

# CSIR SHAREHOLDER'S COMPACT 2022/23



science & innovation

Department:  
Science and Innovation  
REPUBLIC OF SOUTH AFRICA



**CSIR**

Touching lives through innovation



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ACRONYMS

Acronym	
3D	Three Dimensional
4IR	Fourth Industrial Revolution
AFM	Advanced Functional Materials
AG	Auditor General
AI	Artificial Intelligence
AISI	Aerospace Industry Support Initiative
AMTL	Advanced Material Testing Laboratories
API	Active Pharmaceutical Ingredient
APIs	Active Pharmaceutical Ingredients
AR	Augmented Reality
ARC	Audit and Risk Committee
AUDA	African Union Development Agency
B-BBEE	Broad-Based Black Economic Empowerment
BD&C	Business Development and Commercialisation
BEI	Business Excellence and Integration
BIDC	Biomanufacturing Industry Development Centre
BIDF	Biorefinery Industry Development Facility
BIFN	BRICS Institute for Future Networks
BiPAP	Bilevel Positive Airway Pressure
BRICS	Brazil, Russia, India, China, and South Africa
C4IR	Centre for the Fourth Industrial Revolution
CAGR	Compound Annual Growth Rate
CAS	Collision Avoidance System
CBD	Cannabidiol
CeNAM	Centre for Nanostructures and Advanced Materials
CEO	Chief Executive Officer
CF	Commercialisation Fund
CFO	Chief Financial Officer
CH <sub>4</sub>	Methane
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COE	Centre of Excellence
CoGTA	Cooperative Governance and Traditional Affairs
COVID-19	Coronavirus disease 2019



Acronym	
CPAP	Continuous Positive Airway Pressure
CSD	Central Supplier Database
CSIR	Council for Scientific and Industrial Research
DALRRD	Department of Agriculture, Land Reform and Rural Development
DBSA	Development Bank of Southern Africa
DCS	Department of Correctional Services
DCTD	Department of Communications and Digital Technologies
DDM	District Development Model
DERI	Defence Evaluation and Research Institute
DFID	Department for International Development
DHET	Department of Higher Education and Training
DMRE	Department of Mineral Resources and Energy
DoD	Department of Defence
DOW	Dow Packaging and Specialty Plastics Dow Southern Africa (Pty) Limited
DSAC	Department of Sport, Arts and Culture
DSI	Department of Science and Innovation
DSP	Digital Signal Processing
dtic	Department of Trade, Industry and Competition
ECD	Enterprise Creation for Development
EE	Employment Equity
EM	Electronic Monitoring
EPIC	Excellence, People, Integrity and Collaboration
EPO	European Patent Office
ERAs	Emerging Research Areas
ERM	Enterprise Risk Management
ERMS	Enterprise Risk Management Services
ERRP	Economic Reconstruction and Recovery Plan
ESG	Environmental, Social Inclusion, and Governance
EU	European Union
ExCo	Executive Committee
FPP	Fraud Prevention Plan
GCIS	Government Communication Information System
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GIT	Graduate-in-Training
GMP	Good Manufacturing Practice
GPR	Ground Penetrating Radar
H2S	Hydrogen Sulfide
HC	Human Capital





Acronym	
HDPE	High-density polyethylene
HEIs	Higher Education Institutions
HESTIIL	Higher Education, Science, Technology, and Innovation Institutional Landscape
HIP	Hot Isostatic Pressing
HIV	Human Immunodeficiency Virus
HPC	High Performance Computing
HR	Human Resources
HRSEC	Human Resources and Social & Ethics Committee
HySA	Hydrogen South Africa
IAs	Impact Areas
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technology
IDCSA	Industrial Development Corporation of South Africa
IKS	Indigenous Knowledge Systems
IMF	International Monetary Fund
IoT	Internet of Things
IP	Intellectual Property
IPOSS	Integrated Port Operations Support System
IPR	Intellectual Property Rights
ISO	International Organisation for Standardisation
IT	Information Technology
IUDF	Integrated Urban Development Framework
KPIs	Key Performance Indicators
KSS	Knowledge Sharing Systems
LCBE	Legal, Compliance and Business Enablement
LCMS	Locomotive Condition Monitoring System
LF	Learning Factory
LMDN	Light Metals Development Network
LS	Landward Sciences
MEA	Middle East and Africa
MerSETA	Manufacturing, Engineering and Related Services Sector Education and Training Authority
MESA	Manufacturing Enterprise Solutions Association
MFMA	Municipal Finance Management Act
MICT	Media, Information and Communication Technologies
MISSTP	Master Information System & Security Technology Plan
MMP	Mandela Mining Precinct
MQA	Mining Qualifications Authority
MSc	Master of Science
MTEF	Medium-term Expenditure Framework



Acronym	
MTSF	Medium-term Strategic Framework
NACI	National Advisory Council on Innovation
NCACC	National Conventional Arms Control Committee
NDA	Non-Disclosure Agreement
NDOH	National Department of Health
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
NFRI	National Foundation for Research and Innovation
NGEI	NextGen Enterprises and Institutions
NHLS	National Health Laboratory Service
NIDF	Nanomaterials Industrial Development Facility
NLC	National Laser Centre
NLP	Natural Language Processing
NMDMF	Nano-Micro Device Manufacturing Facility
NMISA	National Metrology Institute of South Africa
NNR	National Nuclear Regulator
NPDO	National Policy Data Observatory
NPO	Not for Profit Organisation
NRF	National Research Foundation
NSI	National System of Innovation
NT	National Treasury.
NWU	North-West University
OCT	Optical coherence tomography
OEM	Original Equipment Manufacturer
OP	Operation Vulindlela
PC4IR	Presidential Commission on 4IR
PFMA	Public Finance Management Act, 1999 (Act 1 of 1999) as amended by Act 29 of 1999).
PG	Parliamentary Grant (Baseline)
PGIC	Parliamentary Grant Investment Committee
PGMs	Platinum Group Metals
PhD	Doctor of Philosophy
PLM	Product Lifecycle Management
PoC	Point-of-Care
PoPIA	Protection of Personal Information Act
PPE	Property, Plant and Equipment
PPF	Photonics Prototyping Facility
PPPFA	Preferential Procurement Policy Framework Act
PRASA	Passenger Rail Agency of South Africa
PRDW	PRDW Consulting Port and Coastal Engineers



Acronym	
PSPs	Professional Service Providers
PV	Photovoltaics
QLFS	Quarterly Labour Force Survey
R&D	Research and Development
RD&I	Research, Development and Innovation
REW	Radar and Electronic Warfare
RG	Research Group
RIR	Recordable Incident Rate
Rm	Rand in Millions
RMP	Risk Management Plan
RMT	Roam Materials Testing
ROI	Return on Investment
RPA	Robot Process Automation
RSA	Republic of South Africa
SAAF	South African Air Force
SaaS	Software as a Service
SABC	South African Broadcasting Corporation
SABITA	South African Bitumen Association
SADC	Southern African Development Community
SADiLAR	South African Centre for Digital Language Resources
SAHPRA	South Africa Health Products Regulatory Authority
SALGA	South African Local Government Association
SAMERDI	South African Mining Extraction Research, Development and Innovation
SAMI	South African Mining Industry
SANAS	South African National Accreditation System
SANDF	South African National Defence Force
SANEDI	South African National Energy Development Institute
SANRAL	South African National Roads Agency
SANReN	South African National Research Network
SAPS	South African Police Service
SARIR	South African Research Infrastructure Roadmap
SAWS	South African Weather Services
SCEF	Supercritical Carbon Dioxide Encapsulation Facility
SCF	Super Critical Fluid
SDK	Software Development Kit
SET	Science, Engineering and Technology
SETAs	Sector Education and Training Authorities
SETI	Science, Engineering, Technology and Innovation
SEZs	Special Economic Zones



Acronym	
SGCs	Societal Grand Challenges
SHEQ	Safety, Health, Environment and Quality
SITA	State Information Technology Agency
SLA	Service Level Agreement
SMMEs	Small, Medium and Micro Enterprises
SOEs	State-owned Enterprises
SOs	Strategic Objectives
Stats SA	Statistics South Africa
STI	Science, Technology and Innovation
STISA	Science, Technology and Innovation Strategy for Africa
TD	Technology Demonstrator
TIA	Technology Innovation Agency
TIC	Technology Innovation Centre
TiCoC	Titanium Centre of Competence
TMM	Trackless Mobile Machinery
TOdB	Technical Outputs Database
TRL	Technology Readiness Level
TVET	Technical and Vocational Education and Training
UAVs	Unmanned Aerial Vehicles
UCT	University of Cape Town
UKRI	United Kingdom Research and Innovation
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
UP	University of Pretoria
USA	United States of America
USD	United States Dollar
UVC	Ultraviolet-C
VR	Virtual Reality
VRE	Variable Renewable Energy
WAITRO	World Association of Industrial and Technological Organisations
WaTAA	Wastewater Technology Assessment and Application
WCED	Western Cape Education Department
WEO	World Economic Outlook
Wits	University of Witwatersrand
WSP	Williams Sale Partnership Limited
YES	Youth Employment Service



Abbreviation/ Term	Meaning Ascribed
Accounting Officer	A person as defined in terms of section 36 of the PFMA as CEO
Approval Framework	The CSIR policy document specifying the decision matrix and levels of maximum approval authority for different role-players within the CSIR, as approved by the Board of the CSIR and as amended from time to time.
Audit and Risk Committee	Constituted in terms of the requirements as prescribed by the Treasury Regulations of the PFMA and sound corporate governance practices. The ARC is established to assist the Board in discharging its duties, relating to the safeguarding of assets, the operation of adequate systems, control processes and the preparation of accurate financial reporting and statements in compliance with all applicable legal requirements and accounting standards. The ARC is tasked with reviewing the control, governance and risk management practices within the CSIR and determining appropriate policies, controls and procedures to manage them, proportionate to the risk or opportunity involved.
Code	The CSIR Ethics Statement and Code of Conduct.
Combined Assurance Plan	A planned approach, based on continuous risk analysis, designed to highlight the relevant high-risk areas and the assurance to be provided by management, compliance, external audit, internal audit and other consultants or service providers, in order for the CSIR Board to be appraised of the risk management efforts undertaken to manage the risks to an acceptable level and for assessing the extent and the adequacy of assurance on key organisational risks and reporting on those risks to senior management and the ARC, and in the context of fraud prevention, to the Human Resources and Social and Ethics Committee (HRSEC).
Conditions of Service	The CSIR Conditions of Service as approved by the Board of the CSIR in terms of section 12 of the Scientific Research Council Act, 1998 (Act 46 of 1998) and as amended from time to time.
Contracted Stakeholders	Those persons or parties with whom the CSIR has formal contractual relations, such as its shareholders, employees, suppliers/service providers, collaborators and customers.
Control	A measure employed to modify risk, the existing risk processes, policy, devices, practices or other actions that act to minimise risks or to enhance positive opportunities.
Corruption	An act whereby anybody accepts any gratification from anybody else or offers or gives any gratification (benefit) to anybody else to influence the receiver to conduct herself or himself or itself in a way that amounts to the unlawful or irregular exercise of any duties.
COSO	Committee of Sponsoring Organisations of the Treadway Commission, who developed a globally accepted Internal Control—Integrated Framework, (the “COSO Framework” or the “Framework”), a set of guidelines designed to assist companies in evaluating the effectiveness of their internal control systems.
CSIR Board	The CSIR Board of Directors/Accounting Authority
Disciplinary Code and Procedure	A document that provides guidance when dealing with misconduct and poor work performance. It promotes regulated fairness, certainty and consistency in the application of discipline, establishes standards, principles and procedures when addressing misconduct, and encourages all employees to adhere to the appropriate standards of conduct by providing for progressive and corrective action, as approved by the Board of the CSIR and as amended from time to time.



Abbreviation/ Term	Meaning Ascribed
Ethics Hotline Procedure	Provides employees with an independent mechanism to bring any unethical business practices to the attention of management via telephone, email, web-based tip-off facility, facsimile or post.
Event	An occurrence or a change of a particular set of circumstances.
Fixed Asset Policy	A document that governs the controls associated with the recognition, de-recognition, financing and transfer of assets as approved by the Board of the CSIR and as amended from time to time.
Fraud	The unlawful and intentional making of a misrepresentation, which causes actual prejudice or is potentially prejudicial to another. Additionally, the use of the term “fraud” in this document is an expansive one and is intended to include all aspects of economic crime and acts of dishonesty that are aimed at causing economic loss to the CSIR.
Fraud Prevention Strategy	The CSIR’s strategy to facilitate fraud prevention/fraud risk management and is a process that is adopted by the CSIR in putting mechanisms in place to manage the CSIR’s vulnerability to fraud. Such mechanisms are designed to prevent, deter and detect fraud.
Fraud Risk	The CSIR’s vulnerability to fraud, based on the adequacy of the mechanisms designed and implemented to prevent, deter and detect fraud.
HRSEC	<p>The committee constituted in terms of Regulation 43 of the Companies Act, 2008 (Act 71 of 2008) that must monitor the company’s activities regarding matters relating to:</p> <ul style="list-style-type: none"> <li>• Social and economic development, including the company’s standing in terms of the goals and purposes of: <ul style="list-style-type: none"> <li>○ The 10 principles set out in the United Nations Global Company Principles,</li> <li>○ The Organisation of Economic Co-operation and Development recommendations regarding corruption,</li> <li>○ The EE Act, 1998 (Act 55 of 1998); and</li> <li>○ The Broad-Based Black Economic Empowerment Act, 2003 (Act 53 of 2003);</li> </ul> </li> <li>• Good corporate citizenship, including the company’s:</li> <li>• Promotion of equality, prevention of unfair discrimination and measures to address corruption,</li> <li>• Contribution to the development of the communities in which its activities are predominantly conducted or within which its products or services are predominantly marketed, and</li> <li>• Record of sponsorship, donations and charitable giving;</li> <li>• The environment, health and public safety, including the impact of the company’s activities and of its products or services;</li> <li>• Consumer relationships, including the company’s policies and records relating to advertising, public relations and compliance with consumer protection laws; and</li> <li>• Labour and employment matters.</li> </ul>
ICT Policy	Provides the framework within which the CSIR’s computing facilities and assets that are provided to employees and CSIR representatives, for the purpose of conducting CSIR business, are administered and managed, as approved by the Board of the CSIR and as amended from time to time.
Information Security Policy	Expresses the CSIR’s position and intent to implement, maintain and improve its information security measures as approved by the Board of the CSIR and as amended from time to time.
Inherent risk	The exposure arising from risk factors in the absence of deliberate management intervention(s) to exercise control over such factors.
Institutional Review Report	The report generated periodically in terms of section 3 of the 1997 White Paper on Science and Technology requiring periodic institutional reviews to be carried out on science, engineering and technology institutions by an independent panel.



Abbreviation/ Term	Meaning Ascribed
Internal Control	Is a system designed to promote efficiency, assure the implementation of a policy, safeguard assets or avoid fraud and error. These sets of rules/measures are put in place to prevent or mitigate an undesired event or condition.
ISO 31000	A family of standards relating to risk management codified by the International Organisation for Standardisation that provides generic guidelines for the design, implementation and maintenance of risk management processes throughout an organisation.
King IV	The King IV Report on Corporate Governance for South Africa, 2016.
Non-contracted Stakeholders	Those persons or parties that do not have a formal contractual relationship with the CSIR, but are, nevertheless, affected by what the CSIR does or says, such as communities, the natural environment, and future generations.
Residual risk	The remaining risk exposure after management has put measures in to control the inherent risk.
Risk	An unwanted outcome, actual or potential, to the CSIR's performance objective caused by the presence of risk factors (may also present as an upside potential available for exploitation).
Risk acceptance	An informed decision by the organisation to take a particular risk.
Risk appetite	The amount of residual risk an organisation is willing to accept.
Risk assessment	An overall process by the organisation for risk identification, risk analysis and risk evaluation.
Risk culture	The values, beliefs, knowledge and understanding about risk that are shared by a group of people with a common intended purpose, in particular, the leadership and employees of the organisation.
Risk factor	Any threat or event that creates or has the potential to create risk.
Risk management	A systematic and formalised process of identifying, assessing, managing and monitoring risks.
Risk owner	The person accountable for managing a particular risk.
Risk register	The record of information about identified risks.
Risk reporting	A form of communication intended to inform internal or external stakeholders by providing information about the current state of risk and how it is being managed.
Risk tolerance	The amount of risk an organisation is capable of bearing.
Risk treatment	A process by which existing controls are improved and new controls developed or implemented.
Stakeholders	Broadly defined as those who are affected by an organisation's decisions and actions inclusive of contracted and non-contracted stakeholders – see definitions for "contracted stakeholders" and "non-contracted stakeholders."  Everyone who has direct and indirect interest in affairs of the organisation, persons who and entities that can affect, be affected by, or perceive themselves to be affected by a decision or an activity.
Threats	Risks emanating from the organisation's nature of business.
Treasury Regulations	The regulations issued by NT in support of the PFMA.



## THE SHAREHOLDER'S COMPACT

### OVERVIEW OF THE SHAREHOLDER'S COMPACT

The Shareholder's Compact is a performance agreement between the Council for Scientific and Industrial Research (CSIR) and the Minister of Higher Education, Science and Innovation. It consists of the text of the Compact itself (Chapter 2) and a series of supporting annexures that cover the following aspects:

- a. Strategic planning documents:
  - Strategic Plan (Annexure A); and
  - Annual Performance Plan: 2022/23 (Annexure B).
- b. Documents setting out the governance structures and risk management strategies of the CSIR:
  - Governance Structure (Annexure C);
  - Risk Management Strategy (Plan) (Annexure D);
  - Fraud Prevention Plan (FPP) (Annexure E); and
  - Materiality/Significance Framework (Annexure F).
- c. Documents setting out the CSIR Financial Plan and CSIR's compliance with the applicable financial legislation:
  - Financial Plan (Annexure G)

### SHAREHOLDER'S COMPACT AGREEMENT

FOR THE CYCLE COMMENCING 1 APRIL 2022

MADE AND ENTERED INTO BY AND BETWEEN:

**THE MINISTER OF HIGHER EDUCATION, SCIENCE AND INNOVATION**

Dr Blade Nzimande, in his capacity as Executive Authority, being the responsible Cabinet member (hereinafter referred to as "the Executive Authority")

and

**THE CSIR BOARD**

herein represented by Professor Thokozani Majazi, the Chairperson of the Board (hereinafter referred to as "the Accounting Authority")  
(The Parties are hereinafter collectively referred to as "the Parties")

**WHEREAS:**

The Parties wish to conclude a Shareholder's Compact in order to underscore a constructive working relationship between them, clarify mutual expectations that are to be satisfied, articulate the CSIR's role in support of the effective functioning of the National System of Innovation (NSI) and establish a framework of good corporate governance;

Treasury Regulation 29.2, issued under the PFMA, further requires the Accounting Authority of a Schedule 3B public entity to conclude a Shareholder's Compact with its Executive Authority annually; and





The CSIR Board is the organisation's Accounting Authority and the Minister of Higher Education, Science and Innovation its Executive Authority as the Cabinet member responsible for the CSIR; the Parties have negotiated and reached an agreement on the contents of the Shareholder's Compact and wish to record the same in writing.

**NOW, THEREFORE, THE PARTIES HEREBY AGREE AS FOLLOWS:**

## 1. GLOSSARY OF TERMS

In this Shareholder's Compact, the following words and/or phrases shall have the following meanings:

- a. **Accounting Authority** means the CSIR Board as established in terms of section 7 of the Scientific Research Council Act;
- b. The **Corporate Plan**, as embodied in Annexures A to G to this Shareholder's Compact, with:
  - i. Annexure A being the CSIR Strategic Plan;
  - ii. Annexure B being the CSIR Annual Plan for the 2022/23 financial year;
  - iii. Annexure C being the CSIR Governance Structure;
  - iv. Annexure D being the CSIR Risk Management Strategy (Plan);
  - v. Annexure E being the CSIR FPP;
  - vi. Annexure F being the Materiality Framework; and
  - vii. Annexure G being the Financial Plan (including the Budget and Cash flow for 2022/23; the Group's three-year Financial Plan and the three-year Borrowing Plan).
- c. **Annual Budget** means the CSIR's annual budget as embodied in Annexures A, B and G;
- d. **Balanced Scorecard Framework** means the Executive Authority's framework for evaluating the performance of science, engineering and technology (SET) institutes described in the DSI publication entitled "Reviewing the science, engineering, technology and innovation (SETI) scorecards", dated May 2003;
- e. **Basic Conditions of Employment Act** means Act 75 of 1997;
- f. **B-BBEE Codes** means the Broad-Based Black Economic Empowerment Codes as published in the Government Gazette from time to time;
- g. **EE Act** means Act 55 of 1988;
- h. **Effective Date** means the effective date of this Shareholder's Compact, which shall be 1 April 2022;
- i. **Executive Authority** means the Minister of Higher Education, Science and Innovation;
- j. **KPIs** means the performance measures described in the Corporate Plan, against which the performance of the CSIR shall be evaluated;
- k. **Labour Relations Act** means Act 66 of 1995;
- l. **Materiality Framework** means the materiality framework as envisaged by clauses 6.3 and 13.1.5. below and as recorded in Annexure F;
- m. **Parties** means the Executive Authority and the Accounting Authority, respectively;
- n. **PFMA** means Act 1 of 1999;
- o. **PoPIA** means Act 4 of 2013;
- p. **Shareholder's Compact** means this document and all annexures thereto;
- q. **Scientific Research Council Act** means the CSIR's enabling legislation, namely Act 46 of 1988;
- r. **Skills Development Act** means Act 97 of 1998; and
- s. **Treasury Regulations** means any prescripts or legislative requirements, or practice notes issued by NT for implementation by government departments, trading entities, constitutional institutions and public entities, issued in line with the PFMA.

## 2. THE SHAREHOLDER'S COMPACT

- a. This Shareholder's Compact represents the agreement between the Executive Authority of the CSIR, being the Minister of Higher Education, Science and Innovation, and the Accounting Authority of the CSIR, being the CSIR Board, herein represented by the Chairperson of the Board. It reflects the expectations of each of the Parties, expressed in terms of outcomes and outputs that need to be achieved during the financial year starting on 1 April 2022.
- b. This Shareholder's Compact shall operate from the Effective Date and will be reviewed by the Parties at the end of the financial year ending on 31 March 2023.



### 3. LEGAL REQUIREMENT AND PRIMARY RELATIONSHIP BETWEEN THE SIGNATORIES

Chapter 29 of the Treasury Regulations imposes the following legal requirements on the Accounting Authority of a Schedule 3B public entity, such as the CSIR, and its Executive Authority, in terms of the conclusion of a Shareholder's Compact:

#### *“29.2 Shareholder's Compact*

*29.2.1. The Accounting Authority for a public entity listed in Schedule 2, 3B or 3D must, in consultation with its Executive Authority, annually conclude a Shareholder's Compact.*

*29.2.2. The Shareholder's Compact must document the mandated key performance measures and indicators to be attained by the public entity as agreed between the Accounting Authority and the Executive Authority.”*

### 4. FRAMEWORK OF THE SHAREHOLDER'S COMPACT

a. In terms of section 3 of its enabling legislation, namely the Scientific Research Council Act, the mandate of the CSIR is as follows:

*“The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest, and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors and thereby to contribute to the improvement of the quality of life of the people of the Republic; and to perform any other functions that may be assigned to the CSIR by or under this Act.”*

b. The Shareholder's Compact,

The CSIR's SOs are outlined in the Corporate Plan, which incorporates the CSIR Strategic Plan and the CSIR Annual Plan for the 2022/23 planning cycle; the CSIR's Risk Management Strategy; the CSIR's FPP; the Materiality Framework; the Budget and Cash flow for 2022/23; the Group's three-year financial plan and the organisation's three-year borrowing plan. The Accounting Authority undertakes to oversee the implementation of the said elements of the Corporate Plan.

### 5. INTERNAL TRANSFORMATION

In Annexure A, the Corporate Plan of the CSIR deals with matters relating to transformation, among others. In giving effect to the Corporate Plan, the Accounting Authority will ensure that the CSIR is in full compliance with all applicable legislation, such as, but not limited to, the EE Act, the Skills Development Act, the Labour Relations Act, the Basic Conditions of Employment Act, and the B-BBEE Codes.

### 6. THE ROLE AND POWERS OF THE ACCOUNTING AUTHORITY

a. The role and powers of the Accounting Authority are set out in sections 7(1), 11, 12 and 19 of the Scientific Research Council Act read with section 3 of the Science and Technology Laws Amendment Act, 2014 (Act 7 of 2014).

b. In terms of section 56 of the PFMA, the Accounting Authority has delegated, in writing, certain of the powers entrusted or delegated to it, to officials in the CSIR. To this end, the Accounting Authority has also adopted an approval framework, which governs the authorisation process in the CSIR. It deals with the development of strategic and operational plans and budgets, appointment of staff, approval of salaries and acquisition and disposal of assets, among others. It also defines authority levels in relation to organisational positions.

c. The Materiality Framework for reporting losses through criminal conduct and irregular, fruitless and wasteful expenditure, as well as for significant transactions as envisaged by sections 55 (2) and 54 (2) of the PFMA, is in place and is included as Annexure F attached hereto.



## 7. UNDERTAKINGS BY THE ACCOUNTING AUTHORITY OF THE PUBLIC ENTITY

- a. The Accounting Authority undertakes to act in accordance with the approved Corporate Plan attached hereto.
- b. In the event that the Accounting Authority will not be able to fully execute the plans as embodied in Annexure A, it will promptly, and in writing, inform the Executive Authority accordingly to seek its advice prior to making decisions or taking action.
- c. The Accounting Authority confirms that it will comply with the provisions of sections 50 and 51 of the PFMA, as more fully dealt with in Annexures D, E and F attached hereto, as well as with the reporting requirements as embodied in the PFMA and the relevant Treasury Regulations.
- d. The Accounting Authority undertakes to ensure that the CSIR complies with its statutory mandate as encapsulated in section 3 of the Scientific Research Council Act.

## 8. UNDERTAKINGS BY THE EXECUTIVE AUTHORITY AS THE SHAREHOLDER

The Executive Authority undertakes to allow the Accounting Authority to manage the business of the CSIR as has been approved in the Corporate Plan through ensuring the following:

- Issuing of instructions and requests for information with sufficient prior notice and response times, with due cognisance that this will not be applicable in instances where the information is required by Parliament and must be provided urgently;
- Not renegeing on written guarantees and undertakings given;
- Providing the organisation with strategic direction and control; and
- Complying with the relevant provisions of the PFMA, as well as the Treasury Regulations insofar as the same relates to it in terms of the relationship between the Parties.

## 9. GOVERNANCE

- a. The Accounting Authority recognises that systems of good corporate governance should be in place and reviewed continuously to ensure that they are sound and consistent with world-class standards at all times, and that they are and remain relevant to the business of the CSIR. Apart from complying with the provisions of the Scientific Research Council Act, the Science and Technology Laws Amendment Act, the PFMA, as well as the Treasury Regulations issued thereunder, and all other applicable legislation, the Accounting Authority shall also ensure compliance with the relevant provisions of the King IV Code on Corporate Governance (2016), and the Protocol on Corporate Governance in the Public Sector (2002) issued by the Department of Public Enterprises.
- b. The Accounting Authority will strive to ensure that the CSIR upholds and sets in place review mechanisms and protocols to ensure that reports and publications, including public comments made by the employees of the CSIR, are based on sound scientific analysis, and do not bring the institution into disrepute.

## 10. KPIS LINKED TO THE BALANCED SCORECARD FRAMEWORK

The KPIS have been summarised according to the categories of the Balanced Scorecard Framework of the Department of Science and Innovation and reflect the SOs of the CSIR. The CSIR's SOs are explained in greater detail below.

CSIR's KPIS provide an understanding of performance in terms of inputs, outputs, efficiencies and, to some extent, provide lead indicators of the outcomes and impact that are required for the CSIR to fulfil its mandate. The KPIS are aligned to the strategic objectives and provide a basket of measures that reflect various aspects of organisational performance. The categories and their associated SOs are:

### **SO1: CONDUCT RESEARCH, DEVELOPMENT AND INNOVATION (RD&I) OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION.**

This SO seeks to ensure that the CSIR undertakes cutting-edge research, development and innovation in areas that will bring transformative change in the South African economy and society.



### **KPI 1: Publication equivalents**

Research publications are a measure of the CSIR's research capabilities and outputs. The quantity and quality of peer-reviewed research publications is a measure of the quality and depth of the scientific knowledge base. Publication equivalents consist of peer-reviewed journal articles, peer-reviewed conference papers, peer-reviewed book chapters and books.

### **KPI 2: New priority patent applications filed**

At the CSIR, priority patent filings serve as a pipeline indicator of patent families. A priority patent is the first patent application filed for the protection of a particular invention with the CSIR named as an applicant/assignee/co-applicant/co-assignee.

### **KPI 3: New patents granted**

Patents provide a lead indicator of the potential impact to be achieved when technologies are commercialised. Patents are exclusive rights for inventions granted by an examining patent authority with the CSIR named as an applicant/assignee/co-applicant/co-assignee.

### **KPI 4: New technology demonstrators**

This is a measure of intermediate output of research, development and innovation activities with the potential to be developed further and that can be transferred to various markets for socioeconomic impacts. A prototype – a rough example of a conceivable technology (Product or system) derived from existing knowledge gained from research and/or practical experience as proof of concept.

### **KPI 5: Number of technology licence agreements signed**

This indicator is a measure of the uptake of CSIR intellectual property (IP) in the market. A licence is an agreement in terms of which the CSIR grants rights to another party to exploit IP developed by the CSIR, typically in exchange for royalty payments and/or other licence fees.

## **SO2: IMPROVE THE COMPETITIVENESS OF HIGH-IMPACT INDUSTRIES TO SUPPORT SOUTH AFRICA'S RE-INDUSTRIALISATION BY COLLABORATIVELY DEVELOPING, LOCALISING, AND IMPLEMENTING TECHNOLOGY.**

This SO seeks to improve the competitiveness of South Africa's high-impact industries through research, technology development and localisation in a collaborative manner, thereby contributing to the re-industrialisation of the country.

### **KPI 6: Number of localised technologies**

This indicator aims to diffuse technologies commercialised or industrialised from elsewhere in the world that have demonstrated potential to positively affect the competitiveness of industry upon competent adoption by users or is a strong candidate to be an input into innovation or enhancements of other systems for the improvement of industrial activities or the capabilities of the State. A localised technology is a technology that has been invented or commercialised outside of South Africa and has been or will be introduced/adapted in South Africa for commercial or scientific benefit or a technology that has been locally developed as an import replacement.

### **KPI 7: Number of joint technology development agreements being implemented for industry**

This indicator measures the CSIR's technology development collaborations with industry partners with the intention to commercialise and industrialise. A joint technology development initiative with an industry partner under a written agreement, where each party brings needed capability for the development and/or implementation of the technology.

### **KPI 8: Number of SMMEs supported**

This indicator measures the CSIR's contribution to socioeconomic development and industrialisation through the support of Small, Medium and Micro Enterprises (SMMEs). Support of SMMEs (as described in Schedule 1 of the National Definition of Small Enterprise in South Africa under the National Small Enterprise Act), through the implementation of RD&I and technology interventions that contribute to SMMEs becoming more productive, efficient and sustainable.



## SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RESEARCH, DEVELOPMENT AND INNOVATION (RD&I) THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE.

This SO emphasises the CSIR's role in supporting the development of a capable state and enabling the government to drive the socioeconomic transformation of South Africa through RD&I.

### **KPI 9: Number of reports directly contributing to national policy formulation and development**

The indicator measures the CSIR's support to the government with evidence-based policy development and decision-making that can benefit from a significant science, engineering and innovation input. Evidence-based policy development support is provided to various arms of government.

### **KPI 10: Number of standards delivered or contributed to in support of the State**

The indicator measures the CSIR's support for government policy and regulation through the development of standardised practice guidelines across economic and social sectors. New or updated standards adopted by the State and State-owned entities that the CSIR has developed and delivered or to which it contributed (e.g. interoperability standards, accessibility standards, products or infrastructure standards).

### **KPI 11: Number of projects implemented to increase the capability of the State**

This indicator measures the number of projects that the CSIR implements on behalf of the State. The CSIR-facilitated implementation of technologies (CSIR-created or otherwise) that improve the efficiency of Government and State-owned Enterprises.

## SO4: BUILD AND TRANSFORM HUMAN CAPITAL (HC) AND INFRASTRUCTURE.

This SO seeks to build and transform the required HC and investment in infrastructure to drive industrialisation and the advancement of society.

### **KPI 12: Total Science, Engineering and Technology (SET) staff**

The indicator is a measure of the CSIR's capacity to deliver on research, development and innovation projects. The number of CSIR staff qualified in the field of SET.

### **KPIs 13 and 14: Percentage of SET staff who are black and female, respectively**

These indicators measure the degree of demographic transformation within the RD&I capacity of the organisation. Percentage of SET staff who are black (as per B-BBEE Act definition) and percentage of SET staff who are female, respectively.

### **KPI 15: Percentage of SET staff with a doctoral qualification**

The indicator measures the organisation's capacity to conduct and supervise quality research and to innovate. The proportion of SET staff who have doctoral-level qualifications.

### **KPI 16: Total Chief Researchers**

The indicator is a measure of the quality of SET capacity and their potential influence in the local and international research, development and innovation spaces (capacity to collaborate and share resources). The number of CSIR staff recognised as Chief Researchers through the formal Career Ladder process.

### **KPIs 17 and 18: Percentage of Chief Researchers who are black and female, respectively**

These indicators measure the level of demographic transformation within the Chief Researcher level. The proportion of black (as per B-BBEE Act definition) South African and proportion of female South African citizens who are Chief Researchers (as per CSIR's Career Ladder process).

### **KPI 19: Total Principal Researchers**

The indicator is a measure of the quality of SET capacity and their potential influence in the local and international research, development and innovation spaces (capacity to collaborate and share resources). The number of CSIR staff recognised as Principal Researchers through the formal Career Ladder process.



### **KPIs 20 and 21: Percentage of Principal Researchers who are black and female, respectively**

These indicators measure the level of demographic transformation within the Principal Researcher level. The proportion of black (as per B-BBEE Act definition) South African and proportion of female South African citizens who are Principal Researchers (as per CSIR's Career Ladder process).

### **KPI 22: Number of staff involved in exchange programmes with industry**

The indicator measures the level at which the CSIR shares expertise and resources to strengthen collaborations with industry to achieve organisational growth. The exchange of staff between the CSIR and industry for a period of time to share/gain expertise for the advancement of business growth opportunities and capacity development.

### **KPI 23: Property, Plant and Equipment (PPE) investment (Rm)**

This indicator provides a measure of the CSIR's investment in research infrastructure to develop and maintain world-class facilities and equipment to provide the quality of research, development and innovation that is expected of it. PPE investment is the amount invested in CSIR and government grant-funded PPE, as well as qualifying leases (as per Accounting Standard on Leases) for a financial year.

## **SO5: DIVERSIFY INCOME, MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE.**

This SO seeks to improve the CSIR's financial sustainability by diversifying revenue sources and optimising the business model to achieve competitiveness supported by good, efficient and sound governance.

### **KPI 24: Total Operating Income (Rm)**

The indicator reflects the ability of the CSIR to ensure financial sustainability. Growth in total operating income indicates growth in the outcomes and impact achieved by the CSIR. Total operating income includes revenue declared on research and development contracts (contract R&D income), income derived from licences and royalties, Parliamentary Grant received through the Science Vote, and other income.

### **KPI 25: Net profit (Rm)**

Net profit is a key indicator of financial sustainability and the ability of the organisation to manage its expenses according to the affordability determined by income levels. Profit for a financial year is calculated as total operating income; less total operating expenditure (including the performance bonus accrual); plus, net finance income.

### **KPI 26: South African public sector income (% Total income)**

South African public sector income reflects the degree of government investment in research, development and innovation activities at the CSIR and the ability of the CSIR to contract with the public sector. South African public sector income is the total income earned from South African public entities as listed in the schedules to the PFMA and the Municipal Finance Management Act (MFMA). This includes revenue declared on research and development contracts, ring-fenced Parliamentary Grant received through the Science Vote and any other forms of funding received from South African public entities.

### **KPI 27: South African private sector income (% Total income)**

South African private sector income reflects the degree of private sector investment in the CSIR. South African private sector income is the total contract research and development income earned from South African non-public entities (NOT listed as public entities in the schedules to the PFMA and the MFMA). This includes Not for Profit Organisations.

### **KPI 28: International contract income (% Total Income)**

International contract income reflects the global relevance of the CSIR. Growth in international investment is a key indicator of income diversification, as well as the relevance and impact of the CSIR within the global economy. International contract income is the total income earned from foreign customers (i.e. entities incorporated outside the borders of South Africa). This includes revenue declared on research and development contracts and other income received from foreign entities.

### **KPI 29: B-BBEE rating**

The indicator is a measure of the CSIR's compliance to the B-BBEE Act in its contribution to support socioeconomic transformation in South Africa. A B-BBEE rating is a verification certificate issued by a South African National Accreditation System (SANAS)-approved verification agency that determines the CSIR's contribution to black (as per B-BBEE Act definition) economic empowerment.



### KPI 30: Recordable Incident Rate (RIR)

RIR indicates the effectiveness of the health and safety management system within the organisation in a year. The Recordable Incident Rate is the number of recordable incidences (or cases); multiplied by 200 000; divided by the number of hours worked. A recordable incident is a work-related injury or illness that results in one or more of the following criteria:

- Death;
- Loss of consciousness;
- Restricted work or transfer to another job;
- Days away from work; and/or
- Medical treatment beyond first aid.

### KPI 31: Audit Opinion

The indicator is a measure of the CSIR's Accountability and Governance. The Auditor-General defines a Clean Audit as achieving an unqualified audit opinion on the audits of annual financial statements and pre-determined objectives, as well as not having material findings on the audit of compliance with laws and regulations.

The target values for the set of KPIs are given in Table A1.

**Table A1: CSIR KPIs: 2022/23**

Key Performance Indicator	Actual 2019/20	Actual 2020/21	Target 2021/22	Projected 2021/22	Target 2022/23
<b>SO 1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion.</b>					
<b>KPI 01:</b> Publication equivalents	437.5	406.5	300	339	<b>304.5</b>
<b>KPI 02:</b> New priority patent applications filed	4	5	5	13	<b>7</b>
<b>KPI 03:</b> New patents granted	21	26	8	17	<b>6</b>
<b>KPI 04:</b> New Technology Demonstrators	37	48	46	46	<b>54</b>
<b>KPI 05:</b> Number of technology licence agreements signed	5	3	19	13	<b>18</b>
<b>SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.</b>					
<b>KPI 06:</b> Number of localised technologies	7	5	11	12	<b>11</b>
<b>KPI 07:</b> Number of joint technology development agreements being implemented for industry	23	25	24	14	<b>27</b>
<b>KPI 08:</b> Number of SMMEs supported	116	96	75	64	<b>72</b>
<b>SO3: Drive the socioeconomic transformation through research, development and innovation which supports the development of a capable state</b>					
<b>KPI 09:</b> Number of reports contributing to national policy development	24	21	20	15	<b>13</b>
<b>KPI 10:</b> Number of standards delivered or contributed in support of the state	10	11	9	6	<b>9</b>
<b>KPI 11:</b> Number of projects implemented to increase the capability of the state	67	44	40	45	<b>45</b>
<b>SO4: Build and transform human capital and infrastructure</b>					
<b>KPI 12: Total SET staff</b>	1 367	1 474	1 497	1 530	<b>1598</b>
<b>KPI 13:</b> Percentage of SET staff who are black	63.3%	67%	66%	67%	<b>67%</b>
<b>KPI 14:</b> Percentage of SET staff who are female	35%	36%	37%	38%	<b>38%</b>
<b>KPI 15:</b> Percentage of SET staff with PhDs	22%	21%	23%	22%	<b>21%</b>
<b>KPI 16: Total Chief Researchers</b>	11	15	17	14	<b>16</b>
<b>KPI 17:</b> Percentage of Chief Researchers who are black	18.2%	20%	17%	14%	<b>19%</b>
<b>KPI 18:</b> Percentage of Chief Researchers who are female	18.2%	20%	24%	14%	<b>13%</b>



Key Performance Indicator	Actual 2019/20	Actual 2020/21	Target 2021/22	Projected 2021/22	Target 2022/23
<b>KPI 19: Total Principal Researchers</b>	149	179	193	180	<b>189</b>
<b>KPI 20:</b> Percentage of Principal Researchers who are black	28%	31%	35%	33%	<b>34%</b>
<b>KPI 21:</b> Percentage of Principal Researchers who are female	16%	19%	22%	19%	<b>20%</b>
<b>KPI 22:</b> Number of staff involved in exchange programmes with industry	11	8	13	15	<b>26</b>
<b>KPI 23:</b> PPE Investment (Rm)	85.51	89.4	100	96.6	<b>259.8</b>
<b>KPI 24:</b> Total Income (Rm)					
	2764	2569	3054	2635.5	<b>2903</b>
<b>KPI 25:</b> Net Profit (Rm)					
	55	96	0	-54.4	<b>-5.4</b>
<b>KPI 26:</b> SA Public sector income (% Total Income)					
	56%	56%	53%	52%	<b>51%</b>
<b>KPI 27:</b> SA Private sector income (% Total Income)					
	5%	13%	12%	8%	<b>12%</b>
<b>KPI 28:</b> International contract income (% Total Income)					
	5%	5%	7%	7%	<b>8%</b>
<b>KPI 29:</b> B-BBEE Rating					
	4	2	2	1	<b>1</b>
<b>KPI 30:</b> Recordable incident rate					
	1.82	0.53	1.8	<1	<b>&lt;1</b>
<b>KPI 31:</b> Audit opinion					
	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	<b>Unqualified audit opinion</b>

## 11. REPORTING

- The Accounting Authority will report on the achievement of its KPIs quarterly, based on PFMA requirements.
- A detailed KPI report approved by the Accounting Authority will be submitted to the Executive Authority annually on or before 31 July of each year, in respect of the immediately preceding financial year. The format of such reporting will be based on the CSIR's KPIs linked to the categories of the Balanced Scorecard Framework.
- The Accounting Authority will meet all the external audit requirements, the results of which will be made available to the Executive Authority, the external auditor of the CSIR, being the Auditor-General, who is responsible for independently auditing and reporting on the financial statements of the CSIR.

## 12. EXTRAORDINARY REPORTING

The Accounting Authority will, at its discretion, report to the Executive Authority on matters of strategic importance and/or operational issues that fall outside the agreed framework of this Shareholder's Compact and the PFMA, as agreed to from time to time during its Board meetings.

## 13. SUPPORTING DOCUMENTATION

Supporting documentation to this Shareholder's Compact is to be found in the following supporting documents attached hereto:

- CSIR Strategic Plan as embodied in Annexure A;
- CSIR Annual Plan for 2022/23 as embodied in Annexure B;
- Risk Management Strategy (Plan) as embodied in Annexure D;
- FPP as embodied in Annexure E;
- Materiality Framework as embodied in Annexure F; and
- Financial Plan as embodied in Annexure G





## 14. PENALTIES AND REWARDS

The Accounting Authority, in terms of the provisions of section 12 of the Scientific Research Council Act, shall determine the remuneration payable to employees of the CSIR, and, in addition, approve the payment of allowances, subsidies and benefits, including performance bonuses.

## 15. GOVERNING LAW AND DISPUTE RESOLUTION

- a. This Shareholder's Compact shall be governed by and construed in accordance with the laws of the Republic of South Africa.
- b. In the event of any dispute arising from this Shareholder's Compact, the Parties shall make every effort to settle such dispute amicably.
- c. Should the dispute, despite such mediation, remain unresolved for a further period of 30 days after being so referred, either Party may declare such dispute a formal intergovernmental dispute by notifying the other Party of such declaration in writing. In which event, the Parties will follow the procedure as outlined in section 42 of the Intergovernmental Relations Framework Act, 2005 (Act 13 of 2005).
- d. Should the dispute remain unresolved for a period of 30 days, the said dispute or difference shall be adjudicated upon by a competent third party agreed upon by the Parties, unless otherwise agreed between the Parties by means of arbitration, mediation, or other agreement.
- e. Should the Parties be unable to agree upon a competent third party as contemplated in clause 15.2, the dispute will be adjudicated by a competent court with jurisdiction to hear the matter.

## 16. NOTICES

- a. The Parties choose as their *domicilium* addresses for purposes of this Shareholder's Compact the following physical addresses:
  - i. The Accounting Authority: c/o the Office of the Chief Executive Officer (CEO), CSIR, Building 3, CSIR Campus, Meiring Naudé Road, BRUMMERIA, Pretoria, 0184
  - ii. The Executive Authority: Building 53, CSIR Campus, Meiring Naude' Road, BRUMMERIA, Pretoria, 0184
- b. Each Party shall be entitled, from time to time, by written notice to the other, to vary its *domicilium* to any other address within the Republic of South Africa, which is not a post office box or poste restante.
- c. Any notice given by one Party to the other ("the addressee") which:
  - is delivered by hand during the normal business hours of the addressee at the addressee's *domicilium* for the time being shall be presumed, until the contrary is proved, to have been received by the addressee at the time of delivery;
  - is posted by pre-paid registered post from an address within the Republic of South Africa to the addressee at the addressee's *domicilium* for the time being shall be presumed, until the contrary is proved, to have been received by the addressee on the fourth day after the date of posting; and/or
  - is transmitted by telefax or e-mail shall be deemed (in the absence of proof to the contrary) to have been received within one hour of transmission, where it is transmitted during normal business hours of the receiving instrument, and within two hours of the commencement of the following business day where it is transmitted outside those business hours.

## 17. WHOLE AGREEMENT

- a. This document, together with the annexures hereto, constitutes the whole of the agreement between the Parties. No instructions, agreements, representations, or warranties between the Parties, other than those set out herein, are binding on the Parties.
- b. All undertakings and annexures to this Shareholder's Compact are declared active on the Effective Date.



## 18. VARIATIONS

No variation or modification of any provision of this Shareholder's Compact or consent to deviate therefrom or waiver in terms thereof shall be valid unless such variation or modification or waiver has been reduced to writing and signed by both Parties, and such variation, modification, consent, or waiver shall be valid only for a specific case and only for the purpose and extent to which it was made or given.

## 19. AMENDMENTS TO THE SHAREHOLDER'S COMPACT

Should either Party wish to make any amendment or alteration to the Shareholder's Compact, that Party shall prepare a change order and present it to the other Party, which shall specify the following:

- i. The date of the change order;
- ii. The description of the proposed amendment or alteration;
- iii. Previous unspecified ad hoc work to be undertaken, if applicable;
- iv. The reason for making the proposed amendment or alteration;
- v. When the Party requires the change to be implemented;
- vi. The resources available; and
- vii. The continued balance of the Parties' obligations under this Shareholder's Compact.

The other Party shall be given an opportunity to consider such change order and make a decision on whether it is prepared to accept such change or not; and

No change order shall be of any force and effect until it is signed by duly authorised representatives of each of the Parties.

## 20. UNDERTAKING BY THE CHAIRPERSON OF THE CSIR BOARD

The Chairperson of the CSIR Board, Professor Thokozani Majosi, undertakes to represent the Accounting Authority in the carrying out of the terms of this Shareholder's Compact and in cascading the spirit of the agreement through the ranks of the CSIR.

## 21. UNDERTAKING BY THE MINISTER OF HIGHER EDUCATION, SCIENCE AND INNOVATION

The Minister of Higher Education, Science and Innovation, Dr Blade Nzimande, approves of this approach and looks forward to the successful implementation of the undertakings embodied in this Shareholder's Compact and its annexures. The Minister accepts that, although the detail of this Shareholder's Compact may change due to variations and changes in the market and society, the spirit thereof will remain unchanged.



**THE CSIR SHAREHOLDER'S COMPACT**

Agreed to and signed in PRETORIA on 18/02 2022

Professor Thokozani Majazi



On behalf of the Accounting Authority

Agreed to and signed in Pretoria on 02 March 2022

Dr Blade Nzimande



The Executive Authority



# ANNEXURE A

## STRATEGIC PLAN





## A.1

## ABOUT THE CSIR

### A.1.1 CSIR MANDATE

The CSIR was established on 5 October 1945 by an Act of Parliament. The Act under which the CSIR now operates, the Scientific Research Council Act, 1988 (Act 46 of 1988) as amended by the Scientific Research Council Amendment Act 1990 (Act 71 of 1990), the General Law Amendment Act, 1996 (Act 49 of 1996), the Measurement Units and Measurement Standards Act, 2006 (Act 18 of 2006), the Science and Technology Laws Amendment Act, 2011 (Act 16 of 2011), the Science and Technology Laws Amendment Act, 2014 (Act 7 of 2014), and Science and Technology Laws Amendment Act 2020 (Act 9 of 2020) stipulates the following mandate:

The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act.

Specifically, section 4(a)(i) of the Act dictates that the CSIR supports better utilisation of the resources of the Republic. This is achieved through the improvement of the productive capacity of its population, improvement of technical processes and methods to improve industrial production, the promotion and expansion of existing, as well as the establishment of new industries, standardisation in industry and commerce, and training of the national work force.

### A.1.2 VISION, MISSION AND VALUES

#### OUR VISION

We are accelerators of socioeconomic prosperity in South Africa through leading innovation.

#### OUR MISSION

Collaboratively innovating and localising technologies, while providing knowledge solutions for the inclusive and sustainable advancement of industry and society.

#### OUR VALUES

**Excellence:** We strive for excellence and quality in everything that we do. We always strive to deliver solutions that surpasses the expectations of our stakeholders. We hold each other to the highest possible standard in research, development, and innovation as well as all other facets of CSIR business. We believe that excellence is a product of investing in the continuous development of our people, processes, and ways of doing business.

**People-centred:** Our business is about touching lives of people – our employees and business partners. We care about people. We respect each other's diversity and conduct ourselves in a manner that upholds the dignity of every person. We believe in continuous personal development, and we encourage one another to seize opportunities for personal growth. We treat our stakeholders the way we like to be treated.

**Integrity:** We act with integrity. We are honest and fair in when dealing with each other and our business partners. We respect the trust that our colleagues and our stakeholders place in us and commit to ethical decision-making, delivery, and governance.

**Collaboration:** We are keen to learn from one another and collaborate across the organisation and with external partners, to ensure our work has the best chance to innovate a better future for South Africans. We actively share our knowledge and expertise by design, formally and informally, so that we can realise large-scale impact.



### A.1.3 STRATEGIC INTENT

**Growth:** We intend to grow the CSIR business and use our capabilities to support the inclusive growth of the South African Economy. For organisational growth, this will entail developing and growing new capabilities and competencies especially those that are relevant to the fourth industrial development and to use this to grow the income and impact of the CSIR. We will, in turn, leverage CSIR capabilities such as skilled HC and infrastructure to contribute to growing the South African economy.

**Sustainability:** We will use CSIR-developed technologies to contribute to the advancement and sustainability of South African enterprises and at the same time the financial sustainability of the organisation in a resource-constrained environment.

**Impact:** We will focus on the commercialisation of our technologies and innovations for industrial development, as well as technology and knowledge transfer that enables a capable state.

**Relevance:** Through our work and its impact we will demonstrate the relevance of innovation in achieving economic development. This will ensure that we deliver on our mandate and remain relevant.

### A.1.4 STRATEGIC OBJECTIVES

The organisation's five (5) strategic objectives (SO 1-5) are derived from the prevailing strategic drivers in our operating environment. The strategic objectives provide the framework on which our strategic and operational plan is designed:

**SO1 Conduct RD&I of transformative technologies and accelerate their diffusion.**

This strategic objective seeks to ensure that the CSIR undertakes cutting-edge RD&I in areas that will bring transformative change in the South African economy and society.

**SO2 Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.**

This strategic objective seeks to improve the competitiveness of South Africa's high-impact industries through research, development and technology localisation, and implementation in a collaborative manner with partners, thereby contributing to the re-industrialisation of the country.

**SO3 Drive socioeconomic transformation through research, development, and innovation (RD&I) that supports the development of a capable state.**

This strategic objective emphasises the CSIR's role in supporting the development of a capable state and enabling the government to drive the socioeconomic transformation of South Africa through RD&I.

**SO4 Build and transform human capital and infrastructure.**

This strategic objective seeks to build and transform the required human capital, and investment in infrastructure to drive industrialisation and the advancement of society.

**SO5 Diversify income, maintain financial sustainability and good governance.**

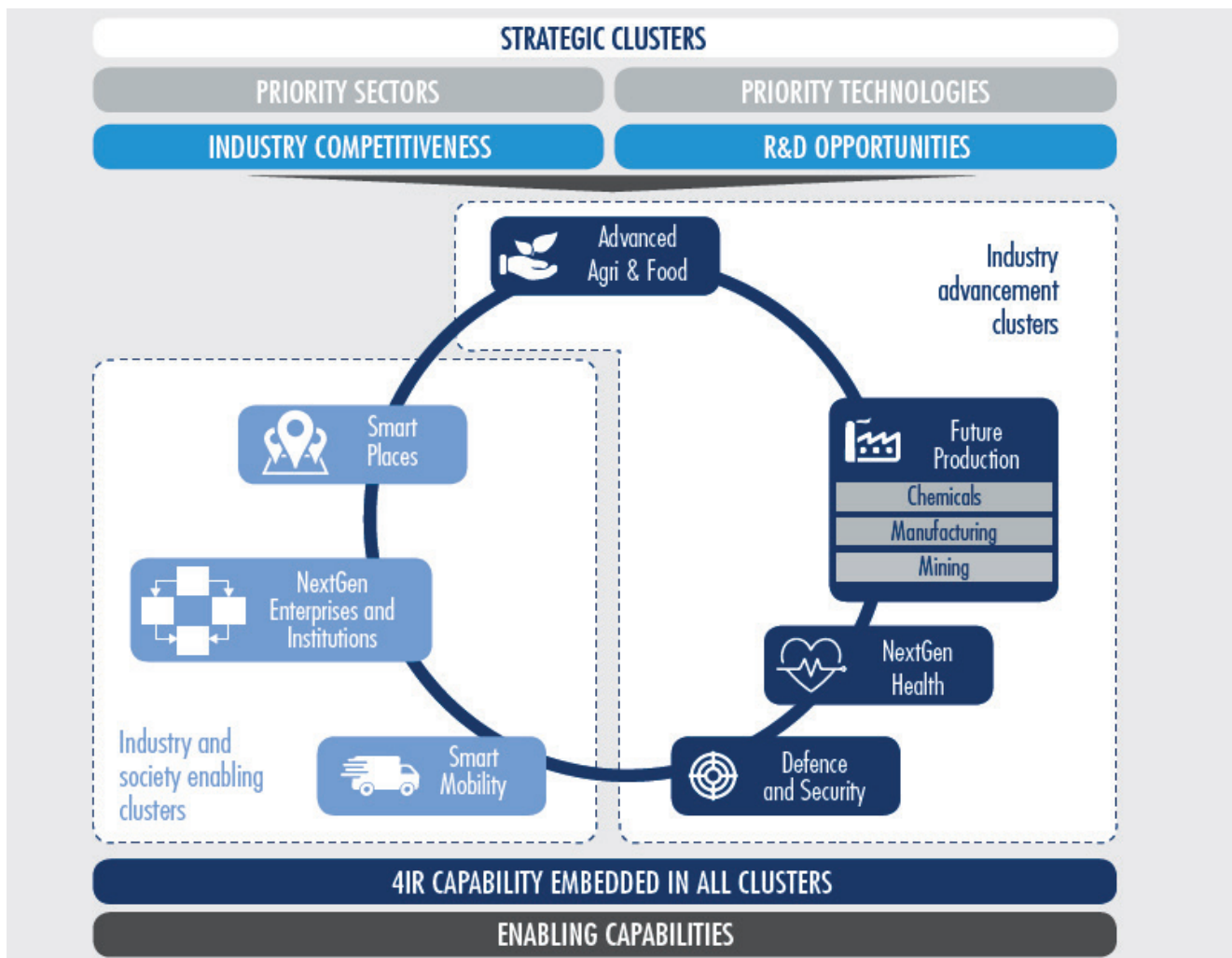
This strategic objective seeks to improve the CSIR's financial sustainability by diversifying revenue sources, optimising the organisation's business model and advancing good efficient and sound governance.



### A.1.5 IMPLEMENTATION OF THE CSIR OPERATING MODEL

The CSIR’s operating model considered organisational design best practices applied by other research and technology organisations and service-offering firms. The CSIR Strategy responds to national priorities and initiatives and, in defining the strategy, an in-depth socioeconomic and technical analysis led to the identification of the sectors that will move the needle economically for South Africa, and the relevant technologies (4IR and non-4IR) that will drive their performance. Nine (9) Clusters through which the CSIR can make the biggest impact were identified and form the backbone of the strategy and are the RD&I-performing components of the CSIR operating model.

The nine (9) CSIR Clusters are depicted in Figure A1 below and are currently operational and performing. There are six (6) industry advancement Clusters namely, Advanced Agriculture and Food, Future Production Clusters (Chemicals, Manufacturing and Mining), Next Generation Health, Defence and Security. The other three (3) Clusters (Smart Places, Smart Mobility and NextGen Enterprises and Institutions) are industry and society enabling Clusters.



**Figure A1:** The synergetic technology Clusters that underpin the CSIR Strategy



Cluster Industry Advisory Panels are currently being appointed to advise leadership and researchers, and are expected to contribute to the achievement of the CSIR’s industrial development objective.

Another key feature of the CSIR operating model is the establishment of the Business Development and Commercialisation function. The introduction of the Business Development and Commercialisation Function has certainly ignited the execution of the strategic objectives by being on the frontlines, engaging CSIR clients and prospective commercialisation partners. As a result, the CSIR is starting to yield a slight but steadily growing income diversification. A Business Development and Commercialisation Forum – a CSIR Community of Practice – has been established and serves as a coordination platform regarding customer interfaces and sharing of practice with regards to commercialisation.

The support functions re-organisation and optimisation process was concluded at the beginning of 2020/21. Support functions are evolving their maturity levels following the Stages of Excellence Framework, to effectively support the delivery of the CSIR strategic intent and the strategic objectives. All support functions have entered into Service Level Agreements (SLAs) with the CSIR Divisions/Clusters and Portfolios.

### A.1.6 IMPLEMENTATION OF THE CSIR BUSINESS MODEL

The renewed CSIR business model (Figure A2) enables the organisation to capture the opportunities identified in the strategy. The CSIR is implementing all the key components of its business model. These include the identification of income sources i.e., PG; contract research income from the public sector, private sector and international sources, as well as commercialisation income. To achieve our strategic objectives and to enhance value creation, we have undertaken customer segmentation and have formulated value propositions. Moreover, we have forged strategic partnerships locally (with partners in industry and public sector) and internationally in pursuit of our mission. The CSIR has also undertaken cost structure optimisation initiatives and the organisational cost structure receives ongoing attention from the CSIR ExCo.

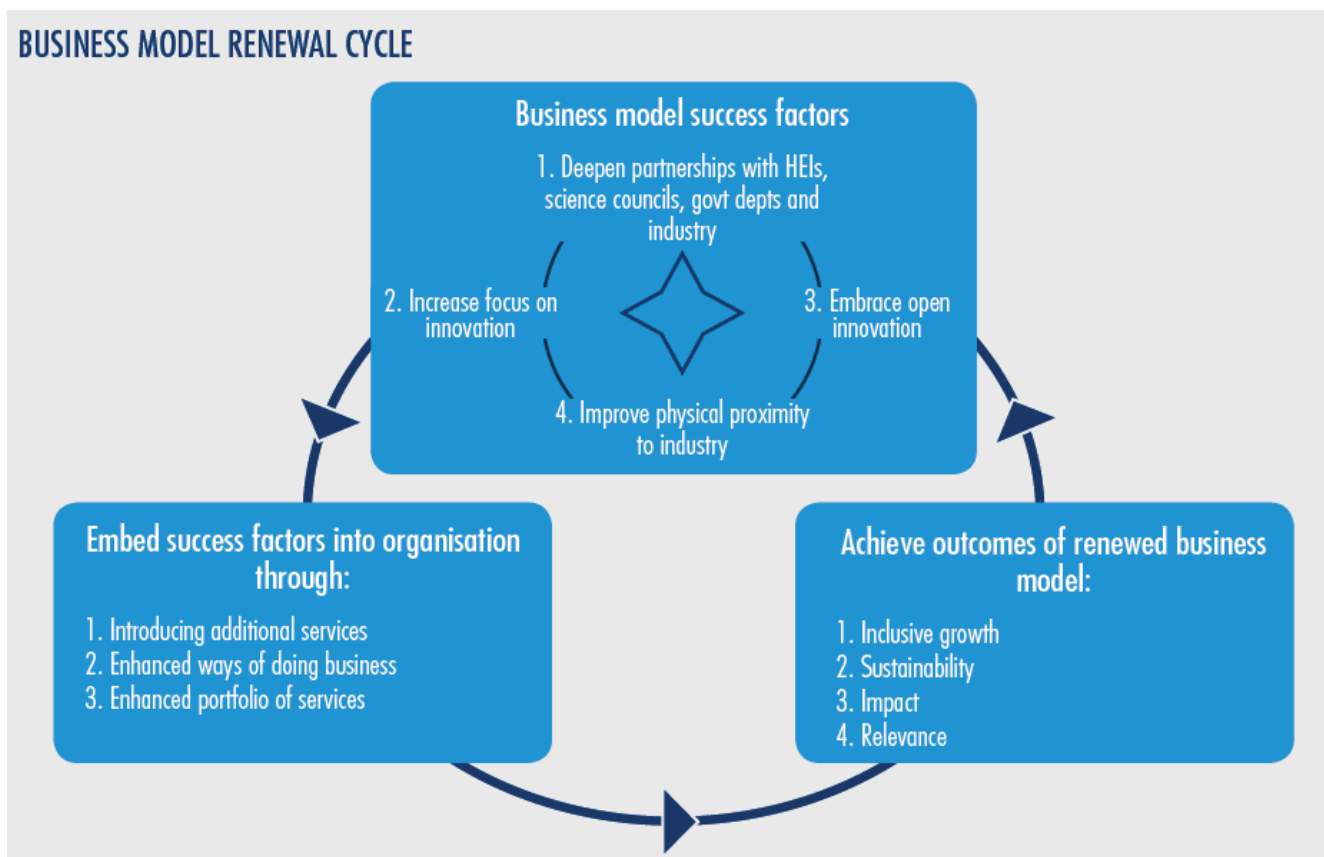


Figure A2: The CSIR Business Model





## A.2

## EXTERNAL CONTEXT

The CSIR Strategy is shaped by key global and regional trends, national imperatives and priorities.

### A.2.1 GLOBAL CONTEXT

#### A.2.1.1 COVID-19, VACCINE DELIVERY, AND MACROECONOMIC AND SOCIAL TRENDS

“Vaccine access has emerged as the principal fault line along which the global recovery splits into two blocs”<sup>1</sup>. The following excerpt from the International Monetary Fund (IMF) World Economic Outlook (WEO) for July 2021 aptly summarises the critical state of affairs globally as the Covid-19 pandemic continues to be the driving force shaping the global economic outlook.

The two blocs are comprised of advanced economies vs the developing and emerging economies. The advanced economies, which are close to fully vaccinating 40% of their populations, will be able to benefit from further economic activity by the end of this year, while the emerging economies, which have only administered vaccines to approximately 13% of their populations, remain plagued by the possibility of additional waves and the subsequent increase in Covid-related deaths. The advanced economies include France, Germany, Italy and the United States of America (USA), to name a few, while Brazil, India, Nigeria, South Africa and Turkey form part of the latter group. It should be noted though that economic recovery cannot be guaranteed as the virus mutates and continuously presents new variants.

In their April 2021 WEO, the IMF projected that the global economy would grow by 6% in 2021, this figure remains as is in their July 2021 forecast. The projection for 2022, however, has improved slightly by a 0.5 percentage-point from 4.4% to 4.9% – this increase though is largely attributed to an improvement in the advanced economies, particularly the USA, which is looking to implement legislation that will strengthen its social safety net and boost infrastructure investment in the latter part of 2021. The projection for advanced economies for 2022 improved from 3.6% to 4.4%, while the emerging economies forecast only improved by a 0.2 percentage-point from 5% to 5.2%.

Differences in fiscal policy support between the two blocs, inflationary pressure, as well as demand and supply mismatches have exacerbated the divergence. The IMF notes that multilateral actions are key to ensuring that this divergence is minimalised, particularly through enabling equitable vaccine delivery, while the World Bank stresses the importance of clear and direct policies that support recovery but still ensure price stability and the implementation of reforms to promote economic growth. There is one sentiment that is central to both the IMF and World Bank’s proposals, and it is that recovery needs to be inclusive and sustainable. The IMF has encouraged countries to improve their efforts to reduce their greenhouse gas emissions, while the World Bank has noted that policymakers, particularly those in emerging countries, need to focus on bringing about “...a durable, resilient, and inclusive recovery while tackling the pandemic’s longer-lasting and harmful legacies”<sup>2</sup>.

#### A.2.1.2 WORLD’S TOP RISKS

According to the 2021 World Economic Forum’s Global Risks Report<sup>3</sup>, risks that are highly likely to happen in the next decade include extreme weather, climate action failure and human-led environmental damage, as well as digital power concentration, digital inequality, and cybersecurity failure. Infectious diseases will be the number one most impactful risk<sup>4</sup>, followed by climate action failure and other environmental risks, as well as weapons of mass destruction, livelihood crises, debt crises and IT infrastructure breakdown.

1 IMF (2021). WEO Update: July 2021. Accessed via <https://www.imf.org/en/Publications/WEO/Issues/2021/07/27/world-economic-outlook-update-july-2021>

2 World Bank (2021). Global Economic Prospects: June 2021. Accessed via <https://openknowledge.worldbank.org/bitstream/handle/10986/35647/9781464816659.pdf>

3 World Economic Forum (2021). The Global Risks Report 2021, 16th Edition - Insight Report. Accessed via <https://reliefweb.int/report/world/global-risks-report-2021-16th-edition-insight-report>

4 Ibid.



### A.2.1.3 TECHNOLOGICAL TRENDS (INCLUDING THE 4IR)

Interestingly, digital inequality, cybersecurity failure and IT infrastructure breakdown are some of the risks associated with the current digital revolution. McKinsey & Company report on the top 10 technologies that have the most momentum in an accelerating world<sup>5</sup>. The technologies chosen are the ones that bring venture money, have generated the most patent filings and had the biggest implications on where companies can compete and accelerate performance<sup>6</sup>. Next-level process automation and virtualisation, the future of programming and the future of connectivity came tops<sup>7</sup>. This trend will shift competition toward capital-expenditure investments in automation technology and toward the social, emotional and technological skills needed as intelligent machines take over more physical, repetitive and basic cognitive tasks<sup>8</sup>.

### A.2.1.4 DISRUPTIONS IN THE PHYSICAL DIMENSION OF WORK – REMOTE WORKING TRENDS

The Covid-19 pandemic has accelerated existing trends in remote working. The physical dimension of work is a new factor shaping the future of work, brought to the fore by health and safety considerations. To determine how extensively remote work might persist after the pandemic, McKinsey & Company analysed its potential in more than 2 000 tasks used in some 800 occupations across eight focus countries. The pandemic demonstrated that much more work could be done remotely than previously thought, including business sales calls, legal arbitration and trials, doctor visits, classroom learning, real estate tours, and even expert repairs of the world's most sophisticated machinery made with the help of virtual reality headsets.

## A.2.2 AFRICAN CONTEXT

### A.2.2.1 COVID-19, VACCINE DELIVERY, AND MACROECONOMIC AND SOCIAL TRENDS

The African continent, having been severely impacted by Covid-19, is expected to recover from what was its first recession in more than half a century. The pandemic has also led to increased debt levels, which continue to rise in many countries.

The situation remains dire for vulnerable groups, such as the poor, women, youth and those working within the informal sector, who have been significantly and, most notably, disproportionately affected. According to the World Bank "This situation could push up to 40 million people into extreme poverty, erasing at least five years of progress in fighting poverty"<sup>9</sup>.

The same divergence that is evident globally can be seen on the continent; not all countries on the continent have been equally impacted by the pandemic and not all are going to experience the same levels of growth either. According to the IMF's WEO for April 2021<sup>10</sup>, oil exporting countries such as Nigeria and Angola were, for example, subject to a decline of 2.3% in their Real GDP in 2020, while middle-income countries such as South Africa and Ghana experienced a decline of 4.4%. This significant decline by the middle-income countries is largely attributed to South Africa, which encountered a staggering 7.0% contraction in 2020.

In terms of sub-Saharan Africa as a regional grouping, the IMF has projected growth of 3.4% in 2021 and 4.0% in 2022. This falls below the global growth projections of 6.0% and 4.4% and the emerging and developing economies forecast of 6.7% and 5.0%, for the same periods, respectively<sup>11</sup>. To further dampen these recovery efforts, the IMF has remarked that "...the worsening pandemic developments in sub-Saharan Africa are expected to weigh on the region's recovery"<sup>12</sup>.

5 McKinsey Digital (2021). *The top trends in tech*. Accessed via <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-top-trends-in-tech>

6 ibid

7 ibid

8 ibid

9 World Bank (2021). *The World Bank in Africa*. Accessed via <https://www.worldbank.org/en/region/afr/overview>

10 International Monetary Fund (2021). *World Economic Outlook Update: April 2021*. Accessed via <https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021>

11 International Monetary Fund (2021). *World Economic Outlook Update: July 2021*. Accessed from <https://www.imf.org/en/Publications/WEO/Issues/2021/07/27/world-economic-outlook-update-july-2021>

12 Ibid.



## A.2.2.2 AFRICAN CONTINENTAL FREE TRADE AREA

In addition to implementing sound fiscal policies, reducing debt levels and ensuring that the process of administering vaccines is accelerated, the World Bank has proposed that, in order to spur on recovery efforts, countries on the continent need to focus on leveraging the African Continental Free Trade Area so as to strengthen their ties into both global and regional value chains<sup>13</sup>. There should be a focus on implementing reforms to deliver a reliable electricity supply, not just to ensure the manufacturing sector is powered but to enable the digital economy<sup>14</sup>. There is a significant focus on the digital economy itself; it is stated that to ensure that connectivity is improved; technology is adopted more swiftly and that more job opportunities are generated, gaps in the digital infrastructure need to be addressed whilst skill sets are developed<sup>15</sup>. The World Bank maintains that these reforms would ensure that the digital economy becomes more inclusive on the continent<sup>16</sup>.

## A.2.2.3 CONTINENTAL SCIENCE AGENDA

The African science context is still anchored in Agenda 2063<sup>17</sup>, the Science, Technology, and Innovation Strategy for Africa (STISA-2024)<sup>18</sup>, which is the first of the 10-year incremental phasing strategies of Agenda 2063. The African Union Development Agency (AUDA) New Partnership for Africa's Development (NEPAD) White Paper: Harnessing Innovation and Emerging Technologies to Address the Impact of Covid-19 in Africa captures the post-pandemic economic recovery plan<sup>19</sup>. The Southern African Development Community (SADC) Industrialisation Strategy guides the development agenda in the region through innovation<sup>20</sup>.

## A.2.3 SOUTH AFRICAN CONTEXT

### A.2.3.1 COVID-19, VACCINE DELIVERY, AND MACROECONOMIC AND SOCIAL TRENDS

South Africa is considered a severely affected country, as a result of Covid-19 in that its GDP contracted by more than 4% in 2020, as previously noted. The growth forecast for 2021 and 2022, published in the IMF's July WEO, albeit positive at 4.0% and 2.2% for 2021 and 2022, respectively, remains comparatively low in terms of the growth projections for the other emerging and developing economies.

PwC, in its South African Economic Outlook 2021 Report published in August 2021<sup>21</sup>, has actually adjusted this forecast downwards to a figure of 2.5%. This is attributed to policy uncertainty, ongoing energy constraints, the unrest in KwaZulu-Natal and Gauteng during July 2021 and the impact that this has had on the rollout of the vaccine programme, in addition to an extended lockdown period. Despite the significant R38.9 billion fiscal support package that government is planning to provide, as announced by former Finance Minister, Tito Mboweni, on 29 July 2021, greater adverse impacts from the risks previously mentioned are anticipated.

It is noted that this fiscal support package, funded by fiscal revenues generated through the mining sector and financial services rather than borrowing, is expected to augment economic growth by up to 0.7%. This, however, is offset by the damaging and long-lasting impacts of the civil unrest which are forecast to reduce growth by 0.8% in 2021<sup>22</sup>.

13 World Bank (2021). *The African Continental Free Trade Area: Economic and Distributional Effects*. Accessed via <https://www.worldbank.org/en/topic/trade/publication/the-african-continental-free-trade-area>

14 World Bank (2021). *The African Continental Free Trade Area: Economic and Distributional Effects*. Accessed via <https://www.worldbank.org/en/topic/trade/publication/the-african-continental-free-trade-area>

15 ibid

16 ibid

17 African Union (2013). *Agenda 2063: The Africa we want*. Accessed from [https://au.int/en/Agenda2063/popular\\_version](https://au.int/en/Agenda2063/popular_version)

18 African Union (2014). *Science, Technology and Innovation Strategy for Africa 2024*. Accessed via [https://au.int/en/Agenda2063/popular\\_version](https://au.int/en/Agenda2063/popular_version)

19 AUDA-NEPAD (2020). *White Paper: Harnessing Innovation and Emerging Technologies to Address the Impact of COVID-19 in Africa*. Accessed via <https://www.nepad.org/publication/white-paper-harnessing-innovation-and-emerging-technologies-address-impact-of>

20 SADC (2015). *SADC Industrialisation Strategy and Roadmap 2015-2063*. Accessed via [https://www.sadc.int/files/2014/6114/9721/Reprinting\\_Final\\_Strategy\\_for\\_translation\\_051015.pdf](https://www.sadc.int/files/2014/6114/9721/Reprinting_Final_Strategy_for_translation_051015.pdf)

21 PwC (2021). *South African Economic Outlook 2021 Report: August 2021*. Accessed via <https://www.pwc.co.za/en/assets/pdf/economic-outlook/economic-outlook-reassessing-key-global-and-local-drivers-of-growth.pdf>

22 ibid



In terms of the official unemployment rate, results from the Quarterly Labour Force Survey (QLFS) published for the second quarter of 2021, show that the rate has increased by 1.8% from 32.6% in the first quarter to 34.4% in the second quarter of 2021<sup>23</sup>. This is significant as it is the highest recorded rate since the inception of the QLFS in 2008. In terms of the unemployment rate according to the expanded definition of unemployment, there was an increase of 1.2% to 44.4% in the second quarter. PwC notes with concern that, despite expecting 315 000 of these jobs to be recovered during 2021, it will have no tangible impact on the unemployment rate.

With regard to activities within the various sectors, Statistics South Africa noted that "...transport and communication, personal services and trade industries were the most significant drivers of growth in the second quarter [of 2021]"<sup>24</sup>. Covid-19-related activities contributed to the growth experienced in the personal services sector. Household spending has led to increased trade activity in the second quarter, with increases in household spending on food, health and transport, while exports increased by 4.0%, as a result of trade in precious metals, vehicles, mineral products and precious and semi-precious stones.

Despite the consistent growth being experienced in the economy since the shock experienced in 2020, unless the pace of this growth hastens, South Africa will not be able to return to pre-Covid-19 levels.

### A.2.3.2 SOUTH AFRICAN ECONOMIC RECONSTRUCTION AND RECOVERY PLAN, POST-COVID-19

To mitigate the shocks and vulnerabilities that the country continues to face because of the Covid-19 pandemic, the South African Economic Reconstruction and Recovery Plan (ERRP)<sup>25</sup> consists of four priority interventions:

- i. A massive rollout of infrastructure throughout the country;
- ii. The rapid expansion of energy-generation capacity;
- iii. An employment stimulus to create jobs and support livelihoods; and
- iv. A drive for industrial growth (including localisation in manufacturing).

In the 2021 State of the Nation Address, President Ramaphosa mentioned that an infrastructure investment project pipeline worth R340 billion in network industries, such as energy, water, transport and telecommunications has been developed.

### A.2.3.3 ACCELERATED IMPLEMENTATION OF STRUCTURAL REFORMS

On the efficient implementation of approved priority structural reforms to enable faster economic growth, Operation Vulindlela (OV)<sup>26</sup>, a 'delivery unit' approach to support Cabinet and the President has been established to ensure efficient, effective and expeditious delivery of government programmes. The five desired outcomes of OV are:

- i. Stabilised supply of electricity;
- ii. Reduced cost and increased quality of digital communications;
- iii. Sustainable water supply to meet demand;
- iv. Competitive and efficient freight transport; and
- v. A visa regime that attracts skills and grows tourism.

The current focus includes the acceleration of digital migration and the auction of spectrum.

23 Statistics South Africa (2021). *Key findings: P0211 - Quarterly Labour Force Survey (QLFS), 2nd Quarter 2021*. Accessed via [http://www.statssa.gov.za/?page\\_id=1856&PPN=P0211&SCH=72944](http://www.statssa.gov.za/?page_id=1856&PPN=P0211&SCH=72944)

24 Statistics South Africa (2021). *The economy grows by 1,2% in Q2: 2021*. Accessed via <http://www.statssa.gov.za/?p=14660>

25 South African Government (2020). *South African Economic Reconstruction and Recovery Plan*. Accessed from [https://www.gov.za/sites/default/files/gcis\\_document/202010/south-african-economic-reconstruction-and-recovery-plan.pdf](https://www.gov.za/sites/default/files/gcis_document/202010/south-african-economic-reconstruction-and-recovery-plan.pdf)

26 South African Government (2021). *Summary of Operation Vulindlela*. Accessed via <https://www.stateofthenation.gov.za/operation-vulindlela/summary-of-operation-vulindlela>



### A.2.3.4 REFORMS IN SOEs IN SUPPORT OF THE ERRP

In June, the Government announced that it plans to sell 51% of South African Airways to a private consortium and that it would retain a minority stake<sup>27</sup>. The proposed sale will amount to the first privatisation in decades and represents a major shift from the State’s stance on SOE control and ownership.

With regards to Energy, Government’s agenda involves securing additional energy from both Eskom and private players. It is also a priority of the government to ensure the legislative and regulatory reform required to support change and restructure power stations and systems to meet climate change requirements.

The Public Enterprises Minister, Pravin Gordhan, and Transnet CEO, Portia Derby, announced the intention to seek private partnerships and secure investment into Transnet’s port network<sup>28</sup>. The transformation and reconfiguration of Transnet SOC Ltd (“Transnet”), is intended to meet the mandate outlined in South Africa’s ERRP.

The ERRP identifies the defence and aerospace industry as key to economic growth, particularly in localisation and exports. The Defence and Aerospace Masterplan was finalised in 2020<sup>29</sup>. Denel’s core capabilities are consolidated and restructured from five divisions into engineering, manufacturing and maintenance. The state of Denel, as one of the few entities through which government incubates high-end technologies for spin-off to the economy and advances the hard science agenda, as well as provides a platform for the pursuit of the 4IR, poses a significant strategic risk to the defence and the sovereignty of South Africa in future<sup>30</sup>.

In the short term, the National government’s plan focuses on high-impact reforms: speeding up the expansion of electricity generation, creating jobs to sustain livelihoods, rolling out infrastructure aligned with the NDP. A central reform from the Government is to restructure the electricity sector and ensure that sufficient electricity is generated to supply businesses and households. Unreliable electricity supply continues to throttle economic activity. An infrastructure investment project pipeline worth R340 billion, according to NT, in various industries such as energy, water, transport and telecommunications has been developed to support and foster economic growth.

### A.2.3.5 DISTRICT DEVELOPMENT MODEL

The District Development Model (DDM) is an operational model for improving co-operative governance aimed at building a capable, ethical developmental state<sup>31</sup>. It embodies an approach by which the three spheres of government and state entities work in unison in an impact-oriented way, and where there is higher performance and accountability for coherent service delivery and development outcomes. It is a method of government operating in unison, focusing on the municipal district and metropolitan spaces as the impact areas of joint planning, budgeting and implementation<sup>32</sup>.

Each district and metro plan will develop a long-term government agenda in these spaces and unpack at least the following developmental issues<sup>33</sup>:

27 BusinessTech (2021). Government aims to complete sale of SAA by early 2022. Accessed via <https://businesstech.co.za/news/government/541982/government-aims-to-complete-sale-of-saa-by-early-2022/>

28 Fin24 (2021). Transnet needs private partners for R100bn ‘super terminal’ at Durban port. Accessed via <https://www.news24.com/fin24/companies/transnet-needs-private-partners-for-r100bn-super-terminal-at-durban-port-20210816>

29 DefenceWeb (2020). South African Aerospace and Defence Ecosystem MASTERPLAN 2020. Accessed via [https://www.defenceweb.co.za/wp-content/uploads/industry/industry/Aerospace\\_and\\_Defence\\_Masterplan\\_November-2020.pdf](https://www.defenceweb.co.za/wp-content/uploads/industry/industry/Aerospace_and_Defence_Masterplan_November-2020.pdf)

30 TimesLive (2021). The demise of Denel is a sovereign risk for SA. Accessed via <https://www.timeslive.co.za/ideas/2021-11-29-the-demise-of-denel-is-a-sovereign-risk-for-sa/>

31 COGTA (2021). How is the District Development Model Aligned to the Integrated Urban Development Framework?. Accessed via <https://www.cogta.gov.za/index.php/2021/08/30/how-is-the-district-development-model-aligned-to-the-integrated-urban-development-framework/#:~:text=The%20framework%20will%20steer%20urban,reversing%20the%20apartheid%20spatial%20legacy.>

32 ibid

33 ibid



- Managing urbanisation, growth and development;
- Supporting local economic drivers;
- Accelerating land release and land development;
- Investing in infrastructure for integrated human settlement, economic activity and the provision of basic services; and
- Addressing service delivery in municipalities.

The DDM complements the Integrated Urban Development Framework (IUDF), which is a framework to steer urban growth towards a sustainable model of compact, connected and coordinated towns and cities. It provides a roadmap to implement the NDP’s vision for spatial transformation – creating liveable, inclusive, and resilient towns and cities, while reversing the apartheid spatial legacy<sup>34</sup>.

The vision for the district model has been articulated through the slogan: “One District, One Budget and One Plan”, which directly correlates with the IUDF’s vision of reaping the urban dividend<sup>35</sup>. The IUDF describes the urban dividend as “an optimal situation where the increasing concentration of an economically active population translates into higher levels of economic activity, greater productivity and higher rates of growth” To optimise the urban dividend, we must focus on three areas<sup>36</sup>:

- People (enhancing their capabilities);
- Economy (more resilient productive and job creation); and
- Place (more liveable pleasure, greater social integration, safety, and access to opportunities).

The common theme between the DDM and IUDF is the need to invest in people, the economy and the environment to improve quality of life<sup>37</sup>.

### A.2.3.6 NATIONAL SCIENCE AGENDA

The South African science agenda is derived from the NDP priorities in areas where RD&I can make a difference to better people’s lives. It is a developmental agenda that is articulated in the 2019 White Paper on STI<sup>38</sup>. The draft STI Decadal Plan will be the 10-year implementation plan for the White Paper and all science entities will have to align their planning to the Decadal Plan, once finalised.

#### A.2.3.6.1 A Review of South Africa’s Higher Education, STI Institutional Landscape (HESTIIL)

To address the gaps and shortcomings identified by the HESTIIL Review Panel, a set of recommendations that are designed to pivot the system and elevate it onto a higher performance trajectory were formulated<sup>39</sup>. The recommendations are organised around a set of five (5) levers of change for the NSI. These levers of change are:

- **Values** – The African philosophy of *ubuntu* may provide a common foundation for rebuilding a values-based HESTIIL and restoring public trust in state institutions and programmes, while affirming indigenous knowledge systems and their role in nation-building among other practical applications. The multimodal promotion of entrepreneurial values, among all sectors of the population, will help to create an enabling environment for technology-based enterprise development initiatives, including training.
- **Governance** – Transitioning the system to the idealised landscape involves initially establishing a three-level agenda and priority setting, steering, implementation and monitoring mechanism. The components of the governance mechanism include the establishment of the Presidential Advisory Council on Science and Innovation, whose primary role is to set the agenda for the NSI through, for example, considering and approving four to five (4 - 5) societal grand challenges (SGC) or missions. The Presidential Advisory Council will be supported by an Inter-Ministerial Committee and an Inter-Departmental Committee of Directors-General. A call is made to reimagine and reinvent the National Advisory Council on Innovation (NACI) into a substantive, legitimate and competent national advisory body. To widen its influence, it is recommended that it should be located within the Presidency as the secretariat to the Presidential Advisory Council.

34 COGTA (2021). How is the District Development Model Aligned to the Integrated Urban Development Framework?. Accessed via <https://www.cogta.gov.za/index.php/2021/08/30/how-is-the-district-development-model-aligned-to-the-integrated-urban-development-framework/#:~:text=The%20framework%20will%20steer%20urban,reversing%20the%20apartheid%20spatial%20legacy>.

35 ibid

36 ibid

37 ibid

38 DSI (2019). *White Paper on Science, Technology and Innovation*. Accessed via <https://www.dst.gov.za/index.php/legal-statutory/white-papers/2775-white-paper-on-science-technology-and-innovation>

39 HESTIIL Ministerial Committee (2020). *A New Pathway 2030: Catalysing South Africa’s NSI for Urgent Scaled Social and Economic Impact. A Review of South Africa’s Higher Education, Science, Technology and Innovation Institutional Landscape (HESTIIL)*



- **Resourcing** – To revitalise the participation of the business sector in the NSI, consideration must be given to conducting a review of the existing business and industry research, innovation and technology transfer tax incentives.
- **Capabilities** – In addition to instituting a programme of industry-based research studies, it is recommended that postgraduate studies and publications within engineering and its allied disciplines (such as computer, information and advanced digital sciences and technologies) be supported urgently. Such action would pivot the skills base towards innovation-supporting capabilities. Additionally, it is recommended that a new Advanced Engineering and Digital Technologies Science Institute to catalyse this nascent industry be created and established within the National Research Foundation (NRF).
- **Coherence** – A centralised single National Foundation for Research and Innovation (NFRI) should be established by 2030 to bring the various entities in the innovation system value chain under one (1) umbrella, from those performing basic research to technology transfer, innovation and commercialisation entities. This would create a seamless innovation funnel that ensures that there are no chasms that stifle industrialisation. It is recommended that the NFRI be created from the consolidation and clustering of existing agencies into councils/fields/clusters according to their key areas of focus and place them under one (1) implementation agency that will facilitate the innovation activities within the clusters. In this regard, the pathway for the establishment of United Kingdom Research and Innovation, and similar implementing agencies in other peer nations is instructive. Establishing the NFRI would add the fourth tier of the national coordinating system (see Governance above).

#### **A.2.3.6.2 STI Decadal Plan**

The intended long-term outcomes of the implementation initiatives proposed in the Decadal Plan are well aligned with the CSIR Strategy and are:

- A productive NSI contributing to economic growth and inclusivity, social development and environmental sustainability;
- Strong institutions; and
- A capable state.

The Decadal Plan identifies six (6) SGCs that capture the core domains for STI priorities and associated interventions. The six SGCs are:

- Climate change and environmental sustainability;
- Future-proof education and skills;
- A re-industrialised modern economy;
- Innovation for a healthy society;
- Innovation for energy security; and
- The future of society.

Strategies to secure financial resources for the implementation of the Decadal Plan recognise that the public component of the NSI is far wider than just the DSI and that joined-up funding from other STI-intensive government departments will be leveraged to implement the Decadal Plan initiatives. Furthermore, the public budget for STI will be coordinated through the involvement of the DSI via high-level governance structures (i.e. a Presidential STI Plenary, and an Inter-ministerial STI Committee). The STI budget allocation will be supported by analysis and evidence provided by a strengthened NACI. Initiatives aimed at increasing investment by the private sector in South African STI are detailed in the Decadal Plan, also acknowledging that policy certainty is critical for private sector participation.

Overall, the Decadal Plan provides the CSIR with a strong basis for planning and alignment of our initiatives to the grand challenges and STI interventions.



## A.2.4 SECTOR-SPECIFIC CONTEXTS AND OPPORTUNITIES FOR THE CSIR

As indicated in section A.1.5, the nine (9) CSIR Clusters (Figure A1) are involved in industry advancement or in industry and society enablement. The sectors that are supported by the CSIR include agriculture, health, chemicals, defence, mining, manufacturing, transport, energy, water, and ICT.

### A.2.4.1 AGRICULTURE AND FOOD SECTOR

At a global level, Sustainable Development Goals 1 (No Poverty), 2 (Zero Hunger) and 3 (Good Health and Wellbeing) all highlight the need for collective action to address the nutrition and health of human populations across the world. Priority 1, as stated in the STISA-2024, is aimed at eradicating hunger and achieving food security for the continent<sup>40</sup>. At a regional level, the SADC Food and Nutrition Strategy calls for programmes that adequately and consistently address nutrition mix challenges as needed for different target groups and geographies. More so, effective controls to ensure populations obtain safe food are needed.

Mega trends in the agriculture sector include digitisation, Internet of Things (IoT), robotics, climate change, protein alternatives, AI-based livestock monitoring systems, genetic innovation, e.g. gene editing for disease control, cannabis products, food loss solutions, natural products (continue to grow), biodegradable packaging, eco-friendly plant production products and the use of blockchain technologies in the supply chains. Food safety remains a major challenge and solutions to detect, monitor and address issues of contamination, toxicity, etc. are being enhanced by nanotechnology, digitalisation and other 4IR technologies.

Globally, agriculture digitisation market is set to be worth US\$10.23 billion by 2025, registering a Compound Annual Growth Rate (CAGR) of 14.2% and this is largely driven by a need to manage complex supply chains. Alternative protein market is expected to grow at a CAGR of 9.5% to reach US\$17.9 billion by 2025 with USA as the major market. Plant-based protein segment estimated \$8.96 billion in 2019 and projected to grow at a CAGR of 8.1% to reach US\$14.32 billion by 2025.

South Africa contributes 57% of total African plant protein market. The market is forecasted to grow at a CAGR of 6.5% and reach US\$560.62 million by 2023, with major opportunities in soy, pea, rice and wheat protein as food and dietary supplements, beverages, animal feed and nutraceuticals.

A 2019 report from the Global Food Safety Partnership found that food safety issues cause Africa US\$16.7 billion in losses every year. Food testing alone is growing at a CAGR of 8% (2020-2030), driven mainly in testing functional foods, infant foods and processed and packaged foods. Areas of interest globally include biological testing (Listeria, Salmonella, NoroVirus, etc.), chemical testing (Mycotoxins, Food Additives, Pesticides), food allergies (wheat, nut, milk) and testing for natural and unnatural substances.

For the CSIR, these trends present an opportunity in several areas, including:

- Smart agriculture with an integrated approach leveraging CSIR capabilities such as robotics, sensors, precision agriculture
- Alternative protein for feed and food
  - Plant proteins such as soy and pea, hemp seed and ancient grains, and insect-based ingredients
- Precision nutrition
  - Nutrition products targeted to individual/population needs
- Circular economy – food waste and loss
- Agro-manufacturing solutions to improve efficiencies and for product development
- Point-of-Care (PoC) for mycotoxins, pesticide testing solutions
  - Lateral flow devices for zoonotics for small scale farming communities
- Other agtech solutions – aquaponics, vertical farming

40 African Union (2014). *Science, Technology, and Innovation Strategy for Africa 2024*. Accessed via [https://au.int/en/Agenda2063/popular\\_version](https://au.int/en/Agenda2063/popular_version)





## A.2.4.2 CHEMICALS SECTOR

The chemicals industry is projected to be driven largely by disruptive trends post 2020 because of the impact of Covid-19<sup>41,42,43,44</sup>. These trends include issues of sustainability, demographics and technology. Investments are expected to lie largely in acquisitions and sustainability:

- R&D spend on non-Covid-19 drugs is anticipated to be much higher than previously forecasted with opportunities in Active Pharmaceutical Ingredients (APIs) and *Small Molecules*;
- There is a growing trend in digitalisation and 4IR underpinning chemical processes;
- *Carbon Capture* technology for greenhouse gas seems to have the industry's interest with ExxonMobil and PetroChina expected to have it in their plans already;
- Europe has an economic stimulus package called "NextGenerationEU" for US\$900 million and it is said to target projects in lithium-ion batteries, *green hydrogen production and storage*, *biorefining*, and *plastics recycling*;
- Alternative proteins, such as *fermentation-derived protein* and bioreactor-grown animal cells, are now seen as a more sustainable way to meet protein demand and more companies are making investments in acquiring businesses in this area to meet the global plant-based meat demand that is expected to reach US\$50 billion by 2025.

The industry creates 3.4% of South Africa's GDP and 22.8% of the country's manufacturing GDP (2018)<sup>45</sup>, and is important for job creation and economic growth. It also accounts for a substantial portion of all imports into South Africa<sup>46</sup>. The main sectors are liquid fuels, plastic products and pharmaceuticals.

The pharmaceutical sector can assist with a reduction in drug shortages and broaden access and affordability for people. The global active pharmaceutical ingredient market is estimated to reach US\$245 billion by 2024, at a CAGR of 6.1%<sup>47</sup> during the forecast period. The plastics sector is an important cog of the chemical industry, employing approximately 60 000 people with ex-converter market size of R70 billion<sup>48</sup>. However, it is currently grappling with negative publicity due to pollution and unsustainable resource utilisation. It also contributes significantly to the trade deficit, with 2018 statistics standing at R18 billion<sup>49</sup>. Therefore, there is a need to develop local sustainable solutions for plastics, from the upstream production processes and materials to downstream end-of-life considerations, such as waste recycle technologies.

CSIR opportunities are driven by the need for local manufacture of APIs and biopharmaceuticals, a worldwide market demand for carbon-based nanostructured materials applications and the development of sustainable plastic products.

The CSIR will, therefore, focus on three (3) strategic capability platforms, namely (bio)-chemical conversions, pharmaceutical technology innovation, and nanostructures and advanced materials.

41 Deloitte Analysis (2021). *Chemical industry outlook*. Accessed via <https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/chemical-industry-outlook.html>

42 McKinsey & Company (2020). *The state of the chemicals industry – it is getting more complex*. Accessed via <https://www.mckinsey.com/industries/chemicals/our-insights/the-state-of-the-chemical-industry-it-is-getting-more-complex>

43 KPMG (2021). *Reaction: Five trends that will shape the 2021 chemical industry*. Accessed via <https://home.kpmg/xx/en/home/insights/2021/03/five-trends-that-will-shape-the-2021-chemical-industry.html>

44 C&EN (2021) *C&EN's World Chemical Outlook 2021 - A look ahead at the issues that will affect—and connect—chemists and chemistry across the globe*. Accessed via <https://cen.acs.org/business/CENs-World-Chemical-Outlook-2021/99/i2>

45 DTIC in CAIA 2019 <https://www.caia.co.za/wp-content/uploads/2019/11/caia-2019-responsible-care-performance-report.pdf>

46 Trade Industry Policy Strategies (2017). *Manufacturing subsectors- Basic chemicals and petroleum refineries*. Accessed via [https://www.tips.org.za/images/Manufacturing-subsectors\\_-\\_Basic\\_chemicals\\_and\\_petroleum\\_refineries\\_2017.pdf](https://www.tips.org.za/images/Manufacturing-subsectors_-_Basic_chemicals_and_petroleum_refineries_2017.pdf)

47 <https://www.grandviewresearch.com/industry-analysis/active-pharmaceutical-ingredients-market>

48 PlasticsSA (2019). *2019 PlasticsSA Report*. Accessed via <https://www.plasticsinfo.co.za/media-room/annual-reports/>

49 2019 PlasticsSA Report [www.plastics.co.za](http://www.plastics.co.za)



### A.2.4.3 HEALTH SECTOR

The Covid-19 pandemic has had a clear effect on health sectors globally and highlighted the need for effective health systems. As a result, governments have faced key health challenges to slow down transmission and mortality associated with the disease. Such challenges included reducing transmission, refocusing on capacitating the public health system and the development of vaccines for novel diseases. This has presented the sector with RD&I opportunities across its various sub-sectors, i.e. drug discovery, product development, healthcare systems, diagnostics, etc. Specific innovation opportunities for the CSIR include:

- **Digitalisation in the health sector**, which is increasingly a strategic discussion point and growth area among the various South African and multinational stakeholders and healthcare providers as digitisation and data analytics are exploited for offering improved health outcomes. Some of the opportunities that exist include screening potential drug targets and using big data analytics in clinical trials to leverage digital technologies to create more efficient processes and disruptive products and services.
- The opportunity to grow **the local medical devices industry** is critical for South Africa, as highlighted by the Covid-19 pandemic. The country is heavily reliant on imports as over 90% of South Africa's medical device demand is covered by imports. **PoC interventions** are also of critical importance to the country.
- The **veterinary care market** is growing at 4.5% and provides an opportunity to respond to animal health, to respond to increased demand for meat and other livestock products, but also to respond to climate change and animal diseases.
- **Synthetic biology** is used in several applications, such as medicine, biofuels, biochemical, and other bio-based substitutes and is an area showing strong growth internationally. This will result in a strong international focus for the CSIR since the market is limited in South Africa.
- There is a dire need for **drug screening** against the African population's host genome and microbiome to ensure that the **genetic diversity** is catered for. Pharmaceutical companies are embracing this requirement and are thus seeking and actively investing in advanced tools that will enable them to formulate drugs based on this genetic diversification. This gives the cluster an opportunity in precision medicine.

The medical device industry is poised for steady growth, with global annual sales forecast to rise by over 5% annually to reach nearly US\$800 billion by 2030. However, the Covid-19 outbreak and the subsequent lockdowns interrupted the supply chains, causing challenges to the outbreak response management. In 2016, the global PoC market reached US\$19.3 billion. The market was forecasted to continue recovery and increasing growth for many segments with an overall CAGR of 8.0% expected over a five-year period (2016-2021), reaching a market worth US\$28.3 billion by 2021. In the veterinary sector, the global animal veterinary market is estimated at US\$24 billion with an annual growth of approximately 4.5%. On the other hand, the ERRP outlined a focus on animal health for the development of animal vaccines (critical for the revitalisation of the veterinary pharmaceutical sector, which currently relies heavily on imports). The global synthetic biology market was valued at US\$22.47 billion in 2018 and is expected to reach US\$5145.62 billion by 2024, with an anticipated CAGR of 34.91% during the forecast period.

### A.2.4.4 DEFENCE SECTOR

The global defence sector has remained relatively stable since the beginning of the COVID-19 pandemic. Most global defence industry players are forecasting moderate growth in 2022. The increasing global terror threats and continuing tensions with Russia has led to increased defence spending in Europe and United States of America. The Middle East remains very volatile from a security perspective, leading to moderate increases in defence spending.

The nature of sovereign threats has changed from the conventional warfare type to a more asymmetric nature of threats. This has led to most global industry players investing in the development of intelligence and cyber technology systems. The focus on development of unmanned combat vehicles is one of the major trends in the global defence market. The emergence of digital threat and smart factory present a host of efficiency and productivity-enhancing technologies that can accelerate time to market and reduce cycle times.



In 2022, the explosion of small-sat constellations could shake up how broadband internet is distributed across the world and bring connectivity to communities and locations where previously not possible<sup>50</sup>. Advanced Air Mobility (AAM) is gaining increased momentum and gradually becoming mainstream, especially as companies developing electric vertical take-off and landing (eVTOL) aircraft continue to receive substantial investment from sources ranging from traditional aerospace companies to private equity investors<sup>52</sup>. The public pressure for the defence sector to lower carbon emissions has led to an increase in environmentally sustainable manufacturing practices within the sector.

The global defence market was expected to grow from \$438.34 billion in 2020 to \$446.59 billion in 2021 at a CAGR of 1.9%<sup>53</sup>. The growth is mainly due to the companies rearranging their operations and recovering from the COVID-19 impact, which had earlier led to restrictive containment measures involving social distancing, remote working, and the closure of commercial activities that resulted in operational challenges.

The defence market is expected to reach \$542.33 billion in 2025 at a CAGR of 5%<sup>54</sup>. Asia Pacific was the largest region in the global defence market, accounting for 34% of the market in 2020<sup>51</sup>. North America was the second largest region accounting for 25% of the global market<sup>55</sup>. Africa was the smallest region in the global defence market.

The local Defence and Security sector has experienced a massive decline in revenue, mainly due to the ever-shrinking defence budget. The decision to stop the Special Defence Account funding had a negative impact on most Defence and Security R&D players as it led to the total cut in the Department of Defence (DoD) Defence Evaluation Research Institutes (DERI) funding in 2021. The National Conventional Arms Control Committee (NCACC) delays and constraints have had a negative effect on the Defence Industry, as critical contracts were delayed or lost due to the delays in approval of export/imports/contract certificates from NCACC.

The increased political and service delivery protests in 2021 further highlighted the importance of strengthening state security systems and technologies. The large dependency on private security companies remains a major concern; the government will need increased support from the CSIR Defence and Security Cluster to be able to prevent or stabilise the protests and political unrest. Technologies developed by the local defence sector will need to be deployed for dual use within the civil security environment to ensure internal security stability and protection of critical infrastructure.

The terror threats in northern Mozambique presents one of the biggest security threats to the SADC region. The South African National Defence Force (SANDF) is part of the SADC team deployed there to bring stability, which will mean that CSIR will have to play a more active role in support of the SANDF in that deployment. These recent asymmetric terror threats will require advanced technologies such as unmanned and intelligence-based systems to be deployed.

For the CSIR's Defence and Security Cluster, the global and local trends present opportunities in several areas including (but not limited to):

- Information and Cyber security support for both national and local government.
- Unmanned (Aircraft, Maritime and Land based) intelligence systems to combat asymmetric threats.
- Integrated security technology solutions that will ensure shared situational awareness and real-time response to national security threats on critical infrastructure.
- Development of defence and security technologies that will improve environmental sustainability and decrease carbon emissions.
- Space-based sensor technologies that will support the defence and security sector.
- Electric vertical take-off and landing (eVTOL) Advanced Air Mobility (AAM) capabilities for security and private sector.
- The development of rapid integrated defence technologies in support of the financially constrained SANDF.

50 The Business Research Company (2020). *Defense Global Market Report 2021*. Accessed via <https://www.thebusinessresearchcompany.com/report/defense-global-market-report-2020-30-covid-19-impact-and-recovery>

51 ibid

53 ibid

54 ibid

55 ibid



#### A.2.4.5 MINING SECTOR

The mining industry has suffered a negative economic period in the past years due to global factors such as the impact of Covid-19, volatile commodity prices and local pressures that include the high production cost and low-profit margins. These economic pressures have limited economic recovery for the industry, resulting in job losses, including multinational mining companies exiting the country. Digital transformation in the industry is said to benefit South African mining businesses to unlock R153 billion in value by 2026 and this is translating to about 51% of the current mining size. This is expected to increase the mining sector's contribution to GDP by 2%. Other benefits include improvement in safety and health conditions, increased output, reduced personnel cost and improved resource utilisation.

The South African mining industry continues to grow at a double-digit figure, with production increasing by 10.3% at the end of July 2021 when compared to the previous year<sup>56</sup>. This growth has largely been attributed to the production of iron ore (42.9%), platinum group metals (PGMs) (10.3%), chromium ore (45.8%) and gold (13.4%)<sup>57</sup>. The sector has reported consistent growth over the past six months of the year, as it continues to be a significant contributor to the country's GDP.

The mining industry at large has experienced a wave of digital transformation with the introduction of automation, IoT sensors that are mounted on unmanned aerial vehicles (UAVs) for faster data collection, the use of data analytics for diagnostics and artificial intelligence for predictive decision support. The adoption of these digital technologies to modernise mining operations result in a significant contribution to solving the complex challenges faced by the mining industry. Global mining companies such as Rio Tinto, BHP Billiton, Vale, Anglo American, and Anglo Gold Ashanti have been early adopters of digital technologies to improve safety, productivity, and cost-effectiveness.

The CSIR has identified opportunities where the organisation can expand the existing capabilities and develop 4IR capabilities in support of the drive to modernise the mining industry. These areas of opportunity are:

- The application of virtual reality and augmented reality (AR) to safely simulate a hazardous workplace scenario to provide an immersive, experiential training offering which will enhance emergency response training for high-risk environments in mining;
- Development of a comprehensive capability offering for trackless mobile machinery (TMM) collision avoidance system (CAS) for the South African mining industry (SAMI);
- Core capability development on existing mine planning/modelling using near real-time 3D software for data analysis and decision support. Investigation into the concept of airborne Ground Penetrating Radar (GPR) which can be applied to cavity detection at coal mines, structural mapping in opencast mines and sinkhole mapping in dolomitic areas in support of zero harm and resource utilisation; and
- Conducting a pilot study to develop a bespoke capability assessment method and to map the future capability needs for selected modernised and mechanised mining systems, specifically for underground gold and PGM mines.

#### A.2.4.6 MANUFACTURING SECTOR

The metals, machinery and mining equipment industries include basic iron and steel, non-ferrous metals, fabricated metal products, and a diverse array of machinery and equipment manufacturing. These industries accounted for 19% of manufacturing value added in 2019 and 23% of employment (284 000 direct jobs), mainly in downstream fabricated metal products, machinery, and equipment. The machinery and equipment industries accounted for 228 000 of the direct jobs in 2019.

The mining sector is very important as it accounted for 24% of domestic consumption of these industries outputs (pumps and valves, material handling equipment, mineral processing, and earthmoving equipment), significantly more than the other end users of construction, agriculture, SOEs and export markets.

Steel and aluminium are the most important basic metals that are cast into basic fabricated products as input into downstream production into machinery and equipment. Foundries, however, have struggled over the past 25 years and declined in numbers, primarily because of a lack of capital investment and technology upgrades.

<sup>56</sup> TradingEconomics (2021). South Africa Mining Production. Accessed via <https://tradingeconomics.com/south-africa/mining-production>  
<sup>57</sup> ibid



An important observation in the decline of the local foundries is that those that are still surviving today are primarily a result of the demand driven by the mining sector, i.e. the mining equipment value chain has very strong backward and forward linkages that propagate challenges and innovation from the end-user (mining operations) requirements all the way back to component manufacturers and their supply chains up to the foundries.

This might be a model for the reindustrialisation of the other priority manufacturing sectors that the CSIR is targeting.

Like the mining sector, the automotive sector has enjoyed significant government support (protection) historically and post-1994 through the Motor Industry Development Programme (1995) and the Automotive Production and Development Programme (2013) that were designed to attract direct foreign investment. The result of these programmes was that foreign-owned assemblers increasingly preferred to source components from joint ventures and wholly owned subsidiaries of their global suppliers rather than from domestically owned firms; this inhibited local technology innovation and advancement and forced local suppliers to import technology from overseas. The 2035 South African Automotive Masterplan attempts to correct this distortion through a 60% local content objective.

Light commercial vehicles have demonstrated the biggest growth since 2011, achieving 25% by 2017 against a 6% growth in passenger vehicles during the same period. No growth is evident in medium and heavy vehicle production. Interestingly, the growth in passenger vehicles has been driven by export demand, while the growth in light commercial vehicles has been driven equally by export and domestic demand.

In 2018, the automotive sector employed 110 000 people across vehicle and component manufacturers (just under 10% of total manufacturing employment).

The current trend in the global automotive sector is towards digital green solutions, viz. increased connectivity of supply chains and driver experience and electric vehicles (battery and fuel cell). Anglo American has indicated hydrogen-powered heavy vehicles as part of their core strategy and is investing strongly in technology development. On the vehicle production side, there appears to be a significant movement towards reducing assembly complexity and cost through upstream integration of assemblies into single components. This trend is supported by the increase in additive manufactured parts, as well as the Giga press capability being established by Tesla Motors for the pressing of the entire vehicle chassis as one single component.

The healthcare system within South Africa (and Africa) has seen a low adoption of digital technologies and is still characterised by manual systems. Additionally, these healthcare systems face operational challenges such as a shortage of healthcare professionals, access to affordable equipment and disparities between rural and urban facilities that ultimately result in divergent outcomes for patients.

Even with this low rate of structural digital transformation, South Africa is one of the largest markets for medical technology in the Middle East and Africa (MEA) region; the market was estimated at US\$1.3 billion in 2019 and is expected to increase to US\$1.8 billion by 2023. The primary product categories driving the demand are consumables (bandages, dressings, suturing materials, needles, syringes, and catheters), diagnostic imaging, orthopaedics and prosthetics, patient aids, dental products and other medical devices.

Despite the significant local demand, South Africa is a net importer of medical technology and devices, having imported R15.2 billion worth of technology, while only exporting R2.67 billion. Most exports have been to the SADC region.

A significant opportunity for the local industry will be the National Health Insurance initiative in combination with the government's Broad-Based Black Economic Empowerment priorities and the Preferential Procurement Policy Framework Act, 2000 (Act 5 of 2000).

The interest of the CSIR in the aerospace and defence sector is centred around the digital transformation and enablement of local supply chains as well as contribution to logistic support through on-demand spare parts localisation and manufacture, e.g. through the Aeroswift additive manufacturing capability and the provision of local manufacturing and refurbishment of navy sonars. While the on-demand parts manufacturing market is more easily accessible in other sectors such as mining, rail and automotive, aerospace provides a goal for the medium term (~five years) and the mining, rail and automotive markets will provide the roadmap to that goal.



Opportunities within this industry, including mining equipment, are predominantly related to 4IR applications in advanced capabilities of design, additive manufacturing, rapid prototyping, sensor technologies for remote condition monitoring and predictive maintenance and the strengthening of digital supply chain integration, specifically within SMMEs.

CSIR priority foci in the manufacturing sector are:

- Metals, Machinery and Mining Equipment;
- Automotive;
- Health (medical devices); and
- Aerospace and defence.

### A.2.4.7 TRANSPORT SECTOR

The mobility of people and goods is changing rapidly, and its future trajectory is non-deterministic. However, we know that mobility will increase as more people and goods move across cities, towns and across the globe: For example, by 2030, annual passenger traffic volumes will exceed 80 trillion passenger-kilometres – a 50% increase compared to 2015; global freight volumes will grow by 70% compared to 2015; and an additional 1.2 billion cars will be on the road – double today's total. Sustainable transport and mobility are fundamental to progress in realising the promise of the 2030 Agenda for Sustainable Development in achieving the 17 Sustainable Development Goals. Mobility should have four key characteristics:

- *Equitable* – it accounts for distributional considerations and places a minimum value on everyone's travel needs, providing all, including the vulnerable, women, young, old, and disabled, in both urban and rural areas, with at least some basic level of access through transport services and leaving "no one behind."
- *Efficient* – it seeks to ensure that transport demand is met effectively and at the least possible cost through the optimisation of resources – energy, technology, space, institutions, and regulations to generate an efficient transport system or network.
- *Safe* – it aims to improve the safety of mobility across all modes of transport by avoiding fatalities, injuries and crashes from transport mishaps. There are internationally agreed global targets for road and air transport safety.
- *Climate responsive* – aims to address climate change through mitigation and adaptation, and to reduce both air and noise pollution.

Transport plays a crucial role in connecting people to goods, services, social and economic advancement opportunities, and fostering development. A review of the economic literature provides solid empirical evidence on the economic, social and environmental benefits of transport.

Improvements in transport infrastructure can also enhance efficiencies and affect the location of businesses and entities. Upgrading highway infrastructure, for example, has allowed businesses to hold inventory for shorter durations, increased the survival rate of existing firms, and induced new firms to open upgraded highways. In Indonesia, expressways have been associated with the dispersion of manufacturing activities.

Transport can play a crucial role in enhancing food security and agricultural productivity. For example, Africa could become self-sufficient in food and create a regional food market worth US\$1 trillion by 2030. But farmers will need better access to roads to trade their products and ports need to become more efficient in transferring goods between ships and road and rail links. Africa's current food insufficiency is not surprising given the deficiencies in its road infrastructure – the average road density in low-income countries in Sub-Saharan Africa is less than one-third that in other low-income countries. Improving rural road connectivity has been shown to increase agricultural productivity by reducing the travel time to agricultural markets, inducing farmers to adopt modern farming techniques and favour cash crops, and raising market participation.

Improving road quality has also been shown to induce migration and shift workers from agriculture to manufacturing. Reducing rural isolation – by lowering transport costs and travel times or improving road access and proximity to markets – may have multiple benefits. It is associated with a reduced likelihood of households facing multidimensional poverty, with increased school enrolment rates for boys and girls and disadvantaged groups. For example, in Ethiopia, proximity to a road in good condition reduced the likelihood of being a chronic poor by 36%. In addition, better rural transport access is associated with lower morbidity and mortality rates and better health and poverty outcomes. The placement of transport infrastructure within a city can alter the production mix of the urban economy, affect employment opportunities for the poor, and alter crime rates.



For example, evidence suggests that the development of city roads in Colombia has shifted economic activity toward the production of lighter tradable goods. Similarly, transport infrastructure has altered the economic landscape of Chinese cities – radial highways have decentralised the services sector, radial railroads have decentralised the industrial sector, and ring roads have decentralised both sectors.

According to the McKinsey Global Institute industry digitisation index (2015), the transportation and warehousing sectors are lagging in digital maturity. Though like previous industrial revolutions, the impact of 4IR is slow, but technologies such as digital twins are becoming the backbone of many engineering applications. In transport engineering, digital twins have been used for approximately three decades, especially using data from the transport sector to build a digital model or “twin” and provide information back to the users. Applications within the mobility sector include making infrastructure management and transport systems smarter by leveraging time and space referencing tools, capitalising on big data (trends) and embracing technological advances.

The CSIR’s Smart Mobility cluster promotes socioeconomic development through efficient mobilisation of goods, services and people that promote trade and re-industrialisation. This will be addressed by:

- Providing advanced mobility solutions to industry;
- Supporting enabling policy development at national, provincial and city level;
- Exploring and enabling the adoption of new disruptive technologies, and developing advanced materials, tools, modelling platforms and new digital technologies;
- Ensuring safe, effective and efficient mobility of people and goods (including informal transport solutions); and
- Providing robust decision support tools.

#### A.2.4.8 ICT SECTOR

The government and private sector are shifting their service delivery model towards the digital domains, ensuring that clients and citizens can access services anywhere and anytime. In support of this, one of the enabling milestones cited on the NDP for 2030 is the realisation of a developmental, capable and ethical state that treats citizens with dignity.

The DSI is finalising the STI Decadal Plan, which will be the implementation plan for the 2019 White Paper on STI.

The Department of Communication and Digital Technologies has published the draft national policy on data and cloud, which “seeks to strengthen the capacity of the State to deliver services to its citizens, ensure informed policy development based on data analytics, as well as promote South Africa’s data sovereignty and the security thereof”.

The development of the Gauteng 4IR Strategy by the CSIR is expected to encourage other provinces to embark on similar strategies to capacitate the State.

The CSIR is better placed to support the 4IR key initiatives highlighted in the NDP, which informed the ICT requirements for the STI Decadal Plan. These initiatives are:

- **Digital Skills**
  - Build capacity to train one million youth on 4IR skills (data science, 3D printing, AI, robotics, cloud computing, etc.);
  - ICT-SETA spend and Skills Levy to develop 4IR skills; and
  - Curriculum innovation at basic education level to include 4IR skills.
- **Digital Government**
  - Digital transformation of government;
  - Digital access to promote trust and security in the use of ICTs; and
  - Digital inclusion to create an enabling environment to promote e-commerce.
- **Digital Infrastructure**
  - Radio frequency spectrum;



- Rollout of broadband infrastructure; and
  - Rapid deployment of electronic communication infrastructure.
- **4IR Special Economic Zones (SEZ)**
    - Under consideration is the 4IR Innovation Corridor (Innovation Hub with linkages with other SEZs, industrial parks, ICT hubs, etc.);
    - ICT Joint Investment Programme for start-ups (Digital Development Fund); and
    - Centre for Digital Transformation.

#### A.2.4.9 WATER SECTOR

Water-related megatrends include big data management and use – water quality, quantity, availability, use and impacts; technologies to monitor and to acquire data (static and real-time); smart (water) management systems for monitoring, control and operations (individual, local and systems levels); modular (water) technologies – waste-water treatment, purification, networks and controls; and integrated designs, systems and infrastructure (multiple use) for enhanced, optimal and sustainable use of water and other natural resources (circular economies, water-energy-food, wastewater treatment and reuse).

To support the agricultural sector with practices that will lead to increased production, conservation of biodiversity and recovery of degraded land, the CSIR is focusing on RD&I in various aspects of understanding the structure, processes and functions of the ecological infrastructure (natural capital) to allow for ecosystem risk assessments (which are also relevant to industries such as insurance companies), but which also have the potential to maximise water efficiency and ecosystem services (such as improved water quality), by including practice such as green water (water from rain retained in soil) to support rain-fed agriculture, and blue water (collection of run-off) to increase water storage in soils, wetlands and groundwater. Planned initiatives will lead to further development of the following technology demonstrators:

- Fruit-tree irrigation scheduling services;
- Provincial/regional water-use projections based on land use and climatic changes to inform land use planning;
- A multiple criteria decision-support system for water resources management;
- Calculation of groundwater storage levels to inform sustainability of groundwater abstraction; and
- The detection of stream flow in torrential streams with remote sensing to facilitate data collection and feed national databases, and the use of Earth observation data/remote-sensing for spatial evapotranspiration estimation and water allocation.

#### A.2.4.10 ENERGY SECTOR

Global energy markets are currently facing a massive restructuring, a global energy transition. The two underlying drivers are the finiteness of all fossil resources, which creates price and policy pressure, and the need to reduce greenhouse gas emissions, which creates policy pressure. These drivers lead to two megatrends – energy-efficiency and renewable energies. A few countries have aggressively pushed forward both energy-efficiency and renewable energies during the last decade. Heavily government-subsidised renewables programmes in the USA, Europe, Japan and, recently, China have brought costs of renewables down so dramatically that they can now be considered being cost-competitive with conventional sources of electricity supply. The mainstream renewable resources of wind and solar photovoltaics (PV) are already independent from government subsidies in many countries (including South Africa) and an increasing number of countries are able to pursue wind and solar PV without subsidies. The accelerated implementation of renewable energy is receiving increased attention as the realities and risks of climate change accelerate plans for the decarbonisation of the energy system. Green hydrogen, as an energy carrier, is seen as critical for energy sector coupling and the decarbonisation of the hard-to-abate sectors such as steel and cement, with several developed countries planning to import green hydrogen from renewable energy rich regions such as South Africa.

The South African energy system today is almost completely self-sufficient. Oil as feedstock to refine liquid fuels and a small amount of gas and liquid fuels is imported, but all other energy is supplied from domestic sources (mainly coal). It is unique to South Africa that large parts of the liquid fuel demand are supplied from coal-to-liquid and gas-to-liquid processes, based on domestic coal, as well as domestic and imported gas as feedstock. The South African energy system is hence not very diversified, gas and renewables in larger volumes being the missing links in the portfolio. South Africa today cannot supply sufficient electricity, which is an impediment to social and economic goals. At the same time, the country is one of the largest emitters of greenhouse gases, which is contrary to environmental goals.





South Africa thus needs a rapid expansion and transition in the energy sector as a catalyst for economic growth; in a reliable, affordable, sustainable and cleaner manner. The two (2) global trends of energy-efficiency and renewable energies present a huge opportunity to address South Africa's energy challenge. South Africa can drive its own energy transition while leveraging its geographic position, economic and innovation power to "energise" Africa sustainably. The aforementioned technology cost reductions for renewables combined with world-class solar and wind resources in South Africa have made renewables cost competitive to any alternative new-build option in the country today. South Africa is one of the first countries where this full new-build cost-competitiveness was achieved. Therefore, it can be a frontrunner in creating the knowledge base around cost-efficient planning, designing, building and operating of renewables-based energy systems. Furthermore, South Africa can be a technology developer and industrialise the new and emerging energy technologies, including batteries, fuel cells and electrolyzers.

The South African integrated resource plan foresees a significant growth of variable renewable energy generation. One of the system operator's most challenging issues, resulting from this increase, is keeping the grid stable and maintaining security of supply as the energy mix diversifies. To achieve this, short-term (intra-day and day-ahead) variable renewable energy forecasting capacity building is essential. South Africa is one of the least efficient countries worldwide when it comes to converting energy input (primary energy) into economic output. This is the result of two (2) factors. Firstly, South Africa's economy was historically built around energy-intensive industries (mining, iron and steel, as well as other metal). Secondly, South Africa has had low electricity and energy prices for decades because of having excess and very cheap primary energy in the form of easy-to-mine coal reserves. This second factor further exacerbated the first factor in the sense that the already energy-intensive industries had no economic incentive to produce their products with less energy input. This poses a significant threat to the South African economy, as any change in energy prices affects an energy-intensive economy much more than an energy-efficient one. Additionally, there is also a need to examine and understand the potential for demand response. How can the demand side be made more flexible to absorb increasing volatility on the supply side (solar PV and wind)? To improve energy efficiency and identify demand-response measures, there is a need to carry out a detailed assessment of current energy end-use across all end-use sectors. Furthermore, energy demand needs to be forecasted accurately because, in the long-run, energy demand determines what type and how many energy supply measures need to be installed, and in the short-run, the demand needs to be forecasted to support the instantaneous balancing of energy supply and demand.

The CSIR anticipates substantial market potential in the field of thermal process optimisation using simulation tools, as well as targeted technology development of new solutions to reduce emissions and energy costs for South African industry. Focus areas include waste heat recovery, power-to-heat sector coupling, solar thermal systems for industrial process heat and thermal energy storage.

Energy Storage Testbeds for South Africa will address old and new problems related to energy access, affordability and adaptation of new technologies. The old problems are lack of access to energy supply by certain communities, limiting their economic activities. The imperfection of the renewable energy sources from their intermittency is a market opportunity for the energy storage choices to complement the Variable Renewable Energy (VRE) and improve the total energy system delivery for mostly stationary applications. Lastly, the market needs testbeds for the testing, certification, localisation and demonstration of safety and performance in real-life settings.

The energy storage market for stationary applications needs independent third-party testers. The testing can be done for securing finances and gaining market acceptance. The adoption of standards for local target applications will be part of the offering. Testing will be used to provide certified solutions with warranties for their market performance.

## A.3

## INTERNAL CONTEXT

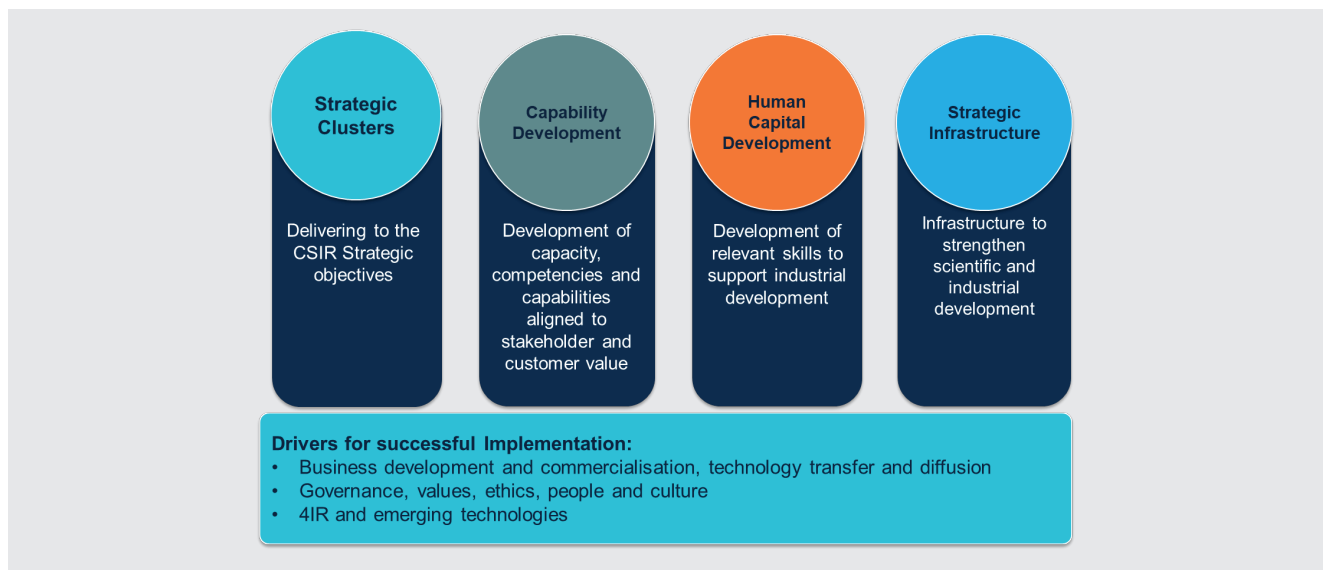
### A.3.1 ENABLING CSIR STRATEGY IMPLEMENTATION

An enabling environment for strategy implementation is key to achieving intended outcomes.

The new CSIR Strategy was launched in 2019/20 – the first year of strategy implementation. Now, in the third year of strategy implementation, the CSIR has made significant strides towards achieving some of its strategic goals, and the current plan seeks to consolidate and build on these gains. The implementation of the new CSIR Strategy is driven through four (4) pillars (Figure A3), namely:

- Strategic Clusters, which deliver on the CSIR's strategic objectives;
- Capability Development, which refers to the development of capacity, competencies and capabilities aligned to stakeholder and customer value;
- Human Capital Development, which involves the development of relevant skills to support industrial development; and
- Strategic Infrastructure to strengthen scientific and industrial development.

The drivers of successful strategy implementation are discussed in section A.4.5 below.



**Figure A3:** Pillars of CSIR Strategy Implementation

#### A.3.1.1 STRATEGIC CLUSTERS

The Strategic Clusters form the core of the CSIR's operational engine, and they deliver on RD&I initiatives.

Despite the onset of the Covid-19 pandemic during the last quarter of the 2019/20 financial year, the organisation was able to demonstrate its strength of RD&I capabilities through pragmatic delivery of the strategic initiatives that capitalised on circumstantial opportunities. A case in point is how the organisation became a significant contributor to the national interventions to combat the Covid-19 pandemic.



### A.3.1.2 CAPABILITY DEVELOPMENT INVESTMENT

The CSIR recently adopted a Capability Development Framework, which will frame systemic development of existing and new capabilities relevant to the implementation of the new strategy.

Since 2019/20, the CSIR has made an intentional investment into supporting new capability development initiatives in the new areas of growth. Such investments included precision agriculture, biochemical conversions and the pharmaceuticals platform. This investment support to capability development has continued in the current financial year – 2020/21 – the CSIR portfolio has expanded to support development of capabilities in precision medicine, smart mobility through the support of a Research Chair in Mining and Circular Economy.

The pillars of new capability development are growth in new knowledge, skills, processes or techniques and infrastructure development.

The former Emerging Research Areas (ERAs) have been re-prioritised to facilitate investment into new research centres, which are at the core of the implementation of the new CSIR Strategy by clusters. This investment focus was also motivated by the fact that CSIR ExCo has invested resources into three (3) ERAs in the past 10 years to develop capabilities in the then-emerging areas of research in nanotechnology, synthetic biology and autonomous robotics systems.

The capability developed in these emerging areas has since been incorporated into new Research Centres in terms of the new Operating Model. These centres are the Centre for Robotics and Future Production, Nanostructures and Advanced Materials and Centre for Synthetic Biology and Precision Medicine.

### A.3.1.3 HUMAN CAPITAL DEVELOPMENT

The Capability Development Initiatives category’s scope includes HC and skills development initiatives. HC and skills development programmes include the Graduate-in-Training, leadership, bursary, Accelerated Researcher Development, and the Youth Employment Services Programmes, as well as the Young Researcher Establishment Fund.

### A.3.1.4 STRATEGIC INFRASTRUCTURE

Research infrastructure is a key component of achieving the strategic objectives of the CSIR. Therefore, there is a need to renew the CSIR’s infrastructure, as shown in Figure A4, to achieve the strategic objectives of the CSIR.



**Figure A4:** Key needs to renew CSIR infrastructure

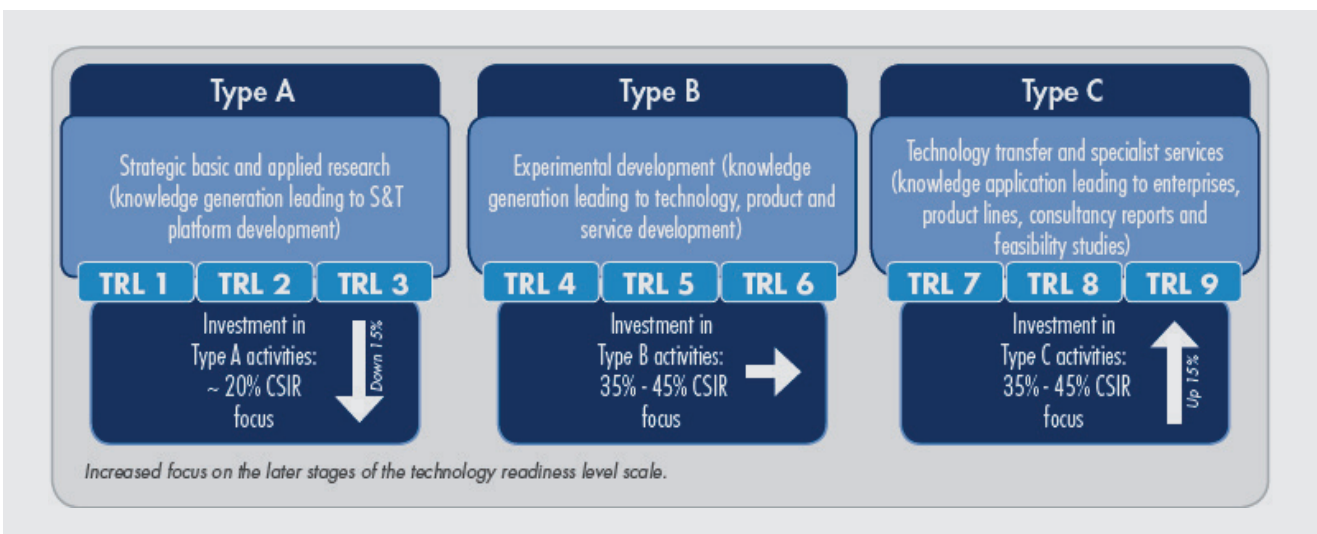
## A.4 STRATEGIC INITIATIVES (2022/23 - 2026/27)

Analysis of national priorities and sector-specific needs and business opportunities for the CSIR have been identified through this process and the strategic initiatives that are represented in this section reflect this analysis. Capability development, human capital development and infrastructure investment plans reflect key niche areas where there are opportunities for CSIR competitiveness, but also areas in which the CSIR can contribute toward the development of a capable state.

As an example, In the manufacturing space, there are opportunities to contribute towards digitally transformed additive manufacturing of aerospace and defence products, spare part localisation and manufacture, medical devices and mining machinery. In the chemicals and health sectors, there are opportunities for lab-on-chip (LoC) PoC diagnostics, active pharmaceutical ingredients production and high-value chemicals. Several of the DSI and NT-funded infrastructure investments have great implications for the CSIR ability to support industry and government.

### A.4.1 STRATEGIC CLUSTER RD&I INITIATIVES

The CSIR continues to adjust the profile of its innovation portfolio by increasing its focus on the later stages of the technology readiness level scale and increasing its income from technology transfer. This is in keeping with best practices from globally successful research and technology organisations. (See figure A5 below).



**Figure A5:** Desired focus (%) of CSIR RD&I activities in the various stages of technology readiness levels

Please see section B of the Shareholder’s Compact for more details on the initiatives. These initiatives address the CSIR Strategic Objectives 1-3.

### A.4.2 STRATEGIC CAPABILITY DEVELOPMENT INITIATIVES AND TECHNOLOGY PLATFORMS

**Cannabis and Cannabidiol Initiative:** This initiative looks at supporting the government, nascent SMMEs, as well as established industries in mainstreaming the use of cannabis through cannabidiol and hemp and valorising these products to be effective end-products for consumer use. A key objective of government in this space is the establishment of a transformed cannabis industry, to which end the CSIR will support SMMEs in the space to gain access to infrastructure and technologies to create value-added products.



**Diagnostics Platform:** This initiative leverages capabilities in the life sciences, chemistry and engineering across the CSIR to ensure a comprehensive approach to diagnostics development to meet market needs. The CSIR will work with appropriate stakeholders to take advantage of the opportunities in this space, driven by the need for strategic independence in healthcare (human and veterinary) technologies brought to the fore by Covid-19, but also to address South Africa's growing burden of infectious and chronic diseases.

**Circular Economy:** Several initiatives contribute to the CSIR's efforts in terms of the Circular Economy. Working relationships across the CSIR were established in 2021/22 with the special initiative PG project where the division is contributing from its sectoral expertise to inform public and private sector responses on where immediate circular economy opportunities are achievable. This positions the organisation to undertake more detailed and targeted projects in this area, based on where significant opportunities are evident.

The **Advanced Nanomedicine Platform's** strategy covers the entire pharmaceutical value chain, starting from preventive measures (i.e. nutraceuticals for healthy microbiome, vaccines) through the rapid detection of diseases, as well as therapeutics (either as prophylactic or curative intervention).

**Indigenous Knowledge Systems (IKS):** This initiative focuses on the development of complementary medicines, cosmetics and food products based on indigenous plants and knowledge. The underpinning capabilities in agro-processing and other techniques, and knowledge of access benefit sharing requirements are used to assist companies with product development and to navigate the IKS regulatory framework. These efforts facilitate compliance and ensure that the benefits accrued from commercialising IKS-based products accrue to the indigenous knowledge holders.

**Precision Agriculture Platform:** Supporting industries along the agricultural value chain with actionable farm-level data or intelligence to enable precision agriculture and cost-effective business decisions at all levels of the value chain. The Precision Agriculture Platform intends to leverage the capabilities that exist across the CSIR to deliver on the precision agriculture information platform that should serve all actors (down and upstream) along the agricultural value chain.

**(Bio)-Chemical Conversion Platform:** The platform focuses on two (2) main focus areas – **biomass conversion** in the Biorefinery Industry Development Facility (BIDF) for the beneficiation of cellulosic biomass to create new value chains and green chemicals and **bio-conversions platform** for the bioprocessing technology and chemicals conversion processes to produce bio-based chemicals and products. In terms of global initiatives in place for CO<sub>2</sub> reduction, the platform is aligned to the development of technologies in novel gas-fermentation processes for chemicals. This involves the utilisation of C1 feedstocks, including greenhouse gases such as CO<sub>2</sub>, CO and methane to generate higher value chemicals.

**Pharmaceutical Technology Innovation Platform:** The platform supports a key South African government priority in the local manufacture of APIs for local pharmaceutical production. The FuturePHARMA, "an open innovation facility integrating molecular engineering and continuous pharmaceutical manufacturing for Africa". The pharmaceutical technology innovation platform will enable a dynamic African pharmaceuticals manufacturing industry with access to critical and modern drugs through innovative and world-class processing technology aimed at leapfrogging the current production methods through open-access infrastructure for the development of prototype clinical-grade materials of both biopharmaceuticals and small molecules. This will be achieved in partnership with tertiary education institutions and parties in the public and private sectors locally and internationally.

**Development of Advanced Carbon-based Nanostructured Materials Platform towards Industrial Development:** The platform uses local capability in the production of commercial graphene and other carbon-based nanomaterials. The CSIR has vast nanotechnology capabilities and equipment that enables the platform to develop, jointly with industry, graphene-based technologies, and products. One of the key focus areas of the platform is polymer nanocomposites where the CSIR has considerable expertise and the special equipment for the characterisation of these materials.

**Bioengineering and Integrated Genomics:** Development of a framework for the data analytics and governance that would enable efficient delivery of public healthcare; development of a microbiome database that can be used to support precision medication; and development of stem cell genome editing tools.

**Companion Diagnostics and Array Technology:** Application of novel malaria drug screening assays for disease eradication; development of novel malaria transmission/infection blocking models and identification of natural products active against malaria. Provision of cutting-edge, cost-efficient, yet high throughput tools for screening drugs against specific genetic profiles.



**A Responsive, Relevant Defence and Security capability:** There are various capability and technology development initiatives in support of enhancing industry competitiveness, enabling a responsive and relevant SANDF and capacitating other strategic state institutions and departments for the security and safety of the country. These initiatives include, but are not limited to, investments in aeronautics, ballistics, command and control, information, cybersecurity, detonics, electronic warfare, explosives, identity authentication, network and data security, optronics, radar and tactical vehicle mobility.

**Manufacturing as a Service:** Formalisation of on-demand manufacturing and manufacturing services capability, including relevant business models to maximise utilisation of the cluster infrastructure and equipment. The Smart Factory will be extended (distributed) across the CSIR (additive manufacturing, metal injection moulding, casting) to enable on-demand manufacturing of items, which is currently unfeasible within the industry. A model will be established to enable the spin out of viable business opportunities emanating from these services.

**Mining Extraction Research Capability:** The pilot will be expanded to survey the full CSIR capability for extraction-related RD&I. Environmental, Social Inclusion and Governance considerations will be incorporated. This phase will be funded by the Mandela Mining Precinct and completed in the 2022 financial year.

**Enhanced Training Capability at Kloppersbos:** The application of virtual reality and AR to safely simulate a hazardous workplace scenario to provide an immersive, experiential training offering that will enhance emergency response training for high-risk environments in mining.

**Automation and Simulation Capabilities for Collision Avoidance:** Develop a comprehensive capability offering for TMM CAS for the SAMI.

**Development of Enhanced Geophysics Tools and Platform:** Core capability development on existing mine planning/modelling using near-real-time 3D software for data analysis and decision support. Investigation into the concept of airborne ground-penetrating radar, which can be applied for cavity detection at coal mines, structural mapping in opencast mines, sinkhole mapping in dolomitic areas in support of zero harm and resource utilisation.

**Smart Cities Offering:** The project's broader objective is to support government and other role-players with assessing the smart readiness of a city to make informed decisions related to the identification, planning and implementation of inclusive smart city initiatives that are appropriate and responsive to the South African context.

**Smart Energy Systems and Tools:** With the evolving energy system inevitably driven by smart technologies, and some of the existing frameworks and tools not responsive to the requirements of a smart energy system, the initiative focuses on integrating CSIR capabilities towards systems and tools with industry relevance.

**4IR for Smart Energy:** Create a national capability at the CSIR to lucratively serve sub-Saharan Africa in its digital transformation of the electricity system. The electrification backlog in sub-Saharan Africa is forecast to affect 600 million people by 2030. Renewable energy technologies, coupled with smart microgrids, present the least cost solution to Africa's electrification and sustained economic growth. There is a significant opportunity to leverage the need for the energy transition to impact re-industrialisation and widen local economic participation by SMMEs and prosumers in this process. The CSIR can play a leadership role in the new microgrid and transactional power market paradigm, which is needed.

**Enhanced Water Domain Offerings:** The project's broader objective is to strengthen capabilities in the water sector through coordination and platform development. The context is supporting the rebuilding of water research and innovation within the CSIR.

**Smart Ports and Coastal Infrastructure:** The CSIR has a long history in the application of science, engineering and technology in support of coastal development and resource planning in coastal zones, from coastal engineering, sustainability and natural resource management, marine Earth observations capacity. The closer association of CSIR numerical modelling, big data and machine learning has the potential to bring in 4IR relevance as the applications are mainly data provision, forecasts and designs.



**Sustainable Infrastructure and Climate Risk Management:** The objective of this project is to formulate a comprehensive strategy and implementation plan for the CSIR impact areas that deal with infrastructure across the full value chain of policy, planning, design, operations (construction, maintenance, rehabilitation, decommissioning) and management to respond to climate change, from both a mitigation and adaptation perspective.

**Research Chair in Smart Mobility and University Collaborations:** The utilisation of the national research and human capital development infrastructure in integrated ecosystems (such as the triple or quadruple helices of academia, government, industry, and society) is seen as a key means of facilitating innovation and strengthening the NSI. In the establishment of the research chair initiative, collaborations to be developed that will enhance the joint capacity of the collaborating institutions to deliver research outputs and to engage in the meaningful ongoing development of human capital in academic and employment contexts

**Smart Logistics Management:** Establish a new area of research in logistics management. The platform will allow the improved competitive positioning of the different South African sectors through logistics.

**Transport Safety Laboratory:** Development of a national asset, dedicated to the investigation of transport users, infrastructure and environmental behaviour and elements that contribute to transport unsafety.

**Technology Innovation Centre (TIC) – Transport Infrastructure Engineering:** A facility that integrates the 4IR to transport infrastructure engineering. This platform will allow 4IR prototyping capability in the asphalt and concrete pavement industry.

**Spectrum Access Management and Innovation:** Capability development in radio frequency spectrum engineering, embedded software development, mobile radio access network engineering, application of AI or machine learning in wireless networks (data analysis), full-stack software engineering, UAV remote piloting for radio frequency applications, and Broadband network deployments. This platform will develop telecommunication technologies that will enable South Africa's re-industrialisation through SMME support, lowering the barriers to entry and reduced ICT imports by using open radio access network solutions.

**Voice Computing:** Development of capability in Natural Language Processing (local languages), Digital Signal Processing (local languages), machine learning applied to voice computing, software development to support voice computing products and services, natural language interface design, development, testing and evaluation and voice computing for resource-scarce languages. This platform will apply natural language interfaces and language technologies to address South Africa's digital, language and literacy divide and create socioeconomic impact.

**Integrated Multiscale Modelling:** Developing capability in multiscale modelling and integrating the models at different length scales through a framework. Development of integrated computational models and methods across the different length scales to solve integrated and complex problems (e.g. understanding materials or processes).

**Data-driven Modelling and Design:** Developing capability in using data science and AI methods to solve, optimise and design complex systems. Implementation of data science and AI-related models and techniques to assist in the development of decision support tools within an engineering environment, e.g. predictive manufacturing, failure detection, image analysis of Scanning Electron Microscopy/Transmission Electron Microscopy, etc.

**Data-driven Multiscale Modelling:** Integrating the capabilities of the multiscale and data-driven frameworks to respond to integrated and complex problems. Leveraging on the capability development within the integrated multiscale modelling and data-driven modelling and design interventions and applying it to manufacturing processes.

**Digital Transformation:** Understanding and application of digital transformation tools to the CSIR offerings for increased value to our customers and unlocking new revenue streams. While much of the value add may be focused on the transformation of individual elements, this will always be done within the context of the surrounding ecosystem (System of Intelligence), for which opportunities will be actively sought. Transformation of internal processes will form a key component of the capability establishment.



**CSIR Data Science Capability Building Programme:** A cross-cutting initiative to significantly improve data science capability across the CSIR. This platform will lead to enhanced CSIR offerings (systems, tools or services) to meet our clients' 4IR technological expectations; improve our internal RD&I processes and systems, and improve systems and processes used by portfolios such as Finance, Procurement, Human Capital, ICT, Legal, etc.

### A.4.3 HUMAN CAPITAL DEVELOPMENT

Investment in the development of skilled human capital is critical in enabling the various CSIR capability development initiatives and technology platforms in support of national imperatives. The CSIR's SO4 – Build and transform human capital and infrastructure – enables the organisation to provide a sustainable supply of human capital to meet internal capacity demands equipped with relevant skills and capabilities for the achievement of the organisational strategic objectives. A conducive workplace, cohesive organisational culture, embedded value system and engaged workforce are some of the prerequisites that the organisation believes should exist to achieve organisational effectiveness, improved productivity, enhanced performance and excellence.

The CSIR ascribes to the call to build and strengthen SET human capabilities as outlined in Sustainable Development Goals, the NDP: A Vision for 2030, the Human Resource Development Strategy for South Africa 2010 - 2030, the 2020 White Paper on Science, Technology, and Innovation, as well as the Department of Science and Innovation's Human Capital Development Strategy for Research, Innovation and Scholarship of 2016. Recommendations from the recent CSIR review also highlighted areas in which the organisation can improve its human capital development efforts to achieve its mandate.

The contribution of the CSIR towards addressing national challenges requires a highly skilled, diverse, developed and capable workforce able to deliver on the CSIR's mandate and national strategic objectives. The continuous development of human capital is imperative to build a sustainable supply of SET staff by entrenching performance and talent management processes to effect career development and performance management culture, which is crucial in developing, rewarding and retaining different segments of talent.

Human capital development remains a priority to ensure that the organisation is adequately equipped with the right skills for it to meet its strategic objectives. Several pipeline development programmes aim to improve the attraction and retention of critical skills. The pipeline programmes provide the organisation with access to doctoral graduates to increase the percentage of staff qualified with doctoral qualifications.

The CSIR plans to implement relevant human capital development initiatives over the short, medium, and long term so that the organisation can develop its capacity to deliver on the mandate. These initiatives are multifaceted and encompass improvements to the pipeline development programmes, a strong focus on leadership development, succession planning, performance management, innovative approaches towards sourcing, developing, and retaining talent, and creating prospects for the long-term growth of CSIR staff. The CSIR is also repositioning its employee value proposition and the reward and recognition aspects to include tangible and intangible benefits that reinforce a culture of high performance across all functions, Portfolios, Clusters and Divisions.

To achieve the fourth CSIR strategic objective (SO4), the CSIR has adopted four strategic pillars aimed at aligning the Human Capital Strategy and operational planning with the CSIR Strategy, vision, mission, and values. The human capital strategic pillars and key initiatives to deliver on the SO4 objectives include:

#### A.4.3.1 BUILDING A DIVERSE TALENT ECOSYSTEM AND A SUSTAINABLE FUTURE SUPPLY

The establishment of a diverse talent ecosystem to capacitate the CSIR with highly skilled human capital is essential to achieve organisational growth and ensure long-term sustainability in delivering on the strategic objectives and mandate and enhance the importance of the CSIR's role and contribution towards socioeconomic development and technological advancement of the country and its people.

The aim is to grow the CSIR talent ecosystem and provide a sustainable supply of human resources aligned to capacity and skills demands to achieve the business objectives of the CSIR. Talent acquisition and management, workforce planning, pipeline development and organisational learning, corporate social investment, an alumni programme and strengthening of external partnerships will be key focus areas in achieving this objective.





### A.4.3.2 STRENGTHENING LEADERSHIP AND DEEPENING PROFESSIONALISM

Our strategy for building a motivated, high-performing, and diverse workforce is multifaceted and it includes a strong focus on leadership development and creating prospects for the long-term growth of our people. Leadership and management capability will be strengthened through the enhancement and rollout of core leadership and management development programmes, which is a commitment to the development of leaders and high potential staff. In the quest to deepen professionalism, focusing on strengthening behavioural competencies of our staff aligned to EPIC values, the CSIR has targeted development programmes and collaborations with industry professionals to foster development and transfer of skills.

### A.4.3.3 IMPROVING INDIVIDUAL AND ORGANISATIONAL PERFORMANCE

This objective aims to elevate individual and organisational performance towards the achievement of excellence and high-performance culture in a systematic and staged approach and address key areas of improvement. The key to the achievement of this objective is the implementation of human capital development initiatives required as imperative for the improvement of our capabilities to drive operational efficiency and increase organisational performance.

Initiatives in this regard include implementing a compelling employee value proposition aimed at improving attraction and retention of talent, improvement of performance management, employee engagement, and implementation of performance-based reward practices.

### A.4.3.4 ADVANCING WOMEN, YOUTH AND PEOPLE WITH DISABILITIES

Engagement activities are key to the CSIR and several initiatives, such as the Women's and Youth Forums, have been introduced in the organisation. The Women's Forum was launched in October 2021 and is intended as a gateway to addressing challenges faced by women in the workplace. The forum emphasises the importance of empowering women in some male-dominated industries and aims to find solutions with women themselves leading the front and championing the women's development agenda. In addition, the advancement of women is prioritised through recruitment planning aligned to the EEP of the CSIR.

The Youth Forum initiative further emphasises the role the youth play in contributing and influencing the strategic future of the CSIR. The forum creates space for networking and collaboration among young professionals, while also contributing towards building a vibrant and inclusive organisational culture within the CSIR.

The advancement of people with disabilities is also a key focus for the CSIR. The organisation currently employs 1.9% of people with disabilities which is 0.1% below the minimum target of 2% that the organisation aspires to achieve. The minimum target is guided by the CSIR's EEP Targets and the organisation's determination to remain on level 1 B-BBEE status.

## A.4.4 RESEARCH AND TRANSLATIONAL INFRASTRUCTURE INVESTMENT PLANS

### A.4.4.1 PG-FUNDED INFRASTRUCTURE INVESTMENTS

**The Transport Safety Lab:** As a "first-of-its-kind" research facility in Africa, the Transport Safety Lab aims to bridge the gap between traditional and future transport safety research by integrating the social, engineering, data/technology, and future fields of science, using modern technology, equipment and skills to translate data into intelligence – therefore providing an evidence-based and data-driven approach to informed decision-making in support of a Safe Transport System.

**Bioprocessing:** Advanced bioprocessing capabilities – a range of equipment that covers the full value chain of bioprocessing to support product development and scaling up for industry in bioprocessing, including digitisation of processes.



#### A.4.4.2 NT-FUNDED INFRASTRUCTURE INVESTMENTS

The four projects that were funded in the previous round that started on 17 February 2021, FuturePHARMA, Road Materials Testing (RMT) Facilities, Hydraulic Model Hall and the Learning Factory are in progress and expected to be completed on time and on budget. Most of the work carried out by November 2021 was attributed towards the programme and project Initiation, acquisition of key equipment, the appointment of Professional Service Providers (PSPs), feasibility and design phases.

Furthermore, additional time and effort were spent to improve the governance and due diligence for implementation purposes, with the aim of minimising risk later during implementation. Unfortunately, this has contributed to pushing out the cashflow expenditure; however, it provides for a more informed implementation model that is still planned to be completed within the three-year agreed period.

Current work is centered on ongoing procurement of equipment and phase 6 of 10 (design), whereby most of the effort and costs carried out to this point are informed by CSIR labour, supported by PSP services and procurement commitments to equipment. There is a lot of attention directed at the preparation of specifications and governance around the procurement of key equipment (approximately 104 procurement items planned), budget spending by the end of March 2022.

**Bioconversion:** Analytical and pilot plant infrastructure upgrade of the BIDF. The BIDF has a key role to play in SO2 in terms of supporting the industry in piloting and scaling up. This equipment reduces the capital expense barriers for industry and SMMEs to develop, test and adapt technologies for biorefinery.

**RMT Facilities:** A feasibility study was conducted to understand the existing capability, capacity, the current and future needs of the RMT Research Group. The findings proved that there is a need to invest in additional funding for the much-needed improvement in RMT facilities to align its operations to new technologies, as well as conform to the CSIR's quality, health, safety, and environmental requirements. This investment will not only address the outlook of RMT facilities but also improve morale and ensure that RMT remain at the cutting-edge of RD&I in the roads industry. NT funding has been secured to upgrade the infrastructure over three years.

**Pharmaceutical Technologies:** FuturePHARMA open lab facility refurbishment and purchase of capital items support capability development in APIs for the country. Localised production technology for APIs to make a direct impact on manufacturing and healthcare in the country.

**Hydraulic Model Hall:** The Hydraulic Model Hall is a 11 000 m research facility in Stellenbosch that is used for physical modelling studies. This facility supports coastal engineering (ports) and ship motion studies both locally and internationally. The facility comprises several basins and flumes in which scale models are constructed and tested. The facility was built in the late 1960s and some equipment and infrastructure have not been upgraded since then. The infrastructure also requires maintenance to remain at an international standard. The components of this infrastructure are mostly procured through capital expenditure and depreciated over a certain period. NT funding has been secured to upgrade components of the infrastructure and equipment over three years.

**The TIC** is a facility that integrates the 4IR to transport infrastructure engineering. The facility will stimulate the growth and competitiveness of current and future technology in the transport sector. The principal function of the TIC is to facilitate the development of 4IR prototypes in the asphalt and concrete pavement industry.

#### A.4.4.3 DSI-FUNDED INFRASTRUCTURE INVESTMENTS

**Advanced Functional Materials:** Establishment of a pre-pilot Supercritical CO<sub>2</sub> pilot facility that will support key new capabilities for industry. The infrastructure will deliver a new process for encapsulation that will allow more efficient products to be developed in the pharmaceutical, nutraceutical, cosmetics and personal care markets.

**AR Device:** Microsoft HoloLens provide a data-driven approach to policy and decision-making, using AI and machine learning techniques where interaction with data is made easier through AR. This will impact the effectiveness of visualisation tools, ensuring that it is easier to engage with data.



**Smart Factory:** Establishment of a reconfigurable 4IR-enabled production facility – a production system level incubator of 4IR technologies, including human-centered automation, digital twins and internal logistics optimisation.

**Metal Additive Manufacturing Equipment:** Investment in the development of high-power laser and beta commercial scanners.

#### A.4.4.4 INFRASTRUCTURE INVESTMENTS FUNDED BY OTHER LOCAL AND INTERNATIONAL INSTITUTIONS

**Advanced Polymer Composite Group:** The United Nations Industrial Development Organisation funded the development of biodegradability testing capabilities and capability development in biodegradability testing of materials. This will support South Africa's transition to more sustainable materials by offering a platform to test and verify claims on the biodegradability of products.

**Engineering 4.0 Facility:** The Engineering 4.0 Facility is a collaborative effort between the South African National Roads Agency SOC Ltd (SANRAL), the University of Pretoria and the CSIR. It was initiated to establish integrated education, national certification, and national reference and research laboratories. The needs identified are to support the significant amount of funds currently spent by the government on the upgrading, maintenance and establishment of new transport infrastructure. The facility consists of an advanced pavement testing track, a concrete research laboratory, a national reference laboratory, and a training and certification laboratory.

**Cost-efficient Open Wireless Network Infrastructure Platform to support Heterogeneous Radio Access Network Technologies:** The platform will support industry (mainly SMMEs and academia) and allow the CSIR to co-create technologies, while conducting RD&I. The TIA and Vodacom are some of the funders.

### A.4.5 DRIVERS OF SUCCESSFUL CSIR STRATEGY IMPLEMENTATION

#### A.4.5.1 BUSINESS DEVELOPMENT AND COMMERCIALISATION

The Business Development and Commercialisation (BD&C) function is embedded in the core activities of the CSIR. The Clusters and the BD&C function are the "left and the right" arms of the organisation that collectively delivers on customer needs as we implement the business model.

#### A.4.5.2 IP AND TECHNOLOGY TRANSFER

The IP and Commercialisation Policy, whose objectives are to promote the generation, development, protection and exploitation of IP to contribute towards improving the quality of life, economic growth and industry competitiveness, creating jobs, building a capable state, and promoting environmental sustainability; accelerate the diffusion of technologies and localisation capabilities in the country; and optimise the application of the CSIR's IP for the benefit of the CSIR, IP creators and society, in alignment with national priorities and legislation and the CSIR's mandate, strategy and policies, was approved by the CSIR ExCo in July 2020.

**The CSIR Commercialisation Fund (CF)** was successfully launched in the 2020/21 financial year:

- The Apex Fund is a sub-fund of the CF that supports high-impact projects (high returns on an investment expressed through solid financial models) to address a gap or need in the market by developing innovations that will ideally be ready for uptake by industry or may form the basis of a start-up in two to three years.
- The Accelerator Fund supports projects from Technology Readiness Level (TRL) 4-6 that require technology development and pre-commercialisation support with the intention to scope and develop the commercialisation case for technologies towards making them licensable or investor-fundable opportunities.

The **CSIR Technology Commercialisation Enterprise:** The strategy of the CSIR is about elevating our contribution to industrial development in line with our mandate. Our contribution to industrial development happens through:

- Improving the performance and competitiveness of existing industrial products, processes and services;
- Introducing new products, processes and services to existing firms; and
- The creation of enterprises that produce new products or provide new services.



The latter presents a number of new opportunities for the CSIR and in the main has not been fully explored. For this reason, the CSIR has embarked on a process to develop a structured and managed approach for the commercialisation of CSIR IP through the creation of new enterprises.

The successful commercialisation of IP requires a combination of relevant business understanding and acumen, capital in addition to the IP itself. The current CSIR effort in this area is intended to strengthen our performance with regards to business understanding and acumen and access to capital. In this regard the CSIR is exploring the possibility of creating a standalone commercialisation enterprise that will hold all CSIR IP and act as an incubator for the commercialisation of start-up enterprises through the provision of non-financial support. In addition, the CSIR has engaged several local and some international funds to explore potential collaboration opportunities.

#### **A.4.5.3 STRATEGIC PARTNERSHIPS**

Collaboration is central to the CSIR mandate and strategy. Strategic partnerships are the primary vehicle through which the CSIR engages with key partners in the innovation value chain. In an endeavour to optimally structure and systematically guide engagement with the vast array of potential partners envisaged by the mandate, the organisation has developed a Stakeholder Engagement Framework, a Strategic Partnerships Framework, and a Strategic Partnerships Policy. The frameworks have been approved by CSIR ExCo and the policy by the CSIR Board. A key and central element in these documents is a mapping and categorisation of the CSIR Stakeholder Universe, which is made up of several stakeholders that the organisation seeks to engage in line with its mandate and strategy. The Stakeholder Engagement Framework defines six (6) categories of stakeholders, including those related to accountability, business and development, innovation, human capital development as well as the public and internal stakeholders. The policy defines strategic partners within the three (3) categories of business and development, innovation and human capital development. It further classifies partners in terms of the nature of the relationship with the CSIR in terms of intended outcomes, modalities of engagement and the nature of resource contribution.

In pursuit of the strategic partnerships to fulfil the CSIR mandate and strategy, there have been several significant partnerships and related developments in the last two (2) years, including:

- AUDA-NEPAD – a partnership with AUDA-NEPAD was concluded in 2020. A new AUDA-NEPAD Centre of Excellence in STI (CoE-STI) was launched as a jointly hosted centre by the CSIR, Stellenbosch University and AUDA-NEPAD. The CoE-STI is physically hosted at the CSIR Stellenbosch campus, and AUDA-NEPAD staff are in the process of occupying offices there.
- United Nations Development Programme (UNDP) – the CSIR and UNDP launched this partnership in August 2021, and the two (2) organisations are in the process of implementing governance structures and some projects under this agreement.
- Siemens – the CSIR and Siemens entered into a strategic partnership agreement in 2020/21 and are currently implementing the provisions of the agreement. Some projects have already been implemented, including the Covid-19 Ventilator Development Project.

#### **A.4.5.4 CSIR COMMUNICATION AND MARKETING STRATEGY**

For the CSIR to succeed in improving the competitiveness of high-impact industries, localising transformative technologies and driving socioeconomic transformation, it needs to raise its profile among key target audiences/stakeholders. The CSIR has diverse stakeholders with different needs, i.e. graduates, youth, government, private sectors, including its own employees. This need for enhanced visibility in society and in the market has become crucial as the organisation implements its new strategy. Ultimately, enhanced visibility is one of the key determinants of the strategy's success.

The CSIR Communication and Marketing Strategy outlines how the organisation must engage with its stakeholders in support of the activities undertaken by BD&C. The aim is to influence new clients to buy the services and innovations, while retaining existing ones and forging new partnerships for the medium to long term relations.

The focus is to employ innovative, creative and effective communication solutions and support business development objectives; buttressed by a sound understanding of the organisation's work and role within the NSI, as well as the organisation's evolving RD&I strategy.

The CSIR Strategic Communication and Marketing Strategy was adopted by the CSIR Board during 2020/21. The CSIR Strategic Communication and Marketing Strategy has five (5) objectives as illustrated in figure A6 below.



**Figure A6:** New CSIR Communications and Marketing Strategy

#### A.4.5.5 ICT INFRASTRUCTURE TO ENABLE RD&I OPERATIONS

The CSIR initiated a project in response to a need for a new ICT Strategy that would allow the organisation to develop into a modern, integrated, secure and digitally enabled/transformed organisation. The required strategy needed to be cost-effective, realistic and allow the organisation to transition from its current “as-is” state and maturity to the target state.

The CSIR has a dual challenge in that it has an existing outdated and non-integrated landscape with multiple pain points coupled with a need to modernise and digitise its operations. As a result, a project approach that would allow a two-step transformation process focused on simultaneously resolving legacy issues, while allowing the organisation to transform to a digital organisation was defined.

The project approach consisted of a three-phase exercise that provided an accelerated validation of the as-is assessment and visioning, articulated the ICT Strategy, designed the enabling operating model and crafted the roadmap for implementation.

The project resulted in the crafting of the ICT Strategy and provided associated multiyear implementation plans. The phased approach proposed three phases; ‘Get Fit’, ‘Get strong’ and ‘Grow’ with all initiatives sequenced based on impact and criticality.

In the financial analysis, the implementation options highlighted that, over the past three (3) years, CSIR ICT capital spend was on average R12.5 million annually. This is far below the annual ICT capital investment of approximately R45 to R50 million needed to align with industry average benchmarks. As a result, the CSIR will need to spend more than the average to address the current pain points identified in the as-is assessment that have arisen from under-investment. The total cost of implementation for the new CSIR ICT Strategy is approximately R300 to R400 million. The CSIR intends to manage the cost of implementation through utilising Software as a Service, cloud-based services, AI and Robot Process Automation. These latest trends will ensure that the CSIR obtains value for the products that are implemented to support the strategy.

In the plans, at least 60% of benefits are driven by operational efficiencies from additional freed-up capacity that can be directed towards value-add activities. Close ICT business integration is required, and business should drive and be made accountable for operational efficiencies benefit realisation.

The implementation plans provide a transition roadmap (people, processes and technology) and plans to transition the CSIR from the current ICT state to the desired future state, including short-term, medium-term and long-term goals. CSIR ICT is fit for purpose, fit for use, and aligned to the new CSIR Strategy.

The CSIR requires requisite financial resources to implement this ICT Strategy and roadmap to ensure that it has modern, integrated, secure, digitally enabled and transformed ICT so that it can partner with the operations to ensure successful implementation of the CSIR-wide strategy.



### A.4.5.6 PG INVESTMENT

The CSIR receives PG Baseline Allocation from the DSI, in line with Vote 35 on Science and Innovation of the Estimates of National Expenditure presented to Parliament by the Minister of Finance during the Budget Speech. On an annual basis, the DSI confirms a MTEF PG allocation to the CSIR in a letter to the Chairperson of the Board. The allocation has two (2) components – a PG Baseline Allocation portion and a ring-fenced portion for the specified programmes or projects that the CSIR implements on behalf of the DSI. The PG represents the largest funding to the CSIR from one source.

A key initiative underlying the organisation’s ability to strengthen its RD&I capabilities was the adoption of a PG Investment Policy. The CSIR Board approved the policy in 2019/20. The policy advocates for a shift from an allocation approach with regard to the PG to an investment approach. To improve alignment with key industry sectors, a PG Investment Committee (PGIC) consisting of external and internal members has been established to advise the CSIR ExCo on strategic investment of PG, including on annual PG Investment Planning.

**Table A2:** PG Investment Framework

<b>PG Investment/ Allocation Categories</b>	<b>PG Investment sub-categories</b>
<b>PG Baseline Investment in divisions/ clusters</b>	Division 1: Chemicals, Agriculture, Food and Health
	Division 2: Mining, Manufacturing, Defence and Security
	Division 3: Natural Resources, Enabling Infrastructure, Public and Professional Services
<b>PG Baseline Allocation to portfolios/ support functions</b>	BEI
	Legal Compliance and Business Enablement
	Finance
	Human Capital and Strategic Communications
<b>Capability Development Initiatives</b>	Research Centres
	New Capability Development Strategic Initiatives
	Research Infrastructure
	Human Capital and Skills Development
<b>Commercialisation and Technology Transfer</b>	Special Commercialisation Investment Initiative
	Accelerator Fund
	Apex Fund
<b>Strategic/ Discretionary Fund</b>	Some CSIR Leadership Initiatives: <ul style="list-style-type: none"> <li>• Project Synapse (co-ordination of the implementation of the CSIR Strategy)</li> <li>• Legal (provision for legal services as required)</li> <li>• Covid-19 risk mitigation – current context specific</li> <li>• Health and well-being</li> </ul>
<b>CSIR Board and CSIR Governance Structures</b>	CSIR Board and other CSIR Governance Committees

The formula (Table A2) for allocating PG investment proportionally across Clusters, capability development and commercialisation activities ensures that the investment (70%) is largely towards core activities of the CSIR.



## A.5

### DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY

Income diversification remains a key objective for the CSIR. The aim is to reduce the financial risk by complementing public sector income with private sector and international income. Income diversification is also expected to improve the CSIR's profitability. Already, several engagements with stakeholders in the private sector, locally and internationally are planned. More details on income diversification and financial sustainability can be found in section B.6 below.

## A.6

### GOOD GOVERNANCE

Inherent in the CSIR mission is to pursue the inclusive and sustainable advancement of industry and society. Beyond leading innovation and providing unique solutions to address South Africa's challenges, the impact we seek is to improve lives and this translates to the wider obligation of the CSIR operating as a responsible corporate citizen. The CSIR must duly comply with all legal imperatives, whether constitutional, national or common law, with due regard for the governance implications for CSIR business. South Africa is also a signatory to several international treaties and, as such, several international strategies inform the work of the CSIR.

Corporate social responsibility is entrenched within our EPIC value system, and we consider it our obligation to carefully consider the interests of all our stakeholders and the environment within which we operate to ensure that we consider the social and environmental consequences of our business activities. In support of the CSIR's corporate citizenship strategy, critical emphasis will continue to be placed on the following initiatives:

- Enhanced implementation of the compliance function as part of our combined assurance model to more effectively manage risks associated with compliance, business ethics and fraud prevention;
- The enhancement of safety, health and environmental practices through integrated collaboration with all internal and external stakeholders to pursue zero harm;
- The active pursuit of strategies to improve the CSIR's carbon footprint against a trajectory of continuous improvement; and
- Contributions to B-BBEE, based on the dtic codes of good practice, with a specific focus on the critical role that the youth of South Africa must play in shaping our economy.

#### A.6.1 IMPLEMENTATION OF A COMPLIANCE FUNCTION

A centrally structured compliance function that allows compliance outcomes to take a central role in our operations and creates the opportunity to promote and embed a strong compliance culture within the organisation has been established. This function sits within the Legal and Compliance portfolio and ensures that compliance matters receive the necessary attention, which translates into visible compliance actions as dictated by the Legal Risk Register.

Emphasis is placed on defining the regulatory environment and translating it into beneficial and practically actionable policies, procedures and processes.

#### A.6.2 MAINTENANCE AND ENHANCEMENT OF SHEQ PERFORMANCE

In 2018, the CSIR revisited the SHEQ's alignment with its mandate, vision, mission and SOs and after the organisation highlighted a need for urgent intervention to improve the state of safety, health, and environment on all CSIR campuses.



During 2020/21, the CSIR focused on understanding the capability requirements for establishing a best-in-class, fit-for-purpose SHEQ functionality and model that is well-integrated and enabling, and responsive to the risks faced across every level of the organisation. Through strategic interventions focused on legal compliance audits, behaviour-based safety, process safety and overall integrated SHEQ management, the journey to demonstrate that the CSIR cares about and strives for zero harm to the CSIR community and the areas in which it operates, is well underway and will be further matured and developed in response to the SHEQ risk environment as it evolves in pursuit of the strategic objectives.

### A.6.3 MEASURING AND REPORTING ON THE CSIR CARBON EMISSIONS

In support of its corporate citizenship strategy, the CSIR strives to become carbon neutral and ensure that emissions created from business operations are neutralised through the purchase of a carbon offset.

In 2018/19, the CSIR launched an initiative to measure its emissions and align its reporting practices with the National Greenhouse Gas Emission Reporting Regulations. This initiative now focuses on continuous improvement through the pursuit of data integrity and emission reduction.

The CSIR believes that carbon effectiveness has the potential to offer untold value to the organisation. Alongside being the morally correct thing to do, carbon management makes excellent business sense as carbon foot printing can add significantly to the CSIR's bottom line over time and, in turn, enhance its ability to support the development of a capable state.

### A.6.4 B-BBEE STATUS

In its most recent B-BBEE audit, the CSIR achieved a Level 1 B-BBEE certification, up from Level 2 the year before. The CSIR performed exceptionally well on all four (4) measurement criteria (i.e. management control, skills development, enterprise and supplier development and socioeconomic development) that are used during the verification exercise. This is testament to the co-operation and collaboration that is prevalent in the CSIR. This, coupled with the YES programme, ensured that the CSIR achieved an unprecedented Level 1 B-BBEE certification. The CSIR's YES Programme focuses on previously disadvantaged youth between the ages of 18 and 35. It provides them with work experience for one year, giving young people a chance to demonstrate their abilities, establish their work ethic and prove their worth. The huge success of the YES Programme is that the CSIR was able to absorb 5% of the initial intake of participants in the programme and a phase 2 intake has already been completed.

While consolidating the past gains in this regard, and to create a truly balanced scoring and improve our contribution to advancing the growth of our smaller trading partners, the organisation aims to now focus more on the enterprise and supplier development element of the B-BBEE scorecard in the coming year.

## A.7

## RISK MANAGEMENT

At the core of the CSIR's Enterprise Risk Management (ERM) Strategy are initiatives facilitating the implementation of sound and effective risk management practices in all areas of the organisation in support of good corporate governance. ERM partners with the organisation to ensure that an effective system of ERM and a positive culture are embedded in all day-to-day working practices to minimise negative outcomes of risk events and maximise upside opportunities.

The CSIR's ERM plan aims to assure the organisation through the entrenchment of a combined assurance model that will be a strategic vehicle for embedding best practice frameworks and guidelines, and strike a good balance on sound corporate governance, effective risk management, improved compliance regime, and independent and objective assurance.

A consolidated organisational risk register is managed on an ongoing basis to inform ExCo and the ARC of the prevailing risks and how they are managed and mitigated to acceptable levels.





## A.8

## MONITORING AND EVALUATION

The CSIR measurement framework seeks to monitor our short-term progress towards meeting our strategic objectives, as well as assessing whether the long-term essence of these aims is being achieved. The two (2) components of our measurement framework are:

- A set of annual performance indicators across the five (5) strategic objectives. These form part of the Annual Performance Plan, on a quarterly basis the CSIR reports on progress towards meeting these targets. In addition to setting targets for the upcoming financial year, the organisation sets five-year targets for these indicators.
- A set of longer-term measures that focus more clearly on the outcomes and, potentially, the impacts of our efforts across the five (5) strategic focus areas.

Impact planning, monitoring, evaluation and learning lead to several tangible deliverables, and these will be recorded in the annual plans. Deliverables include the tracking of RD&I outcomes, the planning of interim outcomes and longer-term impact assessments (case studies), delivery systems modelled and analysed for bottlenecks and leverage points, new solutions and transfer of knowledge, and plans for improving Divisions and Clusters' capability to increase RD&I outcomes and impact.

For the CSIR to fulfil its mandate and mission, each year it must provide its internal and external stakeholders with robust evidence that the impact goal is being accomplished. Case study research design will be utilised to explore the impact of our achievements. This, then, is the purpose of the CSIR's impact evaluation activities – to provide firm evidence of the effects of CSIR research, innovation and industrialisation activities on the economy, environment and society in South Africa and on the continent.

## A.9

## KPI TARGETS

**Table A3:** Five-year KPI Targets

Indicator	Target 2021/22	Forecast 2021/22	Target 2022/23	Target 2023/24	Target 2024/25	Target 2025/26	Target 2026/27
<b>SO1: Conduct RD&amp;I of transformative technologies and accelerate their diffusion</b>							
<b>KPI 01:</b> Publication equivalents	300	339	<b>304.5</b>	331	350	370	389
<b>KPI 02:</b> New priority patent applications filed	5	13	<b>7</b>	8	13	14	17
<b>KPI 03:</b> New patents granted	8	17	<b>6</b>	10	13	17	21
<b>KPI 04:</b> New Technology Demonstrators	46	46	<b>54</b>	64	71	79	82
<b>KPI 05:</b> Number of technology licence agreements signed	19	13	<b>18</b>	23	29	32	39
<b>SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology</b>							
<b>KPI 06:</b> Number of localised technologies	11	12	<b>11</b>	14	17	20	22
<b>KPI 07:</b> Number of joint technology development agreements being implemented for industry	24	14	<b>27</b>	36	38	48	52
<b>KPI 08:</b> Number of SMMEs supported	75	64	<b>72</b>	91	104	117	127



Indicator	Target 2021/22	Forecast 2021/22	Target 2022/23	Target 2023/24	Target 2024/25	Target 2025/26	Target 2026/27
<b>SO3: Drive socioeconomic transformation through RD&amp;I that supports the development of a capable state</b>							
<b>KPI 09:</b> Number of reports contributing to national policy development	20	15	<b>13</b>	13	16	18	21
<b>KPI 10:</b> Number of standards delivered or contributed in support of the state	9	6	<b>9</b>	8	7	9	10
<b>KPI 11:</b> Number of projects implemented to increase the capability of the state	40	45	<b>45</b>	48	52	59	62
<b>SO4: Build and transform HC and infrastructure</b>							
<b>KPI 12: Total SET staff</b>	1 497	1 530	<b>1598</b>	1664	1723	1781	1844
<b>KPI 13:</b> Percentage of SET staff who are black	66%	67%	<b>67%</b>	68%	69%	69%	70%
<b>KPI 14:</b> Percentage of SET staff who are female	37%	38%	<b>38%</b>	38%	38%	38%	39%
<b>KPI 15:</b> Percentage of SET staff with PhDs	23%	22%	<b>21%</b>	21%	21%	21%	22%
<b>KPI 16: Total chief researchers</b>	17	14	<b>16</b>	16	18	23	26
<b>KPI 17:</b> Percentage of chief researchers who are black	17%	14%	<b>19%</b>	22%	25%	28%	36%
<b>KPI 18:</b> Percentage of chief researchers who are female	24%	14%	<b>13%</b>	13%	22%	30%	37%
<b>KPI 19: Total principal researchers</b>	193	180	<b>189</b>	194	209	220	237
<b>KPI 20:</b> Percentage of principal researchers who are black	35%	33%	<b>34%</b>	34%	35%	36%	37%
<b>KPI 21:</b> Percentage of principal researchers who are female	22%	19%	<b>20%</b>	22%	22%	24%	25%
<b>KPI 22:</b> Number of staff involved in exchange programmes with industry	13	15	<b>26</b>	30	32	35	38
<b>KPI 23:</b> PPE Investment (Rm) *	100	96.6	<b>259.8</b>	120	120	100	100
<b>SO5: Diversify income, maintain financial sustainability and good governance</b>							
<b>KPI 24:</b> Total Income (Rm)	3054	2635.5	<b>2903</b>	3445	5956	3740	3890
<b>KPI 25:</b> Net Profit (Rm)	0	-54.4	<b>-5.4</b>	6.3	13.0	15.5	18.7
<b>KPI 26:</b> SA public sector income (% Total Income)	53%	52%	<b>51%</b>	53%	53%	53%	53%
<b>KPI 27:</b> SA private sector income (% Total Income)	12%	8%	<b>12%</b>	13%	13%	14%	14%
<b>KPI 28:</b> International contract income (% Total Income)	7%	7%	<b>8%</b>	8%	8%	9%	9%
<b>KPI 29:</b> B-BBEE Rating *	2	1	<b>1</b>	1	1	1	1
<b>KPI 30:</b> RIR *	1.8	<1	<b>&lt;1</b>	<1	<1	<1	<1
<b>KPI 31:</b> Audit opinion	Unqualified audit opinion	Unqualified audit opinion	<b>Unqualified audit opinion</b>	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion



## A.10

### KPI DESCRIPTIONS

KPIs provide an understanding of performance in terms of inputs, outputs, efficiencies and, to some extent, provide lead indicators of the outcomes and impact that are required for the CSIR to fulfil its mandate. The question of whether the CSIR is meeting its strategic objectives related to achieving outcomes and impact cannot be resolved by KPIs assessment alone and requires a process of programme evaluation as described in the National Evaluation Policy Framework. The strategic objectives provided in the CSIR Strategic Plan make specific statements on planned outcomes that will serve as the basis for future evaluation of performance in this regard.

The CSIR KPIs provide a basket of measures that reflect various aspects of the organisation's performance. The targets that are set reflect, in the context of limited resources, a strategic choice about the areas in which the greatest impact can be achieved.

#### KPI 1: PUBLICATION EQUIVALENTS

Indicator Title	Publication Equivalents
<b>Definition</b>	Publication equivalents consist of peer-reviewed journal articles, peer-reviewed conference papers, peer-reviewed book chapters and books.
<b>Purpose</b>	Research publications are a measure of the CSIR's research capabilities and outputs. The quantity and quality of peer-reviewed research publications is a measure of the quality and depth of the scientific knowledge base.
<b>Performance assessment</b>	The CSIR considers a performance above 95% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	Publications entered in the CSIR Technical Outputs Database (TOdB), which provides the information for reporting.
<b>Data responsibility</b>	BEI: CSIR Information Services.
<b>Method of calculation</b>	The number of publication equivalents assigned to each type of publication as per the approved Publication Equivalent Guidelines. The publications are counted over the calendar year preceding the year in which the financial year ends.
<b>Limitations</b>	Authors submit publications for inclusion in TOdB via WorkFlow. There may be some under-reporting if individual authors do not submit their manuscripts for inclusion. However, there are also measures in place to automatically include publications whose authors are affiliated to the CSIR.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Publications not submitted to the TOdB will not be allocated publication equivalents. Publications not subjected to scholarly peer review.

#### KPI 2: NEW PRIORITY PATENT APPLICATIONS FILED

Indicator Title	New Priority Patent Applications Filed
<b>Definition</b>	A priority patent is the first patent application filed for the protection of a particular invention with the CSIR named as an applicant/assignee/co-applicant/co-assignee.
<b>Purpose</b>	The basic purpose [of the right of priority] is to safeguard, for a limited period, the interests of a patent applicant(s) in their endeavour to obtain international protection for their invention. At the CSIR, priority patent filings serve as a pipeline indicator of patent families.



Indicator Title	New Priority Patent Applications Filed
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source</b>	Knowledge Sharing Systems (KSS) records containing evidentiary supporting documentation (from patent attorneys, patent offices and/or reliable patent databases) offices.
<b>Data responsibility</b>	BEI: Intellectual Property & Technology Transfer.
<b>Method of calculation</b>	Number of qualifying records on KSS.
<b>Data limitations</b>	Steps must be taken to avoid double counting of applications that have been previously filed but withdrawn and refiled at a later date (despite obtaining a new priority number and priority date).
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	<ul style="list-style-type: none"> <li>Any patent application that is not the first application filed in respect of a particular invention, including (without limitation) re-filings/conversions/nationalisations/continuations/divisional, etc. of a previously filed application.</li> <li>Patent applications for which evidentiary supporting documentation is lacking.</li> <li>Patent applications that do not name the CSIR as an applicant/assignee/co-applicant/co-assignee.</li> </ul>

### KPI 3: NEW PATENTS GRANTED

Indicator Title	New Patents Granted
<b>Definition</b>	Patents are exclusive rights granted for inventions granted by an examining patent authority with the CSIR named as an applicant/assignee/co-applicant/co-assignee.
<b>Purpose</b>	Patents provide a lead indicator of the potential impact to be achieved when technologies are commercialised.
<b>Performance assessment</b>	The CSIR considers a performance above 80% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	KSS records containing evidentiary supporting documentation (from patent attorneys, patent offices and/or reliable patent databases).
<b>Data responsibility</b>	BEI: Intellectual Property & Technology Transfer
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>Number of qualifying records on KSS.</li> <li>For patents from the same patent family granted in multiple territories, each patent granted by an examining authority is counted individually.</li> <li>Where a patent is granted by a regional patent authority (e.g. EPO), only the EPO grant is counted, not the national validations in designated countries.</li> <li>In cases where notification of a patent is only received after the results for the financial year have been completed, that patent will be included in the subsequent financial year's results. Only co-owned patents or patents in the name of the CSIR are counted.</li> </ul>
<b>Limitations</b>	South Africa and certain other countries do not have examining patent offices. Therefore, patents filed in these countries are not counted for this KPI. The time taken for a patent to be granted after filing is unpredictable and can range from one to eight or even more years, depending on the efficiency of the patent authority concerned and the complexity of the examination process.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Patents granted by non-examining patent authorities. Patents for which evidentiary supporting documentation is lacking. Patents that do not name the CSIR as an applicant/assignee/co-applicant/co-assignee. Patents that are national validations of a patent granted by a regional patent authority.



## KPI 4: NEW TECHNOLOGY DEMONSTRATORS

Indicator Title	New Technology Demonstrators
<b>Definition</b>	A prototype, a rough example of a conceivable technology (product or system) derived from existing knowledge gained from research and/or practical experience as proof of concept.
<b>Purpose</b>	Measure an intermediate output of research, development and innovation activities with the potential to be developed further and that can be transferred for socioeconomic impacts.
<b>Performance assessment</b>	The CSIR considers a performance above 85% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	All data is collated in a centralised repository of the Technology Demonstrator Evaluation Panel.
<b>Data responsibility</b>	BEI: RD&I Office.
<b>Method of calculation</b>	Technology demonstrators are submitted by Clusters for adjudication to the Technology Demonstrator Evaluation Panel. Count of technology demonstrators as approved by the Technology Demonstrator Panel and adjudicated according to the CSIR Technology Demonstrator Evaluation Framework.
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Only outputs that result from experimental development are considered technology demonstrators, e.g. development of frameworks is not considered.

## KPI 5: NUMBER OF TECHNOLOGY LICENCE AGREEMENTS SIGNED

Indicator Title	Number of Licenced Technologies
<b>Definition</b>	A licence agreement is an agreement in terms of which the CSIR grants rights to another party to exploit IP developed by the CSIR, typically in exchange for royalty payments and/or other licence fees. Technologies licensed in this manner must have been disclosed via the invention disclosure process.
<b>Purpose</b>	This indicator is a measure of the uptake of CSIR IP in the market. Technology licences facilitate commercialisation by other parties of the CSIR's scientific and technological outputs.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	Copies of signed licence agreements and records in KSS.
<b>Data responsibility</b>	BEI: Intellectual Property & Technology Transfer
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>Number of licence agreements signed.</li> <li>Technology licences are proposed and negotiated with other parties by CSIR Divisions and are approved and granted in accordance with relevant legislation and the CSIR Commercialisation and Approval Frameworks.</li> <li>Assignments of IP shall also be included if all other criteria are met, if the assignment is not a conversion of licensed rights to the same IP that have already/previously been licensed to the assignee.</li> </ul>
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Only full licence agreements negotiated and concluded with another party are counted. This KPI excludes: Instant Access Licences; and Evaluation agreements (or similar).



## KPI 6: NUMBER OF LOCALISED TECHNOLOGIES

Indicator Title	Number of Localised Technologies
<b>Definition</b>	A localised technology is a technology that has been invented or commercialised outside of South Africa and that has been or will be introduced/adapted in South Africa for commercial or scientific benefit or a technology that has been locally developed as an import replacement.
<b>Purpose</b>	The indicator aims to diffuse technologies commercialised or industrialised from elsewhere in the world that have demonstrated potential to positively affect the competitiveness of industry upon competent adoption by users or is a strong candidate to be an input into innovation or improvements of other systems for improvement of industrial activities or capabilities of the State.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	Evidence for localised technologies is reviewed by the Planning, Reporting, Monitoring and Evaluation Sub-Committee of the CSIR Operations Committee (OpCco) and should include: <ul style="list-style-type: none"> <li>• Proof such as licence agreements and intellectual property rights ownership, including in the case of expired or lapsed IP rights, that the technology originated from outside the borders of South Africa; and</li> <li>• An implementation report or technology package developed, or other relevant proof that the technology has been piloted or applied/implemented in local South African conditions.</li> </ul>
<b>Data responsibility</b>	CSIR Clusters. Central Repository held by BEI: Institutional Planning.
<b>Method of calculation</b>	Number of technologies localised.
<b>Limitations</b>	The agreement date may be before the current financial year. The KPI can only be claimed once all eligible evidence is satisfied, which may span several years.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Excludes a general list of technologies developed by CSIR R&D.

## KPI 7: NUMBER OF JOINT TECHNOLOGY DEVELOPMENT AGREEMENTS BEING IMPLEMENTED WITH INDUSTRY

Indicator Title	Number of Joint Technology Development Agreements being Implemented for Industry
<b>Definition</b>	A joint technology development initiative with an industry partner under a written agreement, where each party brings needed capability for the development and implementation of the technology. The initiative may be funded by a third party. Industry refers to the private sector.
<b>Purpose</b>	This indicator measures the CSIR's technology development collaborations with industry partners with the intention to commercialise and industrialise.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	<ul style="list-style-type: none"> <li>• A signed joint technology development agreement;</li> <li>• The agreement should clearly show the joint activities which can include joint R&amp;D outputs (R&amp;D reports, papers, patents, Computer aided design (CAD) models, technology test reports, etc.); and</li> <li>• Proof of activities performed in the current financial year.</li> </ul>
<b>Data responsibility</b>	Divisional and Cluster BD&C. Central Repository maintained by BEI: Institutional Planning
<b>Method of calculation</b>	Industry refers to South African private sector or South African non-public entities (NOT listed as public entities in the schedules to the Public Finance Management Act and the Municipal Finance Management Act). This includes Not for Profit Organisations. Industry also includes foreign stakeholders (i.e., entities incorporated outside the borders of South Africa). Number of signed agreements for joint technology development and implementation. Number of active technology agreements in the current financial year.



Indicator Title	Number of Joint Technology Development Agreements being Implemented for Industry
<b>Limitations</b>	<ul style="list-style-type: none"> <li>This definition of the KPI does not differentiate between large joint projects involving many SET base members and small teams.</li> <li>This definition does not prescribe a minimum ratio of hours contributed by each party (this ratio will change as projects progress through TRLs).</li> </ul>
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	<p>South African public entities as listed in the schedules to the Public Finance Management Act and the Municipal Finance Management Act.</p> <p>Pure contract R&amp;D where there is no joint team with an industry partner.</p> <p>Projects where there is no specific product or process development with industry.</p> <p>Projects done with the public sector (including Government departments).</p>

## KPI 8: NUMBER OF SMMEs SUPPORTED

Indicator Title	Number of SMMEs Supported
<b>Definition</b>	Support of Small, Medium and Micro Enterprises (SMMEs) as described in the 2019 Revised Schedule 1 of the National Definition of Small Enterprise in South Africa (Government Gazette no. 42304 of 15 March 2019) under the National Small Enterprise Act, 1996 (Act 102 of 1996), read with the National Enterprise Amendment Act, 2003 (Act 26 of 2003) and the National Small Enterprises Act, 2004 (Act 29 of 2004) through the implementation of RD&I and technology interventions that contribute to SMMEs becoming more productive, efficient and sustainable.
<b>Purpose</b>	The indicator measures the CSIR's contribution to socioeconomic development and industrialisation through the support of SMMEs.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	<ul style="list-style-type: none"> <li>Signed agreement with the SMME; and</li> <li>Proof of SMME status as per National Small Enterprise Act (from e.g. a CSD reports or a signed affidavit); and</li> <li>Proof or acknowledgment of delivery of support by the SMME.</li> </ul>
<b>Data responsibility</b>	CSIR Clusters. Central repository maintained by BEI: Institutional Planning.
<b>Method of calculation</b>	The number of signed agreements with SMMEs. Assumption: even under third-party funding an agreement with a specific SMME should be in place.
<b>Limitations</b>	This is a proxy for impact measurement. Actual impact will only be available from SMME revenue, job growth, growth in number of SMME business contracts.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	<p>Routine analytical services.</p> <p>Subcontracting of SMMEs, unless there is an agreement in place to do capacity development of the SMME to enable delivery.</p>

## KPI 9: NUMBER OF REPORTS CONTRIBUTING TO NATIONAL POLICY DEVELOPMENT

Indicator Title	Number of Reports Contributing to National Policy Development
<b>Definition</b>	Evidence-based policy development support provided to various arms of government.
<b>Purpose</b>	The indicator measures the CSIR's support to government with evidence-based policy development and decision-making that can benefit from a significant SET input.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/eligible evidence</b>	<ul style="list-style-type: none"> <li>The Policy Report delivered; and</li> <li>Acknowledgment of delivery of policy report by the government.</li> </ul>



Indicator Title	Number of Reports Contributing to National Policy Development
<b>Data responsibility</b>	CSIR Clusters. Central repository maintained by BEI: Institutional Planning.
<b>Method of calculation</b>	Count of final reports related to new or updated policies received and accepted by the implementing government department.
<b>Limitations</b>	The KPI as defined here does not account for: <ul style="list-style-type: none"> <li>All national policies that do not have the same level of complexity from a SET point of view; and</li> <li>The effort put in by the CSIR (SET hours), some policy development projects require less input than others.</li> </ul>
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	<ul style="list-style-type: none"> <li>Development of internal policies for government departments, for example general HR policies, quality management policies and general management policies.</li> <li>Contribution to creation or updating of CSIR policies.</li> </ul>

## KPI 10: NUMBER OF STANDARDS DELIVERED OR CONTRIBUTED TO IN SUPPORT OF THE STATE

Indicator Title	Number of Standards Delivered or Contributed to in Support of the State.
<b>Definition</b>	New or updated standards adopted by the state and state-owned entities that the CSIR has developed and delivered or to which it contributed.
<b>Purpose</b>	The indicator measures the CSIR's support for government policy and regulation through the development of standardised practice guidelines across economic and social sectors
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/ eligible evidence</b>	<ul style="list-style-type: none"> <li>The Standard delivered or contributed to; and</li> <li>Acknowledgment of delivery of the Standard by the government.</li> </ul>
<b>Data responsibility</b>	CSIR clusters and portfolios. Central repository maintained by BEI Planning and Knowledge Management.
<b>Method of calculation</b>	Count of new or updated standards adopted by government. In the case of updated Standards, significant changes from previous versions must be demonstrated. Examples of Standards include interoperability Standards, accessibility Standards, products or infrastructure Standards
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

## KPI 11: NUMBER OF PROJECTS BEING IMPLEMENTED TO INCREASE CAPABILITY OF THE STATE

Indicator Title	Number of Projects Implemented to Increase Capability of the State
<b>Definition</b>	The CSIR-facilitated implementation of technologies (CSIR-created or otherwise) that improve the efficiency of government, SOEs and South African universities.
<b>Purpose</b>	This indicator measures the number of projects that the CSIR implements on behalf of the State.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
<b>Data source/ eligible evidence</b>	<ul style="list-style-type: none"> <li>An Active agreement with a government department/SOE/South African university; and</li> <li>A progress report of the project being implemented on behalf of government institutions;</li> </ul>
<b>Data responsibility</b>	CSIR Clusters. Central repository maintained by BEI: Institutional Planning
<b>Method of calculation</b>	Number of projects the CSIR implements on behalf of the State.





Indicator Title	Number of Projects Implemented to Increase Capability of the State
Limitations	None.
Type of indicator	Output.
Exclusions	None

## KPI 12: TOTAL SET STAFF

Indicator Title	Total SET staff
New definition	Number of CSIR staff qualified in the field of science, engineering and technology (SET) field.
Purpose	The indicator is a measure of the CSIR's capacity to deliver on RD&I projects.
Performance assessment	<ul style="list-style-type: none"> <li>Performance in terms of the number of SET staff is influenced by financial considerations and should be assessed in the context of financial performance.</li> <li>The CSIR considers a performance above 95% of the target as acceptable.</li> </ul>
Data source/eligible evidence	Number of SET staff extracted from PeopleSoft HR system.
Data responsibility	CSIR Human Capital.
Method of calculation	Head count of SET staff at the end of the financial year.
Limitations	HC ensures the correct classification of staff in PeopleSoft.
Type of indicator	Output.
Exclusions	Bursars, visiting students/scientists and vacation work appointments.

## KPIS 13 AND 14: PERCENTAGE OF SET STAFF WHO ARE BLACK AND FEMALE, RESPECTIVELY

Indicator Title	Percentage of SET staff who are black and female, respectively
Definition	<p>Percentage of SET staff who are black (as per B-BBEE Act definition) and percentage of SET staff who are female, respectively. South African citizens who are actively involved in RD&amp;I activities. As per B-BBEE Act definition, black South Africans are Africans, coloureds and Indians, who meet the following criteria:</p> <ul style="list-style-type: none"> <li>Citizens of the Republic of South Africa by birth or descent;</li> <li>Became citizens of the Republic of South Africa by naturalisation before 27 April 1994 or</li> <li>After 27 April 1994 and who would have been entitled to acquire citizenship by naturalisation prior to that date.</li> </ul>
Purpose	These indicators measure the degree of demographic transformation within the RD&I capacity of the organisation.
Performance assessment	<ul style="list-style-type: none"> <li>Performance is influenced by the growth in SET staff numbers and may be negatively affected if the target number of SET staff is not achieved.</li> <li>The CSIR considers a performance within two percentage points from the target as acceptable.</li> </ul>
Data source/eligible evidence	Number of employees who are classified as black, as a percentage of the total SET staff extracted from PeopleSoft system.
Data responsibility	CSIR Human Capital.
Method of calculation	The percentages of black South African and female South African staff of total SET staff at the end of the financial year.
Limitations	None – Human Capital ensures the correct classification of staff on the Human Capital database.
Type of indicator	Output.
Exclusions	None.



## KPI 15: PERCENTAGE OF SET STAFF WITH DOCTORAL QUALIFICATIONS

Indicator Title	Percentage of SET Staff with doctoral qualifications
<b>Definition</b>	Proportion of SET staff who have a doctoral level qualification.
<b>Purpose</b>	The indicator measures the organisation's capacity to conduct and supervise quality research and to innovate.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Performance is influenced by the growth in SET staff numbers and may be negatively affected if the target number of SET staff is not achieved.</li> <li>A performance within one percentage point from the target will be considered as acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	Number of SET staff with PhD qualifications as a percentage of the total number of SET staff extracted from the PeopleSoft system.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	The percentage of SET staff with doctoral level qualifications at the end of the financial year.
<b>Limitations</b>	None – Human Capital ensures the validity of data and that evidence of the qualification is on file.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

## KPI 16: NUMBER OF CHIEF RESEARCHERS

Indicator Title	Number of Chief Researchers
<b>Definition</b>	The Number of CSIR staff recognised as Chief Researchers through the formal Career Ladder process
<b>Purpose</b>	The indicator is a measure of the quality of SET capacity and their potential influence in the local and international RD&I spaces (capacity to collaborate and share resources).
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Promotion or appointment at these senior research levels is based on growth in skill and proficiency as measured through the CSIR Career Ladder process.</li> <li>A performance of above 90% of the target is considered acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	Total number of staff appointed as Chief Researchers extracted from the PeopleSoft system.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	Count of the number of SET staff who are classified as Chief Researchers at the end of the financial year.
<b>Limitations</b>	None – Human Capital ensures the validity of data and that the required evidence is on file.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Staff not recognised through the career ladder process.

## KPIS 17 AND 18: PERCENTAGE OF CHIEF RESEARCHERS WHO ARE BLACK AND FEMALE, RESPECTIVELY.

Indicator Title	Percentage of Chief Researchers who are black and female, respectively
<b>Definition</b>	<p>The proportion of black (as per B-BBEE Act definition) South African and proportion of female South African citizens who are Chief Researchers (as per CSIR's Career Ladder process). As per B-BBEE Act definition, black South Africans are Africans, coloureds and Indians who meet the following criteria:</p> <ul style="list-style-type: none"> <li>Citizens of the Republic of South Africa by birth or descent;</li> <li>Became citizens of the Republic of South Africa by naturalisation before 27 April 1994; or</li> <li>After 27 April 1994 and who would have been entitled to acquire citizenship by naturalisation prior to that date.</li> </ul>



Indicator Title	Percentage of Chief Researchers who are black and female, respectively
<b>Purpose</b>	These indicators measure the level of demographic transformation within the Chief Researcher level.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Promotion or appointment at these senior research levels is based on growth in skill and proficiency as measured through the CSIR Career Ladder process.</li> <li>A performance of within five percentage points from the target is considered acceptable</li> </ul>
<b>Data source/ eligible evidence</b>	Percentages of Chief Researchers who are black and female, respectively, are extracted from the PeopleSoft system.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	The percentage of black South African and female South African Chief Researchers at the end of the financial year.
<b>Limitations</b>	None – Human Capital ensures the validity of data and that the required evidence is on file.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

## KPI 19 NUMBER OF PRINCIPAL RESEARCHERS

Indicator Title	Number of Principal Researchers
<b>Definition</b>	Number of CSIR staff recognised as Principal Researchers through the formal Career Ladder process.
<b>Purpose</b>	The indicator is a measure of the quality of SET capacity and their potential influence in the local and international RD&I spaces (capacity to collaborate and share resources).
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Promotion or appointment at these senior research levels is based on growth in skill and proficiency as measured through the CSIR Career Ladder process.</li> <li>A performance of above 95% of the target is considered acceptable.</li> </ul>
<b>Data source/ eligible evidence</b>	Employees who have been appointed as Principal Researchers, as indicated on extracted from the PeopleSoft system.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	Count of the number of SET staff who are classified as Principal Researchers at the end of the financial year.
<b>Limitations</b>	None. Human Capital ensures the validity of data and that the required evidence is on file.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Staff not recognised through the career ladder process.

## KPIS 20 AND 21: PERCENTAGE OF PRINCIPAL RESEARCHERS WHO ARE BLACK AND FEMALE, RESPECTIVELY

Indicator Title	Percentage of Principal Researchers who are Black and Female, respectively
<b>Definition</b>	<p>Percentage of principal researchers who are black South Africans and percentage of Principal Researchers who are female South Africans. As per B-BBEE Act definition, black South Africans are Africans, coloureds and Indians who meet the following criteria:</p> <ul style="list-style-type: none"> <li>Are citizens of the Republic of South Africa by birth or descent;</li> <li>Became citizens of the Republic of South Africa by naturalisation before 27 April 1994; or</li> <li>After 27 April 1994 and who would have been entitled to acquire citizenship by naturalisation prior to that date.</li> </ul>
<b>Purpose</b>	These indicators measure the level of demographic transformation within the Principal Researcher level.



Indicator Title	Percentage of Principal Researchers who are Black and Female, respectively
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Promotion or appointment at these senior research levels is based on growth in skill and proficiency as measured through the CSIR Career Ladder process.</li> <li>A performance of within three percentage points from the target is considered acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	KPI information is extracted from the Human Capital database.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	The percentage of black South African and female South African Principal Researchers at the end of the financial year.
<b>Limitations</b>	None – Human Capital ensures the validity of data and that the required evidence is on file.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

## KPI 22: NUMBER OF STAFF INVOLVED IN EXCHANGE PROGRAMMES WITH INDUSTRY

Indicator Title	Number of staff involved in exchange programmes with industry
<b>Definition</b>	The exchange of staff between the CSIR and industry for a period of time to share/gain expertise for the advancement of business growth opportunities and capacity development.
<b>Purpose</b>	The indicator measures the level at which CSIR shares expertise and resources to strengthen collaborations with industry to achieve organisational growth.
<b>Performance assessment</b>	The CSIR considers a performance above 75% of the target as acceptable.
<b>Data source/eligible evidence</b>	A signed transfer/secondment agreement.
<b>Data responsibility</b>	CSIR Human Capital.
<b>Method of calculation</b>	Industry refers to South African private sector or South African non-public entities (NOT listed as public entities in the schedules to the Public Finance Management Act and the Municipal Finance Management Act). This includes Not for Profit Organisations. Industry also includes foreign stakeholders (i.e., entities incorporated outside the borders of South Africa). Number of staff involved in exchange programmes for a minimum period of one month.
<b>Limitations</b>	None – Human Capital will ensure relevant data is captured.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	South African public entities as listed in the schedules to the Public Finance Management Act and the Municipal Finance Management Act. Exchange programmes with Government departments.

## KPI 23: INVESTMENT (Rm) IN PROPERTY, PLANT AND EQUIPMENT

Indicator Title	Investment in Property, Plant and Equipment (PPE)
<b>New definition</b>	PPE investment is the amount invested in CSIR and government grant-funded PPE, as well as qualifying leases (as per Accounting Standard on Leases) for a financial year.
<b>Purpose</b>	This indicator provides a measure of CSIR's investment in research infrastructure to develop and maintain world-class facilities and equipment to provide the quality of RD&I that is expected of it.
<b>Performance assessment</b>	The CSIR considers a performance above 95% of the target as acceptable. The budget target may be exceeded substantially, arising from additional grant funding. This is a successful result and is not the consequence of an inappropriate target.
<b>Data source/eligible evidence</b>	The information for the financial KPIs is obtained from the CSIR financial systems.



Indicator Title	Investment in Property, Plant and Equipment (PPE)
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	Value of investment in PPE is the amount of CSIR and grant additions for the year. This information is obtained from reports in the fixed assets system, as well as the CSIR trial balance. Reconciliation is done to analyse the movement in the PPE balance and to break this down among additions, disposals and depreciation. This breakdown is also disclosed in the year-end annual financial statements.
<b>Limitations</b>	None.
<b>Type of indicator</b>	Input.
<b>Exclusions</b>	Equipment that goes back to the third party at the end of the project and is not logged in the CSIR asset list.

### KPI 24: TOTAL OPERATING INCOME (Rm)

Indicator Title	Total operating income
<b>Definition</b>	Total operating income includes revenue declared on R&D contracts (contract R&D income), income derived from licences and royalties, PG received through the Science Vote, and other income.
<b>Purpose</b>	The indicator reflects the ability of the CSIR to ensure financial sustainability. Growth in total operating income indicates growth in the outcomes and impact achieved by the CSIR.
<b>Performance assessment</b>	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable.
<b>Data source/eligible evidence</b>	Total operating income measured in South African rand extracted from the Income Statement from the CSIR financial systems.
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements.</li> <li>The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.</li> </ul>
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Net finance income is not included in the definition of total operating income.

### KPI 25: NET PROFIT (%TOTAL INCOME)

Indicator Title	Net Profit (% Total Income)
<b>Definition</b>	Profit for a financial year is calculated as total operating income; less total operating expenditure (including the performance bonus accrual); plus net finance income.
<b>Purpose</b>	Net profit is a key indicator of financial sustainability and the ability of the organisation to manage its expenses according to the affordability determined by income levels.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate.</li> <li>The CSIR considers a performance above 95% of the target as acceptable.</li> <li>Reducing the budget target is a successful result and is not the consequence of an inappropriate target.</li> </ul>
<b>Data source/eligible evidence</b>	The information for the financial KPIs is obtained from the CSIR financial systems.
<b>Data responsibility</b>	CSIR Finance.



Indicator Title	Net Profit (% Total Income)
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements.</li> <li>The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.</li> </ul>
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

### KPI 26: SA PUBLIC SECTOR INCOME (% TOTAL INCOME)

Indicator Title	SA public sector income (% Total Income)
<b>Definition</b>	South African public sector income is the total income earned from South African public entities as listed in the schedules to the Public Finance Management Act and the Municipal Finance Management Act. This includes revenue declared on research and development contracts, ring-fenced Parliamentary Grant received through the Science Vote and any other forms of funding received from South African public entities.
<b>Purpose</b>	South African public sector income reflects the degree of government investment in research, development and innovation activities at the CSIR and the ability of the CSIR to contract with the public sector.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>The CSIR's annual target is the percentage of South African public sector income included in the annual total operating income budget, which the CSIR aims to achieve or reduce.</li> <li>Future targets are set to ensure increased income diversification and impact in other sectors.</li> <li>The CSIR considers a performance above 95% of the target as acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	The total income received from South Africa public organisations, as a percentage of total income, obtained from the PeopleSoft financial system.
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements.</li> <li>The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.</li> </ul>
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.

### KPI 27: SA PRIVATE SECTOR INCOME (% TOTAL INCOME)

Indicator Title	SA private sector income (% Total Income)
<b>Definition</b>	South African private sector income is the total contract research and development income earned from South African non-public entities (NOT listed as public entities in the schedules to the Public Finance Management Act and the Municipal Finance Management Act). This includes Not for Profit Organisations.
<b>Purpose</b>	South African private sector income reflects the degree of private sector investment in the CSIR.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate.</li> <li>The CSIR considers a performance above 95% of the target as acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	The total income received from South African private organisations, as a percentage of total income, obtained from the PeopleSoft financial system.



Indicator Title	SA private sector income (% Total Income)
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	<ul style="list-style-type: none"> <li>The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements.</li> <li>The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.</li> </ul>
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Licences, royalties and interest income is not included in the definition. Income from Government departments.

## KPI 28: INTERNATIONAL CONTRACT INCOME (% TOTAL INCOME)

Indicator Title	International contract income (% total income)
<b>Definition</b>	International contract income is the total income earned from foreign customers (i.e. entities incorporated outside the borders of South Africa). This includes revenue declared on R&D contracts (contract R&D income) and other income received from foreign entities.
<b>Purpose</b>	International contract income reflects the global relevance of the CSIR. Growth in international investment is a key indicator of income diversification, as well as the relevance and impact of the CSIR within the global economy.
<b>Performance assessment</b>	<ul style="list-style-type: none"> <li>Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate.</li> <li>The CSIR considers a performance above 95% of the target as acceptable.</li> </ul>
<b>Data source/eligible evidence</b>	<ul style="list-style-type: none"> <li>The information for the financial KPIs is obtained from the CSIR financial systems.</li> <li>The total income received from foreign organisations, as a percentage of total income, obtained from the PeopleSoft financial system.</li> </ul>
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	Licences and royalties received from foreign entities are not included in the definition of international contract income.

## KPI 29: B-BBEE RATING

Indicator Title	B-BBEE rating
<b>Definition</b>	A B-BBEE rating is a verification certificate issued by a SANAS-approved verification agency that determines CSIR's contribution to black (as per B-BBEE Act definition) economic empowerment.
<b>Purpose</b>	The indicator is a measure of CSIR's compliance to the B-BBEE Act in its contribution to support socioeconomic transformation in South Africa.
<b>Performance assessment</b>	The CSIR would not consider failure to reach a target because of amended Codes of Good Practice targets as a negative result. Improving on the target is a successful result.
<b>Data source/eligible evidence</b>	B-BBEE certificate from a SANAS-approved verification agency.
<b>Data responsibility</b>	CSIR Procurement Office.



Indicator Title	B-BBEE rating
<b>Method of calculation</b>	<p>B-BBEE rating is based on a certificate that is issued after an external auditing process. The B-BBEE certificate indicates the CSIR's status regarding a number of measurements as indicated in the B-BBEE Codes of Good Practice. The B-BBEE rating is a composite score that is made up of the following components:</p> <ul style="list-style-type: none"> <li>• Management and control;</li> <li>• Skills development;</li> <li>• Preferential procurement;</li> <li>• Socioeconomic development; and</li> <li>• Equity ownership.</li> </ul>
<b>Limitations</b>	The external audit ensures that there is no subjectivity in the B-BBEE assessment.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	As the CSIR is a government business enterprise, equity ownership does not contribute to the B-BBEE rating score.

### KPI 30: RECORDABLE INCIDENT RATE (RIR)

Indicator Title	Recordable Incident Rate
<b>Definition</b>	<p>The Recordable Incident Rate (RIR) is the number of recordable incidences (or cases); multiplied by 200 000; divided by the number of hours worked. A recordable incident is a work-related injury or illness that results in one or more of the following criteria:</p> <ul style="list-style-type: none"> <li>• Death;</li> <li>• Loss of consciousness;</li> <li>• Restricted work or transfer to another job;</li> <li>• Days away from work; and/or</li> <li>• Medical treatment beyond first aid.</li> </ul>
<b>Purpose</b>	<ul style="list-style-type: none"> <li>• RIR indicates the effectiveness of the health and safety management system within the organisation in a year.</li> <li>• The CSIR SHEQ policy seeks to establish an effective, accountable and transparent framework for managing, maintaining and implementing SHEQ within the organisation.</li> </ul>
<b>Performance assessment</b>	The CSIR aims to achieve its annual target of an RIR less than 1.8 (equivalent to 40 recordable incidents/cases) through identifying health and safety risks and implementing proactive health and safety interventions to reduce the number of recordable incidents/cases.
<b>Data source/eligible evidence</b>	<ul style="list-style-type: none"> <li>• Statistics of the recordable incidents that occurred at the CSIR, obtained from the SHEQ sub-portfolio.</li> <li>• The information for the health and safety KPIs is obtained from the CSIR SHEQ systems.</li> </ul>
<b>Data responsibility</b>	CSIR SHEQ.
<b>Method of calculation</b>	The RIR is an indication of the percentage of employees exposed to work related injury or illness and classified as recordable incident per year. It is calculated by the number of recordable cases multiplied by 200 000 divided by the number of hours worked.
<b>Limitations</b>	None.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.





## KPI 31: AUDIT OPINION

Indicator Title	Audit Opinion
<b>Definition</b>	The Auditor-General defines a Clean Audit as achieving an unqualified audit opinion on the audits of annual financial statements and pre-determined objectives, as well as not having material findings on the audit of compliance with laws and regulations.
<b>Purpose</b>	The indicator is a measure of CSIR's accountability and governance.
<b>Performance assessment</b>	The CSIR would like to maintain a Clean Audit outcome at the end of each annual audit.
<b>Data source/eligible evidence</b>	Report of the Auditor-General as published in the Annual Report.
<b>Data responsibility</b>	CSIR Finance.
<b>Method of calculation</b>	A Clean Audit is based on the overall opinion of the Auditor-General after the performance of the annual statutory audit.
<b>Limitations</b>	Data from the Auditor-General regarding the audit opinion is only available on the third quarter of the financial period. This KPI relates to the audit opinion of the previous financial year.
<b>Type of indicator</b>	Output.
<b>Exclusions</b>	None.



# ANNEXURE **B**

## ANNUAL PLAN: 2022/23





## B.1 OPERATIONAL PLAN OVERVIEW

Annexure B of the CSIR Shareholder’s Compact outlines programmes and initiatives for the 2022/23 financial year that advance the strategic plan for 2022/23 to 2026/27 detailed in Annexure A. This strategic and operational plan is underpinned by the principles of the CSIR Strategy and its five (5) strategic objectives.

Tables B1, B2 and B4 outline the 2022/23 initiatives in a way that demonstrates the breadth of the CSIR’s efforts to support government priorities and the needs of society and industry. Through these initiatives, the CSIR is able to support the ERRP in areas of industrialisation for localisation, infrastructure investment and delivery, green economy and energy security.

The CSIR Strategy, the mandate and the values are anchored on collaborations with a variety of stakeholders to drive our mission. Overall, the initiatives planned illustrate that emphasis is placed on working with industry partners as intended in the Strategy. However, the initiatives also show that the CSIR continues to support government at national, provincial and municipal levels.

The CSIR plans to support SMMEs with technology solutions; the CSIR has performed well in this area. The CSIR continues to support SMMEs as a contribution to socioeconomic development and industrialisation.

The work that is planned with several Higher Education Institutions shows the integrated nature as to how the CSIR functions within the NSI. Moreover, it is the realisation that only through multidisciplinary efforts that we can realise scientific impact in dealing with the triple challenge the country faces. These collaborations capture the essence of the ideals set out in the Higher Education, Science, Technology, and Innovation Institutional Landscape Review to pivot the NSI and elevate it onto a higher performance trajectory.

## B.2 SO1: CONDUCT RD&I OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION.

### B.2.1 RD&I PROGRAMMES AND INITIATIVES

Table B1: Initiatives in support of SO1

Key RD&I Programme/ Platform/Project	Description	Decadal Plan’s Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR Future Production: Chemicals Cluster</b>				
<b>Biochemical Conversions Platform</b>	The establishment of a bio-chemical conversions platform in the BIDE that will drive bioprocessing technology and chemicals conversion processes for the production of bio-based chemicals and products.	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• Local industry through SMME support</li> <li>• State entities for funding in infrastructure and SMME support</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Pharmaceutical Technology Innovation Platform</b>	FuturePHARMA – An open innovation facility integrating molecular engineering and continuous pharmaceutical manufacturing for Africa.	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• State entities, particular funding through NT</li> <li>• HEI collaboration, particularly the Universities of Pretoria (UP) and the Witwatersrand (Wits) through students</li> </ul>
<b>Biocatalysis Platform</b>	Hosting the Industrial Biocatalysis Hub in South Africa	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• State entities such as the DSI for funding</li> <li>• Local industry collaborations</li> </ul>
<b>Nanostructures and advanced materials</b>	Advanced Functional Materials– Conduct cutting-edge, high-quality RD&I in the technology platform areas of Delivery Systems and Functional Polymers.	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• Local industry, e.g. 3 Sixty Biopharmaceuticals; Tautomer; Lighthouse, Sappi</li> <li>• HEI and international collaborations often for trials and testing purposes</li> </ul>
<b>Advanced polymer composites</b>	<ul style="list-style-type: none"> <li>• Focus on technology areas of polymer nanocomposites, bioplastics, and biocomposites and polymer blends and alloys for higher performance, smart/intelligent, light materials and sustainable resource utilisation.</li> <li>• Continue to converge technologies on nano-clays for passive barrier, active scavenger technology and bioplastics for sustainable packaging solutions.</li> <li>• More emphasis on local biomass content beneficiation to drive the prices of formulated pellets down, while maintaining or enhancing performance.</li> <li>• Continue to develop technologies that enable recycling/upcycling of polymers.</li> </ul>	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• State entities such as TIA</li> <li>• Local industry through SMME support</li> <li>• HEIs and international organisations such as DFID and international universities for collaborative projects</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>o</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Nanomaterials for sensor development</b>	<ul style="list-style-type: none"> <li>Complete the transfer of the breath analyser to commercial use.</li> <li>Research and proof of concept in CO<sub>2</sub>, ethylene and NH<sub>3</sub> sensors for early detection of food spoilage including grain, dairy, meat, fruits and vegetables.</li> <li>Endeavour to deliver optimisation studies on selective detection of diesel particulate matter (DPM) and soot.</li> <li>Develop nanosensors for CH<sub>4</sub>, CO and H<sub>2</sub>S detection as per user specifications.</li> <li>Co-develop gas sensors with local manufacturers for the local market.</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Collaborations planned for local industry for commercialisation of breathalyser and for sensors uptake</li> <li>Local industry for food/agricultural sensors</li> </ul>
<b>Advanced Carbon-based Nanostructured Materials Platform</b>	<ul style="list-style-type: none"> <li>Graphene application development in polymers: technical textiles with antistatic properties for high performance applications in the aerospace industry, in protective clothing and composites.</li> <li>Graphene is also used as an additive in high-performance thermoset resins composites. The graphene project is investigating the value proposition of graphene enhanced resins in a pipe application.</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local industry such as Flowtite for development of graphene additive materials</li> <li>International graphene companies approached for collaboration such as Versarien</li> </ul>
<b>HySA and carbon capture and utilisation</b>	Identify and optimise conditions for the generation of green hydrogen from biogas through the thermal decomposition approach.	<ul style="list-style-type: none"> <li>Innovation for energy security</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>International funding organisations</li> <li>State entities such as Sanedi</li> <li>Some local industry, e.g. Wonderstone</li> </ul>
<b>Materials Characterisation, Testing and Analytical Facility</b>	This facility primarily focuses on providing technical support to various research platforms within the Centre for Nanostructures and Advanced Materials (CeNAM).	<ul style="list-style-type: none"> <li>Supports research across the board that supports the grand challenges.</li> <li>Future-proof education and skills (through training in characterisation techniques)</li> </ul>	<ul style="list-style-type: none"> <li>Supports research across the board that supports these objectives</li> </ul>	<ul style="list-style-type: none"> <li>Undertakes work for most HEIs in the country</li> <li>Some industry work done</li> <li>State entities, e.g. tenders for Eskom for characterisation work</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR Future Production: Manufacturing Cluster</b>				
<b>Smart Factory</b>	<ul style="list-style-type: none"> <li>Establishment of the Smart Factory will continue with the validation of industry use cases. The first use cases will be the development of 4IR enabled manufacturing and production lines for the BiPAP ventilators, Locomotive Condition Monitoring System, copper bushes, QUVIR and Umbiflow.</li> <li>Assembly lines are expected to be replicated in industry, with commercialisation partners, once validated.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Local industry through access to capabilities and infrastructure</li> <li>MESA Africa, MESA International</li> </ul>
<b>High speed 3D printing</b>	<ul style="list-style-type: none"> <li>Develop batch production of multiple complex customised parts more efficiently and on demand.</li> <li>Support the industry via techno-economics to implement additive manufacturing through redesign for parts reduction, light weighting, new materials, etc., as well as to compare different additive manufacturing technologies and machines that best meet the needs of specific companies.</li> <li>Design, print and post process additively manufactured parts on CSIR-developed and partner machines to grow the final part additive manufacturing industry in South Africa.</li> <li>Develop novel additive manufacturing machines (Aeroswift 2.0, Hummingbird and novel metal and polymer research machines), building on the materials, lasers, automation, mechatronic and sensor capabilities that exist at the CSIR.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future-proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Local industry through access to capabilities and infrastructure</li> <li>SOEs</li> <li>HEIs – skills and capability development</li> <li>African Laser Centre</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Artificial Intelligence (AI) and machine learning</b>	<ul style="list-style-type: none"> <li>• Predictive maintenance: AI is used with IoT data to predict and avoid machine failure.</li> <li>• Yield enhancement: AI is used to decrease scrap rates from defective products and get more value out of the materials that go into the production process with machine vision and machine learning.</li> <li>• Quality testing: Machine learning and advanced image recognition systems to automate the visual inspection and fault detection of products, and to trigger the automatic ejection of defective products from a production line.</li> <li>• Supply chain management: With AI, manufacturers can better predict the complex interactions between each production unit and automate requests for parts, labour, tools and repairs.</li> </ul>	<ul style="list-style-type: none"> <li>• A re-industrialised modern economy</li> <li>• Future-proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> <li>• Competitive and efficient freight transport</li> </ul>	<ul style="list-style-type: none"> <li>• Local industry through access to capabilities, technologies and training programmes</li> <li>• SOEs</li> <li>• HEIs – joint technology and skills development</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>o</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Laser applications</b>	<ul style="list-style-type: none"> <li>• Novel, customised lasers for the local mining, manufacturing and remote sensing industries.</li> <li>• Integrated high power laser system and monitoring solutions to increase the productivity and competitive edge of the South African manufacturing industry.</li> <li>• Active monitoring and control of advanced laser enabled manufacturing systems as well as non-destructive three-dimensional imaging of optical transparent materials and parts.</li> <li>• PoC diagnostics and screening devices. This includes detection of HIV using optical trapping and Raman spectroscopy, development of a PoC TB photodiagnose device and a screening device for sub-standard medication.</li> <li>• Laser surface engineering systems and processes to reduce operational costs and improve efficiencies for the manufacturing, transport and power-generation industries through the improvement of material properties of structural or functional equipment, or the material processing of raw material or production components in industrial processes.</li> <li>• Through the Laser Loan Pool Programme and the African Laser Centre initiative, human capital development and new knowledge generation projects are facilitated and supported within NSI.</li> </ul>	<ul style="list-style-type: none"> <li>• A re-industrialised modern economy</li> <li>• Future-proof education and skills</li> <li>• Innovation for a healthy society</li> <li>• Innovation for energy security</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> <li>• Competitive and efficient freight transport</li> <li>• Energy security</li> <li>• Supply of electricity stabilised</li> </ul>	<ul style="list-style-type: none"> <li>• Local industry through access to capabilities, technologies and services</li> <li>• SOEs</li> <li>• HEIs – joint technology and skills development</li> <li>• Local health product original equipment manufacturers (OEMs)</li> </ul>





Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR Future Production: Mining Cluster</b>				
<b>Repositioning CSIR and development of niche capabilities for mining extractions</b>	<ul style="list-style-type: none"> <li>Fit-for-purpose Mining Extraction Roadmap developed with industry.</li> <li>Secure mining industry commitment for the CSIR to become the Centre for Mining Extraction.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future proof education and skills</li> <li>Innovation in support of energy security</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council, Mintek</li> <li>Junior Mining companies</li> </ul>
<b>Conducting a capability and capacity assessment for the acceleration of people-centred modernisation in the South African mining industry</b>	<ul style="list-style-type: none"> <li>Evaluating the relevant 4IR capability readiness of the CSIR to support industry with the people-centred mine modernisation and leading centre for mining extraction and innovation.</li> <li>The identification of 4IR methods, equipment and skills that will be required in modernised and mechanised underground gold and PGM mines.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation,</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council</li> <li>Universities e.g. UP Engineering department</li> <li>Mining Industry Learning factories</li> </ul>
<b>Enhanced emergency preparedness training in support of mining zero harm drive (for safety improvement in mining operations)</b>	<ul style="list-style-type: none"> <li>Development of a Virtual Reality platform and mock-mine to provide an immersive experience for enhanced mine safety training offering.</li> <li>Conducting a pilot run through extending the immersive training experience to some of the existing mining clients and evaluating their emergency preparedness response when compared to the traditional training methods.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council</li> <li>Collaboration with MQA and MerSETA</li> <li>Expanding the offering to SADC mining companies e.g. Zambia, Botswana, Lesotho</li> </ul>
<b>Application and integration of geotechnical tools</b>	<ul style="list-style-type: none"> <li>Development of an integrated platform for the application of geophysical tools such LiDAR, GPR, in-mine ERT to create an enhanced 3-D model that will inform reef delineation, face mapping to improve underground safety and inform production decisions.</li> <li>Assist underground mines to optimise extraction while also contributing to the zero-harm objective.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council, DMRE</li> <li>Junior Mining Companies</li> </ul>



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<b>Digitising rope inspection and prediction of application</b>	<ul style="list-style-type: none"> <li>Investigate the application for visual inspection of mine winder ropes with online video equipment and analytics for real-time condition-based monitoring.</li> <li>Investigating the application of data analytics for winder rope application by using historical rope testing databases to understand the rope failure trends.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council, DMRE</li> <li>Junior Mining Companies</li> </ul>
<b>TMM CAS</b>	<ul style="list-style-type: none"> <li>Complete Phase 2 of TMM digital twin and migration to a cloud-based platform.</li> <li>Facilitate application of a risk-based digital tool: for mining operations to predict and eliminate TMM-related accidents for the South African mining industry.</li> <li>Expand user development requirements for application of the digital solution.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Future proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation,</li> <li>Green economy interventions,</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with the Mandela Mining Precinct and Minerals Council</li> <li>Collaboration with MQA and MerSETA</li> <li>Expanding the offering to SADC mining companies e.g. Zambia, Botswana, Lesotho</li> </ul>
<b>CSIR Advanced Agriculture and Food Cluster</b>				
<b>Cannabis extraction technologies localisation and development</b>	Development of extraction technologies to demonstrate local applicability of such technologies and formulation of innovative product types with SMMEs and big companies.	<ul style="list-style-type: none"> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> <li>Re-industrialisation of the economy</li> </ul>	<ul style="list-style-type: none"> <li>Industry through SMME support</li> </ul>
<b>Addressing food waste in a circular economy model and post-harvest management technologies</b>	Value-add raw commodities or apply organic material to extend product shelf-life.	<ul style="list-style-type: none"> <li>Circular economy</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Supporting SMMEs with technology development</li> </ul>
<b>Indigenous Knowledge Systems (IKS)</b>	Development of complementary medicines, cosmetics and food products and assist companies in or with navigating the IKS regulatory framework to ensure compliance and that the benefits accrued from commercialising IKS-based products accrue to the indigenous knowledge holders.	<ul style="list-style-type: none"> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialisation of the economy</li> </ul>	<ul style="list-style-type: none"> <li>Higher Education Institutions (HEIs) such as the University of Free State and Wits</li> <li>Support local municipalities through rural economy development</li> <li>Support SMMEs such as indigenous knowledge owners</li> </ul>



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<b>Precision agriculture platform</b>	Supporting industries along the agricultural value chain with actionable farm-level data or intelligence to enable precision agriculture and cost-effective business decisions at all levels of the value chain.	<ul style="list-style-type: none"> <li>High tech industry domain</li> <li>ICT and smart systems</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with Agricultural Research Council</li> <li>Supporting small-scale farmers</li> <li>HEI collaborations – e.g. Wits</li> </ul>
<b>CSIR NextGen Health Cluster</b>				
<b>Bioengineering and integrated genomics</b>	<ul style="list-style-type: none"> <li>Development of a framework for the data analytics and governance that would enable efficient delivery of public healthcare.</li> <li>Development of a microbiome database that can be used to support precision medication.</li> <li>Development of stem cell genome editing tools.</li> </ul>	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> <li>Nutrition for a healthy population</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation for precision medicine</li> </ul>	<ul style="list-style-type: none"> <li>HEIs such as the University of Cape Town (UCT), Wits, UP</li> <li>Commercialisation of technology through local companies</li> </ul>
<b>Companion diagnostics and array technology</b>	<ul style="list-style-type: none"> <li>Application of novel Malaria drug screening assays for disease eradication.</li> <li>Develop novel malaria transmission/infection blocking models and identify natural products active against malaria.</li> <li>Provide cutting-edge, cost-efficient, yet high throughput tools for screening drugs against specific genetic profiles.</li> </ul>	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>HEI such as Wits</li> <li>Supporting of SMMEs such as Glen Chem, Silverlabs with technology verification</li> </ul>
<b>Synthetic nanobiotechnology and biomachines</b>	<ul style="list-style-type: none"> <li>To establish industrial Synthetic Biology expression system for biopharmaceutical production.</li> <li>Cancer precision medicine platforms using drug re-purposing.</li> </ul>	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>HEI – International collaborations for funding and technology development and a local HEI such as Stellenbosch University</li> </ul>
<b>One Health Initiative</b>	Development of diagnostics and vaccine technologies for human, animal and environmental health.	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation of technologies for animal health</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Support of SMMEs such as TokaBio</li> </ul>



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<b>Clinical Proteomics Platform</b>	Analysis of biomarker protein signature for early disease detection.	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>HEIs such as UCT, Wits, UP</li> </ul>
<b>Diagnostic Testing Facility</b>	Establishment of an accredited diagnostic testing laboratory to support national facilities, supporting private sector with testing.	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure and service delivery for Covid-19 testing</li> </ul>	<ul style="list-style-type: none"> <li>Support the mining industry with regular onsite testing of Covid-19 e.g. Goldfields</li> </ul>
<b>CSIR Smart Mobility Cluster</b>				
<b>Research Chair &amp; University Collaboration</b>	Establishment of a joint CSIR/NRF Research Chair in Smart Mobility: Cultivate a working relationship with the appointed Research Chair and liaise on the development of the future roadmap of the Chair	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Competitive and efficient freight transport</li> </ul>	<ul style="list-style-type: none"> <li>Local Universities e.g. Cape Town, Durban, Pretoria and Stellenbosch</li> </ul>
<b>Transport Infrastructure Engineering Platform</b>	Establishment of a Technology Innovation Centre, a facility that explores and prioritises applicable 4IR technologies, as well as those bracing the circular economy, and adapts and integrates them into solutions supporting smart mobility, and smart roads in particular.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Competitive and efficient freight transport</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>HEIs such as SU and UP</li> <li>Local Industry, e.g. SABITA, road material producers, contractors and consultants</li> <li>SOEs, e.g. SANRAL, Transnet and Eskom</li> <li>International e.g. DOW, Dynatest, Forum for European Highway Research Laboratories (FEHRL)</li> </ul>



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<b>Transport Systems and Operations</b>	<ul style="list-style-type: none"> <li>Establishment of a new area of research in logistics management including the development of a market-responsive 5-year roadmap with a comprehensive resource plan in support of other CSIR clusters</li> <li>Development of a Transport safety laboratory, a national asset, dedicated to the investigation of transport users, infrastructure and environmental behaviour and elements that contribute to transport unsafety.</li> </ul>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Competitive and efficient freight transport</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Government departments e.g National Department of Transport, Gauteng Department of Transport, Limpopo Roads Agency</li> <li>SOEs e.g. PRASA, Sanral, Transnet</li> <li>Risk management industry</li> </ul>
<b>Smart Mobility Data Portal</b>	Development of a joint passenger-freight data portal, foundational for improved decision support as well as digitalisation of transport networks	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Supports research across the board that supports these objectives</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Private transport operators</li> </ul>
<b>CSIR Defence and Security Cluster</b>				
<b>Integrated safety and security</b>	Establish and maintain integrated capabilities for integrated safety and security	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> </ul>
<b>Aerospace innovations</b>	Conducting RD&I and an enabling environment for research and innovation in civil and military aeronautics.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> <li>International partners</li> </ul>
<b>Optronics surveillance, situational awareness, and intelligence</b>	Develop competitive and innovative optronics systems capability that address potential deficiencies in border management, environmental asset management, infrastructure security, and crime intelligence through visual systems, etc.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> <li>International partners</li> </ul>



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<b>Radar, surveillance, situational awareness, platform protection, electronic support and radar countermeasures</b>	<ul style="list-style-type: none"> <li>Conduct RD&amp;I to develop a competitive and innovative Radar and Electronic Warfare (REW) capability that will be utilised to:               <ul style="list-style-type: none"> <li>Improve the competitiveness of the local REW industry through joint product innovation; and</li> <li>Address potential national deficiencies in border management, environmental asset management, infrastructure security, remote sensing and the SANDF's REW capability.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> <li>International partners</li> </ul>
<b>Special operations capability</b>	RD&I of special operations and technologies in the rapidly evolving fourth industrial revolution operational environment.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and entities</li> </ul>
<b>National Information and Cybersecurity capability</b>	Research and innovate homegrown identity management, cyber and information security solutions, and approaches to securely identify and protect people (cradle to grave) and systems (physical and digital) against vulnerabilities, threats, and risks.	<ul style="list-style-type: none"> <li>The future of society</li> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Gender equality and economic inclusion of women and youth</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> <li>Municipalities</li> </ul>
<b>Integrated capability management for industrial installations and government departments</b>	R&D of innovative solutions to provide integrated capabilities and situational awareness platforms for effective resource utilisation deployment and securing large complex industrial installations and government departments to enable a safe, secure and capable state.	<ul style="list-style-type: none"> <li>The future of society</li> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> </ul>
<b>Landwards Defence and Security</b>	Enhance the competitiveness and effectiveness of landwards defence and security sector through technological innovations on energetic materials, crew survivability, tactical vehicle mobility and dismounted soldier systems.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> <li>International partners</li> </ul>



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<b>CSIR NextGen Enterprises and Institutions Cluster</b>				
<b>Advanced Fire Information System</b>	Natural disaster mitigation by providing wildfire information, including advance warning, monitoring and post-fire assessment and statistics.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> </ul>	-
<b>National Fire Danger Rating System (NFDRS)</b>	Collaboration with South African Weather Service (SAWS) on the development of an improved NFDRS based on previous work done by CSIR.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> </ul>	<ul style="list-style-type: none"> <li>South African Weather Service</li> </ul>
<b>Disaster Response Operations Decision Support System</b>	Joint technology development agreement signed in 2020/21 with industry partner to develop the system.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Collaborating with industry partner</li> </ul>
<b>Open Data Cube (ODC) capacity building</b>	ODC is a strategically important capability for the Geospatial Modelling and Analysis.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> </ul>	-
<b>Ocean and coastal model coupling</b>	Creating a coupling code to couple ocean currents to the input boundary conditions of coastal numerical models in Delft 3D	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Support for the recovery and growth of the tourism sector</li> <li>Macro-economic policy interventions</li> </ul>	-
<b>Ocean modelling and forecasting</b>	Develop a numerical ocean model with forecasting ability that uses machine learning as an integral component. This was a planned three-year project (pushed to four years with a feasibility study)	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Macro-economic policy interventions</li> </ul>	-
<b>Scarce resource planning and optimisation</b>	The objective of this initiative is to: <ul style="list-style-type: none"> <li>Understand available resource tracking and documentation in the country; and</li> <li>Develop numerical models, apply, and integrate existing models and technology to create tools for tracking critical levels of scarce resources (drinking water sources, general waste and sanitation facilities, emergency services facilities, medical supplies and human resources).</li> </ul>	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	-



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<b>Machine learning approach to determining wildfire risk</b>	Deliver a national wildfire risk assessment at a neighbourhood level (level 4 administrative boundaries) that can be updated annually or bi-annually after each fire season.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> <li>Green economy interventions</li> </ul>	-
<b>Ground water management</b>	Developed a modelling tool to determine aquifer storage capacity in response to the 2015 drought in Cape Town, Western Cape, to assist water resource managers to manage their ground water recharge and extraction.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Strengthening agriculture and food security</li> <li>Macro-economic policy interventions</li> </ul>	-
<b>Integrated multiscale modelling</b>	Developing capability in multiscale modelling and integrating the models at different length scales through a framework.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	-
<b>Data-driven modelling and design</b>	Developing capability in using data science and AI methods to solve, optimise and design complex systems.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	-
<b>Data-driven multiscale modelling</b>	Integrating the capabilities of the multiscale and data-driven frameworks to respond to integrated and complex problems.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	-
<b>Building data science capacity across the CSIR</b>	Identify and implement projects that need data science intervention across the CSIR.	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	-
<b>Data analytics in the call centre environment (SENTECH)</b>	Developing data analytics and AI capability using the currently available data in an operations environment and social media. Capacitates team with social media and sentiment analysis.	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> <li>A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with SENTECH (industry/SOE)</li> </ul>
<b>Data Science for Impact and Decision Enhancement</b>	Build data science capacity for the country. Provide data science training and mentorship to university students. To apply the acquired data science tools to solve real-life industry problems, using data from the industry.	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> <li>A re-industrialised modern economy</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Gender equality and economic inclusion of women and youth</li> <li>Industrialisation through localisation</li> </ul>	-





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<b>Election night forecasting</b>	The use of science to predict the outcome of elections long before all voting districts are declared (Model accurate when about 5% of voting districts are declared).	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Gender equality and economic inclusion of women and youth</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with SABC (SOE)</li> </ul>
<b>Motheo analysis tool</b>	Develop capability to read PDF documents using Natural Language Processing and Machine Learning.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Macro-economic policy interventions</li> </ul>	-
<b>4IR for Smart Energy</b>	Create a national capability at CSIR to lucratively serve sub-Saharan Africa in its digital transformation of the electricity system.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> <li>Supply of electricity stabilised</li> </ul>	<ul style="list-style-type: none"> <li>UJ, Wits, City University (Hong Kong)</li> <li>Local manufacturers and service providers</li> <li>AUDA</li> <li>PowerX Energy Exchange (entrepreneur, small micro grid operators, aggregators, and traders)</li> <li>Vendors (e.g. SIEMENS, ABB)</li> </ul>
<b>Product/ service suite for the mining industry</b>	Increment to the next level the development of a suite of products to address safety in underground mining.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Exxaro</li> <li>Industrial license partners (Local manufacturers and service providers)</li> <li>Minerals Council</li> </ul>
<b>Precision agriculture information system using cloud services</b>	Develop a unique Precision Agriculture Information System (PAIS) to provide regular farm-level information.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Strengthening agriculture and food security</li> </ul>	<ul style="list-style-type: none"> <li>Agricultural SMMEs</li> </ul>
<b>Electronic Monitoring Solution</b>	Develop a drop-in replacement to imported electronic monitoring solutions.	<ul style="list-style-type: none"> <li>A re-industrialised modern economy</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Department of Correctional Services (DCS) and other parties in the Integrated Safety Local manufacturers and service providers</li> </ul>
<b>Data Analytics for Post-School System</b>	Provide a data driven solution for decision making, using artificial intelligence and machine learning techniques where interaction with data is through augmented reality.	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Gender equality and economic inclusion of women and youth</li> </ul>	<ul style="list-style-type: none"> <li>DSI, DHET</li> <li>Other governmental departments</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>o</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Spectrum Access Management and Innovation</b>	Capability development in Radio Frequency (RF) spectrum engineering, embedded software development, mobile radio access network engineering, Application of artificial intelligence/machine learning in wireless networks (data analysis), full-stack software engineering, UAV remote piloting for RF applications, broadband network deployments.	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> <li>• Sustainable water supply to meet demand</li> <li>• Gender equality and economic inclusion of women and youth (in partnership with UNDP)</li> </ul>	<ul style="list-style-type: none"> <li>• Department of Communications and Digital Technologies (DCTD) and other SOEs in the ICT sector (Sentech, State Information Technology Agency (SITA), Broadband Infraco)</li> <li>• Telecommunications industry, including SMMEs</li> <li>• BRICS Institute for Future Networks (BIFN)</li> <li>• DSI</li> <li>• HEIs within and beyond South Africa</li> </ul>
<b>Cloud and network architectures and cloud media streaming</b>	<ul style="list-style-type: none"> <li>• Software-defined Networking, Network Functions Virtualisation and Network Slicing.</li> <li>• Cloud, fog and edge computing.</li> <li>• Integration of IoT and 5G.</li> <li>• 5G network core development.</li> <li>• Cloud media streaming.</li> <li>• HTTP encoding.</li> <li>• Cloud media brokerage.</li> </ul>	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> </ul>	<ul style="list-style-type: none"> <li>• Telecommunications industry</li> <li>• DCCT</li> <li>• BIFN</li> <li>• DSI – Decadal Plan</li> <li>• SMMEs</li> <li>• HEIs for capability development</li> <li>• SITA</li> <li>• SENTECH</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>o</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Voice computing</b>	Development of capability in Natural Language Processing (NLP) (local languages), Digital Signal Processing (DSP) (local languages), machine learning applied to voice computing, software development to support voice computing products and services, natural language interface design, development, testing and evaluation, voice computing for resource-scarce languages.	<ul style="list-style-type: none"> <li>• Future proof education and skills</li> <li>• Re-industrialised modern economy</li> <li>• Future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> </ul>	<ul style="list-style-type: none"> <li>• HEIs for capability development and localisation of voice computing technologies</li> <li>• Local industry including SMMEs for support and licensing</li> <li>• DSAC for funding to support local language technology development and implementation projects</li> <li>• GCIS for uptake of language technology services</li> <li>• South African Centre for Digital Language Resources (SADiLaR) South African Research Infrastructure Roadmap (SARIR) for language resource development strategy and funding</li> <li>• Publishers for licensing of localised language technology</li> <li>• Special needs schools as users of local language technology products and services</li> <li>• Western Cape Education Department (WCED) as implementation partner for local language technology products and services</li> </ul>
<b>CSIR Smart Places Cluster</b>				
<b>Industrial Zone Planning</b>	Support regional industrial development in industrial parks and SEZs, through the design and optimisation of integrated energy, water and waste treatment systems.	<ul style="list-style-type: none"> <li>• Climate change and environmental sustainability</li> <li>• A re-industrialised modern economy,</li> <li>• Innovation for energy security</li> <li>• The future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Energy security</li> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• Industry</li> <li>• State entities</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Ocean economy</b>	A modelling and knowledge integration support platform for coastal and ocean development: a one stop expertise and tool platform to enable integrated planning across South Africa's ocean and coastal territory.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> <li>Strengthening agriculture and food security</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> </ul>
<b>Circular economy</b>	Cross cutting expertise to create greater efficiency in material use and circular economic development opportunities across multiple sectors in South Africa.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>Innovation for a healthy society</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> <li>International</li> </ul>
<b>Inclusive smart cities</b>	Becoming the leading authority on the topic of inclusive smart cities within the South African context.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Green economy interventions</li> <li>Macro-economic policy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> <li>International</li> </ul>
<b>Natural resources</b>	Assessment and early warning tools for specific sectors (e.g. agriculture, water, health).	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> <li>Strengthening agriculture and food security</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>State entities</li> <li>International</li> </ul>
<b>Water-food-energy nexus</b>	Nexus-based approaches and tools are being developed to assist in addressing these problems. These tools range from social decision-making platforms "decision theatres" to complex integrated assessment models and quantitative integrated assessments.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> <li>Strengthening agriculture and food security</li> </ul>	

- a Decadal Plan's Societal Grand Challenges – Climate change and environmental sustainability; future-proof education and skills; a re-industrialised modern economy; innovation for a healthy society; innovation for energy security; the future of society.
- b ERRP Priority Interventions – Infrastructure investment and delivery; energy security; gender equality and economic inclusion of women and youth; industrialisation through localisation; support for the recovery and growth of the tourism, cultural and creative industries; green economy interventions; mass public employment interventions; strengthening agriculture and food security; macro-economic policy interventions.
- c Operation Vulindlela Outcomes – Supply of electricity stabilised; reduced cost and increased quality of digital communications; sustainable water supply to meet demand; competitive and efficient freight transport; a visa regime that attracts skills and grows tourism.



## B.2.2 PLANNED COMMERCIALISATION AND TECHNOLOGY TRANSFER PROJECTS IN 2022/23

Table B2: Commercialisation priorities for 2022/23

Project Name	Description
<b>CSIR Chemicals, Agriculture, Food and Health Division</b>	
<b>Breath analyser</b>	Device that uses gate voltage to scan through many gases with each gas having its own unique signature.
<b>Advanced PPE</b>	Water-based antimicrobial hand sanitiser formulations and production processes.
<b>Chicken Probiotic</b>	A multi-strain, multi-mode broiler probiotic product was developed.
<b>Zeolites</b>	Zeolites are of great commercial importance due to their molecular sieving and ion exchange properties that are useful in water treatment and gas separation.
<b>Bioplastic formulations</b>	Biopolymer modification technology that converts conventional plastics into biodegradable and compostable plastics.
<b>Thyme oil</b>	Thyme oil in combination with other edible coating has been shown to reduce stem-end rot incidence in avocados and as a substitute to post-harvest fungicides such as Prochloraz.
<b>PAIS</b>	PAIS will provide actionable data on crop growth parameters in near-real time on mobile phones or computers to support precision agriculture, especially in the emerging farming sector.
<b>Microarray technology</b>	Developed to simultaneously measure the expression/activity of all the genes in an organism.
<b>Bioengineered liver model</b>	Stem cell-derived models of 3D liver 'in-a-dish' used to assess African genetic variants that affect liver metabolism of imported drugs.
<b>Acute kidney injury (AKI) diagnostic kit</b>	A diagnostic kit for early detection of AKI in HIV-infected patients undergoing tenofovir disoproxil fumarate (TDF)-based therapy.
<b>Foot and Mouth Diseases (FMD) POC LAMP assay</b>	Development of PoC Loop mediated isothermal amplification (LAMP) assay for detection of FMD.
<b>CSIR Mining, Manufacturing, Defence and Security Division</b>	
<b>AEROSWIFT</b>	High speed, large build, laser-based additive manufacturing platform (National Laser Centre).
<b>Commercialisation of Laser Engineering Services</b>	The provision of Laser-Based Metal Part Refurbishment Services to Industry (NLC).
<b>Commercialisation of Photonic Prototyping Facility (PPF) Products.</b>	Commercialisation of various photonics-enabled products that are jointly developed with industry and HEIs using the CSIR PPF.
<b>Continuous Positive Airway Pressure (CPAP) ventilator</b>	Affordable CPAP ventilator for treatment of mild respiratory ailments and patients that require oxygen therapy.
<b>Bi-level Positive Airway Pressure (BiPAP) ventilator</b>	Affordable BiPAP ventilator for the treatment of severe respiratory ailments and patients that require oxygen therapy or forced breathing.
<b>IndustIOs Beetle</b>	High functionality, affordable IoT solution for industrial equipment data collection and communication.
<b>Vehicle Condition Monitoring System</b>	Medium to heavy vehicle state of health monitoring and added value services such as passenger counting, route optimisation and enhanced customer experience for public transport vehicles.
<b>License of GASCAM to UVIRCO</b>	Detection of SF6 Gas.
<b>HIP</b>	Manufacturing process to remove inherent defects in components.
<b>RINO: Near Infrared Day-night long range camera</b>	RINO: Long-range camera technology development.



Project Name	Description
<b>TYTO: Multispectral medium range day-night camera</b>	TYTO: Medium-range camera technology development.
<b>Integrated Safety and Security Initiatives (ISSI)</b>	Establish integrated capabilities for safety and security, as well as actionable intelligence initiatives.
<b>Biometric VeristicPrint Software Development Kit (SDK)</b>	SDK for biometric devices at different levels.
<b>Lost Warehouse Packet Service Platform</b>	Solution for collection and analysis of South African cybersecurity incident data.
<b>Cyber Protect</b>	Home-grown solution for threat intelligence to improve the threat landscape.
<b>Optical coherence tomography (OCT) for Crime Scenes</b>	Solution to extract latent fingerprints from different surfaces.
<b>DCS Biometric Device</b>	Hardware and software device for identification of inmates.
<b>Cybersecurity Early Warning System</b>	Low-cost intrusion detection system.
<b>Advanced Design, Manufacturing Innovation Centre</b>	Continued development and improvement of the Advanced Design, Manufacturing production of novel technologies.
<b>Tower Escape Safety System (TESS)</b>	Commercialisation of the TESS.
<b>Hydrogen Fuel Cell Propulsion unit</b>	Commercialisation of the H2 Fuel Cell Propulsion unit for UAVs.
<b>Bundiza System</b>	Commercialisation of the Bundiza UAV System.
<b>Beyond Visual Range Modelling and Simulation System</b>	Commercialisation of the BVR Modelling and Simulation System (Framework)
<b>CSIR Smart Places, Smart Mobility, NextGen Enterprises and Institutions Division</b>	
<b>Circular Roads: Incorporating waste plastics into road pavements</b>	Non-recycled plastic waste added into either bitumen or aggregate to modify or extend the properties of asphalt surfacing to enhance the performance of roads
<b>Restoring Crumb-Rubber Modified Bitumen</b>	A method of re-stiffening an over-digested rubber modified bituminous binder, to a rubber modified bituminous binder, and a method of sealing or asphalt paving a surface.
<b>Improved Bituminous Binders</b>	Bitumen extender, based on micro-filler technology, that augments the performance attributes of bituminous binders used in asphalt layers.
<b>Optimisation of Bio-Stabilisation Technologies for Low-Volume Roads</b>	Biotabilisation technology optimisation and development to optimise performance attributes of local material, and to drive natural resource conservation and sustainable industrial competitiveness by reducing energy costs and emissions.
<b>Road Design Decision Support Tools</b>	A series of software products supporting road engineers to design low-volume roads, to back-calculate layer moduli for rehabilitation design, and to design roads based on mechanistic principles.
<b>Systems dynamics model for improved transport planning in South African cities</b>	Systems dynamics modelling platform for improved integrated transport planning in South African cities in collaboration with National Treasury's Cities Support Programme



Project Name	Description
<b>Lifecycle Sustainability Assessment Modelling Tool</b>	An integrated assessment tool for the economic, social and environmental impacts of manufactured products across their full lifecycle.
<b>Solar PV modules</b>	Support local industry manufacturing/assembly of PV modules via accelerated reliability testing and product manufacturing support.
<b>Lithium batteries</b>	Develop local lithium battery manufacturing industry leveraging CSIR develop precursor materials.
<b>CO<sub>2</sub> Direct Air Capture Technology</b>	Passive CO <sub>2</sub> direct air capture technology that aims to capture CO <sub>2</sub> directly from the atmosphere, in a passive manner, store it and make it available for commercial purposes.
<b>4IR for Smart Energy: Edge emulation, control and inspection v0.1</b>	Development of distributed networks and processing components needed for smart transactive microgrids – Microgrid controllers could be made available for licensing in future. The emulation capability will be an internal facility and capability upon which conformance testing of grid stability and transactive microgrid design services would be turned into commercial offerings in future. The automated inspection platform component will become a service offering to microgrid entrepreneurs.
<b>4IR for Smart Energy: Secure, decentralised energy marketplace software V0.1</b>	Development of IoT Trust and Transactions components needed for smart transactive microgrids. (Commercial energy trading algorithms could be made available in future after development of the base capability.)
<b>4IR for Smart Energy: Federated IoT Platform with Cloud, Edge and Servitisation v0.1</b>	Development of IoT Platform components needed for smart transactive microgrids. (The platform will be open sourced but specific components built on top-of it may be commercialised as microgrid-as-a-service commercial offerings in future.)
<b>Mining product suite: GoafWarn</b>	Device for the detection and early warning of goafs in the underground coal mining process.
<b>Mining product suite: Microseismic Direction Finding Product</b>	Microseismic Direction Finding Product is a device to determine the approximate location of microseismic events that are usually precursors to large rock mass failures to enable better situational awareness and response in the event of such failures.
<b>Mining product suite: Integrated Thermal Acoustic Device (ITAD)</b>	ITAD is a pre-re-entry handheld mine safety tool for re-entry examination to check for loose rock in the underground mine stope's hanging wall (roof) after blasting.
<b>Mining product suite: Multigas sensor product</b>	Multigas sensor product is a wireless, battery-powered fixed multi-gas IoT sensor/airflow sensor combo, deployed in-situ, with sampling rates and variety of gases detected able to be changed dynamically.
<b>Electronic Monitoring (EM) Solution: Bracelet</b>	Tamper proof ankle bracelet with vibration alert, wireless 2G/4G communications, OTA firmware upgrade, diagnostics, GPS, wireless charging that interacts with the EM backend for attachment to tagged persons of interest to provide an alternative to incarceration of offenders in the correctional services of a country.
<b>EM Solution: Backend</b>	EM backend with bracelet management, geofencing and alert services that communicates with the EM bracelet and existing and evolved offender management systems to provide an alternative to incarceration of offenders in the correctional services of a country.
<b>EM Solution: Mobile App</b>	An application for a mobile smartphone that sends EM violation alerts directly to monitoring officials as a means to alleviate stress on a national call centre for Electronic Monitoring and improve situational awareness of their caseload.
<b>Augmented reality (AR)-based decision support tool for the Integrated Resource Plan (IRP)</b>	AR for IRP is a decision support system that visualises historic and forecast data to aid in decision making regarding energy generation and IRP investments.
<b>Solar PV Electro-luminescence Image Defect Detection and Classification</b>	Provides a data-driven decision-making tool to manufacturers (so they can change the production process) and buyers (so they know the type and number of defects).



B.3

SO2: IMPROVE THE COMPETITIVENESS OF HIGH-IMPACT INDUSTRIES TO SUPPORT SOUTH AFRICA'S RE-INDUSTRIALISATION BY COLLABORATIVELY DEVELOPING, LOCALISING, AND IMPLEMENTING TECHNOLOGY.

**B.3.1 CLUSTER RD&I PROGRAMMES AND INITIATIVES**

**Table B3 – Initiatives in support of Strategic Objective 2**

Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR Advanced Agriculture and Food Cluster</b>				
<b>Agro-processing platform</b>	<ul style="list-style-type: none"> <li>Developing post-harvest management technologies for the vegetable and fruit industries in South Africa.</li> <li>Developing automated systems for oil extraction, small processing mills in collaboration with the Manufacturing cluster.</li> <li>Developing technologies and processes to improve post-harvest management of fruits and vegetables.</li> <li>Developing high-protein products in collaboration with industry.</li> <li>Support to SMMEs to produce high quality products together with the B IDC. Developing products and processes from cannabis</li> </ul>	<ul style="list-style-type: none"> <li>Circular green economy interventions</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialisation for economic development</li> <li>Infrastructure investment and service delivery</li> </ul>	<ul style="list-style-type: none"> <li>SMMEs – Ruri Ruri, Sibocally, Busi &amp; Bafo</li> </ul>
<b>Enterprise Creation for Development</b>	<ul style="list-style-type: none"> <li>Provide technical and business skills to SMMEs, including women and youth, in various industries to establish and grow their business.</li> <li>Work with provincial governments to support the establishment of agri-parks, incubators and industrials hubs with the support from the cluster.</li> <li>The refinement of the feasibility study tool to be able to develop commercialisation plans for CSIR technologies and research outcomes.</li> <li>Development of an enterprise development training package.</li> </ul>	-	<ul style="list-style-type: none"> <li>Service delivery</li> <li>Job creation</li> <li>Re-industrialisation for economic development</li> </ul>	<ul style="list-style-type: none"> <li>North West Province</li> <li>Buffalo City Municipality</li> <li>KwaZulu-Natal Province</li> <li>Gauteng Province</li> <li>Limpopo Province</li> </ul>
<b>Food safety</b>	Support for export markets. Food testing and traceability technologies, including logistics, will form part of the key offering.	<ul style="list-style-type: none"> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and service delivery</li> </ul>	<ul style="list-style-type: none"> <li>Industry: NMISA</li> </ul>





Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Precision agriculture</b>	Support several industries, including financing agencies such as Old Mutual, Grobank etc., farmers, government and private companies (for product offtake).	<ul style="list-style-type: none"> <li>High tech industry domain</li> <li>ICT and smart systems</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and service delivery</li> </ul>	<ul style="list-style-type: none"> <li>Industry: Old Mutual, Grobank, Farmsol</li> <li>HEI: Wits</li> </ul>
<b>CSIR Future Production: Chemicals Cluster</b>				
<b>(Bio)-Chemical conversion</b>	Local production of lactic acid and succinic acid via an enzyme-microbial process and their subsequent chemo-catalytic conversion to associated functional performance chemicals and biobased polymers relevant to the South African consumer markets.	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Local industry through SMME support</li> <li>State entities for funding for infrastructure and SMME support</li> </ul>
<b>Biocatalysis</b>	Collaboration with local and international companies as well as SMMEs.	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Local industries for support and subsequent licencing</li> <li>International companies for collaboration and funding</li> <li>State entities for funding</li> </ul>
<b>Pharmaceutical technology innovation platform</b>	<ul style="list-style-type: none"> <li>Development for small molecule and biologic APIs</li> <li>Process co-development for API production</li> <li>Application of robotics, process automation and the application of artificial intelligence for process optimisation through collaborations with Imperial College London and Cambridge University (UK) and other international partners.</li> <li>Localisation of a mature commercialisation-ready manufacturing technology for the production of Insulin from the International Centre for Genetic Engineering and Biotechnology (ICGEB) and investigate further areas for co-development.</li> <li>Development of a Gaucher's Biotherapeutic and CD 146 radioimmunotherapy (RIT) in collaboration with Tautomer will continue.</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>State entities, particularly funding through NT</li> <li>HEI collaboration, particularly UP and Wits, through students</li> <li>International organisations for localisation of technology</li> <li>Over time, support SMME in the health arena</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CeNAM</b>	<ul style="list-style-type: none"> <li>Commercialisation of existing technologies;</li> <li>Assisting companies to improve processes and materials, or develop new materials; and</li> <li>Assisting with scale-up and optimisation of chemical processes, advanced materials production and polymer composites and nanocomposites manufacturing, for market testing, and product or process optimisation at industrial scale.</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Broad collaborations across the board: state entities, international partners, local industries, SMMEs</li> </ul>
<b>Advanced Functional Materials</b>	<ul style="list-style-type: none"> <li>Supporting both the chemical industry and the bioeconomy by converting local natural resources.</li> <li>Partner with the NIDF in piloting and realising the commercial potential of the functional materials.</li> <li>Scaling up, demonstrating reproducibility, and industrial feasibility of the chemical conversion processes and related products to develop market-ready prototypes.</li> <li>Collaborating with 3 Sixty Biomedicine Tautomer for the establishment of a pilot spray dryer plant.</li> </ul>	<ul style="list-style-type: none"> <li>Reindustrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local industry such as 3 Sixty Biomedicine Tautomer, Sappi, Lighthouse</li> <li>HEIs and international collaborations often for trials and testing</li> </ul>



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<b>Advanced polymer composites</b>	<ul style="list-style-type: none"> <li>• Joint development agreements with Tech4Life to develop and demonstrate application lines for their sterilised medical plastic waste.</li> <li>• Develop a formulations and process protocols for crosslinked high-density polyethylene (HDPE) with enhanced thermomechanical properties, for applications as conveyor rollers in the mines in temperature heat zones.</li> <li>• Increase the content of locally sourced materials in the bioplastics formulations, by developing formulations with locally sourced and beneficiated natural polymers.</li> <li>• Deepen relationship with Sappi Netherlands for joint development of cellulose modification technologies and Sappi Southern Africa for biodegradation testing of their products.</li> <li>• Engage SMMEs in the medical field via research collaboration agreements or joint development agreement to develop bio-based material technologies for medical applications.</li> </ul>	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• State entities such as TIA</li> <li>• Local industry, including SMME support, such as Sappi Southern Africa, Tech4Life etc</li> <li>• International industry such as Sappi Netherlands</li> </ul>
<b>Nanomaterials for Sensor Development</b>	Transfer of the Diabetes Breath Analyser to the market.	<ul style="list-style-type: none"> <li>• Re-industrialised modern economy</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• Joint venture planned with local health company for commercialisation of breath analyser</li> </ul>
<b>HySA and Carbon Capture and Utilisation</b>	<ul style="list-style-type: none"> <li>• Green methanol demonstration at multi-litre scale using captured CO<sub>2</sub> and green hydrogen derived from the use of a renewable energy source such as solar photovoltaics. Strategic industry partnerships and collaboration will also be a key feature in the project.</li> <li>• The development of pressure swing adsorption technology will be demonstrated focusing on biogas upgrading application.</li> </ul>	<ul style="list-style-type: none"> <li>• Innovation for energy security</li> <li>• Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Energy security</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• International funding organisations</li> <li>• State entities such as Sanedi</li> <li>• Local industry e.g. Wonderstone</li> </ul>



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<b>Nano Micro Manufacturing Facility (NMMF)</b>	The DSI has approved the establishment of the NMMF, comprising a management hub and five (5) nodes. The management hub and the LoC node will be hosted by the CSIR.	<ul style="list-style-type: none"> <li>Reindustrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>State entities (DSI) for funding through SARIR programme</li> <li>Collaborations with local industry for product development</li> </ul>
<b>Nanomaterials Industrial Development Facility (NIDF)</b>	<ul style="list-style-type: none"> <li>NIDF makes use of nanotechnology as a key enabler, where applicable, to support SMMEs, industry and internal researchers to move from bench scale to pilot production.</li> <li>NIDF also assists with toll manufacturing, as well as localisation of technologies and produces nanomaterials in bulk for market and quality testing.</li> <li>NIDF has a good working relationship with government agencies (Industrial Development Corporation of South Africa (IDCSA), Technology Innovation Agency (TIA)), industry representative bodies (Chemical and Allied Industries (CAIA), Plastic SA and the SA chemical industry.</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Government funding for supporting SMMEs</li> <li>Collaborations with local industry, including SMMEs, in scaling-up and product development</li> </ul>
<b>Industrial materials testing</b>	The characterisation facility offers support to mainly the textile industry and automotive sector, for example, testing support to Toyota for the localisation of fuel tanks.	<ul style="list-style-type: none"> <li>Supports research across the board that supports the grand challenges</li> </ul>	<ul style="list-style-type: none"> <li>Supports research across the board that supports these objectives</li> </ul>	<ul style="list-style-type: none"> <li>Works with local industry in providing characterisation expertise</li> </ul>
<b>Carbon-based advanced nanostructured materials</b>	Position the CSIR as the graphene lead in South Africa by concurrently developing a local graphene synthesis process, while developing local applications for the new wonder material.	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local industry such as flowtite for development of graphene additive materials</li> </ul>
<b>HySA and Carbon Capture</b>	Green methanol demonstration at multi-litre scale using captured CO <sub>2</sub> and green hydrogen derived from use of renewable energy source. Catalysts development for methanol production is being conducted with the aim of obtaining high performance properties. In future, the power-to-methanol focus will be expanded to cover methanol-to-olefins, as well as conversion of olefins to distillate technologies. Strategic industry partnerships and collaboration will also be a key feature in the project.	<ul style="list-style-type: none"> <li>Innovation for energy security</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Local industry collaboration, e.g. Wonderstone</li> </ul>



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<b>CSIR Future Production: Manufacturing Cluster</b>				
<b>Aeroswift</b>	An Aeroswift commercialisation roadmap has been agreed to, in principle, with the DSI, which will include initial industrialisation of a medium-size inert material (stainless steel) version that will be commercialised for the mining and rail requirements followed by a medium-sized reactive material version (aluminium and titanium) for the automotive and aerospace sector requirements over the next two years.	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>DSI</li> <li>Paramount</li> <li>Anglo American</li> <li>Other local manufacturing sector industry</li> </ul>
<b>Metal additive manufacturing</b>	Facilitate the localisation of designated high value components for metal additive manufacturing, as well as Metal Injection Molding (MIM) and advanced casting. Elements of the DSI Collaborative Program in Additive Manufacturing (CPAM), Light Metals Development Network (LMDN) and Titanium Center of Competence (TiCoC) programmes will be redefined to design, develop and qualify/certify components within the automotive, mining, rail and aerospace sectors based on market demand and business case justification.	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>DSI</li> <li>the dtic</li> <li>Paramount</li> <li>Anglo American</li> <li>Other local manufacturing sector industry, specifically mining, automotive and aerospace</li> </ul>
<b>The Light Metals Development Network (LMDN)</b>	<ul style="list-style-type: none"> <li>Developing local capability in aluminium metallurgy, manufacturing, and product development.</li> <li>Assist local industry in process improvement, product development and localisation of products (mainly in automotive industry).</li> </ul>	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>DSI</li> <li>the dtic</li> <li>Local manufacturing sector industry, specifically mining, automotive and aerospace</li> </ul>
<b>Titanium Centre of Competence (TiCoC)</b>	<ul style="list-style-type: none"> <li>Industrialisation and commercialisation of key strategic products and processes such as metal injection moulding, casting technologies and hot isostatic press (HIP)</li> <li>Technology localisation, business case development and the establishment of industry/SMMEs incubation platform/s</li> </ul>	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>DSI</li> <li>the dtic</li> <li>Local manufacturing sector industry, specifically mining, automotive and aerospace</li> </ul>



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<b>The Collaborative Program in Additive Manufacturing (CPAM)</b>	SMMEs support to develop and test new prototypes manufactured through additive manufacturing.	<ul style="list-style-type: none"> <li>• Future proof education and skills</li> <li>• A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• DSI</li> <li>• HEIs</li> <li>• Local manufacturing sector industry, specifically mining, automotive and aerospace</li> </ul>
<b>Photonics Prototyping Facility (PPF)</b>	This national facility aims to address the current innovation chasm experienced in the South African photonics industry by providing the necessary skills and facilities to support the industrialisation and commercialisation of photonics-based technologies.	<ul style="list-style-type: none"> <li>• A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• Local manufacturing sector industry, specifically mining, automotive and aerospace</li> <li>• HEIs</li> </ul>
<b>Cardiflo and both ventilator products (CPAP and BiPAP)</b>	Target the required clinical trials, submission for CE marking and obtaining of SAHPRA registration.	<ul style="list-style-type: none"> <li>• A reindustrialised modern economy</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• TIA</li> <li>• DBSA</li> <li>• UCT</li> <li>• Local health products industry</li> </ul>
<b>Product Development</b>	GasCam, IndustrIOs Beetle, portable handheld ultraviolet-C (UVC) sanitisation device, copper bearings for the automotive sector and the ICU hospital bed are expected to complete product development and industrialisation in 2021/2022 and move to commercialisation and licensing in 2022/2023.	<ul style="list-style-type: none"> <li>• A reindustrialised modern economy</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>• TIA</li> <li>• Local industry</li> </ul>
<b>Learning Factory</b>	Continue to support the rest of the CSIR with the establishment of Learning Factories for their target markets – Phase 1 of the Learning Factory for Anglo American in the Northern Cape will be initiated.	<ul style="list-style-type: none"> <li>• Future proof education and skills</li> <li>• A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>• Anglo American</li> <li>• Local industry in the Northern Cape</li> </ul>
<b>Smart Factory</b>	A collaboration with Danner – a European electric platform OEM, interested in localising production in South Africa as a base to access the SADC and African market.	<ul style="list-style-type: none"> <li>• A reindustrialised modern economy</li> <li>• Innovation for energy security</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Energy security</li> </ul>	<ul style="list-style-type: none"> <li>• Danner</li> <li>• Local industry partners</li> </ul>
<b>CSIR NextGen Health Cluster</b>				
<b>Precision medicine</b>	Develop innovative technology commercialisation models with the intention of securing commercialisation or industry partners.	<ul style="list-style-type: none"> <li>• Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation for precision medicine</li> <li>• Infrastructure investment and deliver</li> </ul>	<ul style="list-style-type: none"> <li>• Industry: OneBio, Discovery,</li> <li>• Government entities: Local healthcare providers such as hospitals</li> <li>• International: Gates Foundation</li> </ul>



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<b>Medical devices and diagnostics</b>	<ul style="list-style-type: none"> <li>Maximisation of the value derived from the CSIR's patented revolutionary approach to manufacturing (printing) microarrays (biochips) is a priority.</li> <li>Demonstrating the applicability of the omics tools in HIV companion diagnostic tools and finalising the commercialisation model with the identified industry partners.</li> <li>In collaboration with the manufacturing cluster, connectivity of the field-deployed devices and the corresponding tracking of the device usage.</li> </ul>	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation of technologies for animal health</li> <li>Infrastructure and service delivery for health testing</li> </ul>	<ul style="list-style-type: none"> <li>Industry: TokaBio, IvacBio, 3 Sixty/Tautomer</li> <li>HEIs: North-West University (NWU), UP, Wits</li> </ul>
<b>CSIR Defence and Security Cluster</b>				
<b>Hydrogen fuel-powered UAV</b>	Develop and test a minimum viable product for a small UAV.	<ul style="list-style-type: none"> <li>The future of society</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>SOEs and government departments</li> </ul>
<b>Bundiza, small hand-launched UAV system</b>	Partner with industry to industrialise and commercialise the technology	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>SOEs and government departments</li> </ul>
<b>Hydrogen fuel cell propulsion unit for UAVs</b>	Develop a fuel cell unit, complete ground and flight tests on test platform	<ul style="list-style-type: none"> <li>The future of society</li> <li>Climate change and environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>SOEs and government departments</li> </ul>
<b>Information and cybersecurity collaboration for localisation</b>	Partner with multi-stakeholders to design, develop, and localise transformative technologies in the ICS domain- enhanced Cyber Protect and Piloted Threat Intelligence Platform.	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Mass public employment interventions</li> <li>Gender equality and economic inclusion of women and youth</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>SOEs and government departments</li> </ul>
<b>HSHL Novel Wind tunnel balance for load measurement</b>	Technology has been prototyped and tested in an operational wind-tunnel environment.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>International industry partner</li> </ul>
<b>Boots technology</b>	Signed collaboration agreement with industry to resolve the challenges experienced by the user on the combat.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>DoD</li> </ul>



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<b>RINO</b>	RD&I in medium to long-range optical surveillance systems– TRL 9 – and insertion of artificial intelligence techniques.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> <li>SOEs and government departments</li> </ul>
<b>New medium range surveillance radar sensor system</b>	Joint development of a new medium range surveillance radar sensor system product in collaboration with Hensoldt South Africa.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Hensoldt South Africa</li> </ul>
<b>Joint development of an Electronic Warfare Mission Support System</b>	Joint development team is addressing several State Entities, as well as subsystem development aspects.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> </ul>
<b>Development of a situational awareness platform for special operations</b>	Prototype (development Model), Collaboration Agreement with SMMEs for co-development.	<ul style="list-style-type: none"> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Local industry (SMMEs)</li> </ul>
<b>Advanced Design, Manufacturing, and Innovation</b>	Design and production of novel and upgraded technologies in collaboration with local SMMEs and international partners.	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local and international industry</li> </ul>
<b>CSIR Smart Places Cluster</b>				
<b>Professional Real Estate Management Information System technology to support strategic immovable asset management and maintenance</b>	<p>Integration and implementation for service delivery impact to government and private sector partners.</p> <p>Develop customised solutions for service delivery impact and other niche applications.</p>	<ul style="list-style-type: none"> <li>A re-industrialised modern economy,</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>State entities</li> </ul>
<b>Strategic and operational planning support to maritime industries</b>	Observational and measurement capability, long term environmental databases, process understanding and modelling capability in coastal and shelf sea environments	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> <li>Strengthening agriculture and food security</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> </ul>
<b>Data science capability in the climate science domain with a focus on modelling</b>	Value addition through data science (machine learning) products and models for regional and global projections as assessment of the consequences of those projections to the social and economic systems in the country and Africa.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> <li>International</li> </ul>





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<b>Maximise water efficiency and ecosystem services (such as improved water quality)</b>	Delivering practice such as green water (water from rain retained in soil) to support rain-fed agriculture, and blue water (collection of run-offs) to increase water storage in soils, wetlands and groundwater.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>HEIs</li> <li>State entities</li> <li>International</li> </ul>
<b>Supporting the emerging local renewable energy industry</b>	<ul style="list-style-type: none"> <li>Solar energy, wind energy, energy resource assessment.</li> <li>Energy supply forecasting</li> <li>Thermal energy, and energy demand.</li> <li>The CSIR's solar energy work includes a structured quality and reliability PV research programme.</li> </ul>	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy</li> <li>Innovation for energy security</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Industry</li> <li>State entities</li> <li>International</li> </ul>
<b>CSIR Smart Mobility Cluster</b>				
<b>Transport Infrastructure Engineering Platform</b>	<ul style="list-style-type: none"> <li>Smart Roads and Intelligent ports: design and harness innovation through strategic projects focusing on energy harvesting, healing of materials through induction heating, smart and high-performance materials, sensor development, digital twinning, machine learning, big data analysis, and climate change adaptation</li> <li>Circular economy: Bio-stabiliser products, Plastic Roads, micro-filler bitumen-enhancement, bitumen-rubber rejuvenation technologies, and long-life roads</li> <li>Establishment of research capacity in southern Africa</li> </ul>	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>Innovation for energy security</li> <li>Future-proof education and skills</li> </ul>	<ul style="list-style-type: none"> <li>Competitive and efficient freight transport</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>HEIs such as SU and UP</li> <li>Local Industry, e.g. SABITA, road material producers, contractors and consultants</li> <li>SOEs, e.g. SANRAL, Transnet National Ports Authority</li> <li>International, e.g. DOW, Delft University of Technology (Netherlands), Forum of European National Highway Research Laboratories (FENHRL), Federal Aviation Authority (FAA), Dynatest, Tanzania National Roads Authority, Uganda National Roads Authority, international R&amp;D organisations and consulting engineers</li> </ul>
<b>Transport Systems and Operations</b>	<ul style="list-style-type: none"> <li>Development of a combined passenger and freight transport modelling platform to dynamically model network performance</li> <li>Finalise the development of the DigiSol Mobile Application as an import replacement technology</li> <li>Develop a Roadworthy Assessment Tool</li> <li>Support sustainable freight transport (Integrated logistics): Piloting of technology-supported supply chain applications</li> <li>Development of Truck safety prediction tools</li> <li>Research on green tyres</li> </ul>	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>A re-industrialised modern economy,</li> <li>The future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Competitive and efficient freight transport</li> </ul>	<ul style="list-style-type: none"> <li>Industry e.g. Discovery Insure, Michelen, Centre for Sustainable Road Freight, Gerotek, SMME farmers: Moringa Development Association of South Africa (MDASA) &amp; Lefakong Farming</li> <li>State Entities e.g. Gauteng Dept of Roads and Transport</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's Societal Grand Challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR NextGen Enterprises and Institutions Cluster</b>				
<b>Industry 4.0</b>	<ul style="list-style-type: none"> <li>• Development of Industry 4.0 IoT digital technology building blocks, cyber-physical industrial lab, real-time information management system, for applications in various industries, such as mining, utilities, etc.</li> <li>• Development of Advanced Spectrum Management technologies and spectrum toolboxes, and next-generation multi-radio access technologies and network solutions. artificial intelligence and machine learning techniques for optimisation of future wireless ICT network infrastructure and effective national spectrum resource utilisation.</li> <li>• Contribute to the development of policies and regulations that promote the adoption, beneficiation and diffusion of transformative technologies to encourage business undertaking in South Africa (i.e., the ease of doing business).</li> <li>• Develop voice computing technologies for the local market and expose these to industry to enable integration in third party applications and services</li> <li>• Develop training programmes and training management software for Industry 4.0 digital technologies, targeted at graduates and artisans.</li> </ul>	<ul style="list-style-type: none"> <li>• Future-proof education and skills</li> <li>• Re-industrialised modern economy</li> <li>• Future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> <li>• Sustainable water supply to meet demand</li> <li>• Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>• Telecommunications industry in partnership with SMMEs</li> <li>• Publishers</li> <li>• Independent Communication Authority of South Africa (ICASA)</li> <li>• UNDP</li> <li>• SENTECH</li> <li>• SITA</li> <li>• BIFN</li> <li>• DCDT</li> <li>• DSI</li> <li>• SMMEs as users of language technology products and services</li> <li>• Industry partners as users of language technology products and services</li> <li>• Provincial government, e.g. Gauteng Province</li> </ul>

- a Decadal Plan's Societal Grand Challenges – Climate change and environmental sustainability; future-proof education and skills; a re-industrialised modern economy; innovation for a healthy society; innovation for energy security; the future of society.
- b ERRP Priority Interventions – Infrastructure investment and delivery; energy security; gender equality and economic inclusion of women and youth; industrialisation through localisation; support for the recovery and growth of the tourism, cultural and creative industries; green economy interventions; mass public employment interventions; strengthening agriculture and food security; macro-economic policy interventions.
- c Operation Vulindlela Outcomes – Supply of electricity stabilised; reduced cost and increased quality of digital communications; sustainable water supply to meet demand; competitive and efficient freight transport; a visa regime that attracts skills and grows tourism.



B.4

SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RD&I THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE.

B.4.1 CLUSTER RD&I PROGRAMMES AND INITIATIVES

Table B4: Initiatives in support of Strategic Objective 3

Key RD&I Programme/ Platform/Project	Description	Decadal Plan's societal grand challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>CSIR Advanced Agriculture and Food Cluster</b>				
<b>Agro-processing</b>	<ul style="list-style-type: none"> <li>Supporting National Biodiversity Economy Strategy that is driven by the Department of Environmental Forestry and Fisheries (DEFF)</li> <li>Supporting the DSI and the Cannabis Masterplan Initiative on policy framework development for cannabis market, analytical support, and development of standards to assist product development in the market.</li> <li>Currently, the cluster is being contracted as the implementation agency to support Department of Environment, Forestry &amp; Fisheries (DEFF), DSI and DALRRD on SMME development in the food, cosmetic and nutraceutical sector. By supporting this value chain, the cluster will contribute to job creation as new ventures.</li> <li>The IKS platform, which will enable communities to obtain economic benefits from their indigenous knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>Circular economy</li> <li>Nutrition for health population</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialisation for economic development</li> <li>Infrastructure investment and service delivery</li> </ul>	<ul style="list-style-type: none"> <li>DSI Cannabis Master Plan</li> <li>DSI Circular Economy</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's societal grand challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Food Safety</b>	<ul style="list-style-type: none"> <li>A specialised animal biometrics identification cluster and verification system that exploits the muzzle patterns, iris patterns and retinal vascular patterns will be developed in collaboration with NextGen Enterprises and institutions.</li> <li>Development of an ISO 17025 accredited mobile laboratory prototype for food safety testing and access by SMMES in the Gauteng Maize Triangle, for the Gauteng Department of Agriculture and Rural Development.</li> <li>Collaborating with NextGen Enterprises and Institutions in the development of a customised laboratory management system for the Food Safety Laboratory in the Department of Agriculture. The pilot project involves the Pretoria and Stellenbosch laboratories.</li> </ul>	<ul style="list-style-type: none"> <li>Nutrition for health population</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and food safety service delivery</li> </ul>	<ul style="list-style-type: none"> <li>NMISA</li> </ul>
<b>Precision Agriculture</b>	<ul style="list-style-type: none"> <li>Development of the Precision Agriculture Information Systems forms an integral part of the government intention to digitise the economy.</li> <li>Continue to provide other Earth observation services to support government's environmental monitoring programmes, e.g. greenhouse gas emissions from the agriculture, forestry and other land uses sector.</li> </ul>	<ul style="list-style-type: none"> <li>High tech industry domain</li> <li>ICT and smart systems</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and service delivery</li> </ul>	<ul style="list-style-type: none"> <li>Farmsol, GroBank</li> </ul>
<b>Enterprise Creation for Development</b>	<ul style="list-style-type: none"> <li>Rapid Review and Sector Study sub-offering.</li> <li>Economic strategies and policies.</li> </ul>	<ul style="list-style-type: none"> <li>a re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Service delivery</li> <li>Job creation</li> <li>Re-industrialisation for economic development</li> </ul>	<ul style="list-style-type: none"> <li>North West</li> <li>KwaZulu-Natal</li> <li>Limpopo</li> <li>Gauteng</li> </ul>
<b>CSIR Defence and Security Cluster</b>				
<b>Project ISSI – Integrated Safety and Security Initiatives</b>	Establish and maintain integrated capabilities for integrated safety and security, and integrated actionable intelligence	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Government departments and SOEs</li> <li>Local Industry</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's societal grand challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>DALRRD UAV</b>	UAV demonstrating integrated (ASIA, OSS, etc.) DSC ability to support DALRRD.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Strengthening agriculture and food security</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>DALRRD</li> <li>Local industry</li> </ul>
<b>Hydrogen (H2) Long Endurance Modular Unmanned (LEMU) Aerial Vehicle propulsion research</b>	Develop local H2 fuel cell propulsion unit for UAVs and in parallel develop a UAV using it for the DSI in support of the HySA initiative.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>Re-industrialised modern economy</li> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Green economy interventions</li> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>DSI</li> <li>Local and international industry</li> </ul>
<b>Store integration</b>	Develop and sustain the ability for the SAAF and local industry to integrate store on aircraft.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>SANDF</li> </ul>
<b>Aeroelasticity/ flutter</b>	Develop and sustain ability to certify new and modified civil and military aircraft as being free from flutter.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>SANDF</li> <li>International and local industry</li> </ul>
<b>Department of Correctional Services enterprise modernisation</b>	Develop an EA map for the modernisation of the Department of Correctional Services using the Master Information Systems and Security Technology Plan.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Department of Correctional Services</li> <li>Local industry</li> </ul>
<b>Support to SA Army headquarters and Department of Correctional Services on intelligence-based CCTV for security</b>	Develop and deploy video intelligence-based security capabilities for protection of correctional facilities and bas.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>SANDF</li> <li>Local industry</li> </ul>
<b>Landward Science</b>	RD&I support for the Development of Operational Prototypes for the SANDF and Industry.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>SANDF</li> <li>Local industry</li> </ul>
<b>Operational support (Verbena)</b>	Provision of RD&I support for Development of Special Operations Standard Operating Procedures, Doctrine and Strategic Plans.	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>SANDF</li> <li>Industry</li> </ul>
<b>Cybersecurity capability development</b>	Supporting the establishment and operationalisation of the cybersecurity capability at various departments and municipalities	<ul style="list-style-type: none"> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>Various government departments and entities (i.e., CoJ, SARB, DCDT, DoD)</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's societal grand challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>National Policy Data Observatory (NPDO) Hosting and Support</b>	Supporting the DSI with the establishment and operationalisation of the NPDO.	<ul style="list-style-type: none"> <li>Climate change and environmental sustainability</li> <li>Innovation for a healthy society</li> <li>Re-industrialised modern economy</li> <li>Future of society</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Green economy interventions</li> <li>Mass public employment interventions</li> <li>Strengthening agriculture and food security</li> </ul>	<ul style="list-style-type: none"> <li>DSI and other government departments entities</li> </ul>
<b>CSIR Future Production: Manufacturing Cluster</b>				
<b>Learning Factory</b>	The contract with the Eastcape Midlands College will continue with detailed design, implementation and operationalisation. Two additional Learning Factory developments will be initiated and contracted. One at False Bay TVET and another at a TVET in Gauteng.	<ul style="list-style-type: none"> <li>Future-proof education and skills</li> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>MerSETA</li> <li>Eastcape Midlands College</li> <li>False Bay TVET</li> <li>Other TVET colleges</li> </ul>
<b>Human-centred automation</b>	<ul style="list-style-type: none"> <li>Continue to support NMISA through its gauge block automation contract as well as the SABS with validation and operationalisation of its ventilator test facility.</li> <li>SANEDI tender for energy monitoring at public buildings that was put on hold in 2021/2022 due to budget constraints is expected to restart in 2022/2023 where the cluster is anticipating providing IoT, data analytics and dashboarding skills to assist the Tshwane Municipality to better manage its energy utilisation.</li> </ul>	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> <li>Innovation for energy security</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Energy security</li> </ul>	<ul style="list-style-type: none"> <li>NMISA</li> <li>Tshwane Municipality</li> </ul>
<b>Laser based processing</b>	Eskom and Transnet are supported with respect to the development of laser-based processing technologies to ensure the competitiveness of these state-owned enterprises.	<ul style="list-style-type: none"> <li>Innovation for energy security</li> <li>A reindustrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Energy security</li> <li>Industrialisation through localisation</li> <li>Green economy interventions</li> </ul>	<ul style="list-style-type: none"> <li>Eskom</li> <li>Transnet</li> </ul>
<b>Medical devices</b>	Medical devices thrust will continue to be targeted as a means to assist government provide improved healthcare services both within and outside the Covid-19 pandemic and to do so at lower cost through locally developed and manufactured products.	<ul style="list-style-type: none"> <li>A reindustrialised modern economy</li> <li>Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation</li> </ul>	<ul style="list-style-type: none"> <li>Local health products manufacturing industry</li> <li>National Department of Health (NDoH)</li> </ul>



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<b>CSIR NextGen Health Cluster</b>				
<b>Precision medicine platform</b>	SAPHRA's regulatory and Pharmacovigilance capabilities to position CSIR tools for application in assessment of side-effects, efficacy and benefit to the South African population.	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation for precision medicine</li> </ul>	<ul style="list-style-type: none"> <li>SAPHRA</li> </ul>
<b>Medical devices and diagnostics</b>	<ul style="list-style-type: none"> <li>Development for molecular diagnostics Bovine Tuberculosis in the short term, which are important diseases affecting the cattle industry.</li> <li>Development of a LoC PoC technology platform for veterinary molecular diagnostics. Furthermore, this area will be supported by the vaccine development which can support government's efforts to localise the animal vaccines.</li> <li>Grow the diagnostics testing service to capacitate the state's response to Covid-19 and expand to other diseases.</li> </ul>	<ul style="list-style-type: none"> <li>Health technologies to prevent and treat ill-health and advance well-being for those who are marginalised</li> </ul>	<ul style="list-style-type: none"> <li>Industrialisation through localisation of technologies for animal health</li> <li>Infrastructure and service delivery for health testing</li> </ul>	<ul style="list-style-type: none"> <li>NHLS</li> </ul>
<b>CSIR NextGen Enterprises and Institutions Cluster</b>				
<b>Policy and standards development</b>	<ul style="list-style-type: none"> <li>Development of standards, policies, technique generation, strategies and frameworks through applied data science and mathematical modelling for government to better deliver services and to create avenues for public service innovation.</li> <li>Contribute to the development of policies and regulations that promote the adoption, beneficiation and diffusion of transformative technologies in order to encourage business undertaking in South Africa (i.e., the ease of doing business).</li> </ul>	<ul style="list-style-type: none"> <li>Re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure investment and delivery</li> <li>Industrialisation through localisation</li> <li>Reduced cost and increased quality of digital communications</li> <li>Sustainable water supply to meet demand</li> </ul>	<ul style="list-style-type: none"> <li>DCDT</li> <li>DSI</li> <li>ICASA</li> <li>Gauteng Provincial Government</li> </ul>



Key RD&I Programme/ Platform/Project	Description	Decadal Plan's societal grand challenge(s) <sup>a</sup> addressed	ERRP Priority Interventions <sup>b</sup> and Operation Vulindlela Outcome <sup>c</sup> supported	Collaborations: Industry, HEIs, other State entities, International, Continental and BRICS countries
<b>Voice computing</b>	Voice computing technologies in local languages in support of applications and solutions that enable equitable access to government information and services.	<ul style="list-style-type: none"> <li>• Future proof education and skills</li> <li>• Re-industrialised modern economy</li> <li>• Future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> </ul>	<ul style="list-style-type: none"> <li>• DSAC as funder of local language technology development and implementation studies</li> <li>• GCIS as user of language technology services</li> <li>• WCED as implementation partner for language technology services and products in special needs schools</li> <li>• SADIaR as implementation partner for local language technology products and services in government departments such as GCIS.</li> <li>• HEIs as co-developers of language technology products and services.</li> </ul>
<b>Electronic Monitoring System for Department of Correctional Services</b>	Reduce incarceration with effective and efficient electronic monitoring alternatives.	<ul style="list-style-type: none"> <li>• A re-industrialised modern economy</li> <li>• The future of society</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Industrialisation through localisation</li> <li>• Reduced cost and increased quality of digital communications</li> </ul>	Department of Correctional Services
<b>Online Radiation Monitoring System for the National Nuclear Regulator (NNR)</b>	Improve situation awareness and disaster management related to nuclear radiation leaks.	<ul style="list-style-type: none"> <li>• Climate change and environmental sustainability, The future of society.</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure investment and delivery</li> <li>• Reduced cost and increased quality of digital communications</li> </ul>	-





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<b>Operational support</b>	Provide operational support in areas that do not have facilities or computing infrastructure for fail-over during downtime; support projects such as Home Affairs National Identification System (HANIS), Department of Health and Water Research Commission (WRC). Fail-over service for South African Weather Service (SAWS), assisting SITA in areas where high performance computing (HPC) skills is required	<ul style="list-style-type: none"> <li>• A re-industrialised modern economy</li> <li>• The future of society</li> <li>• Innovation for a healthy society</li> </ul>	<ul style="list-style-type: none"> <li>• Industrialisation through localisation</li> <li>• Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>• NDoH</li> <li>• Department of Home Affairs</li> <li>• WRC</li> <li>• SAWS</li> <li>• SITA</li> </ul>
<b>CSIR Smart Mobility cluster</b>				
<b>Transport Systems and Operations</b>	<p>Integrated Public Transport Network Spatial Planning Support:</p> <ul style="list-style-type: none"> <li>• The Provision of Technical Assistance to capacitate Metropolitans with the planning, designing, operating and budgeting of sustainable and spatially transformative Integrated Public Transport Networks</li> <li>• Development of digital solutions for law enforcement in the Minibus Taxi Industry.</li> <li>• The implementation of subsidised bus contracts</li> <li>• Taxi Ranks Economic Hubs Development</li> <li>• The provision of support to provinces on road asset management.</li> <li>• Household travel survey to measure mobility impacts</li> <li>• Providing services to the government to address overloading and weighbridge management and control issues.</li> </ul>	<ul style="list-style-type: none"> <li>• The future of society (Safety of society – passengers transport and vehicle safety)</li> <li>• Innovation for a healthy society</li> <li>• A re-industrialised modern economy,</li> </ul>	<ul style="list-style-type: none"> <li>• Competitive and efficient freight transport</li> </ul>	<ul style="list-style-type: none"> <li>• Government e.g. Provincial Departments of Roads and Transport. Johannesburg Road Agency</li> <li>• Local Industry e.g. JG Afrika, Royal Haskoning DHV (Pty) Ltd</li> <li>• SOEs e.g. Sanral, PRASA</li> <li>• International e.g. Namibia Roads Authority</li> </ul>



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<b>Transport Infrastructure Engineering Platform</b>	<p>Smart Port and Coastal Infrastructure technologies:</p> <ul style="list-style-type: none"> <li>• Detached breakwaters as a cost-effective alternative; identification of cost-effective solutions to protect breakwaters and other coastal structures from the effects of weather variability and climate change</li> <li>• Vessel Motion Forecast tool for the port of Ngqura,, as well as for other ports in SA and elsewhere</li> <li>• Integrated Port Operations Support System(IPOSS) – Operational support to SA ports through the provision of wind, wave, tide and current data.</li> <li>• Guide for local coastal authorities on coastal defence solutions (in collaboration with Coastal Systems) on a 'Working with and Working for Nature' guide for government departments and local authorities.</li> <li>• Development of an investment framework to meet rural accessibility needs, linked to the District Development Model</li> <li>• Design specifications for using innovative materials for constructing better performing and more resilient road pavements: advanced asphalt technologies; advanced bituminous Binder Technologies; improved unbound and stabilised material testing and design; alternative and innovative materials; and technologies in support of the circular economy</li> <li>• Climate Adaptation of transport infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Climate change and environmental sustainability</li> <li>• A re-industrialised modern economy</li> </ul>	<ul style="list-style-type: none"> <li>• Competitive and efficient freight transport</li> <li>• Industrialisation through localisation</li> <li>• Green Economy Interventions</li> <li>• Infrastructure investment and delivery</li> </ul>	<ul style="list-style-type: none"> <li>• SOEs, e.g. Transnet National Ports Authority, SANRAL, Eskom</li> <li>• Local Industry, e.g. consultants and contractors</li> <li>• International, e.g. Tanzania National Roads Authority, Uganda National Roads Authority, FAA, Federal Highway Administration (FHWA), international consultants</li> </ul>

- a Decadal Plan's Societal Grand Challenges – Climate change and environmental sustainability; future-proof education and skills; a re-industrialised modern economy; innovation for a healthy society; innovation for energy security; the future of society.
- b ERRP Priority Interventions – Infrastructure investment and delivery; energy security; gender equality and economic inclusion of women and youth; industrialisation through localisation; support for the recovery and growth of the tourism, cultural and creative industries; green economy interventions; mass public employment interventions; strengthening agriculture and food security; macro-economic policy interventions.
- c Operation Vulindlela Outcomes – Supply of electricity stabilised; reduced cost and increased quality of digital communications; sustainable water supply to meet demand; competitive and efficient freight transport; a visa regime that attracts skills and grows tourism.



B.5

SO4: BUILD AND TRANSFORM HC AND INFRASTRUCTURE

**B.5.1 HUMAN CAPITAL DEVELOPMENT**

The organisation has implemented a new operating model, which provides the roadmap for future organisational growth aligned to the organisational and HC Strategy to ensure that the CSIR has a healthy workforce establishment to support its core business. Initiatives that will support the outlined HC Strategy in 2022 / 2023 are as follows:

- Implementing the Principal Researcher and Development Programme;
- Enhancing the career ladders and introduction of support services career paths;
- Entrenching talent management and succession planning initiatives;
- Implementing the new EE Targets;
- Implementing the new CSIR annual short-term incentive bonus scheme;
- Entrenching leadership and management development programmes to equip all levels of management, from supervisory to executive, with critical management competencies with a focus on succession planning;
- Continuing to improve the absorption of the student pipeline which is informed by a workforce skills plan;
- Reviewing and improving the newly launched e-Learning platform as part of the repositioning of the learning and development programmes to offer a blended approach to complement classroom learning;
- Driving and evaluating the implementation of targeted interventions to close gaps identified in the climate survey that was conducted with the aim of evaluating the level of employee satisfaction following the new strategy, the new operating model and EPIC values;
- Continuing to offer psychosocial interventions targeted at employee wellness to promote an engaged, healthy and performing workforce;
- Continuing to drive change management within the business and entrench the CSIR EPIC values, namely Excellence, People-centered, Integrity and Collaboration;
- Entrenching effective retention strategies that reduce turnover of critical staff, including black and female researchers;
- Enhancing the CSIR Skills Development Strategy through strategic partnerships with key stakeholders in the NSI with the focus on SETAs;
- Leveraging on the HC upgraded systems to implement functionality to support talent reviews, succession planning, talent identification and mapping of employees according to performance/potential;
- Actively participating in outreach programmes, specifically in rural areas to increase awareness of the CSIR and HC development programmes; and
- Ensuring SET vs Support staff ratio continues to increase towards the SET staff through natural attrition of support staff.

**B.5.2 INFRASTRUCTURE**

**B.5.2.1 KEY RESEARCH INFRASTRUCTURE PROJECTS 2022/23**

**Table B5: 2022/23 infrastructure priorities with secured funding**

Research infrastructure project	Cluster	Summary of focus 2022/23
<b>CSIR Smart Mobility Cluster</b>		
<b>Hydraulics Model Hall</b>	Wind-wave flume upgrade	
<b>Advanced Material Testing Lab</b>	Granular and cementitious lab upgrade	
<b>Transport Safety Laboratory (TSL)</b>	Operationalise the TSL (Simulator, NDS and integration of technologies)	
<b>Technology Innovation Centre</b>	To facilitate the development of 4IR prototypes in the asphalt and concrete pavement industry.	



Research infrastructure project	Cluster	Summary of focus 2022/23
<b>CSIR Future Production: Manufacturing Cluster</b>		
<b>Smart Factory</b>		Establishment of a reconfigurable 4IR enabled production facility
<b>Hot Isostatic Pressing</b>		Post processing facility that is required for components in structural applications
<b>Metal Additive Manufacturing Equipment</b>		Scanners, high power laser and Beta commercial machine
<b>Metal injection molding</b>		Manufacturing small complex parts (with debinding furnace)
<b>CSIR Future Production: Chemicals Cluster</b>		
<b>Bioconversion</b>		Analytical and pilot plant infrastructure upgrade of the BIDs
<b>Analytical and pilot plant infrastructure upgrade of the BIDs</b>		FuturePHARMA open lab: facility refurbishment and purchase of capital items
<b>Advanced Functional Materials</b>		Establishment of a pre-pilot Supercritical CO <sub>2</sub> pilot facility
<b>Advanced Polymer Composite Group</b>		Development of biodegradability testing capabilities
<b>Bioprocessing</b>		Advance bioprocessing capabilities

B.6

SO5: DIVERSIFY INCOME, MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE

The CSIR has implemented a new strategy that is geared to deliver on the mandate and specifically, to support industrialisation, however the organisation continues to operate in a resource constrained environment.

Although the Parliamentary Grant (PG) for 2022-23 has increased by 2.2% in comparison to the 2021-22 figure, in real terms the amount has decreased due to inflation and the numerous budget cuts that were effected by DSI/NT over the past few years. In fact the 2022-23 figure (R852,8 million) is lower than the allocation for 2018-19 financial year (R874,1 million).

The decline in PG as a percentage of total income is a concern since the execution of our developmental mandate should always be adequately supported. It is of vital importance that the State continues to fund the R&D space and not see it as an expense, but rather as an investment into the future. Many successful countries have achieved their success through the continued investment in R&D. In this regard, it would be beneficial if the PG allocation was positively reconsidered going forward.

Income diversification remains a key strategic objective and will reduce the financial risk associated with a significant reliance on public sector income. Income diversification is also expected to improve the CSIR's profitability as profit margins are currently between 1% and 2% on public sector income. Diversification is expected to be driven by the new commercialisation strategy, which aims to derive more benefit from IP and technology that has been developed. This diversification of revenue streams will assist the organization to become more financially strong in future.

In addition, CSIR would like to become the partner of choice for providing R&D activities to other State-owned entities, Government Departments and Municipalities, in line with its Mandate. In this regard the support of National Treasury is crucial to achieving this stated objective.

On 3 December 2021, the finance minister has published in the government gazette his approval to increase annual limits of financial guarantee facility to R922 m, R1.088 b & R1.144 b in FYs 2022, 2023 & 2024 respectively. This enables the CSIR to take on more revenue generating opportunities.



The following are some of the key risks that impact on the ability of the organisation to generate revenue:

- Reduction in income because of adverse economic conditions (i.e., lower budget votes for government departments and public entities as well as private sector cutting down on discretionary spending which include R&D);
- Inability to deliver on commitments to international clients due to limited mobility because of COVID-19 related restrictions in various countries
- Inability to earn income on contracts due to delays in the procurement (due to COVID-19 restrictions) of goods required to support projects

The CSIR has proven the importance of RD&I in tackling global threats such as pandemics through the National Ventilator Project and others. Our impactful response to COVID-19 has been enabled by past investment in capabilities and infrastructure.

Capability development, human capital development and infrastructure investments are critical to the success of our strategy. The CSIR needs more government investment to implement its strategy in order to respond more effectively to support various prioritised industry sectors with technology solutions.

The CSIR is forecasting a net loss of R5.4 million for the 2022/23 financial year. The CSIR has also adjusted the 3-year plan accordingly with reduced growth targets.

Conservative balance sheet practices, including working capital and cash flow management, are important to enable the CSIR to invest in the scientific equipment and infrastructure required to support strategic objectives.

All financial resources are invested in line with the CSIR's mandate.

## B.6.1 REVENUE GROWTH

The CSIR has budgeted for an increase of 10.2% in total operating revenue on 2021/22 forecast (see Table G1). Contract income and baseline grant funding increase on a comparative basis by 13.3% and 2.2% respectively.

Income from the South African public sector and South African private sector is budgeted to increase by 8.6% and 55.6% respectively, based on secured contracts and current engagements with stakeholders and clients to secure contracts for proposals submitted.

International contract income is budgeted to increase by 12.8% as a result of repositioning the CSIR's value proposition within the International market as aligned to Project Synapse.

Included in contract income from the South African public sector is the Cyber Infrastructure ring-fenced allocation from the DST. These contracts have historically been reflected as such and are included as part of public sector income for comparative purposes.

All necessary efforts are set to generate maximum possible revenue from the opportunities in the sectors that the CSIR supports (refer to section A.2.4 for sector-specific contexts and opportunities for the CSIR).

The CSIR will continue with the cost containment initiatives and operational efficiencies will continue to be actively driven.

## B.6.2 EXPENDITURE

Total expenditure is budgeted to increase in 2022/23 by 8.2% on 2021/22 forecast, with employee remuneration costs and depreciation budgeted to increase by 6.5% and 32.7% respectively. Operating expenses are expected to increase by 7.2%.

The increase in employee related costs is determined by taking into consideration the expected savings from restructuring, human capital development costs, as well as the growth projections on contract income. All planned recruitment will be dependent on the securing of contracts, and resource planning of required skills within the CSIR.



The budget for operating expenses is determined by taking into account contract-specific expenses (directly associated with contract income) as well as operational overheads (inherent in running the business).

Based on the current economic climate and need to improve financial performance, strict cost containment measures have been implemented across the CSIR.

The increase in depreciation is based on affordability and the availability of cash flow. The budget for 2022/23 includes fully funded grant assets. All planned investment in property, plant and equipment will be assessed to ensure alignment with strategy and operational requirements and will be prioritised based on affordability and return on investment.

### **B.6.3 ROYALTY INCOME**

Royalty income is budgeted at R 4,5 million and is based on current registered license agreements. Royalty income is budgeted to decrease by 34.8% from the 2021/22 forecast (R6.9 million).

### **B.6.4 FINANCIAL SUSTAINABILITY**

The 2022/23 budget indicates a net loss of R5.4 million against the 2021/22 forecast loss of R54.4 million. COVID-19 related restrictions locally and other foreign markets have had a negative impact on the operations during the 2021/22 financial year, resulting in contracts not being secured as planned as well as delays on delivering on some large contracts, hence a significant loss forecast.

Table G1 in appendix G provides the high-level CSIR statement of comprehensive income reflecting the forecast for 2021/22, the budget for 2022/23 and estimates for 2023/24 as well as 2024/25. A summary of parliamentary grant income for the Medium Term Expenditure Framework (MTEF) period is provided in Table G7 in appendix G.

### **B.6.5 STATEMENT OF FINANCIAL POSITION**

A CSIR statement of the financial position for the MTEF period is provided in table G2 in appendix G.

One needs to consider the budgeted cash balance of R1.03 billion in conjunction with the current liabilities of R476 million. The current ratio (current assets/current liabilities) is expected to decrease slightly to approximately 2.

### **B.6.6 INVESTMENT IN PROPERTY, PLANT AND EQUIPMENT**

The budgeted investment in property, plant and equipment for the 2022/23 financial year is R 259.8 million.

Notwithstanding the fact that an item is included in the property, plant and equipment budget, the investment remains subject to approval as per the Approval Framework of the CSIR and additional considerations such as strategic alignment, return on investment and available cash flow.

### **B.6.7 CSIR SUBSIDIARIES AND BORROWING PLAN**

As depicted in the figure below, the CSIR has two subsidiaries which are dormant and account for an insignificant portion of the total Group's budget.



**Figure B1:** CSIR Subsidiaries

The five-year borrowing plan is provided in table G8.

B.7

ANNUAL AND QUARTERLY TARGETS: 2022/23

**Table B6: Phased quarterly KPI targets**

Indicator	Q1	Q2	Q3	Q4
<b>SO1: Conduct RD&amp;I, localise transformative technologies and accelerate their diffusion</b>				
<b>KPI 01:</b> Publication equivalents	62	141	224	<b>304.5</b>
<b>KPI 02:</b> New priority patent applications filed	0	2	4	<b>7</b>
<b>KPI 03:</b> New patents granted	0	1	2	<b>6</b>
<b>KPI 04:</b> New Technology Demonstrators	0	9	25	<b>54</b>
<b>KPI 05:</b> Number of technology licence agreements signed	0	3	8	<b>18</b>
<b>SO2: Collaboratively improve the competitiveness of high-impact industries to support South Africa's re-industrialisation.</b>				
<b>KPI 06:</b> Number of localised technologies	0	1	4	<b>11</b>
<b>KPI 07:</b> Number of joint technology development agreements being implemented for industry	2	5	14	<b>27</b>
<b>KPI 08:</b> Number of SMMEs supported	12	29	49	<b>72</b>
<b>SO3: Drive socioeconomic transformation through RD&amp;I that supports the development of a capable state</b>				
<b>KPI 09:</b> Number of reports contributing to National Policy Development	3	5	8	<b>13</b>
<b>KPI 10:</b> Number of standards delivered or contributed in support of the state	0	2	5	<b>9</b>
<b>KPI 11:</b> Number of projects implemented to increase the capability of the state	6	19	32	<b>45</b>
<b>SO4: Build and transform HC and infrastructure</b>				
<b>KPI 12: Total SET staff</b>	1540	1556	1575	<b>1598</b>
<b>KPI 13:</b> Percentage of SET staff who are black	67%	67%	67%	<b>67%</b>
<b>KPI 14:</b> Percentage of SET staff who are female	38%	38%	38%	<b>38%</b>



Indicator	Q1	Q2	Q3	Q4
<b>KPI 15:</b> Percentage of SET staff with PhDs	21%	21%	21%	<b>21%</b>
<b>KPI 16: Total chief researchers</b>	14	14	16	<b>16</b>
<b>KPI 17:</b> Percentage of chief researchers who are black	14%	14%	19%	<b>19%</b>
<b>KPI 18:</b> Percentage of chief researchers who are female	14%	14%	13%	<b>13%</b>
<b>KPI 19: Total principal researchers</b>	181	182	186	<b>189</b>
<b>KPI 20:</b> Percentage of principal researchers who are black	34%	34%	34%	<b>34%</b>
<b>KPI 21:</b> Percentage of Principal Researchers who are Female	20%	20%	20%	<b>20%</b>
<b>KPI 22:</b> Number of staff involved in exchange programmes with industry	11	16	21	<b>26</b>
<b>KPI 23:</b> PPE Investment (Rm)	68	113	183	<b>259.8</b>
<b>SO5: Diversify income, maintain financial sustainability and good governance</b>				
<b>KPI 24:</b> Total Income (Rm)	458	1 094	1 777	<b>2 903</b>
<b>KPI 25:</b> Net Profit (Rm)	-2.2	-1.5	-0.9	<b>-5.4</b>
<b>KPI 26:</b> SA public sector income (% Total Income)	60%	56%	53%	<b>51%</b>
<b>KPI 27:</b> SA private sector income (% Total Income)	9%	11%	13%	<b>12%</b>
<b>KPI 28:</b> International contract income (% Total Income)	8%	8%	8%	<b>8%</b>
<b>KPI 29:</b> B-BBEE Rating	1	1	1	<b>1</b>
<b>KPI 30:</b> RIR	<1	<1	<1	<b>&lt;1</b>
<b>KPI 31:</b> Audit opinion	n/a	n/a	n/a	<b>Unqualified audit opinion</b>





# ANNEXURE C

## GOVERNANCE STRUCTURE





## C.1

## GOVERNANCE STRUCTURE

The Executive Authority of the CSIR is the Minister of Higher Education, Science and Innovation. The Accounting Authority of the CSIR is the CSIR Board, duly appointed by the Minister. The Practice Note issued by NT dealing with the Submission of Corporate Plans requires the inclusion of the following in the Corporate Plan:

- The composition of the CSIR Board and its subcommittees; and
- The members of the Executive Management team.

### C.1.1 CSIR BOARD

The members of the CSIR Board are:

- Prof. Thokozani Majazi (Chairperson)
- Dr Thulani Dlamini (CEO)
- Dr Vuyo Mthethwa
- Dr Christine Render
- Dr Amber-Robyn Childs
- Dr Ramatsemela Masango
- Ms Tiny Mokhabuki
- Mr Joel Netshitenzhe
- Mr Cassim Shariff
- Mr Stafford Masie

The CSIR Board has three sub-committees, namely, Research, Development and Industrialisation Committee, ARC and HRSEC. The members of these committees are as follows:

#### C.1.1.1 RESEARCH, DEVELOPMENT AND INDUSTRIALISATION COMMITTEE

- Dr Christine Render (Chairperson)
- Dr Amber-Robyn Childs
- Dr Ramatsemela Masango
- Mr Stafford Masie
- Mr Joel Netshitenzhe
- Mr Cassim Shariff

#### C.1.1.2 AUDIT AND RISK MANAGEMENT COMMITTEE

- Ms Tiny Mokhabuki (Chairperson)
- Dr Vuyo Mthethwa
- Dr Christine Render
- Mr Stafford Masie

#### C.1.1.3 HR AND REMUNERATION COMMITTEE

- Dr Vuyo Mthethwa (Chairperson)
- Dr Ramatsemela Masango
- Mr Cassim Shariff

Additional details on each Board member are provided in Table C.1.



**Table C1: Board Member details**

Age	Gender	Race	Qualifications	Years	Position(s) on other Boards
<b>Prof. Thokozani Majazi (Chairperson)</b>					
49	Male	Black	<p>University of Manchester Institute of Science and Technology PhD (Process Integration)</p> <p>University of Natal MSc (Engineering) BSc (Chemical Engineering)</p>	7	<p>Director A1 Consulting Engineers CC</p>
<b>Dr Thulani Dlamini (CEO)</b>					
52	Male	Black	<p>University of the Witwatersrand BSc Chemistry BSc (Hons) Chemistry PhD Chemistry, Catalysis</p> <p>University of South Africa Master of Business Leadership</p>	5	<p>Council Member: National Advisory Council on Innovation</p> <p>Director Vumelana Trade 120 CC Kusile Invest 125 CC Mavela Consulting Services CC</p>
<b>Dr Amber-Robyn Childs</b>					
41	Female	White	<p>Rhodes University PhD (Ichthyology) MSc (Cum Laude) (Ichthyology) BSc (Hons) Ichthyology BSc Ichthyology, Zoology, Mathematical Studies</p>	3	None
<b>Dr Ramatsemela Masango</b>					
46	Female	Black	<p>Pennsylvania State University PhD (Nuclear Engineering) MSc (Nuclear Engineering)</p> <p>Lyceum College Diploma in Project Management</p> <p>Cape Peninsula University of Technology B.Tech Degree (Chemical Engineering)</p>	3	<p>Executive Director Mzansi Energy Solutions and Innovations Mzesi Energy Mzesi Academy Mzesi Holdings</p> <p>Non-Executive Director ArioGenix Face to Face Foundation Redhorn Holdings Mzesi Water &amp; Construction Yonga Energy Tingo Technologies Amanzi Technologies Miyezi Investments Vito Africa Energy Wise Solutions</p>
<b>Dr Christine Render</b>					
64	Female	White	<p>Leeds University (England) PhD (Chemical Engineering) BSc Hons. (Chemical Engineering)</p>	3	<p>Partner Owner Team Consultation Pty (Ltd)</p>
<b>Dr Vuyo Mthethwa</b>					
53	Female	Black	<p>University of KwaZulu-Natal PhD Higher Education governance</p>	3	<p>Senior Director Durban University of Technology Hucad CC Bizdom CC</p>



Age	Gender	Race	Qualifications	Years	Position(s) on other Boards
<b>Mr Cassim Shariff</b>					
52	Male		Leicester Business School, DeMontfort University Master's in Business Administration	3	Director Aquaworx Remediator & Infrastructure Solutions Lirazest Southern Cross Diamonds Greenstone Energy Silver Crown Trading 25
<b>Mr Stafford Masie</b>					
47	Male			3	Non-Executive Director and Shares Thumbzup South Africa Thumbzup Australia/AsiaPac Thumbzup International (London) Thumbzup USA  Shareholder/Funder Green Moon Transact  Executive Director and Shareholder/Funder GATTACA SnapTutor Razologix  Shareholder LRXYM Non-Executive Director Discovery Bank
<b>Ms Tiny Mokhabuki</b>					
38	Female	Black	SAICA CA (SA) CIMA Adv Dip in MA Acma, CGMA  University of KwaZulu-Natal PGDA (with CTA)  University of the Witwatersrand Bachelor of Commerce  Global Institute of Business Sciences Aspen Management Programme	3	Director Business Entrepreneur Community (Dormant, Deregistration process) Equota Mokhabuki Building and Construction Sphimokha Digiten  Employee MICT SETA



Age	Gender	Race	Qualifications	Years	Position(s) on other Boards
<b>Mr Joel Netshitenzhe</b>					
65	Male	Black	<i>University of London</i> M.Sc (Financial Economics) Post-graduate Diploma (Economic Principles)  <i>Institute of Social Sciences,</i> <i>Moscow</i> Diploma (Political Science)	6	<i>Executive Director</i> Mapungubwe Institute of Strategic Reflection  <i>Director</i> Nedbank Group Nedbank Life Healthcare Group Lushote Trading (Fledgling): Topaz Sky Trading 316 (Fledgling) Betascape  <i>Member</i> African National Congress NEC Camel Rock Trading 434  <i>Patron</i> Oliver & Adelaide Tambo Foundation  <i>Visiting Professor</i> Wits School of Governance

## C.1.2 EXECUTIVE MANAGEMENT

Several changes have been made to the CSIR Executive portfolios to improve efficiency in the organisation and address:

- Misalignment between strategy and operations, leading to mixed messages and confusion in the organisation;
- The need to better align our strategic partnerships with our investment strategy, innovation strategy and operations; and
- Streamlining our decision-making and ensuring that there is single-point accountability.

To address these concerns and augment the impact of our key deliverables for organisational efficiency, the CSIR Executive portfolios have been consolidated and are now structured as follows:

- **Finance** –CFO: Mr Ashraf Dindar
- **Business Excellence and Integration** – Group Executive: Dr Kaven Naidoo (acting)
- **Chemicals, Agriculture, Food and Health** – Divisional Group Executive: Dr Rachel Chikwamba
- **Mining, Manufacturing, Defence and Security** – Divisional Group Executive: Dr Motodi Maserumule
- **Natural Resources, Enabling Infrastructure, Public and Professional Services** – Vacant, Dr Rachel Chikwamba (acting)
- **Human Capital and Strategic Communications** – Group Executive: Mr Andile Mabindisa
- **Legal Compliance and Business Enablement (LCBE)** – Group Executive: Adv. Esmé Kennedy



**Table C2: Executive Committee Member details**

Age	Gender	Race	Qualification	Years	Position(s) on other Boards
<b>Adv. Esmé Kennedy Group Executive: LCBE</b>					
44	Female	White	<i>University of Pretoria</i> B.Proc  <i>Potchefstroom University</i> LLB LLM (Import and Export Law)  <i>High Court of South Africa</i> Admitted as an Advocate  <i>General Council Bar of South Africa</i> Admitted as member of the Johannesburg Bar  <i>North-West University: Potchefstroom Business School</i> MBA	1	Trustee CSIR Pension Fund  Professional Membership Institute of Directors S.A.
<b>Mr Andile Mabindisa Group Executive: Human Capital and Strategic Communications</b>					
52	Male	Black	<i>University of Natal</i> B Soc Sc  <i>University of Natal</i> B Sco Sc (Hons)  <i>University of Natal</i> Postgraduate Diploma in IR	1	None
<b>Dr Motodi Maserumule Divisional Group Executive: Mining, Manufacturing, Defence and Security</b>					
54	Male	Black	<i>Rensselaer Polytechnic Institute (USA)</i> PhD Mathematics  <i>Clark Atlanta University</i> MSc Mathematics. Applied Math  <i>Morris Brown College</i> BSc Mathematics  <i>IMD, Lausanne, Switzerland</i> Mastering Technology Enterprise  <i>SA National Defence College</i> Executive National Security Programme	1	Professional Membership Institute of Directors S.A. Society of Industrial and Applied Mathematics
<b>Mr Ashraf Dindar CFO</b>					
52	Male	Indian	<i>University of the Witwatersrand</i> BCom BAcc  SAICA CA (SA)  <i>Global Institute of Business Sciences</i> Global Institute of Leadership Development Management Development Programme Global Executive Development Programme	6	None



Age	Gender	Race	Qualification	Years	Position(s) on other Boards
<b>Dr Kaven Naidoo Group Executive: Business Excellence and Integration (acting)</b>					
45	Male	Indian	University of the Witwatersrand PhD Aeronautical Engineering BSc Aeronautical Engineering  University of Pretoria BEng Honours Mechanical Engineering  South African National Defence College Executive National Security Programme	-	Director  Students for the Exploration and Development of Space South Africa NPC  Enterprise K2020192513 (STEM Education)
<b>Dr Rachel Chikwamba Divisional Group Executive: Chemicals, Agriculture, Food and Health</b>					
54	Female	Black	University of Queensland M.Sc (Agricultural studies)  Iowa State University PhD (Genetics)  Gordon Institute of Business Science MBA	14	Member Persomics AB Board  African Union (AU) high-level committee on Science, Technology and Innovation Strategy for Africa 2024 (STISA 2024)  Director Wits Health Consortium (Pty) Ltd  Advisory Board Member Australian Center for International Agricultural Research  Advisory Committee for the IBM Research laboratory Gauteng Provincial Government (GPG) 4th Industrial Revolution (4IR) Advisory Panel



# ANNEXURE D

## RISK MANAGEMENT PLAN







## D.1

## RISK MANAGEMENT PLAN

### D.1.1 BACKGROUND

Every entity exists to provide value for its stakeholders. All entities face uncertainty and the challenge for management is to determine how much uncertainty to accept as it strives to grow stakeholder value. This is achieved through an effective and integrated system of risk management. It is, therefore, important that the Accounting Authority, being the CSIR Board, sets the right tone for risk management in the organisation. Although all staff should be aware of the need to prevent loss and to safeguard stakeholders' interests, they may not be quite so clear about the organisation's standpoint on risk management. The organisation should operate within the terms of a risk management policy approved by the Accounting Authority, as this is a statement that declares the organisation's commitment to risk management.

To this end, CSIR management (all levels) is responsible for ensuring that all risks, both internal and external, are managed effectively. The approach to risk management utilised by the CSIR provides a mechanism to formalise responsibility and establish accountability for all risk management activities, i.e., a consolidated risk report culminating in a Risk Management Plan (RMP). The formalisation of risk management activities is achieved through the ARC, which recommends approval of the RMP to the CSIR Board.

Adequate and effective risk management is a fundamental focus and contributor to a sound corporate governance framework on internal control. The CSIR uses risk management as a tool to drive the achievement of the strategic objectives and goals. Risk management cannot be divorced from a strategy-setting process and successful organisations identify risks (what could go wrong) as part of the genesis of strategy-setting.

A thorough understanding of risk tolerances accepted by the CSIR in the pursuance of its strategic objectives, together with strategies employed to mitigate those risks, is thus essential for a comprehensive appreciation of the CSIR's state of affairs by the CSIR Executive Committee and CSIR Board.

Good risk management is not about eliminating or avoiding risks, but rather taking acceptable risks and managing them well. The RMP assists the CSIR to improve and sustain performance by enhancing its system of risk management to protect against adverse outcomes and optimise opportunities.

In recent years, the CSIR has revised and re-organised its ERMS function to be fit for purpose. The repurposing of the ERMS function is a fundamental element in the RMP and was also informed by the strategic need to align to the organisational needs and requirements as introduced by the CSIR Strategy and Operating Model.

### D.1.2 LEGISLATIVE CONTEXT

The CSIR RMP has been developed in terms of the prescripts of applicable legislation and as amended from time to time, including but not limited to:

- PFMA;
- Treasury Regulations issued in terms of the PFMA;
- The Scientific Research Council Act;
- Occupational Health and Safety Act, 1993 (Act 85 of 1993); and
- Labour Relations Act.

The CSIR RMP also incorporates the requirements of the King IV and associated guidelines, which are in line with the globally accepted COSO Integrated Risk Management Framework, as well as the principles of ISO 31000 as best practice guidelines and framework.



## D.2

## CSIR RMP

### D.2.1 RISK MANAGEMENT PHILOSOPHY

The CSIR maintains a broad view of risk as any event, positive or negative, that could affect its ability to achieve its mandate, mission, vision and strategic objectives.

The CSIR acknowledges that risk, in one form or another, is present in virtually all its endeavours, and that successful risk-taking will often be necessary to achieve strategic objectives. Therefore, the CSIR does not seek to eliminate all risk but seeks to be risk-aware as opposed to risk-averse, and to effectively manage the uncertainty inherent in its environment.

To this end, the CSIR seeks to identify, understand, assess and respond to the risks and opportunities faced, considering their impact on the CSIR's resources, reputational standing, financial position and performance. Furthermore, the CSIR seeks to pursue prudent risks or opportunities that it believes will generate sufficient and sustainable performance and value, avoid intolerable risks, manage residual risk within defined and desired levels, and be prepared to respond to risks or appropriate opportunities when necessary.

The CSIR Exco and the CSIR Board, acting through the ARC, will assess the CSIR risk philosophy on an annual basis, as well as report and implement any recommended and approved changes.

To eliminate uncertainty among employees and stakeholders about the policies and procedures that shape the CSIR's approach to risk management, the CSIR has developed and implemented a RMP. A risk tolerance framework aligned with the RMP will continuously be assessed and defined in support of the strategic objectives and operating landscape of the CSIR.

### D.2.2 PURPOSE OF THE RMP

The CSIR RMP is developed to support the successful implementation and achievement of the CSIR Strategy and to outline what risk management activities are necessary during the financial year. In addition, it aims to entrench a risk management culture throughout the CSIR, creating a corporate culture aligned with the CSIR's **EPIC** values. The development of the RMP for 2022/23 considers the CSIR Strategic Plan and the Annual Performance Plan.

Risk management, as set out in King IV, addresses a much wider spectrum of risk than in the past. In addition, the corporate governance drivers behind risk management today require new ways of reporting and monitoring CSIR's risk exposures. Therefore, it is important to note that the RMP is, by necessity, an evolving risk management instrument. The contents of the plan reflect the current risk management requirements of the CSIR. The document is reviewed and updated annually by the ARC of the CSIR Board.

When ERM is applied to all aspects of the organisation; it assists the CSIR in making informed choices which:

- Provide assurance that current significant risks are effectively managed;
- Improve business performance by assisting with enhancing decision-making and planning;
- Promote a more innovative, less risk-averse culture in which the taking of calculated risks in pursuit of opportunities to benefit the organisation is encouraged; and
- Provide a sound basis for integrated risk management and internal control as components of good corporate governance.

### D.2.3 SCOPE OF APPLICATION

The RMP applies to all business activities of the CSIR.

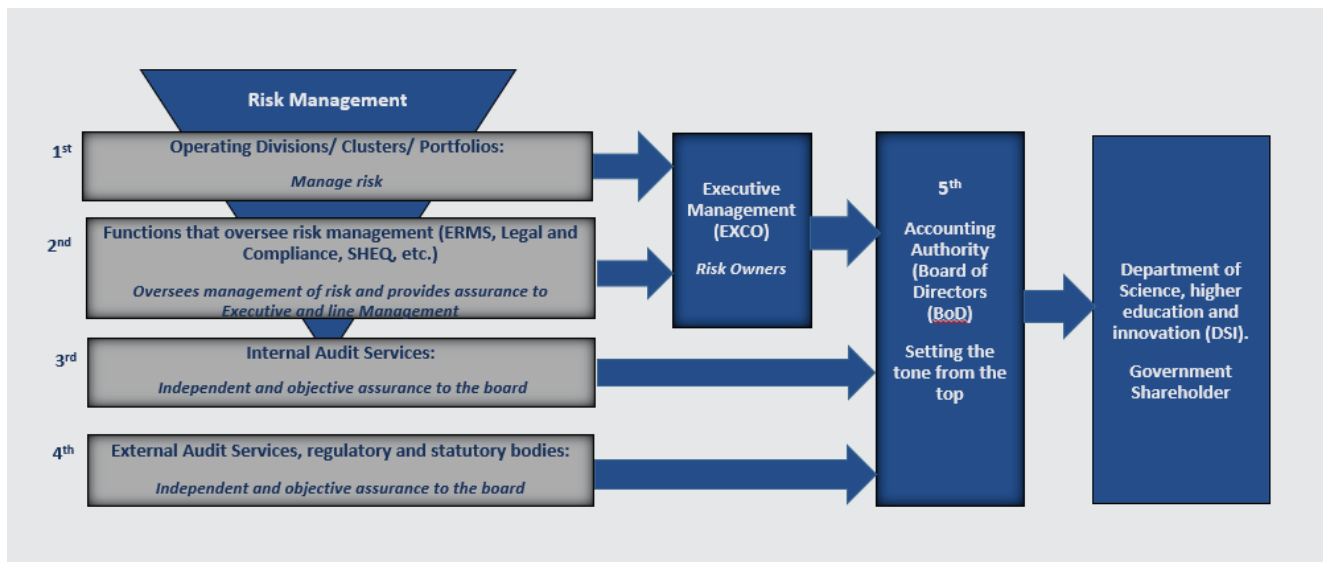
D.3

COMPONENTS OF THE CSIR RMP

The CSIR manages risk through a well-defined risk governance model (commonly referred to as **Five Lines of Assurance Model**). Each component of this governance model is defined through several supplementary guidelines, templates and implementation tools that provide clarity and enhancement for stakeholder use and ensure a single approach to enterprise-wide risk management. The governance model comprises the elements outlined below.

**D.3.1 RISK GOVERNANCE MODEL AND FRAMEWORK**

The CSIR adopted the Five Lines of Assurance Model when approaching risk management as outlined in Figure D1 below. This model is a revised version of the traditional Three Lines of Assurance Model as recommended by best practice.



**Figure D1:** CSIR Five Lines of Assurance Model

As this model illustrates, the ownership and management of risk lies with those who undertake the operations within the organisation (**1<sup>st</sup> line assurance**). Operational staff are also responsible for implementing and maintaining effective internal controls, executing risk and control procedures on a day-to-day basis and implementing corrective actions to address process and control deficiencies. They identify, assess and mitigate risks, guiding the development and implementation of internal controls, policies and procedures and ensuring that activities are consistent with goals and objectives.

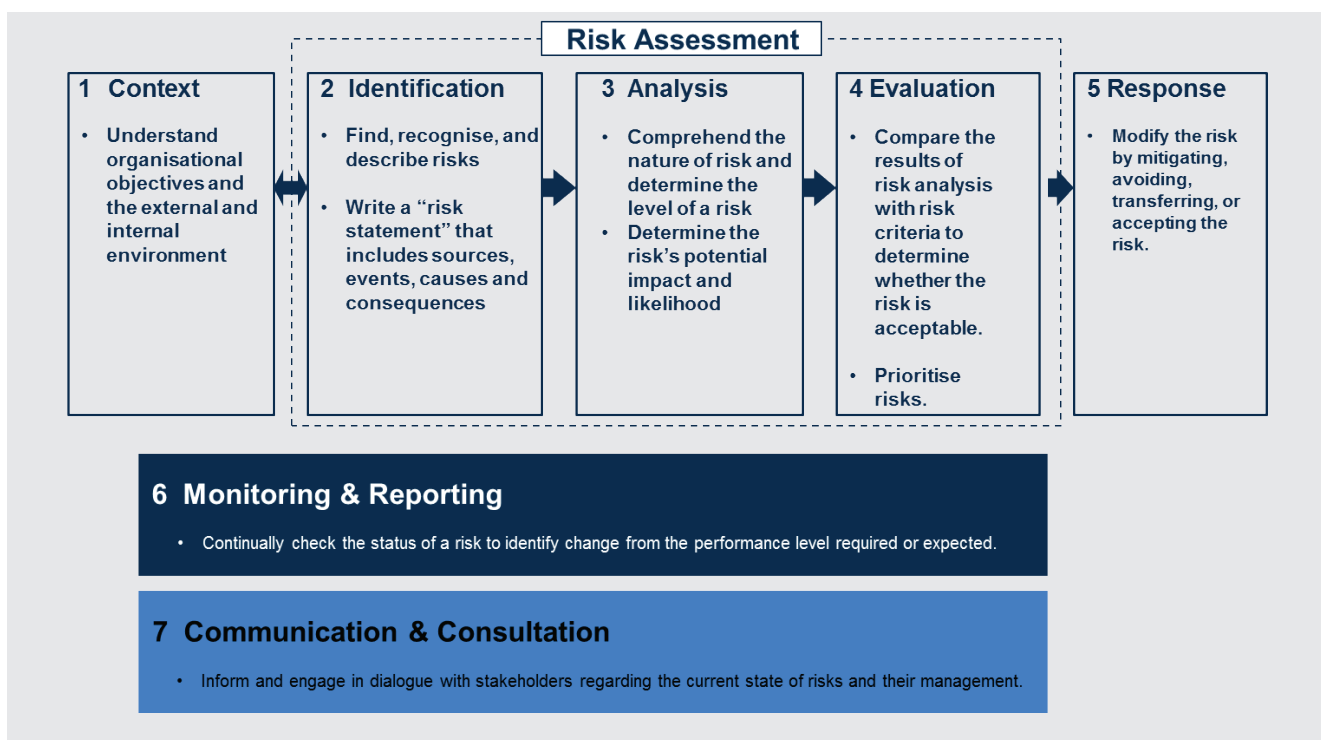
ERMS and other functions that oversee risk management (**2<sup>nd</sup> line assurance**) coordinate the management of risk in support of the risk owners (CSIR Exco), who, in turn, report to the CSIR Board. The latter retains ultimate accountability for risk governance. The Internal Audit function (**3<sup>rd</sup> line of assurance**) provides independent assurance directly to the CSIR Board on the adequacy and effectiveness of internal controls, risk management frameworks, systems and implementation.

The new Five Lines of Assurance Model recognises the external audit function as the fourth (**4<sup>th</sup> line assurance**), providing an independent and objective assurance to the CSIR Board and the shareholder (DSI) on the CSIR financial statements (statutory audit). The Auditor-General of South Africa is the statutory body performing this function.

Robust oversight by the CSIR Board and CSIR Exco (**5<sup>th</sup> line assurance**), establishes the cornerstone of effective risk management and set the tone from the top. To give effect to their fiduciary responsibility, the CSIR Board is supported by the ARC. The ARC is an oversight body delegated with the responsibility of implementing an effective risk strategy, supported by an appropriate risk management framework that include adequate control mechanisms to ensure effective risk management. The ARC also reviews the overall effectiveness of risk management system, i.e., policy, framework, methodology, technology system, structures, response strategies, etc.

### D.3.2 RISK MANAGEMENT FRAMEWORK OVERVIEW

The main elements of the CSIR’s Risk Management Framework, as per the ISO 31000 standard, are reflected in the Risk Management Process depicted in Figure D2 below:

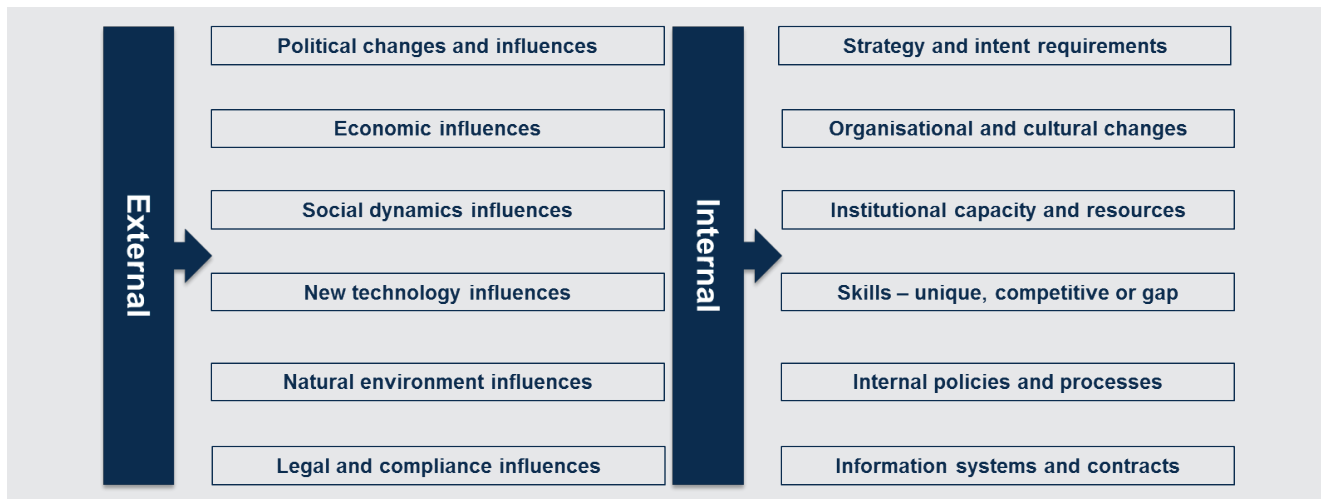


**Figure D2:** Risk Management Process

A general description of each step of the process is given in the following sections.

### D.3.3 ESTABLISHING THE RISK CONTEXT

Establishing the risk context entails analysis of the CSIR’s external and internal operating environment, which is considered when managing risk, as per figure D3 on the following page:



**Figure D3:** Risk Context

To achieve the CSIR’s strategic objectives, a thorough analysis of the overall risk environment is conducted periodically to establish a common understanding of the risk universe that needs to be addressed. As this environment remains in flux, the relevant risk universe is continuously reviewed, updated and agreed upon.

As the ownership and management of risk lies primarily with those who undertake operations within the organisation, CSIR divisions, clusters and portfolios management is largely responsible to identify risk. ERMS consolidates the risk universe for further analysis and eventual agreement based on relevance and potential impact.

### D.3.4 THE RISK ASSESSMENT PROCESS

In summary, the overall systematic approach taken by the CSIR for risk management is aligned to ISO 31000 and undertakes the following steps:

- Profiling the key aspects of the CSIR and the context in which the organisation operates. This highlights dependencies and critical parts of the business and starts to pinpoint vulnerabilities. Identifying and understanding organisational objectives – the ultimate objectives of the CSIR guide the risk appetite within each operational area, while adhering to the prescribed overall CSIR risk appetite. The profile of the individual operating environment objectives should take into consideration:
  - o Revenue and expenditure targets;
  - o Customer objectives and targets;
  - o Socioeconomic targets; and
  - o Other business objectives.
- Identifying and understanding operational activities.
- Identifying and categorising/prioritising risks – risk identification involves the identification of risk sources and events, their causes and potential consequences. This element consists of a detailed classification, analysis of the likely impact and likelihood of occurrence of a risk. A consequence/impact table is used in this process with clearly defined parameters that define the consequence/impact for each category of risk to determine the inherent risk, i.e., risk without controls. An assessment of the effectiveness of the controls is done to determine the residual risks and prioritisation of the risks including additional controls required to mitigate the risk further and escalation to the relevant levels.
- Determining a risk response strategy/identifying current controls/risk mitigation putting controls in place to manage the risk. The four approaches to risk mitigation are tolerate, treat, transfer or terminate the activities that give rise to the risk.
- Determining action plan, responsible person and the target date.
- Developing risk registers to enable comparison and consolidation of the different risk registers in CSIR a common risk register structure has been adopted
- Monitoring and reviewing the risk and the response to it.
- Reporting.



### D.3.5 RISK IDENTIFICATION AND CATEGORISATION

Risk identification involves the identification of risk sources and events, their causes and potential consequences. Management meetings, strategy sessions, engagements with heads of operating divisions, clusters and portfolios are all part of the risk identification process. The process to identify top risks also entails:

- Review of historical top risks and current relevance and threat assessment;
- Review of the CSIR's external operating environment through external macro-economic risk monitoring specialists;
- Consideration of the organisational strategy and risk implications;
- Review of the CSIR Operating Model;
- Analysis of internal audit reports and reporting through a combined assurance model, highlighting weaknesses in the control environment; and
- Analysis of organisational incidents lessons learnt and current local and international incident trends.

### D.3.6 RISK ANALYSIS AND EVALUATION TO DETERMINE PRIORITISATION

The outcomes of the risk identification and classification processes are compiled into risk registers within each area of the organisation. An escalation process is utilised, as outlined in Figure D4 below, wherein each level of the organisation identifies, evaluates and then prioritises the risks it faces, and reports the major risks to the next level in the organisation.

Risks are thus identified for each Cluster or Portfolio at the CSIR, with major risks reported to the next level, ultimately culminating in the formulation of the CSIR's top risks. This escalation process involves executive-level, in-depth analysis of risks that might not be identified at the level below, but which often represent the most critical risks for the organisation. All operational areas are required to compile and maintain a risk register, which is achieved through risk assessment workshops coordinated by ERMS.

Risk registers are reviewed and updated on a quarterly (as well as ad hoc) basis through meetings with the risk and control owners, risk owners and action plan owners and is coordinated by ERMS. After any strategic, policy, mandate or structural change, a risk assessment workshop is conducted to review and update the applicable risk register.

Risks at the CSIR have been classified into the following three broad categories:

- **Systemic risks** originate from macro-economic and national challenges affecting the NSI and National Government Business Enterprise space in which the CSIR operates;
- **Strategic risks** – risks that directly impact on the ability of the CSIR to deliver on its strategic objectives and statutory mandate; and
- **Operational risks** include financial, legal and compliance risks and are those risks affecting the systems, people, and processes through which the CSIR operates.

Assessing and prioritising the total identified risk universe consists of a detailed classification and analysis of the potential impact and likelihood of occurrence of a risk. A consequence/impact table is used in this process with clearly defined parameters that express the consequence/impact for each category of risk to determine the inherent risk, i.e., risk without/prior controls. An assessment of the effectiveness of the controls is done to determine the residual risks and prioritisation of the risks, including additional controls required to mitigate the risk further and escalation to the relevant levels.

To enable comparison and consolidation of the different risk registers in the CSIR, a common risk register structure has been adopted. Annexure H to this document identifies the top organisational risks that have been identified through the top-down and bottom-up risk evaluation processes. The process is based on the following:

- Risks are identified from the bottom up and require analysis by each level of the specific risks pertaining to that level, culminating in a top-down evaluation to determine organisational relevance and the top organisational risks; and
- Risk management is integrated into existing management processes such as planning, budgeting and performance management and evaluation.

The risk register, as well as the management of risk events is built and managed through an escalation from project level to operating division/cluster/portfolio level as illustrated by figure D4 on the following page.



**Figure D4:** Risk Escalation

### D.3.7 RISK MITIGATION

Risk mitigation entails implementing controls to manage the risk. This involves the below options:

- **Tolerate/accept** – accepting the risk by keeping activities unchanged. This option is applied when exposure is tolerable, control is impossible, or the cost of control exceeds potential benefit. The question of whether a particular risk can be tolerated is a key management decision.
- **Treat/reduce** – adjusting (adding or revising) relevant activities.
- **Transfer** – sharing the risk by involving relevant stakeholders. This works well for financial risks, risks to assets and includes securing conventional insurance or sourcing a third party to manage or undertake the risk.
- **Terminate/Avoid** – avoiding or cancelling the activities that give rise to the risk after considering the cost/benefit analysis.

Mitigation strategies are translated into internal control activities with defined implementation timelines. For those areas and items for which the risk owner recommends the option “**treat/reduce**”, i.e., mitigate the risk, actions are taken to reduce the probability of the risk occurring or to reduce the impact of the risk. Mitigation measures are also linked to the best use of resources. A **SMART** principle approach should be adopted when defining/developing risk mitigation action plans, i.e., the action plans should be **Specific, Measurable, Achievable, Realistic and Timely**. This will enable effective reporting and monitoring on progress against action plans.

Mitigation strategies consider the results/reports of the combined assurance efforts and ensure that appropriate action is taken to address identified areas for improvement.



### D.3.8 MONITORING AND REPORTING

After the establishment of detailed risk register and associated mitigation strategies, each risk is monitored by ERMS to verify implementation of the proposed mitigation strategies. ERMS also facilitates the review of the risks taking into consideration:

- Changes in the assessment of the risk;
- Changes to risks as forced by the macro environment;
- Suggested changes to the risk mitigation strategy;
- Progress made against the detailed action plans; and
- Any material factors from internal and external environment.

Internal audits and ad hoc risk assessments, either in accordance with the combined assurance plan or due to a perceived risk, will be conducted to monitor and evaluate the extent of compliance with policies, procedures, and proposed controls. The role of the Internal Audit function is to actively monitor the internal and external environment and, if identified risks are not responded to appropriately, to be the catalyst for ensuring that the risk universe is continually updated.

Furthermore, the CSIR will utilise the Opco forum to establish a focused agenda for a Risk Management, Compliance and Audit Steering Committee to steer and take responsibility for the CSIR RMP and to ensure the effective implementation thereof in support of combined assurance and ensuring that key risks are being managed appropriately. It will also implement a fit-for-purpose combined assurance operating model that will help the CSIR to effectively address its governance, risk management and compliance (GRC) agenda.

The objectives of the combined assurance model on the Risk Management, Compliance and Audit Steering Committee will mainly be to:

- Identify and specify the sources of assurance over the CSIR's risks;
- Provide the ARC, the CSIR Board and CSIR Exco with a framework of the various assurance parties;
- Link risk management activities with assurance activities;
- Assist the Accounting Officer to review the effectiveness of the risk management system; and
- Provide a basis for identifying any areas of potential assurance gaps.

In compliance with King IV, the CSIR Board of Directors will receive assurance regarding the effectiveness of the RMP through the following principles:

- On a monthly basis and once established, the Risk Management, Compliance and Audit Steering Committee will provide CSIR Executive Committee with progress updates against the combined assurance plan and progress against the implementation of the RMP;
- On a quarterly basis, the Enterprise Risk Manager will provide assurance to the CSIR Board that the planned risk management activities are being implemented according to this RMP. This assurance shall be communicated to the CSIR Board via the ARC; and
- On an annual basis, the Internal Audit function will provide a written assessment of the effectiveness of the system of internal controls and risk management to the CSIR Board via the ARC.

For the CSIR Board to discharge their duty of ensuring effective and continual monitoring of risk management takes place, risk monitoring is an integral part of the CSIR RMP to give assurance that measures remain effective.





ANNEXURE E  
FRAUD  
PREVENTION  
PLAN





## E.1

## FRAUD PREVENTION PLAN

### E.1.1 BACKGROUND

The CSIR FPP has been developed in compliance with section 3.2.1 of the Treasury Regulations of the PMFA. The CSIR subscribes to the principles of good corporate governance, which require business to be conducted in an honest, ethical and transparent manner. Consequently, the CSIR is committed to eradicating fraudulent behaviour at all levels within the organisation.

This FPP is premised on the CSIR's core ethical values driving the business of the CSIR, the development of its systems, policies and procedures, interactions with upstream and downstream stakeholders in its value chain and overall value proposition, including public and private sector customers, members of the public at large, suppliers and service providers, employees and its shareholder.

In alignment with the CSIR's core organisational EPIC values, this FPP is the cornerstone in promoting ethical conduct and determining how incidents or suspected incidents of fraud and corruption will be prevented, detected and investigated.

The CSIR has a **zero-tolerance** appetite for fraud and corruption. The organisation has, to this end, established a whistleblowing (i.e., protected disclosures) facility to support the efforts of this FPP. This facility is operated on a 24/7 basis through an independent service provider.

The re-organisation of the CSIR support structure resulted in the establishment of a fit-for-purpose compliance function, under the Legal and Compliance portfolio. In line with the Legal and Compliance portfolio's strategic business plan for FY 2021/2022 and going into FY 2022/2023, the portfolio working with the CSIR's Communications function is working on a detailed programme for the relaunch of the whistleblower hotline and extensive training on the CSIR's Ethics Statement and Code of Conduct to all CSIR employees and other stakeholders. A comprehensive process of establishing a combined assurance model with other key role-players in the business to drive an adequate and effective GRC capability was begun and will reach full maturity and functionality in the financial year 2021/22.

The FPP is a dynamic plan and will continuously evolve as the CSIR strives to further promote ethics and prevent fraud.

### E.1.2 PURPOSE OF THE FPP

The purpose of the CSIR FPP is to establish an approach in dealing with fraud risk as mapped out in the Fraud and Corruption Risk Register, and it recognises the basic fraud prevention initiatives within the CSIR, as well as identifies the custodians responsible for the creation of awareness, enforcement and investigation of incidents or suspected incidents of fraud and corruption.

The primary objectives of the CSIR FPP are to:

- Provide guidelines in creating awareness of, preventing, detecting and reporting fraudulent activities within the CSIR;
- Create and encourage a culture within the CSIR where all stakeholders continuously behave ethically in their dealings with, or on behalf of the CSIR;
- Improve the application of applicable systems and compliance with applicable policies, procedures and regulations;
- Encourage all employees and stakeholders to strive towards the prevention and detection of fraud impacting or with the potential to impact on the CSIR;
- Encourage all employees and stakeholders to report suspicions of fraudulent activity without fear of reprisals or recriminations; and
- Provide a governance framework within which the initiatives that support the creation of awareness, enforcement and investigation of incidents, or suspected incidents of fraud and corruption, are implemented and overseen.



### E.1.3 LEGISLATIVE CONTEXT

The FPP was developed with the aim of giving effect to the requirements and stipulations of the following legislations, among others, as amended from time to time:

- The Constitution of the Republic of South Africa, 1996;
- The PFMA;
- Treasury Regulations issued in terms of the PFMA in April 2001;
- The Scientific Research Council Act;
- The Protected Disclosures Act, 2000 (Act 26 of 2000);
- The Prevention of Organised Crime Act, 1998 (Act 121 of 1998);
- The Prevention and Combatting of Corrupt Activities Act, 2004 (Act 12 of 2004); and
- All mandatory policies adopted by the Board of the CSIR contextualising legislative and related compliance requirements.

### E.1.4 SCOPE OF APPLICATION

The FPP applies to all corruption, fraud, theft, financial misconduct and maladministration or suspected irregularities of such nature involving the following persons or entities:

- All members of the CSIR Board;
- All employees of the CSIR;
- Consultants, suppliers, contractors and other providers of goods or services to the CSIR; and
- All parties representing the CSIR and its business activities in an official capacity.

### E.1.5 POLICY STANCE

The policy of the CSIR is one of **zero tolerance** to fraud and corruption. All alleged cases of fraud and corruption will be investigated and followed up by the application of all remedies available to the full extent of the law, and the implementation of appropriate prevention and detection measures. These measures include existing financial and related controls and verification mechanisms as prescribed in the systems, policies and procedures of the CSIR.

The CSIR seeks and intends to facilitate a culture of voluntary disclosure of information relating to suspected fraud and related misconduct by employees in a responsible manner. Employees and stakeholders are encouraged to report suspicions of fraudulent activity without fear of reprisals or recriminations.

The efficient application of instructions and guidance contained in the regulations, policies and procedures of the CSIR is one of the most important duties of every employee in the execution of his/her daily tasks.

The CSIR's policy stance is currently encapsulated in various CSIR policies and procedures, including, but not limited to, the Code, the CSIR Conditions of Service, CSIR Disciplinary Code and Procedure, CSIR ICT Policy, the Information Security Policy and the CSIR Ethics Hotline Procedure.

To ensure that there is no uncertainty among employees and stakeholders about the policies and procedures that shape the CSIR's approach to fraud, the CSIR has established a dedicated Compliance function within the Legal and Compliance portfolio. The function is personified by a Business Ethics and Compliance Specialist reporting to Manager: Compliance.

The Compliance function serves a management function primarily focused on devising, implementing and overseeing organisational processes to meet its statutory and regulatory obligations. The Compliance function's objective is to integrate legal analysis, design and implement appropriate controls and form part of the Combined Assurance Plan of the organisation. Compliance services focus on educating the Board, senior management and other employees, as well as preventing and rooting out misconduct, whether legal, ethical, criminal or otherwise. Upon its implementation, the Compliance function will serve as the dedicated custodian of fraud prevention, fraud risk management and the process that is adopted by the CSIR in putting mechanisms in place to manage the CSIR's vulnerability to fraud. Such mechanisms are designed to prevent, deter and detect fraud.



## E.2

## COMPONENTS OF THE FPP

### E.2.1 GUIDING PRINCIPLES

The FPP of the CSIR is based upon the CSIR's EPIC values of pursuit of "Excellence", being "People" centred, personification of "Integrity" and welcoming "Collaboration". The FPP places emphasis on Integrity. This principle is founded on honesty in business and other dealings, creating a culture of openness and disclosure, promoting the eradication of criminal, unethical and other irregular conduct and adopting a zero-tolerance approach towards fraud and corrupt activities.

This plan applies to all allegations, attempts and incidents of fraud that have an impact on or with the potential to impact the CSIR.

All CSIR employees, management and other stakeholders must comply with the spirit and content of the plan.

A person who holds a position of authority as stipulated in section 34 of the Prevention and Combatting of Corrupt Activities Act, should report any suspected corrupt activity and/or an offence of theft/fraud to the police.

### E.2.2 COMPONENTS

The CSIR's FPP encompasses controls that have three SOs:

- Prevent instances of fraud and corruption from occurring;
- Detect instances of fraud and corruption when they do occur; and
- Respond appropriately and take corrective action when fraud and corruption happen.

The FPP provides the CSIR with tools to manage fraud and corruption risk and has four phases:

- Assessment of organisational needs, based upon the nature of fraud and corruption risks and existing control environment;
- Design of programmes and controls in a manner that is consistent with legal and regulatory requirements, as well as best practices;
- Implementation of programmes and controls through the assignment of roles, building of internal competencies, training and deployment of resources; and
- Evaluation of programme and control design, implementation and operational effectiveness.

Fraud prevention is a business imperative, and a shared responsibility between management and employees. The FPP forms part of the Shareholder's Compact that is approved by the CSIR Board annually.

The components of the FPP are as follows:

- The CSIR's core organisational EPIC values;
- The Code;
- CSIR systems, policies, procedures, rules and regulations;
- The CSIR Disciplinary Code and Procedure;
- Internal controls to prevent and detect fraud;
- Physical and information security management;
- Internal Audit function;
- Ongoing risk assessments;
- Reporting and monitoring of fraud allegations;
- Creation of fraud and corruption awareness among employees and relevant stakeholders through communication and education;
- Continued establishment and maintenance of a combined assurance forum to steer and take responsibility for the FPP and its effective implementation; and
- Ongoing review of the FPP.



The key deliverables of the FPP are to raise awareness about potential fraud and corruption, and to put fraud prevention and response strategies in place.

In addition to the generic risks and mitigation strategies identified below, the CSIR has also developed and maintains a CSIR Fraud Risk Register as a sub-set of the overall organisational Risk Register. The Fraud Risk Register is a key outcome of the risk identification and assessment process and includes all key risks that require a mitigating response.

## E.3

## APPROACH TO FRAUD PREVENTION

### E.3.1 PREVENTING FRAUD

Fraud prevention strategies are the first line of defence and provide the most cost-effective method of controlling fraud within the CSIR. To be effective, fraud prevention requires several contributory elements, including an ethical organisational culture, a strong awareness of fraud among stakeholders and an effective internal control framework.

#### E.3.1.1 THE CODE

The Code establishes clear guidelines for contracted and non-contracted stakeholders of the CSIR regarding the standard of conduct required in their internal and external dealings for and on behalf of the CSIR.

The generic risks identified by the CSIR in application of the Code, are as follows:

- As with any compliance requirements, non-compliance to the Code by management and employees or official CSIR representatives will always be a potential risk;
- Lack of awareness and/or inadequate communication and training strategy relating to the Code;
- Employees with low integrity and/or standards of professional conduct seeking to enhance personal benefit; and
- Strict compliance with and acceptance of gifts and strong disclosure elements.

Strict compliance with the Code by employees and CSIR representatives, both in its spirit and content, addresses the aforementioned risks. However, recognising that striving to achieve such a status and culture of compliance in totality is idealistic, the CSIR will pursue the following tactics to improve the professional ethics and conduct of its employees and representatives:

- A hard copy and/or easy access to online soft copy of the Code will be circulated to all employees and CSIR representatives and will be included in induction packs for new employees/representatives;
- All employees will be required to sign a declaration annually, serving as an indication of their understanding of commitment to and compliance with the Code; and
- Relevant aspects of the Code will be included in awareness presentations, training sessions and communication programmes to create awareness thereof among employees and relevant stakeholders. Further objectives of this training will include the following:
  - Assisting stakeholders to understand the meaning of fraudulent and corrupt behaviour,
    - Presenting case studies to assist employees in developing behaviour to articulate and encourage attitudes and values that support ethical behaviour in all conduct, and
    - Communicating the implications of unethical behaviour and its impact for individuals, the workplace, professional relationships, the CSIR, external stakeholders and the public.

The CSIR Manager: Compliance will be responsible for reviewing and reviving the relevance and implementation of the Code, its communication and supportive education. Currently, pending the appointment of this professional, this function rests with the Group Manager: Legal and Compliance assisted by Senior Legal Counsel within the Legal and Compliance portfolio.



### E.3.1.2 SYSTEMS, POLICIES, PROCEDURES, RULES AND REGULATIONS

The CSIR has several systems, policies, procedures, rules and regulations designed to ensure compliance with prevailing legislation and limit the risk of fraud. Fundamentally, all stakeholders should be fully conversant and compliant with these. In addition, several operational measures have been designed to control business activities.

The generic risks identified by the CSIR, in terms of systems, policies, procedures, rules and regulations, are as follows:

- Lack of knowledge and understanding of prevailing policies and procedures among employees;
- Lack of structured awareness and training programmes for employees in applicable policies, procedures, rules and regulations;
- Non-adherence with policies and procedures, as a result of weaknesses in systems and tools;
- Lack of proper delegation; and
- Non-compliance due to an absence of a culture of compliance and shared value system.

The aforementioned risks suggest that controls should be reviewed continuously to secure tolerable levels of compliance.

The CSIR recognises that its employees are often best placed to identify shortcomings or weaknesses in systems and procedures. Therefore, it is committed to harnessing this knowledge through the development of a structured programme aimed at encouraging employee commitment and effort in reporting such weaknesses.

In addition, the CSIR will undertake the following actions to mitigate the risks identified:

- A training programme on the Code, being finalised by Legal and Compliance, working collaboratively with the Communications unit of the CSIR, will be implemented vigorously throughout the calendar year 2022, and consistently into the future. It will take the form of in-person training (within existing Covid-19 protocols), online tuition, CSIR Intranet snippets, etc.
- Creative re-launch of the whistle blower hotline through awareness days, employee competitions, posters, etc., all with emphasis on its purpose, processes, proper use, implications for its abuse and acceptance by stakeholders.
- Review of other CSIR policies that may conflict with the Code to bring them to harmony with the Code's core principles and prescribed procedures.
- Distribution of pocket-size and/or access to online copy, as the circumstances may demand, of quick reference booklet on the Code to employees.
- Internal audits and ad hoc risk assessments, either in accordance with a combined assurance plan or due to a perceived risk, will be undertaken to monitor and evaluate the extent of compliance with policies and procedures. This exercise may also take the form of surprise audits in areas of the organisation identified as of high risk or strategic importance where an undetected incident of fraud could have seriously devastating effect.
- In instances where breaches occur, swift and appropriate disciplinary action will be undertaken to set an example to other potential wrongdoers.
- Staff and third-party or stakeholder (security) vetting. This exercise involves checks on employment references, criminal records, civil judgement records, disciplinary records, insolvency enquiries, connection with other businesses, validity of qualification and the like on prospective employees.
- A specific effort will be made to ensure that measures are put in place for the censure of suppliers and/or other providers of goods and/or services who are found guilty of unethical conduct or other irregularities. Any employee found to be colluding with suppliers will be subjected to immediate disciplinary action with a possible sanction of dismissal and/or personal liability for losses suffered.

### E.3.1.3 DISCIPLINARY CODE AND PROCEDURE

The CSIR Disciplinary Code and Procedure prescribes appropriate steps to be taken to resolve disciplinary matters. The identified risks of fraud regarding discipline and the application thereof are as follows:

- In some instances, the disciplinary process is too lengthy;
- Inadequate training of investigating officers presenting the case and parties chairing or adjudicating the charges;



- Inadequate maintenance and security of source documents to be used at disciplinary, criminal and civil proceedings; and
- Inconsistent application of rules, disciplinary actions and outcomes.

The CSIR recognises that the consistent, fair and efficient application of disciplinary measures is an integral component of making the FPP a success. The CSIR will continue to pursue the following steps to ensure the consistent, efficient and speedy application of disciplinary measures:

- Review and re-align the Disciplinary Code and Procedure by HC department by specifically establishing offences premised on the breach of principles and rules laid down in the Code; and working with Legal and Compliance portfolio, create a continuous training and awareness programme.
- Make sure that all managers are aware of the content of the Disciplinary Code and Procedure, their responsibility for maintaining discipline, the standards of discipline expected of them, the procedure for the application of disciplinary measures and the disciplinary process through communication and awareness exercises.
- Provide ongoing training of managers and investigate officers with regard to the content of the Disciplinary Code and Procedures, the application of disciplinary measures and process, and sustaining this training in conjunction with the Compliance function and HR department.
- Develop a system to facilitate the consistent application of disciplinary measures, e.g. a monitoring system that includes proper record keeping of all disciplinary actions taken.
- Develop a system where managers are held accountable for the management and addressing of misconduct and fraud within their areas of oversight.
- Implement a private and/or public recognition (as circumstances may demand) of those employees and other stakeholders who display conscientiousness by passing on information about fraudulent activities.

### E.3.1.4 INTERNAL CONTROLS

This section of the FPP relates to basic internal controls to prevent and detect fraud. The systems, policies, procedures, rules and regulations of the CSIR prescribe various controls, which, if effectively implemented, will limit fraud within the CSIR. It being recognised that the categories contain overlapping elements, these controls may be categorised as follows:

- Prevention controls: These are divided into two sub-categories, namely:
  - Authorisation, and
  - Physical;
- Detection controls: These are divided into four categories, namely:
  - Quality assurance,
  - Physical,
  - Supervision, and
  - Management Information; and
- Segregation of duties.

#### E.3.1.4.1 Prevention Controls

- Authorisation: All transactions require authorisation or approval by a responsible person with the appropriate authority limits. The authority limits are specified in the CSIR Approval Framework, the latter having been recently reviewed and approved by the Board.
- Physical: These controls are mainly concerned with the custody of assets and involve procedures and security measures designed to ensure that access to assets is limited to personnel who have been duly authorised, in writing. The CSIR Fixed and Movable Assets Policy governs the controls associated with the recognition, de-recognition, financing and transfer of assets.

#### E.3.1.4.2 Detection Controls

- Arithmetic and accounting: These are basic controls within the recording function that check that transactions to be recorded and processed have been authorised and that they are completely and correctly recorded and accurately processed. Such controls include checking the arithmetical accuracy of the records, the maintenance and checking of totals, reconciliation and accounting for documents.



- Physical: These controls relate to the security of records. Therefore, they underpin arithmetic and accounting controls. Their similarity to preventive controls lies in the fact that they are also designed to limit access to unauthorised persons.
- Supervision: This control relates to managers' supervision of day-to-day transactions and the recording thereof.
- Management information: This relates to the review of management accounts and budgetary control. These controls are normally exercised by management outside the day-to-day routine of the system.

#### **E.3.1.4.3 Segregation of Duties**

The lack of segregation of duties, or the overriding of existing internal controls, is a generic risk that exposes the CSIR to the inherent risk of fraud and manipulation of data. One of the primary means of control is the separation of those responsibilities or duties, which, if combined, enables one individual to record and process a complete transaction, thereby providing him/her with the opportunity to manipulate the transaction irregularly and commit fraud. Segregation of duties reduces the risk of intentional manipulation or error and increases the element of verification. Functions that should be separated include those of recording, checking, authorisation, approval, custody, execution and, in the case of computer-based accounting systems, system controller functions and daily operations. In the context of fraud, segregation of duties lies in separating either the authorisation or custodial function from the verification function, thus introducing and maintaining the vital checks and balances in the performance of fraud-prone obligations.

To ensure that these internal controls are applied effectively and consistently, deficiencies and non-compliance identified by internal audit will be addressed as follows:

- The CSIR will continue to regularly re-emphasise to all managers that consistent compliance by employees with internal control is in itself one of the fundamental controls in place to prevent fraud. Managers will be encouraged to recognise that internal control shortcomings identified during the course of audits are, in many instances, purely symptoms and that they should strive to identify and address the causes of these internal control weaknesses.
- The CSIR will ensure that the performance appraisal of senior managers will consider the number of audit queries raised and the level of seriousness of the consequent risk to the CSIR, as a result of the internal control deficiency identified. This is intended to raise the level of accountability for internal control by the Accounting Officer and managers. Where managers do not comply with basic internal controls, e.g. non-adherence to the limits of the CSIR Approval Framework, firm disciplinary action will be considered.

#### **E.3.1.5 PHYSICAL AND INFORMATION SECURITY**

- Physical security: Recognising that effective physical security is one of the "front line" defences against fraud, the CSIR will take regular steps to improve it and access control at its sites of operation to limit the risk of theft of assets. The CSIR continues to conduct a regular review of the physical security arrangements at its offices and facilities and improve on weaknesses identified.
- Information security: The CSIR will ensure that employees are sensitised to the risks of fraud associated with poor management of information security on a regular basis to enhance their understanding thereof and the risks to the CSIR associated with poor control over confidential information.

Regular reviews of information and computer security will also be considered. Weaknesses identified during these reviews will be addressed with the respective managers. The CSIR Information Security Policy expresses the CSIR's position and intent to implement, maintain and improve its information security measures.

### **E.3.2 DETECTING, REPORTING AND INVESTIGATING FRAUD**

Detection controls are designed to discover any fraud or corruption as soon as possible after it has occurred. Despite best practice prevention activities, fraud and corruption may occur. The next line of defence is a robust suite of detection strategies to discover any incident of fraud and corruption as soon as possible to minimise any detrimental impacts. The CSIR's detection controls include:

- Maintaining an effective system of internal controls;
- Review and approval of financial transactions;
- Review and approval of management reports;
- Internal and external audits;
- Monitoring and evaluation;





- Data analysis; and
- The CSIR Ethics Hotline Procedure to report allegations of fraud, corruption and unethical conduct.

### E.3.2.1 RESPONSE

The CSIR's response strategies ensure that appropriate mechanisms are in place to:

- Take corrective actions;
- Minimise the impact of fraud and corruption risks;
- Improve prevention and detection strategies; and
- Report any occurrences to the relevant stakeholders.

All identified occurrences of fraud and corruption will be investigated in accordance with the principles enshrined in the Protected Disclosure Act, 2000 (Act 26 of 2000), the CSIR Ethics Hotline Procedure and this FPP. The principles include confidentiality, protection from victimisation and the application of justice.

Key CSIR response strategies include:

- Investigation of all allegations of fraud and corruption;
- Central registry of all fraud and corruption allegations maintained, reported and monitored;
- Disciplinary procedure;
- Review of internal controls post incident;
- Implementation of corrective and preventative actions and recommendations;
- Recovery of losses; and
- Fidelity and employee dishonesty insurance.

### E.3.2.2 FRAUD POLICY AND FRAUD RESPONSE PLAN

The CSIR's policy stance is currently encapsulated in various CSIR policies and procedures, including but not limited to, the CSIR Ethics Statement and Code of Conduct, the CSIR Conditions of Service, CSIR Disciplinary Code and Procedure, CSIR ICT Policy, the IS Policy and the CSIR Ethics Hotline Procedure. To ensure that there is no uncertainty among employees and stakeholders about the policies and procedures that shape the CSIR's approach to fraud, the CSIR has developed, for implementation, a dedicated Fraud Management and Prevention Policy aligned with the FPP and the associated strategy. This policy was approved by Board in July 2021.

### E.3.2.3 WHISTLE-BLOWING AND PROTECTION OF WHISTLE BLOWERS AND THE FALSELY ACCUSED

Based on the Protected Disclosures Act, the CSIR commits itself to guarantee protection to whistle blowers and stakeholders against victimisation and is intended to encourage and enable stakeholders to raise serious concerns without fear of victimisation. To ensure that the protection measures are effective, the hotline is administered by an outside third-party organisation that undertakes strict confidentiality. It is also important for the organisation to get the right CSIR professionals trained in and who understand professional privilege and confidentiality in the conduct of investigations and consistently taking disciplinary action against those who breach this confidentiality and privilege. These professionals are legal counsel and privacy specialist within the Legal and Compliance portfolio, and by virtue of their training and work appreciate legal the principles of confidentiality and legal privilege and the serious effects of a breach of these. Through education and screening reported cases to establish *prima facie* facts and evidence pointing to possible misconduct or breach of the Code and, where necessary, taking disciplinary action against the false accusers, the CSIR aims to limit incidents of abuse.

The protected disclosures set-up must also possess the ability to identify hoax calls or reports and allegations that spring from personality clashes or possess political or racial undertones that do not by themselves seek to point to a suspected fraud and corruption incident. The identification of these is cardinal in ensuring the integrity of the hotline and avoiding wasting the organisation's resources on chasing wild geese.



## E.3.3 FURTHER IMPLEMENTATION AND MAINTENANCE

### E.3.3.1 CREATING AWARENESS

This component of the plan comprises two approaches, namely, education and communication.

Key CSIR response strategies include:

- Education: The CSIR will ensure that regular presentations and formal training are carried out for employees to enhance their understanding of the manifestations of fraud, prevention and detection techniques and the components of the FPP.
- Communication: Communication is crucial in creating awareness of the FPP among employees and other stakeholders. This is intended to facilitate a culture where all stakeholders strive to make the FPP a success and sustain a positive, ethical culture within the CSIR. This will increase the prospect of fraud being reported and improve the CSIR's prevention and detection ability.

The CSIR will continuously consider various means of communicating its fraud prevention initiatives, including the following:

- Conducting workshops and creating awareness about the FPP;
- Developing a poster campaign aimed at all stakeholders to advertise the CSIR stance to fraud and its expectations with regard to the ethics and integrity of all stakeholders;
- Circulating appropriate sections of the Code to other stakeholders and integrating by reference, giving a web link to, the Code into all contracts, e.g. consultants and contractors;
- Publicising "lessons learned", following investigations into allegations of fraud among employees;
- Circulating successes related to the FPP and fraud modus operandi;
- Placing notices or other communiqués related to the FPP on notice boards and other areas to which employees and the public have access;
- Giving copies of the Code to suppliers of goods and services and seeking commitments from them, in writing, as a precondition to contracting with the CSIR;
- Developing promotional items communicating the FPP or components thereof; and
- Using the Intranet to communicate issues relating to the prevention and detection of fraud, including matters reported and action taken.

#### **E.3.3.1.1 Combined Assurance Forum**

The CSIR has established an operationally based combined assurance collaboration forum to steer and take responsibility for the FPP and ensure the effective implementation thereof in support of combined assurance and to ensure that key fraud risks are being managed appropriately in the CSIR.

The objectives of the combined assurance forum are mainly to:

- Identify and specify the sources of assurance over the CSIR's risks;
- Provide the ARC, HRSEC, Accounting Officer and Executive Management with a framework of the various assurance parties;
- Establish a combined assurance strategy and plan;
- Link risk management activities with assurance activities;
- Assist the Accounting Officer with reviewing the effectiveness of the risk management system; and
- Provide a basis for identifying any areas of potential assurance gaps.

The forum is responsible for the ongoing maintenance and review of the FPP, including:

- Evaluating reports of fraud and highlighting areas of risk within the CSIR;
- Considering fraud threats to the CSIR and addressing them;
- Monitoring action taken to implement recommendations relating to incidents of fraud;
- Steering and taking responsibility for the FPP;
- Reviewing and making appropriate amendments to the FPP;



- Continuous monitoring of the effectiveness of controls already in place and making improvements where necessary; and
- Ensuring that ongoing implementation strategies are developed and carried out.

### E.3.3.2 CONTROL ENVIRONMENT

The CSIR's ARC and HRSEC significantly influence the fraud control environment, particularly by setting the tone at the top. This is done in the discharge of its duties in terms of the PFMA and Treasury Regulations.

The ARC and HRSEC systematically oversee and periodically review the internal controls established by the management of CSIR. Oversight extends to:

- Enterprise risk and fraud risk management;
- The potential for management to override controls or exercise other inappropriate influence over the financial reporting process;
- Mechanisms for employees to report concerns;
- Receipt and review of periodic reports describing the nature, status and eventual resolution of alleged or suspected fraud;
- An internal audit plan that addresses fraud risk, and a mechanism to ensure that internal audit can express any concerns about management's commitment to appropriate internal controls, or to report suspicions or allegations of fraud;
- The involvement of other experts, such as legal and HR, as needed to investigate any alleged or suspected wrongdoing;
- The review of accounting principles, policies and reasonableness of significant estimates used by the CSIR;
- The review of significant non-routine transactions (if any) entered into by management and employees; and
- Functional reporting by internal and external auditors to the ARC.

### E.3.3.3 INDEPENDENT ASSURANCE

The internal and external auditors will provide an independent assurance on the adequacy and effectiveness of CSIR's internal controls to prevent, detect and manage fraud and corruption. The independent risk assurers will also advise on the effectiveness of the CSIR's FPP.

## E.4

## CONCLUSION

The CSIR proposes a proactive and progressive approach towards managing fraud risk in the organisation. It seeks to make ethics and integrity an intuitive response to ethical dilemmas confronting all CSIR stakeholders. The approach seeks to entrench ethical principles as an important consideration in business transacting and laying a foundation for sustainable collaboration with all stakeholders. This exercise is much in line with the stated EPIC values that aim to make the organisation and its people a blueprint of business morality. Consequently, the CSIR has adopted a zero-tolerance approach towards fraud, theft and corruption and will continue to take the necessary measures to ensure that the risks are managed effectively.



ANNEXURE **F**  
MATERIALITY/  
SIGNIFICANCE  
FRAMEWORK





## F.1

### EXECUTIVE SUMMARY

In terms of Treasury Regulations for government departments, trading entities, constitutional institutions and public entities, issued in terms of the PFMA, the CSIR must have a materiality framework of acceptable levels of materiality and significance within the organisation.

The CSIR's reputation, built over more than half a century, depends on the nature of every business transaction, conducted by every employee, daily. It is built on an implicit set of values, which inspires our employees to maintain the highest ethical standards in all their dealings with our clients and stakeholders, as well as their relationships within the CSIR.

The CSIR is committed to a policy of fair dealing and integrity in conducting its business. This commitment is based on a fundamental belief in honest, fair and legal conduct in all business activities. We expect all our employees to share this commitment to high morals, ethics and legal standards.

Ethics involve the ability to distinguish right from wrong and a commitment to do what is right. Values are core beliefs that create individual attitudes. Although individual values may differ, this does not imply a choice about behaving ethically in the business environment of the CSIR. Our Code of Conduct, as well as the Constitution of the Republic of South Africa and the national laws and regulations, prescribe the legal conduct that embodies values based on ethical principles, while respecting cultural diversity.

## F.2

### TREASURY REGULATION 28.1.5

"For purposes of "material" [sections 50(1), 55(2) and 66(1) of the Act] and "significant" [section 54(2) of the Act], the Accounting Authority must develop and agree on a framework of acceptable levels of materiality and significance with the relevant Executive Authority in consultation with the external auditors."

(HOWEVER, THE CSIR HAS BEEN EXEMPTED FROM SECTION 54 (2) AND THIS SCHEDULE DOES NOT INCLUDE THIS SUBSECTION.)



		Material
Section 50 (1)	<p>(1) The Accounting Authority for a public entity must –</p> <p>(a) Exercise the duty of utmost care to ensure reasonable protection of the assets and records of the public entity;</p> <p>(b) Act with fidelity, honesty, integrity and in the best interest of the public entity in managing the financial affairs of the public entity;</p> <p>(c) On request, disclose to the Executive Authority responsible for that public entity or the legislature to which the public entity is accountable, all material facts, including those reasonably discoverable, which in any way influence the decision or actions of the Executive Authority or that legislature; and</p> <p>(d) Seek, within the sphere of influence of that Accounting Authority, to prevent any prejudice to the financial interests of the state.</p>	<p>Significant audit findings that could negatively impact on the CSIR's operations and the attainment of strategic goals.</p> <p>The CSIR sets high standards on fidelity, honesty and integrity. The best interest of the public entity is always relevant in fulfilling its mandate and in the execution of the Shareholder's Compact. Any acts of dishonesty, infidelity and others that are not in the best interests (from a research, financial and reputation perspective) of the CSIR are viewed in a serious manner.</p> <p>The CSIR is committed to disclosing any relevant information to its stakeholders. Materiality can only be determined if the nature of the information is known.</p> <p>The CSIR employs an ongoing ERM System, as well as controls that are aimed at the prevention/mitigation of any prejudice to the financial interest of the entity. Lack of the required governance processes, lack of due diligence in conducting business, and fruitless and wasteful expenditure are inherently regarded as material.</p>
Section 55 (2)	<p>(2) The annual report and financial statements referred to by PFMA subsection 55 (1)(d) must –</p> <p>(a) Fairly present the state of affairs of the public entity, its business, its financial results, its performance against pre-determined objectives and its financial position as at the end of the financial year concerned;</p> <p>(b) include particulars of –</p> <p>(i) Any material losses through criminal conduct and any irregular expenditure and fruitless and wasteful expenditure that occurred during the financial year;</p> <p>(ii) Any criminal or disciplinary steps taken as a consequence of such losses or irregular expenditure or fruitless and wasteful expenditure;</p> <p>(iii) Any losses recovered or written off;</p> <p>(iv) Any financial assistance received from the state and commitments made by the state on its behalf; and</p> <p>(v) Any other matters that may be prescribed; and'</p> <p>(c) include the financial statements of any subsidiaries.</p>	<p>Significance/materiality is calculated as 1% of revenue, which amounts to R31 309 000.</p> <p>R1 000 000. All cases are unique and will thus be treated as such. These will be subject to internal audit reviews.</p> <p>R1 000 000. All cases are unique and will thus be treated as such. Issues that inform steps to be taken are:</p> <ul style="list-style-type: none"> <li>• The level of responsibility and position of the person involved;</li> <li>• The affected core business/support/operational; and</li> <li>• The impact on other areas of operation of the CSIR.</li> </ul> <p>R1 000 000 (excluding losses incurred through normal operating activities).</p> <p>Will disclose as prescribed.</p> <p>Will disclose as prescribed.</p> <p>All subsidiaries are consolidated.</p>
Section 66 (1)	<p>(1) An institution to which this Act applies may not borrow money or issue a guarantee, indemnity or security, or enter into any other transaction that binds or may bind that institution or the Revenue Fund to any future financial commitment, unless such borrowing, guarantee, indemnity, security or other transaction –</p> <p>(a) Is authorised by this Act;</p> <p>(b) In the case of public entities, is also authorised by other legislation not in conflict with this Act; and</p> <p>(c) In the case of loans by a province or a provincial government business enterprise under the ownership control of a provincial executive, is within the limits as set in terms of the Borrowing Powers of Provincial Governments Act, 1996 (Act 48 of 1996).</p>	<p>The CSIR complies with this requirement.</p>



ANNEXURE **G**  
FINANCIAL  
PLAN





G.1

CSIR BUDGET AND PG CASHFLOW 2022/23

**G.1.1 CSIR STATEMENTS OF COMPREHENSIVE INCOME OVER THE MTEF PERIOD**

**Table G1: Statement of Comprehensive Income – MTEF Period**

	Forecast	Budget	Estimate	Estimate
	2021/2022	2022/2023	2023/2024	2024/2025
	R'000	R'000	R'000	R'000
<b>Total Operating Revenue</b>	<b>2 635 537</b>	<b>2 903 138</b>	<b>3 444 843</b>	<b>3 596 343</b>
<b>R &amp; D Contract Income</b>	<b>1 903 100</b>	<b>2 157 023</b>	<b>2 695 874</b>	<b>2 811 690</b>
Public - South Africa	1 368 000	1 485 100	1 831 436	1 904 693
Private - South Africa	217 200	337 900	462 013	485 114
International	184 100	207 600	272 008	285 608
Parliamentary Grant - Ringfenced	133 800	126 423	130 417	136 274
<b>Parliamentary Grant</b>	<b>725 537</b>	<b>741 615</b>	<b>744 469</b>	<b>777 903</b>
<b>Royalty Income</b>	<b>6 900</b>	<b>4 500</b>	<b>4 500</b>	<b>6 750</b>
<b>Other Income</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Total expenditure</b>	<b>2 734 500</b>	<b>2 959 200</b>	<b>3 475 607</b>	<b>3 621 168</b>
Employees' Remuneration	1 552 700	1 653 500	1 960 883	2 047 161
Operating Expenses	1 030 400	1 104 800	1 338 664	1 394 425
Depreciation	151 400	200 900	176 061	179 582
<b>Operating Profit before Investment Income</b>	<b>(98 963)</b>	<b>(56 062)</b>	<b>(30 764)</b>	<b>(24 826)</b>
Net Finance Income	44 600	50 700	37 038	37 779
<b>NET PROFIT/(LOSS)</b>	<b>(54 363)</b>	<b>(5 362)</b>	<b>6 274</b>	<b>12 953</b>





## G.1.2 CSIR STATEMENTS OF FINANCIAL POSITION OVER THE MTEF PERIOD

**Table G2: Statement of Financial Position over the MTEF Period**

Statement of financial position	Forecast	Budget	Estimate	Estimate
	March 2022	March 2023	March 2024	March 2025
	R'000	R'000	R'000	R'000
<b>ASSETS</b>				
<b>Non-Current assets</b>	<b>869 141</b>	<b>928 041</b>	<b>871 980</b>	<b>812 397</b>
Property, plant, equipment, and lease assets	862 097	920 997	864 936	805 353
Interest in Joint Ventures and Associates	2 394	2 394	2 394	2 394
Interest in Subsidiaries	4 650	4 650	4 650	4 650
<b>Current Assets</b>	<b>775 118</b>	<b>745 890</b>	<b>904 884</b>	<b>976 908</b>
Trade and other receivables	316 264	348 377	413 381	431 561
Inventory and contracts in progress	(579 818)	(638 690)	(757 865)	(791 195)
Cash and cash equivalents	1 038 672	1 036 204	1 249 369	1 336 542
<b>TOTAL ASSETS</b>	<b>1 644 259</b>	<b>1 673 931</b>	<b>1 776 864</b>	<b>1 789 305</b>
<b>EQUITY AND LIABILITIES</b>				
<b>Reserves</b>	<b>1 182 392</b>	<b>1 177 030</b>	<b>1 183 304</b>	<b>1 196 257</b>
Retained earnings	1 182 392	1 177 030	1 183 304	1 196 257
<b>Non-current liabilities</b>	<b>20 970</b>	<b>20 304</b>	<b>19 719</b>	<b>19 207</b>
Post retirement medical benefits and lease liabilities	20 970	20 304	19 719	19 207
<b>Current Liabilities</b>	<b>440 897</b>	<b>476 597</b>	<b>573 841</b>	<b>573 841</b>
Advances received	131 777	145 157	172 242	172 242
Trade and other payables	309 120	331 440	401 599	401 599
<b>TOTAL EQUITY AND LIABILITIES</b>	<b>1 644 259</b>	<b>1 673 931</b>	<b>1 776 864</b>	<b>1 789 305</b>

One needs to consider the budgeted cash balance of R1.03 billion in conjunction with the current liabilities of R476 million. The current ratio (current assets/current liabilities) is expected to remain at approximately 2.



### G.1.3 CSIR CASHFLOW STATEMENT

**Table G3: CSIR Cashflow Statement**

Cashflow statement	MARCH 2022	MARCH 2023	MARCH 2024	MARCH 2025
	R'000	R'000	R'000	R'000
<b>Cashflow from operating activities</b>				
Cash receipts from external customers	1 819 445	2 201 663	2 781 630	2 800 260
Parliamentary Grant income	725 537	741 615	744 469	777 903
Cash paid to suppliers and employees	(2 544 191)	(2 735 980)	(3 229 387)	(3 408 256)
<b>Cash generated from operating activities</b>	<b>791</b>	<b>207 298</b>	<b>296 711</b>	<b>169 907</b>
Net finance income	44 600	50 700	37 038	37 779
<b>Net cash from operating activities</b>	<b>45 391</b>	<b>257 998</b>	<b>333 749</b>	<b>207 686</b>
<b>Cashflow from investing activities</b>				
Acquisition of property, plant and equipment	(259 800)	(259 800)	(120 000)	(120 000)
<b>Net cash utilised in investing activities</b>	<b>(259 800)</b>	<b>(259 800)</b>	<b>(120 000)</b>	<b>(120 000)</b>
<b>Cashflow from financing activities</b>				
Decrease in non-current liabilities	(756)	(666)	(585)	(512)
<b>Net cash generated from financing activities</b>	<b>(756)</b>	<b>(666)</b>	<b>(585)</b>	<b>(512)</b>
<b>Net increase in cash and cash equivalents</b>	<b>(215 165)</b>	<b>(2 468)</b>	<b>213 164</b>	<b>87 173</b>
<b>Cash and cash equivalents at beginning of the year</b>	<b>1 253 837</b>	<b>1 038 672</b>	<b>1 036 204</b>	<b>1 249 369</b>
<b>Cash and cash equivalents at end of the year</b>	<b>1 038 672</b>	<b>1 036 204</b>	<b>1 249 369</b>	<b>1 336 542</b>

### G.1.4 TWELVE-MONTH CASHFLOW PROJECTION FOR PG: 2022/23 (INCLUDING VAT)

**Table G4: Cashflow for PG**

R'000	Total	April	July	October	January
	<b>1 353 706</b>	338 427	338 427	338 427	338 425
Baseline	852 857				
National Laser Centre	40 968				
Laser Loan Programme	12 027				
African Laser Centre	6 570				
WEF Affiliate Centre	17 279				
Implementation: ICT R&D Roadmap	72 568				
Infrastructure Programme	66 000				
Cyber Infrastructure (NICIS)	285 437				



## G.1.5 PPE BUDGET SUMMARY

**Table G5: PPE Budget Summary**

Category	2022/23
	R'000
Buildings	25 400
Equipment	84 300
ICT equipment	70 900
Furniture and fittings	78 700
Vehicles	500
<b>TOTAL</b>	<b>259 800</b>

The budgeted investment in property, plant and equipment for the 2022/23 financial year is R259.8 million, which includes fully funded grant assets.

Notwithstanding the fact that an item is included in the property, plant and equipment budget, the investment remains subject to approval as per the Approval Framework of the CSIR and additional considerations such as strategic alignment, return on investment and available cash flow.

## G.1.6 ALIGNMENT OF PG BUDGET AND STRATEGIC OBJECTIVES

**Table G6: Link between PG and CSIR Strategic Objectives**

PG ALLOCATION DESCRIPTION	2022/23 Allocation (incl VAT) R'000	Strategic Objectives
<b>Total Baseline Allocation</b>	<b>R 852 857</b>	
<b>Baseline Allocation to Clusters</b>	R 366 875	SO1,SO2 & SO3
<b>Portfolios and Support Functions</b>	R 226 547	
Leadership Team	R 38 658	SO5
Campus Master Plan Office	R 2 993	SO4
Internal Audit	R 10 051	SO5
CSIR Board and sub committees	R 3 095	SO5
Research and Development Office	R 12 382	SO1,SO2 & SO3
Planning and Knowledge Mgmt	R 28 270	SO1,SO2 & SO3
BEI Operations	R 14 290	SO1,SO2 & SO3
Facilities and Security Services	R 2 651	SO1,SO2 & SO3
Strategic Communications and Stakeholder Relations	R 18 808	SO5
Legal and Enterprise Risk Management	R 18 108	SO5
Compliance	R 6 383	SO5
Knowledge Commons	R 3 648	SO5
Information and Communication Technology	R 38 229	SO5
Human Capital	R 28 982	SO4
<b>Capability Development Programs (Previously: Strategic Programmes) - Thematic</b>	<b>R 179 246</b>	
Research Centres	R 51 750	SO1,SO2 & SO3



PG ALLOCATION DESCRIPTION	2022/23 Allocation (incl VAT) R'000	Strategic Objectives
New Capability Development Initiatives (Thematic Programme)	R 50 107	SO1,SO2 & SO3
RDI Infrastructure	R 11 500	SO4
Human Capital Skills Development	R 52 088	SO1,SO2 & SO3
Young Researcher Establishment Fund (YREF)	R 13 800	SO4
<b>Commercialisation and Technology Transfer (Thematic)</b>	<b>R 17 825</b>	
Commercialisation Seed Fund	R 5 750	SO1, SO2 & SO3
Technology Demonstrator Fund	R 9 200	SO1,SO2 & SO3
Technogy Commercialisation (APEX)	R 0	SO1,SO2 & SO3
<b>Governance Structures and CSIR Committees</b>	<b>R 1 840</b>	
Research Ethics Committee	R 690	SO4
PG Investment Committee & Industry Panel	R 1 150	SO4
<b>Strategic Fund (Discretionary Special Initiatives)</b>	<b>R 60 525</b>	
Communications Projects / Rebranding	R 3 450	SO5
COVID - PPE	R 1 319	SO5
Health & Wellbeing	R 1 150	SO4
Legal Matters	R 1 725	SO5
Synapse	R 3 283	SO5
Mining Innovation Strategy Development	R 0	SO5
Exco initiatives	R 49 597	SO1,SO2 & SO3
<b>Ring-Fenced Allocations</b>	<b>R 497 183</b>	
Implementation :ICT R&D Strategy	R 72 568	SO2 & SO3
WEF Affiliate Centre	R 17 279	SO2 & SO3
National Laser Centre	R 40 968	SO2 & SO3
African Laser Centre (NLC)	R 6 570	SO2 & SO3
Laser Loan Program (NLC)	R 12 027	SO2 & SO3
Infrastructure Programme	R 66 000	SO2 & SO3
Cyber Infrastructure	R 281 771	SO2 & SO3
<b>Total</b>	<b>1 350 040</b>	



**Table G7: MTEF allocation to the CSIR (excl. VAT)**

Category	2021/22	2022/23	2023/24	2024/25
	R'000	R'000	R'000	R'000
<b>Baseline Parliamentary Grant</b>	<b>725 537</b>	<b>741 615</b>	<b>744 469</b>	<b>777 903</b>
Parliamentary Grant	725 537	741 615	744 469	777 903
<b>Ring fenced allocation</b>	<b>418 509</b>	<b>435 520</b>	<b>439 483</b>	<b>459 219</b>
Laser Loan Programme	10 085	10 458	10 498	10 970
National Laser Centre	34 353	35 624	35 760	37 366
African Laser Centre	5 510	5 713	5 735	5 992
WEF Affiliate Centre	24 672	15 025	5 179	-
Implementation: ICT R&D Strategy	50 668	63 103	73 245	81 946
Infrastructure Programme	53 913	57 391	59 917	62 607
National Integrated Cyber Infrastructure System (NICIS)	239 308	248 206	249 149	260 338
<b>TOTAL</b>	<b>1 144 046</b>	<b>1 177 135</b>	<b>1 183 952</b>	<b>1 237 122</b>

G.2

FIVE-YEAR BORROWING PLAN

**Table G8: CSIR 5-year Borrowing Plan**

Financial year ending	Total annual limit
	R million
31 Mar 22	922
31 Mar 23	1 088
31 Mar 24	1 144
31 Mar 25	1 144
31 Mar 26	1 144



# ANNEXURE H

## CSIR TOP RISKS REGISTER





31 Mar 27

1 144

The top risks identified have a specific focus on the significant factors (internal and external) that have a direct impact on the CSIR’s business. These factors have a potential negative impact on the CSIR’s ability to achieve its strategic objectives and goals.



**Legend:**

	Critical Risk		High Risk
	Medium Risk		Low Risk



**SYSTEMIC RISKS:**

These are risks that originate from macro-economic and national challenges affecting the NSI and National Government Business Enterprise space in which the CSIR operates.

Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No. 1 – Regulatory environment: Inter-governmental/public sector procurement</b>						

Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
CSIR's inability to become a service provider of choice to government departments, constitutional institutions and public entities due to legislative constraints relating to procurement	External	<ul style="list-style-type: none"> <li>Loss of business opportunities</li> <li>Loss of revenue</li> <li>Lack of financial sustainability</li> <li>Inefficiency in resource utilisation dealing with protracted exemption processes and motivations</li> <li>Achieving SO3 supporting the development of a capable state and enabling government to drive the socioeconomic transformation of South Africa through RD&amp;I impacted</li> <li>Could also impact delivery against SO1 and SO2</li> </ul>	High 	<ul style="list-style-type: none"> <li>NT treats procurement among departments, constitutional institutions and public entities as standard public sector procurement governed by the PFMA and applicable Regulations requiring competitive bidding</li> <li>Exemptions for procurement deviation are available on a case-by-case basis, but no blanket exemption available</li> <li>Exemptions secured have long lead times (NT reluctance to approve exemptions for departments, constitutional institutions and public entities to procure and contract services from the CSIR without full procurement process prescribed by PFMA and applicable Regulations)</li> </ul>	<ul style="list-style-type: none"> <li>Reduce high dependency on public sector income</li> <li>Increase private sector income stream</li> <li>Develop and implement pre-defined exemption process and supporting templates</li> <li>Long-term lobby for pre-determined/special exemptions based on motivated service offering</li> </ul>	CFO, supported by Exco, Business development executives and Cluster executives)
<b>Risk No. 2 Local economic downturn in local activity, growth and/or recovery</b>						
Downturn in local economic activity, growth and/or recovery.	External	<ul style="list-style-type: none"> <li>Loss of business opportunities</li> <li>Loss of revenue</li> <li>Lack of financial sustainability</li> </ul>		<ul style="list-style-type: none"> <li>Fiscal constraints in terms of funding ability and public sector spend</li> <li>General business failures and distress negatively affecting industry collaborations and new business opportunities for the CSIR</li> <li>Fiscal damage caused by Covid-19 and many sectors are battling to get going again post lockdown</li> <li>Rating agency downgrades to junk status</li> </ul>	<ul style="list-style-type: none"> <li>Move into new areas of business and capability building (consider new income streams)</li> <li>Position CSIR services to attract global demand</li> <li>Downscaling the business size/capabilities</li> <li>Reposition value proposition to the market (capabilities and ability to diversify)</li> <li>Increase resilience</li> <li>Engage with banks and fund managers to identify alternative investment instruments to increase returns on cash investments</li> </ul>	CFO, supported by Exco, Business development executives Cluster executives)
<b>Risk No. 3 Global economic downturn</b>						



Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
Contraction in global economy affecting international business opportunities and collaboration efforts	External	Loss of business opportunities Loss of revenue Lack of financial sustainability	High 	Contraction in global economy affecting international business opportunities and collaboration efforts Downgrading by rating agencies Pro-longed impact of Covid-19 pandemic	Move into new areas of business and capability building (consider new income streams) Position CSIR services to attract global demand Downscaling the business size/capabilities Reposition value proposition to the market (Capabilities and ability to diversify). Increase resilience Engage with banks and fund managers to identify alternative investment instruments to increase returns on cash investments	Group Executive: Business Intelligence and Excellence, supported by Exco, Business development executives and Cluster executives)
<b>Risk No. 4 – Regulatory Constraints – Disaster Management Act, 2002 (Act 57 of 2002)</b>						
Covid-19 regulatory environment Lockdown regulations and related impact on business activities	External	Impact on SO1 to SO5 Delay, deferral and cancellation of strategic programmes and projects. Loss or business opportunities Loss or revenue Lack of financial sustainability	Medium: 	The CSIR has implemented specific protocols to curb the virus spread among its staff, contractors, tenants, and visitors. Covid-19 stats reported by the organisation suggest that the current controls/protocols are effective. Impact imposed by different adjusted risk response levels. Covid-19 waves resulting in stringent government controls and protocols to curb the spread of the virus. Some pockets of the society not willing to take vaccination (Vaccine hesitancy) Prevalence of new COVID-19 variants	Implementation of CSIR specific protocols and controls to curb the spread of Covid-19 (in line with national and international regulations and guidelines). Introduced hybrid working model to reduce and restrict campus activity	Group Executive: Legal, Compliance and Business Enablement (support by Specialist from the SHEQ department and the CSIR Incident Response Team/IRT)


**STRATEGIC RISKS:**

These are risks that directly impact on the ability of the CSIR to deliver on its mandate.


**SO1: CONDUCT RD&I OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION**

Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No. 5 Lack of a balanced IP Portfolio</b>						



Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<p>Portfolio of IP offerings too short-term focussed and lacking in long-term sustainability; IP Portfolio not fit for purpose</p> <p>Inability to remain cutting edge with market leading IP offerings balanced with adequate portfolio maturity</p>	Internal	<p>Impacts SO1, but also SO2 and SO4</p> <p>Inability to be agile and responsive to market demands</p> <p>Unsustainable commercial relevance</p> <p>Limited financial sustainability</p>	<p>Medium</p> 	<p>Lacking quantitative data and market intelligence to inform market demands</p> <p>competitive intelligence analysis, involving a comparative benchmark and a survey of the current and potential competitor landscape</p> <p>IP capabilities generally have a short-term/relative monopoly in the market they require revamping/changes to remain relevant and competitive</p> <p>Inadequate capability development and relevance for continued sustainability</p>	<p>Improve current technology offerings for short-term and long-term sustainability.</p> <p>New investment into IP and portfolios/capability development</p> <p>Develop frameworks, guidelines, tools for market intelligence at different tiers of technology maturity, TRL5 and below and TRL 6 and above and provide support in priority cases]</p> <p>Division 3 intends to assess 22/23 PG investment proposals for potential IP pipeline and implications on the balance, including stage-gate process</p> <p>Institutionalising or deepening of the IP accretive approach to the development and management of IP and technology (balancing the extent of IP assignment versus IP access and usage rights paradigms/ approaches in contract R&amp;D so as to preserve and strengthen the IP base)</p>	<p>Divisional Executives, Cluster Executives, supported by the BD&amp;C managers</p>

**Risk No. 6 – Inadequate IP Portfolio investment and commercialisation**


<p>Over-investment in IP assets that are no longer strategic or do not provide return</p> <p>Insufficient and/or lacking commercialisation resources</p> <p>Undertaking technology development and/or commercialisation transactions or arrangements that result in suboptimal realisation of value from IP</p> <p>Lack of effective commercialisation models and/or vehicles</p>	Internal	<p>Negative impact on long-term sustainability</p> <p>Under-investment due to limited scope for proceeds and returns from IP commercialisation</p> <p>Erosion of IP base</p> <p>Potential loss of capability</p>	<p>Medium</p> 	<p>Lacking quantitative data and market intelligence to inform IP assets value and return on investment (ROI) – monitor the company’s intellectual property rights (IPR), particularly commercial status (e.g. licences granted and obtained, etc.), financial status (e.g. royalties received and paid, etc.) and compliance status (e.g. non-contentious or litigious counterfeiting procedures, etc.)</p> <p>Limited funds to invest in commercialisation resource development/acquisition</p> <p>Diverse IP Portfolio requiring longer lead times to achieve commercialisation capability maturity</p>	<p>Implementation of centralised knowledge management system with quantitative data on IP Portfolio</p> <p>IP and Licence Management System should include a reference number to indicate existence of a relevant trade secret</p> <p>Sharing best practices across the CSIR</p> <p>Strengthen pre and post-investment capabilities for due diligence, valuation and active portfolio monitoring, evaluation and management</p> <p>Integrated IP and Licence Management system, including tracking of licensee performance, royalties, audit proceedings, litigation, etc.</p> <p>Develop and implement commercial investment policy and decision-making process</p>	<p>Group Executive: Business Excellence and Integration supported by Cluster Executives and BD&amp;C managers</p>
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**SO2: Improve the competitiveness of high-impact industries to support South Africa’s re-industrialisation by collaboratively developing, localising, and implementing technology**


Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
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**Risk No. 7 Inadequate strategic collaboration and partnering**



<p>Insufficient number of “productive” strategic partnerships and collaborators that build financial sustainability and position the CSIR with respect to the new strategy</p> <p>Limited internal capacity to convert opportunities into increased financial returns for the CSIR</p> <p>Inadequate and ineffective enabling internal CSIR policy, framework, and governance to formalise/ regulate income generating strategic partnerships and collaboration</p>	<p>Internal</p>	<p>Inability to contribute to the competitiveness of industry Diminished relevance to industry Long lead times to completing transactions Frustration of partners with respect to speed of • closing commercialisation transactions Partners seeking R&amp;D capacity outside the CSIR Partners avoiding CSIR Poor financial sustainability</p>	<p>High</p> 	<p>Poor market visibility of CSIR and/or its capabilities, offerings, technologies, products, etc. Lack of attractiveness for industry and potential investors Limited local industry financial capacity and appetite for investment in RD&amp;I Lack of uniformity on the institutionalisation of the BD&amp;C function Low capacity to process high demand/volume of commercial opportunities within reasonable time-scales: number of suitable qualified, experienced individuals to get this done (BDC capacity)</p>	<p>Institutionalisation of the BD&amp;C functions (common and uniform application across the business) Development of guidelines and best practise in management of strategic partnerships CSIR wide effort by Business Excellence and Integration Build and solidify track record in innovatively packaging, negotiating and realising high impact technology development and commercialisation initiatives with partners</p>	<p>Group Executive: Business Excellence and Integration and BD&amp;C</p>
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**Risk No. 8 – Marketing, brand positioning and communication**

<p>Marketing and brand positioning lacking business and technology intelligence, including ineffective marketing of the CSIR portfolio/ capabilities</p>	<p>Internal</p>	<p>Lost or deferred business opportunities Lost or deferred revenue Lack of financial sustainability Impact delivery against SO 1 to SO3</p>	<p>Medium</p> 	<p>CSIR Marketing and Communication Strategy new and under implementation Poor market visibility of CSIR and/or its capabilities, offerings, technologies, products</p>	<p>General marketing and brand positioning directed at increasing the number of strategic partnerships (development of appropriate high-quality passive marketing material including website design, brochures, etc. Our website is not on par with other international institutes) Participation and networking in formal events of industry bodies, OEMs, professional communities of practice, etc. Local and international trade shows Annual technical events. including forums, conferences, etc, Employment of agents in certain territories Launch of CSIR conference Develop and implement appropriate internal policy environment to enable marketing and stakeholder engagement. Implementation of CSIR Marketing and Communication Strategy; positioning RD&amp;I offerings and technologies informed by market intelligence phased delivery</p>	<p>Group Executive: HC and Communication, supported BD&amp;C executives and Cluster Executives</p>
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**SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state**




Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No. 9 Inadequate positioning of the CSIR’s capabilities to support the development of a capable state</b>						
<p>Bureaucratic internal controls hampering the flow of information regarding public entity needs/ opportunities and how it aligns with the CSIR capabilities and offerings</p> <p>CSIR inadequately positioned to secure proactive intelligence of constraints and how its capabilities are aligned to provide solution</p> <p>Low levels of investment by public sector in R&amp;D to service delivery</p>	Internal and external	<p>Lost or deferred business opportunities</p> <p>Lost or deferred revenue</p> <p>Lack of financial sustainability</p> <p>Impact delivery against SO1, SO3, SO4 and SO5</p>	High	<p>Stakeholder engagement protocols not supportive of free information flow</p> <p>Lack of clarity on policy to enable strategic collaboration and partnering</p> <p>Under-prioritisation/low appetite on research, development, and innovation at the highest level, to achieve the country’s development agenda</p> <p>Inadequate profile of capabilities to continuously garner intelligence that feed into solution offering development</p>	<p>Develop and implement stakeholder engagement and management framework</p> <p>Engage with government policymakers to develop and RD&amp;I investment strategy to support the country’s development agenda</p>	Group Executive: Business Excellence and Integration and BD&C


**SO4: Build and transform HC and Infrastructure**

Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No. 10 Inability to attract and retain talent</b>						
Limited capacity to attract and retain core SET skills and expertise (at principal and senior researcher levels)	Internal and external	<p>Loss of knowledge and key capabilities</p> <p>Can impact delivery against all SOs</p>	High	<p>Tough external competition in terms of employee value proposition and packages</p> <p>Lack of internally defined and bankable incentives to reward employees</p> <p>Pouching of staff by competitors as soon as skill or capability reach maturity and inability for retention</p> <p>Reward and recognition programs limited and not aligned with new strategy</p> <p>Lack of modern attractive work environment</p> <p>Lack of agile working environment supported by modern enabling business systems</p>	<p>Improve meaningfulness of the employee value proposition</p> <p>Succession planning to build pipeline and capability</p> <p>Implementation of management and leadership development programmes</p> <p>Collaborations agreements with institutions of higher learning, SETAs and science councils.</p> <p>Benchmark salaries against market and review as appropriate</p> <p>Incentive bonus scheme review</p> <p>Youth Forum and alumni programmes</p>	Group Executive: Human Capital and Communication
<b>Risk No.11 Transformation related to EE demographic representation in occupational levels</b>						
<p>Inadequate in middle and senior management</p> <p>Inadequate in respect of demographic – female and disability</p>	Internal and external	<p>Business sustainability and continuity (impacts on licence to operate)</p> <p>Impact on B-BBEE performance and related tender contract qualification</p>	<p>Medium</p>	<p>Market competition fierce and market pool limited</p> <p>Infrastructure not suited to cater for man disabilities</p>	<p>Diversity and inclusion as part of onboarding</p> <p>Implementation of CSIR Women’s Forum</p> <p>Targeted recruitment of females and people with disabilities in specified roles</p>	Group Executive: Human Capital and Communication
<b>Risk No.12 Obsolete and aging RD&amp;I infrastructure</b>						





Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
Ageing infrastructure prone to failures and downtime, increased and costly maintenance requirements, at risk if becoming irrelevant or obsolete and non-competitive real estate offering internally and externally	Internal	Deterioration in infrastructure leading to frequent breakdowns and lengthy down time High unplanned costs associated with maintenance and unplanned repairs Failure of critical infrastructure impacting ability to deliver against obligations and ultimately on SOs Increasing vacant unproductive space Loss of rental revenue	 Medium	Lack of an effective infrastructure investment model that allows for progressive sustained development and maintenance of infrastructure Reactive infrastructure investment strategy in-state of a proactive and targeted to align with business needs Large investment required, over R350 million in a constrained fiscal environment Grant-funded infrastructure lacking lifecycle maintenance strategy and funding or long-term strategy for repurposing Real estate offering non-competitive in a market flooded with modern, space optimised offerings coupled with attractive set-up packages	Conduct building condition assessment and develop risk-based infrastructure defects rectification plan Develop and implement infrastructure funding model Develop and maintain a rolling five-year investment strategy for infrastructure renewal, upgrade and modernisation Develop space optimisation strategy that considers CSIR occupied space, remote working and leasing mix	Group Executive: Legal, Compliance and Business Enablement

**SO5: Diversify income and maintain financial sustainability and good governance**



Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No. 13 Limited financial guarantee facilities</b>						
Inadequate/limited financial guarantee facilities to allow competitive bidding for local and international projects	External	Exclusion from high-value contract bidding Impact delivery against SO1, SO2 and SO4	 High	Payment and performance guarantees facility value inadequate to support high value growth projects Cumbersome and lengthy process to secure increases in facility guarantee values Initiatives to improve CSIR forecasting framework underway	Improve CSIR forecasting framework Engagement with the Minister (guarantee request does not align with the Shareholder's Compact (SHC)	CFO
<b>Risk No. 14 Capability investment and development misaligned with market trends, technology and demand</b>						




<p>Lack of appropriate balance between cost of capabilities and overhead costs</p> <p>Inadequate strategic investment in capability development for long-term sustainability</p> <p>Inadequate resources to support capability renewal</p>	<p>Internal</p>	<p>Impacts all SOs Unable to offer market leading offerings Inability to be agile and responsive to market demands Unsustainable commercial relevance Limited financial sustainability</p>	 <p>Low</p> 	<p>Historically poor performance on commercialisation and low levels of passive income Poor visibility of CSIR and/or its capabilities, offerings, technologies, products, etc. to public and private entities</p> <ul style="list-style-type: none"> <li>Insufficient attractiveness for state, industry and potential investors</li> </ul> <p>Inappropriate balance between cost of capabilities and overhead costs</p>	<p>Develop and implement methodology of new capability framework Redirecting and reprioritisation of PG investment into priority capabilities Appropriate portfolio management/ability to exit non sustainable capabilities Linking market demand to capability requirements Renewal of demand for capabilities Development for new capabilities</p>	<p>CFO, supported by the Cluster Executives and BD&amp;C Executives</p>
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## OPERATIONAL RISKS:

These include financial, legal and compliance risks and are those risks that affect the systems, people and processes through which the CSIR operates.

Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<b>Risk No.15 – ICT Infrastructure failure</b>						
<p>Ageing and obsolete infrastructure</p>	<p>Internal</p>	<p>Downtime of key systems and tools</p>	 <p>High</p> 	<p>New ICT and roadmap approved and being implemented Phased approach to ICT investment in high-impact areas</p> <p>ICT governance committee steering ICT investments Maintenance and support for the current infrastructure Replacement of old technology infrastructure with latest technology platforms</p>	<p>Implementation of the new ICT Strategy and Roadmap Implement long-term strategy for ICT network refresh. Implement structured investment over 3 years as approved by the CSIR Exco (enable scalable/robust and newer hardware into the ecosystem Implementation and use of cloud-based services Increase external revenue through selling of spare capacity to strategic third-parties (NDoH and Council for Geo-Sciences)</p>	<p>CFO</p>
<b>Risk No. 16 - Lack of integrated business systems</b>						



Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<p>Lack of agile internal operating environment to support innovation</p> <p>Inadequate management system and reporting to provide visible status and progress on programmes</p> <p>Inadequate systems for programme and project management</p> <p>Prohibitive cost of ICT strategy implementation – long lead time to improvement, risk of not realising SOs</p>	Internal	<p>Reduced productivity</p> <p>Increased manpower requirements</p> <p>Manual inputs and processing leading to errors</p> <p>Lack of real-time information in support of effective decision making</p> <p>Inability to deliver projects and programmes on time, budget and brief</p>		<p>Lack of effective and integrated business systems</p> <p>Lack of structured investment approach</p> <p>Lack of long-term strategy and resources</p>	<p>Implementation of the new ICT Strategy, roadmap and supporting operating model.</p> <p>leveraging on the Microsoft investments to enable collaboration and create the base for future investments that will address integration, process automation, reporting, etc.</p> <p>Implement project server, which leverages investment in Microsoft platforms for collaboration</p>	CFO

**Risk No. 17– Information security breach**



Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
<p>Use of potentially vulnerable tools, such as virtual private networks that lack adequate safeguards, amplifying the threat to individuals and organisations</p> <p>Working-from-home arrangements increasing risk of hacking, cyber-attacks and ransom demands</p> <p>Critical patches released by Microsoft and other platforms not implemented/ applied</p> <p>Lack of cyber training and awareness</p> <p>Lack of investment funding for implementation of ERM system</p> <p>Non-compliance with the information security policy, e.g. change control, email policy, anti-malicious code, etc.</p>	Internal	<p>Loss of critical information</p> <p>Greater dependence on technology</p> <p>increased cybersecurity risk profile</p> <p>Business interruptions</p> <p>Bad service delivery reputation</p>	Medium	<p>Approved ICT Strategy and Roadmap</p> <p>Deployment of information security controls (logical access management, intrusion prevention controls, penetration testing, regular monitoring and review)</p> <p>Deployment of security patches released by technology houses</p>	<p>Development of a business cases for information security investment for approval by Exco</p> <p>Develop and implement Information Security roadmap</p> <p>Appoint a service provider for Professional Security Services</p> <p>Roll-out information security awareness campaign.</p> <p>Regular patch updates on key network infrastructure and operating systems</p>	Chief Information Security Officer
<b>Risk No. 18 Physical security failure and mobile asset loss</b>						
Physical security risk/threat to persons and property	Internal	<p>Increase in financial loss/theft of CSIR assets</p> <p>Fatalities and serious injuries to people</p> <p>Destruction/ malicious damage to CSIR property</p> <p>Business disruptions</p> <p>Reduced real estate value proposition</p>	Low	<p>Old/obsolete layers of interdependent security systems that include CCTV surveillance, security guards, protective barriers, locks, access control, perimeter intrusion detection, deterrent systems and other systems designed to protect assets and people</p> <p>Limited funding</p> <p>Guarding outsourcing model that does not allow for objective monitoring and evaluation of contractor performance</p>	Develop and implement an investment plan for security infrastructure upgrade aligned to the organisation security strategy	Group Executive: Legal, Compliance and Business Enablement.
<b>Risk No. 19- Health and Safety:</b>						





Detailed risk description	Risk context	Risk impact	Risk rating	Risk status rationale	Key remedial actions	Action plan owner
CSIR at risk of having a higher number of health, safety and environmental incidents and accidents and legislative penalties	Internal	Increase in: Occupational health hazards Injuries (recordable incidents) Loss of human life Environmental impacts Business disruptions/ stoppage of operations Loss of valuable assets Reputational damage Legal liability associated with fines and penalties, civil claims and potential criminal liability. Inquiry and investigation by authorities Financial loss (if fines are imposed) Non-renewal of annual licensing Damage to reputation	Medium	Poor health and safety culture where safety is not taken seriously, employees are not watchful, are complacent, and compromise too readily on health and safety Non-compliance with established laws, regulations, municipal by-laws and associated best practice. Increased risk to health due to Covid-19 pandemic	Procurement and roll out of integrated SHEQ system, SHEQ Induction for staff, contractors, and tenants,  Conduction legal compliance audits, Revision of Environmental management plan, •	Group Executive: Legal, Compliance and Business Enablement.











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