Effective opportunities for Bioeconomy Development in Africa and the Global South

Bioprocessing opportunities for Bioeconomy Development in the Global South

Dr Santosh Ramchuran
Council for Scientific and Industrial Research
Chief Researcher and Research Group Leader

Department of International Relations and Cooperation

25 February 2025

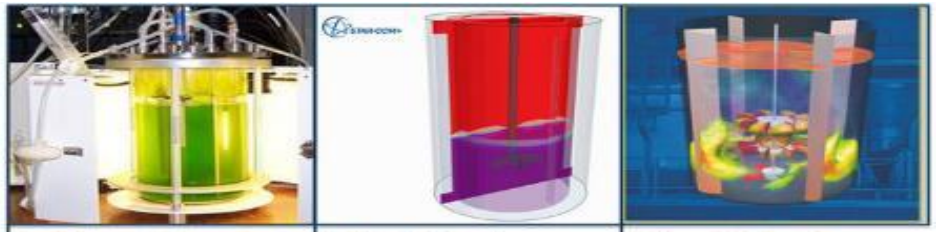
OVERVIEW

"Bioprocessing" - use of living organisms or their components to produce valuable products across various sectors (Industrial, Food, Health, Environmental, Pharma)

Key contribution to a Bioeconomy → Disruptive bio-based technologies and products

- ❑ Drives the bioeconomy by enabling the production of diverse bio-based products
- ❑ The bioeconomy is emerging as a transformative force for sustainable development

- Visualize Patterns
- Understand Phenomenon
- Analyze & Quantify Non-idealities
- Modify Design
- Repeat at higher scale
- Optimize /Explore at Final scale



Lab or Bench	Pilot Scale	Plant Scale
• Simulation + Experiment • = Validation	• Simulation + Experiment • =Scale up Rules	• Only Simulation • =Reliability, Confidence, Safety • =Value

A complete bioprocessing facility to allow Process Development for bio-based technologies using wild-type and genetically modified microorganisms.

Scale up considerations → Process Modeling and Simulations

SUPERPRO DESIGNER

Aspen HYSYS®

BIOPROCESSING – IMPACT ON BIOECONOMY

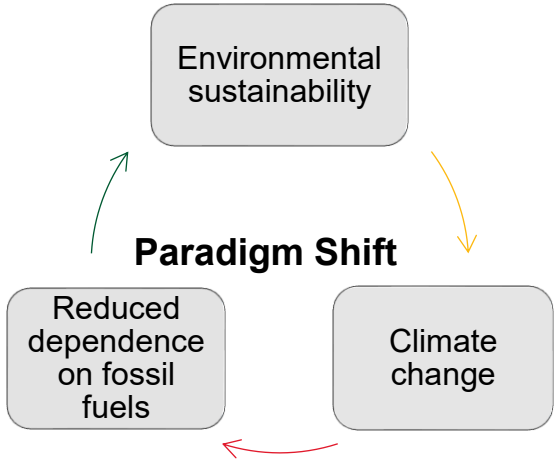
Alignment to global initiatives- green products and processes

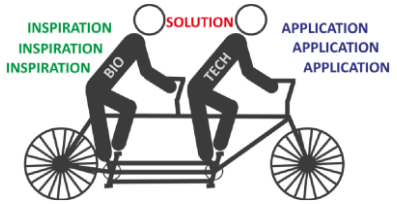
- ❑ Chemical sector enjoys ambitious growth, offers high employment and is competitive
- ❑ Market is currently dominated by the use of petrochemicals-based feed-stocks
- ❑ Negative climate impact

Climate Change

Research show that since the industrial revolution we have burned 1.4 Trillion Tons of Carbon into the Atmosphere

Global paradigm shift towards the conversion of renewable feedstocks to chemical products





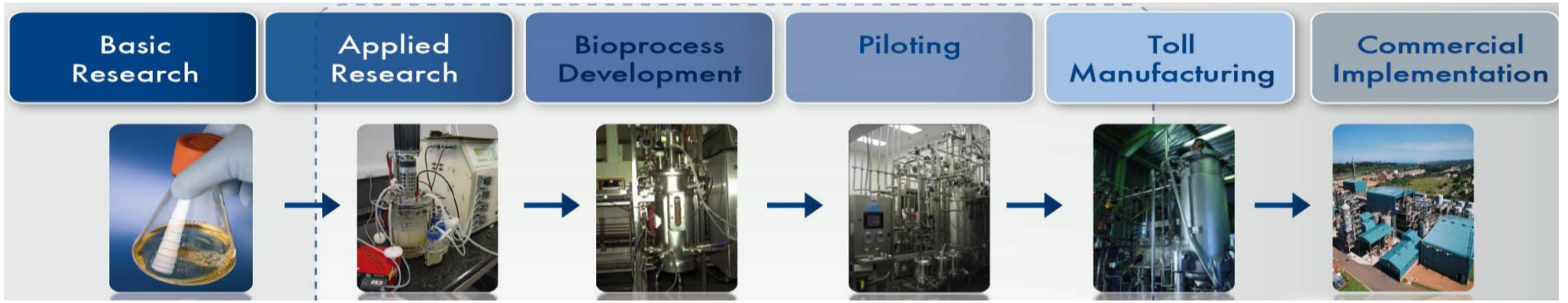
Disruptive bio-based technologies and products

Competition for new value chains from bio-based feed-stocks

BIOPROCESSING VALUE CHAIN

VALIDATION, SCALE-UP AND COMMERCIALIZATION SUPPORT FOR THE BIOMANUFACTURING INDUSTRY

"From Bench to Commercial"



Solidarity
Equality
Sustainability

G20
SOUTH AFRICA 2025

Solidarity
Equality
Sustainability

CHALLENGES AND SOULTIONS

CHALLENGES

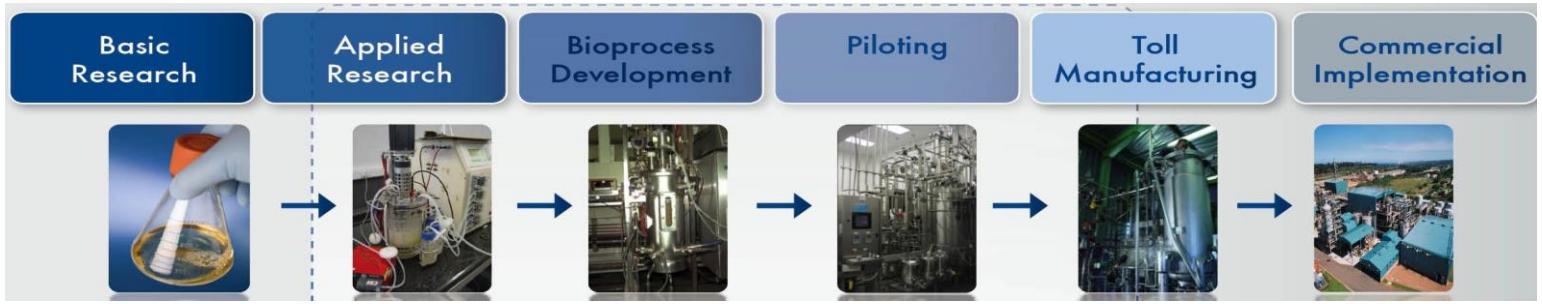
Limited Infrastructure and Skills – SMME's

- SMME's cannot test or validate new and innovative products or technologies at market scale
- Investment finance only available post-market entry
- Risk-averse industry that does not invest in innovation-driven growth

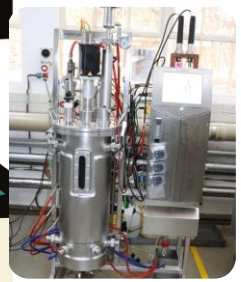
- ❑ Limited availability of **infrastructure** for process or product development, scale-up & prototyping
- ❑ **Skills** for product and process development are scarce and fragmented

- **Stagnant Bioeconomy**
- **Limited translation of R&D into market-ready products**
- **Enterprises has limited success of surviving**

BIOMANUFACTURING INNOVATION FLOW



“Fermentation Concept to Commercial Reality”



Biomanufacturing Platform Technologies

“Hands-on Training and Development”

HUMAN CAPITAL DEVELOPMENT

WORKFORCE DEVELOPMENT AND TRAINING

Globally accepted intervention

WORKFORCE TRAINING PROGRAMS

Programs designed to improve the skills of current employees and prospective job applicants in industry

STEM intensive workforce

Rapid technology development pace

Technically skilled workforce

Course 1

Biomanufacturing Technologies

- Bioprocess development: Upstream process operations
- Bioprocess development: Downstream process operations
- Hands-on production of a recombinant product (30 L bench scale)

Course 2

Vaccine Production

- Production stages – Upstream and downstream
- Single-use and perfusion systems
- Hand-on production – Bench-scale cell culture (CHO)

Course 3

Biopharmaceutical Quality

- Compliance and regulation
- Introduction to QMS
- Hands-on training in fill-finish methods and Certificate of Analysis development

Course 4

Good Manufacturing Practice (GMP) Biomanufacturing at Scale

- Process validation
- Process scale-up simulations
- Hands-on GMP biomanufacturing (bacteria, yeast and CHO)

Solidarity

Equality

Sustainability

STRUCTURED DEVELOPMENT PROGRAM







- **network**
- BioPark
- OneBio
- BIDC networking accelerator events
- B2B introductions

Access to trained staff/workforce development

- Training courses
- Intern programme

African Biomanufacturing Workforce Training and Skills Development initiative

BIDC technical support

- Product and process development, packaging, scale-up/piloting, technology validation, techno economics/costing
- Licensing of technologies

Model/support training to the continent

Access to market

- BioPanza Market Access Cluster
- Cecosa
- SAEOPA

Access to funding

- Pitching events
- Introductions to funders
- Raising awareness of different instruments

Solidarity
Equality
Sustainability

G20
SOUTH AFRICA 2025

Solidarity
Equality
Sustainability

CASE STUDIES

PRODUCT AND TECHNOLOGY DEVELOPMENT SHOWCASE

PROBIOTICS

Broiler
- Bacterial-based
- Four-strain consortium
- Multimode
- Pilot-scale production

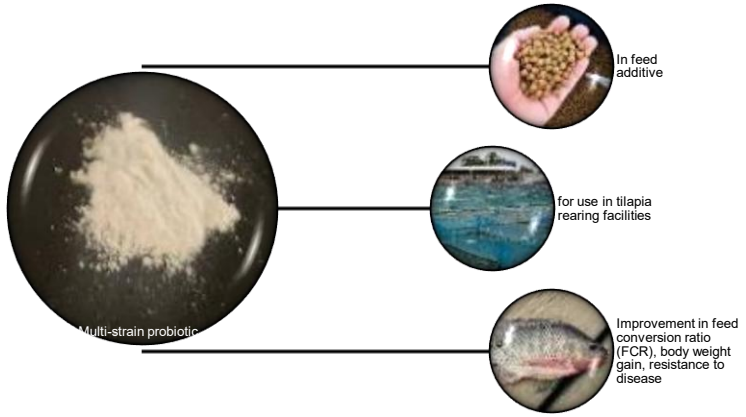
Abalone
- Bacterial-based
- Three-strain consortium
- Multimode
- Pilot-scale production

Aquaculture
- Bacterial based
- Single strain
- Pilot-scale production

Emerging areas
- Horses and dogs
- Bacterial-based
- Four to six strains development stage

- ❑ Focus on localization
- ❑ Manufacture of probiotics strains
- ❑ Import replacement
- ❑ Use of indigenous strains

Several animal and Human probiotic technologies have been developed for SMME's



Aquaculture Probiotics

PRODUCT AND TECHNOLOGY DEVELOPMENT SHOWCASE

AGRICULTURAL BIOLOGICALS

Biofertilizers	Biostimulants (PGPR)	Bio-control
Bacillus based at TRL 9 Commercial partners in place	Trichoderma based TRL 6-7 Commercial partner in place	Trichoderma based TRL 6-7 Commercial partner in place

Product Testing on Plum tomatoes

Efficacy in other crops

Solidarity
Equality
Sustainability

PRODUCT AND TECHNOLOGY DEVELOPMENT SHOWCASE

BIO-BASED ADDITIVES AND POLYMERS

- Exploring new opportunities involving the use of biological processes and products for Industrial Applications – Biobased –chemical replacement
- This has lead to the development of Novel Biomaterials and Bio-additives

Research and Development Approach

Biorefining

Fractionation of lignocellulosic biomass streams

Feedstock Extraction

Bio-Processing

Forestry, timber, pulp, paper industries

Sugar cane industry

Agro-processing wastes

Cleared alien invasive plants

Hemp and cannabis industries

CO_2

Microbial Production

Bio-based chemicals

Bio-based Products

Disruptive bio-based technologies and products

Applications

Bio-stabilizer for unpaved Roads
Bio-additive for pothole repairs

Bio-cement (self-healing concrete

Dust –Suppression

Post-harvest coating

Solidarity
Equality
Sustainability

G20
SOUTH AFRICA 2025

Solidarity

Equality

Sustainability

IMPACT

IMPACT

Growing the BIOMANUFACTURING SECTOR

BIOMANUFACTURING INDUSTRY DEVELOPMENT CENTER

- Facilitates the translation of R&D to market ready products and technologies
- Makes skills and infrastructure available to industry and SMEs
- Workforce development in bioprocess and product development skills
- Partners have been the DSI, TIA and the Jobs Fund

41 **ENTERPISES** CONTRACTED SINCE INCEPTION

119 **PRODUCTS** DEVELOPED FOR SMES

>180 **INTERNS SUPPORTED** AND EQUIPPED WITH VOCATIONAL SKILLS

29 **LICENCES** SIGNED

9 **TECHNOLOGY DEMONSTRATORS**

Solidarity
Equality
Sustainability

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

technology innovation AGENCY
innovating tomorrow together

THE JOBS FUND
South Africa Siyasebenza

MODEL FOR DRIVING THE AFRICAN BIOECONOMY

Phase 1: Human Capital Development

- Bio-entrepreneurship
- Introduction at school level
- Included in undergraduate studies
- Post-graduate internships in product and process development

Phase 2: Enabling Environment

- Technology and Business Development Centre's
- Open access Infrastructure – POC to higher TRL
- Scale- up medium scale manufacturing facilitates
- SMME's funding support

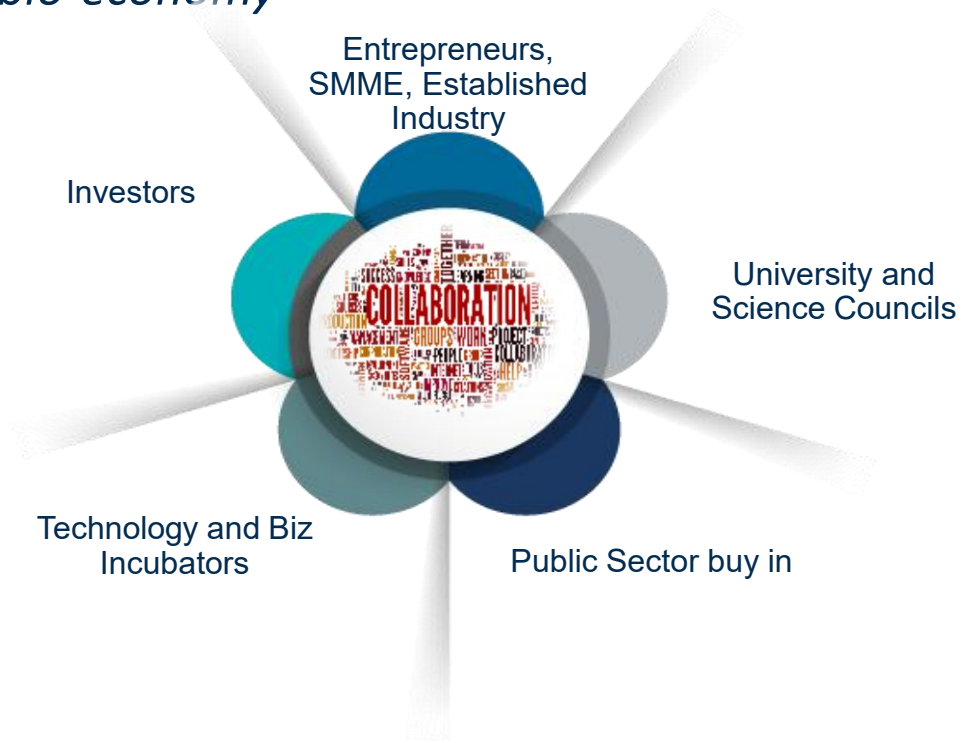
Phase 3: Competency Building

- Develop Distinctive Competency in Bioprocessing
- Hand-on specific training and specialization
- Knowledge-Transfer

Solidarity
Equality
Sustainability

KEY TO SUCCESS
SHARED VISION AND COLLABORATION

- **Strategic Intent -** *Aligned to National strategy (Science and Innovation Department)*
- *Key focus on Human Capital and Technology Development*
- *Aligned to global innovation and research directions*
- *Focus and Drive towards building a local bio-economy*



Thank you

Dr Santosh Ramchuran
sramchuran@csir.co.za