



# **KARNATAKA**

## **BIOECONOMY REPORT**

# **2020**



**SHRI B.S. YEDIYURAPPA***CHIEF MINISTER OF KARNATAKA*

**K**arnataka took the pioneering initiative to formulate the state-level Biotechnology Policy nearly two decades ago. The Karnataka Millennium Biotechnology Policy of 2001 was the first dedicated biotechnology promotion and development of Biotech Industry policy in the country. This provided the right stimulus and impetus to the growth of the industry that has now become one of the key engines of growth for Karnataka's economy.

As the biotechnology industry surged with the introduction of many cutting-edge technologies, Karnataka pro-actively revised the policy in 2009 and 2017 to incorporate the right regulatory, fiscal and policy changes to meet the changing needs of the sector.

Our Government is conscious of the innovative spirit of the sector and is prepared to do whatever it takes to tap the benefits of biotechnology for the welfare of people.

To take full advantage of the tools of biotechnology and its associated benefits, our government has set an ambitious target of achieving 50% market share of the national BioEconomy valuation of \$100 billion by the year 2025. The first-ever Karnataka BioEconomy Report (KBER) is an attempt to take stock of the state's current position and formulate a set of strategic initiatives to attain and surpass the \$50 billion BioEconomy goal that we have set for ourselves.

I am confident that with the support of all stakeholders, Karnataka will continue to be the national leader in biotechnology and emerge as a global hub in the sector.

  
(B.S. YEDIYURAPPA)



**DR C.N. ASHWATH NARAYAN**

*DEPUTY CHIEF MINISTER AND MINISTER FOR ELECTRONICS, INFORMATION  
TECHNOLOGY, BIOTECHNOLOGY AND SCIENCE & TECHNOLOGY*

**K**arnataka has been striving to maintain its leadership position in innovation and technology with a series of initiatives for all round development, leveraging the talent and skills available across the state in biotechnology, information technology and nanotechnology. The unprecedented challenges imposed by the COVID-19 pandemic has further spurred our efforts to mitigate the suffering of people by using all available technological tools at our disposal.

Biotechnology industry has been at the forefront of providing a range of products and solutions to successfully handle various challenges posed by the corona virus. Some of the most innovative biotechnology companies and startups in Karnataka have contributed immensely to these efforts.

For nearly a decade, it has been evident that biotechnology provides a range of products and services to heal, feed and fuel the people. Many countries have attempted to capture the broader impact of various biotechnological tools by studying the multiplier effects as BioEconomy impact. Nationally too, we have started measuring the impact of biotechnology using the India BioEconomy Report.

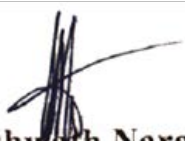
Karnataka has been at the forefront of launching many pioneering initiatives to foster biotechnology growth through participative efforts like setting up the Vision Group on Biotechnology, the Biotechnology Skill Enhancement Program, the Elevate Program to boost startups and others to provide impetus to innovation in the state.

Continuing in the same pioneering path, our government has commissioned the first of its kind study by any state to measure the status of our BioEconomy through the Karnataka BioEconomy Report (KBER).



The preliminary findings of KBER indicate that Karnataka's BioEconomy is valued at US \$ 22.6 billion, accounting for slightly over one-third of the national BioEconomy of \$62.5 billion in 2019. We are aiming higher and our government has set a challenging task of more than doubling the value of BioEconomy in the next five years. Our target is to raise Karnataka's BioEconomy share to 50% of the national BioEconomy revenue target of \$100 billion by the year 2025.

We are grateful to the members of the Vision Group on Biotechnology, all the experts and various stakeholders and the Association of Biotechnology Led Enterprises (ABLE) for preparing the Karnataka BioEconomy Report 2020 and for the strategic recommendations to provide a booster dose to the biotechnology industry



(Dr. Ashwath Narayan C.N)



**DR KIRAN MAZUMDAR-SHAW**

*CHAIRPERSON OF KARNATAKA'S VISION GROUP ON BIOTECHNOLOGY  
AND BIOCON GROUP*

**T**he first ever state level effort to measure the contribution of the BioEconomy through the Karnataka BioEconomy Report (KBER) 2020 has highlighted some important data points. Karnataka's BioEconomy has been measured to contribute \$22.6 billion in 2019. This accounts for 10.2% of the Karnataka's Gross State Domestic Product (GSDP) \$ 221.82 billion in 2019. Why is this important?

At the national level, the BioEconomy valuation of \$62.5 billion contributed 2.3 % to the national GDP of \$2.8 trillion in 2019. So for our state, biotechnology is a significant value creator accounting for double digit share. This fits in with the other trends in Karnataka's economy with innovative sectors playing a major role and we were therefore rightly named the most technologically innovative state in the country by the Government of India.

The rise of biotechnology in the state did not happen by chance. For more than two decades, the state government, biotech industry, research institutions and other key players of the biotech community have worked together to foster, encourage and boost the development and use of biotechnological tools.

While the state's BioEconomy at \$22.6 billion contributes slightly more than a third to the national BioEconomy (\$62.5 billion), Karnataka has set a more ambitious target of contributing at least 50% of the national BioEconomy target of \$100 billion by the year 2025. As the KBER indicates, even if the current growth trends continue to be impacted by a few minor COVID-19 hiccups, Karnataka is estimated to reach on \$42 billion by 2025.

So to bridge the gap in likely revenues, the report recommends a series of strategic initiatives to overcome this hurdle and cross the target in time, in the continuing spirit of the state's industry, policy makers and government working together with a visionary approach.

**#1 Vaccine Hub:** Karnataka as India's largest biotech hub has no large-scale vaccine manufacturing facility. The COVID-19 pandemic has brought global attention to vaccine hubs and as one of India's pre-eminent BioCluster, Karnataka should proactively attract few vaccine manufacturers from India and abroad in a special Vaccine Hub

**#2 BioManufacturing Hub:** Set up at least one BioManufacturing Hub outside Bengaluru. This hub can be in a minimum of 100 acres. The hub can house five to ten dedicat-

ed manufacturers with 10-20 acres each. The Hub should have Common infrastructure facilities.

**#3 Bt Crops:** Karnataka is a significant grower of Bt cotton. Karnataka is also a major grower of brinjal and the central government has allowed field trials of first genetically modified (GM) food crop, Bt brinjal.. The state can Grant No Objection Certificate (NOC) for trials and commercialization of Bt Brinjal. Karnataka can aim for doubling production to 8 lakh tons.

**#4 Marine Biotech:** The current marine production is nearly 800,000 tons. The total value is nearly \$2 billion. The state can with a focused approach help in annual yield increase by 20-25 % with scientific inputs.

**#5 BioMedical Cluster:** Karnataka is already identified as a Biomedical Manufacturing cluster for insulin pens, stents and implants, medical electronics. The state has over 100 medical devices startups in Karnataka. Karnataka is a major maker of ventilators.

**#6 Integrated Biorefineries Cluster:** There has been a thrust on increasing ethanol production. Since the last six months the efforts on Biorefineries and BioEnergy have been revamped in the country. Distributed manufacturing may be the order of the day. Hubballi-Dharwad-Belagavi can house this cluster.

**#7 Agritech:** Value added agriculture enabled by farm to market technology platforms will be a significant contributor to Karnataka's BioEconomy. From biofertilizers, biopesticides and micro-propagation technologies, Karnataka can lead in new agricultural technologies. Focusing on key agri-belts of Hassan, Dharwad and Belagavi will provide inclusive economic opportunities.

I am happy to note that the Biotechnology Facilitation Cell in KITS, set up by the state government to implement the state Biotech Policy and promote the industry has provided valuable inputs in developing the report. The members of the Vision Group of Biotechnology(VGBT) and the Association of Biotechnology Led Enterprises (ABLE) too have played key role in preparing this report.

I am confident that government and industry will work once again together wholeheartedly to reach the \$ 50 billion aspirational target.

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***"IF FAVORABLE BUSINESS ENVIRONMENT IS CREATED, THE BIOTECHNOLOGY AND HEALTHCARE SECTORS COMBINED WILL BE ABLE TO GROW AT A RATE OF 25-30% AND HAVE THE POTENTIAL TO GENERATE REVENUES OF US \$100 BILLION BY 2025" EMPHASIZED THE REPORT INDIAN BIOTECHNOLOGY: THE ROADMAP TO THE NEXT DECADE AND BEYOND, AUTHORED BY THE ASSOCIATION OF BIOTECHNOLOGY LED ENTERPRISES (ABLE) IN 2012, FOR THE DEPARTMENT OF BIOTECHNOLOGY (DBT), GOVERNMENT OF INDIA.***

Since then, this report has become the guiding force for transforming a host of national policies, regulations, and processes to reach this goal by 2025.

Karnataka has been at the national forefront in harnessing the benefits of the transformational nature of biotechnological tools for the past two decades with a series of steps like setting up the first of its kind, Vision Group on Biotechnology (VGBT), Karnataka Biotechnology Policy, updated every 5 to 6 years, fostering innovations by encouraging biotechnology startups, business friendly policies to make the state a sought after place for biotech investments companies and so on.

One of the key goals of the Karnataka Biotech Policy (2017-22), released in 2017 is for the state to aim for a 40 to 60% market share of the national BioEconomy target of \$100 billion by the year 2025. This target was reiterated in the Karnataka State Budget 2020 with the emphasis on the state aiming to garner 50% of the national BioEconomy target.

**The Karnataka BioEconomy Report (KBER) 2020** is an attempt to outline the strategic roadmap to harness the transformative power of biotechnology to achieve the goal of \$50 billion by the year 2025 in the state itself. This is a major challenge as the state's BioEconomy output at the end of 2019 is valued at \$22.6 billion. Karnataka's BioEconomy registered a 17% growth from \$19.3 billion in 2018. The growth in the year prior to that was 15% and if the growth trend continues with a CAGR of 17-18% only then can the state's BioEconomy value reach \$50 billion.

The sector has to more than double its contribution in the next 4-5 years. How important is biotechnology to Karnataka? According to the India BioEconomy Report 2020, the national BioEconomy value stood at \$62.5 billion or about 2.3% of the national GDP (Gross Domestic Product) of \$2,800

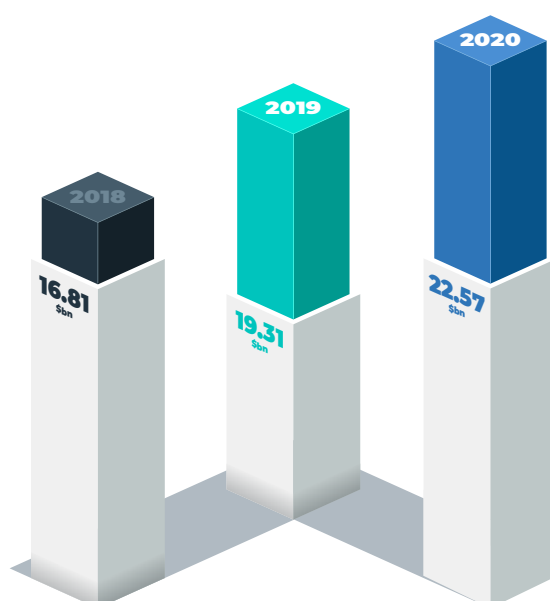


Table 1 BioEconomy of Karnataka (FY2018-2020)



Table 2 **GSDP OF KARNATAKA**

Gross State Domestic Product (GSDP) of Karnataka (\$ bn) FY 21 by Budget Estimate	258.37
Gross State Domestic Product (GSDP) of Karnataka (Rs crore) FY 20	1,699,115
Gross State Domestic Product (GSDP) of Karnataka (\$ bn) FY 20	221.82
The GSDP CAGR between 2015-16 and 2020-21 in rupee term	11.56%
GSVA of Karnataka (\$ bn)	216
GSVA of Karnataka (Rs Crore) FY 20	1,518,554

Source: MOSPI (<http://www.mospi.nic.in/>)

million (\$2.8 trillion). Karnataka's Gross State Domestic Product (GSDP) was valued at \$221.82 billion by 2020. At \$22.6 billion, BioEconomy contributes nearly 10.18% of the state's economic output. This indicates the critical role played by biotechnology in the state's economy.

In the post-Covid world and with slight dip in economic growth, Karnataka's BioEconomy is likely to reach only around \$40 billion. The pessimistic view is that the BioEconomy will reach only \$30 billion in the current prevailing scenario. The BioEconomy is projected to fall by 2-6 percent in FY21 as some segments have been effected by the Covid conditions. The BioEconomy will bounce back in FY2022 but it is likely to grow at the rate 8-10 percent between FY2022 and FY2025.

However, experts observing the scenario expect the industry to recover in FY2022 and grow at 10-12 percent between FY2022 and FY2025 and reach \$35 billion in revenues in business as usual situation. The optimistic view is that the BioEconomy will rebound faster and at an annual growth rate of 10-15% reach the \$40 billion by FY 2025. The state needs to make some strategic moves and attract investments in a few areas if it has to reach the \$50 Billion BioEconomy target by FY25. This can be done by creating opportunities for the industry to generate additional revenues of \$8-10 billion. The state government can play a significant role in development of trade and investment promotion strategies to give boost to the industries in the bio-based Economy.

In March 2020, the Union government introduced Production-Linked Incentive (PLI) Scheme. The scheme was to provided companies in specific sectors incentives on incremental sales from products manufactured in domestic units. The not only invites foreign companies to set shop in India but also aims to encourage domestic companies to establish new facilities or expand existing manufacturing units. The scheme for the Pharma and Medical Devices came into effect from July 2020. The PLI scheme witnessed good traction and this is now being extended to 10 more sectors including Food and Textiles.

BioPharmaceuticals and Medical Devices Industry are two important pillars of the BioEconomy of Karnataka. The two account for nearly 35 percent of the total contribution of the BioEconomy. Bio-Agriculture (Agriculture and Animal Husbandry) and BioIndustrial (Enzymes, BioFuels, Biomass, and Green Chemicals) industries are the other two segments. Focused approach on each of these segments will help align the stakeholders in all the value chains and create the needed thrust. To reach a targeted goal of \$50 billion by 2020, few segments need to double their contributions by FY2025.

This report has taken into consideration four possible scenarios.

**1 PESSIMISTIC SCENARIO**  
*This is when things aren't moving and are at standstill*

**2 REALISTIC SCENARIO**  
*This is when it is business as usual condition*

**3 OPTIMISTIC SCENARIO**  
*This is when conditions turn favorable*

**4 TARGETED / DESIRED SCENARIO**  
*This is where the gravity needs to be defied to achieve the goals, where Government's support will be very much needed to break the barriers and leapfrog*





**Table 3 BioEconomy of Karnataka (Forecast FY2020-2025)**

	FY21 (\$ bn)	FY22 (\$ bn)*	FY23 (\$ bn)*	FY24 (\$ bn)*	FY25 (\$ bn)*
<b>Scenarios</b>	<b>Value in (\$ Billion)</b>				
Pessimistic	21.29	22.63	24.35	26.26	29.83
Realistic	22.09	23.72	25.74	29.83	34.60
Optimistic	22.93	25.74	29.83	34.60	40.22
Desired Target	22.93	28.73	34.60	42.22	51.97

Source: ABLE Projections

**Table 4 BioEconomy of Karnataka (Forecast FY2020-2025): Pessimistic Scenario**

Sector	FY20 (\$ bn)	FY21 (\$ bn)*	FY22 (\$ bn)*	FY23 (\$ bn)*	FY24 (\$ bn)*	FY25 (\$ bn)*
BioPharma	4.2	4.3	4.5	5.0	5.3	6.1
Medtech	3.9	3.9	4.0	4.1	4.5	5.1
BioAgri	4.7	3.0	3.8	4.5	5.0	5.4
BioServices	2.1	2.1	2.1	2.3	2.5	2.8
BioIT	2.3	2.5	2.5	2.8	3.0	3.3
BioIndustrial, Biofuels, BioEnergy	1.4	1.5	1.6	1.6	1.5	2.0
Reagents & Analytical Business	1.5	1.6	1.7	1.5	1.7	2.2
Marine Biotech	1.8	1.9	1.9	2.0	2.2	2.5
Others	0.5	0.5	0.5	0.5	0.5	0.5
<b>TOTAL</b>	<b>22.6</b>	<b>21.3</b>	<b>22.6</b>	<b>24.4</b>	<b>26.3</b>	<b>29.8</b>
<b>GROWTH</b>		<b>-6%</b>	<b>6%</b>	<b>8%</b>	<b>8%</b>	<b>14%</b>

\* Projections

**Table 5 BioEconomy of Karnataka (Forecast FY2020-2025): Realistic**

Sector	FY20 (\$ bn)	FY21 (\$ bn)*	FY22 (\$ bn)*	FY23 (\$ bn)*	FY24 (\$ bn)*	FY25 (\$ bn)*
BioPharma	4.2	4.3	4.6	5.1	6.1	6.9
Medtech	3.9	3.9	4.1	4.4	5.1	6.0
BioAgri	4.7	3.8	4.5	4.9	5.4	6.1
BioServices	2.1	2.1	2.1	2.4	2.8	3.3
BioIT	2.3	2.5	2.8	2.7	3.3	3.8
BioIndustrial, Biofuels, BioEnergy	1.4	1.5	1.6	1.7	2.0	2.5
Reagents & Analytical Business	1.5	1.6	1.5	1.9	2.2	2.5
Marine Biotech	1.8	1.9	2.0	2.1	2.5	3.0
Others	0.5	0.5	0.5	0.5	0.5	0.5
<b>TOTAL</b>	<b>22.6</b>	<b>22.1</b>	<b>23.7</b>	<b>25.7</b>	<b>29.8</b>	<b>34.6</b>
<b>GROWTH</b>		<b>-2%</b>	<b>7%</b>	<b>8%</b>	<b>16%</b>	<b>16%</b>

\* Projections



Table 6 BioEconomy of Karnataka (Forecast FY2020-2025): Optimistic

Sector	FY20 (\$ bn)	FY21 (\$ bn)*	FY22 (\$ bn)*	FY23 (\$ bn)*	FY24 (\$ bn)*	FY25 (\$ bn)*
BioPharma	4.2	4.8	5.1	6.1	6.9	7.6
Medtech	3.9	4.0	4.4	5.1	6.0	6.8
BioAgri	4.7	3.8	4.9	5.4	6.1	7.5
BioServices	2.1	2.1	2.4	2.8	3.3	3.8
BioIT	2.3	2.5	2.7	3.3	3.8	4.5
BioIndustrial	1.4	1.6	1.7	2.0	2.5	3.0
Reagents & Analytical Business	1.5	1.7	1.9	2.2	2.5	2.8
Marine Biotech	1.8	1.9	2.1	2.5	3.0	3.5
Others	0.5	0.5	0.5	0.5	0.5	0.5
<b>TOTAL</b>	<b>22.6</b>	<b>22.9</b>	<b>25.7</b>	<b>29.8</b>	<b>34.6</b>	<b>40.2</b>
<b>GROWTH</b>		<b>2%</b>	<b>12%</b>	<b>16%</b>	<b>16%</b>	<b>16%</b>

\* Projections

Karnataka's BioEconomy target of \$50 Billion is possible if the government supports the key industry in their business goals. A key broad plan will be to see how the BioPharma can be scaled up to increase its contribution from \$4.2 Billion in FY2020 to \$9.5 billion in FY2025. Similarly, Medical Devices and Diagnostics sector has the potential to move from \$3.9 Billion in BioEconomy value to \$8.7 Billion by FY2025. BioAgri is a very important segment and efforts towards removing of policy barriers and infusion of new age technologies will boost the entire value chain.

BioIndustrial segment comprising of biorenewables, bioenergy, biofuels, and green chemicals is throwing up huge potential. Though this segment always had the future, it didn't take off in a big way in India. This segment has the potential to quadruple its contribution to the BioEconomy of Karnataka from \$1.4 Billion BioEconomic value to \$5.7 billion. The others that are likely to see growth are the Research & Development services, Marine Biotechnology, and BioIT and informatics services.

Table 7 BioEconomy of Karnataka (Forecast FY2020-2025): Targeted

Sector	FY20 (\$ bn)	FY21 (\$ bn)*	FY22 (\$ bn)*	FY23 (\$ bn)*	FY24 (\$ bn)*	FY25 (\$ bn)*
BioPharma	4.2	4.8	5.8	6.9	8.6	9.5
Medtech	3.9	4.0	4.8	6.0	6.8	8.7
BioAgri	4.7	3.8	4.9	6.1	7.5	7.9
BioServices	2.1	2.1	2.8	3.3	3.8	5.5
BioIT	2.3	2.5	3.3	3.8	4.5	6.0
BioIndustrial	1.4	1.6	2.0	2.5	4.0	5.7
Reagents & Analytical Business	1.5	1.7	2.2	2.5	2.8	4.0
Marine Biotech	1.8	1.9	2.5	3.0	3.5	4.2
Others	0.5	0.5	0.5	0.5	0.5	0.5
<b>TOTAL</b>	<b>22.57</b>	<b>22.93</b>	<b>28.73</b>	<b>34.6</b>	<b>42.22</b>	<b>51.97</b>
<b>GROWTH</b>		<b>2%</b>	<b>25%</b>	<b>20%</b>	<b>22%</b>	<b>23%</b>



Some of the possible specific areas that can boost the state's BioEconomy in the next five years are:

## #1 VACCINE HUB

Karnataka as India's largest biotech hub has no large-scale vaccine manufacturing facility. The COVID-19 pandemic has brought global attention to vaccine hubs and as one of India's pre-eminent BioCluster, Karnataka should proactively attract few vaccine manufacturers from India and abroad in a special Vaccine Hub. (Investment: \$ 1 billion. BioEconomy potential; \$ 2 billion)

## #2 BIOMANUFACTURING HUB

Set up at least one BioManufacturing Hub outside Bengaluru. This hub can be in a minimum of 100 acres. The hub can house five to ten dedicated manufacturers with 10-20 acres each. The Hub should have Common infrastructure facilities. The Government can be set up with an investment of \$ 800 million. The hub can generate revenues of \$1.5 billion.

## #3 BT CROPS

Karnataka is a significant grower of Bt cotton. Karnataka is also a major grower of brinjal and the central government has allowed field trials of first genetically modified (GM) food crop, Bt brinjal. Karnataka's brinjal production is 4.32 lakh tons (3.5% share). The revenue value is nearly \$500 million. The state can Grant No Objection Certificate (NOC) for trials and commercialization of Bt Brinjal. Karnataka can aim for doubling production to 8 lakh tons. Additional economic value: \$ 1 billion. Other Southern states are not major producers now. National market exists

## #4 MARINE BIOTECH

The current marine production is nearly 800,000 tons. The total value is nearly \$2 billion. The state can with a focused approach help in annual yield increase by 20-25 % with scientific inputs. The focus on this sector can add another \$3 billion to state BioEconomy. Marine biotech has already been identified as one of the future focus areas for the state in the latest Biotech Policy.

## #5 BIOMEDICAL CLUSTER

Karnataka is already identified as a Biomedical Manufacturing cluster for insulin pens, stents and implants, medical electronics. The state has over 100 medical devices startups in Karnataka. Karnataka is a major maker of ventilators. It should piggyback on the PLI scheme and create self-reliant and sustainable market. Scope to set up a Biomedical manufacturing cluster on the lines of AMTZ in Visakhapatnam with all ancillary industries and a good support network. Diagnostic devices to be major products in demand. (India imports 80% of diagnostic devices worth \$5 billion).



## #6 INTEGRATED BIOREFINERIES CLUSTER

There has been a thrust on increasing ethanol production. Since the last six months the efforts on Biorefineries and BioEnergy have been revamped in the country. Distributed manufacturing may be the order of the day. In the last six months over 50 Projects have been approved by Department of Food & Public Distribution (DFPD), Government of India, under the "New Scheme for extending financial assistance to sugar mills for enhancement and augmentation of ethanol production capacity" notified on 08.03.2019. Hubballi-Dharwad-Belgaum can house this cluster.

## #7 AGRITECH

Value added agriculture enabled by farm to market technology platforms will be a significant contributor to Karnataka's BioEconomy. From biofertilizers, biopesticides and micro-propagation technologies, Karnataka can lead in new agricultural technologies. Focusing on key agri-belts of Hassan, Dharwad and Belagavi will provide inclusive economic opportunities.

The importance of this high technology sector will become evident as its products catalyze the transformation of the Indian economy by offering solutions to the multitude of challenges that both India and the world will encounter in food security, fuel security and healthcare. Furthering these three foundational areas, on which a nation's economy and prosperity depend, represent the key opportunities for India to evolve into a big BioEconomy.

In particular, as the 2012 report emphasized, the BioEconomy opportunities for India predominantly lie in biologics, especially biosimilar and vaccine manufacturing, stem cells, medical devices and diagnostics, contract research and manufacturing, integrating scientific evidence-based traditional knowledge into healthcare, agri-biotechnology and green biotechnology, especially bioremediation and bioenergy. Technology enablers in the form of systems and synthetic biology will help advance the aforementioned areas.

Karnataka has done well with a systematic approach in the past decades to build on the innovation excellence shown by scientific institutions of long standing in the state, innovative entrepreneurs by providing the right incentives, mentoring and inputs. It is a tribute to this pro-active approach that over the past three decades the government's investments in few thousand crores has attracted setting up of several national and international biotech companies. And these steps have led to the emergence of a \$ 22.6 billion BioEconomy with thousands of high value jobs created, leading to huge tax collections, boost to the local economy and also earn global acclaim.

KBER is an attempt to capture the tremendous efforts that have gone into making Karnataka one of India's most sought after biotechnology hub.



**KARNATAKA WAS THE FIRST STATE IN INDIA TO ANNOUNCE A BIOTECH POLICY TO FOCUS ON DEVELOPING THE BIOTECHNOLOGY SECTOR IN THE STATE.****1.1.1****BACKGROUND & OBJECTIVES**

**T**he first policy popularly known as, **Millennium Biotech Policy – I**, was announced in 2001. Karnataka did not halt with that policy. In fact, every dispensation that ruled the state, since 2001, continued to engage with the industry, leaders, academics, investors, and the end-user beneficiaries to strengthen the sector.

The second biotech policy termed as, **Millennium Biotech Policy II**, was launched in 2009 to build on the momentum achieved through the 2001 policy. The third policy was announced in 2017.

These Biotech Policy Frameworks helped the state to become one of the leading Biotech destinations in the country. Below are some of the milestones that Karnataka achieved due to the support of the Government as outlined in directions under the three Biotech Policies.

- ✓ **Finishing schools:** Establishment of Biotechnology finishing schools across the state to increase the employment, fill the skill gap that the industry had, and also create industry-ready human resource.
- ✓ **Ecosystem:** Enabled creation of a supportive environment. It created an enabling ecosystem for start-ups, facilitated infrastructure building, and building network platforms for the industry.
- ✓ **Industry-Academia collaboration:** The policy framework helped the industry and academia to come together and develop opportunities in a holistic way.
- ✓ **Premier institutes and centers of excellence:** The state through proactive policy initiatives set up premier research institutes and centers of excellence.
- ✓ **Incubators, accelerators, mentoring:** The state has several state-of-art incubators. There are nearly 10 incubators that have been supported by the state government. Some of them provide infrastructural and specialized facilities, some are also accelerators facilitating techno-commercial aspects besides mentoring and proof-of-concept funding support. Karnataka has witnessed collaborative intra-incubator relationships as well.
- ✓ **Start-up facilitation:** Any start-up ecosystem has three key characteristics. Access to Capital, Access to Know-how, and an entrepreneurial mindset. Karnataka, through programs like IDEA2POC Grant, Grand Challenges, and Bio Venture Fund, has managed to attract start-ups in a big way. The state government provides financial support to a tune of Rs 300 crore. This comes in both Grant and Equity formats. Such support has resulted in nearly 350 dedicated biotech start-ups mushrooming in the state.
- ✓ **R&D response:** The biotech companies in Karnataka have also been able to focus on cutting edge research. Several companies from Karnataka feature in the national list of fame. A few examples of start-ups include Achira Labs, Aten Porus, Azooka Life Sciences, Bayou Life Sciences, Bugworks Research, Nirmai Healthcare, Pandorum Technologies, Sea6Energy, and StringBio. During Covid the start-ups responded to come up with nearly 40 products or platforms.

**BioEconomy Now:** Karnataka is now taking the next big leap to focus on Bio-based Economy. This assumes significance as the concept of BioEconomy is generally taken up at the national level. And Karnataka government wishes to take the lead in the state through this approach. The state government, its leaders, and visionaries are keen that Karnataka transcends beyond the traditional industry-growth focus. Hence, the state wants to focus on BioEconomy.

The Association of Biotechnology Led Enterprises (ABLE) has been commissioned to conduct a study of **BioEconomy** of Karnataka. This is also the first time any state in India has commissioned such a project.

The study is to get a better understanding of the current status, the strengths of the state, the reasons for focusing and developing a BioEconomy. It is also an opportunity to understand where the state stands in comparison to national-level progress. It will also analyze the capacity and gaps in the innovation ecosystem of Bio-based Economy. The objective is to stimulate, foster and enhance BioEconomy of the state.

## 1.1.2

### DEFINITION OF BIOTECHNOLOGY SECTOR

So far the focus across the globe was on Biotechnology as a sector meeting the fuel, food, and health requirements. BioEconomy is a much wider concept and becoming integral to the next decade of growth and opportunities. Leading Biotech Industry Organization defines Biotechnology as a sector that harnesses cellular and biomolecular processes to develop technologies and products that help improve lives and the health of our planet.

The Indian biotech industry comprising of over 4,000 companies (including 3,325 start-ups) and generates over \$12 Billion in sales of goods and services. It employs nearly a million people. The biotech industry comprises of five major segments: BioPharma, BioAgriculture, BioServices, BioIndustrial, and BioInformatics.

BioPharma is the largest sector accounting for nearly about 60% of the total biotech revenues followed by BioServices (18%); BioAgri comprising of Bt Cotton, Biofertilizers, and Biopesticides (5%), BioIndustrial (5%), and Bioinformatics (2%).

Exports from the country generate nearly 50 percent of the total Biotech Industry revenues.

**The key components of the biotechnology sector in Karnataka also comprise of:**

- ✓ **BioPharmaceuticals & Diagnostics:** Biologics and Biosimilars, Vaccines, Stemcell therapy, Molecular Diagnostics, Point-of-Care Diagnostics
- ✓ **BioAgri:** Bt Cotton, Biomarkers, Biofertilizers and pesticides
- ✓ **BioIndustrial:** Enzymes, Biofuels, Biochemicals
- ✓ **Bioinformatics and BioIT Solutions:** Artificial intelligence, Big Data, Computationally intensive Bioinformatics, Biostatistics, Systems Biology, Genomics, Proteomics, Transcript omics, Multi omics
- ✓ **Contract Research, Clinical Research, Contract Development:** Drug discovery and drug development and manufacturing services including clinical data management
- ✓ **BioSuppliers:** Providers of Single-Use Bioprocessing, High-Content Screening (HCS), Lab Data Management & Analysis Software, Lab Plasticware & Supplies, Microarray Analysis, Molecular Biology, Protein Biology, Sequencing, Clinical and Diagnostics science products, and Industrial applications





Karnataka's ecosystem in Karnataka comprises of nearly 750 large, medium and small companies, including biotech start-ups.

Karnataka has considered as India's biotech, medtech, and bio-it start-up hub with nearly 300 biotech start-up companies operating in Bengaluru, across sectors of BioAgri, BioPharma, BioServices, BioIndustrial, and BioInformatics.

### 1.1.3

#### DEFINITION OF BIOECONOMY

Focus on BioEconomy started around mid-2000s globally. Europe was one of the early adopters and the US announced its intentions to encourage BioEconomy since 2012. Simply put BioEconomy or Bio-based Economy has to be seen as an economic activity that is driven by research, development, and innovation in the life sciences and biotechnology. It has to be enabled by technological advances in engineering and in computing and information sciences.

The Global BioEconomy Summit 2018 adopted the definition of BioEconomy as follows.

**BIOECONOMY IS THE PRODUCTION, UTILIZATION AND CONSERVATION OF BIOLOGICAL RESOURCES, INCLUDING RELATED KNOWLEDGE, SCIENCE, TECHNOLOGY, AND INNOVATION, TO PROVIDE INFORMATION, PRODUCTS, PROCESSES AND SERVICES ACROSS ALL ECONOMIC SECTORS AIMING TOWARD A SUSTAINABLE ECONOMY.**

**Valuing of the BioEconomy** is challenging as it comprises approaches that focus on industrial activity and biomedical activity. The aim is to promote sustainability through activities that may include products for downstream industrial use (including crops) and also breakthroughs in the biological sciences and biotechnology feed through to innovations in the pharmaceutical, medical device and health care industries. It also encompasses the ecosystem conducted in government and university laboratories as well.

While growth in demand for food, feed, fuel and fibers presents significant opportunities for application of biotechnology, Government Support and Conducive Policies are important in promoting BioEconomy.

The KARNATAKA BIOECONOMY REPORT (KBER) will monitor the extent to which policies adapt to growth, resilience and sustainability needs

Although the uptake of these technologies is routine in industrialized countries, many developing countries however, are lagging behind in adopting some of these modern biotechnologies for the sustainable growth of industry. Furthermore, not all states are faced with identical challenges and priorities, and each one is at a distinct stage of development, with a wide difference in technological capabilities.

**THE BIOECONOMY DEFINITIONS ADOPTED FOR THE PURPOSE OF CALCULATING THE VALUE AND BASING THE STUDY ARE IN SYNC WITH THE DEFINITION AND EXPLANATIONS USED IN THE INDIAN BIOECONOMY REPORT ANNOUNCED BY BIRAC.**

## 2.1 THEORETICAL OVERVIEW

The term "BioEconomy" generally refers to an economy using renewable natural resources to produce food, energy, products and services. The important renewable natural resources include the biomass in forests, soil, fields, bodies of water and the sea and fresh water.

The BioEconomy is more than accumulating the performance of Biotechnology sector. It is not just aggregating the revenues of a few sectors and providing numbers. It is very important to understand that majority of the sectors work in silos. The success of BioEconomy strategy depends on linking the various sectors together.

Here are a few examples.

**BioEconomy based on Bt Cotton:** In Karnataka, Bt Cotton was grown in nearly 420,000 hectares of field area. Karnataka's total cotton production in 2019-20 stood at 21,00,000 bales of 170 kg each. So Karnataka produced approximately 357 million kg of cotton last year. The average price of Bt cotton is Rs 55 per kilogram. At this average price, the raw value of cotton produced last year in Karnataka amounted Rs 1963 crore.

Now comes the real economic value of cotton. Almost all of the cotton grown in Karnataka is the Bt cotton hybrids. Industry estimates show that over 4,80,000 packets of Bt cotton seeds of 450 gm each were sold to the farmers in the state. There is price ceiling of Rs 750 per packet of 450 gm Bt cotton seeds.

The harvested cotton is used to make a variety of fabrics and studies indicate approximately 40 per cent of all fabrics produced have cotton. To calculate the final economic value of cotton, let us assume all the cotton is converted into a high value Men's pure cotton formal shirts. After various levels of processing, each kilogram of cotton churns out an average 3.5 formal shirts for an adult male. Even assuming a conservative average value of Rs 300 per shirt, the total 357 million kg of Bt cotton produced in Karnataka will create an economic value of Rs 37,470 crore or approximately US\$ 4.9 billion.

Let us look at the economic value creation by Bt cotton seed. For each Hectare of planting a farmer buys on an average 2.5 packets of Bt cotton seeds priced at Rs 750 per packet. So the cost of Bt cotton seed per hectare is Rs 1837. The average yield of cotton per hectare is 2400 kg. As explained earlier, each kg of cotton could lead to production of 3.5 shirts costing Rs 300 each, translating into a value of creation of Rs 25,20,000. Essentially, the value addition created by Bt cotton seeds sown in one hectare of land is 1371 times the seed value.

There are further value creations along the entire value chains in terms of employment created at each level during farming, harvest, harvest related services, transport, ginning, value production at textile units, further transport and distribution to retail outlets of value added products, sales staff, tailoring units converting the fabric into a shirt and so on. And all these sectors are inter-dependent having a long chain economic value creation from a tiny seed packet.

**Take another example, the Biofuels.** All this while one would only look at Biodiesel as the base. But BioEconomy changes the scope. Biology is being used to commercially produce petrochemical



replacements through fermentation route. The value chain would include the raw material suppliers to end user segments like the aviation and car manufacturers adopting sustainability goals. Hence a whole set of Byproducts and waste are also considered in the projections. With the coming of the BioEconomy focus the state would like put its efforts in addressing the entire economy in a circular fashion. This would help the segments to get linked. It means the agriculture and the chemicals sectors which were not aligned with the fossil economy, will now begin to do so with the emphasis on BioEconomy.

An interesting case in point is that Karnataka is emerging as one of the leading states with few Biorefineries projects. These refineries are being set up by Sugar manufacturers as part of Sustainable fuels goals. This sector was so far delinked from the petroleum, biotech, medical, and chemical sectors. Getting them under one umbrella of BioEconomy will take the state and country towards a better world.

## 2.2

### MEASUREMENT OF THE IMPACT OF BIOTECHNOLOGY

The BioEconomy calculations are based on several publicly available statistics. A few nations are also focusing on obtaining statistics for import constituents so that they can get better estimates. The transactions that are recorded try to capture calculations related to output, value additions, investments, employment, exports and imports of BioEconomy goods, etc.

Also sectors that are defined as being part of the BioEconomy have been selected in their entirety for the calculations. The relative share of the BioEconomy has been estimated for some sectors using expert opinions and other statistical sources including media reportage.

The thumb rule that is being targeted is this.

**Biotech + Rest of Agriculture + Fisheries + Forestry + Ecosystem services + Biodiversity =  
15-25% of GDP**



**THE METHODOLOGICAL APPROACH USED IN THIS STUDY COMPRISED OF TWO PHASES. ONE FOR THE ANALYSIS OF DIFFUSION AND THE OTHER FOR ANALYSIS OF THE EMPLOYMENT IMPACT.**

### 3.1 OVERVIEW

In preparing this report, a four-step methodology was followed.

The **first step** was to identify sectors and collect data from publicly available resources. The data was gathered from industry associations related to various sectors, from government portals, from policy vision documents of various sector, from news media studies and current highlights. This was mainly for the quantitative portions of the report. This is to understand the diffusion of Biotechnology.

The **second step** was to measure the socio-economic impact. ABLE conducted two different sets of survey of stakeholders to get qualitative feedback. The two surveys were designed to assess the impact of some of the pioneering initiatives launched by the Government of Karnataka.

- (i) Survey to measure the Impact of support by the Government of Karnataka on incubation networks.
- (ii) Survey to measure the Employment impact. This was a focused study and reached out to the graduates of Karnataka Biotechnology Finishing School Program Phase II - Biotechnology Skill Enhancement Program (BiSEP).

The **third step** was to seek information from experts and industry leaders to understand the opportunities and challenges.

The **fourth step** was to study various successful BioEconomy models, cases, and literature reviews to draw out the recommendations and strategy.

The methodological approach used in this study comprised of two phases. One for the analysis of diffusion and the other for analysis of the employment impact.

### 3.2 DIFFUSION OF BIOTECHNOLOGY

The main challenge in development of this report was measurement of value of BioEconomy. This is a problem that is applicable to study of BioEconomy of any state in India. There are several reasons.

- ✓ BioEconomy is not a clearly defined subject
- ✓ No sector of the industry is purely bio-based
- ✓ Most or all industries use bio-based materials to some extent in their production process or as ingredients to the final products.

#### Sectors & Industry

A nation's economy can be divided into sectors to define the proportion of a population engaged in different activities. A nation's economy can be divided into sectors to define the proportion of a population engaged in different activities.



Definition	Activities
<b>Primary Sector</b>	
This sector is engaged in extraction or harvesting of products from the earth such as raw materials and basic foods.	Activities associated with primary economic activity include agriculture (both subsistence and commercial), mining, forestry, grazing, hunting and gathering, fishing, and quarrying. The packaging and processing of raw materials are also considered to be part of this sector.
<b>Secondary Sector</b>	
The secondary sector of the economy produces finished goods from the raw materials extracted by the primary economy. All manufacturing, processing, and construction jobs lie within this sector.	Activities associated with the secondary sector include metalworking and smelting, automobile production, textile production, the chemical and engineering industries, aerospace manufacturing, energy utilities, breweries and bottlers, construction, and shipbuilding.
<b>Tertiary Sector</b>	
The tertiary sector of the economy is also known as the service industry. This sector sells the goods produced by the secondary sector and provides commercial services to both the general population and to businesses in all five economic sectors.	Activities associated with this sector include retail and wholesale sales, transportation and distribution, restaurants, clerical services, media, tourism, insurance, banking, health care, and law.
<b>Quaternary Sector</b>	
Although many economic models divide the economy into only three sectors, others divide it into four or even five. These two sectors are closely linked with the services of the tertiary sector, which is why they can also be grouped into this branch. The fourth sector of the economy, the quaternary sector, consists of intellectual activities often associated with technological innovation. It is sometimes called the knowledge economy.	Activities associated with this sector include government, culture, libraries, scientific research, education, and information technology. These intellectual services and activities are what drive technological advancement, which can have a huge impact on short- and long-term economic growth.
<b>Quinary Sector</b>	
Some economists further narrow the quaternary sector into the quinary sector, which includes the highest levels of decision-making in a society or economy. This sector includes top executives or officials in such fields as government, science, universities, nonprofits, health care, culture, and the media. It may also include police and fire departments, which are public services as opposed to for-profit enterprises.	Economists sometimes also include domestic activities (duties performed in the home by a family member or dependent) in the quinary sector. These activities, such as child care or housekeeping, are typically not measured by monetary amounts but contribute to the economy by providing services for free that would otherwise be paid for.
<b>For the purpose of this report we will take into consideration only four sectors – Primary, Secondary, Tertiary, and Quaternary.</b>	
Source of definitions: <a href="https://www.thoughtco.com/sectors-of-the-economy-1435795">https://www.thoughtco.com/sectors-of-the-economy-1435795</a>	



Here is an example of Diffusion of Biotechnology

### Categorization of Sectors and Industries

Sector	(A) Non-bio-based industries examples	(B) Bio-based industries examples
(P) Primary production sector	(PA): e.g., mining, quarrying	(PB): Primary production of biomass, e.g., agriculture, forestry, animal husbandry, fishing, aquaculture
(S) Secondary production sector	(SA): e.g., other manufacturing industries	(SB): Transformation of raw biomass, e.g., food and beverages industry, tobacco, textiles, wood, paper and pulp, pharma, footwear, etc.
(T) Tertiary production sector	(TA): e.g., computer programming, financial services	(TB): Transformation of processed biomass, e.g., restaurants, trade and transportation of bio-products

The focus is on three bio-based sectors of the economy as shown in Column (B).

Most of the manufacturing sectors are treated as mixed bio-based as not 100 percent of their goods are biotech.

Industries can be part of multiple segments as well. BioEconomy is the sum of the primary bio-based production, secondary bio-based production, and the tertiary bio-based production.

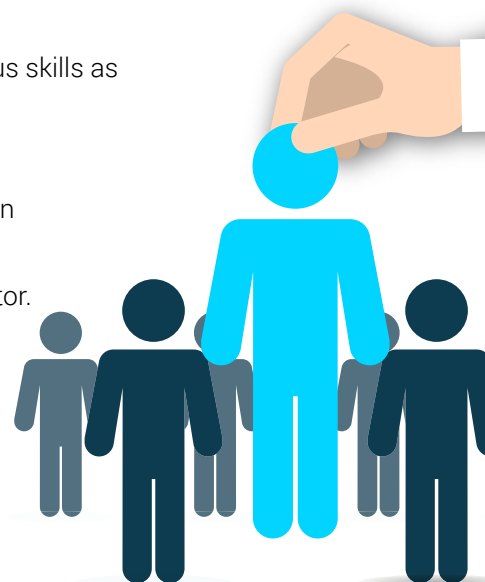
**(1) BioEconomy = Sector PB + Sector SB + Sector TB**

## 3.3 EMPLOYMENT

This is one of the important activities of any sector. The main objective of any economic activity is to generate employment. The data gathering for this is quite complex as the sectors are mixed categories and perfect data is not available. A lot of approximations had to be done.

### Key Trends

- ✓ The nature of the jobs created also varies across the four sectors. Interestingly women are key players in the use of local knowledge, particularly in the processing stage of the biomass value chain.
- ✓ New BioEconomy activities offer many opportunities for employment for various skills as well. The jobs require different degrees of qualification
- ✓ The employment is both direct and indirect employment.
- ✓ Training and development is part of BioEconomy because of the fast changes in technology adoption.
- ✓ The BioEconomy is a big employment generation factor for the quaternary sector. This sector focuses on research and development.
- ✓ Preliminary finding suggests that nearly 50 percent of the labor force is tertiary workers in Karnataka. Nearly 25 percent of the workforce is in Primary and 20 percent in primary and 15 percent in quaternary sectors.



## THIS SECTION WILL FOCUS ON UNDERSTANDING THE BIOECONOMY AND BIOTECHNOLOGY STATUS AND PERFORMANCE OF KARNATAKA.

The Biotechnology industry has been tracked and developed by the state government through its Department of Science, Technology, and Innovation over the last two decades. Various segments of the industry have come together and various stakeholders have been working in unison. The stress has been more on the Research, Development, Manufacturing, and Services.

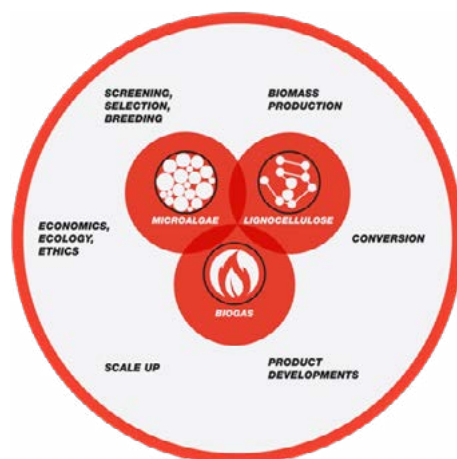
### 4.1 VALUE CHAIN OF BIOTECHNOLOGY

The basic value chain of biotechnology industry constitutes basic research, applied research, integration and development, production and manufacturing, testing and validation, marketing and sales, and post-marketing services. However, the value chain of the Biotechnology differs from segment to segment. The differences could be in many aspects like volume-price, potential advantage, product characteristics, and maturity.

The concept of value chain of a BioEconomy is more comprehensive as the underlying factor is sustainability. The focus is on trying to meet the Sustainable Development Goals that all the UN United Nations Member States adopted. The goals are aimed at ending poverty and other deprivations, improving health and education, reducing the inequality, and spurring economic growth. All these have to be managed while tackling climate change and working to preserve our oceans and forests.

The BioEconomy is seen as an approach to operationalize and meet sustainability goals. Hence development and provision of bio-based products and services require to take into consideration economic, ecological and social impact aspects in the strategy. This means if all steps in the production process – from biomass supply to use – follow the key sustainability criteria. The focus is on allowing for complete value chains and efficient use of resources, which can be achieved by harmonizing the various process steps involved in the value chain.

## BIOMASS VALUE CHAIN



## BIOECONOMY VALUE CHAIN IN MARINE INDUSTRY

Global Biotechnology Summit 2018 Presentations. These are examples to illustrate the value chains for Biomass and Blue (Marine Biotech)

Industrial Biotechnology is applied in segments ranging from specialty chemicals, biofuels, bioenergy, bio-based plastics, other biomaterials, biolubricants, biosurfactants, etc.

### 4.1.1

#### DISCOVERY, BIOPROSPECTING AND R&D

Karnataka has a very strong position in the BioEconomy. The state's BioEconomy is driven on the wheels of strong life sciences industry, engineering capabilities, computational and information sciences industry, and biotechnology and biology industry.

**Life sciences:** The strengths of Karnataka are in the biological, biomedical, environmental biology, food sciences and agricultural sciences areas. Almost all the leading players are based in Karnataka.

**Biotechnology:** This is mainly an enabler of the life sciences sector. Karnataka is one of the leading contributors to biotechnology areas related to advanced sequencing, metabolic engineering, etc. Biotechnology is used in modern medicine, diagnostics, crops, etc.

**Engineering:** Karnataka is also home to a lot of work in the space of robotics, microfluidics, tissue engineering, cell culture. These capabilities are being used to develop portable diagnostics and precision farming and medicine to the forefront.

Computing and information sciences: Karnataka has a robust Information Technology industry. It has extensive strengths in machine learning, big data, artificial intelligence and bioinformatics skills.

### 4.1.2

#### CLOSING THE BIOTECH LOOP

The success of Karnataka's BioEconomy banks on a strong research culture. Traditionally Karnataka has been a favorable environment for Biotechnology industry and Research activities. This has been mainly because of the well-established research environment, which is supported by a strong funding ecosystem in Karnataka. This not only spurs innovation and growth of highly skilled and qualified workforce.

Karnataka government has backed science and engineering research both in terms of funding support and infrastructure support. Karnataka is one of the leading producers of doctoral graduates. The BioEconomy approach will now help the state to bring together all the other industries on the same platform as the hitherto biotechnology sector. BioEconomy will open up new opportunities for research and also facilitate distributed manufacturing.

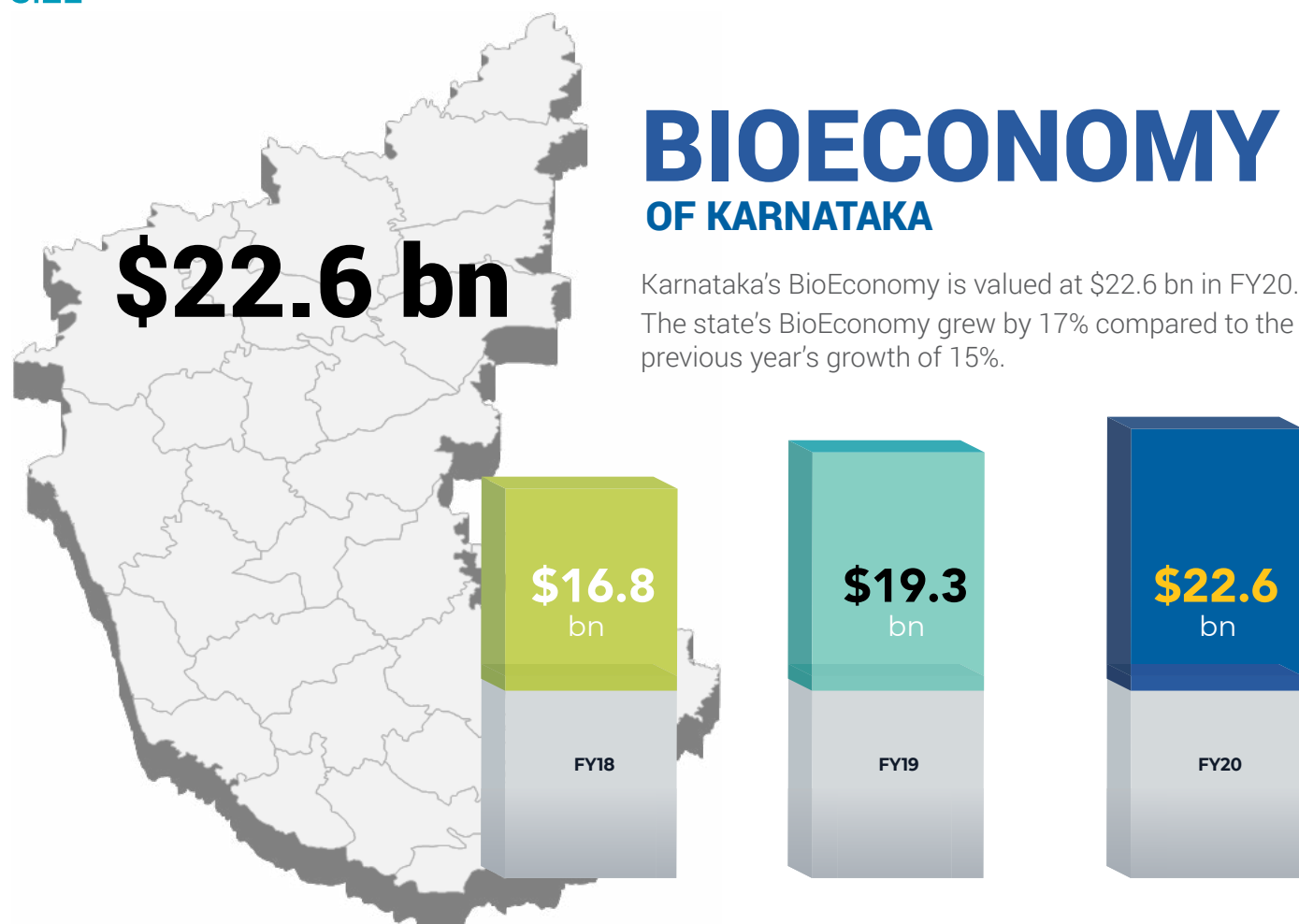


## 4.2

### OVERALL SIZE AND STRUCTURE OF THE BIOTECHNOLOGY INDUSTRY

Karnataka has a very diverse and established biotech industry.

#### 4.2.1 SIZE



The BioEconomy of Karnataka is estimated to be \$22.6 Billion in FY 2020. The sector witnessed nearly 17 percent growth compared to FY 2019. The BioEconomy of Karnataka was valued at \$19.3 Billion in FY2019 and at \$16.8 Billion in \$FY2018.

#### 4.2.2 STRUCTURE

Karnataka's BioEconomy has a mixed contribution from the various sectors. BioAgri and animal husbandry industry segments accounted for nearly 21% share of the state's BioEconomy in FY20. The next big contributors are BioPharma and Medtech industries. The BioEconomy value of BioPharma is estimated at \$4.2 billion, while the MedTech is valued at \$3.9 billion and witnessed nearly 17 percent growth compared to FY 2019.

The estimates of key industry segments are as follows.

✓ <b>BioAgri:</b> \$4.7 billion <b>(21%)</b>
✓ <b>BioPharma:</b> \$4.2 billion <b>(18.8%)</b>
✓ <b>Biomedical:</b> \$3.9 billion <b>(17.4%)</b>
✓ <b>BioServices:</b> \$2.1 billion <b>(9.4%)</b>
✓ <b>BioIT:</b> \$2.3 billion <b>(10.3%)</b>
✓ <b>BioIndustrial:</b> \$1.4 billion <b>(6.3%)</b>
✓ <b>Reagents &amp; Analytical Business:</b> \$1.5 billion <b>(6.7%)</b>
✓ <b>Marine Biotech:</b> \$1.8 billion <b>2.2%</b>

Table 11 BioEconomy of Karnataka (FY2018-20) by Industry Segments			
Sector	FY18 (\$ bn)	FY19 (\$ bn)	FY20 (\$ bn)
BioPharma	3.0	3.6	4.2
Medtech	3.0	3.4	3.9
BioAgri	3.3	3.9	4.7
BioServices	1.8	2.0	2.1
BioIT	1.8	2.0	2.3
BioIndustrial	1.0	1.2	1.4
Reagents & Analytical Business	1.1	1.3	1.5
Marine Biotech	1.3	1.6	1.8
Others	0.5	0.5	0.5
<b>TOTAL</b>	<b>16.81</b>	<b>19.3</b>	<b>22.6</b>
<b>GROWTH</b>	<b>20%</b>	<b>15%</b>	<b>17%</b>

## 4.3

### BIOTECHNOLOGY SECTORS WITHIN THE WIDER LANDSCAPE

The important segments of focus traditionally in Karnataka were BioPharmaceuticals, Medical Diagnostic, BioAgri comprising of Bt Cotton, Bioinformatics, Contract Research and Clinical Research. The focus of the Government of Karnataka has been to bring as many inter-disciplinary science streams together and support the industry.

Here is a quick focus areas as outlined in different policies

Till 2017 (Millennium Policy 1 & 2 period)	2017-21 Goals (Millennium Goals +)	BioEconomy Focus along with 2017-21 Goals
<b>BioPharma</b> ✓ Therapeutics ✓ Drug Discovery ✓ BioSimilar	<b>BioPharma +</b> ✓ Rare disease management and support	<b>BioPharma</b> ✓ Synthetic communities of microbes and synthetic, multi cellular plants and animals

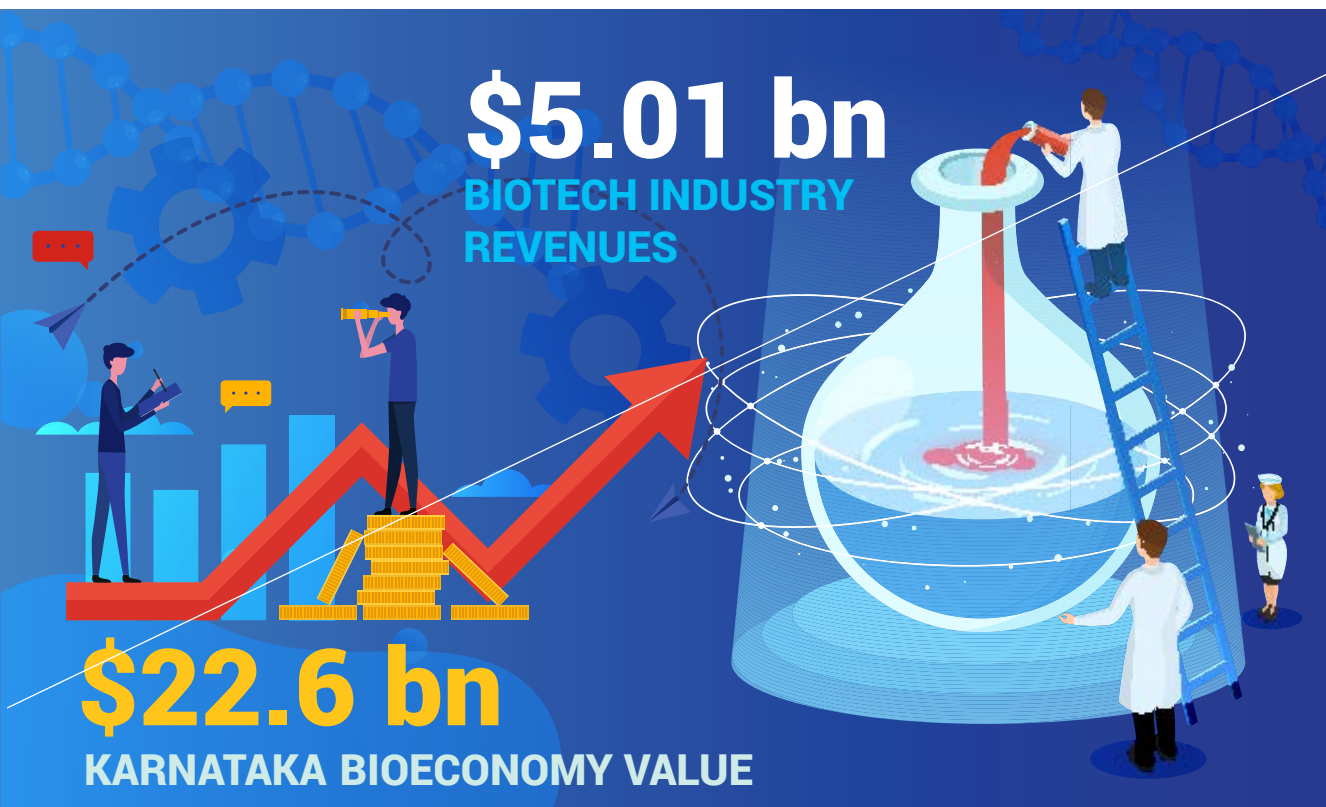




<ul style="list-style-type: none"> <li>✓ BioManufacturing</li> <li>✓ Diagnostics</li> </ul>	<ul style="list-style-type: none"> <li>✓ Synthetic biology for new biological parts and systems to produce complex drug</li> <li>✓ Stem cell and regenerative medicine</li> <li>✓ Fight Antimicrobial resistance</li> <li>✓ Microbiome for targeted treatment and alternative drugs</li> </ul>	<ul style="list-style-type: none"> <li>✓ Metagenome and microbiome engineering</li> <li>✓ Population and Ecosystem engineering</li> </ul>
<b>BioAgri</b> <ul style="list-style-type: none"> <li>✓ GM Crops</li> <li>✓ Biofertilizers</li> </ul>	<b>BioAgriculture</b> support to biotic and abiotic stresses	<ul style="list-style-type: none"> <li>✓ Focus on Genetically Modified Crops like Bt Cotton</li> <li>✓ Smart and AI Based farming practices</li> <li>✓ Biomass</li> <li>✓ Crops with CRISPR knockouts</li> <li>✓ Animal cell culture–derived products</li> </ul>
	<b>Marine biotechnology</b> to tap marine biodiversity of the state	<ul style="list-style-type: none"> <li>✓ Drugs, health and beauty products</li> <li>✓ Bioluminescent microbes for home and landscape uses</li> <li>✓ Biosensors, bioremediation, CO2 mitigation etc.</li> <li>✓ Biopolymers, biomaterials, enzymes</li> </ul>
<b>Industrial Biotech</b> Enzymes for various sector	Enzymes	Enzymes
<b>Biofuels</b>	BioEnergy Biofuels and Biorefineries	<ul style="list-style-type: none"> <li>✓ Microbes and Microbial Products</li> <li>✓ BioEnergy</li> <li>✓ Biorefining (food)</li> <li>✓ Biofuels (ethanol)</li> <li>✓ Bio based petrochemicals</li> <li>✓ Bioluminescent microbes for home &amp; landscape uses</li> <li>✓ Gas phase microbial systems</li> <li>✓ Algae-derived products (e.g., substitute for shrimps, biofuels, ethylene)</li> </ul>
	BioEngineering for innovative Products	Implantable biosensors Biological / Mechanical sensors
	Medical Devices	<ul style="list-style-type: none"> <li>✓ Medical Devices</li> <li>✓ Surgical and medical</li> <li>✓ Instruments</li> <li>✓ Point of Care Devices</li> <li>✓ Organ on a chip</li> </ul>
<b>Contract Research and Manufacturing Services</b>	Contract Research, Drug Discovery	<ul style="list-style-type: none"> <li>✓ Contract Research and Manufacturing services</li> </ul>

## 4.4 Conclusions

Tracking the sector-specific aspects of the BioEconomy is not easy. This is because the diffusion is not uniform across industries. Further BioEconomy has a very large scientific and research base and the products take 10-15 years to arrive on the market. So measuring this area of activity will be challenging. Yet another challenge comes from relying on data from inter-industry relationships for bio based production.

**BIOTECHNOLOGY IS A KEY PILLAR OF THE OVERALL BIOECONOMY****5.1****SECTOR REVIEW****5.1.1****OVERVIEW OF SUB-SECTORS**

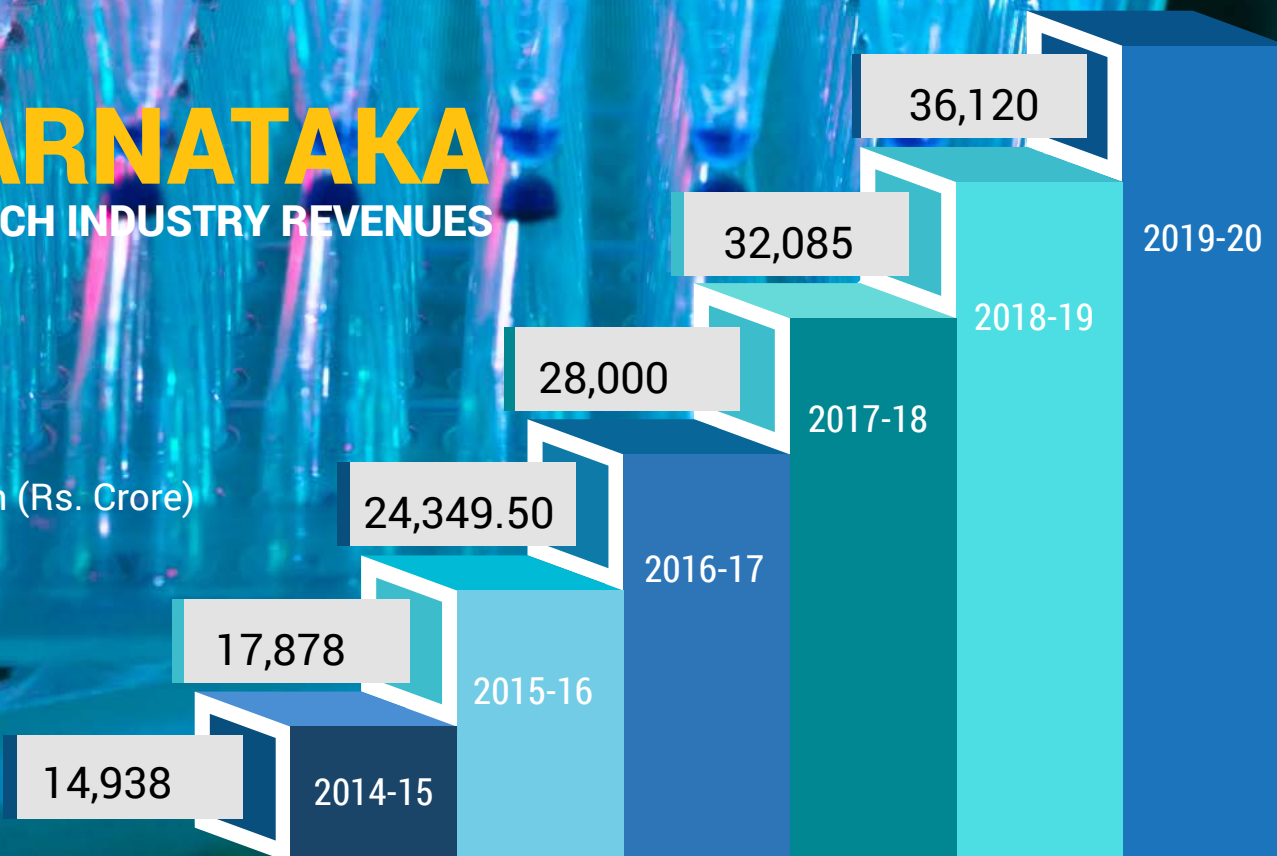
**T**he BioEconomy encompasses all the sectors – primary, secondary, tertiary, and quaternary. Government of Karnataka has focused on creating the necessary infrastructure and funding support to the modern Biotechnology. This section will concentrate on understanding the performance of Karnataka's Biotechnology Industry.

Till a couple of years ago the performance of Biotechnology industry meant assessing the industry in terms of revenues generated due to sales of biotech products only. The industry estimates were product sales and revenues. The products and services were categorized under BioPharma, BioAgri, BioIndustrial, Bioinformatics & Bio-IT, and BioServices. Only sales of r-DNA products, Biologics, Biosimilars, and Vaccines, Enzymes, Bt Cotton and Biofertilizers, BioMarkers, Bioinformatics, Diagnostics, Molecular Diagnostics and services, and Contract Research and Development and Manufacturing were considered.



# KARNATAKA BIOTECH INDUSTRY REVENUES

Total in (Rs. Crore)

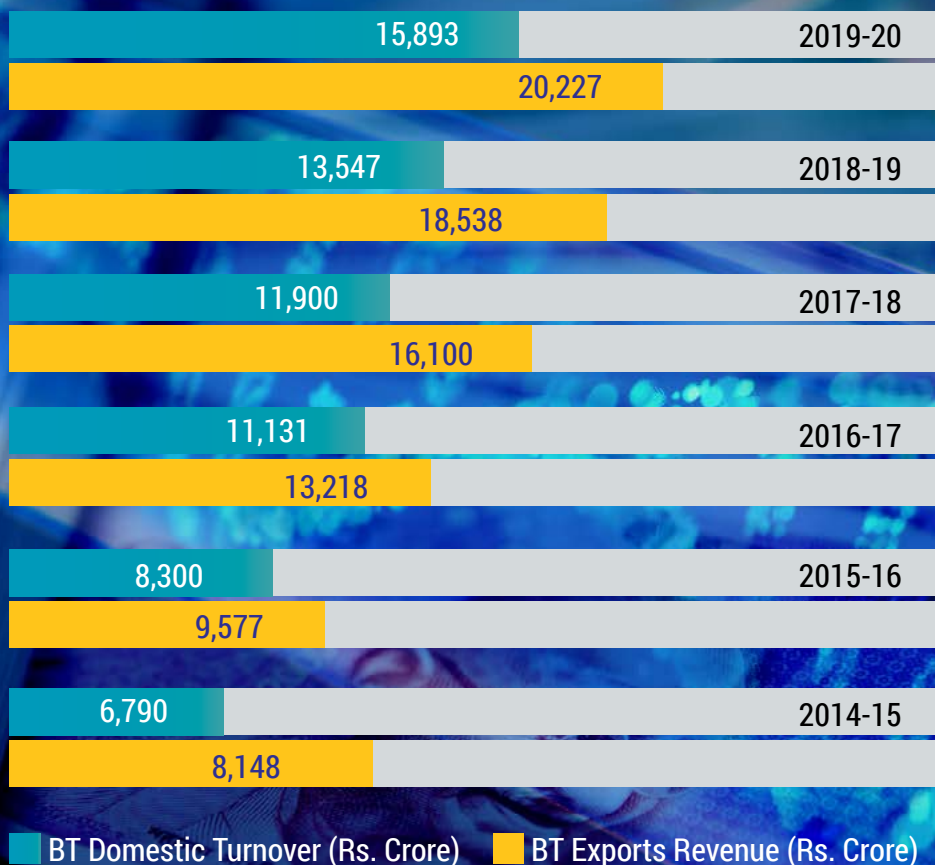




# KARNATAKA

## BIOTECH INDUSTRY TURNOVER

### EXPORTS / DOMESTIC SALES



## 5.1.2

### POTENTIAL PRODUCT AREAS IN RESEARCH AND DEVELOPMENT

Karnataka is home to innovation. The state is home to anchor-companies, SMEs, and Start-ups in key segments. The companies are spread across sectors and in various product segments.

Here is a table of start-ups and their work to explain the nature of work. This list doesn't include the established names as they have dedicated R&D units and are working on products and technologies that are either satisfying the pressing needs of the consumer or the markets.



Segment	Company Name	Elaborative
<b>Agriculture and Animal Husbandry</b>		
<b>Agriculture and Animal Husbandry</b>	Cisgen Biotech	Developing a POC diagnostic kit for bovine TB
	Equine Biotech	Point of care diagnostics, including a lateral flow and a PCR chip for field based detection of animal Trypanosomiasis (Surra)
	FarmGulp	Value addition of agricultural byproducts and the extraction of natural molecules
	Fibsol Life Technologies	Translate advanced material technologies from research to industry.
	SM Plant Technologies	Micro propagate quality planting materials of economically important plants
	Thomas Biotech & Cytobacts Centre for Biosciences	Endophytic Microbiology.
	Woolly Farms	Novel Technologies in Urban areas through aquaponics.
<b>BioIndustrial / Environmental Biotechnology</b>		
<b>BioIndustrial / Environmental Biotechnology</b>	Biomoneta	Working on the design of a novel air purification device for the reduction of airborne bacteria.
	Butacel Bioresearch	Developing processes for microbial overproduction of 2, 3-butanediol from lignocellulosic biomass based on metabolic engineering.
	Cleanergis	Developing innovative, high-quality enzymes for food and waste-water-treatment
	Codon Biosciences	Development and production of fruit based value added products.
	Drumlins Water Technologies	Work on Fluoride removal from drinking water
	Harvestwild Organic Solutions	Manufactures bio-surfactants from unutilized soapnuts harvested by tribal communities, thus providing them with livelihood.
	India Biolabs	Researching novel all-natural antimicrobials for the food and pharma industry.
	Log 9 Materials	Development of new frontiers in graphene synthesis of various forms, reduction and functionalization and designing innovative applications paved the way of the foundation of the company.
	openwater.in	To provide smart solutions in the area of waste water management.



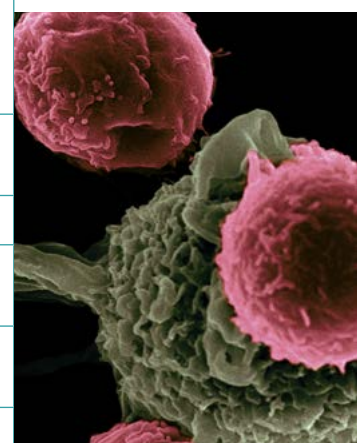


**BioIndustrial /  
Environmental  
Biotechnology**

Prakhoj	Working on malodour management and long lasting freshness by a novel technology for Health and Hygiene
Sea6energy	Bio-energy end-to-end solution to replace the fossil fuels, biostimulants
Shirdi Sai Nutraceuticals	Working on the development of high performance immobilized lipases for non-aqueous esterification of oils and fats in stirred batch reactors.
String Bio .	Rapid, cost-effective and sustainable solutions to global problems using advanced synthetic biology technologies.
Tranalab	Developing novel methods for BioSimilar production. Systems with broad platform potential are being examined, with a focus on IP opportunities.
VT Ecogreen Technologies	Developing eco-friendly technologies for application in the field of food, agriculture, health and environment.
Zero Plast Labs	To solve India's plastic pollution problem
NanoBubbles	Micro & Nano Bubble based STP/WWTP, Project is based on Micro & Nano Bubble technology for treating Sewage/Municipal Waste Water into Potable/Drinkable Grade water for Reuse/Recycle

**Discovery and development****Discovery and  
development**

4BaseCare	Onco-Tech company building a unified and patient centric ecosystem to study the evidence generated from real-world settings
Affigenix	Focus on precision diagnostic kit development for personalized medicines
Ameliorate Biotech	Ameliorate strives to develop innovative technologies and improved processes and provide solutions to give cost effective, affordable products without compromising on quality and safety.
Aten Porus	Focused on nanotechnology based therapeutics for lysosomal storage disorders and other rare diseases
Atrimed Biotech	High quality research and developmental activities
Bioroot Exploration India	Biomedical research and environment protection to improve the quality of human life.
Biotide Solutions LLP	Developing conformationally restricted short peptides as drugs and drug delivery vehicles for cancer.
Bugworks	Aims to discover novel biopharmaceutical assets for the treatment of antibiotic resistant bacterial infections
Diponed Bio	Development of therapeutic molecules.



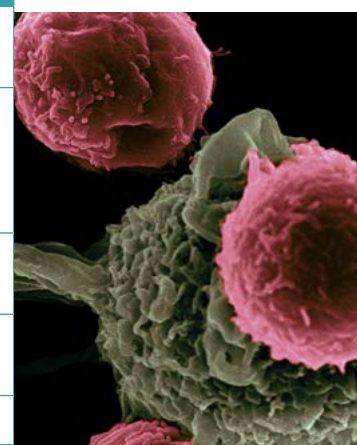


**Discovery and  
development**

Eyestem	Using stem cell and gene editing technologies to create breakthrough therapies for degenerative diseases of the eye.
Fibroheal Woundcare	Working on various biomedical application of silk proteins for various healthcare needs
Galore TX	Focused on discovery and development of small molecule therapeutics targeting various indications including cancer and inflammation
Genext Genomics	Development of recombinant proteins and monoclonal antibodies against clinically relevant targets through the integration of bioinformatics, recombinant DNA technology, proteomics and immunology using novel high-throughput technologies.
Geniron Biolabs	Addressing the unmet needs of Rabies, FMDV, Mastitis and other chronic infectious diseases of domestic animals. Their core proprietary technology includes a platform for DNA synthetic vaccines.
Hanugen Therapeutics	Provide high quality oligonucleotides.
InvivoD Solutions	Focused on providing a novel platform for anti-cancer drug screen in vivo.
Kinome Pharma	Focused on developing solutions for neurodegenerative disorders.
Luxmatra	Working on developing a novel radio-wave responsive, biodegradable nanoparticle platform for image-guided hyperthermia combined with immunotherapy for liver cancers.
OCT Therapies	Working on establishing a mesenchymal stem cell bank to treat burns and ulcers
Pandorum Technologies	Develops proprietary science and technology platforms with the vision to manufacture personalized homochippiens and human organs on demand
Pentavalent Biosciences	Focusing on the development of novel vaccine molecules against fatal human diseases
Plabeltech	Precision labeling of proteins and antibodies with the probe of interest
Sekkei Bio	Developing a peptide editing platform to specifically deliver peptide drugs orally.
Seragen Biotherapeutics India	Treating humans, cattle and agriculture, Artificial Reproduction space, magnifying intervention outcomes helping overcome infertility conditions.
Seragene Bio-Therapeutics	Use of stem cells and platelets to develop antiaging solutions for regeneration of reproductive system.
Snaayu Lifesciences	Working towards isolating and characterizing novel analgesics from cone snail venom



<b>Discovery and development</b>	Theramyt Novobiologics	Focused on biologics and biobetters.
	Viravecs	Focusing on developing transgenic model systems for life science research.
	Vital Bioscientific Solutions	development of a novel monolayer based parallel artificial membrane permeability assay to determine permeability of chemical entities and drugs.
	Western Range Biopharmaceuticals	Developing treatment modalities for cancer patients.
<b>Healthcare</b>		
<b>Healthcare</b>	Biofi	Traditional medical technology that caters exclusively only to physicians and hospital systems
	Biomoneta	Preventing transmission of infection in hospital spaces and the spread of microbial contamination in commercial and academic laboratories using novel air decontamination technology.
	E2E Biotech	Biotechnology research and development of products, services and marketing
	Indoor Biotechnologies	Immunodiagnostics and biotechnology
	Yostra	Healthcare technology in diabetes management
<b>Medical Devices, Diagnostics and Medtech</b>		
<b>Medical Devices, Diagnostics and Medtech</b>	Accord Innovations	Developing a predictive technology platform for the early detection of critical illnesses.
	Achira Labs	Development of a proprietary lab-on-chip platform to perform rapid, quantitative and multiplexed immunoassays
	Althion Tech Innovations	Developing import-substituting medical/healthcare equipment & devices
	Autoyos Private Limited	Autoyos offer comprehensive eye care delivery in non-clinical or resource-poor settings without depending on special infrastructure or skilled manpower.
	Bagmo	Addressing issues of poor blood transfusion facilities in rural areas in India
	Bendflex	Developing devices that enable mechano-diagnostics using a novel design paradigm called compliant mechanisms
	Carditek Medical Devices	A revolutionary way to improve the cardiac care.
	Cartosense	Building products that enable neurosurgeons to plan and safely perform brain surgery through the smallest openings in the skull
	Cellworks Research India	Biopharmaceutical therapeutic design and development company





**Medical  
Devices,  
Diagnostics  
and Medtech**

Coeo Labs	Focused on innovative medical devices for Emergency, Trauma and Critical Care
df3d	Healthcare solutions using 3D printed medical models and customized 3D printed surgical guides.
Empathy Design Labs	Developing a fetal monitoring device to prevent still births in developing countries.
Indio Labs	Developing platform technology devices for soft tissue core biopsy
InnAccel Acceleration Services	Development of affordable medical devices
Innov4Sight Health and Biomedical Systems	Innov4Sight Health and Biomedical Systems is a socially conscious business enterprise having an expertise in the fields of Big Data Analytics, Content Development and Training, Biotech R&D as well as Medical Simulation.
Isense Innovations	Development of Diagnostic kit for food adulteration.
Jiva Sciences	Microfluidics & Photonics based Cell Sorting; Microfluidics & Photonics based Point-of-Care Diagnostics; Lab Automation
Kyntox Biotech	Rapid Point-Of-Care Test Kit to be used in treatment of snake bite.
Lab4life Bioresearch	Provide affordable diagnostics and health care technologies to address biomedical problems
Lifespark Technologies	Specializing in curated solutions for Parkinson's disease
Mercuri Biotechnologies	Developing an all new novel technology for detection and quantification of nucleic acids. This will bring down the cost, time, space without the use of any harmful dyes and enable easy integration into point of care (PoC) diagnostics at very nominal costs
MimyK	Developing immersive medical simulation technologies
Mocxa Health	Video-EEG system for accurate diagnosis of seizures named 360evs
Module Innovations	Biosensors for the detection of E. coli in food and clinical samples
Morphle Labs	Digital Pathology and In-Vitro diagnostics
Muse Diagnostics	Working on a futuristic digital stethoscope
Neospec Labs	Developing a point of care, handheld Bilirubin Meter for accurate detection of jaundice in Neonates





**Medical  
Devices,  
Diagnostics  
and Medtech**

Nesa Medtech	Accessible, minimally invasive procedure to treat symptomatic uterine fibroids safely and effectively
NextGen Invitro Diagnostics	Developed products areas of novel and point of care diagnostics
nWarehouse	Plans to establish IoT network framework to monitor organoleptic properties and the spoilage biomarker of paddy.
Oreva Medicare Research	Works on a hands free "electronic larynx" which is affordable, aesthetic in appearance with near normal sound quality.
Prantae	Working on the development of a diagnostic platform for the miR-based detection of pre-eclampsia
Qawach Bio	Development of a device for the early detection of acute and chronic kidney diseases.
RCupe Life Sciences	Medical devices
Scidogma Research	Develops cost-effective medical technology to serve low-resource settings
Sensivision	Focuses on finding innovative and affordable medical device solutions for Neonatal health challenges
Sepio Health	Developing novel biomaterials to solve unmet clinical needs
Shanmukha Innovations	Develop an imaging-based point-of-care diagnostic device, which can fully-automate the complete work flow of conventional clinical microscopy
Shilps Sciences	Focused on harnessing the power of nanotechnology instruments to solve problems in healthcare
Siamaf healthcare	Working on developing a new method of detecting how far a patient's cancer has spread
Sirfbio	Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes except optical instruments.
SkyFire Applied Intelligence	AI-enabled healthcare solution provider using state-of-the-art technologies to develop economical, accessible, and reliable screening solutions by employing technologies such as Artificial Intelligence
Spotsense	Affordable and accessible diagnostics especially in the field of pediatric medicine
Strand Lifesciences	Data mining, predictive modeling, computational chemistry, software engineering, bioinformatics, and research biology to develop software and services for life sciences research
Svasthyaadhar	Bio-medical research





## Medical Devices, Diagnostics and Medtech

Tejomir Diagnostics LLP	Detection of alcoholic and non-alcoholic liver disease are neither comprehensive nor accurate for all situations and add to increasing costs for patients.
Terrablue XT	Working on technologies to monitor mental health and manage epilepsy
Unilumen Photonics	Biomedical and bioimaging
VNIR Biotechnol- ogies	Imaging and Diagnostic solutions. Unique product line for live cell imaging and early stage disease diagnostics.
Yostra Labs	Diabetic Care
Aindra Systems	At Aindra, we are building a world where Clinical Pathology is Data driven, Fast and Patient focused.
Aprus	Developing "novel", differentiated, cost effective, active wound care devices to address deep wound trauma, chronic wounds, ulcers and Biodegradable diapers/ sanitary napkins
Glogene	R&D firm producing/developing innovation based biotech/life science research products through recombinant protein and peptide technology.
Omix Labs	developing a platform that allows for cost-effective DNA testing for pathogens, outside of laboratory settings.

## Nutraceuticals

## Nutraceuti- cals

Aspartika Biotech	Working on the development of value added products such as nutraceuticals, poultry feed, and aqua feed from the wastes/byproducts of palm oil mills and silk reeling industries
Biotherm Fragrances & Flavours	Delivering quality fragrances and flavors products extracted from sustainable natural resources.
Iosynth	Iosynth is a full service biocatalysis and biotransformation company serving the Indian pharmaceutical, nutraceutical, fine chemical and cosmetic industries.
Mallipatra Nutraceuticals	Artificial cultivation of one of the most expensive mushroom, Cordyceps, which is highly valued for its medicinal properties.
NatIn Therapeutics	Developing scientific and clinical evidence-based nutraceuticals as well as herbal therapeutics for chronic diseases such as obesity, diabetes, anorexia, or cancer.
Robust Herbals	Focus on developing Ayurveda's herbal tradition into a range of proprietary technologies and formulations as alternatives for existing pharmaceuticals/drugs.



	Theevanam Additives & Nutraceuticals	Development of the novel formulation of natural polysaccharide immunity booster for booming Shrimp aqua industry of India.
	Tojo Vikas	Produce high value natural chemicals for the flavor and fragrance industry using innovative biocatalysis or biotransformation processes and renewable raw materials.
<b>Other Emerging &amp; New Areas</b>		
<b>Other Emerging &amp; New Areas</b>	Next Big Innovation Labs	Development of products and services for R&D and clinical applications.
	Cellagility	Delivery of ethically-approved, quality-controlled safe iPSC lines for medical research, affordable regenerative medicine and treatment.
	Jananom	Synthetic biology, biomolecular engineering, strain optimization, analytical characterization, scale up and production.
	Pandorum Technologies	Tissue engineering and regenerative medicine. Building 3D functional tissues through a combination of cells, gels and cell modulators, using self-assembly, 3D printing and other fabrication methods to construct desired tissue like micro-architecture





### 5.1.3

## Landscape of Biotechnology infrastructures in Karnataka

Karnataka due to its focused efforts and collaborative approach has managed to create a strong hub for BioEconomy propagation.

#### Robust biotech Industry

- ✓ The state is home to over 1000 companies and has created more than 100,000 direct jobs in the state. The state has companies spread across all segments of the biotech.
- ✓ The industry has established home grown companies, who have gone to become global leaders to large multinational companies that have made their home.
- ✓ Majority of the entire industry in the state. has MSMEs (Micro, Small, and Medium Enterprises)

#### Important Segments

- ✓ BioMedical segment comprising of BioPharma and Medical Devices is a major driver for BioEconomy. The state has over 60 percent of the companies working in this segment. There are nearly 200 companies
- ✓ BioIndustrial and Biofuels is a very important segment in the Value-chain creation.
- ✓ Research, Development, and Innovation is another important trait of the industry in Bengaluru. Most of the companies are engaged in research services.
- ✓ The industry spans almost all important areas of biotechnology from renewable energy, ethanol production, structural biology of infectious diseases, plant biotechnology, pharmacogenetics, food biotechnology, proteomics, bioinformatics, nanotechnology.
- ✓ BioAgri is another important segment and a lot of players are into plant biotechnology

#### Biotech Incubation and Government Support

- ✓ Karnataka government offers structured support for the industry. It is known to take holistic approach for the development of the entire industry in the state.
- ✓ The government supports skill development, trade promotion, industry-academia collaboration, infrastructure and facilities support, fiscal incentives, and funding support.
- ✓ Skill Development: Karnataka Biotechnology Finishing School Program Phase II - Biotechnology Skill Enhancement Program (BiSEP) is a pioneering program and nearly 700 students have benefited from the program.
- ✓ Infrastructure like Centers of Excellence, Bio-Information Technology Centre at Institute of Bioinformatics & Applied Biotechnology, Bengaluru, Centre of Excellence for Agri Innovation.
- ✓ The state has created several biotech and agribiotech parks.
  - Bengaluru Helix Biotechnology Park is houses two of India's finest institutions – (i) Institute of Bioinformatics and Applied Biotechnology, (ii) Centre for Human Genetics.
  - Bengaluru Helix Biotechnology also has an incubation center with common infrastructure facility operated by Bengaluru BioInnovation Centre, a section 8 company. This incubation center has supported nearly 45 start-ups. Cumulatively all the start-ups are estimated to have raised funding to a tune of Rs 400 crore. Nearly 20 products have been developed at the center. The start-ups played a significant role in responding to Covid (refer section 5.1.6 for detailed information).



- ✓ The other incubation centers that have been supported by the state government include -
  - Incubation Centre-cum Common Instrumentation Facility at Institute of Agri-Biotechnology, Dharwad; Incubation Centre-cum Common Instrumentation Facility at CFTRI, Mysuru; Centre for Biotechnology Research, University of Horticultural Sciences, Bagalkot; Centre of Excellence for Agri Innovation at The Centre for Cellular and Molecular Platforms (C-CAMP). It also supports 30 institutions under New Age Incubation Network initiative and has five technology business incubators (TBI) which house over 30 odd start-ups.
- ✓ The state helps in patent cost reimbursement and marketing support as well.
- ✓ Funding like Bioventure Fund (KITVEN-III). It is a venture capital fund of Rs 35.5 crore corpus and invests in the range of Rs 1-3.5 crore in the initial stage with a follow-on investment up to Rs 5 crore. Its have invested in four biotech companies -- Pandorum, String Bio, Vipragen, and Jiva Sciences.
- ✓ Karnataka has a exciting start-ups encouragement program. Its dedicated start-up cell has be the backbone of encouraging start-ups. The state provides funding in form of Grants to start-ups inder Idea-to-Proof of Concept (Idea-to-POC) program. The funding is up to Rs 50 Lakh for an idea. It also supports social impact programs through Grand Challenges Award.



## Clusters

The Bengaluru Helix Biotechnology Park comprises premier academic and research institutions such as: The Institute of Bioinformatics and Applied Biotechnology (IBAB), Centre for Human Genetics (CHG) and Bengaluru Bioinnovation Centre (BBC), a state-of-the-art incubation center

Biotechnology incubation centers in tier 2 cities of Mysuru and Dharwad in food technology and agriculture, respectively

Developing Incubation centers in Mangaluru and Bidar for aqua-marine and animal biotechnology





### The Bangalore Bio Cluster is comprised of several major institutions

- ✓ National Centre for Biological Sciences (NCBS)
- ✓ Institute for Stem Cell Biology & Regenerative Medicine (InStem)
- ✓ Indian Institute of Science (IISc)
- ✓ University of Agricultural Sciences (UAS, Bengaluru)
- ✓ Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)
- ✓ Indian Institute of Horticultural Research
- ✓ Indian Institute of Nano Science & Technology
- ✓ National Institute of Mental Health and Neurosciences
- ✓ National Institute of Unani Medicine
- ✓ National Tuberculosis Institute
- ✓ Neurobiology Research Centre



## INDUSTRY PLAYERS

### CROs

- ✓ Accenture
- ✓ ClinTecInternational
- ✓ ConnexiosLife Sciences
- ✓ Ecron Acunova /Navitas
- ✓ GSS Pharma
- ✓ ICON
- ✓ iMEDGlobal Solutions
- ✓ Indegene
- ✓ IQVIA (Quintiles and IMS Health)
- ✓ Kinapse
- ✓ Lotus Labs
- ✓ PARAXEL
- ✓ Pharmaceutical Product Development
- ✓ Quanticate
- ✓ Syngene International

### BioPharma

- ✓ AstraZeneca India
- ✓ Biocon
- ✓ Novo Nordisk
- ✓ Strides Arcolab Ltd

### Neutraceuticals

- ✓ Sami Labs Ltd
- ✓ Himalaya Drug Company
- ✓ Natural Remedies

### Enzymes

- ✓ Novozymes
- ✓ Richcore Bio

### Biologics Contract Manufacturing ...

- ✓ Anthem Biosciences
- ✓ Kemwell Biopharma
- ✓ Syngene International





## 5.1.4

### SOCIO-ECONOMIC PERFORMANCE

ABLE conducted two qualitative studies to understand the social-impact of BioEconomy Diffusion.

- ✓ One is a study with the students who have graduated or currently pursuing the Biotech Finishing Schools (BTFS) Program, now called Biotechnology Skill Enhancement Program (BiSEP)
- ✓ The second survey is with the Technology Business Incubators / Centers of Excellence

#### BTFS / BiSEP Students Survey

The Government of Karnataka launched a flagship Biotech Finishing Schools (BTFS) Program in 2011 to help produce industry-ready professionals through a pioneering initiative. Students were provided 100 percent internships and participating institutions signed agreements with industry for training. The first phase was from 2011 to 2016. In the initial phase, 12 institutions were supported by the state Government. After the success of BTFS program, the Karnataka government expanded the program to include 18 more institutions. The BTFS program was revamped in the second phase as Biotechnology Skill Enhancement Program (BiSEP), and offered in collaboration with the Life Science Sector Skill Development Council (LSSSDC) and the Indian Institute of Chemical Technology (CSIR-IIT). Here are key outcomes of the study. The study had representation from the BE Biotechnology and MSc Student from 2011 to date. The Survey was carried out in October 2020 and had over 30 respondents.

#### #1 90% of the respondents have joined jobs

#### #2 If there was no such program, the participants would have gone in for higher studies

Most of the program graduates would have either gone for doing a PhD or Higher studies or joined Academia as a lecturer. This is very interesting. If there was no finishing Biotechnology program, the immediate choice for those passing out with BE / MSc would be to pursue higher education.

#### #3 The participants highlighted the following three as main advantages and disadvantages of doing the course.

##### ADVANTAGES

- ✓ Helps to get a job easier because of the Internship that is done as part of the course. The candidates are generally absorbed by the company in which the internship is done.
- ✓ The monthly stipend was very helpful.
- ✓ Exposure to industry and connect with the employers of Biotechnology companies



##### DISADVANTAGES

- ✓ Remuneration isn't high despite completion of the program.
- ✓ Syllabus is nearly same of the master's program. The syllabus needs overhaul again.
- ✓ The industry link is getting weak. The internships many a times are different from the subject of interest or course. The campus placements activities are a concern now



#### #4 How does the participant view this program?

- ✓ Very good bridge program for fresher
- ✓ The BTFS/BiSEP program is one of the unique program to enhance the knowledge of students. It helps the candidate to be ready to join in different biotechnological industries by enhancing the technical knowledge.
- ✓ Exposure to research, idea in starting up own business, getting a job in a biotechnology firm.

**#5 Suggestions for inclusions**

- ✓ Majority of the respondents have called for updating of the Syllabus. The syllabus is becoming repetitive with what they have already studied in their PG programs. Additional new domains have been suggested for inclusion.
- ✓ BiSEP course is well known in the state of Karnataka. But the outreach is limited to only a few companies. Can it be marketed and the uniqueness be shared with more industrialists both in Karnataka and other states?
- ✓ Include regulatory affairs as a 6-months core course and internship should be strengthened.

**Supporting an innovation culture**

The second survey was about the impact of the Technology Business Incubators, BTFS/BiSEP Host Institutes, New Age Incubation Network, Academic Institutes, and Incubation Centre-cum-Common Instrumentation Facility providers to see the impact these organizations created. The analysis will be presented as case studies.

SI	Case Studies / Activities	Type	Focused own research initiatives	Facility for development, Infrastructure, & instrumentation	Product / Technology Development	Incubation of Start-ups	Catalyze employment generation	Conduct awareness program
			(i)	(ii)	(iii)	(iv)	(v)	(vi)
1	Centre for Human Genetics, Bengaluru	AI / TBI	✓	✓			✓	✓
2	Institute of Agricultural Bio-technology, UAS, Dharwad	AI / TBI	✓	✓	✓	✓	✓	✓
3	Nutra-Phytopharmaceutical Incubation Centre, Mysuru	ICIF	✓	✓	✓	✓	✓	✓
4	Biotechnology Research Centre, UHS, Bagalkot	ICIF	✓	✓	✓	✓	✓	✓
5	K-tech - Manipal Bioincubator	TBI		✓		✓	✓	✓
6	Centre of Excellence for Agri Innovation, C-CAMP, Bengaluru	TBI		✓		✓	✓	✓



7	JSS College of Arts, Commerce & Science	BiSep HI					✓	✓
8	School of Life Sciences, MAHE	BiSep HI					✓	✓
9	Yenepoya (Deemed to be University)	BiSep HI					✓	✓
10	NMAM Institute of Technology, Karkala Taluk, Nitte, Udupi	BiSep HI	✓				✓	✓

### Case Studies

Institute	Projects	Impact Example
Centre for Human Genetics	The Centre for Human Genetics has been pioneering in research in human genetics, training of specialized personnel in human genetics research and diagnostics as well as providing services to patients with rare genetic disorders from all over Karnataka.	<ul style="list-style-type: none"> <li>✓ Over 27,000 families have been assisted over 10 years.</li> <li>✓ Free assessment of patients and counselling in most cases where families were poor.</li> <li>✓ Over 5000 genetic tests (cytogenetics and molecular genetic tests) are performed per year in patients and family members of these patients at nominal or no cost to families.</li> <li>✓ Over 500 doctors, scientists and technical staff have been trained in short courses in genetics</li> <li>✓ Over 50 students completed MSc in Human Disease Genetics program conducted at CHG.</li> </ul>
Institute of Agricultural Biotechnology, UAS, Dharwad	First instalment of Rs 500 lakh was received to establish the state-of-the-art facility to carry out biotechnology-related teaching and research. The second instalment of Rs 600 lakh was received to establish incubation facilities for six incubators. About Rs 20 lakhs was received for offering Diploma students have been trained in the area of Plant Genetic Engineering. Nearly 20 students have been trained.	<ul style="list-style-type: none"> <li>✓ The product/technologies include Bt brinjal, MABC lines of groundnut, sorghum, pigeon pea and rice, apart from cloning of novel genes and development of thousands of new markers.</li> <li>✓ Four patent applications were submitted. At least 150 high-impact research papers have been published in the national and international journals.</li> <li>✓ At least 200 M. Sc. and 25 Ph. D. students have been trained, who have been placed both in the public and private institutions nationally and internationally.</li> <li>✓ Over the last two years, at least 15 PG Diploma students have been trained in the area of Plant Genetic Engineering under BiSEP, KITS, GoK.</li> <li>✓ Incubated at least five startups. Trained four BIRAC Fellows, among them one received ELEVATE assistance and another one received BIG support.</li> </ul>

Nutra-Phyto-pharmaceutical Incubation Centre	<ol style="list-style-type: none"> <li>1. Focused research initiatives for functional foods and nutraceuticals.</li> <li>2. Facilitate incubation facility for entrepreneurs.</li> <li>3. Provide testing and safety evaluation studies.</li> <li>4. Promote SMEs</li> <li>5. Catalyze employment generation</li> </ol>	<ul style="list-style-type: none"> <li>✓ <b>Employment:</b> A total of 16 companies has been part of the Centre so far and they have employed 30-40 trained manpower at different time period.</li> <li>✓ <b>Patents filed:</b> Discussion is under progress with one of the companies for patenting.</li> </ul> <p>Products Developed by Incubatees.</p> <ul style="list-style-type: none"> <li>✓ <b>NutriPlanet Foods Pvt Ltd, Bengaluru:</b> Range of nutrition bars</li> <li>✓ <b>Potential Health Development Pvt Ltd, Bengaluru:</b> Plant based, high protein, low GI, gluten free formulation designed for optimum nutritional benefits. The company established its production facility in Hubli and the product is already in the Market.</li> <li>✓ <b>Nutriparadise Foods LLP, Bengaluru:</b> The Incubatee has come out with number of nutritious health bars for the hospitalized segment and currently their formulations are served in leading hospitals in and around Bangalore.</li> <li>✓ <b>sCOOL Meals Food Ventures, Bengaluru:</b> This company successfully graduated from the center having a range for nutritious meals formulations for school children. The company is supplying the meals I tiffin box in selected schools of Bangalore.</li> <li>✓ <b>Atharva Plantation Solutions Pvt Ltd, Mysuru:</b> It has come out with a unique high premium coffee beverage which is expected to be in the Market soon. The company has tied up with a VC for commercialization and marketing.</li> <li>✓ <b>Dhriti Biosolutions, Mysuru:</b> An existing incubatee, it has established a manufacturing facility for biopolymers at Hunsur (Mysuru). The factory is in the final stage of launching its operations.</li> </ul>
Biotechnology Research Centre, UHS, Bagalkot	<p>State-of-the-art laboratory and field facilities to undertake advanced biotechnology research in horticulture and to train the students.</p> <p>Research projects in tomato; Garcinia indica and G. cambogia; Banana and Pomegranate.</p>	<ul style="list-style-type: none"> <li>✓ Over 70 postgraduates (M.Sc. and PhD) students have used this facility and done the research.</li> <li>✓ Over 150 faculty from UHS and other Universities / Institutions in India have been trained (21 days duration) and the well-attended workshop was also undertaken.</li> <li>✓ Advanced breeding lines of tomato are in farm trials at present.</li> <li>✓ A well-established field gene bank of Banana, Pomegranate, Garcinia indica and Garcinia Cambogia has been established and currently being used to genetically improve the species.</li> </ul>



K-tech - Manipal Bioincubator	<p>Develop facility, Infrastructure and instrumentation</p> <p>Conduct awareness, program, DiYs, workshop, Hackathons, Innovation Day, Industry Experts Talks</p> <p>Incubate at least two new Technologies or New Products/Innovations and minimum 5 startup every year.</p>	<ul style="list-style-type: none"> <li>✓ Has 14 tech start-ups from Biomedical devices, Bio-Pharma, Biotech, Dental Innovation, Diagnostics &amp; Healthcare domains</li> <li>✓ Out of 14, 5 startups received a total fund support of Rs 203 lakh from BIRAC &amp; NSTEDB for the product development.</li> </ul> <p>The socio-economic impact is going to happen once the products are rolled out to market.</p> <ul style="list-style-type: none"> <li>✓ The Bioincubator has incubated newly registered start-ups who are working on deep-tech innovation which will be very impactful as these startups will be addressing apart from all the other problems like providing job opportunities, IPR, economic growth, publications etc.</li> <li>✓ One of the very important problems that our country is facing i.e. to provide high-quality jobs to skilled labor.</li> </ul>
Centre of Excellence for Agri Innovation, C-CAMP	To run an immersion and grand challenges program in agriculture	Once the grand challenges are identified and startups are funded, C-CAMP hopes to have 3-5 cutting edge technologies in agriculture that will transform agriculture in the country.
JSS College of Arts, Commerce & Science	The main objectives of the activities are strengthening the skill sets in the students so that they will become industry ready.	Achieved the goal up to 70-75%
School of Life Sciences, MAHE	Course on Cellular and Molecular Diagnostic (CMD) domain	<ul style="list-style-type: none"> <li>✓ These programs have definitely helped many of the students to pursue their higher studies and providing them with the fellowship during their training period has helped many students who are economically backward. Many students have attended conferences and presented papers. Few students after completion of the course are pursuing their research career and doing Ph.D.</li> <li>✓ The placement record of the institution is above 80% for all the batches.</li> </ul>



Yenepoya (Deemed to be University)	The objective is to train the candidates selected by KBITS in multiomics technologies for 12 months and help placed in industries.	<ul style="list-style-type: none"> <li>✓ 21 students were trained.</li> <li>✓ Out of the 21, 15 people are already placed in the industries, 3 opted for higher studies, and 2 of them are transitioning to Industries now.</li> </ul>
NMAM Institute of Technology, Karkala Taluk, Nitte,Udupi	Projects include 1. To find the efficacy of mycorrhizal and rhizobium bio-fertilizer using RSM approach. 2. Development of Bio-adsorbents for the removal of toxicants from Industrial Effluents. 3. Development of value-added products from Areca Nut 4. Production of Bio-Ethanol using coffee Berry mucilage. 5. Soap/toilet disinfectant production 6. Manufacturing Eco-Friendly Adhesive from jackfruit seed.	<ul style="list-style-type: none"> <li>✓ Students were trained in various aspects of technical expertise during the process of product development.</li> <li>✓ During the process of incubation, they were mentored by experts from industry and academia. They were also trained on business model development and were able to design the financial projection for their overall idea.</li> <li>✓ Almost all the students who were part of NAIN activities are placed in various companies.</li> </ul>

## 5.1.5

### THE ROLE OF MSMES

The very nature of the Biotechnology industry is Small and Medium Enterprises. In June 2020 the Indian Government changed the classification of 'Micro, Small and Medium Enterprises Development (MSME)'. The new criteria for the MSME segment is:

- (i) **a micro enterprise**, where the investment in Plant and Machinery or Equipment does not exceed Rs 1 crore and turnover does not exceed Rs 5 crore;
- (ii) **a small enterprise**, where the investment in Plant and Machinery or Equipment does not exceed Rs 10 crore and turnover does not exceed Rs 50 crore;
- (iii) **a medium enterprise**, where the investment in Plant and Machinery or Equipment does not exceed Rs 50 crore and turnover does not exceed Rs 250 crore.

A quick glance at the list of Top 50 companies published by magazines like BioSpectrum and newspapers points out that most of the biotech businesses will fall in the Micro or Small enterprise category.

**Only less than 100 companies across all segments – BioPharma, Diagnostics, BioAgri, BioIndustrial, Contract Research and Development Services, and BioSuppliers – make biotech revenues of over Rs 250 crore and above from the sales of Biotech Products and Services.**



BioSpectrum in 2019 reported that the Indian Biopharma Industry with over 300 companies is growing at 12 per cent growth. For the year 2018-19 the Biopharma Industry alone crossed Rs 22,124 crore. **The report says that Top 3 BioPharma companies contribute to 46 percent of the total biopharma industry of Rs 22,145 crore.** The top three companies as per that list is Pune-based Serum Institute of India (Rs 4984 crore), Biocon (Rs 3946 crore), and Novo Nordisk (Rs 1352 crore). The three companies add to Rs 10,283 crore.

Karnataka too follows similar pattern. Biocon, Syngene, and Novo Nordisk are the few companies that are over the Rs 1,000 crore mark. The rest of the companies will be under Rs 500 crore.

Karnataka has over 1000 companies. Nearly 90 percent of the sector comes under MSME category. It is important to note that this industry focuses on innovation and platform development. The gestation period of the biotech companies is approximately 10 years before companies take off beyond the MSME category.

## 5.1.6

### PRODUCTS AND SERVICES ALREADY IN USE

Karnataka has a very vibrant BioEconomy in the country. The ecosystem is developing products ranging from farm to pharma. Several examples of the technologies being developed by the Karnataka's companies have been shared in the section below.

Karnataka's Biotech industry responded very proactively to Covid. Here are few products in Karnataka.

Product	Developer/ Founder	Company	Description
Padma Vitals	Dr. Madan Gopal	Cardiac Design labs	Padma Vitals+ is a centralized monitoring system for ECG, respiration, Spo2 and body temperature, which can measure the vitals continuously and the analysis sent through telemetry, with an alerting system embedded in it. The device is much needed for contactless monitoring of patients during Covid-19 Pandemic. The product has been validated at Narayana Hrudayalaya.
Malli's Cordytea	Dr. Moushmi Mondal	Mallipatra Nutraceuticals	Cordytea is an immunity booster tea prepared from medicinal mushroom - Cordyceps. The mushroom variety grown under laboratory conditions is developed by the Innovator. Cordicepin, an active ingredient is known to have antiviral properties too. In the Covid-19 times, it will be helpful in boosting the immunity levels. The product has been patented and is approved by FSSAI.
CD4 Shield	Dr. Vijay Lanka	Stabicon	CD4 Shield is a chewable tablet containing curcumin and Vitamin B12. Both the ingredients fight inflammation and infection. The product ensures activation of innate immunity by activating CD4+, CD8+ and IFN 1 to virus specific effect and has immunomodulatory properties. It also reduces cytokine storm in response to viral infection. The product is approved by FSSAI.

BeamRoti	Dr. Srinivas	Aspartika	BeamRoti is an immunity booster chapati having mixture of herbs recommended by AYUSH Ministry. The ingredients have been prepared using supercritical fluid extraction technology to ensure optimum concentration of herbal extract reaches the body. The chapatis are easy to store with good shelf life and Patent application has been filed. The product is approved by FSSAI.
Immune booster daily drops	Dr. Srinivas	Aspartika	This product is an immunity booster drop having a mixture of herbs recommended by AYUSH Ministry. The ingredients have been prepared using supercritical fluid extraction technology to ensure optimum concentration of herbal extract reaches the body by mixing just one drop of the product in a glass of hot water. The product is approved by FSSAI.
VegPhal - Fruit and vegetable sanitizer	Deepak Bhajantri	Krimmi Biotech	This sanitizer is prepared using edible ingredients effective against microbes and removal of pesticides. It is chlorine and alcohol free.
Water Sanitizer - Kitchen tap	Ravi Kumar	Biofi	This is a miniaturized version of UV purifier that can be attached to a water tap and kill 99 per cent of microbes including viruses such as phages.
Antimicrobial HVAC module	Ravi Kumar	Biofi	It is a module that can be fitted to HVAC systems to ensure circulating air is sanitized. This is especially useful during Covid-19 times as many enclosed spaces in which AC circulated air may be contaminated. Based on UV-silver titanium dioxide technology, the product is patented and has been validated.
Shieldex 24	Mr. Ravi Kumar	Biofi	A UV-ROS box for COVID 19 sterilization. It is a device that can eliminate virus located on any object; ideal for applications in the transportation industry.
Florescence probes and PCR mix for RTPCR detection	Dr. Govindarajan and Dr. Meher Prakash	VNIR	The probes are part of the Covid-19 test kits; the probes are currently imported. Without the probe, virus detection is not possible.
Remote foetal monitoring device- Daksh	Dr. Arun Agrawal	Janitri, Viral Transport Media-DeConto	This is useful for Covid-19 positive pregnant women; the device helps remote monitoring of the fetus.
VTM	Mr. Manjunatha and Mr Dinesh	Deno Bio labs	It helps in safely transporting the live virus sample from the sample collection center to the testing lab.



Cov-Astra an AI-based device for detection	Mr. Adarsh Natarajan	Aindra	A significant breakthrough that can detect Covid-19 virus through an x-ray; eliminates the conventional throat swab way of testing people. Cost per detection is significantly lesser at INR 150-250 per person.
Anti-microbial face wash containing herbal antimi- crobials	Dr. Latha Damle	Atrimed	A herbal product that can kill any virus, including Covid-19 virus from any person's face within seconds.

## 5.1.7

### DRIVERS AND BARRIERS IN THE BIOTECHNOLOGY SECTOR

The major drivers for an industry is when it has conducive environment to offer products and services. Having the right kind of the ecosystem is important.

#### Key Drivers

- ✓ Karnataka's BioEconomy has an industry driven by Innovation-led enterprises.
- ✓ The state is home to many pioneering anchor companies and incubation facilities. The incubation facilities are recognized globally for their innovative programs and favorable environment.
- ✓ The government is supportive very supportive. It has led from the front in promotion of the industry. It is one of the pioneers to create a start-up cell to foster start-up and an incubation ecosystem that besides facility support offers mentorship.
- ✓ The Ecosystem has a good investor community. Leading Venture Capital firms have offices here. The government's start-up cell is a major draw. Nearly over 1000 start-ups apply for every call for funding activity / program.
- ✓ The government has spent nearly Rs 10,000 crore over a period of 10-years to promote the sector in the form of incubators, skill development programs, centers-of-excellence, and fostering of collaborations.

#### The Barriers

The state has a good environment and start-ups are mushrooming. A significant number of these start-ups will have to expand and space has been a big barrier for scaling up,

BioDiversity laws and regulatory environments are key barriers across the country. The state can play a major role in taking up the issues at the state and national levels. The state can push for exemption to startups from Biodiversity laws, similar to Hakims, till IP is filed. The state should support transgenic crops. It needs to rework the Agriculture policy to give clarity on GMOs.

Develop a state level Agriculture Policy that promotes use of emerging technologies like gene-editing/CRISPR, use of biomarkers, development of food alternatives or plant varieties with improved yield and quality, Molecular Farming.

Though the state is moving ahead with progressive policies, it should also be a major player in consuming the goods and services by bringing all the segments from government in one platform in the Healthcare, BioPharma, BioIndustrial, Biofuels segment, Smart Agriculture etc.



Government can give push to Indian companies by strengthening programs that will help companies here to file global IPs.

## 5.2

### NETWORK, CLUSTER AND POLICY ANALYSIS



### 5.2.1

#### NATIONAL AND REGIONAL CLUSTERS, INITIATIVES AND NETWORKS

The number of start-ups in the country are on the rise. In 2018, nearly 937 start-ups were established across the country. By December end 2019, the number of biotech startups in the country stood at 3,325. This was nearly 25% higher than the previous year's figure.

Mumbai, Delhi, Hyderabad, and Bangalore are the cities of choice of registration of startups. These four cities account for 43% share of the total registrations.



## BIOTECH STARTUPS 2012-2019

OTHERS  
**1353**

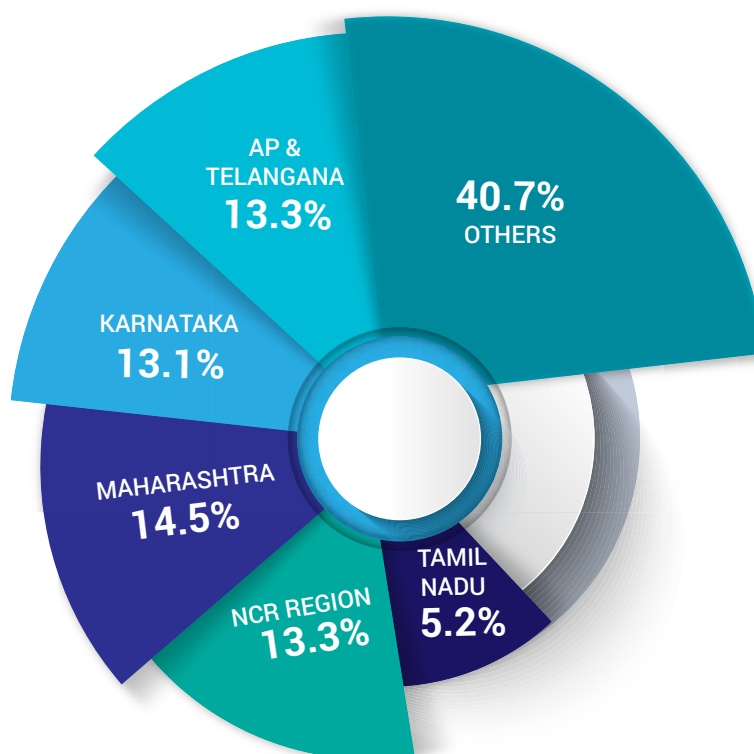
TOTAL STARTUPS  
**3325**

### 5.2.2 CONCLUSIONS

Karnataka is at a threshold from where it can further leap forward to a better world with Support to BioEconomy by supporting the ecosystem and removing the barriers.

## STARTUPS (% SHARE)

*Karnataka accounts for 13% share  
of the total biotech formed during  
2012 - 2019*



**KARNATAKA'S BIOECONOMY IN 2020 IS ESTIMATED AT \$22.6 BILLION (RS 159,330 CRORE). THIS IS NEARLY 10 PERCENT SHARE OF THE GROSS STATE DOMESTIC PRODUCT (GSDP) OF KARNATAKA) WHICH IN FY 20 STOOD AT \$221.82 BILLION (RS 1699115 CRORE).**

## BioEconomy Potential

The state's BioEconomy has potential to grow strongly. ABLE sees 4 case scenarios.

**#1: Pessimistic Scenario** – This is when things aren't moving and are at standstill

**#2: Realistic Scenario** – This is when it is business as usual condition

**#3: Optimistic Scenario** – This is when conditions turn favorable

**#4: Targeted / Desired Scenario** – A scenario where the gravity needs to be defied to achieve the goals. This is a scenario where Government's support will be very much needed to break the barriers and leapfrog.

**Table 3: BioEconomy of Karnataka (Forecast FY2020-2025)**

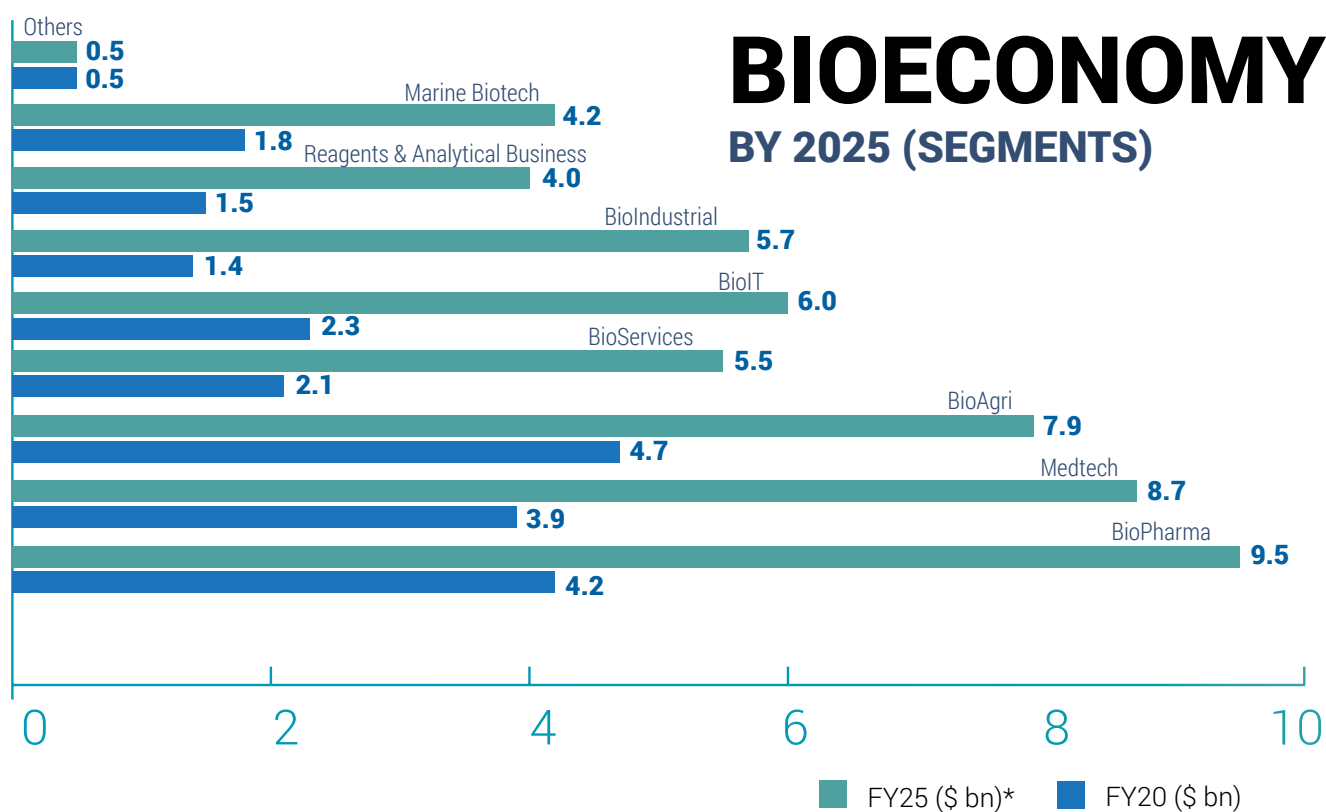
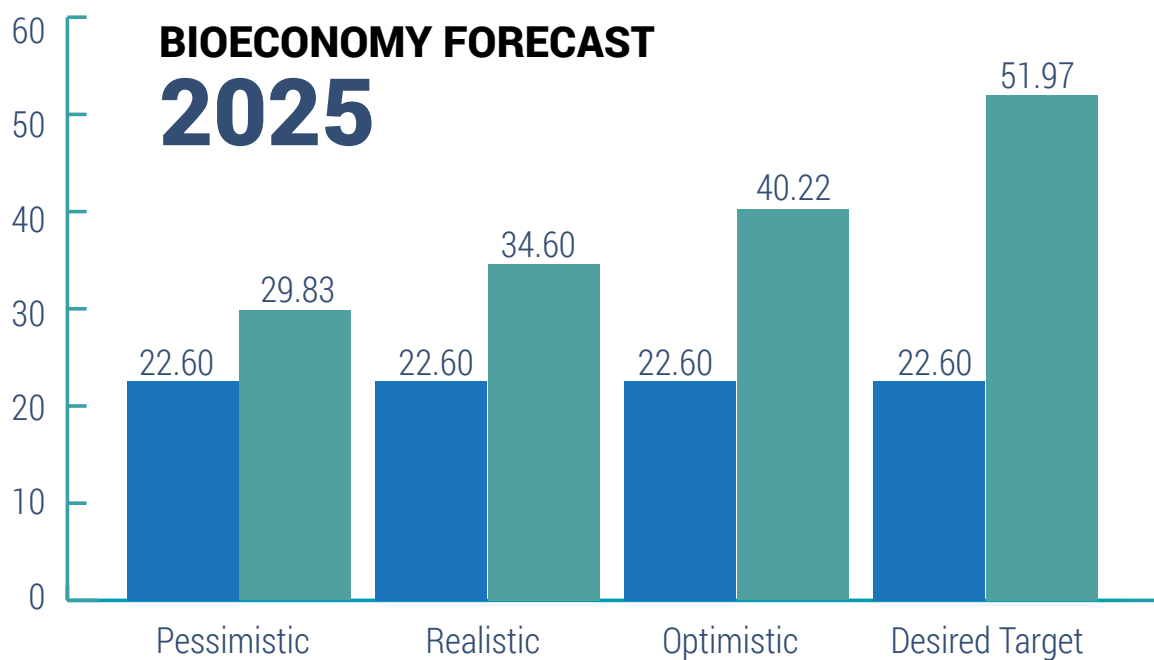
Scenarios	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Scenarios	Value in (\$ Billion)				
Pessimistic	21.29	22.63	24.35	26.26	29.83
Realistic	22.09	23.72	25.74	29.83	34.60
Optimistic	22.93	25.74	29.83	34.60	40.22
Desired Target	22.93	28.73	34.60	42.22	51.97

Source: ABLE Projections

The pessimistic forecast puts the BioEconomy of Karnataka to be at \$29.83 Billion in 2025. The BioEconomy most likely in Realistic conditions will touch \$34.6 billion. In an optimistic scenario, the BioEconomy will be at \$40.22 Billion. But with support from the Karnataka government, the BioEconomy value is likely to cross \$50 billion. This is the Desired / Targeted Scenario.

This chapter gives insights into what the Karnataka government can do to reach a \$50 billion BioEconomy by 2025.









## 6.1

### REVISITING THE BARRIERS AND PROBLEMS

It is important to keep reminding and checking the performance of any policy, strategy, or goal on five key indicators.

- ✓ The cross-sectional nature of Biotechnology products and services.
- ✓ The market dynamics in a BioEconomy are different. They vary from segment to segment and sector to sector.
- ✓ The purpose and visions contrast from segment to segment as well. BioEconomy fosters heterogeneous characteristics as it has to meet societal needs.
- ✓ The level of product maturity, innovations, and markets are different.
- ✓ Interdependent yet independent. Interestingly, the innovation and diffusion of biotechnology advance independently between the sectors. The evolution is in disconnected innovation systems. This means barriers and solutions change with segments.

Taking into consideration these traits will help development of BioEconomy in a more circular way.

## 6.2

### OBJECTIVE 1: ENHANCE COOPERATION BETWEEN RESEARCH, SMEs AND START-UPS

#### Preliminary Analysis

Researchers, SMEs, and Start-ups come with different energy levels and different priorities. Generally big firms dominate production activities. Small companies normally work in niche segments and with small productions. Large production and manufacturing companies are fewer in number than the SMEs,



Research enterprises, and start-ups. While support for SMEs and Start-ups is there from Governments, the support to large companies need to be ushered so that the entire ecosystem grows.

#### Possible Policy Actions

- ✓ **International Investments:** Promote international investment.
- ✓ **Fiscal benefits:** The SMEs that incorporate sustainable and circular economy processes and solutions into their pipelines should be incentivized.
- ✓ **Networking & Communication:** Formal networking events to facilitate informal collaborations
- ✓ **Public Private Partnership (PPP):** Encourage PPP creation to assist BioEconomy activities.

## 6.3

### OBJECTIVE 2: PROMOTE INTEGRATION OF KNOWLEDGE AND EXPLORATORY INFRASTRUCTURE

#### Preliminary Analysis

The overall impact of bio-based bulk products based on sustainability is ambiguous. For some industries like the Biopharmaceuticals and Enzymes focus is on advances in knowledge development. This activity is a continuous process. These sectors are developing new products or applications regularly. However, this is not the same across all sectors and segments. Hence access to advanced technologies across the value chains will help create better products and process optimization and efficiency.

#### Possible Policy Actions

- ✓ **Biotech Portals:** Create State-level Portal Hubs within formation about all stakeholders, their expertise, products and services. These Portals can be for several industries: Blue BioEconomy Hub (For Marine Biotech), BioIndustrial Hub (Green Chemicals & Biorefineries), Biomass Hub, etc.
- ✓ **Bio resources Infrastructure Network:** The Government can help create and support a network that centralizes requests for infrastructures related to Bio resources, prototyping, and pilot upscaling facilities.
- ✓ **Entrepreneurship and Business Training session:** Implement training sessions in entrepreneurship, management and industrial skills in the training programs for scientists to non-scientists in identified areas.
- ✓ **Investor Connect:** Promote knowledge dissemination and help connect with investors and funding stakeholders. This can be done through focused and regular events, workshops, and market research.

## 6.4

### OBJECTIVE 3: FACILITATE ACCESS TO FINANCE FOR SECOND AND THIRD ROUNDS OF PRODUCT DEVELOPMENT

#### Preliminary Analysis

In general, it has been observed that smaller innovative firms focus on niches or certain activities, such as R&D development or services. A few large firms which required large production sites or scale-up effects only exist to a limited degree in the Industrial sector. Their requirement is different. Irrespective of size, market access and relatively large investments are still needed, favoring larger firms.

### Possible Policy Actions

- ✓ **Acceleration Programs:** Create BioEconomy Acceleration programs, competitive funding calls to address challenges suggested by the industry, and funding schemes for high-risk experimentation and exploratory projects.
- ✓ **Funding Schemes:** Simplification of national funding schemes through the implementation of two or three stage submission projects, and implementation of fast track processes from decision to payment.
- ✓ **Support for companies in value chain:** Karnataka's biotech venture fund should now expand its scope to the start-ups in the value chain as well. Karnataka's Bio-Venture Fund (KITVEN III), set up by KITS, in association with multiple state entities should further increase its Fund size and support the concept of **BioEconomy**.
- ✓ **R&D Investment into BioEconomy at 2% level of BioEconomic Value:** Low investment in R&D and translation capability and lack of investments of private players in innovation are major contributors to suboptimal innovation outcomes. Gross domestic expenditure on research and development (GERD) in India is mainly driven by the government sector, of which 45.4% is the Central Government, 6.4% state governments, 6.8% higher education, and 41.4% industry—with 4.6% from public sector industry and 36.8% from private sector industry during 2017–18.5. Karnataka should create \$1-3 billion investment support for R&D by 2022.
- ✓ Continue funding of **start-ups in the BioEconomy** activities with Idea2POC (fund size of up to INR 50 Lakhs), Start-up Fund of Fund (Rs 200 Crore), Grand Challenges among others.
- ✓ **Support for other segments:** Technology business incubators (TBI) being set up in universities and R&D Institutions and New Age Incubation Network (NAIN) in colleges need to also support the other segments in the BioEconomy. They focus could be on Marine, Biofuels and Biorefineries, Green Chemicals, etc.

## 6.5

### OBJECTIVE 4: IMPROVE CLARITY AND COMPLETENESS OF LEGAL FRAMEWORK

#### Preliminary Analysis

In general, most of the private players shy away from investing in innovation due to lack of incentives. This phenomenon is not limited to just India but most low-income or middle-income countries. Innovation is very crucial in generating competitiveness. It helps a sector to grow and expand leveraging scientific and technological excellence. However, the development of innovative products and services can happen in environment with better and continuously improving legal frameworks.

Biotechnology innovations often get stuck or take a long time due to delayed in regulatory processes. These delays affect the entry of innovative bio-based products into the market. Also the process of approval in most segments is cumbersome. It is a challenging task.

#### Possible Policy Actions

**Database Support:** For R&D, start-ups are required to leverage information from several databases providing information on patents and legal aspects, among others. This is critical for product development. However, these databases need to be subscribed to annually, are expensive and lead to additional costs for companies. Support services providing access to relevant databases will help minimize operational costs for start-ups and give access to mentorship cells that help hone business skills of scientists.



Karnataka has a policy for provide access to scientific patent databases to start-ups, incubators and academic institutions as part of the start-up booster kit. Provision of access to co-share Patent and Legal databases should become part of the BioEconomy support scheme. This will help R&D start-ups conducting extensive research and development. This facility should continue to extended to technology business incubators (TBIs), BiSEP and new-age incubation network (NAIN) institutions across the state. Policy Initiative: Provide start-ups with business advisory services and facilitate access to private investors through a mentorship cell set up at incubation centers

## 6.6

### OBJECTIVE 5: DEVELOPMENT OF POLICY OPTIONS

#### Preliminary Analysis

The transition to the modern BioEconomy is driven by new knowledge and developments in technology. The aim is to develop new renewable products and services that have the capacity to become economically relevant.

**Minimize Regulatory uncertainties:** States should look at minimizing regulatory uncertainty, while ensuring the social perspectives in BioEconomy Development.

**Fostering Entrepreneurship Among Research Scientists:** KITS should plan to set up a mentorship cell in association with the Association of Biotechnology-Led Enterprises (ABLE) to help scientists and founders of start-ups focus on business. The cell will comprise a committee or a pool of expert consultants and will be run at state-run incubation centers and new-age incubation networks. The cell is aimed at facilitating start-ups to develop:

**Idea Validation:** Guidance related to review of proof of concept, business idea validation, provision of feedback will be provided by expert consultants to startups.

**Business Plan:** Start-ups will receive support to develop an attractive business plan entailing the market, commercial and technical feasibility for the start-up's idea, and will help attract relevant funding from banks, private institutions, and venture capital funds.

**Sales and Marketing Strategy:** Following the successful development of the product/solution, start-ups will receive guidance to prepare a go-to-market strategy which will detail the sales and marketing efforts required to commercialize the product/solution successfully and access PE/VC funding for their ventures.

**Start-up/Entrepreneur Education and Training Program:** This program is aimed at providing education and training to start-ups and potential entrepreneurs through short-term courses, workshops, conferences, covering a wide area of subjects of relevance such as HR, finance, IP, management, leadership, and regulations.

These programs can be developed in collaboration with institutes such as IIM Bengaluru. IBAB, CHG & BBC IABT (Dharwad) and CFB@UHS (Bagalkot) can lead in coordinating such a program, and this, in the form of a pitch document, can help start-ups develop a market entry strategy along with access to private equity/ venture capital funding.

This needs to be extended to the entire Bio-based companies.



**A** complete analysis of the full range of data available for measuring all of the subsectors of the BioEconomy would be ideal. This will help capture the social benefits of the BioEconomy's contribution to human and environmental health.

## 7.1

### INVENTORY OF RELEVANT ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

Measurement of the benefits is really difficult and complex as well. It is based on several parameters. Here are some details of raw data for a few segments.

#### Key Economic Details of Karnataka

Sl.	Parameters	Karnataka
1	Geographical area (sq km)	192,000
2	Administrative districts (No)	30
3	Population density (persons per sq km)	319
4	Total population (million)	61.1
5	Sex ratio (females per 1,000 males)	973
6	Literacy rate (%)	75.6
7	Male literacy rate	82.5
8	Female literacy rate	68.1
9	Gross State Domestic Product (GSDP) of Karnataka (Rs crore) FY 21 by Budget Estimate	1,806,000
10	Gross State Domestic Product (GSDP) of Karnataka (\$ Billion) FY 21 by Budget Estimate	258.37
11	Gross State Domestic Product (GSDP) of Karnataka (Rs crore) FY 20	1,699,115.33
12	Gross State Domestic Product (GSDP) of Karnataka (\$ Billion) FY 20	221.82
13	The GSDP CAGR between 2015-16 and 2020-21 in rupee term	11.56%
14	GSVA of Karnataka (\$Billion)	216
15	GSVA of Karnataka (Rs Crore) FY 20	1,518,554.66
16	Primary Sector (Share of GSVA) FY 20	12.36%
17	Secondary Sector (Share of GSVA) FY 20	23.92%
18	Tertiary Sector (Share of GSVA) FY 20	63.71%

Source: IBEF and Ministry of Statistics and Program Implementation



### Cotton Market

	2019-20			2018-19		
Karnataka	Pressed	Loose	Total	Pressed	Loose	Total
<b>Figures in Lakh Bales</b> (of 170 kg pack)	19.9	1.1	21.0	14.4	1.1	15.5
<b>Figures in Rs crore</b>	226	13	239	164	13	176

Bioresource	Total energy, Mkal	% Contribution
Agriculture	26560047	13.6
Forest	79431779	39.8
Horticulture	86871417	43.6
Plantation	312604	0.15
Livestock	5997527	3.01

### Renewable Energy Progress Report - upto September - 2020

Allotted Capacity in MW	Commissioned Capacity in MW	Cancelled Capacity in MW
18469.77	4823.54	8565.78
3010.25	903.46	765.51
2182.65	1731.16	0.00
391.18	139.03	0.00
51.00	0.00	0.00
9791.44	7336.51	432.00
33896.29	14933.70	9763.29

## 7.2

### ASSESSMENT OF IMPACTS BY MEASURE

Based on the four economic sectors—primary, secondary, tertiary, and quaternary—here are the suggested segments that need to be tracked. This table is for illustrative purposes the strength of some of the competing states based on revenues generated by companies in their respective states and the gross state value. Karnataka as part of its BioEconomyStrategy should Monitor these 25 industry segments to observe the progress being made in the BioEconomy. These sectors will include the not only the Gross Value but also the Employment Index. This is important to assess the direction the state is taking to meet its BioEconomy targets.

SECTORS	ANDHRA PRADESH	TELANGANA	NCR / DELHI	KARNATAKA	GUJARAT	MAHARASHTRA	TAMIL NADU
AGRICULTURE	5X	5X	4X	5X	5X	5X	5X
AUTOMOTIVE AND MECHANICAL ENGINEERING	5X	5X	5X	5X	5X	5X	5X
BIOFUELS/ BIOENERGY	3X	3X	2X	4X	3X	4X	3X
BIOINDUSTRIAL ENZYMES	2X	2X	3X	4X	3X	4X	3X
BIO-IT & INFORMATICS SERVICES	4X	4X	2X	5X	4X	4X	4X
BIOMASS PRODUCTION	4X	4X	4X	4X	4X	4X	4X
BIOREFINING	3X	2X	2X	3X	4X	4X	3X
CHEMISTRY (INCL. BIOPLASTICS)	3X	3X	3X	3X	3X	5X	4X
CONSTRUCTION/ BUILDING INDUSTRY	5X	5X	4X	5X	5X	5X	5X
CONSUMER GOODS SUCH AS COSMETICS AND CLEANING PRODUCTS	2X	2X	3X	3X	2X	4X	3X
FEED	3X	3X	2X	4X	3X	4X	3X
FISHERIES	4X	3X	2X	4X	4X	4X	4X
FOOD & BEVERAGE INDUSTRY	3X	4X	4X	4X	4X	4X	4X
FORESTRY	3X	3X	2X	4X	3X	3X	3X
HEALTH	4X	3X	4X	4X	3X	4X	2X
KNOWLEDGE/ INNOVATION	3X	3X	3X	5X	2X	4X	3X
LABORATORY EQUIPMENT, REAGENTS, BIOSUPPLIER SERVICE SUPPORT	2X	2X	4X	4X	3X	4X	3X
MEDICAL DEVICES & DIAGNOSTICS	4X	4X	3X	4X	3X	4X	4X
MINING	2X	2X	2X	3X	2X	2X	3X
PHARMACEUTI- CALS INDUSTRY	2X	4X	4X	3X	3X	5X	3X
PULP AND PAPER	3X	3X	3X	3X	2X	3X	2X
RESEARCH & DEVELOPMENT AND SERVICES (CROs +)	2X	4X	3X	5X	3X	4X	3X
TEXTILES	4X	4X	2X	4X	4X	4X	4X
ACADEMIC / PUBLIC RESEARCH INSTITUTES	4X	4X	2X	4X	4X	4X	4X

Notes: X represents the strength on a scale of 5. 1X is the lowest and 5 times X the highest. This means sector included in BioEconomy strategy

## 8.1 DIFFUSION OF BIOTECHNOLOGY

**T**he BioEconomy of Karnataka can ramp up from \$22.6 billion BioEconomy to \$50 billion BioEconomy. The state has been on track with its focus with dedicated policies. However, now with the state taking the pioneering effort to target BioEconomy as a whole and not just Biotech Industry and the beneficiaries of that sector, Karnataka is taking a major leap.

This is a movement from working in silos to engage the various economic sectors simultaneously keeping in mind the sustainable development goals (SDG) in its Economic activities push.

Globally, some thinkers suggested that the state's BioEconomy activities should contribute nearly 15-25 % of the Gross Domestic Product value.

The state can create 250,000 to 300,000 direct jobs and another 500,000 indirect employments.

The state should support creation of at least one unicorn in each of the 25 segment in the next 10 years.

With an annual BioEconomy output of \$22.6 billion, Karnataka accounts for one-third of the national BioEconomy revenues and the nation looks up to the state to propel this sector.

## 8.2 KARNATAKA'S COMPETITIVENESS AND INNOVATION CAPACITY

Karnataka has a good record on innovation and an ecosystem that promotes technology start-ups. There are nearly 300 start-ups that have bagged funding support from the science, technology, and innovation department of the state. Here are a few important things that the Government can focus on apart from the directions mentioned in the Biotech Policy and Start-up Policies.

These suggestions are based from the industry's view and the detailed analysis done by IKP Knowledge Park on Innovation.

In Bengaluru, a number of industries focus on industrial biotech and applied microbiology while there is no institute with major focus in these areas. This limits the choice of collaborations to certain faculty in the institutes. The other mismatch in Bengaluru is the presence of such a niche institute as NIMHANS which focuses on mental health and neurosciences, but there is no major industrial R&D center that has neurology and mental sciences as its focus areas.

Bengaluru industries consistently have good citations for their publications which can be correlated to the large number of collaborators.

Large companies in every growing cluster serve as anchors to support innovation. These companies invest in promising start-ups and some of them set-up research centers such as Mazumdar Shaw Cancer Centre and Biocon-BMS Research Centre. South Indian have nearly a dozen such anchors which generate over billions of rupees in revenue. A part though small is invested into R&D and improves the innovation profile of the cluster.

These anchors also generate skilled workforce and create talent pools because of the large number of employees trained in world-class setups. A good number of employees also move out and create start-ups.

Bengaluru is one of the most hi-tech entrepreneurial cities in India. It has the highest number of venture-funded life sciences companies, largely in healthcare IT and medical devices.

Innovation indicators	Bengaluru
Strong research institutes	😊😊
Business schools	😊
Clinical community for large animal and biocompatibility studies	
Strong clinical community	😊😊
Presence of investors	😊😊
Community investments	
Good presence of industries in all areas of biotech	😊
Mature markets and customers	😊
Strong manufacturing sector	
Pharma industry	
Strength of IT sector	😊😊
Vibrant start-up community	😊😊
Networking forums	😊😊
Job availability in diverse streams	😊😊
Talent pool	😊
Mentors with global experience	😊😊
Legal and CA community	😊😊
Incubation	😊😊
Infrastructure	
Support for women entrepreneurs	
Supplier and vendor base	😊
Government support	😊😊
Weather	😊😊

A comparative table of attributes indicating the quality of the innovation ecosystems. This feedback was compiled by IKP in 2017 interviewing key opinion leader. The degree of satisfaction for each attribute has been captured qualitatively through the ubiquitous smiley - two smileys indicating very good, one smiley for satisfactory / okay and blank indicating a gap / need for improvement.





## 8.3

### MEASURES TO MAXIMIZE IMPACT

Karnataka has a great potential for growth and with a focused approach. Karnataka can target to create a \$50 Billion BioEconomy by 2025. Here are a few are the recommended Strategies for Growth

It is evident from the study that even in the most optimistic scenario, Karnataka's BioEconomy revenues will only reach \$42 billion in 2025. To achieve the desired goal of crossing the \$50 billion mark, the state could consider the following strategic initiatives to attract additional investments and boost to some of the existing sectors. Some of these new initiatives will start giving results in a few years and help the state to achieve the challenging task of garnering 50% market share of national BioEconomy by 2025. Here are the recommendations:

#### #1 VACCINE HUB

Karnataka as India's largest biotech hub has no vaccine manufacturing facilities. Proactively attract few vaccine manufacturers from India and abroad in a special Vaccine Hub. (Investment: \$1 billion. BioEconomy potential; \$2 billion)

#### #2 BIOMANUFACTURING HUB

Set up at least one BioManufacturing Hub outside Bengaluru. This hub can be in a minimum of 100 acres. The hub can house five to ten dedicated manufacturers with 10-20 acres each. The Hub should have Common infrastructure facilities. The Government can be set up with an investment of \$800 million. The hub can generate revenues of \$1.5 billion.

#### #3 BT CROPS

Karnataka's brinjal production is 4.32 lakh tons (3.5% share). The revenue value is nearly \$500 million. The state can Grant No Objection Certificate (NOC) for trials and commercialization of Bt Brinjal. Karnataka can aim for doubling production to 8 lakh tons. Additional economic value: \$ 1 billion. Other Southern states are not major producers now. National market exists

#### #4 MARINE BIOTECH

The current marine production is nearly 8 lakh tons. The total value is nearly \$2 billion. The state can with a focused approach help in annual yield increase by 20-25 % with scientific inputs. The focus on this sector can add another \$3 billion to state BioEconomy. Here are the suggested 4-step approach.

**Re-circulatory aquaculture systems:** Karnataka currently has a need for prawn hatcheries and nurseries using a re-circulatory system rather than having to depend on fresh sea water daily. Poor quality sea water near the coastline is often contaminated with effluents and other runoff from land which poses a biosecurity threat. This is increasingly becoming a major concern for India's aquaculture industry and a concern for importers too.

**Fin fish aquaculture:** High dependence on shrimp aquaculture in terms of volume and value. There is a significant priority on diversifying into fin fish aquaculture in a sustainable manner especially in barramundi, cobia, tilapia, group and trout.

**Oyster and crab hatcheries:** There is a growing interest for commercial production of crabs and bivalves such as oysters. This involves accessing technology, expertise and international capability to partner with Indian organizations.

**Shrimp feed:** Seafood export is dominated by shrimp (predominantly the vannamei species). Frozen shrimp contributes more than 65 percent of exports, by value. There is a significant demand for good quality shrimp feed.

#### #5 BIOMEDICAL CLUSTER

Karnataka is already identified as a Biomedical Manufacturing cluster for insulin pens, stents and implants, medical electronics. The state has over 100 medical devices startups in Karnataka. Karnataka is a major maker of ventilators.



Scope to set up a Biomedical manufacturing cluster on the lines of AMTZ in Visakhapatnam with all ancillary industries and a good support network. Diagnostic devices to be major products in demand. (India imports 80% of diagnostic devices worth \$5 billion).

## #6 INTEGRATED BIOREFINERIES CLUSTER

There has been a thrust on increasing ethanol production. Since the last six months the efforts on Biorefineries and BioEnergy have been revamped in the country. Distributed manufacturing may be the order of the day. In the last six months over 50 Projects have been approved by Department of Food & Public Distribution (DFPD), Government of India, under the "New Scheme for extending financial assistance to sugar mills for enhancement and augmentation of ethanol production capacity" notified on 08.03.2019. Hubli-Dharwad-Belgaum can house this cluster.

## #7 AGRITECH

Value added agriculture enabled by farm to market technology platforms will be a significant contributor to Karnataka's BioEconomy. From biofertilizers, biopesticides and micro-propagation technologies, Karnataka can lead in new agricultural technologies. Focusing on key agri-belts of Hassan, Dharwad and Belagavi will provide inclusive economic opportunities.

### Few Case Studies

## #1 VACCINE HUB

Karnataka is one of India's largest biotech hubs. Yet it has no large-scale vaccine manufacturing facility. The COVID-19 pandemic has brought vaccine manufacturing to the forefront. As one of India's pre-eminent BioCluster, Karnataka should proactively attract few vaccine manufacturers from India and abroad and create a special Vaccine Hub. (Investment: \$ 1 billion. BioEconomy potential; \$2 billion)



## Why a Vaccine a Hub?

India is a major supplier of affordable vaccines to the world. Vaccines are a very important component of the BioPharmaceuticals business and a key component of a successful BioCluster in India. There is at least one major vaccine anchor in every region.

A case in point, the National Capital Region of Delhi has players like Panacea Biotec and Premas Biotech. The Hyderabad region has Bharat Biotech, Biological E, Indian Immunologicals, and Sanofi. Now Dr Reddy's and Aurobindo Pharma are also actively working towards building the vaccine manufacturing capabilities and focus. Pune Cluster is anchored by Serum Institute of India. It is a world leader and is now leading the way to make Covid vaccine supplies at unprecedented scales. Pune Cluster also has Haffkine BioPharmaceuticals. Gujarat has manufacturing plants of Chiron Behring Vaccines (acquired by Bharat Biotech International) and Intas Biopharmaceuticals.

### Here are some characteristics of strong biotech regions:

- ✓ Each of the successful BioPharmaceutical clusters has a vaccines manufacturing base.
- ✓ 60% of Vaccines made in India are exported
- ✓ Large pharmaceutical players are now expanding their portfolio to vaccines. Zydus Cadila invested significantly. Hyderabad-based Dr Reddy's is entering the space. Aurobindo has a joint venture with Tergene for vaccines and ready to manufacture Covid Vaccines in 2021.
- ✓ India will be one of the most important suppliers of Covid Vaccine. India's image is likely to get further etched in this field especially with its contributions to the global Covid supplies.
- ✓ Animal vaccines are also a big opportunity.

With vaccines industry getting the due attention in the current pandemic situation, Karnataka has the opportunity to fill the vacuum in this space. The state can leapfrog and help facilitate in building world class modern manufacturing and cold chain facilities for many new vaccines. Many reports suggest that India will play a significant role in supplying of vaccines to the world when several of the vaccine candidates get the regulatory approvals.

Below is an example as to how the Covid Vaccine alone is creating a new opportunity.

According to ABLE's preliminary understanding, Indian companies are setting up facilities for nearly 5.5 billion doses of Covid vaccines by 2021. The estimated investments are to the tune of Rs 1650 crore (\$250 million). The procurement cost by the GAVI alliance for Covid vaccine will be Rs 250 (\$3). At that rate Indian companies will supply vaccines valued at nearly Rs 123,750 crore (\$16.5 billion). This price globally will be nearly \$20 according to some estimates.

There is an opportunity in cold storage as well. The current capacity as per the immunization program is nearly for 600 million doses and the cold chain infrastructure of the private sector is for 250-300 million doses. Hence the gap is for another 550-600 million doses annually.

Sl	Company	Million Doses (by 2021)
1	Serum Institute of India	2000
2	Bharat Biotech	500
3	Biological E	1400
4	Aurobindo Pharma	300

5	Panacea Biotech	1000
6	Zydus Cadila	100
7	Indian Immunologicals	100
8	Mynvax	
9	Dr Reddy's Labs	100
<b>Total Doses</b>		<b>5500</b>
<b>Cost per Dose</b>		<b>Rs 225 (\$3)</b>
<b>Cost per Dose Globally</b>		<b>\$20</b>
<b>Total Value</b>		<b>Rs 123,750 crore (\$16.5 billion)</b>
<b>Total Investments</b>		<b>Rs 1,650 crore (\$250 Million)</b>
<i>Source: ABLE</i>		

Vaccine manufacturing systems have changed evolved over the last few years. Yet the production and distribution systems big costs are around production and purification of vaccines and storage by refrigeration between 2 and 8 °C. Karnataka has an opportunity to strengthen the infrastructure to support the needs of the vaccine development through an academia-industry interface as well.

## #2 BIOMASS, BIOENERGY, BIOFUELS, AND OTHER RENEWABLES

Karnataka has a renewable energy policy. This needs to be amended with the current dynamics for tapping the BioMass, BioEnergy, and Municipal Solid waste. This is a very important segment of the BioEconomy and the state can close align the BioEconomy and BioRenewables goals.

Here are some of the segments that present opportunity and why Karnataka needs to strengthen various projects. Here is an example of the Ethanol projects opportunity.

### Ethanol Projects

Karnataka is the third largest state after Maharashtra and Uttar Pradesh in terms of the number of approvals from Department of Food and Public Distribution, Government of India, (DFPD) for ethanol projects.

The Indian Government as of October 31, 2020 has extended soft loans of about Rs 19,000 crore through banks to about 368 projects. These include 351 sugar mills and 17 molasses based standalone distilleries for augmentation and enhancement of ethanol production capacity. These projects on completion would increase ethanol generation capacity by 189 crore litres in another two years. This is likely to increase India's total ethanol generation capacity from 426 crore litres per annum to 615 crore litres. India aims to achieve 20% blending target and would have to reach 800 crore litres more ethanol distillation capacity. Hence, the government is supporting sugar mills to go in for ethanol capacity augmentation.

Karnataka accounts for nearly 18 percent share of the total number of projects approved and nearly 21 percent share of the Project value as per ABLE's preliminary study. Over 50 projects from Karnataka, that total to nearly over Rs 3,250 crore, have been approved for loans.

The state government's support can help create the ecosystem. This segment has the potential to grow by five-fold times from the current level by 2025 to over \$5-6 billion



### List of Companies Approved for Ethanol Projects

Sl	Company
1	Bannari Amman Sugars Ltd, Dist., Mysuru
2	Bhalkeshwar Sugars Ltd, Near I.B. Bhalki, Bidar
3	Bhavani Khandsari Sugars Ltd, Dist-Bidar
4	Bhimashankar Sahakari Sakkare Kharakane Niyamit, Vijaypur
5	Bidar Kissan Shakhar Karkhana Ltd, Bidar
6	Bilagi Sugar Mill Ltd, Bilagi, Distt- Bagalkot
7	Core Green Sugar and Fuels Pvt. Ltd., Tumkuru , Dist. Yadgir
8	Davangere Sugar Company Ltd, Shamanur, Davangere
9	E.I.D-Parry(I) Ltd, Hullati Village-Haliyal, Nainegali
10	G M Sugar & Energy Ltd, Sangur, Dist.- Haveri
11	Gem Sugars Ltd, Distt. Bagalkot
12	Godavari Biorefineries Ltd
13	Harsha Sugars Ltd, Belagavi
14	Indian Cane Power Ltd, Davangere
15	Jamkhandi Sugars Ltd., Dist-Bagalkot
16	K.P.R. Sugar Mills Pvt Ltd, Kadani Road, Almel Village, Dist. Vijayapura
17	Krishna Sahakari Sakkare Karkhane Niyamit
18	Laila Sugars Private Ltd, Dist. Belgaum
19	Mahatma Gandhi SSK , Bhalki
20	Markandeya Co-operative Sugar Mills Ltd, Dist-Belagavi
21	Mylar Sugars Ltd., Distt. Bellary
22	Naranja SSK Niyamit, Bidar
23	Nirani Sugars Ltd, Bagalkot, Mudhol, and Mandya
24	NSL Sugars Ltd., Aland, Gulbarga
25	Ryatar SSK Niyamit, Bagalkot
26	Satish Sugars Ltd., Dist.Belgaum
27	Shamanur Sugars Ltd, Davangere Dist
28	Shiraguppi Sugar Works Ltd, Belagavi, Belgaum
29	Shree Halasidhanath Sahakari Sakhar Karkhana Ltd, Nipani, Belgaum
30	Shree Renuka Sugars Ltd, Unit-1, Munoli, Athani, Havalga
31	Shri Balaji Sugars & Chemicals Pvt Ltd
32	Shri Devi Sugars Private Ltd, Jalikatti, Dist. Belgaum,
33	Shri Doodhganga Krishna Sahakari Sakkare
34	Shri Hiranyakeshi Sahakari Sakkare
35	Shri Malaprabha Sahakari Sakkare Karkhane



36	Shri Sai Priya Sugars Ltd, Hippargi-Mygur
37	Sovereign Industries Ltd., Dist.-Bagalkot
38	The Ugar Sugar Works Ltd, Ugar Khurd, Kalaburgi

### Production Linked Incentive (PLI) Scheme for Pharmaceutical India

The scheme aims to boost domestic manufacturing of identified Key Starting Materials (KSMs), Drug Intermediates, and Active Pharmaceutical Ingredients by attracting large investments in the sector and thereby reduce India's import dependence in critical APIs.

- ✓ The scheme shall be provided on sales of 41 identified products for six (06) years at the following rates
- ✓ For fermentation based products, incentive for FY 2023-24 to FY 2026-27 would be 20%, incentive for 2027-28 would be 15%, and incentive for 2028-29 would be 5%.
- ✓ For chemical synthesis based products, incentive for FY 2022-23 to FY 2027-28 would be 10%.
- ✓ Scheme is applicable only to greenfield projects

### Production Linked Incentive (PLI) Scheme for Medical Devices

The Scheme intends to boost domestic manufacturing and attract large investments in the

- ✓ Medical Devices Sector.
- ✓ Financial incentives shall be given to selected companies based on threshold investment and incremental sales (over Base Year) of medical devices covered under target segments.
- ✓ Financial incentive at the rate of 5% of incremental sales (over Base Year) of goods manufactured in India. Coverage is for a period of five (5) years from FY 2021-22 to FY 2025-26.
- ✓ The target segments include (i) Cancer care/Radiotherapy medical devices, (ii) Radiology & Imaging medical devices (both ionizing & non-ionizing radiation products) and Nuclear Imaging Devices; (iii) Anesthetics & Cardio-Respiratory medical devices including Catheters of Cardio Respiratory Category & Renal Care Medical Devices; (iv) All Implants including implantable electronic devices like Cochlear Implants and Pacemakers.

## 8.4

### MONITORING AND EVALUATION

BioEconomy is a circular economy concept and tracking the sectors and segments will be very crucial to see the progress being made. This Monitoring and Evaluation system needs to capture Employment demographics, Product Sales, Investment details, R&D spends, and the Carbon emission contributions.

## ANNEX 1 EVENTS AND POLICY DOCUMENTS

### National Policy On Biofuels

The Union Cabinet, chaired by the Prime Minister Shri Narendra Modi, approved National Policy on Biofuels. The document states that the crude oil price has been fluctuating in the world market. Such fluctuations are straining various economies the world over, particularly those of the developing countries.

#### The Salient Features being:

- ✓ The Policy categorizes biofuels as “Basic Biofuels” viz. First Generation (1G) bioethanol & biodiesel and “Advanced Biofuels” - Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio- CNG etc. to enable extension of appropriate financial and fiscal incentives under each category.
- ✓ The Policy expands the scope of raw material for ethanol production by allowing use of Sugarcane Juice, Sugar containing materials like Sugar Beet, Sweet Sorghum, Starch containing materials like Corn, Cassava, Damaged food grains like wheat, broken rice, Rotten Potatoes, unfit for human consumption for ethanol production.
- ✓ With a thrust on Advanced Biofuels, the Policy indicates a viability gap funding scheme for 2G ethanol Bio refineries of Rs.5000 crore in 6 years in addition to additional tax incentives, higher purchase price as compared to 1G biofuels.
- ✓ The Policy encourages setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, Used Cooking Oil, short gestation crops.
- ✓ Roles and responsibilities of all the concerned Ministries/Departments with respect to bio-fuels has been captured in the Policy document to synergize efforts.

### The DNA Technology (Use and Application) Regulation Bill - 2019

In a landmark decision, the Lok Sabha passed “The DNA Technology (Use and Application) Regulation Bill - 2019”. The Bill has been formulated recognizing the need for regulation of the use and application of Deoxyribonucleic Acid (DNA) technology, for establishing identity of missing persons, victims, offenders, under trials and unknown deceased persons.

### Genetic Enhancement Of Pulses: A Mission Program

Improvement of legumes is one of the priority areas of Department of Biotechnology (DBT). Department has initiated a mission program on “Genetic Enhancement on Pulses”. NITI Aayog has directed to take necessary scientific interventions in a targeted and mission mode approach in this direction. Department through this “Mission program on Genetic Enhancement of Pulses” is targeting complex biological system of pulses which has been neglected. Program envisages providing farmers with improved and productive varieties, disease and climate resilience.

### Make-In-India, Startup India

- ✓ Biotechnology has emerged as an integral part of the Indian BioEconomy. Currently, Indian biotech industry holds 3% of the global market share and is third largest in Asia-Pacific region.
- ✓ The DBT along with BIRAC is playing a crucial role in the implementation and delivery of the flagship programs of the Government of India, such as ‘Make-in-India’ and ‘Startup India’. DBT recognizes the necessity for entrepreneurship development among the youth in the country and hence has several pioneering initiatives.

### Biotechnology Parks/ Incubators

- ✓ The Department of Biotechnology and BIRAC have established Biotechnology Parks and Incubators respectively across the country to translate research into products and services by providing necessary infrastructure support. These Biotechnology Parks offer facilities to Scientists, and Small and Medium sized Enterprises (SMEs) for technology incubation, technology demonstration and pilot plant studies for accelerated commercial development.
- ✓ BIRAC has supported 41 bio-incubators to provide incubation space to Startups and entrepreneurs along with access to high end instrumentation; technical, business, regulatory compliances & IP mentorship and networking opportunities with investors and stakeholders. This BioNEST incubator network is spread out across India including tier 2 cities and expected to grow to 50 in FY 2019-20.

### National Biopharma Mission

The National Biopharma Mission was formally launched on June 30, 2017 and the legal agreement with World Bank for flexible financing arrangements for this Mission of DBT was executed on April 24, 2018. The Mission aims to make India a hub for design and development of novel, affordable and effective biopharmaceutical products for combating public health concerns. It would strengthen translational capability of academic researchers; empower bio- entrepreneurs and SMEs by decreasing the cost and risk during early stages of product development and also elevate the innovation quotient of the industry. The global experience of World Bank would be instrumental in building sustained global linkages, technical assistance and knowledge flow between public private partners for business promotion in biotech sector.

### Following capacity building activities have been initiated under the mission

- ✓ 2 GLP bio-analytical labs (Bangalore, EDC- Pune); 1 CMC Facility for GMP mammalian work (Dharwad); 2 GCLP labs for supporting vaccine clinical trials (Pune; Bangalore); 2 Facilities for Rapid prototyping; EMI-EMC safety testing (Kanpur); Preclinical Large (swine) animal facility for Med Tech Devices (Hyderabad); 4 Vaccines candidates; 6 Biosimilar candidates for advancing development; 2 Translational Research Consortia for dengue & chikungunya diseases and setting up of 5 Technology Transfer Offices are being supported.
- ✓ It is envisaged that this program will help deliver 6-10 new products in the next five years, create several dedicated facilities for next-generation skills, and hundreds of jobs in the process.

### Mission Program "Ind-Cepi"

- ✓ DBT is implementing a Mission Program "Ind-CEPI" to strengthen development of vaccines for the diseases of epidemic potential in India.
- ✓ This Mission Program aims to implement targeted support for rapid vaccine development and also build public health preparedness system for emerging infectious diseases in India.
- ✓ This will help in strategic engagement with the global Coalition for Epidemic Preparedness Innovations (CEPI) –an innovative global partnership between the public, private, philanthropic and civil society sectors undertaken with the aim to explore new ways of working to drive vaccine innovation to address public health in alignment with the WHO blueprint for R&D.
- ✓ The SFC approval for the IndCEPI Mission has been obtained in March 2019, for implementation by BIRAC.



### Karnataka Biotech Policy 2017-2022

#### Key Policy Directives of Karnataka

- ✓ Simplify administrative and clearance processes to create an enabling environment for the public and private sectors to invest across the biotech value chain
- ✓ Realign academic and training discourses to strengthen and retain human capital, meet evolving industry requirements and contribute to mitigating challenges
- ✓ Conduct coordinated and integrated R&D with emphasis on facilitating progress beyond the lab to address key prioritized societal issues.
- ✓ Invest in foundations of life sciences by creating technology platforms and encourage more effective multi-disciplinary collaborations to expand the scale and scope of biotechnology and its impact on the society and economy
- ✓ Leveraging IT and other technology (ESDM/AVGC) capabilities of the state to encourage development of Bio-IT tools and solutions
- ✓ Institute funding mechanisms and mentorship programs for biotech start-ups to stimulate innovations and discoveries that would benefit the society and boost growth in BioEconomy
- ✓ Extending financial incentives and concessions for attracting investments in the biotech sector
- ✓ Foster the development of BioEconomy by supporting research and development (R&D) in emerging technologies -- Bio Agriculture, Aqua-Marine Biotechnology, Rare Diseases Management, Synthetic Biology, Omics, Stem cell and regenerative medicine, Antimicrobial Resistance, Bioengineering, Medical Devices Technology, Microbiome.

## ANNEX 2

### TOWARDS A VALUATION OF THE BIOTECHNOLOGY SECTOR

Case Studies of Different Countries in the report "Innovation Ecosystems in The BioEconomy OECD Science, Technology And Industry Policy Papers September 2019 No. 76"

The promise of an innovation ecosystems approach is derived following Kanter (1994). This case study defined innovation ecosystems as "groupings of companies in different industries with

different but complementary skills which link their capabilities to create value for ultimate users." The emergence of new types of value chains and innovation ecosystems related to opportunities across firms, sectors and countries can eventually support the BioEconomy transitions (for a general overview see Hansen and Coenen (2015); for a biorefinery-specific example see Hellsmark et al. (2016)).

Attention to innovation ecosystems grows out of both a commitment to the idea of transitions management and the sustainability development challenge. It is a concept very similar to that of value-chains but it also includes the idea that value chains may converge and develop into cross-industrial networks where a broader range of also horizontally related actors create value to each other, e.g. through industrial symbiosis/circular economy solutions.

The literature on emerging technological innovation systems can be helpful for understanding generalized functional drivers, and differences therein. Extensive empirical work on emerging technologies and innovation ecosystems across a broad range of countries has identified seven such drivers:

1. entrepreneurial activities in terms of experiments and demonstrations
2. knowledge development involving learning activities, mostly on the emerging technology, but also on markets, networks, users and other;
3. knowledge exchange through networks and across value chains
4. guidance of the search including individual choices related to the technology but also in terms institutions e.g. related to policy target
5. market formation involving activities that contribute to the creation of a demand for the emerging technology e.g. taxation, procurement
6. resource mobilization, or the allocation of financial, material and human capital,
7. support from advocacy coalitions to promote new technologies and innovations.

These insights can be applied to the BioEconomy. There, large investments in biorefineries can become stranded if diverse supply and value chains cannot be developed to fully optimize these investments.

In addition, these value chains would need to be sufficiently both vertically and also horizontally interlinked across sectors so that closed loop production could be achieved in a sustainable and profitable way through new types of innovation ecosystems. Joining up these sectors is in line with broader policy thinking related to the circular economy, including at the European level (e.g. BBI JU, 2016; European BioEconomy Stakeholders Manifesto, 2016).

## ANNEX 3 STAKEHOLDER DATABASE ANALYSIS

The report took into consideration details from different sources from imports to exports and start-ups. It also analyzed various awards in arriving at this.





## ANNEX 4 BIOTECHNOLOGY ROADMAP OVERALL PLUS SECTORS

(Source: Indian BioEconomy Report March 2020)

INDIAN BIOECONOMY	
SEGMENT	VALUE IN \$BILLION (2019)
BIOAGRI	12.0
BIOINDUSTRIAL	5.0
BIOPHARMA	36
CRO/BIOIT/Research	9.8
<b>TOTAL BIOECONOMY</b>	<b>\$62.5 B</b>

INDIAN BIOECONOMY – SUB SECTORS		
INDIAN BIOECONOMY	SUB-SEGMENT	VALUE IN \$BILLION (2019)
<b>BIOAGRI</b>		<b>12.00</b>
	BT COTTON	11.1
	BIOFERTILIZERS / BIOPESTICIDES	0.9
<b>BIOINDUSTRIAL</b>		<b>5.00</b>
	ENZYME	2.30
	BIOFUELS	2.70
<b>BIOPHARMA</b>		<b>36.00</b>
	BIOLOGICS / THERAPEUTICS	7.00
	VACCINE	12.00
	DIAGNOSTICS / MEDICAL DEVICES	17.00
<b>BIOIT/CRO/HEALTHCARE RESEARCH</b>		<b>9.50</b>
<b>TOTAL BIOECONOMY</b>		<b>\$62.50 B</b>

## ANNEX 5 PATENT PROFILING – METHODOLOGY AND DETAILED RESULTS

### GII 2020: Who Will Finance Innovation?

The 2020 Global Innovation Index (GII) report provides valuable insight into country innovation models and each country's position on various innovation indicators. The Global Innovation Index has been instrumental to India in shaping its policies and designing an actionable agenda for innovation excellence. The Confederation of Indian Industry (CII) launches the Global Innovation Index in collaboration with the Department for Promotion of Industry and Internal Trade, the Government of India, and the World Intellectual Property Organization.

**India among Top 3 Lower middle-income economies**

Lower middle-income economies (29 in total)

- 1 VietNam (42)
- 2 Ukraine (45)
- 3 India (48)
- 4 Philippines (50)
- 5 Mongolia (58)

**ANNEX 6: SUB-SECTOR REVIEWS**

INDIAN BIOECONOMY – BY KEY PRODUCT SEGMENTS		
SEGMENT	SUB-SEGMENT	PRODUCT SHARE (2019)
	Diagnostics / Medical Devices	50.60%
	Vaccine	35.71%
	BT Cotton	33.04%
	Biologics / Therapeutics	20.83%
	BIOIT/CRO/Healthcare Research	15.20%
	Biofuels	8.04%
	Enzyme	6.85%
	Biofertilizers / Biopesticides	2.68%
<b>TOTAL BIOECONOMY</b>		<b>\$62.5 B</b>

Source: India BioEconomy Report 2020 of BIRAC

## ANNEX 7

### INVENTORY OF RESEARCH INFRASTRUCTURES

**Financing Innovation in India: Challenges and Opportunities**

Chapter by Ms Deepanwita Chattopadhyay, IKP Knowledge Park in 2020 Global Innovation Index (GII) report

India's investment in R&D has decreased over the last decade from 0.85% of GDP in 2008–2009 to remain stagnant at around 0.7% for the last several years. This is significantly lower than the top five R&D spenders globally in 2017—4.3% for the Republic of Korea, 4.2% for Israel, 3.3% for Japan, and 3.2% for both Switzerland and Finland—and lower than the R&D investments of other BRIC countries, which include Brazil, Russia, India, and China.

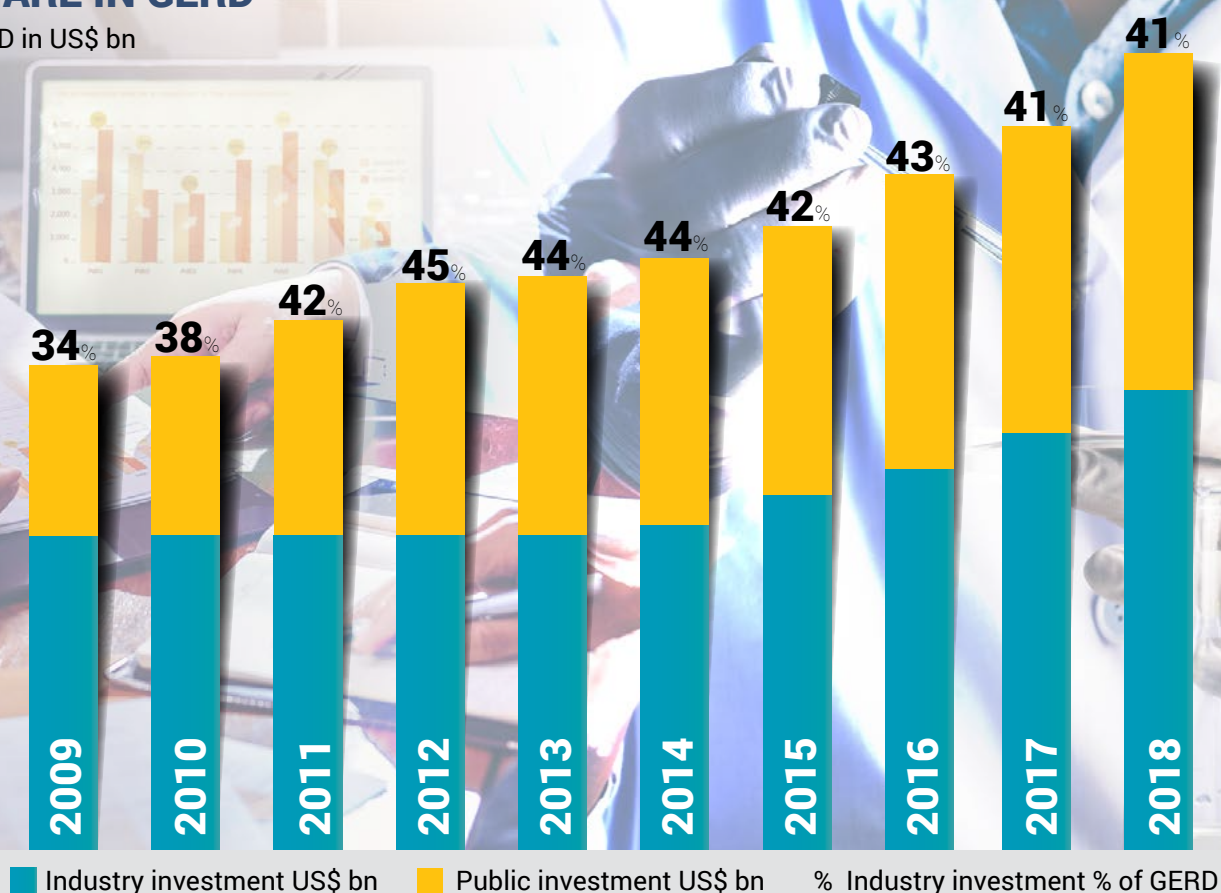


Gross domestic expenditure on research and development (GERD) in India increased to US\$63.2 billion in purchasing power parity (PPP) terms in 2017–2018 from US\$50.3 billion PPP in 2014–2015 and accounted for 2.9% share in world GERD during 2017–18.

GERD in India is mainly driven by the government sector, of which 45.4% is the Central Government, 6.4% state governments, 6.8% higher education, and 41.4% industry—with 4.6% from public sector industry and 36.8% from private sector industry during 2017–18.5

# INDUSTRY'S SHARE IN GERD

GERD in US\$ bn



Twelve major scientific agencies accounted for 99.8% of the R&D expenditure incurred by the Central Government in 2017-18. Of this, 61.4% was spent on R&D in defense, atomic energy, and space, while the remainder was allocated as follows: 11.1% to the Indian Council of Agricultural Research (ICAR), 9.5% to the Council of Science & Industrial Research (CSIR), 7.3% to the Department of Science & Technology (DST), 3.7% to the Department of Biotechnology (DBT), 3.1% to the Indian Council of Medical Research (ICMR), and 3.7% to the Ministry of Earth Sciences, Ministry of Electronics and Information Technology, Ministry of Environment, Forest and Climate Change, and Ministry of New & Renewable Energy.

## ANNEX 8

### SUB-SECTOR SPECIFIC BARRIERS

Here are some of the recommendations that the Industry had given to DBT / BIRAC to overcome barriers that the industry in general faces.

- ✓ Key amendments to the Biodiversity Act to make it more industry-friendly.
- ✓ Duty-free manufacturing zones for Biomed industry
- ✓ Fast track regulatory approval for authorized cell & gene therapies transferred from USA, Europe and Japan
- ✓ Scale for Market Share/ Diversification/ M&A consolidation (Private Equity)
- ✓ DCGI be the sole authority to approve biosimilars/biotherapeutics for product approval and market authorization.
- ✓ Regulatory guidelines CRISPR/Gene-edited products in human health and agriculture.
- ✓ Accelerate new framework/regulations for approval of Agricultural Biostimulants, Bio fertilizers & Novel Biocontrol Agents. (Currently mainly covered by the Pesticides Act)
- ✓ Set up a nodal agency for trials, validation and certification of MedTech and BioTech innovation under DCGI.
- ✓ Rework Agriculture policy to give clarity on GMOs
- ✓ National Agriculture Policy that promotes use of emerging technologies like gene-editing/CRISPR, use of biomarkers, development of food alternatives or plant varieties with improved yield and quality, Molecular Farming
- ✓ Amend Section 3(2) of the Biodiversity Act to align the definition of foreign companies as per Corporate Law.
- ✓ Government tenders should have preferential norms for indigenously manufactured medicines, vaccines, diagnostics, devices and medical equipment
- ✓ Stronger push to ensure Indian companies file global IP (subsidize or reimburse patent fees.)
- ✓ Access to lab infrastructure in public laboratories at nominal rates for biotech companies
- ✓ Facilitation of manufacture of key equipment used in biotech research and industry under Make in India program. This will reduce costs and increase availability within the country.
- ✓ Incentivize foreign technology vendors to manufacture their products in India under Make in India program.
- ✓ Policy emphasis on emerging technologies like synthetic biology, gene therapies to allow these areas to gain traction



- ✓ Encourage funding mega Genomics project in the private sector because public sector facilities are under utilized.
- ✓ Fund large population genomics studies (National Bioscience Mission proposal with PSA should trigger some of this). The new data sharing and storage policies drafted by DBT are skewing genomics towards academia. Industry too should benefit.
- ✓ Create Biotechnology Industrial Estates with the following minimum infrastructure starting with existing DBT/Government funded incubators to promote the natural growth of startups.
- ✓ The estate should have a reliable and continuous source of power @ 500 KVA/ acre of land
- ✓ The estate should be laid with proper roads, stormwater drains, streetlights and developed greenspaces.
- ✓ The estate should have a reliable source of water @ 1 MLD per acre and potable water treatment plant with distribution
- ✓ The estate should have a Common Effluent Treatment Plant to handle the effluent from each of the plots with a capacity of 0.7 MLD per acre
- ✓ The estate should have good connectivity to highways, airports and railway station
- ✓ The estate should be close to training centers, Biotechnology Clusters, Universities, including finishing schools dedicated to the biotechnology industry.





*The collective face of the Indian Biotech Industry*



Streamlining the  
**REGULATORY  
PROCESS**



Recommending  
union **BUDGET** for  
biotech sector



Proposing fiscal  
**INCENTIVES** for  
Biotech Sector



Strengthening the  
**PR REGIME**



Recommending  
Venture  
**CAPITAL FUND**



Accelerating industry  
growth via  
**ADVOCACY**



Kindling & fostering  
the fire of  
**ENTREPRENEURSHIP**



Promoting linkage  
between  
**INDUSTRY-  
ACADEMIA**



Catalysing  
opportunities for  
**START-UPS & SMEs**



Facilitating  
partnership through  
**COLLABORATION**



Encouraging sector  
growth through  
**INVESTMENT**



Implementing  
member focused  
**INITIATIVES**

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Karnataka has a very vibrant Biotech industry in the country. The ecosystem caters to companies developing products ranging from farm to pharma. Karnataka's Biotech industry responded very proactively to Covid. Here are few products and examples on how the ecosystem in Karnataka responded to situation.

## MONITORING DEVICES

**1. Padma Vitals+ by Cardiac Design Labs:** Padma Vitals+ is a centralized monitoring system for ECG, respiration, Spo2 and body temperature, which can measure the vitals continuously and the analysis sent through telemetry, with an alerting system embedded in it. The device is much needed for contactless monitoring of patients during Covid-19 Pandemic. The product has been validated at Narayana Hrudayalaya.

**2. Florescence probes and PCR mix for RTPCR detection by VNIR:** The probes are part of the Covid-19 test kits; the probes are currently imported. Without the probe, virus detection is not possible.



**3. Remote foetal monitoring device-Daksh:** This is useful for Covid-19 positive pregnant women; the device helps remote monitoring of the foetus.

**4. VTM by Deno Biolabs:** It helps in safely transporting the live virus sample from the sample collection center to the testing lab.



**5. Cov-Astra an AI-based device for detection by Aindra:** A significant breakthrough that can detect Covid-19 virus through an x-ray; eliminates the conventional throat swab way of testing people. Cost per detection is significantly lesser at INR 150-250 per person.

**6. RNAWRAPR by Azooka Labs:** Azooka is waiting for the United States Food and Drug Administration (USFDA) approval to scale up its facility to produce one million kits of RNAWRAPR, a medium to safely transport Covid test swabs. With RNAWRAPR, the aqueous medium will inactivate the virus and retain the RNA, which can also be stored at room temperature.



**7. Electrochemical detection of Covid by PathShodh:** Pathshodh is adding a Covid-19 antibody test and an antigen test to the device Anupath. The company's electrochemical detection of Covid is claimed to be better than the antibody ELISA (enzyme-linked immunosorbent assay) test, capturing the quantitative value of the antibody and letting one know how susceptible they are to contracting the virus a second time. Clinical trials are complete in four hospitals at Vellore. The device also resolves the data management issue.



**8. MafCyto by Siamaf Healthcare:** The magnetic nanotechnology 'MafCyto' will take out cytokines through a method similar to dialysis. MafCyto is currently in the pre-clinical study stage, and the invitro studies (animal testing) are expected to be completed in five months.

**9. GlobalTM diagnostic kit by Equine Biotech:** It is an extremely sensitive, rapid, and affordable diagnostic kit that is approved by the Indian Council of Medical Research (ICMR). Azooka Life Sciences



**10. LAMP-CRISPR-LFD by Azooka:** The start-up has patented DNA and RNA stains that are widely used in molecular diagnostics. Azooka has PCR and RT-PCR master mixes for Covid-19 diagnostic kit development and is trying to ramp up manufacturing. Azooka's kits are made with indigenous dyes. LAMP or Loop mediated isothermal amplification is a single-tube technique to amplify DNA.

**11. AI Health Highway:** This startup, which launched its prescreening and triage tool for Covid-19 as early as in mid-March, was the first to categorize risk assessment into 'red, orange and green' or high, mild and low-risk zones. According to the company, more than a 1,000 users have benefitted from their screening and triage tool.

**12. Sensitive method to detect inflammation by MicroX:** Global studies have established that a significant number of carriers of Covid-19 are asymptomatic. MicroX's solution is a sensitive method of detecting inflammation. Early and rapid detection of inflammation helps track potential carriers and slows the spread of the disease. Product development is currently in progress.



**13. Mobile Lab for RT-PCR by Shanmukha Innovations:** This startup has designed a mobile lab for RT-PCR tests.



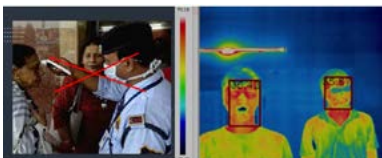
**14. Lung Imaging by Predible Health:** The LungIQ solution with COVID19 analysis (Aikenist) is to help radiologists detect, quantify and communicate COVID19 findings from Lung CT imaging.



**15. Dozee by Turtle Shell Technologies:** A contact-less health monitor which can be slipped below the mattress and it converts any bed into continuous health monitoring system.



**16. RespirAID by Biodesign Innovation Labs and Remidio Innovative Solutions:** RespirAID helps to reduce morbidity caused by a shortage of ventilators in low-resource settings. This is claimed to be portable, affordable and easy to use, reliable alternative to prolonged manual ventilation, smart ventilation with alerts and fail safe, suitable for transport and emergency ventilation.



**17. Niramai FeverTest – MP:** It is claimed to be a contactless, cost efficient camera to measure temperature of multiple people in public places. This helps in enabling automated screening of population and detect likely COVID19 infected people by checking for fever and associated respiratory diseases using NIRAMAI Thermalix solution (Artificial Intelligence Algorithms over thermal images).



**18. COVID-19 RT-QPCR Diagnostics:** Affigenix's COVID-19 Real-Time RT-qPCR molecular in vitro diagnostic test is to aid in the detection of SARS-CoV-2 RNA in human samples. The kit component includes real-time reverse transcription polymerase chain reaction mix and primer - probe sets designed to detect RNA from individuals suspected of COVID-19. The designed primers and probes will amplify regions in the SARS-CoV-2 nucleocapsid (N) gene to be used for screening and for confirmation of the

disease another primer and probe set were designed to detect ORF (open reading frame) 1ab gene fragment in human respiratory samples.





**19. Saans and VAP Care by Coeo Labs:** VAP-Care is a device to prevent secondary infections. It is an automated oral hygiene maintenance system, which is claimed to be the first of its kind sensor-based fully automated secretion and oral hygiene maintenance system. Saans is a portable, multi-modal Continuous Positive Airway Pressure (CPAP) respirator which can be used as an alternative to conventional intubated ventilators.

**20. Zebox by Biomoneta:** It is an air decontamination device that can trap and kill microbes, and prevent the transmission of infections in hospital and healthcare settings.

## PLATFORMS

**21. Mynvax Vaccine:** This startup has been working on a vaccine for SARS-CoV-2. The vaccine is expected to provide significant protection to healthcare workers and elderly people, as well as to those deemed 'high risk' due to a comorbid condition. The vaccine is expected to be ready for testing in six months.

**22. Stempeucel by Stempeutics:** The company developed a Mesenchymal Stem Cell (MSC) therapy to target severe lung disease in COVID-19 affected patients. MSC-based therapy is currently under clinical trials in Europe, and Stempeucel is claimed to be the only Indian/Asian regenerative stem-cell therapy solution being tested, along with solutions from companies in Israel, the US, and Europe.

**23. Human lung progenitor cells as a novel screening platform for anti-COVID-19 drugs by Eyestem:** The firm has developed a pluripotent stem cell-based cellular system, which consists of first-generation alveolar epithelial cells in an air-liquid interface. These are differentiated lung organoids in the making and can be used as anti-COVID-19 screening platforms.

**24. Plasma and cytokine-mediated immunomodulatory therapies by Innaumation:** The company has robust platform to extract convalescent plasma from the blood of recovered patients and transfuse it to critically ill COVID-19 patients.

## NUTRITION & IMMUNITY BOOSTERS



**25. Malli's Cordytea:** Cordytea is an immunity booster tea prepared from medicinal mushroom - Cordyceps. The mushroom variety grown under laboratory conditions is developed by the Innovator. Cordicepin, an active ingredient is known to have antiviral properties too. In the Covid-19 times, it will be helpful in boosting the immunity levels. The product has been patented and is approved by FSSAI.

**26. CD4 Shield by Stabicon:** It is a chewable tablet containing curcumin and Vitamin B12. Both the ingredients fight inflammation and infection. The product ensures activation of innate immunity by activating CD4+, CD8+ and IFN 1 to virus specific effect and has immunomodulatory properties. It also reduces cytokine storm in response to viral infection. The product is approved by FSSAI.



**27. BeamRoti by Aspartika:** This is an immunity booster chapati having mixture of herbs recommended by AYUSH Ministry. The ingredients have been prepared using supercritical fluid extraction technology to ensure optimum concentration of herbal extract reaches the body. The chapattis are easy to store with good shelf life and Patent application has been filed. The product is approved by FSSAI.



**28. Immune booster daily drops by Aspartika:** This is an immunity booster drop having a mixture of herbs recommended by AYUSH Ministry. The ingredients have been prepared using supercritical fluid extraction technology to ensure optimum concentration of herbal extract reaches the body by mixing just one drop of the product in a glass of hot water. The product is approved by FSSAI.

## SANITIZERS, PURIFIERS

**29. VegPhal by Krimmi Biotech:** A Fruit and vegetable sanitizer prepared using edible ingredients effective against microbes and removal of pesticides. It is chlorine and alcohol free.



**30. Water Sanitizer - Kitchen tap by Biofi:** This is a miniaturized version of UV purifier that can be attached to a water tap and kill 99 per cent of microbes including viruses such as phages.

**31. Antimicrobial HVAC module by Biofi:** This can be fitted to HVAC systems to ensure circulating air is sanitized. This is especially useful during Covid-19 times as many enclosed spaces

in which AC circulated air may be contaminated. Based on UV-silver titanium dioxide technology, the product is patented and has been validated.

**32. Shieldex 24 by Biofi:** It is A UV-ROS box for COVID 19 sterilization. It is a device that can eliminate virus located on any object; ideal for applications in the transportation industry.

**33. Anti-microbial face wash containing herbal antimicrobials by Atrimed:** A herbal product that can kill any virus, including Covid-19 virus from any person's face within seconds.

**34. Kerasiev by Need Innovation:** Need has developed a ceramic membrane-based bio-hazardous waste water filtration system that is claimed to successfully block the SARS-Cov2 virus in suspensions in case it has a smaller pore size compared to the diameter of the Cov2 virus.

**35. COVID-19 care products by Leaf Box:** Its portfolio includes a compact UVC-based, air-purifier and a UVC-based surface sterilizer. The air purifier also includes HEPA and activated carbon filter for fast removal of particulate matter and microbes.





# INNOVATE KARNATAKA



**DR EV RAMANA REDDY, IAS**

*ADDITIONAL CHIEF SECRETARY (ACS),  
DEPARTMENT OF ELECTRONICS, IT, BT, AND S&T*

“The first Karnataka BioEconomy Report has laid out the strategies to further propel the biotechnology industry that contributes more than 10% of the state's economy and the department of Electronics, IT, BT & S&T looks forward to work with all stakeholders to ensure that the challenging target of \$ 50 billion BioEconomy valuation by the year 2025 is achieved.”



**SMT MEENA NAGARAJ C.N, IAS**

*MANAGING DIRECTOR, KITS,  
DIRECTOR, DEPARTMENT OF ELECTRONICS,  
IT, BT, AND S&T*

“The Department of Electronics, Information Technology, Biotechnology, and Science & Technology has been at the forefront of devising policies and activities to harness the power of biotechnology for the growth of Karnataka. The key role of BioEconomy highlighted in this report shows that biotechnology will continue to be a crucial economic growth driver for Karnataka.”





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