

# AUDIT OF THE SOUTH AFRICAN BIOECONOMY SECTOR

Innovation  
for a **BETTER**  
Future

2 February 2022



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Science and Technology

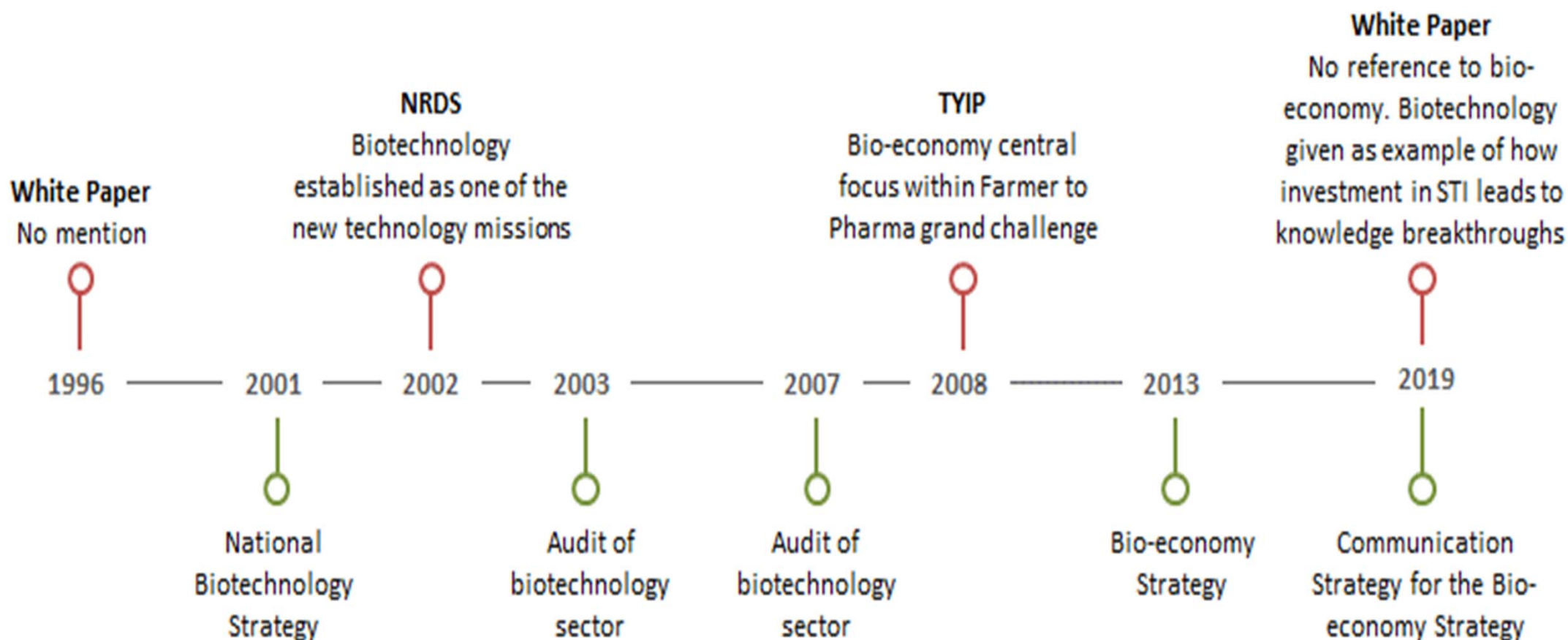
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# **PRESENTATION OUTLINE**

- 1. Background – From Biotechnology to the Bioeconomy**
- 2. Project Brief**
- 3. Approach (Indicators)**
- 4. Findings**
  - 4.1 Input Measures**
  - 4.2 Output Measures**
  - 4.3 Growth Measures**
  - 4.4 Employment Measures**
  - 4.5 Remuneration**
  - 4.6 Investment Measures**
  - 4.7 Export Measures**
- 5. High Level Findings (Summary)**
- 6. Conclusion**



# 1. Background – From Biotechnology to the Bioeconomy



# Biotechnology and Bio-economy Defns

## **SA Biotechnology Defn. (2001)**

set of technologies including, but not confined to, tissue culture and recombinant DNA techniques, bioinformatics and genomics, proteomics and structural biology, and all other techniques employed for the genetic modification of living organisms, **used to exploit and modify living organisms so as to produce new intellectual property, tools, goods, products and services**

## **SA Bio-economy Defn. (2013)**

activities that make use of bio innovations, based on biological sources, materials and processes to generate sustainable economic, social and environmental development

# 1. Background - Defining the Bioeconomy (Continued)

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**South Africa:** activities that make use of bio innovations, **based on biological sources**, materials and processes to generate sustainable economic, social and environmental development (2013).

**The European Union (EU):** the **production of renewable biological resources** and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products as well as bio-energy (2018).

**Bioeconomy Corporation Malaysia:** Refers to all economic activity that is derived from the continued commercial application of biotechnology. Bioeconomy encompasses the **production of renewable biological resources and their conversion into food, feed, chemicals, energy and healthcare wellness products via innovative and efficient technologies** (2021).

**Global Bioeconomy Summit:** 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. (2018)

**US:** economic activity that is driven by research and innovation in the life sciences and biotechnology, and is enabled by technological advances in engineering and in computing and information sciences (2020)





# 1. Background – SA Bioeconomy (Continued)

Agriculture	Health	Industry	IKS
<ul style="list-style-type: none"> <li>• Crop improvement (heat-resistance and drought-tolerance)</li> <li>• Livestock improvement</li> <li>• Food quality and nutritional value</li> <li>• Energy crops</li> <li>• Bio-pesticides and bio-fertilisers</li> <li>• Vaccines and diagnostics</li> </ul>	<ul style="list-style-type: none"> <li>• Active pharmaceutical ingredients</li> <li>• Vaccines</li> <li>• Biopharmaceuticals</li> <li>• Diagnostics</li> <li>• Medical devices</li> </ul>	<ul style="list-style-type: none"> <li>• Bio-based chemicals</li> <li>• Biomaterials</li> <li>• Bio-energy</li> <li>• Water and waste (water treatment and waste recycling)</li> <li>• Food</li> <li>• Bio-plastics</li> <li>• Paper and pulp</li> </ul>	<ul style="list-style-type: none"> <li>• Bio-prospecting</li> <li>• Herbal medicine</li> <li>• African traditional medicine</li> </ul>



# 1. Background (Continued)

(Sectors forming part of bioeconomies of different countries)

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	Argentina	Germany	Malaysia	The Netherlands *	South Africa	USA *
Agriculture	■ ■	■ ■	■ ■		■	■ ■
Automotive and mechanical engineering		■ ■				
Chemistry (incl. bioplastics)	■ ■	■ ■	■ ■	■ ■	■	■ ■
Biofuels/bioenergy	■ ■	■ ■	■ ■	■ ■	■	
Biorefining		■ ■	■ ■		■	■ ■
Construction/Building industry		■ ■				
Consumer goods (e.g., cosmetics, cleaners)	■ ■	■ ■			■	
Feed	■ ■	■ ■	■ ■		■	
Fisheries	■ ■	■ ■	■ ■		■	
Food and Beverage industry	■ ■	■ ■	■ ■		■	
Forestry	■ ■	■ ■	■ ■	■ ■ **	■	■ ■
Health			■ ■		■	
Knowledge/Innovation		■ ■	■ ■	■ ■	■	
Mining					■	
Pharmaceutical industry	■ ■	■ ■	■ ■	■ ■	■	
Pulp and paper	■ ■	■ ■		■ ■	■	
Textiles	■ ■	■ ■		■ ■	■	■ ■



# Sectors for measuring the Bioeconomy

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- Fully bio-based sectors e.g. agriculture, food etc – included.
- Partially bio-based sectors e.g. chemical (bio-chemicals), materials (biomaterials)-need to estimate the bio-share.
- Not bio-based sectors e.g. steel manufacturing – excluded.





# Bio-economy Sectors with available economic data

Economic Activities	SIC Code	Comments
FULLY BIOBASED (PRIMARY PRODUCTION)		Primary sectors (agriculture, forestry, fisheries-are the bioresource
Agriculture, forestry, fishing	SIC 1	Primary sectors which constitute the bioresource
FULLY BIO-BASED (MANUFACTURING)		Manufacturing that exclusively use biomaterial as main inputs
Manufacture of food products, beverages and tobacco	SIC 320	Primary agriculture as bioresource inputs
Manufacture of wood and paper products (excludes furniture)	SIC 321/326	Forestry as Bioresource inputs
Manufacture of furniture	SIC 391	Forestry as bio-resource input
Other manufacturing e.g. recycling	392 to 395	

# Manufacturing sectors without economic data

PARTIALLY -BIOBASED SECTORS	SIC code	Sectors which have a “biobased share” in their composition
Chemistry (including bio-plastics -bioethanol Other Chemicals (includes pharmaceuticals)	331 335	The SIC codes does specify the bio-based share e.g. bio-ethanol. Including the entire sector distorts the size of bio-chemicals. No information on bio-pharmaceuticals and API .
Petrochemicals, coke, nuclear fuel – bioenergy	331, 332, 333	This should include bio-diesel, biogas & bio-electricity.
Textiles	311	This sector is also partial-but the bio-share is also unknown i.e. textiles that are made bioresource wool and silk.
Mining (bio-mining and bioleaching)	21, 22,23,24, 25, 29	This refers to bio-mining activities.
Medical devices, diagnostics, vaccines	374	



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## 2. Project Brief



- The White Paper has assigned NACi the responsibility of becoming the national M&E institution with abilities to analyse STI information and undertaking work to inform government planning on science, technology and innovation (STI).
- To audit of the South African Bioeconomy 'sector' using readily available data from reputable sources.
- The results of the audit should be used to create a baseline for the South African bioeconomy sector.
- This will enable the DSI and other organisations to:
  - Monitor the implementation of the Bioeconomy Strategy.
  - Measure impact on of the strategy on economic development (for example on employment growth).
  - Measure the bioeconomy share of national GDP, and
  - Measure bioeconomy rate of growth as compared to other sectors of the wider economy.



### 3. Approach (Indicators)

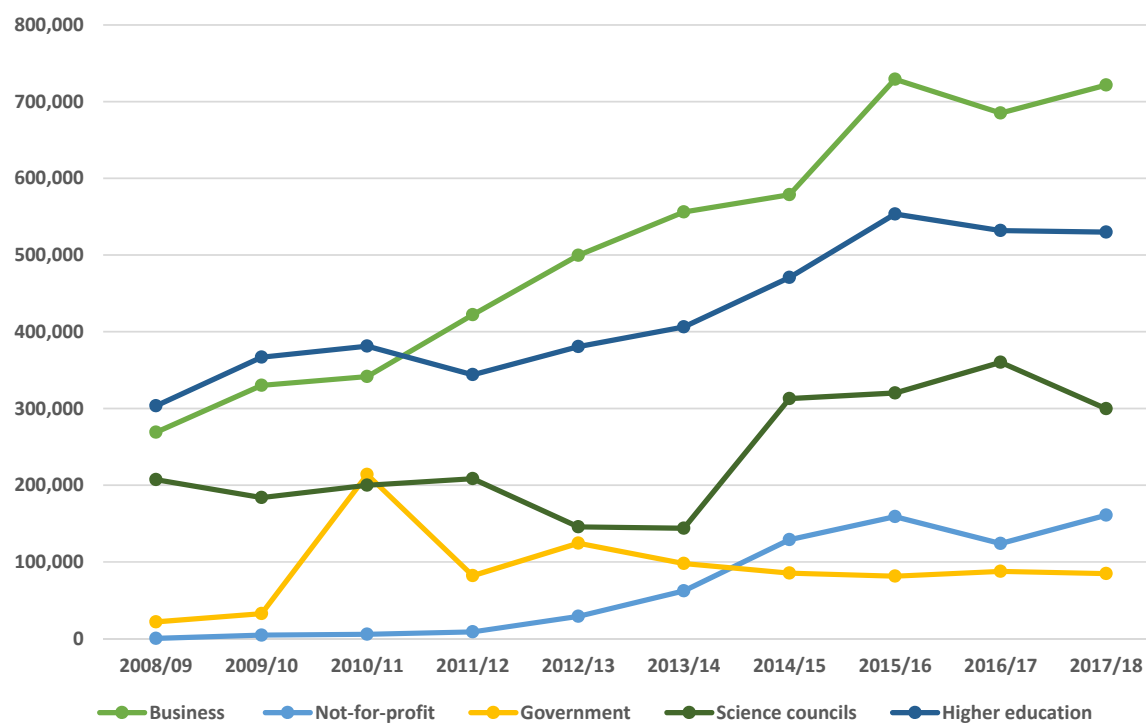


Input measures	Output Measures	Growth Measures	Employment Measures	Investment Measures	Export measures
<ul style="list-style-type: none"> <li>Bioeconomy GERD &amp; BERD</li> </ul>	<ul style="list-style-type: none"> <li>Patents</li> </ul>	<ul style="list-style-type: none"> <li>The bioeconomy share of national GDP</li> </ul>	<ul style="list-style-type: none"> <li>Total employment in the bioeconomy sector</li> </ul>	<ul style="list-style-type: none"> <li>Gross Fixed Capital Formation (GFCF) for the bioeconomy sector</li> </ul>	<ul style="list-style-type: none"> <li>Bioeconomy exports</li> </ul>
<ul style="list-style-type: none"> <li>Number of full time equivalent (FTE) researchers engaged in R&amp;D and innovation in the bioeconomy sector</li> </ul>	<ul style="list-style-type: none"> <li>Publications</li> </ul>	<ul style="list-style-type: none"> <li>The rate of growth of the bioeconomy</li> </ul>	<ul style="list-style-type: none"> <li>Employment by skill level in the bioeconomy sector</li> </ul>	<ul style="list-style-type: none"> <li>GFCF for the Bioeconomy/ turnover (sales) and/or value add of the bioeconomy</li> </ul>	<ul style="list-style-type: none"> <li>The composition of bioeconomy exports</li> </ul>
	<ul style="list-style-type: none"> <li>Output attributed to innovation by firms in the bioeconomy sector</li> </ul>				

## 4. FINDINGS

## 4.1 Input Measures: Biotechnology R&D Expenditure

R&D expenditure (R million in constant 2010 values) for biotechnology from 2008/09 to 2017/18

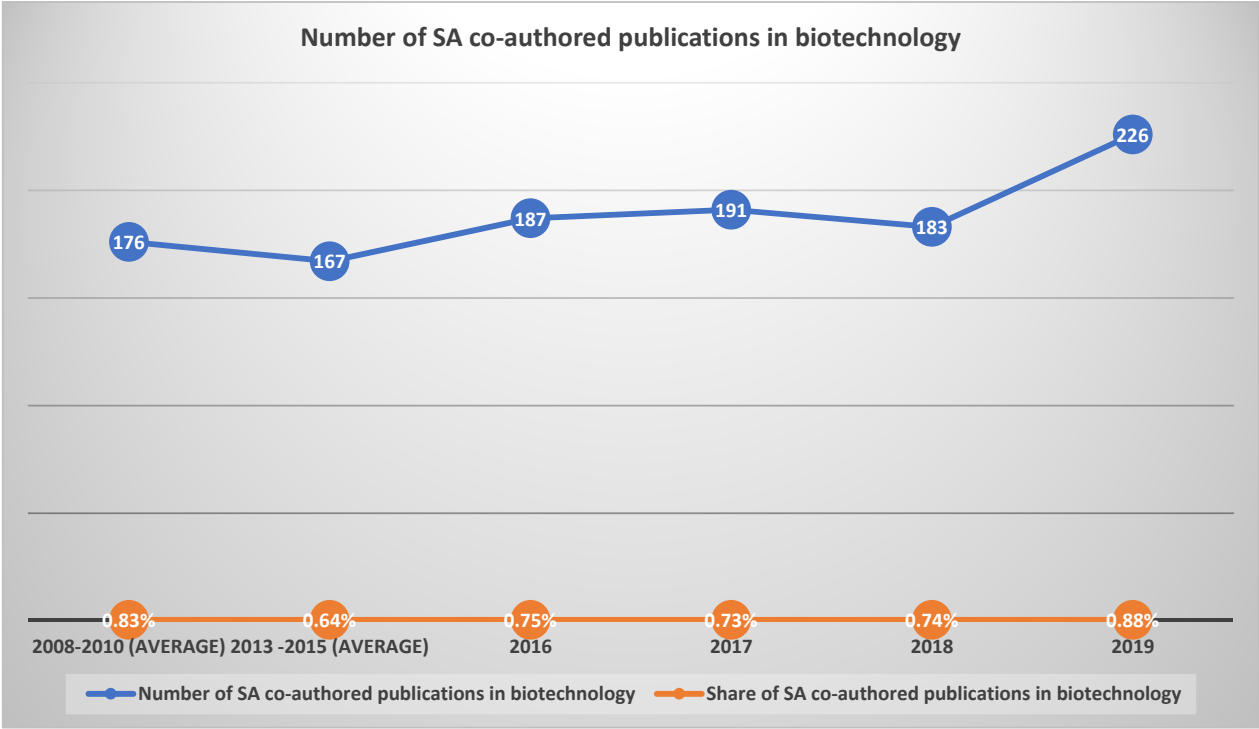




# 4.2 Output Measures: Biotechnology Publications

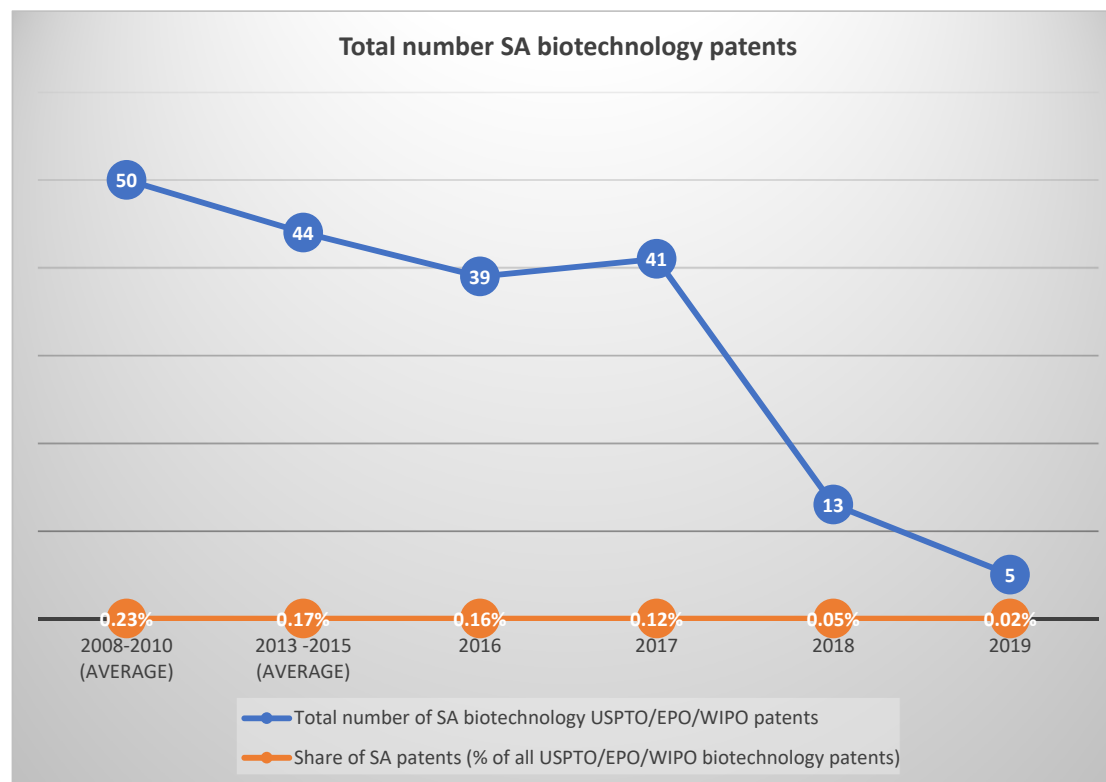


## South African publications in the field of biotechnology since 2008



## 4.2 Output Measures: Biotechnology Patents

### South African patents in the field of biotechnology since 2008

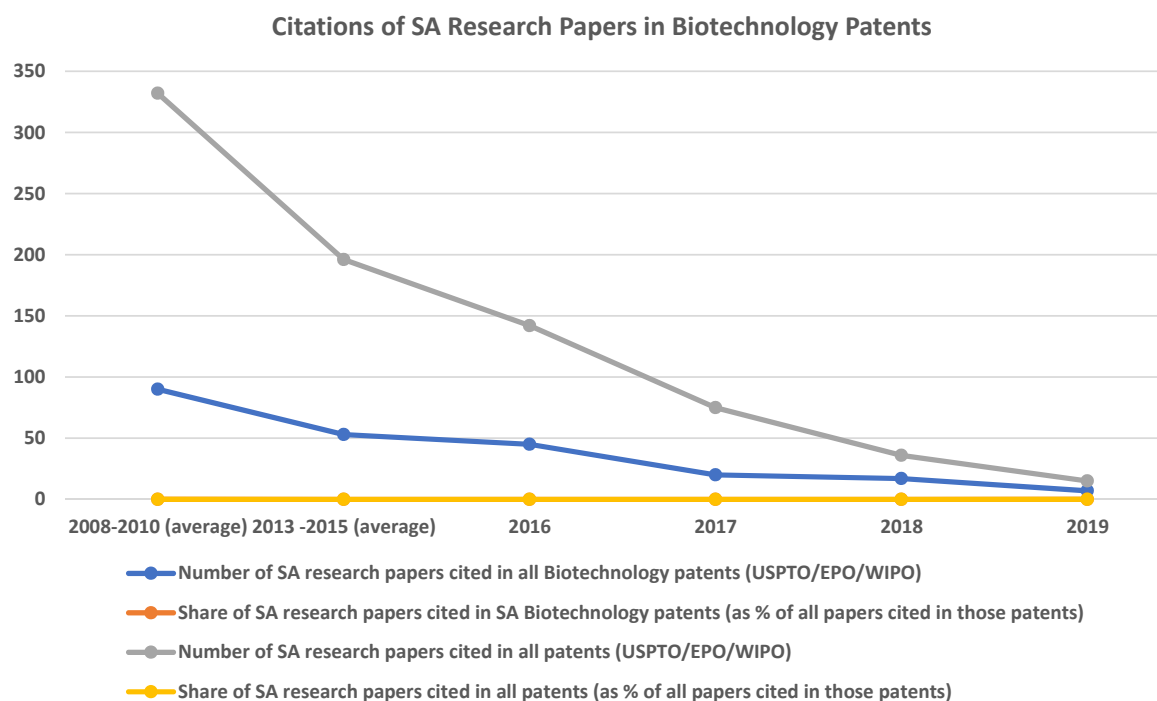


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## 4.2 Output Measures: Citations

Number of times South African publications were cited in patents in the field of biotechnology since 2008



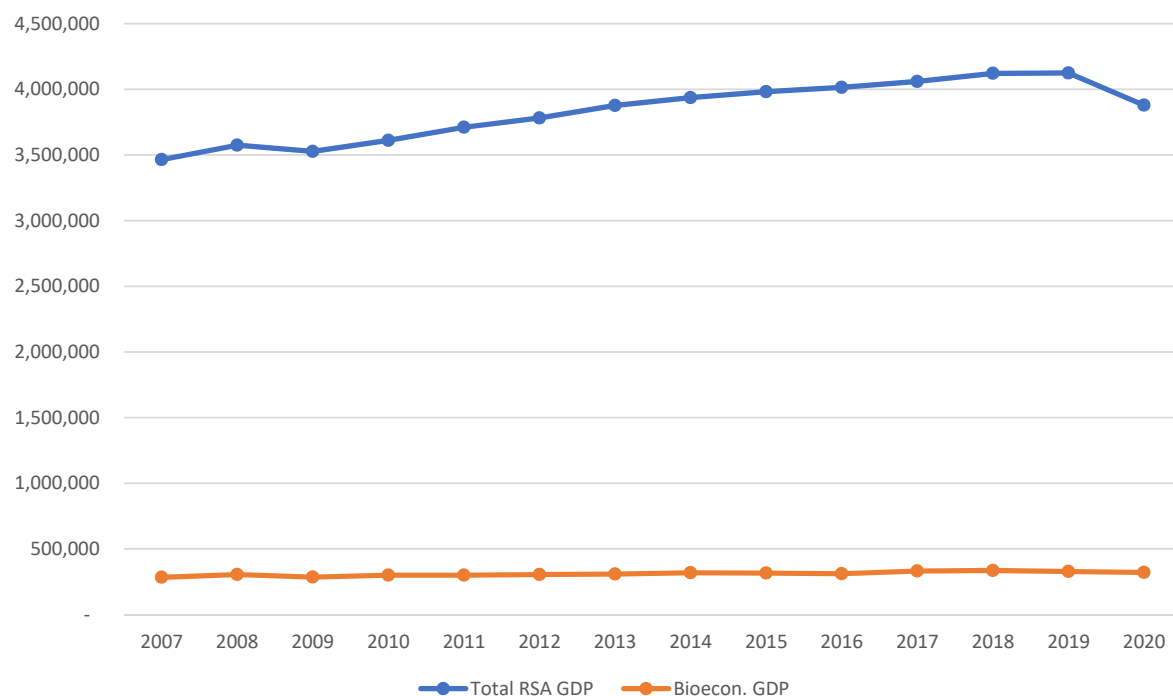
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## 4.3 Growth Measures: Bioeconomy Share of GDP



Economic Growth (GDP) (Rm Constant 2015 prices)



- The South African bioeconomy in 2007 represented 8.2% of GDP.
- During the base years of 2013/15, the situation remained almost the same, as the bioeconomy sector still represented 8.0% of GDP.
- In 2020, the bioeconomy's growth grew slightly to 8.3% of the total GDP.
- the bioeconomy maintained a flat trajectory even as the bioeconomy strategy was implemented.



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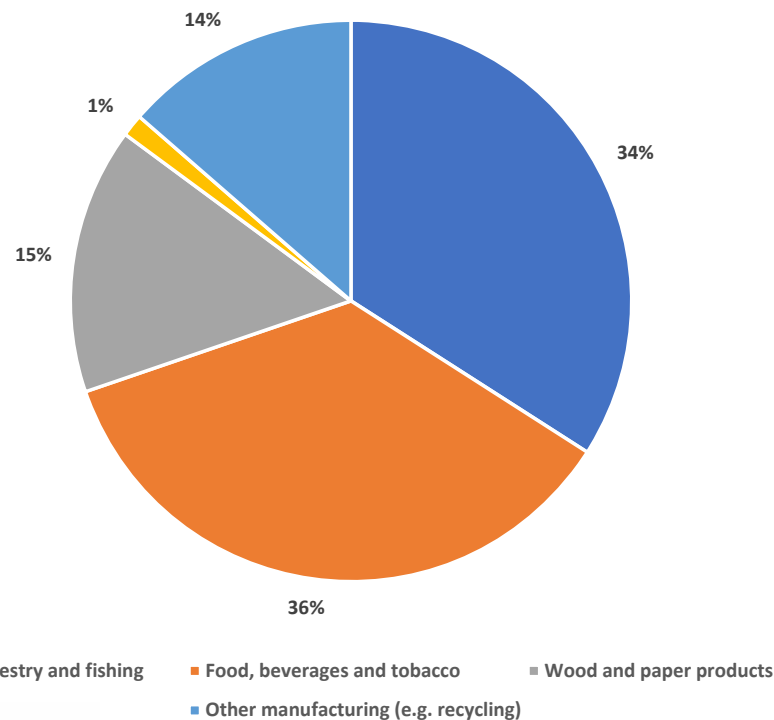
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## 4.3 Growth Measures: Share of Bioeconomy Sectors



GDP of Bioeconomy Sectors

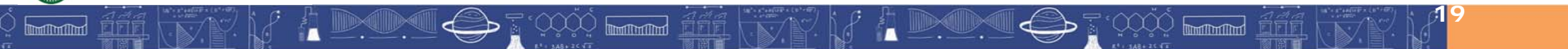


- Food and beverages sector is the largest sector more capital intensive/manufacturing sector/more value add in nature.
- Agriculture is the second largest contributor to GDP.



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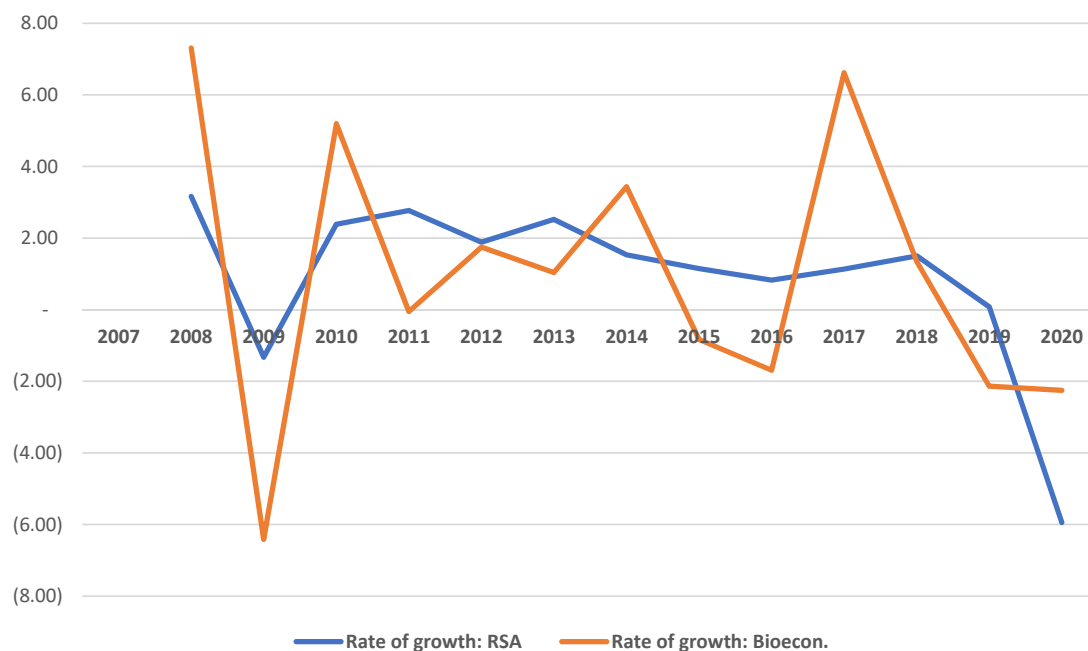
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## 4.3 Growth Measures: Bioeconomy Growth Rate



Bioeconomy Growth Rate



- The South African bioeconomy's rate of growth fluctuated more than that of the whole economy during the period under consideration.
- Around 2017, the bioeconomy contracted at a steeper rate than that of the whole economy, in fact dipping into negative growth after 2019.
- The COVID-19 pandemic affected the bioeconomy growth less than the whole economy probably due to Rand depreciation which allowed for cheaper exports.



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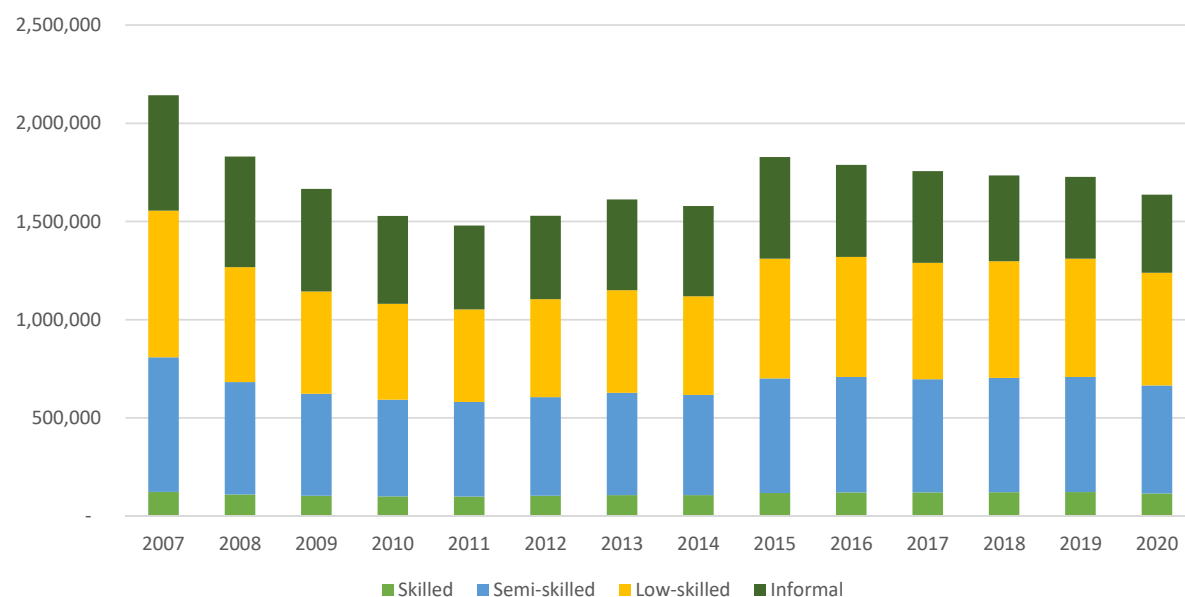




## 4.4 Employment Measures



Bioeconomy Employment



- Formal employment includes employees from VAT-registered private and public enterprises in non-agricultural sectors while informal employment includes employees from non-VAT registered SMEs and micro enterprises, informal traders, and agricultural labourers.
- The skills development has remained constrained during the period before and after the bioeconomy was implemented.
- The trends observed in this data show that there is a need to review and refine current policies aimed at growing skills within this sector.



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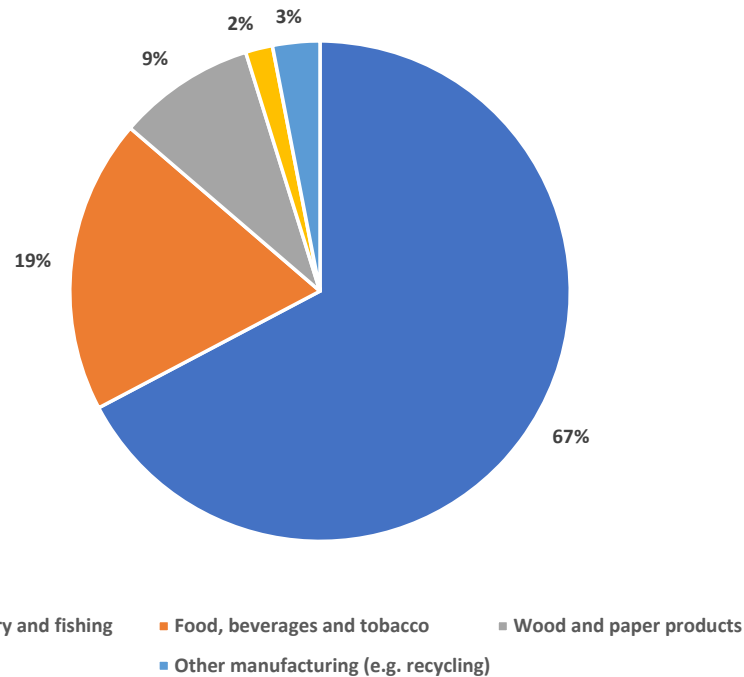
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## 4.4 Employment Measures



Employment Share of Sectors



- Agriculture is labour intensive and absorbs greater share of workers.
- Food and beverages industries are mechanised and absorbs less labour than agriculture.



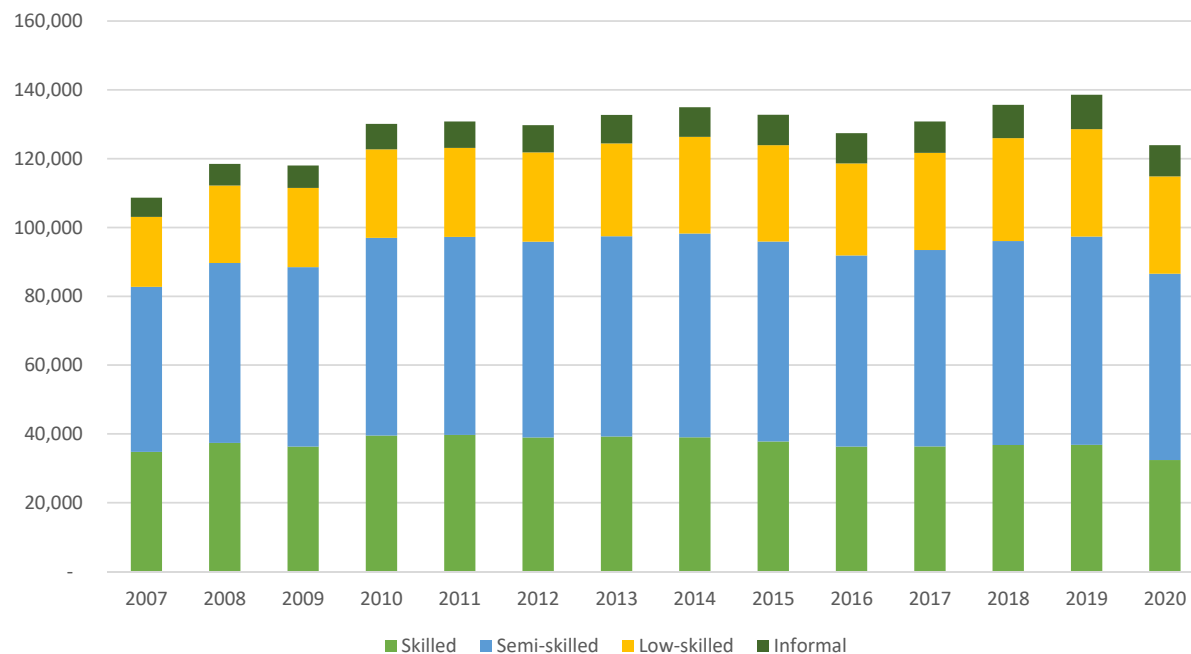
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## 4.5 Remuneration

Remuneration (Rm Constant 2015 prices)



- Remuneration is highest for the skilled workers and decreases down the skills levels.
- The sector is dominated by the semi-skilled workers and the largest share of the wage bill goes to this group.
- Low-skilled and informal workers have the lowest share of the remuneration.

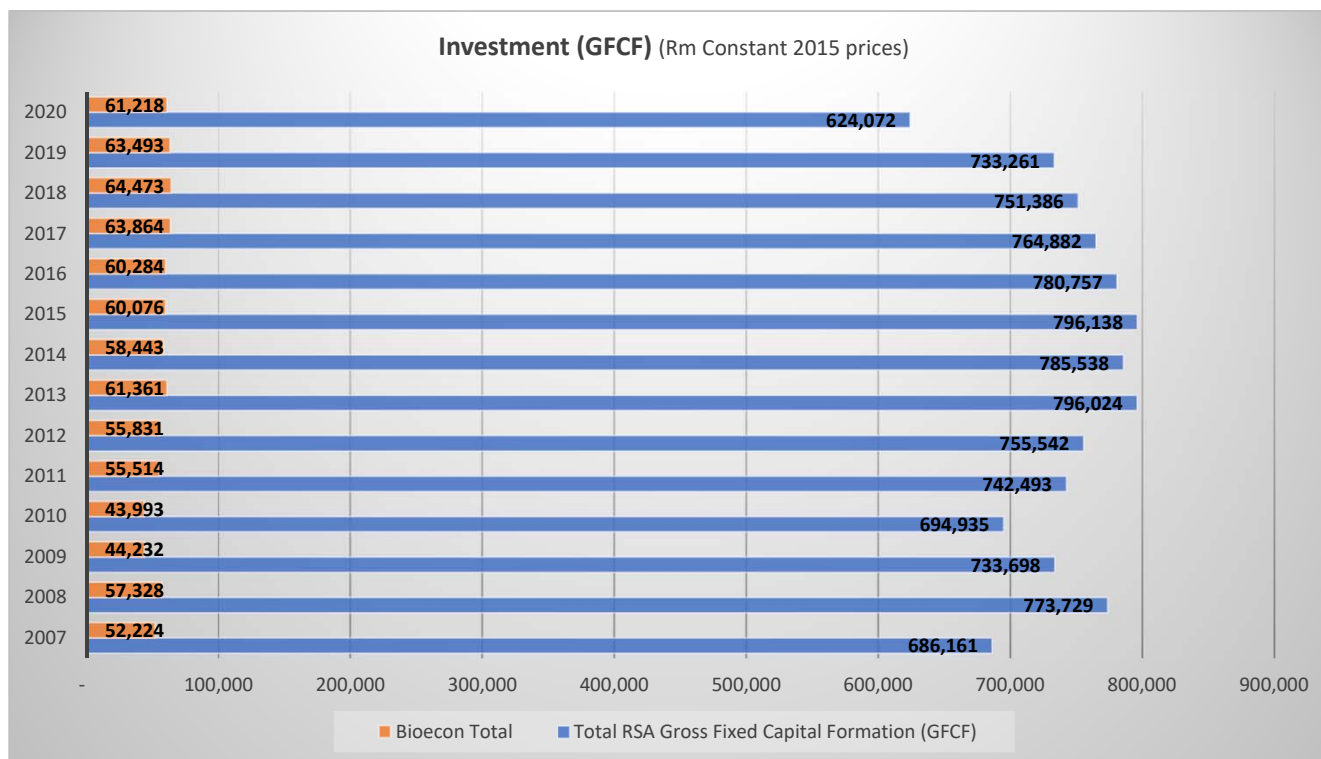


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## 4.6 Investment Measures



- GFCF remained almost constant within the bioeconomy between 2007 and 2020 even as the economy as whole experienced fluctuations.
- What are the growth inducing policy measures that can be implemented?

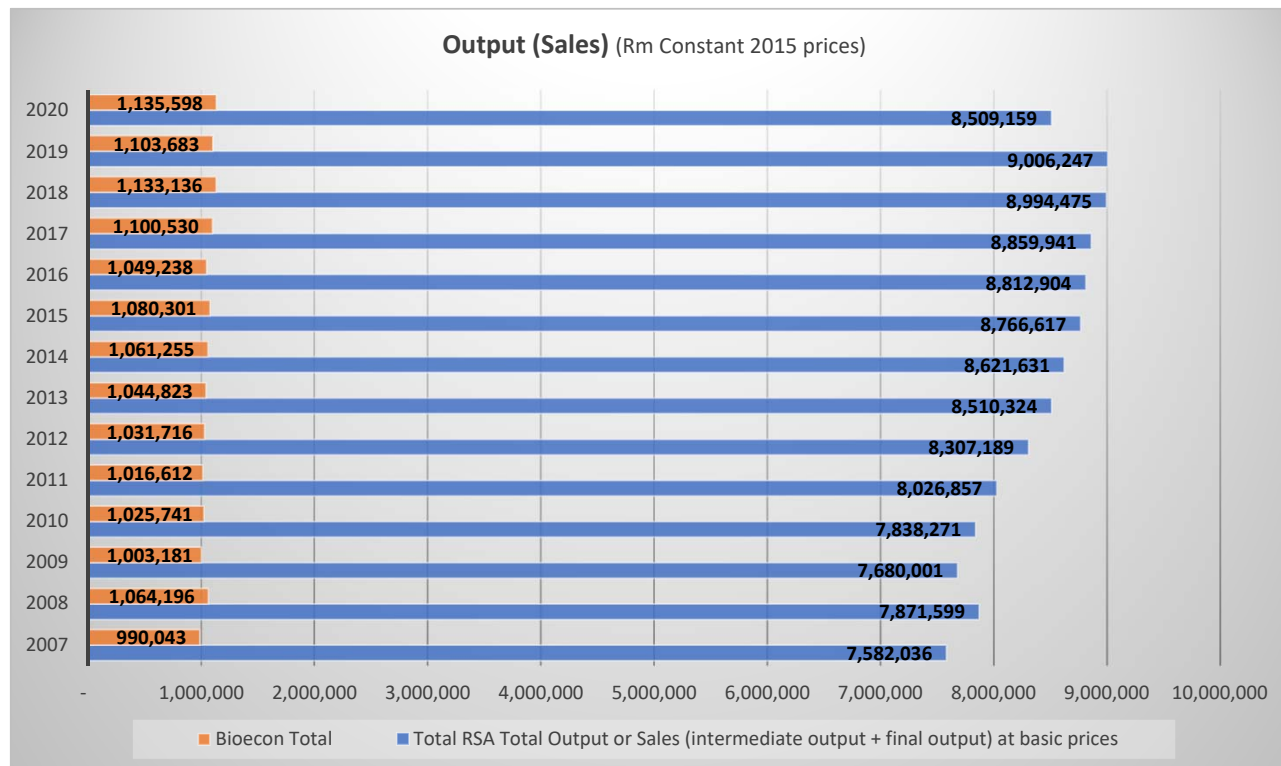


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## 4.6 Investment Measures (Continued)



- Output which encompasses the quantity of goods and services produced by the bioeconomy has increased marginally within the period under review.
- The implementation of the bioeconomy strategy did not seem to introduce increases in output.

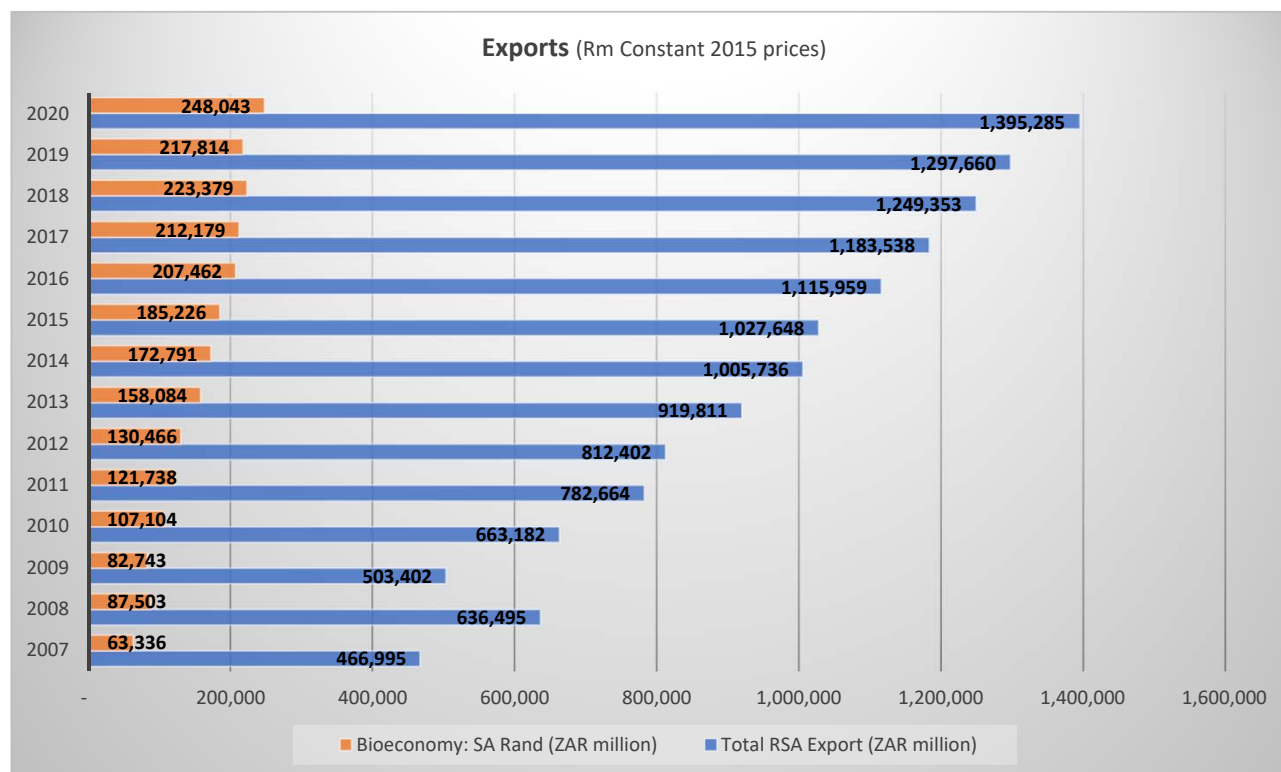


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## 4.7 Export Measures



- The growth in bioeconomy exports has mirrored that of all other exports combined over the period under consideration.
- The sophistication of products developed within the bioeconomy sector is another indicator that needs to be developed in order to better understand the impact of the strategy on technology content of exported products.





## 5. High Level Findings



- The data shows that the business sector, science councils, and the higher education sector are the biggest contributors when it comes to R&D expenditure for biotechnology.
- Since 2011/12, the business sector has been the largest contributor to R&D expenditure in the field of the bioeconomy
- The promise of the bioeconomy is strongest when it comes to **its contribution to the country's total GDP**. The sector is about 8.3% of the South African GDP.
- The bioeconomy **offer skilled employment, semi-skilled employment, and low-skilled employment.**
- The sector shows the promise of being **able to absorb all sectors of formal employment** in South Africa and has been responsible for between 14 and 16 million jobs over the period under review.
- There is a slight increase over the period under review of the quantity of goods and services produced by the bioeconomy.
- The data suggests that with appropriate support from government, the bioeconomy is a potential earner of foreign exchange.



## 5. Recommendations



- **Recommendation 1:** At the centre of government policy is transformation of the South African economy in order to make inclusive. The data from data providers including CeSTII is not disaggregated in terms of race, gender and youth. The DSI, CeSTII and other data providers should get into discussions and explore how the data can be disaggregated in order to inform the transformation agenda of government.
- **Recommendation 2:** Whilst large firms account for the majority of R&D activity in any sector, the biotech sector is dominated in number by SMEs firms. The data collected by CeSTII has a bias against these. The DSI and CeSTII must address this bias if the size of the bioeconomy sector is to be correctly measured.
- **Recommendation 3:** Economic data for traditional sectors is readily available. Future audits should focus on collecting data for emerging sectors and products of the bioeconomy



## 5. Recommendations (Continued)



- **Recommendation 4:** This audit relies on official statistics in the form of SIC codes. This system reports data based on traditional sectors which makes no distinction between synthetic and bio-based production. However, some sectors are “hybrid” since only a part of the production can be considered as bio-based. NACI needs to urgently review the selected SIC codes through the use of expert interviews and surveys to establish the bio-based share of these sectors.
- **Recommendation 5:** The South African bioeconomy strategy is too inclusive when compared with other bioeconomy strategies. This will have the effect of spreading the resources earmarked for the implementation to be spread too thin and thus diluting the intended effects. The DSI will need to prioritise the sectors to be covered to those that can benefit the most from innovation and funding dedicated to those fields.
- **Recommendation 6:** NACI must institutionalise the bioeconomy audits and conduct them periodically in order to be able to effectively track the implementation of the strategy and the growth of the bioeconomy.



## 6. Conclusion



- ☐ The indicators proposed provide a clear and detailed view of the bioeconomy strategy as a whole and on the role of science, technology and innovation within that strategy.
- ☐ The indicators allow for a comparison of performance after the implementation of the bioeconomy strategy with the performance prior to the implementation of the strategy.
- ☐ Most of the data that are required to evaluate the impact of the bioeconomy strategy on the economy as a whole is available. However, there is a paucity of information on non-VAT-registered SMEs
- ☐ The challenge with the available data is that it does not respond to the transformation agenda (race, gender and youth issues).

