a unique opportunity for us to position India as a Global manufacturing hub with a big push under 'Make in India'. Already, several companies currently located in China, have expressed their desire to relocate to India.

It is in this context that Technology Information, Forecasting and Assessment Council (TIFAC), Technology Think Tank of the Nation, has done a commendable job in bringing out a White Paper on "Focussed Interventions for 'Make in India' -post- COVID-19".

The White Paper has brought out an understanding of the resultant economic situation and impact. The paper presents suggestions to policy makers and public with guidance of steps which need to be taken to mitigate the widespread economic shock and spearhead the recovery of the Indian economy. This document also suggests new models of recovery of Indian economy, post- Covid-19. The design of recovery curve post-Covid-19 is based on our national priorities and technological strengths. In doing so, the paper has redefined priorities and suggests fundamental changes towards evolving new business models to support and strengthen the economy.

I am sure this White Paper will be very useful in shaping the Indian economy in coming days.

  
(Dr. Harsh Vardhan)

कार्यालय: 348, ए-स्कंध, निर्माण भवन, नई दिल्ली-110011 • Office: 348, A-Wing, Nirman Bhawan, New Delhi - 110011

Tele: (O) : +91-11-23061661, 23063513 • Telefax: 23062358 • E-mail: hfm@gov.in

निवास: 8, तीस जनवरी मार्ग, नई दिल्ली-110011 • Residence: 8, Tees January Marg, New Delhi - 110011

Tele: (R) : +91-11-23794649 • Telefax: 23794640





सत्यमेव जयते

प्रो. आशुतोष शर्मा  
Prof. Ashutosh Sharma



सचिव  
भारत सरकार  
विज्ञान और प्रौद्योगिकी मंत्रालय  
विज्ञान और प्रौद्योगिकी विभाग  
Secretary  
Government of India  
Ministry of Science and Technology  
Department of Science and Technology



4<sup>th</sup> May, 2020

### MESSAGE

COVID 19 pandemic, though unprecedented in impact, has galvanized whole Nation in not only facing it resolutely and unitedly but also combating it with all the resources. Each citizen of the country has gone beyond the normal call of duty in this moment of crisis and contributed to this endeavour.

Govt. of India has very effectively managed and contained the pandemic so far and done exceedingly well in mitigating the impact. The fight against novel corona virus may last some more time until a vaccine is developed or an effective cure is found.

Department of Science and Technology, is very proactively directing and leading the S&T initiatives across the country towards combating the pandemic by way of catalyzing, developing, promoting and commercializing technologies related to management, prevention and cure from the pandemic.

Apart from health, COVID 19 is severely impacting the world economy. Post COVID, it's going to be very different world with very different business models. However, every challenge is also an opportunity and there will be several for India to seize.

In this context I am very happy to note the timely initiative of Technology Information, Forecasting & Assessment Council (TIFAC), an autonomous body of DST in bringing out a White Paper for undertaking focussed interventions for Make in India, post COVID 19.

White Paper has focussed on five specific sectors crucial from National perspective and brought out the Indian prerogatives for supporting and rejuvenating economy. It captures sector specific, strengths, market trends and opportunities. The study also identifies the challenges, support system required for development, and defines clearly short and long term recommendations.

I am sure the TIFAC White Paper will help in formulation of our policies and purposeful actions as the instruments of shaping the Indian economy in the days ahead.

(Ashutosh Sharma)





डॉ. वी.के. सारस्वत  
Dr. V.K. Saraswat  
सदस्य

Member

Tele : 23096566, 23096567

Fax : 23096603

E-mail : vk.saraswat@gov.in



भारत सरकार  
नीति आयोग, संसद मार्ग  
नई दिल्ली-110 001

Government of India  
NATIONAL INSTITUTION FOR TRANSFORMING INDIA  
NITI Aayog, Parliament Street  
New Delhi-110 001



### Foreword

World in recent history has not witnessed the scale of pandemic which COVID 19 has unleashed. It has led to destruction, death and fear. It's impact is far greater than that of Great Depression. It has transformed our lives and also the way we work and do business by creating new norms.

The crisis, however has also demonstrated to the world our collective National resolve and indomitable spirit, with which we have combated the pandemic. India with very quick steps has been able to successfully mitigate the impacts so far.

With time, the pandemic will abate but it will leave behind a totally new world order with crumbling global relations, global mistrust, disrupted supply lines, paradigm shift in social structure and realigned global economic cooperation as well.

However, like every crisis, COVID has also presented India with an opportunity. Radical disruption brought on by COVID has presented India with an opportunity to formulate structure and initiate Policy and structural reforms to reposition itself as a Global Manufacturing hub.

It is in this context that the White Paper brought out by TIFAC is very timely. The paper has highlighted five thrust sectors that would be critical for India's economic growth, using technology stimulus and charted out sector specific as well as aggregate policy and technological recommendations. The document also presents models of recovery of Indian economy, leveraging new international partnerships in important sectors based on national priorities and technological strength.

TIFAC will follow it up with sectoral experts towards charting out sector specific follow up initiatives.

I am sure TIFAC White Paper will be very useful input for the policy makers in shaping and transforming India's future.

(Dr. V K Saraswat)

Chairman, TIFAC Governing Council



एक कदम स्वच्छता की ओर



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## Executive Summary



**Prof. Pradeep Srivastava**  
Executive Director,  
TIFAC

The onslaught of the COVID-19 pandemic has ripped through the Indian economy. This is certain that the scale of the economic damage caused by the COVID-19 pandemic will be far greater than that caused by the 2008 global financial crisis and also the considerable uncertainty of the duration of crisis prevails. The COVID-19 pandemic constitutes an unprecedented challenge with very severe socio-economic consequences. It is pertinent to mention, that Indian economy had already experienced significant slowdown over the last fiscal year, during which the economy grew at a six-year low rate of 4.7%. COVID-19 pandemic has impacted both demand and supply side elements of the economy, and crashed all hopes for any recovery this year in 2020.

We are still in the middle of the crisis, but the data-points considered, data collected, collated and analysed for this study give us enough suggestions worth-considering. Accordingly, an attempt has been made by TIFAC to understand, evaluate and define the impact of the pandemic on Indian economy and to provide policy makers (Government of India) and public with guidance of steps that can be taken to mitigate the widespread economic shock and spearhead the Indian economy, cut through the noise of fall and prepare the ground for recovery using self-reliance as the new mantra. COVID-19 has strained global relations, disrupted supply chain and has created a trust deficit. The potential sectoral impact has been in manufacturing (equipments, machines, electronics, textile, pharma, etc), Civil Aviation, Travel and Tourism, Human health, Agriculture, etc. In the aftermath, there is bound to be a paradigm shift in our socioeconomic structure, global cooperation and realignment of supply chains. But behind every dark cloud, there is a silver lining and a light of hope.

Hon'ble Prime Minister of India also underlines that this crisis presents an opportunity to Indian economy. The impacts and imperatives emerging out of this pandemic will shape the new World order. The current pandemic is global, but the solutions to the challenge should be local. The important levers of change

are ownership of value chain, technology push, operating flexibility and supply chain resilience and variable cost models. Amidst deep recession in the first quarter of the year, with GDP below 1.0, India looks for sharp transition to a forward rise in its economy. At this juncture, it is quite crucial and pertinent, to redefine our priorities based on our strength and enhanced capacities and further plan fundamental changes the way we act to evolve our new business models to support and strengthen our economy. This document is an attempt to suggest new models for recovery of Indian economy, post COVID-19. The design of recovery curve, post COVID-19, is based on our national priorities and technological strength. The road to national economy recovery would traverse through measures like policy support to unconventional strategies, leveraging into new international partnerships in important sectors of Agriculture, Electronics, Health, ICT and Manufacturing and providing new technology stimulus.

This white paper which captures sector-specific strengths, market trends and opportunities in five (5) sectors, critical from country's perspective, includes Healthcare, Machinery, ICT, Agriculture, Machinery & Manufacturing and Electronics with reference to supply and demand, self sufficiency and production capacity of technologies and products. The relative sector area strength and advantages have been identified, with an understanding of market sizes, export and import trends, identification of MSME clusters and the collaborating institutions. Indian competencies and technology trends have been pinned precisely in the white paper. The study also identifies the challenges, support system required for development, and defines short and long term recommendations clearly. The focus areas of the underlying policy options have been projected to include Public health system, MSME sector, Global relations: FDI, recalibrated trade alignments, new age technologies, etc. This is precisely important to include recommendation and emphasise upon development of technology clusters in Champion segments, development of incubation startup highway for X leverage and build a monetization exchange on Uber platforming model, identify, support and pilot ten blockbuster technologies, collaborate with new dynamics with incubators of Israel, Germany, etc., promote import substitution, evolve technology platforms in sunrise technologies on Energy sector, Artificial Intelligence (AI) and Machine Learning(ML), Health care support through telemedicine, etc. This White paper has been developed as an internal exercise considering opinions of experts and various stakeholders, with the objective to design a broader roadmap and action. I strongly believe that this white paper will catapult the Indian economy and eventually make our country "ATMANIRBHAR".

I would extend, without fail, my sincere acknowledgements to the entire team of TIFAC Scientists, DST Scientists, Designers, Sapio Analytics, Innovant International and Dr. Kingshuk Poddar (Tata Steel) who have worked with full dedication to complete this mammoth task of white paper preparation in a very short duration of COVID-19 lockdown.

## 1.0 | Introduction

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The COVID-19 pandemic has hit the entire world like a tsunami, unaware and unprepared, and jeopardized the global growth including that of developed economies like the US, UK, Germany etc. and India as well. Originating from Wuhan city in Hubei province, China sometime in December 2019, this pandemic has shaken almost the entire globe, with death tolls approaching over a lakh, and looming to a further rise, in coming days. With no proven vaccine or drug as yet, most countries have resorted to lock-down in a desperate attempt to contain the spread of COVID-19 and all economic activities are put to a big halt. It has unleashed death, destruction, misery, loss and panic of a scale never seen before. The United States has more than four times as many confirmed cases as any other country. India, with prompt actions, has so far done exceedingly well in containing the pandemic with around 1 lakh infections and more than 3000 associated deaths by third week of May, 2020.

As a result of lockdown in varying degrees, virtually the entire world has enforced travel ban & social distancing. This has brought the wheels of the global economy to virtual grinding halt. The situation is such that saving lives is paramount while saving economy has become a secondary consideration. Hon'ble Prime Minister on 24<sup>th</sup> March 2020 had called for a complete lockdown of the country which has now been extended with relaxations till 31<sup>st</sup> May 2020.

The Indian economy was already going through a rough patch before the arrival of the pandemic. With nationwide lockdown, the economy has taken a very bad hit and inflicted untold miseries especially to the poor people of the country. There has been significant reduction in orders and cash flow across the sector, deep hit in the supply chain, and a significant downside effect on businesses. The travel and hospitality sector has suffered one of the harshest blows, and airline companies are on the verge of facing bankruptcy, with global and domestic travel networks being shut.

However, human race is very resilient. We have bounced back from every crisis and shall overcome this too. In a matter of months, COVID-19 would be behind us. But, COVID-19 will leave behind a profound effect and impact. Post pandemic, there would be a paradigm shift in our social structure, global cooperation and economic cooperation as well. The global supply chains are crumbling and so is the world order. In such a scenario, it is critical how fast we internalize the lessons, look ahead and



prepare ourselves for the World beyond. To bounce back from such a situation, India needs to strengthen building blocks of the economy as well as that of society. The Hon'ble Prime Minister of India has also made a clarion call to utilize this challenging time not as a national crisis, but as an opportunity for economic revival, to promote 'Make in India' initiatives and become self reliant.

This white paper is a roadmap on defining technology impetus required to push India, post COVID-19, towards self reliance and being a global major manufacturing hub. In doing so, the paper covers, at a macro level, the needs and analysis of sectors critical to National economy, and suggests requisite policy recommendations for creating an enabling ecosystem for effecting the transformation.

## 2.0 Global Economy vis-a vis Indian Economy - A REVIEW

### 2.1 GLOBAL ECONOMY

Before exploring options for India towards revival and capitalizing on post-COVID-19 situation, this section looks at the global economy and attempts to position India vis-a-vis other major economies. In fact, global economy due to various geopolitical reasons was experiencing slowdown over the last two years as shown in the Table 1 below:

**TABLE 1: GLOBAL ECONOMY AT A GLANCE**

*Real GDP growth rates %*

Top 10 Countries by GDP	2017	2018	2019
U.S.	2.4	2.9	↓ 2.3
CHINA	6.9	6.7	↓ 6.1
JAPAN	2.2	0.3	↑ 0.7
GERMANY	2.8	1.5	↓ 0.6
U.K.	1.9	1.3	↑ 1.4
FRANCE	2.4	1.7	↓ 1.3
INDIA	6.5	6.7	↓ 5.3
ITALY	1.7	0.7	↓ 0.3
BRAZIL	1.3	1.3	↓ 1.1
CANADA	3.2	2.0	↓ 1.6

The data reveals that developed nations (US, Germany, UK, France etc.) showed maximum slowdown as compared to both India and China. The Purchasing Managers Index (PMI) data indicates the prevailing direction of economic trends in the manufacturing and service sectors of any nation. The PMI data over the last few months for various countries also depict a grim story (Table 2). The struggling Chinese economy was severely affected by COVID-19 with PMI @ 40 in the month of February, 2020, as against India which maintained a fairly good run-rate till February, 2020.

**TABLE 2: PMI DATA OF VARIOUS COUNTRIES**

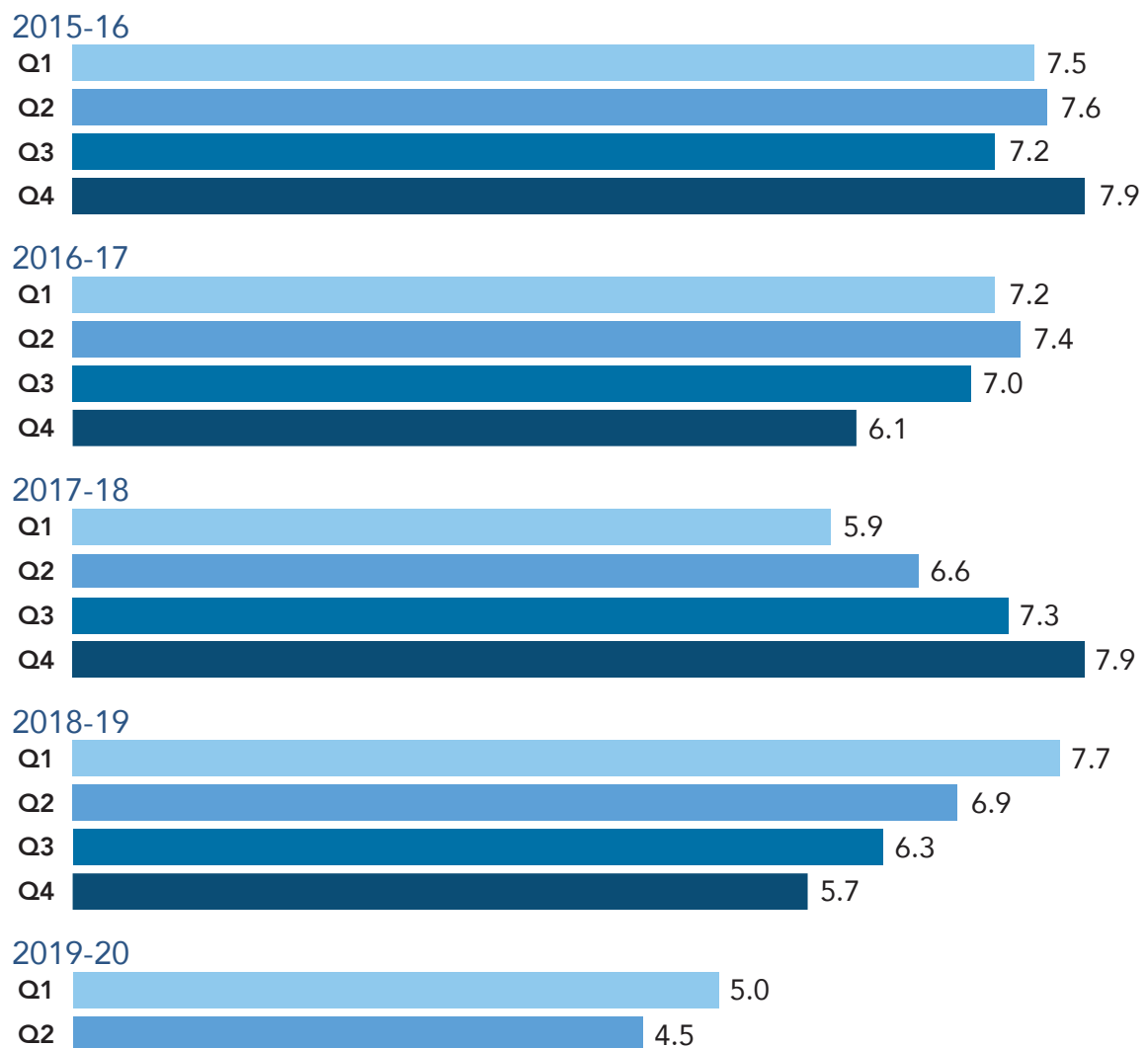
	JUN-19	JUL-19	AUG-19	SEP-19	OCT-19	NOV-19	DEC-19	JAN-20	FEB-20	
EUROPE	FRANCE	51.9	49.7	51.1	50.1	50.7	51.7	50.4	51.1	49.8
	GERMANY	45.0	43.2	43.5	41.7	42.1	44.1	43.7	45.3	48.0
	IRELAND	49.8	48.7	48.6	48.7	50.7	49.7	49.5	51.4	51.2
	ITALY	48.4	48.5	48.7	47.8	47.7	47.6	46.2	48.9	48.7
	SPAIN	47.9	48.2	48.8	47.7	46.8	47.5	47.4	48.5	50.4
	U.K.	48.0	48.0	47.4	48.3	49.6	48.9	47.5	50.0	51.7
AMERICAS	BRAZIL	51.0	49.9	52.5	53.4	52.2	52.9	50.2	51.0	52.3
	CANADA	49.2	50.2	49.1	51.0	51.2	51.4	50.4	50.6	51.8
	MEXICO	49.2	49.8	49.0	49.1	50.4	48.0	47.1	49.0	50.0
	U.S.	50.7	50.4	50.3	51.1	51.3	52.6	52.4	51.9	50.7
ASIA & PACIFIC	AUSTRALIA	52.0	51.6	50.9	50.3	50.0	49.9	49.2	49.6	50.2
	CHINA	49.4	49.9	50.4	51.4	51.7	51.8	51.5	51.1	40.3
	JAPAN	49.3	49.4	49.3	48.9	48.4	48.9	48.4	48.8	47.8
	KOREA	47.5	47.3	49.0	48.0	48.4	49.4	50.1	49.8	48.7
	INDIA	52.1	52.5	51.4	51.4	50.6	51.2	52.7	55.3	54.5
	INDONESIA	50.6	49.6	49.0	49.1	47.7	48.2	49.5	49.3	51.9
	MALAYSIA	47.8	47.6	47.4	47.9	49.3	49.5	50.0	48.8	48.5
	SINGAPORE	49.6	49.8	49.9	49.5	49.6	49.8	50.1	50.3	48.7
	VIETNAM	52.5	52.6	51.4	50.5	50.0	51.0	50.8	50.6	49.0

In this context, UN has also predicted that the post pandemic global economy, could now shrink by 3% in 2020 and may contract even further if restrictions on the economic activities are extended without adequate fiscal responses.

## 2.2 INDIAN ECONOMY

India's growth rate year 2000 onwards has been, by and large, stable and resilient across broad based sectors: agriculture, industry and services. The growth is also linked to increased productivity both labour as well as total factor productivity. The diversified trade basket and trading partners have given India a cushion, which insulates from slowdown at any particular part of world. One of the major highlights of India's GDP growth has been the continuous tilt towards services away from agriculture. The GDP growth of India during the period 2015 to 2020 is depicted in Fig 1 below:

**FIG 1: GDP GROWTH OF INDIA (2015-2020)**



**Real GDP growth (percent, constant 2011-12 prices)**

Source: Quarterly estimates of gross domestic product for the third quarter (Q3) of 2019-20, Ministry of Statistics and Programme Implementation (MoSPI), 28 February 2020, accessed on 24 March 2020

India's GDP for the year 2018-19 at current prices level, is around Rs.190 Lakh Crores, fifth largest in the world. In September 2019, India's Forex had grown to 433.7 Billion dollars which was enough to sustain ten months of imports, reflecting the sustained growth and growing stability. The share of agriculture in GDP of Indian economy has gone down gradually from 23.02 % in 2000 to 14.39% in 2019. Services contributed 54.15 % in 2019 while Industry contributed 31.46%. Whereas in China, the contribution of agriculture came down from 10.33% in 2009 to 7.10 % in 2019, while services contributed 53.9% in 2019. However in countries like USA and Japan, the contribution of agriculture remained around 1% during 2007 to 2017.

The disparity in the contribution of agriculture to GDP with other developed nations emphasizes the urgent need for furthering investment in developing infrastructure, industrialization, creating demand, modernizing farming and creating jobs to attract manpower who are moving out of agriculture. Accordingly, Indian government should target to create 100 million new jobs by aggressively promoting manufacturing with a target to increase GDP share of manufacturing primarily through Make in India initiative. The median age of Indian is still 26.8 years and around 10 million people enter workforce every year. At present, 68% of youth live in rural India and majority of them are fit for low skill work. Therefore, they migrate from rural to urban. They ideally provide a good basic workforce for the aforesaid initiatives. In addition, India also has around 0.5 million highly skilled and experienced scientists who could be leveraged to make the economy export oriented. India's vast young engineer/scientists/entrepreneur base has already contributed to the impressive growth of start-up thus contributing in Startup India and Digital India initiative.

Prime Minister has set a target of 5 trillion dollars economy by FY 2025. To meet this target, we need a sustained growth @ 8%. This will require massive private sector investments and moreover "animal spirits" as in the words of Keynes i.e higher investment and higher consumption. This in turn would require policy and infrastructural support. Higher investment would need to follow economic reforms so as to address hindrances in growth of MSMEs, enforcement of legal contracts etc. This would spur investment including foreign, create demand capacity, increase productivity, introduce new technologies and create new jobs.

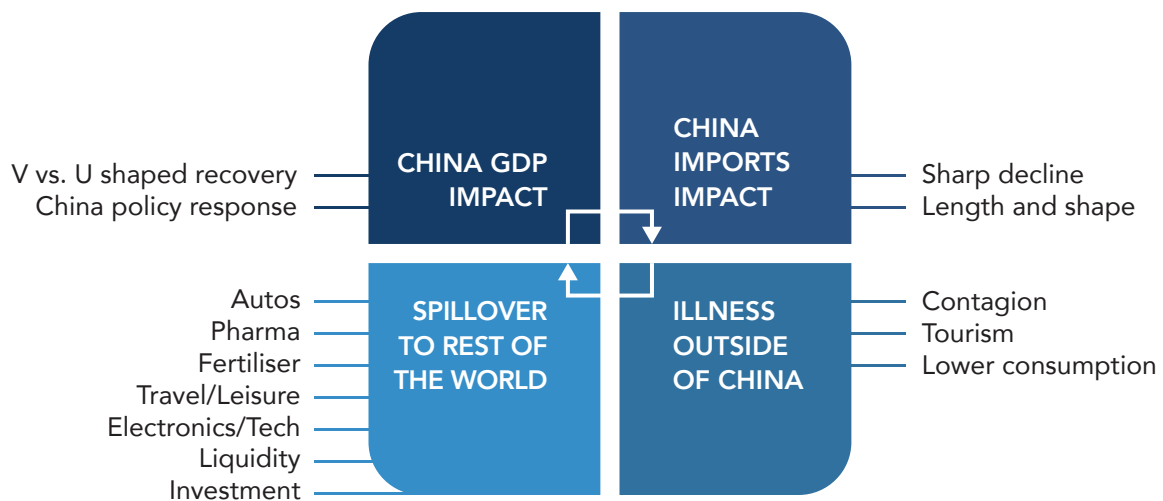


## 3.0 COVID-19 Onslaught and India

3.1 As per an IMF estimate, the pandemic, even if swiftly controlled, could shrink per capita GDP across 170 nations by at least 3%. It could result in drastic drop in industrial production, uncertainty over the supply chain, large scale unemployment and even drop in agricultural production etc. The scenario looks very grey with global lockdown in force and resultant impact on the demand and supply scenario.

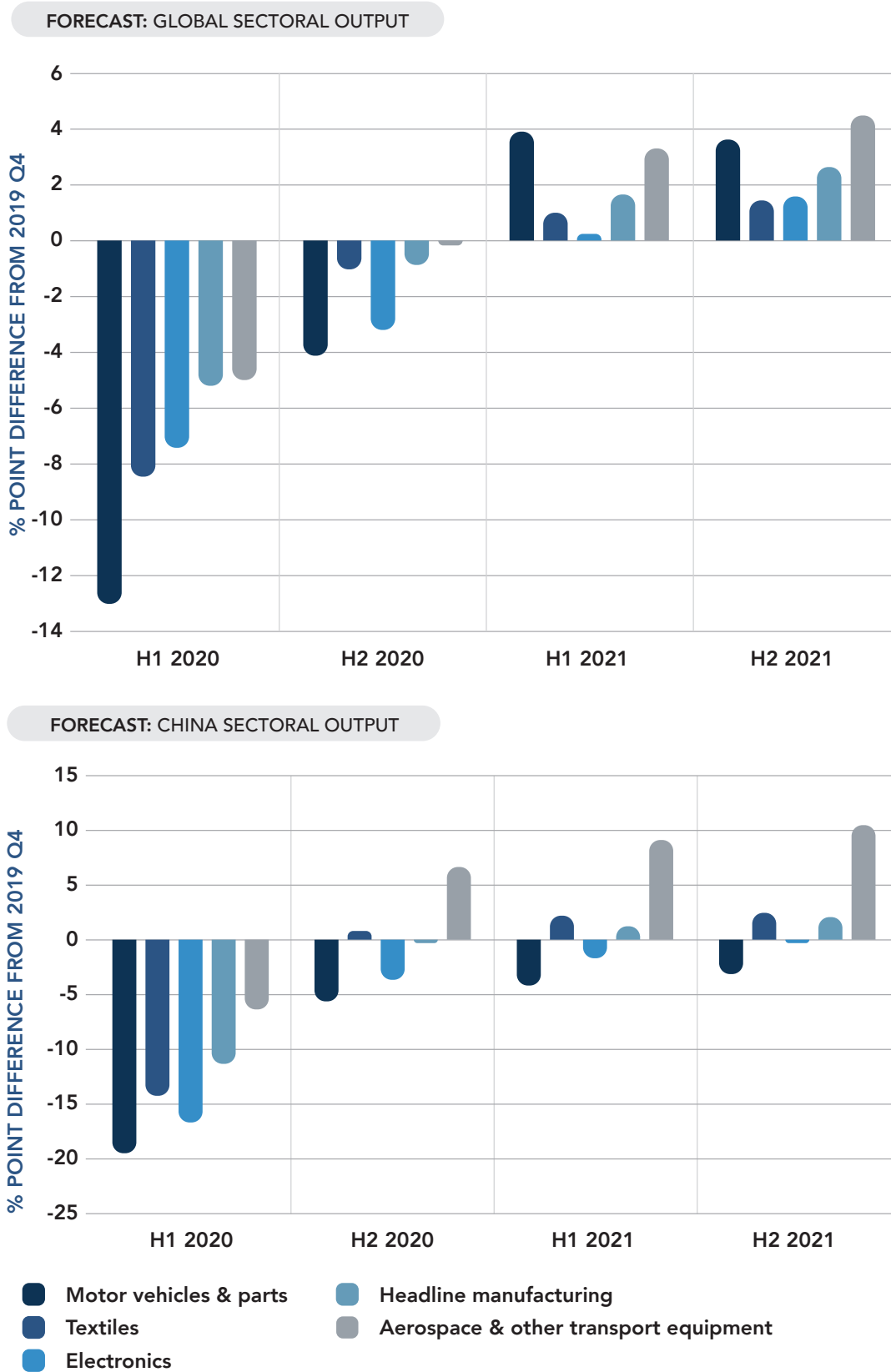
China has been one of the major drivers of global economy with around 18% contribution to the world's GDP. With such size and broad base, slowdown in Chinese economy will have a cascading effect on the entire world, virtually on all the sectors as depicted in Fig 2:

FIG 2: POTENTIAL ECONOMIC SPILLOVER OF THE WORLD FROM CHINA



Source: KPMG Report on the Impact on Indian Economy, 2020

FIG 3: POTENTIAL IMPACT ON COVID-19 ON DIFFERENT SECTORS



It reveals that amongst Manufacturing: Automobile, Textiles, Electronics, Aerospace are the most affected sectors globally

3.2 In India, COVID-19 infection is yet to reach the peak. With preemptive, proactive and graded control, India would be able to flatten the growth curve. Even if plateau is reached, prolonged control measures has to be ensured. IMF has also projected the reduction of GDP growth for India from 5.8% to 1.9%. Current estimates are even lower in case of prolonged lockdown. As such, recoveries would take many months but in case of a repetition of outbreak next year, recovery could take several years.

IMF also forecasted growth in Asian countries to fall to zero percent. If so, it would be the worst performances since last 60 years. China’s growth could decelerate to 1.2 %. However, India and China are the only two countries in the world predicted to have positive GDP growth this fiscal year.

Shri Swaminathan, a noted Economist, as reported in a newspaper daily (Times of India), has postulated three scenarios. In the most optimistic scenario, the crisis may spread rapidly but also peter out fast. This would manifest in deep recession in the first half of the year followed by sharp recovery. In the second scenario, the virus and recession would continue till September 2020 with higher deaths and bankruptcies. GDP will recover but would hobble till 2020. In the third scenario, it would take longer time to control the virus, and the crisis could continue till 2021. **Despite the extreme slowdown in the scenario-3, India, unlike many other countries, is estimated to have positive GDP growth. It indicates that the scope of turning it around to high-hyper growth range is better with India than others.** Fig 4 depicts the three scenarios.

FIG 4: DIFFERENT SCENARIOS



After two months of lockdown in India and burgeoning number of COVID-19 cases, the economy is heading towards a blend of Scenario 2 & 3.

### 3.3 MAGNITUDE OF IMPACT ON ECONOMY SECTORS:

Based on a detailed analysis of various sectors in reference to employment and GDP contribution as defined under **National Industrial Classification System**, the impact of COVID-19 has been highlighted in Table 3. The following factors were taken as input parameters for each sector and its category:

- Normal labor availability
- Critical labor availability
- Regular inward stock
- Critical inward stock
- Inward logistics
- Working capital availability
- Outward logistics
- Distribution efficiency

**TABLE 3: IMPACT OF COVID-19 ON DIFFERENT SECTORS**

Sectors	% of GDP	Employment (2018-2019)	COVID-19 IMPACT in 2020-2021
Apparel/Textiles	2	45 Million	Med-High
Auto	7-8	40 Million	High
Aviation and Tourism	11.4	43 Million	High
Building and Construction	~10		High
Retail	10	10% of total workforce	Med-High
Education and Skilling	3		Medium
Financial Sector (Incl. Insurance)	9		Medium
Food and Agriculture	15	43% of total workforce	Medium
MSME	30	11.4 crore (99% Micro)	High

### 3.4 STUDY OF IMPACT OF COVID-19 ON INDIAN ECONOMIC SECTORS: DEMAND & SUPPLY

COVID-19 with global shutdown and quarantine has severely affected the supply side of economy without collateral damage to the demand side. However, mankind history is replete with several instances of not only recovering but also coming back strongly from several pandemics including two world wars. We shall overcome COVID-19 also. In order to calculate impact on demand, correlations between demand, lockdown and spread were taken into account. Impact of COVID-19 on supply and demand in various sub sectors of economy also has been analyzed and presented in the table as annexed.

It is inferred from the table that supply side in the sectors of Mining, Manufacturing, construction, food, entertainment and recreation have been badly impacted whereas in sectors like agriculture, textile, electrical equipment, education and healthcare services, the demand is not so affected.

Some sectors which are crucial to the national economy like: Healthcare, Agriculture and Food Processing, Manufacturing & Machinery, ICT and Electronics etc. have been studied in greater details in next section. However, the broad approach in each sector is mentioned below:

**HEALTHCARE:** This sector has components that show increase in demand while limitations are projected on supply side. This calls for technology boosts using ICT and new-age technologies to make this sector a positive earner for India.

**AGRICULTURE AND ALLIED SECTORS:** The production is not as impacted as most other sectors, while the demand exists. This is a sector that can help India in covering losses posed by other sectors, if the right kind of technology support is provided. Technology adoption is also required to strengthen Public Distribution System, to reduce post harvest losses and mechanization for agriculture operations,

**MANUFACTURING:** Some categories of this sector are severely impacted, while not so much in other categories. The difference in impact across categories within the sector poses an interesting challenge where there may be need of shift of roles for a number of stakeholders in the sector.

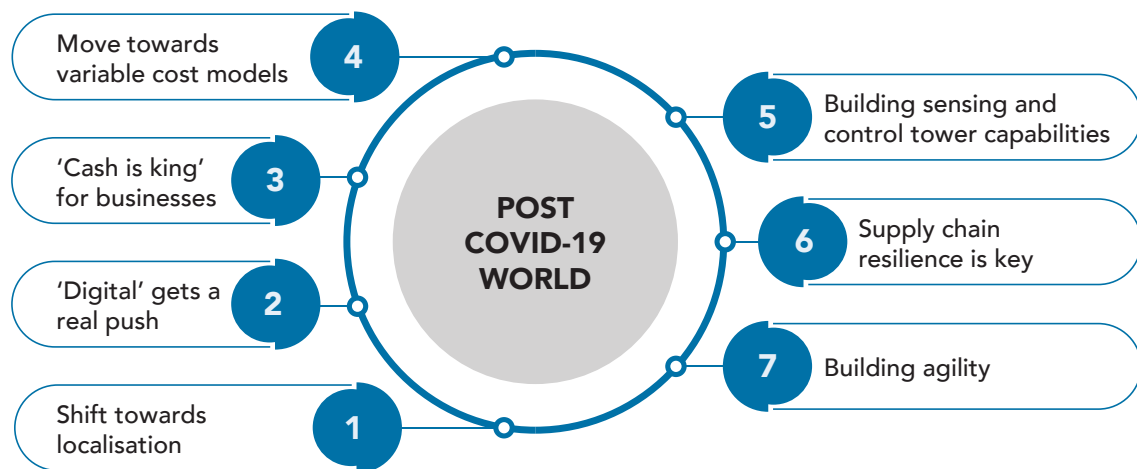
**ICT AND ELECTRONICS:** Some of the categories within the sector are showing a boost for the economy, thus creating a need of technological interventions in this sector for helping other sectors.



## 4.0 Post COVID-19 Business Imperatives: *TECHNOLOGY STATUS & OPTIONS AHEAD*

Following are the impacts and the imperatives which are likely to emerge and would be instrumental in shaping the new world order (Fig 5)

FIG 5: POST COVID-19 PERSPECTIVE IN SHAPING THE WORLD

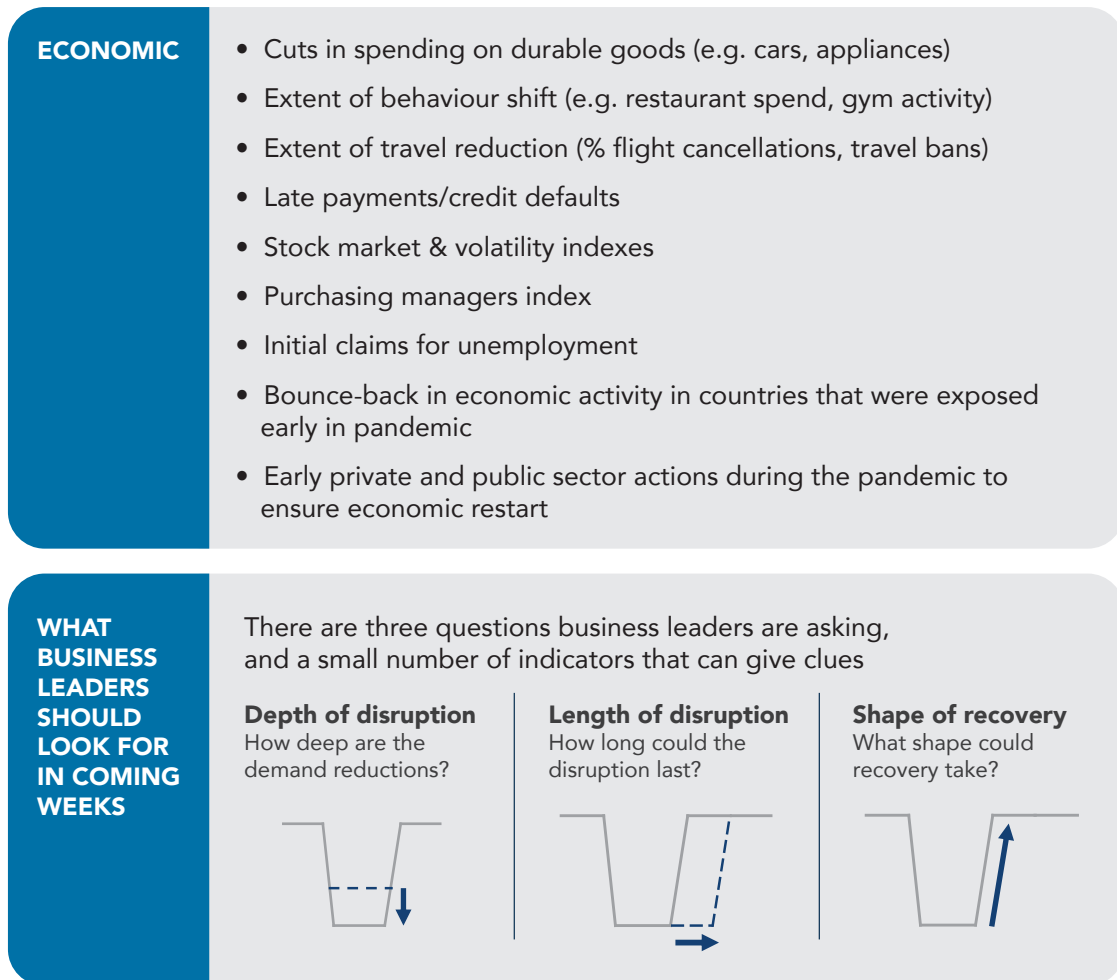


**Important levers of change are Ownership of value chain, Technology Push, Operating Flexibility and Variable Cost Models.**

Source: KMPG Report on Impact on Indian Economy, 2020

The current COVID-19 pandemic is Global but the solutions to the challenges have to be Local. It is crucial that we urgently rethink, refocus our priorities and plan fundamental changes in the way we do business and support economy. **Self-reliance will be the new mantra.** Some factors that are affecting the recovery are depicted in Fig 6.

**FIG 6: FACTORS CAUSING HINDRANCE IN POST COVID-19 RECOVERY**



Source: McKinsey & Company, April 2020

Recovery of Indian economy will depend upon adoption of appropriate measures e.g. Policy support to unconventional strategies, depth & breadth of foreign partnerships, leveraging international partnerships in important sectors like: agriculture (viz. partnership with Israeli companies), MSMEs (with German companies) and large manufacturing tie ups with US and Japan under Start up India etc. Planning ahead would warrant a detailed understanding of sector wise business imperatives, demand supply position, technology status in India, existing capacity, its further strengthening and initiatives (long term & short term).

This white paper captures sector specific strengths, market trends, opportunities, technology imperatives etc. in five (5) Sectors which are crucial to country’s perspective namely: Health, Manufacturing, ICT & Tele-medicines, Electronics, Agriculture & Food processing at a macro level. This report addresses issues primarily from a technology perspective.

#### 4.1 MEDICAL AND HEALTH (Pharma, Biogenetics, Diagnostics, Active Pharmaceutical Ingredient(API), Medical Devices and associated products)

Ensuring efficient affordable and accessible healthcare for all is crucial for country's economic growth and prosperity. Even though India has a broad based infrastructure in medical sector including pharma, vaccines, diagnostics, diagnostic kits/ devices etc, but it needs an enabling mechanism for wider outreach and faster response to emerging requirements.

##### 4.1.1 Indian Pharma Industry

Our country has a well established domestic pharmaceutical industry with a strong network of 3000 drug companies distributed over several thousands of manufacturing units. Out of these, 1,400 units are approved by World Health Organization (WHO) for having Good Manufacturing Practice (GMP); 1,105 have Europe's certificate of suitability (CEPs); more than 950 match Therapeutic Goods Administration (TGA) guidelines; and 584 sites are approved by the US Food and Drug Administration (USFDA). India is going ahead with efficacy trials of 30 different vaccines for Coronavirus, which are at different stages of development.

This industry has gained advantage due to the following reasons

- Low cost production capacity with focused target
- High economic growth and penetration of health insurance
- Conducive policy to support 100% FDI, resulted to cumulative FDI worth US\$16.39 billion
- Increasing private sector investment

##### Market Size & Character

The Indian pharmaceuticals market stood at Rs 1.39 Lakh Crore (US\$ 19.89 billion) as on November 2019.

- Indian pharmaceutical sector being largest segment of generic drug globally captured almost 71% of market share.
- Pharmaceutical exports from India, which include bulk drugs, intermediates, drug formulations, biological, Ayush & herbal products and surgicals reached US\$ 19.14 billion in FY19 and US\$ 10.8 billion in FY20 (up to November 2019).

- Important export destinations include: United Kingdom (US\$383.3 million), South Africa (US\$ 367.35 million), Russia (US\$ 283.33 million) and Nigeria (US\$ 255.89 million).
- India also has the expertise for Active Pharmaceutical Ingredients (APIs) and there lies significant opportunities for value-addition.
- India's biotechnology industry (comprising bio-pharmaceuticals, bio-services, bio-agriculture, bio-industry and bioinformatics) is expected to grow at an average growth rate of around 30% a year and reach US\$ 100 billion by 2025.

### Challenges

The industry is extremely fragmented with approximately 24,000 units in MSME's sector accounting for 70% of production by volume and 50% by value on ex-factory basis with an annual turnover of approximately Rs.60,000 crores which is an integral part of predominantly formulations. In spite of this, MSMEs contribute almost 50% to exports. The MSME-Pharma sector is facing many challenges as mentioned below:

- Lack of proper industrial infrastructure, capital, compliance with environmental laws, regulatory stringencies.
- Lack of awareness about regulatory compliance of stringent quality norms, ever changing technology in the drug making procedures, meeting international standards requirements.
- Lack of Venture Capital Funds.

### Future Potential

- Medicine spending in India is projected to grow 9-12% over the next five years (2020-2025), leading India to become one of the top 10 countries in terms of medicine spending.
- Alignment of product portfolio towards chronic therapies for diseases such as acute respiratory diseases, communicable/infectious diseases, cardiovascular, anti-diabetes, anti-depressants and anti-cancers that are on the rise.
- Introduction of generic drugs into the market including anti cancer, anti infectives, anti virals, Biogenerics and preventive vaccines.

The pandemic has brought several changes to the pharma sector which has opened up new opportunities as below (Table 4):

**TABLE 4: NEW OPPORTUNITIES IN THE PHARMA SECTOR**

Changes brought by Post COVID-19 world	Opportunities created in form of
Unstable and uncertain economy	Pharma R&D Outsourcing
Need of increased continuous research	
Need of research involving other sectors, especially new-age technologies (Data Analytics, Artificial Intelligence, etc)	
Faster decision making environment	Data Driven Smart Systems for Pharma; More consolidation within Indian MSMEs driven by technology
Cost effective production need	Generic drug market driven by Indian MSMEs
Increased fear of virus	Broader global market for existing vaccines and new market for new vaccines
Increased usage of vaccines	

## RECOMMENDATIONS

- GMP Compliance of SMEs : Quality Monitoring System (QMS)
- Development of clusters : Technology facilitation, process support
- New product baskets/ technology support from academic institutions
- Forward and backward integration capabilities, consolidation through mergers and acquisitions : co-marketing and licensing agreements
- Exploitation of core competency in production of drugs: anti infectives/ Peptides/etc/ Biologicals/ Bio Pharmaceuticals
- Prioritized production of 53 raw materials and APIs as part of its 'China-plus-one' policy to fill in supply gaps



#### 4.1.2 Indian Biopharma

- This sector is growing at a rate of around 12% and its total output is valued at over Rs.22,000 crore. New products which need to be developed include Interferons, Granulocyte-Macrophage colony-Stimulating Factor (GM-CSF), Blood Factor VIII, Herceptin, Oral Insulin, New Monoclonal Antibodies (more than 200 molecules are available globally).
- India also has the potential to become a net exporter of biosimilars of Insulin, Inteferons, mAbs (Monoclonal Antibodies) , Enbrel, Humira, Rituxan, etc. The existing Indian manufacturers should be facilitated to increase their capacity and develop new products in association with Indian Institutions and R&D Centres. Even FDI may be invited from South Korea, Japan and Europe. India can be a big playing field for Clinical studies in the process of drug validation, trials and equivalence studies.
- Even before COVID-19, there was a huge market for vaccines for BCG, Rota virus, Polio, swine-flu, dengue, rabies, hepatitis. The global vaccines market is projected to reach USD 58.4 billion by 2024 from USD 41.7 billion in 2019, at a CAGR of 7% during the forecast period (2017-24). The growth of vaccines market in Asia is due to high prevalence of infectious diseases. India currently exports about Rs 5,000 Cr (USD 50 billion) value of vaccines and about Rs 8,000 Cr (USD 80 billion) of other Biosimilars. This may be enhanced with governmental push at a rate of 15% CAGR.
- The COVID-19 pandemic has only given it a further big push. The race world over is towards developing a vaccine for corona virus. Needless to say that early players would be able to capture the market. India has also taken quick start with organizations like Zydus Cadilla, Serum Institute, Biological E, Bharat Biotech, Indian Immunologicals and Mynvax.

India finds itself in the cusp of a major transformation of global order, global economy and global supply lines. India should exploit this opportunity to quickly initiate policy support to facilitate ease of regulations for bulk drug manufacturers, building process efficiencies, and supporting manufacturers in the form of subsidy, low taxes and fiscal incentives.

A US\$ 33 billion opportunity, the pharmaceutical industry in India presents considerable potential for collaborative and outsourced R&D in drug development, biotechnology, chemicals, and manufacturing of medicinal products. India's Contract Research and Manufacturing Services (CRAMs) sector is globally recognized for its high-end research services and is one of the fastest growing segments of the country's pharmaceutical industry. The country has a low cost of production, low R&D costs, innovative scientific manpower, and a large number of national laboratories that have the potential to steer the industry ahead to a higher level.

### 4.1.3 Medical Devices and Associated Products

Outbreak of COVID-19 has provided immense opportunities for manufacturing of medical devices such as testing kits, ventilators and medical consumables (Masks, Personal Protection Equipments, Sanitizers). During COVID-19 pandemic, many of the academic institutions have collaborated with medical device companies to develop new medical technologies. Further, several non-medical equipment companies have converted their manufacturing facilities for producing ventilators, sanitizers and other equipments. This synergy shall be carried forward for future collaborations in the medical devices sector. In this section, the status of product development, its potential to contribute in Make in India programme for each of medical devices and its associated products are analyzed.

#### Future Research areas

- Medical equipment for cardiac catheterization, interventional radiology and general radiography applications. SmartSPOT - digital photospot system for ERCP, urology, GI
- AccuKnife for stereotactic radiosurgery and conformal radiotherapy
- Workstations with new disease-detecting technology that incorporates nuclear medicine and X-ray Tomography (CCT) allowing functional anatomical mapping.
- Magnetic Resonance (MRI) guided Focused Ultrasound (MRgFUS) devices focusing ultrasound energy and to destroy tumor cells inside the body
- Non-invasive vascular and Transcranial Doppler (TCD) systems for diagnosing and monitoring cerebral circulation. Automatic detection of embolism
- Development of Guided sensor attached to the biopsy needle or other interventional tool and to the ultrasound transducer and easy-to-read graphics on real-time ultrasound image, showing how to position the needle in three-dimensional space.
- Production of Liquid Crystal Glasses (LCG) : To function as an electronic shutter incorporated into the optical refractive lens. Applications in treatment of ocular disorders.
- Quantitative sensory testing (QST) devices for evaluation of the Central and Peripheral Nervous system. Applications include assessment of Pain caused by injury or disease

#### 4.1.3.1 Diagnostic Testing

Most of the diagnosis uses In Vitro Diagnostics (IVD), which comprises of molecular diagnostics as well as immunoassays. Molecular diagnostics uses real-time reverse transcriptase polymerase chain reaction (RT-PCR). Immunoassay is based on techniques such as Lateral Flow Immunoassay (LFIA), Enzyme linked immunosorbent assay (ELISA) and Chemiluminescence immunoassay (CLIA). Both are commonly used testing methods for diseases like COVID-19, TB, etc.

##### Demand Scenario - Global

- As per Market Data Forecast, the global market for IVD was USD 70.01 billion in 2019 and expected to grow to USD 91.93 billion by 2024, with a CAGR of 5.6%, in the pre COVID-19 scenario.
- The IVD market in the Asia-Pacific region in 2019 was USD 13.31 billion and the market would be USD 18.15 billion by 2024 with a CAGR of 6.4%.
- TechSci Research envisages that global market for corona virus diagnostics would be about USD 2.2 billion by 2025.
- The global medical device industry comprising of medical and diagnostics equipments, medical disposables, supplies and medical implants was USD 425.5 billion in 2018 and as per the estimate by Fortune Business Insights, the market would be around USD 612.7 billion by 2025.

##### Demand Scenario - India

- The medical device market in India was about USD 11 billion in 2019 and expected to reach USD 25 billion by 2025.
- As per Global Data, in 2019, the IVD market in India was about 21% of Asia-Pacific market. They have predicted a growth rate of 2.5% in the Indian IVD market, through 2025.

India imports about 80% of the medical devices, out of which 21% is from USA, 14% from Germany, 11% from Singapore, 10% from China and 7% from Netherlands. High end medical equipments for medical imaging, ultrasound scans, cancer diagnostics, PCR diagnostics etc. are mostly imported to India. Forecasts by global data indicate that medical devices market in India contributed about 13% of the Asia-Pacific market in 2019 and would grow at a CAGR of 7.5% through 2025.

## RECOMMENDATIONS

- Products using cutting edge technologies AI, big data, IoT & products to be harnessed for outreach, accessibility & accuracy
  - Handheld Aptamer-based diagnostic device,
  - Recombinase aided amplification (RAA) assay,
  - Smartphone-based point-of-care (POC) electrochemical test,
  - Detection with optical biosensor nanotechnology,
  - Detection based on changes in sound patterns - speech, breathing and coughing
- Tele-medicine to be leveraged to provide accessibility
- Domestic manufacturing to be promoted vigorously with major thrust on MSMEs

### 4.1.3.2 Medical Ventilators

As per estimates, a traditional ventilator costs approximately Rs. 4 – 5 lakhs and there are around 40,000 - 45,000 ventilators available in the country. The number is far less considering the number of ICU beds available in the country. Most of the high end ventilators are being imported. China is the manufacturing hub supplying around 20% of the world ventilator demand. During the pandemic, the need for ventilators has grown substantially in the country with projected requirement between 1,50,000-1,70,000 units.

Critical sub-components like: Blowers/ Turbine modules, Alarm units, Medical displays & Medical grade batteries etc are largely import-dependent and hence establishing a proper indigenous manufacturing and supply chain base is necessary.

There is acute shortage of Flow Sensors world-wide and in absence of that, volume control mode of operation is not possible to implement. The HLL guidelines as per the Gol committee recommend both pressure and volume as mandatory. However in cases of acute emergency ventilators having only pressure control mode may also be allowed. It has been reported that Canada and UK have come up with emergency ventilators having such flexibility in specifications.

India's ventilator manufacturing capacity was around 2500 units per month during pre-COVID-19 and it has been planned to further increase the capacity to around 50,000 ventilators per month by May 2020. Many Indian manufacturers are in the process of designing and making ventilators keeping in mind the requirement of Tier2/Tier 3 cities which can operate even in the absence of hospital Oxygen/Medical Air line connection and can be run on solar power, mechanical hand cranked, etc.

## RECOMMENDATIONS

## for Efficient, Affordable and Accessible healthcare

- Guidelines to be reoriented as per requirements
- Design & functional modification to suit varied requirements.
- Production of low cost broad range of Ventilators- Critical Care: Neo-natal, Paediatric and Adult, Transport Emergency Medical Services, Anesthesia, Bi-PAP & C-PAP, Oxygen concentrator, Respiratory Humidifying Equipment etc.
- Facilitate and enable entrepreneurs and MSMEs to set up production units on licence sharing and joint ventures. Guidelines to be reoriented as per requirements

## 4.1.3.3 Face Masks and PPE

Personal Protection Equipment (PPE) including Coverall/gowns, gloves, goggles, face masks etc form a very essential shield in fighting this pandemic for self protection as well as prevention of further spread.

## Demand Scenario

- It is estimated that the global market of masks is around 4581.9 million USD in 2020. This is further expected to grow at around 24 % and reach USD 21,210 by 2026.
- The PPE global market is estimated at 50.9 billion USD and expected to grow at 6.6 % till 2027. The pandemic has pushed up the demand dramatically.
- India needs 2 million PPE suits along with approximately 2 million coveralls and goggles.
- Requirement of masks have been estimated to be around 4 million – N-95 category- and 2 million gloves (nitrile). Around 2 million three layer masks along with 6 lakhs of face shields are required. India has resorted to imports to meet the sudden surge in demand while at the same time augmenting its own infrastructure.
- India has increased its production of PPEs from 30,000 to 50,000 and it is expected that several lakh units would be produced to meet domestic requirements.

## RECOMMENDATIONS

to meet new Global hygiene norm

- Establish manufacturing infrastructure for high end masks using technologies: nano fibers, multi ply, coatings of silver nitrate and titanium dioxide, bio-polymer coated, etc( Fast evaluation and validation)
- Distributed manufacturing of masks throughout India ( MSME Sector): Promotion of society level distribution and sale through dispensers
- Capture the Global PPE market ( Enhanced production of such kits) : Economy of scale

## 4.1.3.4 Sanitizers

Alcohol-based hand sanitiser kills many types of viruses by dissolving their fat membranes and it kills bacteria by disrupting its cell membrane. Several types of sanitizers are available in the market including alcohol based (ethanol or isopropyl – atleast 60%), Chlorine based (cetrimonium /chlorhexidine), ammonia based (benzalkonium chloride/ benzethonium), Iodine/Silver based, Essential oil based (clove, cinnamon, and thymol), Triclosan based, etc. Other forms of hand sanitizers also use antiseptic disinfectant.

## Demand Scenario

- Post pandemic worldwide, the demand for sanitisers has gone up to 2.9 Billion Litres (BL) per month i.e. ~ 35 BL per annum.
- In India, hand sanitizers, hitherto considered a premium segment, has been a small volume product with a market of around Rs 110 crore and growing at the rate of 15% per annum.
- In countries across the world like USA, Italy, UK etc, the demand has shot up exponentially.

## RECOMMENDATIONS

to meet new Global hygiene norm: quick sanitation of large areas

- Establish production centers using new technologies: hypochlorous acid-generating units, electrostatic application systems etc
- Commercialize domestic technologies: scanner like portable device, sanitization chamber, nasal gel etc.
- Promote disaggregated manufacturing pan India.

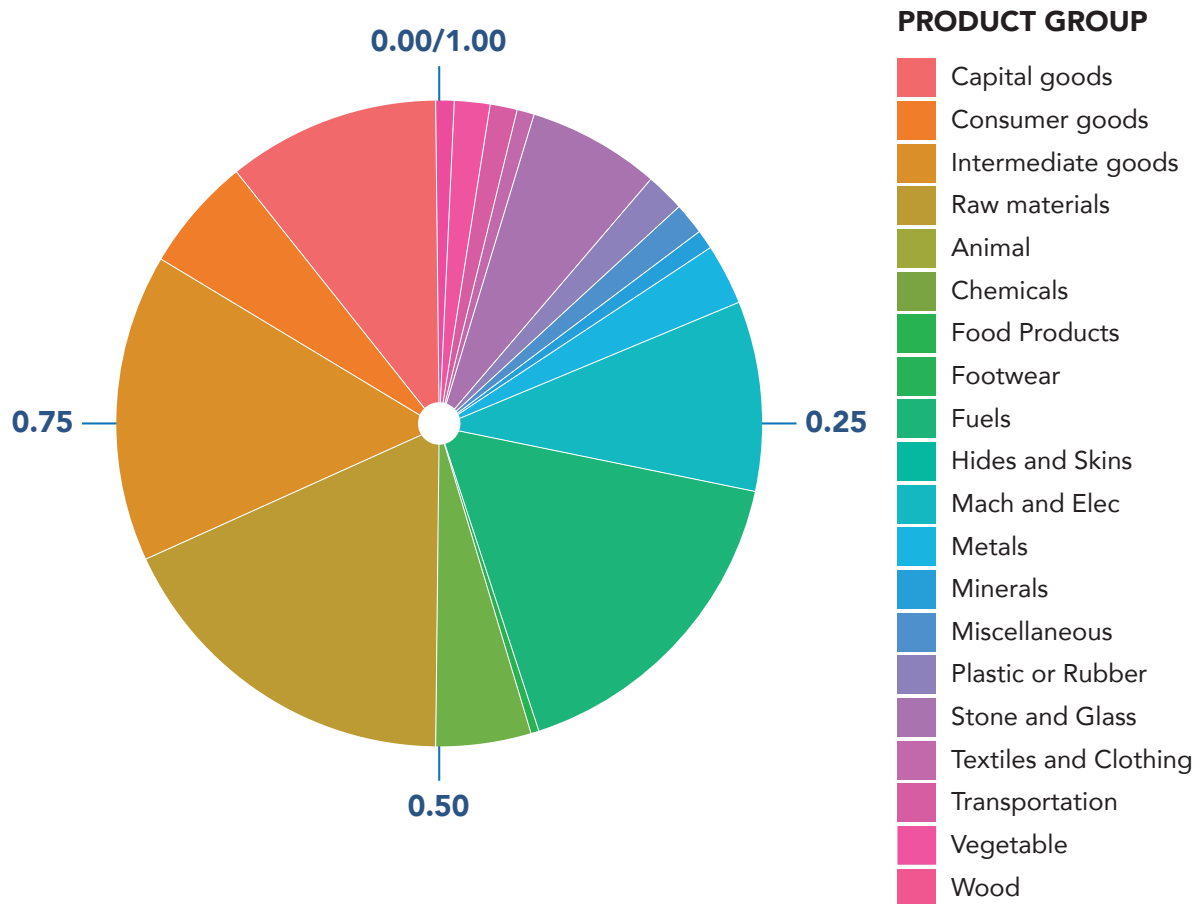


## 4.2 MACHINERY & MANUFACTURING (Machines, Auto, Textile, Solar Panels etc.)

### 4.2.1 Machinery

The machinery sector is of strategic importance to the Indian economy and forms the backbone of the Indian manufacturing industry. China occupies a lion's share in machinery manufacturing sector with around 20 % of global production. India has significant dependence on imports in the machines and electronics (~18%), fuels (~16%), capital goods (~11%) sectors. These include machines for infrastructure development as well as for supporting manufacturing industries, automotive and textile industries etc. The country also needs to develop competency in emerging areas such as battery and photovoltaic cell manufacturing. Share of different components in export is depicted in Fig 7.

FIG 7: SHARE OF IMPORTS OF DIFFERENT COMPONENTS



Source: WITS, 2020

The resultant regressive globalization and supply chain disruptions, post COVID-19, has given India an opportunity to position itself as an alternate global manufacturing hub. Some target segments are:

- Critical Equipments / Machinery which are being imported from China.
- Raw Material sourcing from China or Eastern Europe in areas of renewable energy e.g semiconductors, inverters, photovoltaic cells etc.
- Cutting, Drilling CNC and Robotic machinery used for Component manufacturing in Indian Railways and Infrastructure sector.

American, European and Japanese manufacturers are already planning for exiting China and India could be a cost-effective manufacturing alternative. India's Broad based Labor force, 519 million, only second to China's 783 million is a big enabling factor. However, to set up a Global manufacturing base, India needs to invest in following areas:

- **Robust Infrastructure:** Assured power supply, efficient port and road operations and greater ease in custom clearance.
- **Support Base System:** Move away from input / raw material base system & be a part of the supply/ value added chain.

An analysis of the existing opportunities, target segments (import substitution) are summed up in Table 5.

TABLE 5: SEGMENT AND PRODUCT AREAS FOR INDIA TO INVEST

Metal & Infrastructure/ Equipment / Products	Global and India Products / Industries served	Setting foot in India
Metal cutting technologies for Plasma and laser based cutting	<ul style="list-style-type: none"> <li>Railway bogie under frames, Fiat Body, Bio Toilets, Metro coaches.</li> <li>Pre Engineering Buildings &amp; Sheds.</li> <li>Panels and formworks for Station Buildings, Control rooms.</li> <li>Formwork for tunnels and sub structures.</li> <li>Bus and truck bodies and frames.</li> <li>Make in India items for Aerospace and Defence artillery.</li> </ul>	<ul style="list-style-type: none"> <li>Using Indian bases in MSME segments in Pune , Chennai.</li> <li>Developing the western borders of the country and the available ports to import major components from abroad</li> </ul>
Welding and Drilling Machinery, Multiple Axis and Two Axis Spindle Drilling, Machining Shops etc.	<ul style="list-style-type: none"> <li>Super structure Bridges for Bullet Train Projects, rapid rail projects, expressways and elevated corridors.</li> <li>Railway bogie under frames</li> <li>Pre Engineering Buildings &amp; Sheds.</li> <li>Critical Design trusses for Airports and Exhibition centres</li> <li>Framework for tunnels and sub structures</li> </ul>	Developing the western borders of the country and the available ports to import major components from abroad
Tunnel Boring Machines	<ul style="list-style-type: none"> <li>Long stretch tunnels in Mountain terrains.</li> <li>Sub terrain tunnels for metro railway and underpasses for city traffic.</li> </ul>	<ul style="list-style-type: none"> <li>None available in India as critical expertise is involved in same.</li> <li>However, technologies from Norway, Sweden, Austria can be brought to India and developed.</li> </ul>
Cold Forming Machinery for Solar Industry and Infrastructure	<ul style="list-style-type: none"> <li>Purlins for Solar module mounted structures.</li> <li>Purlins for building structures.</li> <li>W beam road guards for multiple lane expressways</li> </ul>	India has a large MSME base for component manufacturing. Rollers for these machines use a hard grade steel alloy which is usually imported from China. Taiwan is an alternate base for similar and better technologies than China.

## 4.2.2 Automotive Sector

Indian auto industry is at critical juncture due to varied factors, which include a dip in the sale of passenger cars, roll out of the BS VI emission norms (which is equivalent to Euro VI), a set of new safety norms and the Government's plan for a major shift towards electric mobility. The new safety regulations would increase the component intensity of the vehicles including Antilock braking systems (ABS), airbags, sensors for seat belt reminders, reverse parking sensors, speed limit reminders and a manual override switch for central locking systems. There are opportunities for industry manufacturers to raise competency level to manufacture BS-VI components.

As per the Automotive Mission Plan 2026, the Indian auto industry, including both vehicle and component industry, can potentially scale up export to the extent of 35-40% , which would further increase the import intensity of electronics . This calls for self-reliance and *"the enhancement of the value of engineering and design in making of vehicles and components"*.

A study by ACMA has identified export opportunities to the tune of US\$ 20 billion to OEMs in China for the components manufactured in India. Out of this, components such as piston, con rods and other small engine hardware, cam and crank shafts, lighting and signalling equipment, shock absorbers etc have addressable opportunity to the tune of about US\$ 7.5 billion.

There is significant dependence on import from China for battery, motor and electronics. China produces Rare earth materials –95% of total global production. **India's ambitious plan of 'Make in India' of lithium ion battery will largely depend on adequate supply of lithium.** In such scenario, **Lithium recycling would become crucial.**

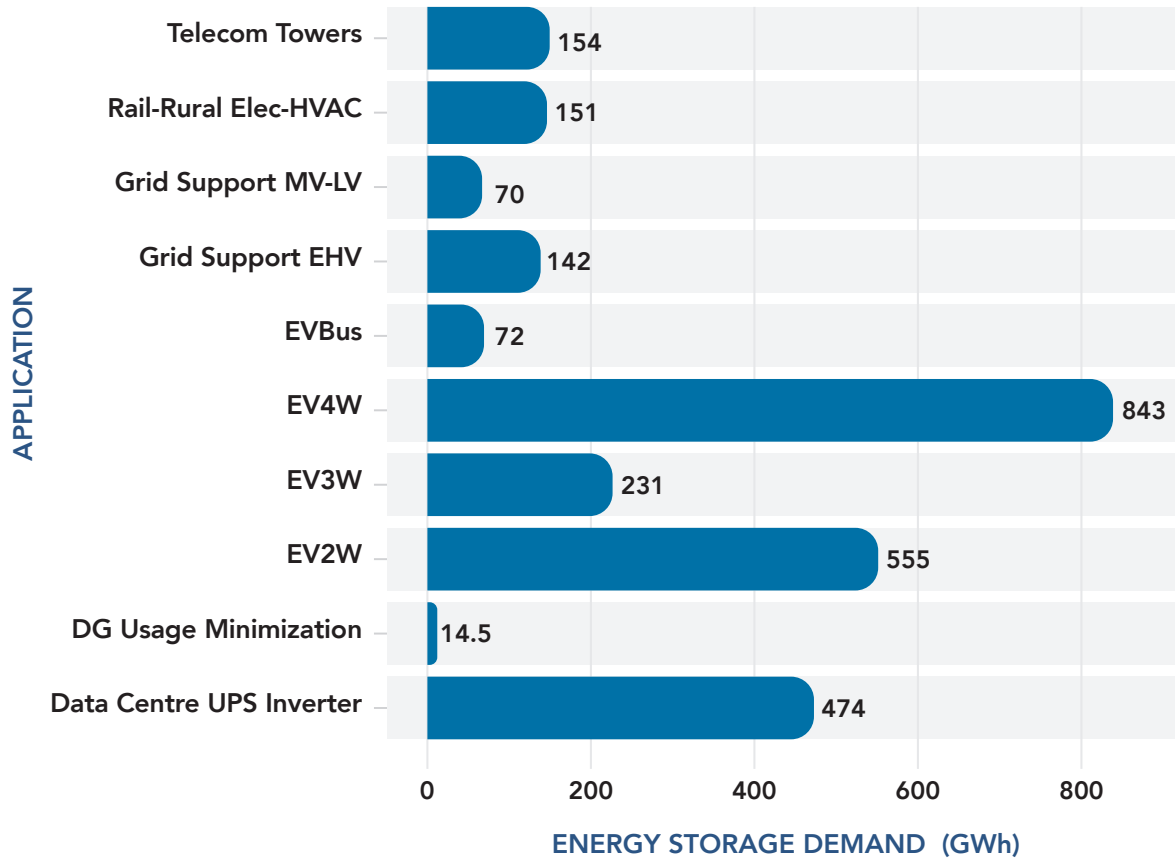
### Global Trends

Efforts on low carbon and low emission pathways and Euro VI require improvements in engine combustion and calibration, increased injection and cylinder pressures, NOx and PM after treatment solutions. Advanced DPF for diesel vehicles, EGR and SCR technologies could be used for reduction of NOx emission. On Board Diagnostics (OBD) is a must for the vehicle and more electronic controllers are being used in vehicles. The auto component and OEMs have started adopting technologies that promote lightweight materials such as aluminum.

### 4.2.3 Battery and Super capacitor

A study by India Smart Grid Forum (ISGF) and India Energy Storage Alliance (IESA) has projected the demand for energy storage systems in various applications in the year 2032 as below (Fig 8):

**FIG.8: PROJECTED ENERGY STORAGE REQUIREMENT IN 2032**



Source: ISGF; Energy Storage System - Roadmap for India: 2019-2032

It is noted that there is a big shift towards electrochemical storage devices, particularly lithium ion battery. Most of the lithium ion batteries for consumer electronics, mobile phones as well as electric vehicles are being imported from China, South Korea etc. Lithium is mainly available in Australia, South American countries, China etc. and most of the production is accessible to companies from China, South Korea and some other countries. It is desirable that India develops indigenous energy storage supply chain.

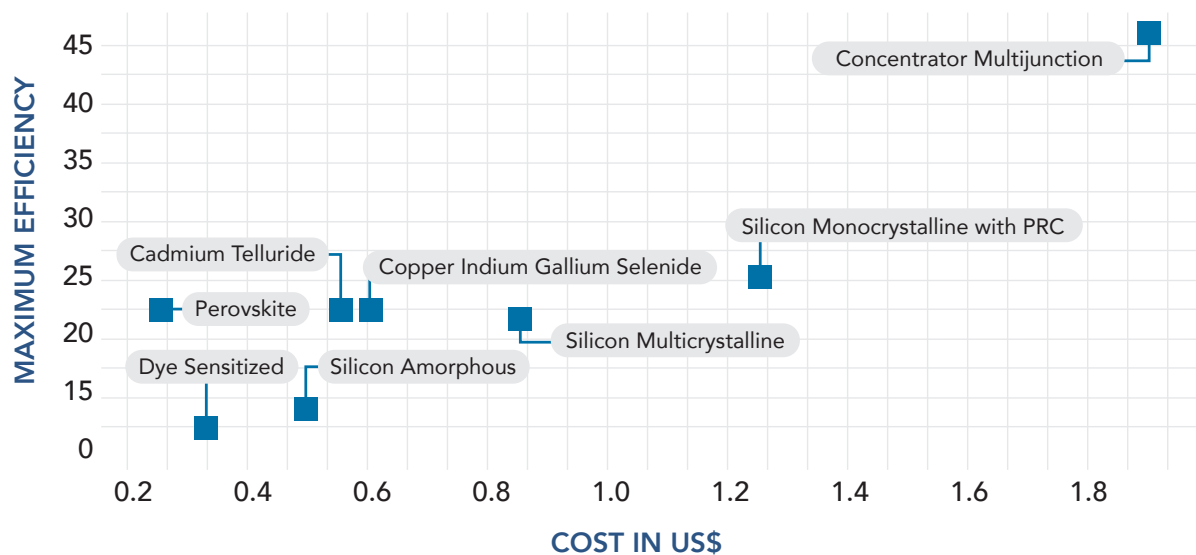
Solid State Lithium ion battery is under development to achieve higher safety, thermal tolerance and specific energy. Other emerging battery chemistry includes sodium ion, aluminum air, zinc-air, redox flow battery etc. Also, Supercapacitor with characteristic like fast charging and thermal stability, may even be used in on-board energy storage system of electric vehicles : trains, trams, GPS, portable media players, laptops, mobile devices etc.

#### 4.2.4 Solar Photovoltaics

The Government of India targets to develop solar PV capacity of 175 GW by 2022 with annual capacity of 20 GW.

Solar PV manufacturing value chain includes silicon production, wafers, solar cell, modules and panels. India has installed solar cells manufacturing capacity of 3 GW/year and solar PV modules capacity of around 10 GW/year. (Source: MNRE). There are no manufacturers for polysilicon/ ingots/ wafers in India at present. More than 80% of the capacity addition is made by importing solar cells and modules from countries like China, Malaysia, Taiwan, Singapore etc. Total import of solar PV cells (assembled or not) in the year 2018-19 was more than Rs.24720 crores. COVID-19 is bound to hit the supply and this would emphatically underline the need for enhancing domestic manufacture of solar cells and modules. Further, domestic manufacturing can save US\$ 42 billion in equipment imports by 2030.

FIG 9: VARIOUS SOLAR PV CELL TECHNOLOGIES



#### Global Trends

Improvement of energy efficiency and reduction of cost have been the major driving forces for R&D activities on solar photovoltaic cells (Fig 9). Mono-crystalline solar cell with PERC technology gives higher efficiency than present multi-crystalline technology. Some of the manufacturers in India are able to manufacture mono PERC solar PV modules.

For Higher efficiency: (a) use of photoluminescence materials: higher energy capture  
(b) using multiple cells stacked into a single device to capture a broader spectrum of solar radiation.

#### 4.2.5 Textile Sector

The textile manufacturing activity covers both spinning, weaving and allied machinery. Scope for import substitution exists in the technical textiles industry. Indian textile industry depends mainly on cotton. Most of the synthetic raw materials for synthetics like PTA, PSF, PFY, acrylic fibers, etc. are imported and expensive because of high customs and anti-dumping duties on raw materials. COVID-19 brings the following challenges and opportunities for the Indian textile sector (Table 6):

**TABLE 6: CHALLENGES AND OPPORTUNITIES FOR THE INDIAN TEXTILE SECTOR**

Changes brought by Post COVID-19 world	Opportunities created for Stake holders
Unstable and Uncertain Economy (opens door for new ecosystems)	Creation of new markets for technical textiles
More respect for protocols (effectively increasing usage of protective gears etc)	
Increased fear of safety	

Most of the garment manufacturers operate at small scale. There would be cascading effects on the suppliers of this industry, such as the fabrics and zipper manufacturers. As the industry recovers, there would be an ample opportunity of enhancing export market share as some of the key competitors such as China may lose part of their shares.



## KEY RECOMMENDATIONS

**Machinery**

- Enhanced production of competitive capital goods (CG) : ensuring parity of import duties with domestic duties, providing incentives etc
- Creating *Integrated Industrial Infrastructure Facilities* popularly known as Machine Tool Parks (for High end Machines)
- Create a 'Start-up Centre' with support from the Department of Heavy Industries and Institute of Research & Collaborations with European Industry
- Manufacturing hub in transformers, IGBT, Control Panels, inverters for motors, drives and power sources, cutting , drilling equipment, robotics

**Automobiles**

- For electric mobility, utilization of domestic reserve of rare earth : processing of rare earth materials, development of rare earth permanent magnets and development of permanent magnet motors
- Development of alternative technologies for lithium ion batteries such as Sodium ion battery, aluminum air battery, Super-capacitor, etc
- Wide band-gap semiconductors such as GaN or SiC for power electronics solutions for electric mobility
- Automation and Digitalization in vehicle and component design to leverage IoT capabilities in gear, steering , braking system etc.( MSME In collaboration with big industries)

**Solar Photovoltaics**

- Focus on solar PV cell manufacturing, starting from semiconductor fabrication
- Solar projects/ parks on engineering, procurement, and construction (EPC) basis of modules, cells and ancillary equipment like backsheets, glass, inverters, transformers and cables so as to cater to entire ecosystem of renewable energy

### Textiles

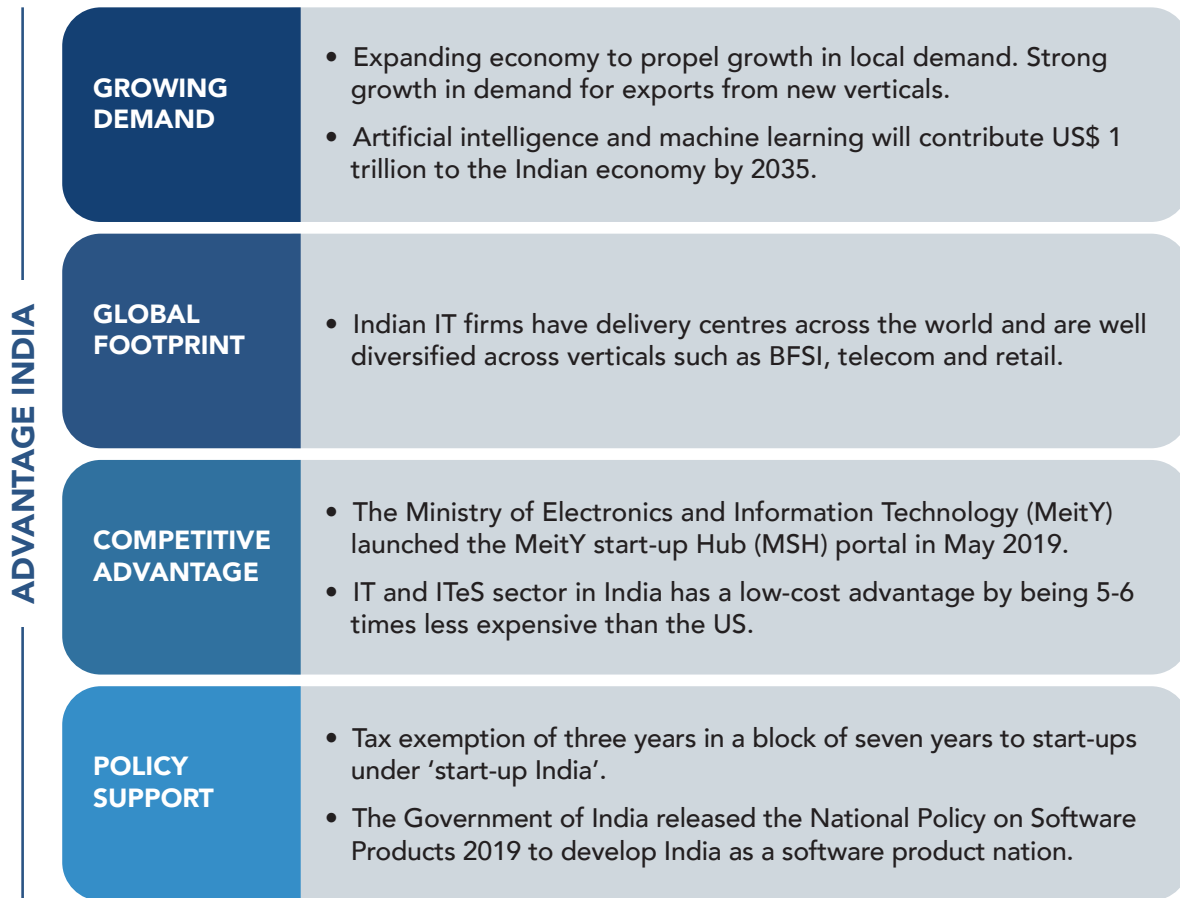
- High-speed looms Design development
- Make more factories FFI compliant w.r.t international standards and giving support through special schemes such as Textile Upgradation Fund (TUF)
- Thrust areas of Technical textiles (e.g. Agrotech, Protech, Meditech and Mobiltech).
- Specialized coating and lamination for the fabrics: add value to the fabrics by imparting special fabric surface properties like fire retardant, anti-microbial, easy-care etc.
- Design and Availability of local Jacquard for designing
- Development of Good eco friendly dyes/ mordants
- Machine development for producing 3D fabrics, nonwovens, ink jet printing and plasma processing & finishing

## 4.3 INFORMATION & COMMUNICATION TECHNOLOGY

ICT sector in India contributes about 8% to the GDP. The recent proposal of NITI Aayog to set-up ICT Commission envisioned India's share in global ICT market about 5% (up from current 0.2%) with the potential of revenue about Rs 7 Lakh Crore from global market in 10 years. It is about 25% of current annual budget. The Industry could enhance its capacity on supply side as the most of the task could be performed from home and more qualified people could be engaged. The challenges in this sector are on demand side due to project delays, deferment of new projects and global stagflation.

The basic supporting technologies for sustainable and robust ICT infrastructure and its enabling platform are Cyber Security, Internet (High speed broadband connectivity, stability and ubiquitous coverage, may be through 4G, 5G and broadband), Cloud to store huge data, indigenous simulation model for big data analytics, Artificial Intelligence and its technologies. ICT sector would play a significant role in uplifting the economy of the world.

FIG 10: ADVANTAGES OF INDIAN ICT SECTOR



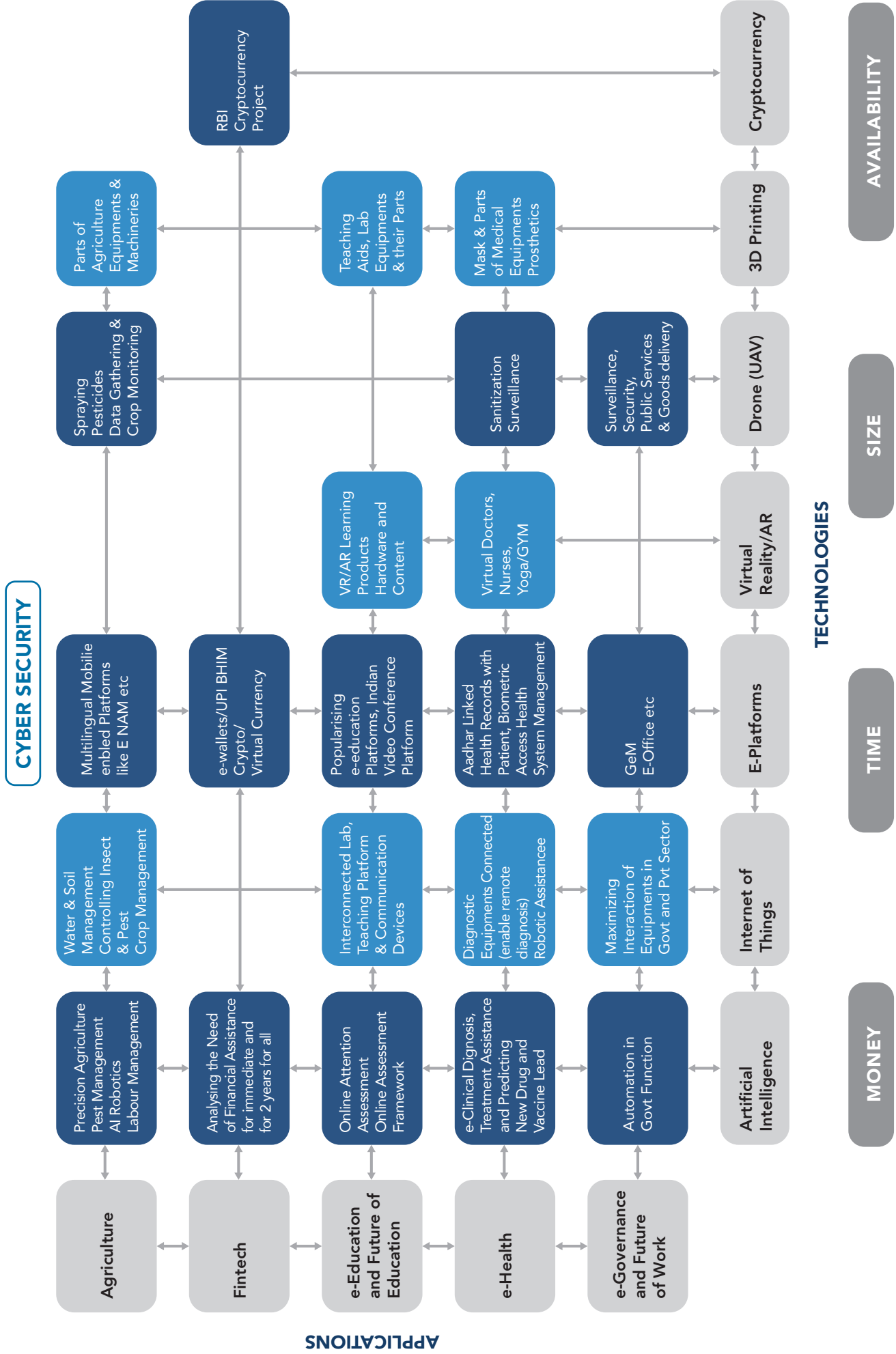
Note: BFSI - Banking, Financial Services and Insurance

Source: [www.ibef.org](http://www.ibef.org), Jan 2020

India leads the IT economy of the world, accounting for approximately 55% market share of the US\$ 185-190 billion business in 2017-18. Indian IT companies have set up over 1,000 global delivery centres in about 80 countries across the world. India has become the leader in the digital capabilities of the world with around 75% of global digital talent present in the country. The notable achievements are :

1. Total export revenue of the industry is expected to grow 8.3% year-on-year to US\$ 136 billion in FY19
2. NASSCOM launched an online platform which aims at upskilling of over 2 million technology professionals and skilling another 2 million potential employees and students
3. Private Equity (PE) investments in the sector stood at US\$ 2,400 million in Q4 2018

FIG 11: TECHNOLOGY-WISE ANALYSIS IN ALL 5 AREAS OF ICT APPLICATIONS



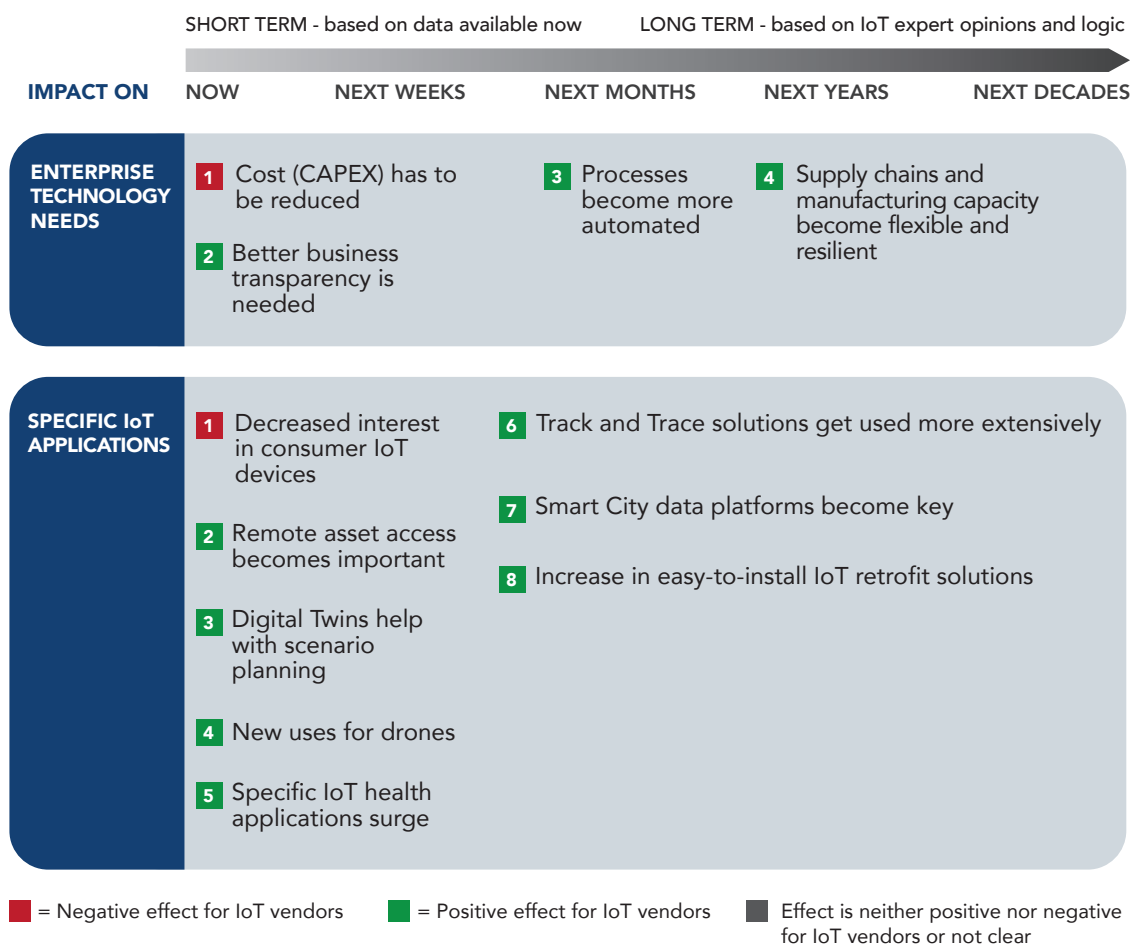
Affordable and Ubiquitous High Speed Internet with Large Cloud Infrastructure as a Base

Three important areas of ICT i.e. Internet of Things (IoT), Artificial Intelligence (AI) and Cyber Security are mentioned in detail below:

### Internet of Things

With the objective of making technology infrastructure with M2M (Machine to Machine communication) in distant mode operations, India would require full automation; and deployment of vast array of technologies specially wireless communication, AI, embedded devices and IoT.

**FIG 12: IMPACT OF COVID-19 ON IoT**



Source: Adapted from IoT Analytics 2020

## Artificial Intelligence

AI would play a significant role in the identified sectors (Fig. 11). India needs to invest in mitigating following challenges to fast track AI Development and AI enabled services for India and the world in post COVID-19 era:

- Cost effective high computational power for handling data analysis etc.
- Standardization for interfaces and interoperability for seamless connectivity
- Cloud infrastructure for data storage.

Domestic and foreign collaboration of Industry, academia and R&D institutes alongside skill development in areas like high tech industry, telecommunication, automotive and financial services had high AI adoption rate in pre-COVID-19 era but two major sectors i.e. health care and education still need to have high adoption rate of AI in post COVID-19 era. Other sectors where AI need to be deployed are travel and tourism which has very low rate of adoption, may be in the form VR/AR assisted by AI as an alternative to present form of tourism. Energy and resources, retail, professional services could be as usual progression whereas there may be decline in use of AI in transportation and traditional logistics sector (Table 7).

## Cyber Security

Use of cyber security for artificial intelligence, deep data intelligence, machine learning, blockchain, cryptography and encryption, quantum key distribution, behavior detection for endpoint security. This ecosystem should refocus and evolve/ deploy technologies to handle enhanced and altered cyber threat perception. Table 8 depicts a glimpse of components related to cyber security covering market status and projections for 2022 for different sectors.

**TABLE 7: CYBER SECURITY IN INDIA POST COVID-19**

S. No.	Key Sectors	Market Status (Spending in 2019 in USD Million)	Normal Projections for 2022 (Spending in 2019 in USD Million)	Post COVID-19
1.	Banking and Financial Service Industry (BFSI)	518	810	Digital transaction has increased considerably and increased financial volatility would further fuel the need of ramping up the cyber security and further fuel the growth.

S. No.	Key Sectors	Market Status (Spending in 2019 in USD Million)	Normal Projections for 2022 (Spending in 2019 in USD Million)	Post COVID-19
2.	IT and IT enabled Services (ITeS)	434	713	With estimated about 1.5 networked devices per individual, increased utilisation of these services would enhance cyber attack.
3.	Government	395	581	Changing geopolitical situation arising out of COVID-19 would fuel the demand to deal with state actors (foreign government induced) threat perception, Example: Use of zoom app and data security threat, enhancing Teleworking would seek higher expenditure.
4.	Health Care and Energy	630	949	Health sector has witnessed unprecedented challenges due to COVID-19 and seeking stronger shield from cyber threat. Government seeking centralized health data, Ayushman Bharat scheme to deal with Digital Information Security in Healthcare Act.
Total		1977	3053	

Data Source: Study of PwC and Data Security Council India (December 2019)



## RECOMMENDATIONS

India needs to adopt ICT related technologies mentioned as below:

- Seamless health care delivery system and standard platforms: such as Telemedicine, E-medical Records, IoT enabled healthcare equipments for testing, diagnostic, therapeutic and clinical monitoring
- Agricultural Processes : Use of Drones / IoT for development of Agri Stations in Districts
- Fin Tech: Use of E-wallet/ UPI BHIM/ Crypto-currency/virtual currency
- E-education: Use of AR/VR, online learning platforms, installation and use of low cost Indian educational cloud.
- Low cost bandwidth for broadband connectivity
- Detection and delivery: Robots & Drones/ Machine learning enabled diagnosis
- Development of low cost Drones and Robots equipped with GPS, cameras, and other equipment/ IoT sensors
- Use of cyber security for artificial intelligence, deep data intelligence, machine learning, blockchain, cryptography and encryption, quantum key distribution, behavior detection for endpoint security.

### Implementation Strategy

- Technology Excellence Centres (On the lines of NitiAyog-Mckinsey) to be opened in all the Universities and Technical Institutions of Repute (recently designated list) alongwith the national / global technology companies. Private companies' investment will be incentivised in the form of day-1 recruitment from the campus, academic research & consulting etc. Government funding to the institution should be mapped to number of patents (categorized under without and with commercialization).
- "Single Health Highway" (Connecting Primary Health Centres, District Hospitals upto AIIMS) and all privately managed care & treatment platforms to be digitally integrated. Government needs to have the data on disease pattern, treatment modelling, spend efficacy and other related details.

- Large value tenders to consortium of companies by the government to manufacture technologies required to support the mammoth networks and infrastructure needed to support the ICT era. It will entail 4G/5G technologies, Cloud technologies, Digital Storage etc.
- Education – Potentially one of the largest opportunity to translate India's behemoth education system producing low-skilled graduates into a high-quality & skilled resources at school and college level using Online learning platforms, AI-enabled assessment models (for teachers and students) and outcome-pegged incentives. AR/VR based simulation will provide scenarios to the policy makers to pool in broader set of tools to make education adaptive and industry-oriented.
- Financial inclusion – Depth of financial inclusion to be enhanced using digital currency supported by BHIM (in limited circuit to begin with) and other government-anchored tools. Initiative, in on Fintech using blockchain and cybersecurity would develop a huge network of beneficiaries with their track record of financial dependence. Issues of solvency and liquidity can be monitored.
- Agritech – Agri Universities and KVCs (Krishi Vigyan Kendra) need to be trained in the usage of IoT, Drone technology, Micro-weather systems, Refrigerated Seed Banks and various post-harvest and online pricing techniques (Futures etc.) and need to become the Agri Excellence Centres.
- SMEs – Application of full-suite from workflow automation to Deep-Learning/ AI-led algorithm, supply-chain optimization technology, adaptive flexi-design, warehousing & safekeeping techniques and transitioning to the next-phase are the important areas for the SMEs
- Technology officers at district level to be Digital Mobility Custodians - The local hub of administering TECs, Health Highway and Education's ICT platform. TECs (in conjunction with incubation centres) is the biggest potential boost SMEs can expect.

#### 4.4 ELECTRONICS

The electronics sector in India has been witnessing steady growth, and this is poised to grow further. A study by ASSOCHAM and PWC predicts that India will have 859 million smart phone users by 2022.

Emergence of 4G/LTE networks and the Internet of Things (IoT), coupled with government initiatives like Digital India, Smart Cities, wider broadband connectivity, rural electrification and e-governance programs will ignite the demand for electronics components further.

Currently, India's electronics sector contributes the most to India's trade deficit after oil.

From the year 2000-01 to 2014-15, the total production of electronics in India was Rs 13.83 lakh crores cumulative, out of which electronic components produced were Rs 2.3 lakh crores, while electronics used for end use constituted approximately Rs 8.5 lakh crores. This does not include the data of strategic electronics.

To understand more on what this sector needs, let us have a look at some production, export and import numbers.

**TABLE 8: ELECTRONIC GOODS PRODUCTION, IMPORT AND EXPORT**

	Produced by India	Exported by India	Imported by India from China PRC and Hong Kong	Ratio between Imported from China to Produced in India
Consumer Electronics	73.5	2	14.4	0.1959
Electronics Instruments	54.5	7.5	15.9	0.2917
Electronics Components	59.1	1.6	34.1	0.5770

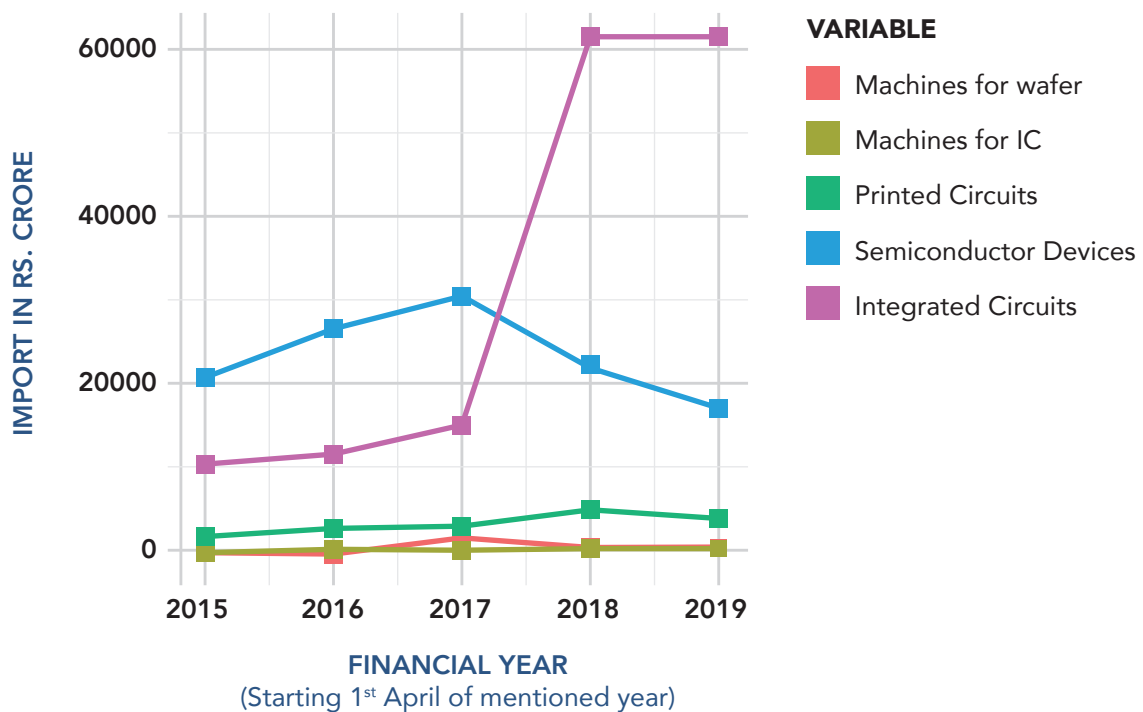
*Data from 2017-18 (Source: Ministry of Statistics and Programme Implementation; extrapolation where data was not available); All values (except ratio) in INR '000 Crores*

It is clear that India has had a large dependency for electronics components on China. The data shows that the dependency is so high that much of the production of consumer electronics in India is a function of the import of required electronic components from China.

This needs to be seen with the context that electronic components sub-sector also drives the consumer electronics and electronics instruments sub-sectors, by being the feeder to these sectors. The lower import for consumer electronics shows India’s capabilities for end user products, that is driven by competency in system integration, packaging, and final production.

This high dependency also creates a new opportunity for India in the post-COVID world, that will lead to reverse globalization.

**FIG 13: IMPORT OF ELECTRONIC INDUSTRY INPUTS**



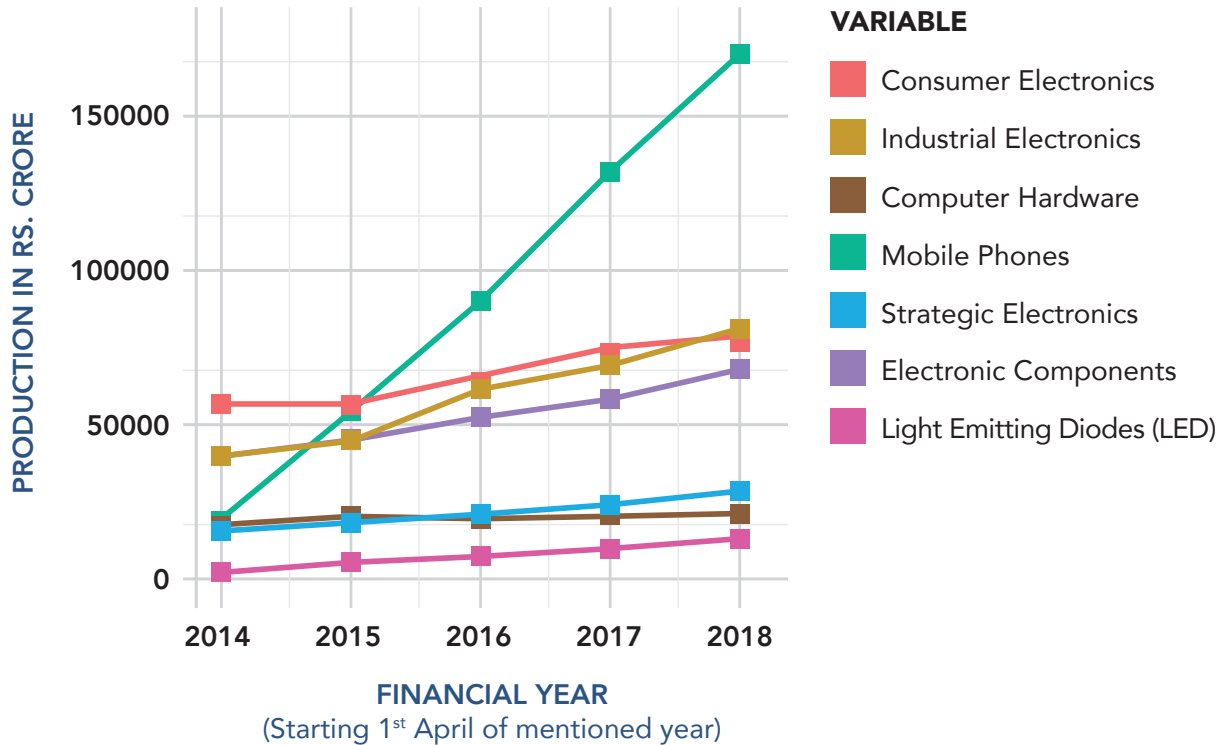
Source: Ministry of Commerce (Data for 2019-20 is till January 2020)

As per the estimates of the Ministry of Electronics and Information Technology, the demand for Electronics System Design and Manufacturing (ESDM) may reach US\$ 400 billion by the year 2025.

India’s electronics imports touched a record US\$55.6 billion in FY19, against US\$51.5 billion the year before.

Integrated Circuits is an item whose need has jumped since the past few years. Also, the import for semiconductor devices is very high.

FIG 14: PRODUCTION TRENDS IN INDIAN ELECTRONIC SECTOR



Source: Annual Report, Min. of Electronics and Inf. Technology

Indian industry manufactures passive electronic components. Focus is mainly on assembling and testing work.

Share of imports is higher for specialized and precision components in electronics. (70: 30).

Import from China, Japan, Taiwan, South Korea, and some European countries. The Mobile phone segment, in which import of completely built in units (CBUs) has given way to local assembly/ manufacturing with components purchased from overseas.

No domestic manufacturing of semiconductors, which form about 30% of the cost of the electronic product/system. Leading semiconductor companies such as ARM, Qualcomm, Intel, Cadence and Texas Instruments etc. have established design and software development infrastructure in India.

SITAR in Bengaluru and Semiconductor Laboratory in Chandigarh manufacture silicon chips for strategic purposes like defence and space.

TABLE 9: INDIAN COMPETENCY IN ELECTRONICS VALUE CHAIN

Manufacturing Phase	Design	Manufacturing/ Production	Equipment Manufacturing	Testing Equipment
Silicon Material Production	No	No	No	No
Silicon wafers	No	No	No	No
Silicon Die Manufacturing	No	No	No	No
Integrated Circuits	Yes	No	No	No
PCB Manufacturing	Yes	No	No	No
Packaging Components	Yes	Yes	Limited	No
Discrete Components	Yes	Yes	Limited	Limited
Systems Integration	Yes	Yes	Limited	Limited
Device/ Product	Yes	Yes	Limited	Limited

Based on the data shared above (production data, export data, import data, and competency data), analysis shows dependency of specific components in the electronics value chain on countries like China.

**Some insights:**

- India's growth in the sector would depend on its capability to increase manufacturing competency for integrated circuits and other active electronic components.
- India's competency in system design and system integration can be used to make it an end to end player in the entire ecosystem if required incentives are provided.

## Global Trends

### Semiconductors – shrinking size, higher efficiency and new applications

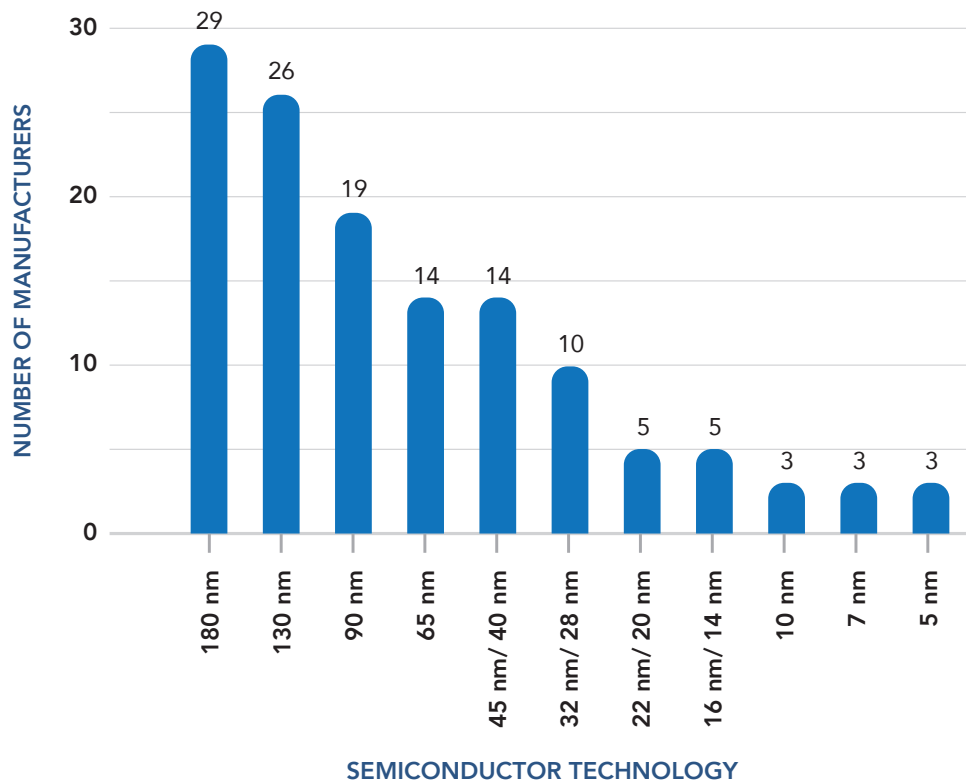
Lead players in manufacturing of polysilicon for electronics are Japan, USA, Germany, Korea, and China. Together they control more than 98% of the market. A small number of companies manufacture the semiconductors. These include Samsung, Intel, TSMC etc.

A higher level of integration with shrinking size, an increased number of layers and higher efficiency has been a general trend in the semiconductor industry.

Wide Bandgap Semiconductors such as Gallium Nitride and Silicon Carbide based devices have started entering commercial applications as higher efficiency and temperature tolerance.

'Flexible hybrid electronics', and printed electronics promise to reach new frontiers enabling direct integration of electronics into wearables, manufactured items and structures.

**FIG 15: STATUS OF MANUFACTURING OF SEMICONDUCTORS**



SEMICONDUCTOR TECHNOLOGY: SIZE REDUCTION

Source: [https://en.wikichip.org/wiki/technology\\_node](https://en.wikichip.org/wiki/technology_node)



### PCB packaging and systems integration

Countries like China, USA, Japan and Korea dominate the PCB related technology field.

Surface Mount Technology (SMT) is the modern technique for integrating components on the PCB. This is an area in which robotics, automation, machine vision systems along with thermal design and management can contribute significantly.

### Potential Impacts of COVID-19

China, the major supplier of various inputs for electronics manufacturing in the country, may exhibit some supply chain disruption. But this can be an opportunity for promoting local manufacturing.

China is the prominent player in the global electronics export market. With the Government of India increasing customs duties on the import of PCBs, local manufacturing of PCBs and their assembly is expected to increase. Local manufacturing of PCBs needs competency in Surface Mount Technology (SMT).

### The COVID-19 Opportunity for India

The digital revolution shall be powered by electronics. The current situation shall create a number of opportunities for India to take lead in the global race to the top.

**TABLE 10: POST COVID-19 OPPORTUNITY FOR INDIA IN ELECTRONICS SECTOR**

Changes brought by Post COVID-19 world	Opportunities created in form of
Unstable and Uncertain Economy	A Collaborative Environment involving R&D and Commercialization where multiple stakeholders of the ecosystem can benefit from each other
Need of Increased Continuous Research	
Faster Decision Making Environment	
Need of research involving other sectors	New Electronics Inventions driven by the Data Revolution (as covered under ICT sector)
Reverse Globalization	Need of development of indigenous products including capital equipment for manufacturing electronics
More respect for protocols	More standardization in form of protocol-driven operations, Creation of new Standards for production and usage

## Strategy for India

The Government of India has introduced the new National Policy on Electronics 2019 (NPE 2019). It 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.

**Government initiatives to promote electronics manufacturing in the country include:** Modified Special Incentive Package (M-SIPS), Electronic Manufacturing Clusters, Electronics Development Fund, and Compulsory Safety Standards for Electronics.

## Original Equipment Manufacturing

The Government of India has taken up a policy to encourage multinational companies to set up manufacturing facilities in India. Accordingly, few original equipment manufacturers from abroad have decided to set up manufacturing facilities in India. Whereas Indian OEMs have so far largely been present in a few areas such as mobile phone manufacturing, there is tremendous potential in other sectors like medical, automotive, power electric and electronics for storage technology.

## Equipment/ Machinery Development

Development of equipment required for SMT and packaging need to be encouraged. Appropriate policies will need to be formulated to promote export of such equipment.

## Semiconductor/ Integrated Circuits

Considering that the silicon wafer and integrated circuits contribute significantly to overall value addition, indigenous efforts for semiconductor and integrated circuit manufacturing is important.

Large multi-national players to set up facilities in India may be the most immediate solution and a means to create an ecosystem that encourages Indian start-ups to venture into niche and emerging areas.

India, in terms of indigenous competency development, may be the segment which does the development of discrete components, packaging with PCB and systems integration. Focus is required on surface mount technology, thermal management etc.

## Focus on Electronic Components manufacturing

**New Age Technology Usage:** It is a long journey to make India self-reliant for electronic components. Hence, it needs to be done in well designed stages. A detailed analysis

of demand across the globe along with the amount supplied by China and other countries, needs to be studied and analyzed to decide what types of ICs need to be focused upon. Since the capital intensity is so high, pre-planning driven through data would be critical.

More importantly, India has the advantage of being a nation of consumers. This is where India's ability to use new age technologies such as data analytics and artificial intelligence should come into play. India should make policies around collection of big data (anonymized) coming in from the usage of varying consumer electronics and industrial electronics products. Analytics driven from this data, when applied in the production and manufacturing strategy of electronic components, can prove to be a major unmatched advantage in this plan. India should protect such analytics through policies and strategies, so that the same can also help India even establish itself as an exporter in the future.

Integrated R&D: Analytics alone cannot lead to design and research. This needs to be driven through integrated research efforts involving collaboration with academia. Our analysis shows that there is a lot of academic work that is happening in the area, which has not yet been used for industrial collaboration due to the lack of required infrastructure.

Parallel to encouraging globally established chip manufactures to establish manufacturing facilities in India, it is necessary to develop an ecosystem for chip design and development in which start-ups, R&D institutions and academia can actively participate in association with Indian industry. Innovation in new semi-conductor materials needs to be encouraged.

## RECOMMENDATIONS

- Focus on Electronic Components manufacturing : Integrated Circuits and Chips : Power supply/ Clean water
- Development of capital equipment for electronics manufacturing, such as surface mount technology, machine vision systems
- Electronics Manufacturing Clusters set up by the Ministry of Electronics & Information Technology (MeitY) & Collaboration with academia
- Develop Standards
- Skill Development
- Policy: Anti Dumping

## 4.5 AGRICULTURE & FOOD PROCESSING

Around 56% population are still engaged with agriculture or associated activities in India and the sector contributes around 16.5 % to the national GDP. The annual growth rate in agriculture and its allied sectors has been around 2.9% in 2018-19. Considering the large percentage of population engaged in agriculture, there is urgent need to pay attention to the sector to improve efficiency and productivity.

The current global outbreak of COVID-19 has disrupted agricultural and food systems and supply chains around the world. Countries with high dependency on imports (for equipment such as for cooling meats, processing feed, or for food products themselves), are having tough times and facing emergent food crisis. Some of the crucial Technology areas which need urgent attention are following:

- Optimizing water use in agriculture (Use of hydroponics and aquaponics)
- Reducing soil loss and arrest degradation(Use of Zeolites)
- Augmenting genetic diversity for both crop and animal improvement
- Early and rapid detection and prevention of plant and animal diseases
- Improved food processing
- Robust supply chain and marketing infrastructure
- Use of ICT technologies (Blockchain, IoT and AI technologies)
- Use of drones, robotics, etc for crop surveillance and crop protection

## RECOMMENDATIONS

- Reducing agricultural waste by developing, optimizing, and validating advanced food processing and packaging technologies such as Vacuum Freeze Drying & Microwave Vacuum Drying, Pulsed Electric Field Application, Ohmic Heating/ Non-thermal Processing Techniques, High capacity/Fully Automatic Colour & Size sorters
- Irradiation of perishable foods for prolonged preservation. Use of modern State-of-Art & high capacity packaging machines
- Bio-fortification and nutrition enhancement of foods including micronutrients
- Agricultural machinery like laser leveller, happy seeder technology and small equipment like power weeders, tillers etc. catering to small and marginal farmers
- Restoration of degraded soils with the use of new sensor based technologies.
- Optimization of nutrient-use efficiency with novel sensor based technologies.
- Promotion of precision agriculture technologies coupled with hyper-spectral imaging.
- Rapid detection kits for diagnosis of animal diseases and management of zoonotic diseases to check epidemics.
- Tractor trolleys for collection and storage of harvest. Use of special bags and storage containers which can be installed at the farms for storage of harvest
- Use of satellite imagery (1.1 mm resolution) for identification pests, disease and management through computer analysis using big data analytics.
- Promotion of startups on ICT use for supporting agricultural practices and also supply chain management.

## 5.0 | Policy Options

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To effectively, mitigate the economic impact of pandemic, and catapult India in the global manufacturing league, new trade effective policy, with technology stimulus, need to be structured for further action by policy-makers and business leaders. Some stringent policy measures may be defined on the basis of:

1. Demand and Supply Shocks (Reduction in supply chain capacity through lost productivity)
2. Second and Third order impacts (Loss in Tourism, foreign exchange volatility, Oil prices crash)
3. 4D Risks (Financial, business and operating models)

The analysis in the paper lists out some focus areas that would be critical for India's economic growth.

1. **MSME Sector:** needs special stimulus as they are heavily impacted but have the right potential and flexibility to transform leveraging new technologies. .
2. **Public Health Systems:** Additional pressure on this system shall make it more dependent on financial and technology stimuli.
3. **Workforce Management:** The significant decrease in growth signals a major impact on India's workforce, and the right utilization of the same with intervention through government policies, can help drive the economy.
4. **Global Relations:** Global supply chain shall undergo a complete overhaul, thus opening new areas of relations globally.
5. **Under-privileged Areas of the Society:** This would have highest impacts of the current situation of people living in such areas.
6. **New Age Technologies:** Special focus on these would help benefit all other areas that need focus.

Based on the understanding of Indian economy, evaluation of the focus areas, suggested policy measures, and insights drawn from opportunities and recommendations in each sector, following policy shifts are recommended:

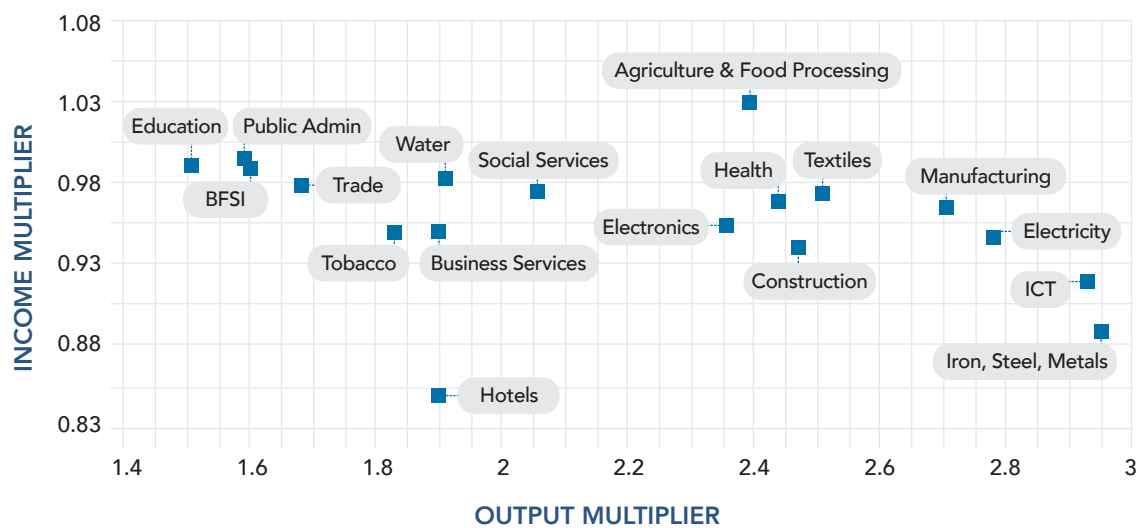
1. MSME sector needs to be supported on issues of liquidity crunch, credit support and fiscal compliances.
2. Substantial support is needed for the public health systems to ensure regular supply of PPE, medicines, equipment, etc..
3. Policies around tele-medicine and other technologies that enable digital transformation in the domain should be strengthened, to provide better infrastructure.
4. Incentivization of Employers to help them incentivize their workforce.
5. Re-charting of global supply-chain – A Significant relocation of manufacturing units & service hubs
6. Re-calibrated trade alignments
7. Re-imagined global institutions
8. Constant communication at district level for response planning
9. Increased co-ordination between all levels of government would be needed. Digital Transformation may help drive this.
10. Relax factory compliances to enable the industry to continue operation with a much lesser workforce over longer work / shift hours but in a healthier environment (Enabling Social distancing)
11. BPL Families to be supported through DBT and use of ICT for transparency

# 6.0 Recommendations

## POLICY & TECHNOLOGY

Individual sections have identified technology needs for their respective sectors. The correlations between various sectors were evaluated to understand the impact of one sector on the output of all sectors. Based on the linkages and interdependencies between the outputs of different sectors, along with a calculation of income according to existing data, output multiplier and income multiplier for various sectors have been calculated on certain assumptions (assumption for the principle of homogeneity, principle of proportionality and principle of consistency (Fig 16).

FIG 16: SECTORAL MULTIPLIERS FOR POLICY MAKING



**Higher the output multiplier for a sector, higher the need for focus on the sector in case of a strong Make in India and China plus One policy.** Focusing on sectors that have a strong output multiplier and making them less dependent on imports from China would mean impact across sectors would be multiplied highly, thus helping increase the GDP value significantly.



As seen from this graph, we can see certain sectors with high output multiplier and decent income multiplier that deserve a special focus in form of technology intervention.

However, based on the policy shift suggestions, the following technology-specific recommendations are made which will help accelerating India's growth during post COVID-19 scenario. Thus, in turn, it will **strengthen 'Make in India'** initiative.

- Technology clusters across India demography be established for homogenous job creation

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- Identify technologies in champion sector: Segment wise solution- Aggregation platform as single window.

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- Develop incubation startup highway for X leverage and build a monetization exchange Technology .Technology Startup Exchange be created.

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- Promote import substitution, indigenous innovation in association with academic institutions and research centres (Link the funding support to identified technology translation).

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- Identify 10 blockbuster technologies of mass impact, coordinate with all research institutions and pilot the technologies in the field.

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- Evolve technology platforms in solar technologies, e -vehicle, and innovative agri-processing, in association with Israel, Japanese and German COE.

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- Creation of value addition centres for upscaling, demonstration and value addition to technologies and coordination with investors facilitating upscaling of Technology, improvement, making it investor ready: Indian Institutions to work on such technologies. Collaboration with Incubation mentoring platforms from Germany, USA.

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- Special focus on high value medical products/technologies that are currently majorly imported and facilitation of clinical trials and regulatory compliance.

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- Affordable Technologies development/downsizing/adoption for rural areas: onsite agri processing, hydroponics, aquaculture, mobile test centers, e-vehicle, distancing learning & knowledge platform.

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- Extensive application of Telemedicine for outreach to rural areas on a PPP model.

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- A technology ready repository to be maintained.

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## 7.0 | Conclusions

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The overall GDP of the country is expected to get impacted by Rs. 14.88 Lakh Crores, if appropriate incentivization in the form of technology and finance is not provided. The expected import from China to India in FY20 is approximately 5% of India's GDP, value amounting to Rs. 8.5 Lakh Crores. If a major portion of this import is replaced with indigenously developed products, it would significantly reduce the expected GDP loss. The same can be done by following **China plus one** policy, strengthening '**Make in India**' initiative in identified sectors. A stimulus of around Rs. 8 Lakh Crores, distributed across sectors, focused on technology (including hardware and new age technology such as AI and data analytics), will improve India's GDP values significantly. Increased exports because of the technologies shall be an added advantage, adding to the overall GDP. Hence, with the help of a planned technology stimulus enabling significant reduction of dependency on China for imports, India's GDP can soar high this FY with positive numbers along with needful employment generation.

India has an unusual providential opportunity to fill this space provided it takes measures to improve its production ecosystem and also design new global alignments. For this, proactive, large-scale and integrated measures across all policy areas are necessary to make strong and sustained impacts. The recommendations in this white paper have identified and evaluated various sectors, which need immediate technology impetus to push the above mandate on the basis of identified sectoral policies and make "ATMANIRBHAR" India.

*We need to follow up this white paper with sector specific thematic workshops, to draw elaborate product/ sector based DPR for Make in India with matching technologies, budgetary support and incentives to realize the opportunity and aspirations.*

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# Annexure

## IMPACT OF COVID-19 ON DEMAND & SUPPLY SECTORS

Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Agriculture	Crop and animal production, hunting and related service activities	Medium-High	Low
	Forestry and logging	Medium-High	Low
	Fishing and aquaculture	Medium-High	Medium
Mining	Mining of coal and lignite	High	High
	Extraction of crude petroleum and natural gas	High	Medium
	Mining of metal ores	High	High
	Other mining and quarrying	High	High
	Mining support service activities	High	Low
Manufacturing	Manufacture of food products	High	Medium
	Manufacture of beverages	High	High
	Manufacture of tobacco products	High	Low
	Manufacture of textiles	Medium	Low
	Manufacture of wearing apparel	High	High
	Manufacture of leather and related products	High	High
	Manufacture of wood and wooden products, except furniture	High	High
	Manufacture of paper and paper products	High	High
Printing and reproduction of recorded media	High	High	

Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Manufacturing	Manufacture of coke and refined petroleum products	High	Medium
	Manufacture of chemicals and chemical products	High	Medium
	Manufacture of pharmaceuticals, medicinal chemical and botanical products	Medium	None
	Manufacture of rubber and plastics products	High	High
	Manufacture of other non-metallic mineral products	High	Medium
	Manufacture of basic metals	High	High
	Manufacture of fabricated metal products, except machinery and equipment	High	High
	Manufacture of computer, electronic and optical products	High	None
	Manufacture of electrical equipment (motors, generators, transformers)	High	Low
	Manufacture of machinery and equipment n.e.c.	High	High
	Manufacture of motor vehicles, trailers and semi-trailers	High	High
	Manufacture of other transport equipment	High	Medium
	Manufacture of furniture	High	High
	Other manufacturing	High	High
Repair and installation of machinery and equipment	High	None	

Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Electricity & Gas	Electricity, gas, steam and air conditioning supply	Low-Medium	High
Water supply & Sewerage	Water collection, treatment and supply	Low-Medium	None
	Sewerage	Low-Medium	None
	Waste collection, treatment and disposal activities; materials recovery	Low-Medium	None
	Remediation activities and other waste management services	Medium-High	None
Construction	Construction of buildings	High	High
	Civil engineering - Roads / Railways and Projects	High	High
	Specialized construction activities	High	High
Wholesale & Retail trade	Sale of Motor vehicles and repair of motor vehicles and motorcycles	Medium-High	High
	Wholesale trade, except motor vehicles	Low-Medium	Medium
	Retail trade, except of motor vehicles and motorcycles	Medium-High	High
Transportation & Storage	Land transport and transport via pipelines	Low-Medium	High
	Water transport	Low-Medium	High
	Air transport	Low-Medium	High
	Warehousing and support activities for transportation	Medium-High	None
	Postal and courier activities	Low-Medium	High
Hotel & Food	Accommodation	Low-Medium	High
	Food and beverage service activities	Medium-High	High

Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Information & Communication	Publishing activities	Low-Medium	None
	Motion picture, video and television programme production, sound recording	Low-Medium	None
	Broadcasting and programming activities	Low-Medium	Positive
	Telecommunications	Low-Medium	Positive
	Computer programming, consultancy and related activities	Low-Medium	Medium
	Information service activities / Portals	Low-Medium	Positive
BFSI	Financial service activities, except insurance and pension	Low-Medium	Medium
	Insurance, reinsurance and pension funding	Low-Medium	None
	Other financial activities	Low-Medium	High
Real Estate	Real Estate	Medium-High	High
Professional & Technical	Legal and accounting activities	Low-Medium	Low
	Activities of head offices; management consultancy activities	Low-Medium	Low
	Architecture and engineering activities	Low-Medium	Medium
	Scientific research and development	Low-Medium	Positive
	Advertising and market research	Low-Medium	Medium
	Other professional, scientific and technical activities	Low-Medium	Medium
	Veterinary activities	Low-Medium	High

Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Administrative and Support	Rental and leasing activities	Low-Medium	High
	Employment and Recruitment activities	Low-Medium	High
	Travel agency, tour operator and other reservation service	Low-Medium	High
	Security and investigation activities	Low-Medium	Low
	Services to buildings and landscape activities	Low-Medium	High
	Office administrative, office support and other business support	Low-Medium	Medium
Public Administration and Defence	Public administration and defence; compulsory social security	Low-Medium	Positive
Education	Education	Low-Medium	Medium
Healthcare and Social Work	Hospital activities	Low-Medium	Positive
	Residential care activities	Low-Medium	Positive
	Social work activities without accommodation	Low-Medium	Positive
Entertainment & Recreation	Creative, arts and entertainment activities	Medium-High	Medium
	Libraries, archives, museums and other cultural activities	Medium-High	Medium
	Gambling and betting activities	Medium-High	Medium
	Sports activities and amusement and recreation activities	Medium-High	Medium



Sector	Category	COVID-19 Impact on Supply (FY21)	COVID-19 Impact on Demand (FY21)
Other Services	Activities of membership organizations	Medium-High	Medium
	Repair of computers and personal and household goods	Medium-High	Medium
	Other personal service activities	Medium-High	Medium
Activities of households	Activities of households as employers of domestic personnel	Medium-High	Medium
	Undifferentiated goods- and services-producing activities of private households	Medium-High	Medium
Extraterritorial organizations	Activities of extraterritorial organizations and bodies	Medium-High	Medium





