Annual Performance Plan
2023/24-2025/26

science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation

Statement by the Chairperson of the Board

Prof Mosa Moshabela

Chairperson of the Board

This Annual Performance Plan responds to the country's developmental agenda set out in the National Development Plan (NDP), focusing on the development of key capabilities of both people and the country. The NDP goes on to list these capabilities as skills, infrastructure, social security, strong institutions and partnerships, both locally and internationally.

The National Research Foundation (NRF) welcomes the approval of the Science, Technology and Innovation (STI) Decadal Plan 2022, which emphasises a deliberate focus on harnessing the capabilities built through application of STI over the years in sectors such as health, education, and energy to enhance the state's capabilities for improved service delivery outcomes. The NRF is well positioned to respond and contribute to the STI Decadal Plan aims of a better coordinated and well-resourced National System of Innovation (NSI) that is internationally competitive and responsive to South Africa's national development priorities.

The NRF has an important role to play in the implementation of the STI Decadal Plan and will be working closely with the Department of Science and Innovation (DSI) to ensure that government priorities over the next medium to long term are geared towards achievement of the objectives as set out in the STI Decadal Plan and other government plans including the NDP, the District Development Model (DDM), the Medium-Term Strategic Framework (MTSF) and the Economic Reconstruction and Recovery Plan (ERRP).

The NRF strategic direction premised on research for a better society allows it to adapt its service offerings to support the STI priorities of finding

sources of new economic growth for a re-industrialised, modern economy, modernising existing industries on delivery of innovation outcomes and a growing pace to exploit the Fourth Industrial Revolution (4IR) technologies to advance development and gain a competitive advantage. During the MTEF period, the NRF will go through engagement with the DSI and review its business model for alignment to find an optimal fit to create value that meets stakeholder expectations. The NRF Strategic Plan (NRF Strategy 2025) is in its third year of implementation. The mid-term review towards the end of 2022 was received favourably by the NRF Board, indicative of encouraging progress towards achievement of the strategic outcomes and impact statement of the strategy.

The importance of innovation to economic development has been recognised globally, leading to a greater demand for publicly funded research to yield more innovation outputs as return on investments in research for society. Therefore, the NRF's critical role is that of an enabler through support, promotion and coordination, whereby it contributes to the availability of high-end skills, provision of critical research infrastructure needs, promote excellence in research and maintain national and international inter-organisational networks needed for globally competitive research. During the MTEF period, the NRF will review the geo-political footprint of its partnerships to harness the dividends of science diplomacy for improved developmental outcomes and align with the STI Decadal Plan's priorities for internationalisation of South Africa's science initiatives.

On behalf of the NRF Board, I would like to express our sincere appreciation to the Minister of Higher Education, Science and Innovation, the Honourable Dr Bonginkosi Nzimande, for the Department's support to the NRF and willingness to engage with the NRF Board and Executive Committee. I would also like to express appreciation to the Parliamentary Portfolio Committee on Higher Education, Science and Innovation for their regular and constructive engagements with the NRF. My sincere acknowledgement goes to the NRF Corporate Executive Committee and all staff for their continued commitment to the organisation. I extend my gratitude to my fellow Board members for providing good governance, strategic direction and oversight over the planning process and in guiding the NRF to achieve its vision.

The Accounting Authority (the NRF Board) endorses this Annual Performance Plan and is encouraged by the progress made towards achievement of the strategic outcomes and impact statement of the NRF Strategy 2025.

Prof Mosa Moshabela

Chairperson of the Board

National Research Foundation

Statement by the Chief Executive Officer

Dr Fulufhelo Nelwamondo

Chief Executive Officer

The NRF continues to play a critical role within the National System of Innovation (NSI). In the coming year, the NRF will finalise its new service delivery model aimed at putting emphasis on enhancing innovation capability of the research enterprise to improve its impact on national development and broader society. The NRF has made significant progress towards achieving the targets in its five-year Strategic Plan (NRF Strategy 2025), as outlined in its Strategic Plan Mid-Term Progress Report in November, 2022.

We have entered an exciting era for the NSI, that was ushered in by Cabinet's adoption of the new STI Decadal Plan during the third quarter of the 2022/23 financial year. The STI Decadal Plan provides an exciting opportunity for the NRF to calibrate its investment priorities and reimagine its operations to better contribute to outcomes and planned impact of the NSI. The continuing threat of pandemics, illustrated recently by COVID-19, climate change, water and energy insecurities, and their direct and immediate impact on livelihoods are providing a compelling case for prudent investments in research and innovation. This calls for extensive collaboration between and within disciplines, and institutions across the world to tackle increasing complex societal challenges characterised by multiple interdependencies.

Over the years, the NRF has utilised a range of funding instruments to support STI human capital development and provide for the development of and access to cutting-edge research infrastructure. During the next MTEF period, a review of these funding approaches will be undertaken to optimise allocations of funding that provide for meaningful investment that can reasonably contribute to the resolution of problems of national and global significance. The NRF will also continue to extend

the portfolio Research Infrastructure Platforms (RIPs) in the areas of South Africa's scientific comparative advantage, such as astronomy, biodiversity and heritage. Strategic investments such as South African Research Chairs Initiative (SARChI) and Centres of Excellence (CoEs) will also be improved and rationalised for better alignment with the STI Decadal Plan priorities.

The focus of the work of the NRF over the next MTEF period will be centred on:

- Transformation of postgraduate students and researchers through funding programmes that advance improved success, throughput and excellence.
- Advancing innovation through research support and industry partnerships.
- Research Impact Framework to enhance the innovation and impact of the research enterprise.
- Establishing partnerships with industry to leverage resources for human capacity development and for the development and deployment of innovation outputs.
- Improving the Science Engagement programme to improve delivery of the Science Engagement Strategy.
- Developing and maintaining research infrastructure platforms to remain globally competitive.
- Building on national and international partnerships to improve access to research expertise and research infrastructure.
- Creating an ethical, innovative and high-performance organisational culture.

The NRF continues to leverage strategic partnerships that enable the organisation to pursue its mandate, in collaboration with local and international public and private sector institutions that share mutual interests towards a research enterprise that contributes to national development.

I would like to express my sincere gratitude to the outgoing NRF Board, which has served with diligence the Minister of Higher Education, Science and Innovation in steering the NRF towards a strategic direction of research for societal impact. I also look forward to working closely with the incoming Board in delivering on this performance plan. The immense contribution to the NRF is noted and appreciated by the NRF Executive and its employees. Further appreciation goes to the Department of Science and Innovation (DSI) Director-General and the entire Management of the Department for their continued support and direction in implementing the NRF mandate and STI priorities.

Dr Fulufhelo Nelwamondo

Chief Executive Officer

National Research Foundation

Official Sign-off

It is hereby certified that this Annual Performance Plan:

- Was developed by the management of the National Research Foundation;
- Takes into account all relevant policies, legislation and other mandates for which the National Research Foundation is responsible; and
- Accurately reflects the outcomes and outputs which the National Research Foundation will endeavour to achieve over the period 2023 to 2026.

Mr Bishen Singh

Chief Financial Officer

Dr Fulufhelo Nelwamondo

Chief Executive Officer

Prof Mosa Moshabela

Chairperson of the NRF Board

Approved by:

Dr BE Nzimande, MP

Minister of Higher Education, Science and Innovation

List of Acronyms

AESA	Accelerating Excellence in Science in Africa
ARUA	African Research Universities Alliance
BAAP	Black Academic Advancement Programme
BPF	Budget Prioritisation Framework
CoE	Centre of Excellence
CoPs	Communities of Practice
DAAD	German Academic Exchange Service (in German)
DCEO	Deputy Chief Executive Officer
DHET	Department of Higher Education and Training
DSI	Department of Science and Innovation
ERRP	Economic Reconstruction and Recovery Plan
F'SATI	French South Africa Technology Institute
FCS	Full Cost of Study
FRF	First Rand Foundation
GERD	Gross Expenditure on Research and Development
GKP	Global Knowledge Partnership
HDIs	Historically Disadvantaged Institutions

HEIs	Higher Education Institutions
HICD	Human and Infrastructure-Capacity Development
HIRAX	Hydrogen Intensity and Real-time Analysis eXperiment
HRLS	Human Resources and Legal Services
IKS	Indigenous Knowledge Systems
JINR	Joint Institute for Nuclear Research
LRS	Leading Research and Scholars
LRSP	Leading Researcher and Scholars Programme
MTEF	Medium-Term Expenditure Framework
MTSF	Medium-Term Strategic Framework
NDP	National Development Plan
NEP	National Equipment Programme
nGAP	New Generation of Academics Programme
NIP3	National Institute for the Preparedness and Prevention of Pandemics
NMU	Nelson Mandela University
NITheCS	National Institute for Theoretical and Computational Science
NRF	National Research Foundation

NRIP	National Research Infrastructure Platforms
NSFAS	National Student Financial Aid Scheme
NSF	National Skills' Fund
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
ORTARChI	Oliver Reginald Tambo African Research Chairs Initiative
PDFP	Postdoctoral Fellowship Programme
PIU	Poverty, Inequality and Unemployment
R&D	Research and Development
RG	Reference Group
RIISA	Research, Innovation and Impact Support and Advancement
TIES	Transformation, Impact, Excellence and Sustainability
SAASTA	South African Agency for Science and Technology Advancement
SAIAB	South African Institute for Aquatic Biodiversity
SAEON	South African Environmental Observation Network
SARAO	South African Radio Astronomy Observatory

SARChI	South African Research Chairs Initiative
SARIR	South African Research Infrastructure Road Map
SDGs	Sustainable Development Goals
SGCI	Science Granting Councils' Initiative
SMMEs	Small, Medium and Micro Enterprises
SRE	Strategic Research Equipment
STA	Science and Technological Activities
STET	Scientific and Technical Education and Training
STI	Science, Technology and Innovation
STS	Scientific and Technological Services
TID	Technical Indicator Description
TIES	Transformation, Impact, Excellence and Sustainability
TVET	Technical and Vocational Education and Training
UKZN	University of KwaZulu-Natal
WP STI	White Paper on Science Technology and Innovation
WP-PSET	White Paper on Post-School Education and Training

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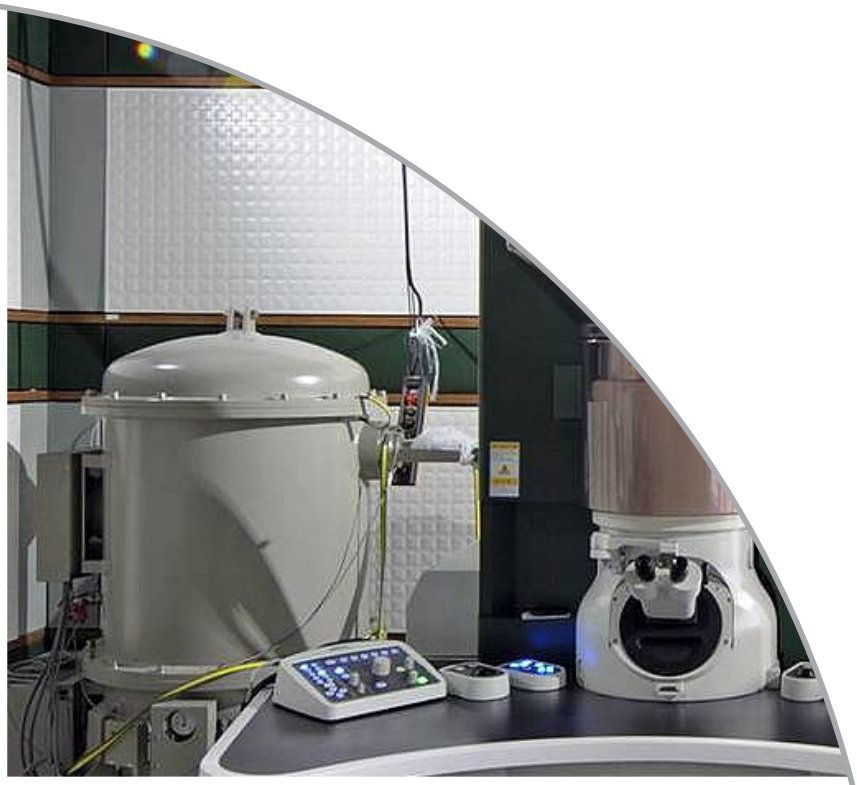
PART A: Our Mandate



1. Relevant Legislative and Policy Mandates

The mandate and priorities of the National Research Foundation (NRF) are informed by legislation and various policies within the Higher Education, Science, Technology and Innovation (STI) sectors.

1.1 NRF Founding Legislation

The National Research Foundation Act 23 of 1998 (as amended) established the NRF, and prescribes the primary mandate of the NRF as "to contribute to national development by":

a) Supporting, promoting and advancing research and human capacity development, through funding and the provision of the necessary research infrastructure, in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including humanities, social sciences and indigenous knowledge;

b) Developing, supporting and maintaining national research facilities;

c) Supporting and promoting public awareness of, and engagement with, science; and

d) Promoting the development and maintenance of the national science system and support of government priorities.

1.2 Institutional Policies, Plans and Strategies

The National Development Plan (NDP) Vision 2030

The NDP is a blueprint of South Africa's socio-economic development. Among other enablers, it places Science, Technology and Innovation (STI) as key to South Africa's socio-economic development agenda. The NDP also seeks to mitigate the adverse legacies of the triple challenge of poverty, inequality and unemployment. The NDP also outlines the need to improve the relationship between government, industry and the knowledge enterprise. It further sets targets to which the NRF can directly contribute through its programmes, such as:

a) Increase the percentage of doctoral qualified staff in the higher education sector from the 2012 baseline of 34% to over 75% by 2030.

b) Increase the number of students eligible to study towards maths and science-based degrees to 450 000 by 2030.

c) Produce more than 100 doctoral graduates per million per year by 2030 – implying an increase from the 2021 baseline of 1 420 to over 5 000 per year.

The Medium-Term Strategic Framework (MTSF) 2019-2024

The 2019-2024 MTSF identifies seven apex government priorities. The MTSF time horizon corresponds with the period of a five-year electoral cycle and political administration of the state. The MTSF contributes to the achievement of the NDP Vision 2030 targets. These are:

- **Priority 1**: Building a capable, ethical and developmental state.
- **Priority 2**: Economic transformation and job creation.
- **Priority 3**: Education, skills and health.
- **Priority 4**: Consolidating the social wage through reliable and quality basic services.
- **Priority 5**: Spatial integration, human settlements and local government.
- **Priority 6**: Social cohesion and safe communities.
- **Priority 7**: A better Africa and World.

Transformation of the South African socio-economic landscape is cross-cutting for all the MTSF priorities and focuses on the demographic dimensions: Women, Youth, Persons with a Disability and Spatial Development. NRF Strategy 2025 is anchored on Transformation, Impact, Excellence and Sustainability (TIES) to align to the MTSF and the Department of Science and Innovation (DSI). The four strategic outcomes in the NRF Strategy 2025 directly contribute towards the realisation of MTSF for Priority 2 and support achievement of Priority 3. The NRF strategic direction and implementation plans align to the current Strategic Plan of the Department of Science and Innovation.

White Paper on Science, Technology and Innovation (WP STI), 2019

The White Paper on STI recognises rapid technological advances internationally and the need for South Africa to position itself in responding to these developments. It prioritises the need to increase investment and expansion of the research system and promote partnerships among and between universities, society, industry and government to ensure a cohesive National System of Innovation (NSI). The key objectives of the WP STI are envisaged as:

- Improved coherence and coordination.
- Increased NSI partnering between business, academia, government and civil society.
- Strengthened and transformed NSI institutions.
- Increased human capabilities.
- Expanded research enterprise.
- Enhanced enabling environment for innovation.
- Improved funding across the NSI.

The object of the NRF Act and current five-year priorities align to the objectives of the WP STI, hence making the NRF a key contributor to the improvement of the South African STI landscape.

Science, Technology and Innovation Decadal Plan, 2021-2031

Cabinet adopted a ten-year Implementation Plan for the 2019 WP STI (STI Decadal Plan) in the third quarter of the 2022/23 financial year. The STI Decadal Plan aims to implement a suite of interventions geared towards a more effective and efficient NSI with a focus on outputs, outcomes and societal impact with:

- An inclusive and coherent NSI.
- An enabling innovation environment.
- Increased and transformed human capabilities.

- An expanded and transformed research system.
- Significantly increased funding for STI.

The NRF is in constant engagement with the DSI on the role that it will play towards the achievement of the STI Decadal Plan objectives and interventions. Work in this regard has already begun within the NRF to drive the organisation from being output driven to being focused on the impact of its work over the medium to long term. The NRF's plans over the Medium-Term Expenditure Framework (MTEF) are focused on driving innovation and pursuing impact through goal-directed investment of its resources.

White Paper on Post-School Education and Training, 2013

The White Paper on Post-School Education and Training (WP-PSET), 2013, advances priorities in the post-school education sector, including the expansion of the variety and number of post-school opportunities available to the youth. It advances diversity, quality education, expanded access to postgraduate education, and research and researcher advancement. It also aims to rebalance the number of students between the Technical and Vocational Education and Training (TVET) colleges and Higher Education Institutions (HEIs). Through the DSI-NRF Postgraduate Funding Policy, the NRF will advance access, success and throughput of postgraduate students.

White Paper 3: A Programme for the Transformation of Higher Education, 1997

The White Paper 3 emphasises a holistic approach to transformation and the need to balance the transformation imperative with the need for expansion and development. It advances a higher education and research sector that is responsive to the needs of a democratic society and an inclusive economy. In addition, White Paper 3 recognises the importance of countering the isolation of the university sector during the apartheid period through international partnerships and internationalisation.

NRF Vision 2030

The NRF Vision 2030 hinges on four pillars: Transformation, Impact, Excellence and Sustainability (TIES). These pillars are considered by the NRF as critical success factors for a research enterprise to effectively contribute to development. The vision of the NRF is **Research for a better society**. This compelling vision finds more expression through the NRF Mission: **To enable and facilitate the contribution of knowledge and scientific research to national development**. The success of Vision 2030 will be determined by the outcomes and impacts on the following key components of the NRF's value-creation framework:

People: Highlights the NRF's ambition to introduce deliberate interventions to ensure an excellent, transformed, and sustainable South African cohort of researchers and technical expertise. In this regard, the DSI-NRF Postgraduate Funding Policy which has equity, excellence, and sustainability at its core was implemented in 2020, with the first cohort funded in 2021. The NRF is also developing the Leading Researcher and Scholars Programme (LRSP), focusing on accelerating career progression and increasing the number and diversity of South African Black and/or Women researchers among leading international researchers and scholars in the NSI.

The Research Enterprise: Focuses on strategic positioning of the NRF in the research enterprise institutional landscape to steer and nudge the NSI towards responding to societal challenges and the need for systemic transformation. Transformation achievements overlap with those discussed under People above.

Research Infrastructure: Focuses on the need for research infrastructure platforms to be establishment in all domains of science, a differentiated approach to research infrastructure provision, and a national lens approach for research infrastructure provision. Attention is being given to developing research infrastructure platforms within the humanities, arts and social sciences.

The relationship between science and society: Envisions a society in which knowledge is created, used, challenged, valued and shared by all in the interest of addressing the needs and demands of communities.

The organisation we want to be: Describes a transformed, coherent learning organisation that strives for excellence through its lived organisational culture.

Resourcing: Highlights the need for sustainable, predictable and dependable resourcing. The constrained fiscus adversely affects the extent of the NRF's contribution to national development priorities. The NRF will implement an income source diversification strategy and invest for maximum return.

Other STI Policies

In addition to the above policies, the NRF also implements the following macro-STI policies of government to advance STI and human-capacity development:

- The Strategy for Human-Capacity Development for Research, Innovation and Scholarships;
- The Staffing South Africa's Universities Framework;
- The Science Engagement Strategy;
- The Research Outputs Policy;
- The South African Research Infrastructure Roadmap (SARIR);
- The Ministerial Guidelines for Improving Equity and the Distribution of DST/NRF Bursaries and Fellowships; and
- Discipline-specific strategies and plans that include Astronomy, Marine Biology, Biotechnology, Palaeosciences and Nanotechnology.

2. Updates on Relevant Court Rulings

None.

PART B: Our Strategic Focus

3. Updated Situational Analysis

The NRF continues to play an integral part in the development of an inclusive NSI. This focuses on its plans and programmes geared towards transformation, innovation and impact. This aspiration will not be easy to pursue considering the budget constraints that are lingering beyond the devastating effects of the COVID-19 pandemic on the economy and escalation of global geo-political contestations.

The country is still confronted by intractable socio-economic challenges of rising levels of unemployment, poverty and inequality. With the current official unemployment rate recorded at 33.9% (second quarter of 2022, Stats SA), the majority of government resources still need to be channelled towards addressing subsistence needs. In the aftermath of the recent shock to the economy, government adopted the Economic Reconstruction and Recovery Plan (ERRP). The plan is implemented through prioritisation based on the planned recovery of economic sectors that are translated into the MTEF budget allocations by the National Treasury through the Budget Prioritisation Framework (BPF).

Despite the current South African economic outlook, the NRF is committed to ensuring the maximisation of resources available through the Parliamentary Grant, the DSI Contracts and other income to drive innovation and STI impact over the next MTEF. In this regard, various national and international Private Public Partnerships and agreements will be leveraged to drive national development priorities within the Science, Technology and Innovation landscape where the NRF is able to make a meaningful contribution. Some of these partnerships have already been established with partners such as Sasol and the National Student Financial Aid Scheme (NSFAS) during the 2021/22 financial year and will continue during the medium to long-term.

4. External Environment Analysis

South Africa: Post 1994

Since 1994, the South African government's main objectives have been focused on the creation of jobs, elimination of poverty and reduction of inequality. This was later expressed in the National Development Plan adopted by Cabinet in 2012 as a long-term developmental vision and plan for the country.

STI has been recognised nationally and globally as a key enabler for development and dealing with poverty, unemployment and inequality. The pre-1994 period was characterised by a disconnect between science and society. The STI system was small, exclusive and oriented towards the narrow agenda of the apartheid state. Over the years, various policy instruments have been developed to address the challenges of a constrained and exclusive science system. These policies and strategies aimed to transform the STI system to serve all South Africans, counter fragmentation, support economic growth, expand and transform human resources and support for researchers to build the required STI institutions, expand knowledge infrastructure, and increase innovation.

Promoting Research and Development Investment

Although the implementation of various STI strategies and policies has advanced over the

years, the NSI remains constrained by certain key factors such as low investment (specifically by public institutions) in research and development (R&D), the stagnant evolution to bridge the innovation chasm, and the growing need to link research with societal challenges, among others.

The MTSF has coined outcome indicators that are geared towards growing the knowledge economy and elevating STI as an enabler for sustainable socio-economic development. These include, but are not limited to raising investment in research and development, increasing throughput through human capacity development and supporting the economic recovery plan of government through innovation and technological advancement.

The roles of South African public entities towards research and development are diversified. Some entities perform scientific research activities, while others fund it. The NRF plays a dual role in that it performs research through its National Facilities and is also a major funding entity responsible for competitively awarding funding to the research community.

Promoting Human Capacity Development

The 2012 Ministerial STI Landscape Report revealed that the major weakness of the South African NSI was the shortfall in human capital development, and a science system that is dominated by previously advantaged individuals and less representation of previously disadvantaged individuals, creating exclusivity within the NSI. One of the key recommendations of the report is for the strengthening of the relevance and transformation of human capacity and the coordination of components of the knowledge enterprise. Among the anchors of the NRF Vision 2023 is investment in people (human capacity) with specific focus on transformation.

The Human Capital Development Strategy for Research, Innovation and Scholarship underpins the efforts of the South African NSI in ensuring that South Africa gears towards meeting the required human capacity needs for a knowledge economy and global competitiveness. Some of the interventions that have been taken forward through the Strategy over the years include:

- Postgraduate and research funding support.
- Supervision of postgraduate students within universities and national research facilities.
- Extending the supervisory capacity of the higher education system through appropriate international partnerships and programmes.
- Supporting academic staff to upgrade their research qualifications and skills.
- Creating incentives for continuing with postgraduate studies.

Public STI Funding and Investments

During the 2021/22 financial year, the national government funding of Science and Technological Activities (STA) amounted to R29.6 billion. Of this total, Research and Development received R17.7 billion (59.8%), Scientific and Technological Services (STS) received R7.1 billion (23.9%) and Scientific and Technical Education and Training (STET) was allocated R4.8 billion (16.2%). For the same performance period, only 1.91% of the total government budget went towards Science and Technological Activities (STA). There was also a 4.85% decrease in STA activities funding from the 2020/21 to 2021/22 financial year (DSI Report on Government Funding for Scientific and Technological Activities, 2021/22).

To establish a better STI budget coordination system for the NSI, the Decadal Plan proposes the introduction of an STI investment framework as an instrument within the STI budget coordination process to secure the baseline for the budget priorities of the Decadal Plan.

NSI Research Infrastructure

Access to adequate levels and standards of research infrastructure is essential for the advancement of quality research and achieving the desired societal impact of basic and applied research. Various reviews, including the Organisation for Economic Cooperation and Development (OECD) Review of the South African NSI and the Ministerial Review of the South African STI Landscape revealed this common principle. Equally so, adequate levels of funding for research infrastructure should underpin the development and promotion of an impactful research enterprise.

Over the years, plans and efforts were developed to encourage investment in research infrastructure in South Africa to match global standards. The South Africa Research Infrastructure Roadmap (SARIR) was developed to facilitate a research infrastructure investment programme for the NSI. The SARIR is intended to provide a strategic, rational, medium to long-term framework for planning, implementing, monitoring and evaluating the provision of research infrastructure necessary for a competitive and sustainable national system of innovation. The SARIR also provides a basis for discussion concerning financing future infrastructure for research in South Africa and participating in joint international research infrastructures. The NRF currently manages some of the key research infrastructures and/or components thereof from the scientific domains also highlighted in the SARIR, including research in the areas of Earth and environment (e.g. SMCRI, EFTEON, SAPRI by SAEON and the Biobank, Collections and Diplomics by SAIAB).

South Africa has also attracted attention as a partner and host in some large international astronomy programmes such as the Southern African Large Telescope (SALT) and MeerKAT, and hosting of the Square Kilometre Array (SKA). Its role in the Southern Oceans and Antarctica has been recognised. The NRF has been tasked with hosting some of these research facilities and ensuring that they contribute to knowledge production and solving key societal challenges in specific areas of health and climate change to mention a few.

Impact of the COVID-19 Pandemic on the NSI

The COVID-19 pandemic, although having had a negative impact on the economic outlook of South Africa, has also increased the recognition of STI in key sectors such as health. The pandemic has also impacted negatively on some of the NSI targets, such as decreasing the Gross Expenditure on Research and Development (GERD) to 0.62%, instead of moving towards the 1.5% targets (NACI STI Indicators Report, 2022). Changes in the level of R&D investment will continue to affect innovation.

Over and above the negative monetary cuts to the NSI, due to the reprioritisation of funds towards mitigating the effects of the COVID-19 pandemic, various public research institutions invested some of their limited resources into research geared towards the fight against the pandemic. These research focus areas include, but are not limited to:

- Safety and protective equipment.
- Surveillance and epidemiology.
- Diagnostic tools and resources.
- Clinical trials.
- Vaccine manufacturing.
- Digitisation of screening technologies.

The NRF has equally contributed in this regard through its participation in the National Ventilator Programme via its National Research Facilities, namely SARAO and SAAO.

The South African STI Landscape

Investments in scientific research and innovation are not sufficiently bridging the innovation chasm, particularly in comparison with global standards. South Africa's latest innovation index is at 32.7 points (2021), against a global average of 34.30 measured against 132 comparator countries (The Global Economy, 2021). This is a significant decline for South Africa from the 2014 baseline of 38.20.

The current NSI is characterised by positive and negative performance in key priority areas of the STI framework outline in the WP STI 2019, STI investments and innovation. NACI South African STI Indicators Report (2022), shows the following trends:

- The number of researchers employed in R&D has been decreasing since 2018.
- The proportion of female academic staff at the South African public universities increased from 46.40% in 2010 to 50.44% in 2019.
- The number of technicians employed in R&D has been on the decline since 2015, with the proportion of technicians to researchers employed in R&D decreasing from 32.8% in 2014/15 to 24.3% in 2019/20.
- The country's publications per million population increased consistently and has been above the average for upper middle-income countries (452 in 2020).
- South Africa's digital competitiveness ranking declined sharply in 2020 to 60 out of 63 countries – the largest decline by a country in that year's ranking.

5. Internal Environment Analysis

Enhancing the Impact of Research

The NRF finalised the Framework to Advance the Societal and Knowledge Impact of Research during the 2020/21 financial year to enhance the impact of the research enterprise on society. The Framework outlines how the NRF, through its core mandate areas can best advance the impact of research. It provides for: i) a context-relevant definition of impact; ii) high-level impact pathways within the NRF's areas of control, influence, and interest; and iii) types of assessment at a conceptual level.

To advance this Framework, the NRF has realised milestones during the 2021/22 and 2022/23 financial years, such as the development of an NRF Impact Implementation Plan and the implementation of an organisational Impact Literacy Campaign. Over the next MTEF period, the NRF Impact Implementation Plan approved by the Corporate Executive in 2022 will be focused on five core focus areas, namely:

- Ensuring policy and instrument coherence.
- Further developing impact literacy.
- Introducing impact-promoting rewards, incentives and recognition.
- Promoting research methodologies that advance impact such as mission-oriented research, engaged and partnered research, and interdisciplinary research.
- Introducing appropriate impact assessment ex-ante and ex-post. This includes considerations for funding instruments, funding proposals and post-funding review as well as planning for impact in project planning and infrastructure development.

The majority of the work on development of impact literacy was concluded during the 2022/23 financial year, with the focus now to shift to the other four areas, as outlined above over the next MTEF.

Income Diversification

The NRF continues to get most (88%) of its funding from DSI transfers, which includes the Parliamentary Grant (20%) and contract funding (68%). The other 12% is made up of contract funding from other sources (9%) and sales and sundry income (3%). With the current trajectory of economic performance and the resulting fiscal constraints, it is likely that both the DSI contract funding and the direct Parliamentary Grant will continue to deteriorate or remain flat-lined, which will not sustain the ever-growing demands of a competitive and impactful research enterprise. To this end, the organisation is currently working on an Income Diversification Framework to maximise resource efficiency for the NRF operations and significantly increase income from other sources.

Becoming the Organisation we want to be

Fit-for-purpose structures, business processes and technology systems are required to ensure delivery of excellent goods and services. The NRF Board has approved a revised organisational structure which will be supported by a new Service Delivery Model envisaged to be finalised during the 2022/23 financial year and implemented in 2023/24. The Model aims to enable the NRF to contribute to fostering innovation and enhancing the realisation of research impact.

From the 2022/23 financial year onwards, the NRF will implement a plan to address the areas that have been identified as gaps through the NRF Culture Survey Projects. Plans are in place to improve accountability, diversity and inclusion at an organisational level, as well as change management, collaboration and leadership.

Elements of the organisational change programme include an Employee Wellness Programme, Skills Audit, and review of the Educational Assistance Programme.

Digitisation of Business Processes

A key imperative of ICT Strategy 2025 is "Transformation through sustainable inclusive Digital Frameworks". This, based on the understanding that Digital Transformation can force organisations to radically rethink their business processes by exploiting digital technologies and supporting capabilities to create robust new digitally enabled business models that support a fundamental change in business performance.

In an era of rapid digitisation and the Fourth Industrial Revolution, coupled with the evidence that the COVID-19 pandemic has demonstrated

the limit of manual business processes and accelerate the pace and scope of business processes that the NRF has digitised. This includes postgraduate students and research grants management system, through the implementation of an Enterprise Resource Planning (ERP) system. The 2022 academic year was the first year where the entire granting system was migrated to a digital mode. The system eliminates manual business processes and promotes accountability through an enhanced audit trail.

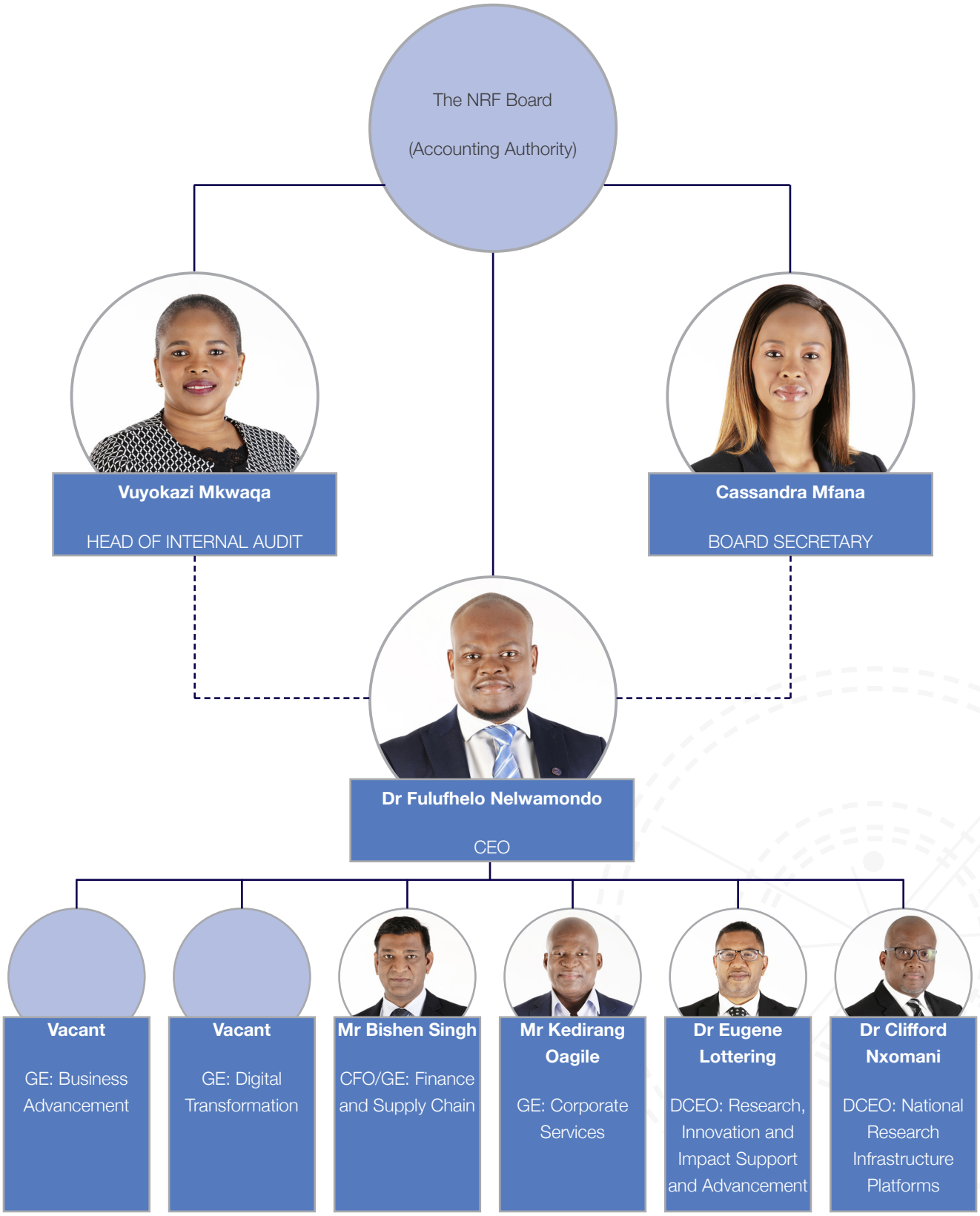
In aspiring towards the expectations of the WP-STI: 2019, the Decadal Plan, the NRF Vision 2030, and Mandate, as well as the impact agenda the NRF is establishing a Research and Development Information Platform (RDIP) as a single point of entry to obtain comprehensive Research and Development (R&D) data and analysis that can service the broader NSI as well as the NRF. The RDIP platform is a consolidation and expansion of current functionality and infrastructure that the NRF will use to provide the NRF, the DSI and the rest of the NSI with access to data or analysis of data pertaining to the NRF and the NSI.

Governance

The NRF received Clean Audit Awards in three successive years from the Auditor-General South Africa (AGSA). This achievement demonstrates a sound system of internal control by NRF management and employees.

The term of the previous NRF Board ended in November 2022, which culminated in handing over to the Minister of Higher Education, Science and Innovation an account of its performance over its term and a mid-term strategic review. A new Board was appointed effective from 1 December 2022. Certain pending changes to the high-level organisational structure will be made to the Corporate Executive Structure of the NRF at the beginning of the 2023/24 financial year. Below is the currently envisaged high-level organisational structure of the NRF:

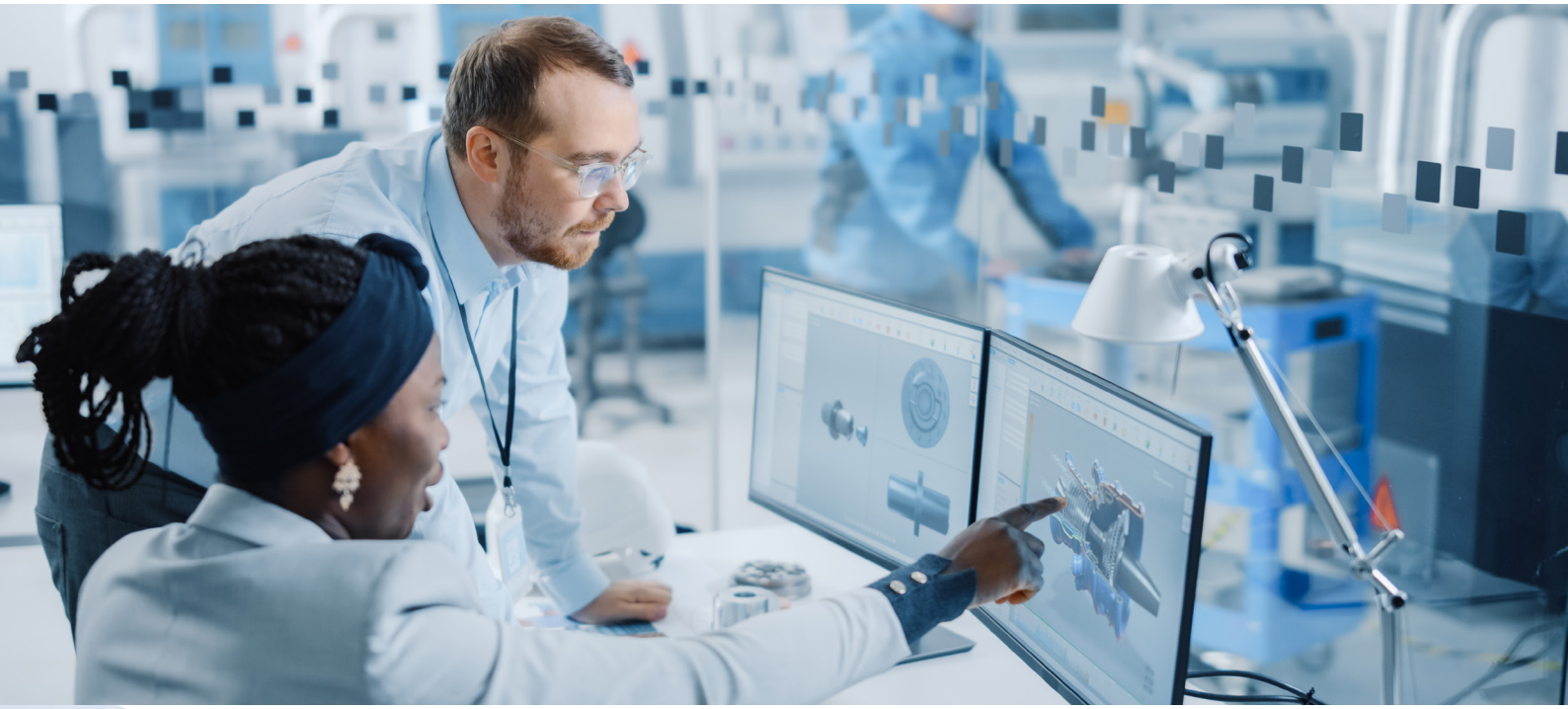
Figure 1: High-level Organisational Structure



6. Strategic Partnerships and Internationalisation

The NRF has garnered extensive programme and fund management experience within South Africa and with regional and global partners, and has established robust internationally recognised systems and procedures to carry out these tasks. This is reflected in the organisation's significant footprint as a leading funding and knowledge agency across the African continent, and increasingly with other countries in the Global South, as well as its cooperation with countries of the Global North in the funding and coordination of international research initiatives. Major programmes, amongst others, that the NRF is currently managing are the COVID-19 Africa Rapid Grant Fund, the O.R. Tambo Africa Research Chairs Initiative, the Science Granting Council Initiative (SGCI) in Sub-Saharan Africa, and the Belmont Forum's Collaborative Research Action on Transdisciplinary Research for Ocean Sustainability.

For 2023, 22 bi-and-multilateral calls have been agreed to with the DSI, as well as 12 international symposia and researchers' workshops. The SGCI will continue to be a flagship programme that includes 17 African countries (8 from SADC). In addition, 5 SADC countries are involved in international consortia and EU programmes. A major Pan-African programme to be launched in 2023 is the South-West Indian Ocean Initiative, co-led by the NRF, with 4 African Science Granting Councils participating through funding and capacity support initiatives. These initiatives are aimed at addressing the needs of the broader international community as they relate to the growth, sustainable development, and inclusion of the global south in the world order. This particular focus resonates with the over-arching theme of South Africa's 2023 BRICS chair-ship, which is "*BRICS and Africa: partnership for mutually accelerated growth, sustainable development and inclusive multilateralism*". The current BRICS STI research awards to South African researchers in this context will continue to bolster the already established focus on Africa's partnership for sustainable development.



7. Overview of 2023/24 Budget and MTEF Estimates

Table 1: NRF Income and Expenditure Estimates

CATEGORY	Actual R'000	Projected R'000	Projected R'000	Projected R'000	Projected R'000
	2021/2022	2022/2023	2023/24	2024/25	2025/26
MTEF allocation – Parliamentary grant	962 587	997 408	1 001 295	1 046 051	1 092 914
MTEF allocation – DSI contract income*	3 010 250	3 872 630	4 243 582	3 608 501	3 433 866
Other contract income*	350 904	516 514	538 632	502 921	382 754
Interest received	40 217	40 638	25 005	25 005	25 005
Other income	102 417	118 963	116 951	136 901	168 121
Total income	**4 466 375**	**5 546 153**	**5 925 465**	**5 319 379**	**5 102 660**
Grants and bursaries	2 421 963	2 635 420	2 783 778	2 616 967	2 692 538
Operating expenditure	1 008 279	1 480 123	972 522	1 017 904	1 056 203
Salaries	801 280	927 622	1 115 438	1 209 668	1 275 597
Total expenditure	**4 231 522**	**5 043 165**	**4 871 738**	**4 844 539**	**5 024 338**
Net income before capital acquisitions	234 853	502 988	1 053 727	474 840	78 322
Less: Net capital expenditure and transfers	(227 579)	(502 988)	(1 053 727)	(474 840)	(78 322)
Net budgeted unspent funds	**7 274**	**-**	**-**	**-**	**-**

*Carry forward funding included

Income

The NRF has a total budgeted income of R5.9 billion for the 2023/2024 financial year. This comprises of the following sources of funding:

- Parliamentary Grant (PG) R1 billion (17%).
- Contract funding received from the DSI R4.2 billion (72%).
- Contract funds from other government departments, entities & private institutions R539 million (9%).
- Income generated through sales and interest income R142 million (2%).

The PG which is the baseline income used for the essential operations of the organisation has not kept up with real inflation. The projections based on the indicative MTEF letter for the next three years are projected to increase well below CPI at 0.4% in 2023/24, 4.5% in 2024/25 and 4.48% in 2025/26. DSI contract income will increase significantly in 2023/24 and 2024/25, due to additional new earmarked funding of R1.26 billion for SARAO capital expenditure relating to several building requirements for the SKA Project as part of RSA obligations. The total NRF funding levels, comprising the PG and Contract funding are not linear due to the National Equipment Programme, which is funded every alternate year i.e. in 2023/24 and 2025/26.

Expenditure

In the light of the NRF MTEF allocation not mirroring projected inflationary levels, the NRF must ensure that it remains sustainable over the medium-term with particular focus on carefully managing the following:

- Movement in the overall salary bill and staffing requirements (based on government's stance on minimising the public sector wage bill).
- Operational costs which generally exceed inflation such as utilities and maintenance.
- Impact of foreign exchange volatility.
- Lack of flexibility in initiating necessary bold new initiatives and its impact on targets.

Grants and bursaries are directly linked to the movement in funding and subsequently to movements in performance targets. Research grants and bursaries account for 57% of the total NRF expenditure which is disbursed for research grants, scholarships and bursaries at universities through various funding instruments.

Operating expenditure will increase in line with increased activities following the lifting of the pandemic restrictions in travel and accommodation, conferences and purchases across the business units of the NRF.

Employees' remuneration is forecast to increase in line with a cost-of-living adjustment as per National Treasury guidelines. The budget also includes new staffing requirements for new initiatives such as the South African Research Infrastructure Roadmap (SARIR) project and SKA1 (SARAO) project, as it moves into the next phase of the international build requirements.

Capital expenditure is provided at a bare minimum in order to maintain the operations based on the limited resources – mostly office and computer equipment. The exceptional growth stems from the major infrastructure investments through the new funding of R1.26 billion for the SKA building requirements which includes the Science Processing Centre, Regional Centre, SKA Science Operations Centre, SKA Engineering Operations Centre, MeerKAT National Park fencing and the MeerKAT extension and preparatory costs for the SKA1 build. Additional infrastructure projects from new sources of funding include the South African Research Infrastructure Roadmap (SARIR) requirements, the South African Polar Research Infrastructure (SAPRI) and the SARAO Northern Cape Visitors' Science Centre.

PART C: Measuring Our Performance

Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON)

8. Alignment with National and Sector Policies

The NRF supports one of the main pillars of the Budget Prioritisation Framework (BPF), namely, increasing public and private employment through its various infrastructure projects across various District Municipalities.

Table 2: NRF alignment to MTSF and BPF

Revised MTSF and BPF	DSI-led/ supported interventions/ indicators across outcomes (relevant to NRF)	NRF contribution over the MTEF
Within the revised Medium- Term Strategic Framework (MTSF) and Budget Prioritisation Framework (BPF), the NRF will be directly impacted by: • **Priority 2**: Economic transformation and job creation. • **Priority 3**: Education, skills and health.	• Number of PhD students awarded bursaries through the NRF and DSI. • Number of pipeline postgraduate students awarded bursaries through the NRF and DSI.	**Health:** • Production of radioisotopes by iThemba LABS for the diagnosis and treatment of cancer. • SARChIs and CoEs in the Health Sector. **Education:** • DSI-NRF Postgraduate Student Funding Policy. • National Astrophysics & Space Sciences Programme (NASSP, R20m and +100 students annually). • South African Institute for Nuclear Technology & Sciences (SAINTS). • SARAO Human Capacity Development Programme. **Skills:** • African Coelacanth Ecosystem Programme (ACEP) Phuhlisa Programme. **Economic Transformation & job creation:** • NRF Supply Chain Transformation Framework. • Employment of local community members at the NRF Business Units in rural areas (Northern Cape and Eastern Cape). • SARAO Artisan Training Institute.

Table 3: NRF alignment to STI White Paper and Decadal Plan

STI WP and Decadal Plan	NRF contribution over the MTEF
Modernisation: • Manufacturing • Mining • Agriculture	**Modernisation:** • 32 SARChI chairs in manufacturing, mining, and agriculture related fields. • Support through RIPs, Grants, CoEs and Science Engagement.
New concepts innovation opportunities: • Circular Economy • Digital Economy	**New concepts innovation opportunities:** • 11 SARChI chairs in circular and digital economies related areas. • Big data storage by NFs – SARAO, SAAO and iThemba LABS. • Support through RIPs, Grants, CoEs and Science Engagement.
Innovation in key critical service delivery areas (state capability and entrepreneurship): • Health • Energy	**Innovation in key critical service delivery areas (state capability and entrepreneurship):** 45 SARChI chairs for Health have been established. • 7 Energy related SARChI chairs. • Risk & Vulnerability Atlas by South African Environmental Observation Network (SAEON) and iThemba LABS isotopes for medical applications. • Support through RIPs, Grants, CoEs and Science Engagement.
Address Societal Grand Challenges (SGC): • SGC 1: climate change and environmental sustainability. • SGC 2: Future proofing education and skills. • SGC 3: Future society (safe, secure and equitable society).	**Addressing SGCs:** • SGC 1: 29 SARChI and 1 CoE have been established in this field and the NRF has 2 national research facilities aligned to the SGC1. • SGC 2: 21 SARChI have been established in this field. • SGC 3: 43 SARChI have been established in this field. • Support through RIPs, Grants, CoEs and Science Engagement.

9. Institutional Programme Performance Information

The scope of work of the NRF is organised into four budget programmes to deliver on its legislative mandate and contribute to national priorities as outlined in the national strategic frameworks, legislation, policies and plans. The budget programmes are as follows:

- **Programme 1**: Administration
- **Programme 2**: Science Engagement (SE)
- **Programme 3**: Research, Innovation and Impact Support and Advancement (RIISA)
- **Programme 4**: National Research Infrastructure Platforms (NRIP).

The scope of work for each of these budget programmes intersect and are interdependent whereby relevant parts of the work are coordinated in one of the programmes but implemented across all or other programmes. The following areas of work are of significant importance in this regard:

- Local and global partnerships
- Access to National (the NFs) and Global Research Infrastructures
- Open Science
- Science Engagement
- Human and Institutional Capacity Development.

9.1 Programme 1: Administration

Purpose

Programme 1 comprises support services functions and systemic enterprise-wide coordination capabilities to achieve synergies, shared systems and economies of scale and to provide strategic direction, performance, risk and compliance frameworks. The frugal yet optimal and efficient design of this programme is necessary, especially in this phase of the national economic cycle, where resources are scarce, and the needs are too numerous for the available resources. Programme 1 comprises the following performance areas:

- Finance and Supply Chain
- Corporate Services
- Business Advancement
- Digital Transformation.

Finance and Supply Chain

The Finance and Supply Chain function in the office of the CFO provides cross-cutting shared services across the NRF. It draws its mandate from the Public Finance Management Act (PFMA, Act 1 of 1999, as amended) and various laws, National Treasury regulations and prescripts in ensuring that the NRF has and maintains effective, efficient, and transparent systems of financial management and procurement with proper internal controls that warrant the most economical and transparent use of resources.

Corporate Services

The Corporate Services function consists of support services to ensure that the organisation has the required human capital, safe workplace, secure and functioning facilities, communication and stakeholder management. The function is responsible for the following:

- Human Capital Management
- Safety, Health, Environment and Quality (SHEQ)
- Facilities Management
- Stakeholder Engagement, Public Relations and Corporate Communications.

Business Advancement

This function fosters effective support systems to advance and grow the NRF's impact and contribution to the NSI by enabling national and international research and innovation funding opportunities, increasing research impact by promoting joint research between academia and industry, and supporting and facilitating South Africa's engagement in the global science system. The function is responsible for the following:

- New Business Development
- Marketing
- Partnerships
- Partnership contracting.

Digital Transformation

This function provides the technology infrastructure and applications that enable the organisation to transition and thrive in the high velocity unfolding Industry 4.0 and beyond. The function will transform the organisation to utilise digital platforms and applications to achieve service delivery excellence and use market and

performance analytics in strategic decision making. The function is responsible for the following:

- IT support & Digital Enterprise
- Knowledge and Information Management
- Business Process Analysis and Management
- Research and Development Information Platform
- Performance Planning, Monitoring, Evaluation and Reporting
- NRF Policies Coordination.

Table 4: Outcomes, Outputs, Performance Indicators and Targets

Strategic Outcome: A Transformed organisation that lives its culture and values							
Outputs	Output Indicators	Audited/Actual performance		Estimated Performance	MTEF Period Targets		
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
A transformed Leadership and management cohort	Proportion of employees from designated groups at Peromnes levels 1-7	53%	61%	64%	65%	67%	69%
Predictable and Sustainable resourcing of the NRF mandate	Outcome of annual audit by AGSA	unqualified	unqualified	unqualified	unqualified	unqualified	unqualified

Table 5: Indicators, Annual and Quarterly Targets for 2023/24

Output Indicators	Annual Target	Q1	Q2	Q3	Q4
Proportion of employees from designated groups at Peromnes levels 1-7	65%	–	–	–	65%
Outcome of annual audit by AGSA	unqualified	–	–	–	unqualified

Explanation of Planned Performance over the MTEF period

A transformed and transforming NRF is an inclusive and diverse organisation that supports and promotes the simultaneous eradication of all aspects of unfair discrimination, recognises and respects diverse cultures and knowledge systems, and supports a research and higher education sector that gives full expression to opportunities for all in line with the ambitions of national education, science, technology and innovation policy.

Business Advancement

Key activities and deliverables for the MTEF period will include:

- Increasing the resources, both financial and in-kind for the country's research enterprise from local and international partnerships.
- Building capability for effective management of IP commercialisation.
- African Open Science Platform (AOSP): Strategic operationalising of the platform and exploring opportunities for cost-effective access by researchers and wider dissemination of knowledge outputs.
- Provision of value-added services.

Finance and Supply Chain Management

Key activities and deliverables for the MTEF period will include:

- The NRF has always achieved unqualified audits endorsed more recently by consecutive Clean Audit awards in the prior three years. To ensure that this trend of good governance continues, the function plans and prepares the Annual Financial Statements (AFS) which will take all necessary steps aligned to the PFMA and NRF policies and procedures to ensure an Unqualified Audit Opinion that encompasses a range of internal controls, systems and accountability mechanisms.
- Endeavour and ensure prudent financial management in the management of public resources through well considered budgets and projections aligned to business needs with special focus in ensuring the prevention of irregular, fruitless and wasteful expenditure.
- Procurement and Supply Chain Management (SCM): Focus on leading SCM strategies and assisting business units in meeting their procurement plan targets and the implementation of the NRF SCM Transformation.
- Implement strategies towards improving the NRF's Broad-Based Black Economic Empowerment (B-BBEE) rating.
- Compliance with SCM standards, instruction notes and regulations.

Corporate Services

Key activities and deliverables for the MTEF period will include:

- Implementation of One NRF Culture initiatives to ensure a desired culture compatible with the strategic direction and reflective of the NRF's values become the lived culture among all employees.
- Implement a unified, coherent NRF-wide communication and marketing approach.
- Management and Leadership Development Programmes: Update and implement the Strategic Management Development Programme (SMDP), New Managers Development Programme (NDP) and Future Managers Development Programme (FMDP) to ensure their effectiveness and impact on succession planning and organisational performance objectives.
- Skills Development and Staff Retention: Intensify efforts to achieve the desired transformation objectives.
- Talent Management: Ensure targeted attraction and retention of particularly scarce and critical skills.

- NRF Brand and Communication Strategy.

Digital Transformation

Key activities and deliverables for the medium-term will include:

- NRF embracing the vision and benefit of digital transformation and embarking on a process of adopting digital technologies to innovate and optimise business processes and operational efficiency, while improving user experience. The function will continue with the rollout of the NRF ICT Strategy 2025.
- Development and implementation of the NRF Digital Transformation Framework to enhance organisational performance for the following shared initiatives:
  - The National Integrated Cyber Infrastructure System (NICIS);
  - The African Open Science Platform (AOSP); and
  - The interaction and synergies with the World Data System (WDS).
- Continue to enhance and optimise the Enterprise Resource Planning (ERP) system and provide systems support per business requirements.
- Continue to embed the RDIP in the NSI through a concerted effort to address the requirements of the White Paper, the Decadal Plan, and NRF Vision 2030. The focus will be on harvesting data required to inform the landscape in the priority areas of the above strategic policy documents, as well as the development and maintenance of partnerships required to ensure access to data or analytics. The priority areas include:
  - Human Capacity Development (HCD) – Transformed and Expanded Capabilities
  - Research Impact
  - Internationalisation
  - Increased Funding for the NSI.
- The RDIP will continue to embed the data emanating from the ERP system into its Business Intelligence warehouse. The RDIP's collaboration with the DHET will continue the management and support of the Research Output Submission System (ROSS), as well as the provision of Business Intelligence reporting on data emanating from the Higher Education Management Information System (HEMIS). The RDIP will continue its partnership with the National Advisory Council on Innovation (NACI) and specifically collaboration in their rollout of the National Science, Technology and Innovation Information Portal (NSTIIP) repository.
- Upgrade and implement an organisational performance management system to ensure achievement of the organisation's 10-year strategic direction, NRF Vision 2030.
- Revise and implement the NRF Policy Framework to improve the effectiveness and efficiency of development, implementation and maintenance of policies to enable good governance and achievement of performance objectives.

Programme Resource Considerations

Table 6: Planned Budget for Programme 1 to achieve its planned performance targets

	Budget R'000 2022/2023	Budget R'000 2023/2024	Budget R'000 2024/2025	Budget R'000 2025/2026
Parliamentary Grant	125 142	128 851	136 272	142 376
DSI Contracts	0	0	0	0
Other Contracts	3 382	575	575	0
Internal Income	31 943	30 924	24 725	26 059
Other Income	20 070	20 075	20 073	20 075
Total Income	**180 536**	**180 425**	**181 645**	**188 510**
Running Expenses (Excluding Depreciation)	54 794	53 195	52 901	53 984
Grants and Bursaries	774	1 167	1 167	1 167
Internal Expenses	21 931	19 870	19 929	19 990
Salaries	100 570	106 135	111 783	115 886
Capital Expenditure and Transfers	2 467	58	(4 135)	(2 517)
Total Expenditure	**180 537**	**180 425**	**163 145**	**188 510**

9.2 Programme 2: Science Engagement

Purpose

The purpose of Programme 2 is to transform the relationship between science and society through a focus on public awareness of, and engagement with science. The transformation in this relationship will be achieved through the national coordination of science engagement and active implementation of problem directed interventions. The national coordination ensures the pooling of resources from both the public and private sector towards the design and implementation of interventions that have national level of impact, and with the aim of contributing to the achievement of a scientifically literate society.

Science is seen as central to sustainable development by enabling for prudent governance towards the attainment of a positive impact on the triple bottom line results of environmental, social and economic change. One of the prerequisites for an effectively functioning NSI is a society that is aware of both the value and potential dangers and challenges of science and has the ability to evaluate the products of science; use the processes of science in its daily life (for example, asking questions, collecting and analysing evidence, and evaluating possible results); and engages in debate on science-related matters of public interest (Science, Technology and Innovation White Paper, 2019).

The DSI's Science Engagement Strategy (SES) designates the NRF as a National Coordinator of Science Engagement through assignment of this responsibility to SAASTA. During the MTEF the implementation of additional capacity will be undertaken in these areas:

- Excellence in SE grant management to support the participation of the network of collaborating institutions in science engagement programmes.
- Improved interventions to achieve the aims of the Science Engagement Strategy (SES), including the establishment of necessary partnerships with relevant institutions.
- Embedding an engaged research approach throughout NRF supported research.
- Appropriate performance monitoring and evaluation system for science engagement.

The NRF will focus on SE interventions as follows:

- Deliberate emphasis of engaged research.
- Enabling improved public access to research and science engagement infrastructure.
- Development of STEM education.
- Building science engagement capacity and capability.

Table 7: Outcomes, Outputs, Performance Indicators and Targets

Strategic Outcome: Enhanced Impact of Science Engagement (SE)							
Outputs	Output Indicators	Audited /Actual performance		Estimated Performance	MTEF Period Targets		
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Science engagement interventions	Number of public engagements with, and in science interventions	New	New	12	12	13	13
	Number of interventions supporting the development of skills for the future of work	New	New	14	16	18	18
	Number of interventions to build SE capacity across the NSI.	New	New	New	4	5	5

Table 8: Indicators, Annual and Quarterly Targets for 2023/24

Output Indicators	Annual Target	Q1	Q2	Q3	Q4
Number of public engagements with and in science interventions	12	5	8	10	12
Number of interventions supporting the development of skills for the future of work	16	5	8	12	16
Number of interventions to build SE capacity across the system.	4	2	2	3	4

Explanation of Planned Performance over the MTEF period

Over the medium term, Programme 2 will gradually position itself to execute the science engagement mandate as per NRF Act (1998), as amended and to coordinate science engagement in South Africa in line with the Science Engagement Strategy (SES) of 2015. The Programme`s services provide a pathway towards enhanced societal impact of the knowledge enterprise in line with the strategic intents of the NRF Strategy 2025. Science engagement activities are performed by all NRF service delivery business units responsible for research infrastructure platforms, knowledge generation and human and institutional capacity development.

The strategic intent to build a more critically science-aware and engaging society and influence the relationship between science and society as outlined in the SES and NRF Strategy 2025, requires a change in approach and emphasis. The long-term NRF outcomes are research that is increasingly responsive to societal needs and demands; wider acceptance of the practice of sound, evidence-informed policy and decision-making; and increased dialogue on critical science-related issues which is more firmly embedded in the public discourse.

Programme 2 performance priorities over the MTEF (Table 9), consist of interventions for the delivery of SE services targeted at learners and the general public. In addition, the NRF will implement interventions for SE capacity development for SE partner institutions, practitioners (e.g. journalists), postgraduate students and scientists.

Programme 2 performance priorities will be pursued through interventions with emphasis on the key performance areas: science awareness, science communication, and science education to support the full science engagement value chain for the development of a scientifically literate society that can critically engage on science matters, especially those affecting the daily lives of the different publics that include the general public and learners. These three areas are interdependent, each enhancing the effectiveness of the other while accommodating different target audiences and creating opportunities to work collaboratively with other sectors, both public and private as well as government departments, HEIs, science councils, science centres, industry, and other parties interested in science. Capacity development interventions aimed at this network of collaborating institutions, knowledge workers and practitioners (e.g. journalists) will be implemented across the three key performance areas.

Annually, the NRF implements various interventions across the country with a reach of over 172 000 learners and approximately one million members of the public. An overview of the SE areas of interventions is given below.

- **Science education (learner and educator)**: Several interventions will be initiated through project implementation to augment learning and teaching in the critical areas of mathematics, sciences, life orientation and technology. This is generally achieved through supplementing the curriculum through career profiling; role modelling; learning and teaching support material; Olympiads and competitions; science camps and workshops; and visits to the various science infrastructure platforms. The ultimate aim is to contribute meaningfully to the much-needed skills and careers in science fields by improving the quality of teaching and learning in STEMI subjects.

The role of an educator is imperative in the nurturing of a learner's evident or latent talent and therefore continuous educator support and development is vital. In this regard, the NRF has formed partnerships with the Department of Basic Education (through mathematics, science and technology (MST) coordinators, curriculum advisers and district managers), professional associations (including the South African Association for Science and Technology Educators and the South African Institute of Physics) and universities to innovate, conceptualise and implement content and methodology workshops and resource development for distribution across the country. Some of the key projects include the National Science Olympiads, Competitions, educator workshops, Techno Youth™, science camps for learners with potential and school-based and supported science clubs.

- **Science awareness (Public, science and Infrastructure support)**: South Africa's research and innovation system is expected to assist in finding solutions to the social and economic challenges of the country. Global competitiveness, shrinking resources availability and the requirements for a skilled labour force means that broader awareness and understanding is increasingly required to develop a critical and knowledgeable society. With the experiences brought about by the COVID-19 global pandemic, this has become even more important to advance public awareness of developments in scientific fields and technological know-how. Members of the public are generally engaged through science festivals, exhibitions, and facility tours at the National Research Facilities (NFs).

  Some of the NFs also offer internships and/or job-shadowing opportunities. It is imperative to ensure that public awareness initiatives extend to rural communities. Some of the initiatives include projects such as the mass events of National Science Week (NSW), science festivals and international days, exhibits, Ministers' Imbizos, and evening public viewings (astronomy). Other programmes include the Youth Science Journalism Programme (YSJP), Programmatic Support Grant Intervention (PSGI), development of the National Network of Science Centres through science accreditation and science centre capacity building.

- **Science communication**: This is a critical component in developing an informed public that actively engages with and participates in the national discourse on science and technology. Specialist areas within science communication include media engagement, audience analysis, scientific editing, ICT specialisation and discipline-specific science communication. DSI discipline-specific communication areas currently include biotechnology, nanotechnology, hydrogen fuel cell technology, space science, palaeosciences and Antarctic research. These priority areas are under discussion with the DSI for a possible change in emphasis and operation. In addition, science communication in scientific disciplines such as astronomy, biodiversity, conservation, and nuclear science is also undertaken by the various National Facilities.

  To further engage with society on science-related matters, the established Science for Society Lecture Series is held several

times each year in collaboration with various universities and researchers, especially those from the Centre of Excellence (CoE) and SARChI programmes. Partnerships with community media aim to promote science in indigenous languages and achieve an increased media placement of science-related material. This includes translation of scientific information into audience-specific resources (e.g. through science editing, production, and ICT functions). The products thereof are amongst others fact sheets, posters, media-friendly articles, communication products, booklets, career brochures and information videos. As a result of collaboration with the Media Development and Diversity Agency (MDDA), in 2020, the NRF managed to achieve the communication of science in 10 of the 11 official South African languages using existing databases of scientists and researchers.

- **Capacity development for science engagement**: The NRF offers a variety of interventions to improve capacity in quality science communication. Two South African Research Chairs Initiative (SARChI) Chairs in Science Communication funded by the NRF are fully active and will provide research leadership in this discipline over the MTEF. Researchers and scientists are encouraged to participate in science engagement and also involve communities in their research by inculcating a culture of participatory research and engaged scholarship. There will be more focused attention given to embedding an engaged research culture in partnership with RIISA and the NFs.

  During the MTEF period more investment will be made into building the capability and capacity of SAASTA to effectively execute the role of coordination of the national science engagement programme in line with SES. Additionally, SAASTA will implement interventions to build capacity among key stakeholders to become partners in executing science engagement.

The long-term results of successful science engagement programmes are expected to enhance scientific literacy in South Africa and the public's confidence, trust, and attitude towards the sciences. Currently, the absence of regular periodic, dedicated studies measuring such changes leaves the system without sufficient baseline data to establish, with confidence, the meaningful impact of the investments in science engagement. In recognition of this, the DSI Science Engagement Strategy and its Monitoring and Evaluation Framework indicate the need for a science engagement and information management system. The latter is currently under development by the Council for Scientific and Industrial Research (CSIR). To this end, the NRF through SAASTA will collect, manage, and analyse science engagement data on an ongoing basis. The long-term impact of the implementation of the science engagement programme of the NRF will be assessed using large-scale surveys to be administered by the HSRC.

Programme Resource Considerations

Table 10: Planned Budget for Programme 2 to achieve its planned performance targets

	Budget R'000 2022/2023	Budget R'000 2023/2024	Budget R'000 2024/2025	Budget R'000 2025/2026
Parliamentary Grant	30 641	32 744	35 050	36 620
DSI Contracts	58 986	61 044	64 750	67 631
Other Contracts	3 342	3 853	3 500	3 500
Internal Income	22 561	28 595	22 297	22 017
Other Income	1 466	1 566	1 684	1 738
Total Income	**116 996**	**127 802**	**127 281**	**131 506**
Running Expenses (Excluding Depreciation)	26 118	31 360	30 697	31 057
Grants and Bursaries	35 013	33 389	35 686	37 655
Internal Expenses	1 721	1 010	1 056	1 178
Salaries	53 608	56 972	59 370	61 079
Capital Expenditure	536	5 071	472	537
Total Expenditure	**116 996**	**127 802**	**127 281**	**131 506**

9.3 Programme 3: Research, Innovation and Impact Support and Advancement (RIISA)

Purpose

The purpose of Programme 3 is to provide financial and non-financial support for research and innovation in human capacity development, acquisition of small to medium equipment and infrastructure, and access to local and global cutting-edge research infrastructure. The strategic intent for RIISA is to contribute to the transformation of the knowledge enterprise. That is, to achieve excellence and production of impactful knowledge and innovation outputs in all fields of research to contribute to societal impact.

The scope of RIISA is organised as follows:

- Human Capacity Development: Funding postgraduate students and researchers – access to equipment and research infrastructure (acquisition and cost of access).
- Excellent research and knowledge generation: Anchored on the Research Agenda aligned to STI Decadal Plan Priorities, such as Societal Grand Challenges Priority industry sectors, Geographic Advantage and Science Missions – with the focus on knowledge and innovation outputs.
- Institutional Research Capacity: Strategic investment for individual institutions, group of institutions, local and global networks such as South African Research Chairs Initiative (SARChI), Centres of Excellence (CoEs), Community of Practices (CoPs) and National Research Institutes (NRIs) – taken together, the focus of these strategic investments is to improve South Africa's international research and innovation competitiveness, while responding to social, economic and transformation imperatives of the country. This includes production and application of knowledge and innovation outputs, which address pertinent and high priority research problems that require large and long-term investments as well as integrated, inter and multi-disciplinary teams.

Human Capital Development (people)

The purpose of Human and Infrastructure Capacity Development (HICD) is to develop individual research capabilities by supporting next-generation and early career/emerging researchers and, institutional research capabilities through the provision of and access to research infrastructures. HICD contributes towards establishing a transformed (demographically representative), internationally competitive (productive) and sustainable knowledge workforce and globally competitive research infrastructures and platforms.

The ring-fenced NFs funding of 45 postgraduate bursaries per NF per annum will greatly assist the transformation of the postgraduate student cohort. Also, some of the NFs have designated student support programmes which require realignment with the new policy and process of centralised application and funding decision-making. While a special dispensation has been allowed to accommodate these programmes, such as with NASSP and the SARAO Bursary Programme, there are still issues of timing, articulation of decision-making, communication between the different parts of the process etc., which still

require discussion and resolution internally in the NRF and with stakeholders.

Excellent Research and Knowledge Generation

The purpose of support for excellent research across knowledge domains is to promote and advance knowledge production and application through funding and other interventions, and in the process support human capacity development. This facilitates the advancement of the frontiers of existing knowledge and the creation and discovery of new knowledge; promotes active interaction and collaboration between researchers within and across disciplines and knowledge fields; strengthens scientific and professional organisations in the South African research and innovation landscape; and investigates, maps, analyses research interests and trends within and across disciplines and knowledge fields.

Institutional Research Capacity

The purpose of institutional capacity development support is to strengthen the scientific research and innovation capacity of South Africa to improve the quality of research and innovation outputs, integrate research projects into larger science programmes, support HCD for young and mid-career researchers, raise the international esteem of South Africa's science to secure stable, long-term funding for research and dissemination of its results, and provide for optimisation through sharing of resources such as research equipment.

The strategic investments enable South African public universities, national research facilities, and science councils to collectively attract and retain excellent researchers and scientists and establish multi-disciplinary and multi-institutional research capacity. The current institutional capacity investment instruments include: SARChI, CoEs and the NRF Ratings System. The NRF is in the processes of establishing National Research Institutes (NRIs) which are contemplated to be mission-directed research performing organisations. In this regard, a National Institute for Theoretical and Computational Science (NITheCS) and a National Institute for the Preparedness and Prevention of Pandemics (NIP[3]) are in the process of being established.

Table 11: Outcomes, Outputs, Performance Indicators and Targets

Strategic Outcome: A transformed (internationally competitive and sustainable) research workforce							
Outputs	Output Indicators	Audited/Actual performance		Estimated Performance	MTEF Period Targets		
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
NRF-funded postgraduate students	Number of NRF-funded postgraduate students	11 093	7 732	6 218	5 943	5 314	5 451
NRF-funded researchers	Number of NRF-funded researchers	3 000	3 201	3 000	3 612	3 000	3 000
NRF-rated researchers	Number of rated researchers	New	New	New	4 452	4 586	4 723

Table 12: Indicators, Annual and Quarterly Targets for 2023/24

Output Indicators	Annual Target	Q1	Q2	Q3	Q4
Number of NRF-funded postgraduate students	5 943	3 538	4 978	5 864	5 943
Number of NRF-funded researchers	3 612	1 726	2 187	2 569	3 612
Number of rated researchers	4 452	–	–	–	4 452

Explanation of Planned Performance over the MTEF period

Human Capacity Building (people)

The development of a future base of researchers and academics to support the development of the NSI is central to the NRF's mandate. The academic process is also reliant on a transformed and excellent cohort of peer reviewers as an assurance provider safeguarding the future research enterprise.

The NRF will scale up the development of a research and innovation workforce for renewing, regenerating and replenishing the South African researcher cohort; establish a transformed knowledge workforce, with greater diversity of people and ideas to lead the knowledge enterprise (Table 11); and focus on excellence to advance the international competitiveness of the knowledge workforce. The NRF recognises that the researcher workforce includes the next generation, emerging/early career researchers and established researchers. A shortage of researchers in any one of these categories will negatively affect the future academic pipeline. For this reason, the NRF will strategically invest its resources at all levels to ensure a transformed, excellent and sustainable researcher cohort.

Funding for this cohort of researchers has been declining in real terms, which hampers the progress in the transformation and expansion of the researcher cohort. Sustained support for exceptional early career/emerging and mid-career researchers and scholars, with an emphasis on Black and female researchers and scholars is needed to transform the research workforce leadership. International research exposure for next generation and emerging researchers will be facilitated through international bi-lateral partnerships via the NRF's Global Knowledge Partnerships (GKP) framework.

In the recent past, a number of research travel grants funding instruments, including those funded through the parliamentary vote, namely, Blue Skies Research grants and Community Engagement Research, and the contract funded Indigenous Knowledge Systems (IKS) have been discontinued due to limited financial resources with the contract sponsor moving the funds elsewhere. No new calls for applications or grants will be made for these discontinued funding instruments. However, the continuing grants will be supported up to completion. Community Engagement Research and Indigenous Knowledge systems completed their funding cycles in 2022. Blue Skies has one remaining commitment in 2023.

Since 2015, the NRF has invested in and leveraged strategic partnerships in the Science Granting Councils Initiative in Sub-Saharan Africa (SGCI) to work together with its sister agencies with the aim of collaboratively funding and partnering to support Africa's development agenda. The O.R. Tambo

Africa Research Chairs Initiative (ORTARChI), which is funding 10 chairs in 7 (seven) African countries is an example of such a programme. These chairs are focused on the following areas that are contributing solutions to the challenges of Africa: climate change and adaptation in water, vegetation, and livestock resources; cancer and public health; food safety and quality; entrepreneurship and youth employment; ecosystems for arid and semi-arid zones; livestock health; anti-malarial drug delivery; environmental management; and water quality and catchment protection. The NRF will continue to invest in these chairs in the 2023/24 financial year with a focus on consolidating the research ecosystem they are developing. The SGCI provides an excellent platform to grow additional research programmes. As such, the NRF's strategy is to continue working with agencies in Africa to conceptualise and implement such programmes to enhance and ensure their sustainability. In 2023, the NRF will collate lessons from the implementation of the COVID-19 Africa Rapid Grant Fund, which utilised this model of partnering on the continent to further shape future programmes. This will further advance the objectives of inclusive growth and sustainable development in line with the thematic focus of South Africa's 2023 BRICS chair-ship.

The consequence of the discontinuation of some funding opportunities and lower budget will negatively impact the total number of researchers supported, although this will not affect the disaggregation of targets according to gender, race and disability. In addition, the new research-focused partnership with Sasol will contribute to the number of established researchers and enhance academia and industry collaboration during 2023 to 2024.

Excellent and Impactful Research

The NRF will continue to support and advance the growth of a competitive and transformed research workforce through grants and recognition schemes aimed to attract, develop, support and retain researchers to develop the next generation of researchers and lead the knowledge enterprise in NRF research priorities aligned to the research agenda priorities in the STI Decadal Plan. The Decadal Plan prioritises the following:

- Support the modernisation of key sectors of the economy (agriculture, mining and manufacturing) by driving competitiveness and productivity improvements and, ultimately, higher GDP.
- Explore opportunities presented by emerging innovation concepts of the circular and digital economy as new sources of economic growth.
- Harness the capabilities built by the NSI over the years to drive innovation across several sectors (such as the health and energy sectors) to support the development of a capable and entrepreneurial state.
- Address the SGCs in the areas of climate change and environmental sustainability (SGC 1); future-proof education and skills (SGC 2); and a secure, safe and equitable society (SGC 3).

The support provided to researchers is customised according to different phases of the development pipeline. The support is aimed at ensuring production of excellent knowledge and innovation outputs that can contribute to developmental impact, development of the next generation of researchers, an increase in the number of researchers and transformation of those that

produce knowledge. Researchers are supported through the following:

- Investing in all knowledge domains through competitive processes.
- Further investment in SARChI, CoEs.
- New investments in NRIs.
- Evaluation and ratings.

The main categories for researchers are:

- Next Generation Researchers.
- Emerging Researchers.
- Established Researchers.

Evaluating and rating of individual researchers is a mechanism for the recognition of their achievement and assisting them in maintaining their levels of research excellence through benchmarking. The drive is to grow the number of rated scientists and transform the cohort to be representative of the population of South Africa.

The growth in the number of rated researchers will be supported through a redesigned programme consolidating the current instruments of Competitive Support for Rated and Unrated Researchers, and Developmental Support for Y-rated Researchers. The programme's development will be concluded during 2023 for implementation in 2024. The proposed reconfiguration will endeavour to support both basic and applied research by providing streamlined funding for emerging researchers, and overall to support both emerging and established researchers in a more coordinated manner.

SARChI is a strategic intervention of the South African government designed to attract and retain excellence in research and innovation at South African universities, national research facilities and science councils. In particular, the programme is aimed at increasing national scientific research capability through the development of human capacity and stimulating the generation of new knowledge. It is also intended to support the realisation of South Africa's transformation into a knowledge-based economy in which the generation of knowledge translates into socio-economic benefits.

The contract for the first cohort of 6 CoEs has come to an end. The remaining number of CoEs is 10. During the 2023/24 financial year the NITheCS and NIP3 will be established, although optimal implementation is not expected in 2023. Additional new CoEs aligned to the Decadal Plan, once approved, will also be established.

Emerging Researchers

The 2018 Study on Building a Cadre of Emerging Scholars for Higher Education in South Africa discounted the assumption that there is an unexploited pool of academics in the ranks of lecturers and senior lecturers in South Africa (the so-called "silent majority") that can act as the feeder for emerging researchers. Furthermore, the high percentages of senior lecturers and lecturers without a doctorate degree is considered to be one of the biggest structural barriers to increasing the number of active, emerging researchers and scholars. The NRF recognises the need to strategically invest in this cohort of researchers to transform, renew and replenish the research cohort for a sustainable science system.

Postdoctoral Fellowships provide funding for young scientists and professionals of the highest calibre to receive postdoctoral research training and international exposure to strengthen their research profiles and career advancement.

The NRF supports the transformation of the NSI through targeted interventions with a focus on: Historically Disadvantaged Institutions (HDIs), academic staff with disabilities, Black South Africans in general, including emerging and mid-career researchers. Targeted interventions in this area include:

- **The Black Academics Advancement Programme (BAAP)** provides grants for lecturer replacement funding to (i) doctoral candidates to accelerate the completion of their studies; and (ii) recent doctoral graduates to enhance their research training and accelerate their progression to become established researchers.
- **Thuthuka Research Grants** support individuals pursuing doctoral studies and those that recently completed their doctoral training, as well as researchers fast-tracked to apply for NRF rating.
- **New Generation of Academics Programme (nGAP)** research development grants, which afford nGAP scholars in their first or second year of appointment funding to develop a strong research grant application that can successfully compete for the Thuthuka and other research grants.
- **Customised Intervention Grants** aim to contribute to the transformation of the research landscape of the country by increasing the number of female researchers with an NRF rating. Universities with low numbers of established researchers that are Black and Female are the target for this grant with specific emphasis on Historically Disadvantaged Institutions (HDIs).

In addition, the NRF will revive its collaboration with Universities South Africa (USAf); the Department of Higher Education and Training (DHET) and other local and international partners, in supporting a customised pilot intervention – the National Graduate Academy for Mathematical and Statistical Sciences. The National Academy will be a consortium of South African universities that collaborate on training of the next generation of mathematicians and statisticians, including data scientists who will serve the NSI over the coming decades. Conceptualisation of the approach will be finalised during 2023 for implementation in 2024.

The NRF is in the process of developing a funding programme specific to HDIs which will seek to capitalise on all available grant funding within the DHET. This programme will only take effect in the 2024/25 planning cycle and will be geared towards supporting three of the Sibusiso Bhengu Development Programme (SB-DP) objectives, in particular, the improvement of the research infrastructure of HDIs, provision of effective research development opportunities for academics at HDIs, and the leveraging of the NRF's established regional and international collaborations and partnerships to support the identified research areas of these institutions.

Support for Y-Rated Researchers – These researchers are an important category of emerging researchers with supervisory potential and are part of the pipeline for established researchers of the future. Competitive grants awards up to R300 000 that can run from one to three years are made to Y-rated researchers to support their research development.

Research Infrastructure

State-of-the-art research infrastructure linked to the development of highly skilled knowledge-workers is a prerequisite for the generation of

globally competitive new knowledge, technologies, and innovation for the 21st Century. Over the past decade, investments in state-of-the-art research equipment have advanced research mainly in the thematic areas spanning communicable diseases; Nanotechnology; Biosciences and Environmental management; Global Change and Energy; Cellular and Molecular Biology; Physical Sciences; and Mining and Engineering. New research infrastructures will be created in a way that is research domain-balanced, fit for purpose, and globally competitive.

The National Equipment Programme (NEP) and Strategic Research Equipment (SRE) grants contribute to two of the NRF's pillars for development, which are: building and/or upgrading research infrastructures as well as enhancing professional and technical competencies. The NEP is a crucial enabler for internationally competitive research in South Africa, as it makes funds available for the acquisition, upgrade or development of state-of-the-art research equipment to South African public research institutions. The SRE funding opportunity is intended to complement the NEP and South African Research Infrastructure Roadmap (SARIR) in providing appropriate levels of strategic research equipment and infrastructure.

This funding opportunity supports the acquisition or development of equipment that advances the frontiers of science, addresses the development of scarce skills, attracts industry investment and drives scientific and technological productivity research in priority areas.

Access to national research platforms and Global Research Infrastructure is necessary to support South African researchers and the training of the next generation of scientists alongside leading researchers and scholars. The NRF will continue to support the provision of and access to Research and Development infrastructure across the NSI, as well as support access to Global Research Infrastructure including those through bilateral programmes such as:

- Access to the European Synchrotron Radiation Facility through the SA-ESRF Programme.
- The Joint Institute for Nuclear Research (JINR)-NRF Research and Innovation initiatives through the SA-JINR Programme.
- Access to the European Organization for Nuclear Research (CERN), through the SA-CERN Programme.

Programme Resource Considerations

Table 13: Planned Budget for Programme 3 to achieve its planned performance targets.

	Budget R'000 2022/2023	Budget R'000 2023/2024	Budget R'000 2024/2025	Budget R'000 2025/2026
Parliamentary Grant	491 450	473 766	492 063	514 107
DSI Contracts	1 749 241	2 077 009	1 922 518	2 119 220
Other Contracts	249 827	353 844	317 315	198 046
Internal Income	8 038	32 400	32 402	32 402
Other Income	4	36	35	35
Total Income	**2 498 560**	**2 937 055**	**2 764 333**	**2 863 810**
Running Expenses (Excluding Depreciation)	81 037	92 976	92 804	94 515
Grants and Bursaries	2 246 830	2 655 989	2 489 787	2 581 243
Internal Expenses	26 985	38 562	28 423	31 120
Salaries	138 228	142 723	146 809	150 552
Capital Expenditure	5 480	6 805	6 510	6 380
Total Expenditure	**2 498 560**	**2 937 055**	**2 764 333**	**2 863 810**

9.4 Programme 4: National Research Infrastructure Platforms

Purpose

The purpose of Programme 4 is to provide leading-edge research infrastructure platforms in support of the production of world-class knowledge and innovation outputs and in the process facilitate human capacity development and science engagement. This is done to ensure that the national research enterprise has the requisite infrastructure to undertake globally competitive discovery science, train the next generation of researchers, support engagement with science by and with the public, and promote innovation that has a positive social, environmental, and economic impact.

Programme 4 effects its mandate largely through:

- Management of the suite of National Research Facilities (NFs) in the Nuclear Sciences (iThemba Laboratory for Accelerator-based Sciences (iThemba LABS)), the Biodiversity and Environmental Sciences (South African Institute for Aquatic Biodiversity, (SAIAB) and South African Environmental Observation Network (SAEON)) and the Astronomy and Geodetic Sciences (South African Astronomical Observatory (SAAO) and South African Radio Astronomy Observatory (SARAO)).
- Co-management with Programme 3 of access to National and Global Research Infrastructures for South African researchers and postgraduate students, through multi-year travel and access grants. This is for them to access large-scale multilateral research infrastructures that no individual country could afford by themselves, namely CERN and ESRF in France, JINR in Russia, the High Energy Stereoscopic System (HESS) in Namibia and the Cherenkov Telescope Array (CTA).
- Management of multilateral research infrastructure platforms located in South Africa and in which South Africa has a stake, such as the soon-to-be SARAO-operated Square Kilometre Array (SKA) and the currently SAAO-operated Southern African Large Telescope (SALT), of which South Africa owns a 52% share.
- Support of research infrastructure platforms that are not formally declared National Research Facilities, but whose significance, scale, scope, cost and impact scientifically is of a national nature, such as the Centre for High Resolution Transmission Electron Microscopy (C-HRTEM) hosted by the Nelson Mandela University (NMU).
- Advance engagement of the public with the science being undertaken at the research infrastructure platforms managed and/or supported by the NRF, in accordance with the SES.
- Undertake human capacity development through designated student support programmes hosted by research infrastructure platforms and implemented largely with and through Programme 3.
- Foster technological innovation through the current conceptualisation and prototyping of Technology Innovation Hubs at each one of the NFs.

Management of the National Research Facilities

The National Research Facilities support the national research and development strategy by exploiting geographic advantage (e.g. Astronomy and Astrophysics from the southern skies) and knowledge advantage areas (e.g. Biodiversity & Environmental Sciences) that are unique to Southern Africa. They provide unique and cutting-edge research platforms through a network of distributed institutions. These Facilities support research of strategic importance and provide access to "big science" infrastructure to national and international researchers. It is through these Facilities that South Africa can compete and co-operate effectively with international counterparts in selected strategic research areas. These national research infrastructure platforms and the role they play in the NSI are summarised below:

- **iThemba LABS** is a multidisciplinary research facility based on the development, operation and use of particle accelerators and related research equipment. The beam time from the main accelerator, the Separated Sector Cyclotron (SSC), for example, is used for basic nuclear and hadron physics research; radioisotope research and development as well as their supply to the medical sector; radiobiology research related to particle therapy; and applications such as radiation hardness testing of electronic components used in satellites and detector calibrations. The research facilities are utilised by national and international researchers for basic science research, and several applied research areas such as ion beam analysis, nanotechnology studies, atomic mass spectroscopy for dating ancient artefacts, radiobiology, nuclear medicine, and environmental studies.

  The Long-Range Plan that was developed in 2017 and endorsed in 2018 by the Scientific and Technical Advisory Committee (STAC) provides a definitive blueprint of a research and infrastructural development roadmap of iThemba LABS in the medium to long-term, anchored on three major projects, namely:

  a) The South African Isotope Facility (SAIF) with its two phases.

  b) The Southern African Institute of Nuclear Technology and Sciences (SAINTS).

  c) The Technology Innovation Platform (TIP).

- **SAEON** (yet to be declared a National Research Facility) is a comprehensive, sustained, coordinated and responsive national network of in situ environmental observatories that delivers long-term reliable data for scientific research and postgraduate student training. It has a distributed nodal structure covering all of South Africa's biomes spread across 5 of the 9 provinces of the country, with geographically dispersed observation nodes along different ecosystems such as Arid Lands, Bushveld, Fynbos, Coastal areas, Grasslands, Forests, Wetlands and off-shore marine. SAEON scientists and technicians as well as collaborating students and other researchers utilise SAEON platforms to generate data. The openly accessible data acquired by SAEON and its collaborators are then used for the analysis of long-term patterns and processes and the creation of models, publications and archived datasets. These research products form the basis for policy and other decision-making inputs, as well as decision-support tools

- **SAAO** is the national facility for optical and infrared astronomy in South Africa. Its primary function is to conduct fundamental research in astronomy and astrophysics. SAAO operates a number of telescopes, including the Southern African Large Telescope (SALT). The latter is owned by the SALT Foundation formed by an international consortium of institutions, with the NRF as the major shareholder on behalf of South Africa. **SAAO**'s research and engineering expertise and output are strong, with the Sutherland based research facilities serving as the backbone of this success, with SALT as the flagship. The Sutherland site characteristics are also world class, leveraging strong international connections and collaborations, together with our scientific and technical reputation.

- **SARAO**'s mission is to establish South Africa as a global leader in radio astronomy and associated technologies and disciplines by successfully hosting, and participating in the design and construction of the SKA telescope and other radio astronomy and geodesy facilities. This mission is implemented through programmes and activities that deliver against SARAO's four strategic objectives:

  - To manage and optimise South Africa's contribution to and benefit from the international Square Kilometre Array (SKA) Project.

  - To establish and sustain globally competitive and transformed radio astronomy and space geodesy research and infrastructure in South Africa and abroad, where appropriate.

  - To maximise the associated national socio-economic benefit from radio astronomy and space geodesy activities.

  - To promote radio astronomy and space geodesy capacity in Africa.

SARAO is primarily an enabler of scientific research through the provision of world-class research platforms to an externalised research community – this includes the design, construction and hosting of the MeerKAT, MeerKAT Extension and the Square Kilometre Array radio telescopes. These projects and programmes are delivered by a number of divisions and have established a critical mass of engineering research and development expertise. As an organisation that is primarily an enabler of research, SARAO prioritises programmes that ensures high operational availability of cutting-edge research platforms for use by an externalised research community. As a result, a broad range of high-impact publications using SARAO-produced data by an international research community is enabled and monitored.

- **SAIAB** has developed a number of cutting-edge research platforms, unique to South Africa. Over the next ten (10) years, these platforms will be kept up to date and their capabilities expanded. The aim of these platforms is to provide those within the NSI to undertake research and innovation projects to drive sustainable development of the Blue Economy. Research infrastructure unique to SAIAB includes:

  - A number of special-purpose laboratories that are available to internal and external research scientists and students for research in molecular science and eco-physiology.

- A wet-collections facility including preservation laboratories, glass store, alcohol store, dermestarium and tissue preparation laboratory, as well as storage for the National Fish Collection, the African Amphibian Collection, the Aquatic Biodiversity Tissue Bank and the National Diatom Collection.
- The marine research platform, which includes the Coastal Craft Fleet with vessels based in Durban and Port Elizabeth; ATAP, which has over 100 underwater base stations along the East Coast of South Africa; and the Marine Remote Imagery Platform that manages a range of remote visual platforms such as ROVs, which are robots that dive hundreds of metres deep into the ocean.
- The largest document collection and resource centre for African aquatic biodiversity research in Africa.

Management of multilateral research infrastructure platforms located in South Africa and in which South Africa has a stake

In addition to providing access to researchers and postgraduate students at the National Research Facilities and Global Research Infrastructures, the NRF hosts on behalf of South Africa multilateral research infrastructures in which South Africa has a stake. The NRF holds on behalf of South Africa a 52% shareholding in SALT, a 10m class optical telescope operated and hosted by the SAAO on behalf of a Consortium of institutions in the US, UK, Poland and India. SALT is the biggest single optical telescope in the southern hemisphere. SARAO hosts and operates the South African designed MeerKAT Telescope – a precursor to the international Square Kilometre Array (SKA), which will be the biggest and most sensitive and scientifically versatile radio-telescope in the world when completed. The NRF, through SARAO is a site entity on behalf of South Africa for the SKA Observatory (SKAO), the multilateral intergovernmental organisation that will own and oversee the SKA Telescope. In this role, SARAO will deliver many of the construction and operational requirements of the SKA, as well as hosting obligations on behalf of the Department of Science and Innovation.

Support of research infrastructure platforms not formally declared National Research Facilities

Certain research infrastructures and platforms are of such significance, scale, scope, cost and impact scientifically and of a national nature, that they require designated support for their establishment and operation over the long term. An example in this regard is the Centre for High Resolution Transmission Electron Microscopy (C-HRTEM) hosted by NMU, which was established through a collaborative arrangement between the DHET, DSI and NMU. Through the NEP, the NRF supported the establishment of GAMKA, a Gamma-Ray spectroscope integrated into the research infrastructure of iThemba LABS. GAMKA is spearheaded by a Consortium of Higher Education Institutions and the NRF-iThemba LABS. In addition, the NRF has supported the establishment of the Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX) Telescope, which will be built on the SKA site, and the commissioning of the equipment will be completed in the 2024/25 financial year. The latter two projects were enabled through NRF's Strategic Research Equipment (SRE) Grant.

Advancing Science Engagement

Within the NRF, the National Research Facilities play a crucial role in advancing science engagement. This they accomplish by amongst others: (a) providing platforms for engagement by society with the science they perform via facility tours, science talks, and science communication publications; (b) inspiring an interest amongst the youth to pursue careers in science, engineering and technology through exposure to the scientific environment and role modelling; (c) contributing to the improvement of the quality of learning and teaching in SMET subjects through educator and learner development initiatives and activities; (d) enhancing the profile of South African science through achievement of ground-breaking knowledge advancements and/or technological breakthroughs, as well as international engagement and partnerships; (e) enabling participation of the community in scientific research through implementation of citizen science projects; and lately through (f) evolution and prototyping of the Responsible Research & Innovation (RRI) framework in a South African context e.g. by SAIAB.

Human Capacity Development

The National Research Facilities undertake intensive human capacity development through designated student support programmes implemented largely with and through RIISA. History has shown that one of the most significant returns on investment in high-end global-scale research infrastructures is the human capacity dividend realised through targeted training programmes linked to such investments. The same applies to the portfolio of National Research Facilities of the NRF, as exemplified in the following:

- **SARAO's HCD Programme**: to establish a transformed and sustainable radio astronomy community capable of exploiting the scientific return of its research platforms, as well as research and development in related engineering disciplines.
- **African Coelacanth Ecosystem Programme (ACEP) Phuhlisa**: as SAIAB's flagship Marine Science transformation programme, ACEP Phuhlisa provides specialist equipment and training to equip the next generation of scientists and research platform-managers with tools to research, analyse and thus understand and manage environmental change with a focus on HDIs.
- **National Astrophysics and Space Science Programme (NASSP)**: is a DSI-NRF-funded multi-institutional initiative to train South African students in Astrophysics & Space Science at Honours and Masters levels and provide a pipeline to doctoral studies in these and related areas.
- **Stobie-SALT Scholarship Programme:** is SAAO's postgraduate training programme with both a local and international placement at SALT partner institutions. SAAO has commenced the re-introduction of this training programme.
- **Southern African Institute for Nuclear Technology and Sciences (SAINTS)**: to accelerate, structure, coordinate and integrate articulated capacity development in nuclear science and technology. The development of the programme is underway at iThemba LABS.

In addition to the above, the NRF will be spearheading a programme to grow a diverse and representative technical cohort that will possess the right skills and knowledge mix to (a) custom design and manufacture cutting-edge research infrastructure, instruments and components; (b) maintain, refurbish and operate specialist research instruments, equipment and components; (c) support research through technical training of postgraduate students and researchers; (d) enable evolution of instrumentation to a higher degree by creating a pipeline from technicians to instrument scientists; (e) constitute the nucleus for fostering and advancing technological innovation in the knowledge enterprise. A programme framework is being finalised and stakeholder engagement is planned for the immediate future.

Institutional Capacity Development

The transformation imperative of the NRF includes a commitment to contribute meaningfully to the diversification of the actors, spaces and places in terms of by whom, where and how knowledge is produced. In the case of the research infrastructure provision there are a number of notable developments, namely:

- Within the SA-CERN Programme which seeks to develop national capacity at a globally competitive level in the area of nuclear and particle physics, the University of Zululand has been admitted as a contributing member within the South African ATLAS cluster.

- The Joint Marine Laboratories Project spearheaded by SAIAB and supported by the DSI, involves the establishment of specialist marine science laboratories at four HDIs, namely the universities of Zululand, the Western Cape, Walter Sisulu and Fort Hare; notably, the Fort Hare Laboratory. In addition, SAIAB's ACEP-Phuhlisa Programme drives transformation in the marine science sector through designated support of over 20 researchers and over 60 postgraduate students from HDIs.

- Upon commencement of the SKA programme, SARAO (then SKA SA) engaged with the higher education sector with the strategic intent of establishing astronomy programmes in educational institutions beyond those that historically undertook astronomy, and particularly within the HDIs. This early engagement resulted in the establishment of an Astronomy Department at the University of the Western Cape in 2008, with the support of SARAO. It now hosts the Centre for Radio Cosmology, supported by SARAO, and a globally recognised research group that includes three SARAO-funded research chairs. This approach has also resulted in strong collaboration and links with other African universities that have established astronomy programmes.

- The Masters programme in Materials and Nuclear Physics (MaNuSMatSci), supported by the DSI, involves iThemba LABS and the universities of Zululand and the Western Cape, and is aimed at developing home-grown capacity in these scarce skills.

Table 14: Outcomes, Outputs, Performance Indicators and Targets

Strategic Outcomes: Enhanced impact of the research enterprise							
Outputs	Output Indicators	Audited /Actual performance		Estimated Performance	MTEF Period Targets		
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Socio-economic contribution of the NFs	Foreign income (*rand million*) derived from NFs activities / operations*	R93	R107	R163	R235	R252	R281
Knowledge translation for societal benefit	Number of patient doses generated from radioisotopes produced by iThemba LABS	143 793	171 713	200 000	220 000	253 000	316 250
Knowledge produced/ transferred/ shared/ applied by rips to the benefit of society	Number of technical and policy briefs produced or published by NFs in the reporting period	New	New	20	20	20	20
Knowledge produced/ transferred/ shared/ applied by rips to the benefit of society	Number of active intellectual property products produced or completed (registered or not) at the end of the relevant reporting period.	New	New	4	3	2	3

*The scope of the indicator has been increased to include income for SARAO. This necessitated restating of previous years' audited figures to include SARAO.

Table 15: Indicators, Annual and Quarterly Targets for 2023/24

Output Indicators	Annual Target	Q1	Q2	Q3	Q4
Foreign income (*rand million*) derived from NFs activities / operations*	R235	R90	R166	R189	R235
Number of patient doses generated from radioisotopes produced by iThemba LABS.	220 000	50 000	100 000	150 000	220 000
Number of technical and policy briefs produced or published by NFs in the reporting period.	20	5	10	15	20
Number of active intellectual property products produced or completed (registered or not) at the end of the relevant reporting period.	3	–	–	–	3

Explanation of Planning Performance over the MTEF period

Each of the National Facilities contributes to the performance indicators and targets of Programme 4 using its portfolio of the research infrastructure platforms and human capital capabilities. This is done on a differential and proportional basis based on the unique circumstances of each NF and the scientific and technical context in which it operates.

Research Translation for Societal Benefit and Impact

One of the pathways to impact creation through science is the translation of science into tangible useable products, processes and systems that beneficiaries within society can engage with and apply to improve the quality of their lives. This relates and translates into a socio-economic contribution by science generally, but by the National Research Facilities in particular. Through such, you get translation of research outputs and outcomes into products and services that either enhance the capacity of the state and/or improve the competitiveness of sectors of industry or add value to the lives of people on the ground directly or indirectly in areas such as health and social support. Each one of the NFs, individually and collectively, possess great potential for translation of their knowledge products into beneficial applications in society.

Examples of these include the following:

- The supply of accelerator-based medical isotopes produced by iThemba LABS enables treatment and diagnosis of cancer in patients locally and internationally. The acquisition of the new C70 cyclotron is envisaged to lead to a manifold increase in the beamtime dedicated to the production of accelerator-based radioisotopes.
- SAIAB's contributions to rural fisheries management, invasive species management and climate change understanding and mitigation, enhance national capabilities in sustainable management of natural resources thus building resilience at community and national level.

- SAEON's Risk and Vulnerability Atlas enables risk analysis and modelling at an environmental/ecosystem level as well as socio-economic level e.g. in municipal risk and vulnerability analysis.
- SARAO and SAAO recently led the technical management of the National Ventilator Project, thus providing a crucial and an affordable pandemic/disease management tool against COVID-19 for the country's national health system.
- National Research Facilities procure goods and services in pursuance of their mandate, and these are procured from local entities and communities, thus contributing to socio-economic development in the respective communities adjacent to the NFs.
- Foreign income derived from the sale of goods and services produced by the NFs contributes to the country's balance of payments.
- Given the deep levels of unemployment in the country, especially in rural areas, the recruitment of labour by the NFs from communities adjacent to their operations makes a direct contribution to boosting employment levels in such areas.
- The translation of scientific knowledge generated by the NFs into technical or policy briefs contributes to the enhancement of the capacity of the State in the commensurate areas.

During the MTEF period, performance towards socio-economic impact will be measured with the following performance indicators:

- Foreign income.
- Patient doses of radioisotopes.
- Technical and Policy Briefs.
- Intellectual Property Products.

Foreign Income

Foreign income derived from the sale of goods and services produced by the NFs and foreign investment leveraged for the operations and projects of the NFs is a source of incremental income for the country and thus contributes to the balance of payments. The biggest consistent contributor to foreign income is the sale of radioisotopes and service fees for the management operations of RIPs, and foreign investment funds leveraged for the operations and projects of the NFs. The remainder is made up of fees earned from scientific services and contracted research projects.

Patient Doses of Radioisotopes

The supply of accelerator-based medical isotopes produced by iThemba LABS enable treatment and diagnosis of cancer in patients locally and internationally. The firm international customer base also signals international confidence in the NRF's facilities and positively contributes to the country's international reputation.

Lack of consistency in the national power supply negatively impacts radioisotope production and thus the number of radiopharmaceutical doses that can be titrated from produced quantities. As a result, the relevant indicator is at a critical risk, despite mitigation measures taken and planned by the Facility.

Technical and Policy Briefs

The translation of scientific knowledge generated by the NFs into technical or policy briefs contributes to the enhancement of the capacity of the State in the commensurate areas, such as policy

development, decision-making as well as future scenario planning. The nature of policy briefs is such that they are a result of synthesis of the latest body of knowledge and emerging considerations in a particular area. Some are commissioned by government departments and/or entities that report to them.

Fostering Technological Innovation

Among primary foci of the WPSTI and the Decadal Plan for STI, Innovation and Societal Impact have taken centre stage. With that comes specific expectations for state entities and projects and initiatives supported by the DSI to demonstrate their contribution to the fostering and advancement of Innovation. This means that the NRF, through the national research Facilities as the primary locus for research and development performance, has to be prepared to enunciate clearly what the understanding of this Innovation focus means for the organisation and what realistically and practically can, will and should be done about it. In that regard, the NRF has developed an Innovation Framework that will be the subject of discussion and implementation over the next MTEF. In addition, each one of the National Research Facilities has identified a focal theme for the prototyping of a Technology Innovation Hub. The identified thematic areas are: Marine Robotics and Artificial Intelligence (AI) underwater vision for SAIAB; Compute and Data for SARAO; Sensing and Metrology for SAEON; Nuclear Medicine and Accelerator Technology for iThemba LABS as well as Optical Engineering and Instrumentation for SAAO. These hubs will be utilised to focus the effort, resources and creative energy of the NFs to drive, foster and advance innovation within the context of their scientific and technological foci.

Intellectual Property (IP)

Scientific knowledge generated by the NFs and its translation into intellectual property products contributes to the enhancement of the technological capacity of the country in the relevant areas. In addition, once commercialised, patent-protected technologies and intellectual property products have the potential to derive an additional income stream for the Facilities to supplement operational income and/or reinvestment into further development capacity. However, the majority of IP-related products from the National Research Facilities are in the form of proprietary know-how rather than directly patentable outputs, e.g., the radioisotope production processes of iThemba LABS or the computational and data processes of SARAO.

The operational capability of the different research platforms of the NFs needs to be maintained at a qualitative and productive level to provide effective and impactful support to the science system. In order to achieve that most effectively, it is essential to set performance standards, specifically in relation to the uptime availability of the research platforms to the users of the platforms. That in turn reflects on the effectiveness of the maintenance regime of the underlying infrastructure and instrumentation. When optimised or even maximised, this contributes positively to the productivity of the research platforms. The factors measured in this context relate to operational uptime and platform availability, monitored on an ongoing basis in terms of day-to-day operational management of the research platforms.

Global and Continental Engagements

Africa and the Diaspora

SARAO plays a crucial role in exploiting and delivering opportunities to establish radio astronomy research infrastructure across the African continent. It implements the Africa Programme, including the African VLBI Network, as well as two Development of Africa through Radio Astronomy (DARA) programmes: (i) for the training and development of radio astronomy and engineering related skills in African countries; and (ii) for the development of Big Data and data science skills. In this regard, SARAO has hosted three successful Data Science Intensive programmes in collaboration with international partners. For the 2022 programme, 20 students (45% female) participated chosen from 2 268 applicants, representing 10 African countries. SARAO continues to identify and exploit initiatives and opportunities globally, and is currently delivering the HERA, C-BASS, MeerKAT Extension and SKA programmes.

SAIAB is part of the Indian Ocean Global Ocean Observing Platform (GOOS)-Africa, a permanent global system for observations, modelling, and analysis of marine and ocean data, lined up to the African continent and adjacent island states. Linked to its Biobanking facilities and the hosting of the National Collection for fish related taxa, it is a participant in the Inter-African Bureau for Animal Resources (IBAR), specifically around African fish collections and biobanks. This is in support of the AU IBAR Conservation of Aquatic Biodiversity for the Blue economy.

SAAO spearheads a BRICS-Astronomy Flagship programme in an effort to build (first) an African Integrated Observation Network as an extension of the SAAO Intelligent Observatory project, with the aim to be later enlarged to a BRICS-wide observational/technological effort.

iThemba LABS has for the past 5 years been building a strong network of collaborating institutions in Africa, Europe, Asia and America. Memoranda of Understanding (MoU) have been signed and are being actively pursued and managed with higher education and research institutions from Africa (the most recent ones are Botswana, Eswatini, Tanzania and Algeria). The facility has been designated by the IAEA as a collaborating centre with the task of training African and other member states in accelerator-based sciences and technologies. iThemba LABS initiated a collaboration between all African countries that have particle accelerators under the coordination of African Particle Accelerators Coordination Committee (APACC) in order to develop shared scientific and technical capacity and for the appropriate global positioning of African accelerator-based science.

Research Collaboration

The NRF is a founding member of the Global Research Councils (GRC) and has utilised that relationship to build alliances with other granting councils in the area of research infrastructure provision. Following the signing of a MoU with the United Kingdom Research & Innovation (UKRI), the NRF will be hosting a second workshop/side event on the socio-economic relevance and contributions of research infrastructures on

the side lines of the International Conference on Research Infrastructures (ICRI2022) in Brno, Czech Republic.

The SAIAB-led Acoustic Tracking Array Platform (ATAP) is a collaborative marine science programme that aims to provide a service to the greater marine science community by monitoring the movements and migrations of inshore marine animals. The platform comprises an expanded network of automated datalogging acoustic receivers that are moored to the ocean's floor around the South African coastline. The Canadian based global Ocean Tracking Network (OTN) project has provided much of the acoustic telemetry hardware. Since the launch of the OTN project in South Africa in August 2011, acoustic receivers have been deployed at monitoring sites from Cape Point to Ponta do Ouro in Mozambique. Receivers have also been deployed in selected estuaries to facilitate studies on habitat connectivity of estuarine associated animals. The national network of receivers is maintained by SAIAB and its local collaborating partners, and the data uploaded is stored on a national database. SAIAB will continue its long standing relationship with the global Ocean Tracking Network (OTN).

Access to National and Global Research Infrastructures

In addition to having access to the National Research Facilities, South African researchers and postgraduate students have access to large-scale multilateral research infrastructures that no individual country could afford by itself, through a combination of multi-year travel and access grants and subscription-based access to same that is administered by Programmes 3 and 4 of the NRF. The multilateral research infrastructures to which the NRF is an implementing agent on behalf of South Africa's DSI are CERN and ESRF in France; JINR in Russia; the High Energy Stereoscopic System (HESS) in Namibia; and the Cherenkov Telescope Array (CTA). This kind of access ensures that South African scientists and postgraduate students have access to best-in-class research infrastructure platforms enabling them to undertake cutting-edge research that often helps South Africa punch above its weight.

Open Science

Principles of Open Science are embedded into the "Open Skies" approach taken by SARAO, and most radio astronomy research infrastructures globally. With the more recent development of principles and technical standards, Open Science principles will be embedded into the design and development of the future South African SKA Regional Centre for which SARAO will be the primary design authority and implementing agent.

The National Research Facilities broadly subscribe to open data and open science principles in their operational management approaches.

Programme Resource Considerations

Table 16: Planned Budget for Programme 4 to achieve its planned performance targets

	Budget R'000 2022/2023	Budget R'000 2023/2024	Budget R'000 2024/2025	Budget R'000 2025/2026
Parliamentary Grant	350 175	365 934	382 666	399 810
DSI Contracts	1 528 531	2 105 529	1 621 233	1 247 017
Other Contracts	108 960	180 360	181 531	181 208
Internal Income	76 907	63 428	50 297	50 350
Other Income	109 225	120 279	140 114	171 277
Total Income	**2 173 798**	**2 835 530**	**2 375 841**	**2 049 662**
Running Expenses (Excluding Depreciation)	391 787	479 266	498 564	512 076
Grants and Bursaries	109 152	93 234	90 329	72 471
Internal Expenses	88 812	95 905	80 313	78 540
Salaries	741 465	809 607	891 706	948 081
Capital Expenditure	842 582	1 357 518	814 929	438 494
Total Expenditure	**2 173 798**	**2 835 530**	**2 375 841**	**2 049 662**

- The core parliamentary grant for 2023/24 increased by 4.5% on 2022/23 projection, which is a more favourable increase compared to prior periods where the income allocation was restrained due to COVID-19 related funding priorities within the fiscus. The increase of 4.5% however still remains well below average operational cost that have escalated aggressively over the past year, partly due to the impact of the Russia/Ukraine situation, over and above the legacy challenges posed locally by the energy crisis.
- Operational expenditure continues to be strained due to the need to ensure retention of critical expertise and scarce skills and alignment with the broader market.
- Running expenses are being stretched by major spend categories like utilities which continue to see double digit increases from high Eskom tariffs, compliance costs and shared services costs.
- Due to limited funding, some critical positions remain frozen, which will have a major effect on some programme deliverables. This will be monitored on an ongoing basis.
- No core grant is available to fund capital infrastructure and capital maintenance since 2021/22 into the MTEF period. This

poses a huge risk on research infrastructure platforms. The SRIG allocation for the MTEF period will only be confirmed based on the outcome of the review of the recapitalisation plan submitted by the NRF to the DSI. Meanwhile the NFs infrastructure funding requirements remain unmet.

- Huge reliance on contract funding, which is seasonal and not sustainable and cannot be allocated on a strategic and predicable basis to meet known and unknown future needs, poses a systemic risk to high-end and specialised research infrastructure platforms.

10. Updated Key Risks and Mitigation Plans

The following key risks may affect achievement of the identified Strategic Outcomes. Measures to mitigations of these key risk have been identified below:

Table 17: Risk identification and mitigation

Strategic Outcomes	Key Risk	Risk Mitigation
[1] A transformed (internationally competitive and sustainable) research workforce.	Inadequate funding due to escalating cost of studies and research.	Regular review of DSI-NRF Postgraduate Funding Policy, continuous engagement with the DSI on additional funding, and revenue diversification.
[2] Enhanced impact of the research enterprise.	Research cost escalation and loss of influence over the research workforce.	Monitor stakeholder feedback and use it to improve the design of support instruments. Ensure alignment of NRF initiatives with the STI Decadal Plan.
[3] Enhanced impact of science engagement.	Limited success and stakeholder acceptance of the required transition from the current capability and operating model.	Include comprehensive stakeholder engagement when completing the NRF Engaged Research Framework.
[4] A transformed organisation that lives its values.	Absence of articulated employee value proposition and Human Capacity Development (HCD) support that meet the needs of staff from designated groups.	Establish internal HCD support for the production of technical skills linked to the requirements of research infrastructure and implement a suite of incentives tailored to attract and retain the critical skills required for the sustainability of the organisation.

11. Infrastructure Projects

Table 18: Infrastructure Projects

No.	Project Name	Project Description	Outputs	Project Start date	Project Completion date	Total Estimated cost - R'000	2022/23 Expenditure (cumulative) R'000
1	Aquatic Biodiversity RIPs	Auxiliary water supply	Cutting-edge infrastructure available for research, innovation, HCD, and science engagement	2022/23	2023/24	R6	R6
2		Live animal handling facility		2022/23	2023/24	R4	R3
3		Technical hub building		2023/24	2024/25	R5	–
4	Environment Observatory RIPs	Shallow Marine and Coastal Research Infrastructure (SMCRI)		2016/2017	2030/31	R635.5	R186
5		Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON)		2016/17	2030/31	R509.5	R38.5
6		South African Polar Research Infrastructure (SAPRI)		2021/22	2036/37	R1 billion	R19.1
7	Radio Astronomy RIPs	SKA MeerKAT extension – 20 additional dishes		2020/21	2024/25	R545	R322
8		SKA Dark Fibre		2022/23	2024/25	R128	R6
9		SKA Northern Cape Visitors' Science Centre		2023/24	2025/26	R32	–
10		SKA Regional Centre – South Africa (SKA SRC-ZA)		2023/24	2027/28	R25	–
11		SKA Engineering Operations Centre (EOC)		2023/24	2025/26	R142	–
12		SKA Science Operating Centre (SOC)		2023/24	2025/26	R450	–

No.	Project Name	Project Description	Outputs	Project Start date	Project Completion date	Total Estimated cost - R'000	2022/23 Expenditure (cumulative) R'000
13		SKA Science Processing Centre (SPC)		2023/24	2025/26	R607	–
14		National Park (MeerKAT) game fence.		2023/24	2025/26	R60	–

12. District Development Model

Table 19: District Development Model

Project Name or Initiative:	Development of the SKA-Mid
Brief Description	South Africa will host the SKA Observatory's mid frequency telescope (SKA-Mid). SKA-Mid will comprise an array of 197 dishes, including 64 dishes of the MeerKAT telescope. A large concentration of the dishes will be in the core, while others will span out along three spiral arms, stretching 150 kilometres end to end. SKA-Mid will be located in the Northern Cape, a legislated radio controlled zone in remote Karoo region, around 450kms north-east of Cape Town, and 60kms west of the town of Carnarvon. This project will bring investment to the Namaqua and the Pixley Ka seme Districts. The towns impacted is primarily Carnarvon Williston and Vanwyksvlei. From the Kareeberg and Karoo Hoogland Municipalities. Some farm land in the Hantam local Municipality is affected.
Objectives:	Development of a Radio Astronomy Observatory
Anticipated Project Impact:	R192m
Estimated Number of beneficiaries:	30 SMME's
Partners involved:	SKA, NRF, DSI, Sector Departments, South African HEI's, International Organisations and HEI's
District Municipality:	Namaqua and Pixley ka Seme
Local Municipality:	Pixley ka Seme: Kareeberg Namaqua: Hantam and Karoo Hoogland
Geographical Area Coordinates (Latitude & Longitude):	GPS: 30° 58' 26.29" E 21° 59' 39.33"
DDM One Plan - 6 categories	• Economic Positioning • Infrastructure Engineering

DSI Strategic Outcome Addressed (2020-2025 period):	• Outcome 1: A transformed, inclusive, responsive and coherent national system of innovation. • Outcome 2: Human capabilities and skills for the economy and development. • Outcome 3: Increased knowledge generation and innovation output. • Outcome 4: Knowledge utilisation for economic development in (a) revitalising existing industries and (b) stimulating R&D-led industrial development. • Outcome 5: Knowledge utilisation for inclusive development. • Outcome 6: Innovation in support of a capable and developmental state.
STI White Paper Policy Intent Addressed:	24
Sustainable Development Goals (SDGs) Addressed:	1 and 9
Project Duration - FY (Start - End):	2021 - Ongoing
Project Status (Active, Proposed, or Closed):	Active
Project Outputs for Current Financial Year (e.g., FY 2020/21)	Whole year
Please expound on your output as per the above selection:	The commitments of the NRF|SARAO with regard to the development of the SKA in South Africa is ongoing and different projects are running in two regional municipalities concurrently. Some of these are difficult to provide specific budgets and timelines for. The investment in these municipalities is linked to the 5-point strategic approach as identified by SKA, for Northern Cape Community Engagement that guides all development and engagement activities. This strategy includes: a) Youth development. b) Identifying and nurturing talent. c) Economic development. d) Connectivity. e) Community development. f) Annual Projects. These projects include: **Namaqua:** 1) Community Development and Schools grants. 2) Bursary programme for learners to study in Carnarvon where SARAO placed educators. 3) SMME Development in Williston and Brandvlei. 4) Construction activities lined to the development of MeerKAT+ and the SKA. This includes supplier development, SMME training and manual labour. 5) Star Tours Tourism Development Programme 6) Development of the Meerkat National Park. 7) General supplier development.

	Pixley ka Seme: 1) Community Development and Schools grants. 2) Development of an Artisan Training Centre in Carnarvon. 3) Bursary programme for learners to study in Carnarvon where SARAO placed educators. 4) SMME development in Williston and Brandvlei. 5) Construction activities lined to the development of MeerKAT+ and the SKA. This includes supplier development, SMME training and manual labour. 6) Star Tours Tourism development programme. 7) Development of a Science Exploratorium by the DSI and Tourism.
Budget Allocation (As per contract):	There are different contracts for different projects. With the Development of SKA, we will only know when procurement starts.
Actual Budget Expenditure (Amount to date):	R192 (excluding salaries).
Source of Funding:	International SKAO, NRF and DSI.
Is Funding Secured for the Project? (Yes/No):	Yes.
Implementing Agent:	NRF SARAO.
Contact Person (Project Manager):	Anton Binneman anton@ska.ac.za.

Technical Indicator Descriptions

13. Technical Indicator Descriptions

Programme 1

Indicator Title (Indicator 1)	Proportion of employees from designated groups at Peromnes levels 1-7.
Definition	This indicator measures the demographic representation of the NRF leadership, management and supervisory cohort with specific annual MTEF targets set for the proportion of Black (African, Coloured and Indian) and women employees in the specified Peromnes levels. Designated groups will be identified in accordance with the requirements of the Employment Equity Act.
Source of Data	NRF Human Resources Information Management System.
Method of Calculation / Assessment	Divide the count of employees from designated groups occupying positions that fall in the Peromnes 1-7 levels by the overall count of all employees in the same levels, expressed as a percentage (%).
Means of Verification	Employment records.
Assumptions	An appropriate attrition rate and availability of candidates when positions become available.
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Based on cumulative numbers over the reporting period.
Reporting Cycle	Annually.
Desired Performance	Actual performance in line with targeted performance is desirable.
Indicator Responsibility	Group Executive – Corporate Services.

Indicator Title	Outcome of annual audit by AGSA.
Definition	This indicator measures the efficiency of the organisation in management and allocation of funds and spending towards delivering on its mandate.
Source of Data	Audit Report issued by AGSA.
Method of Calculation / Assessment	The outcome stated in the Management Report AGSA.
Means of Verification	Final Audit Report from AGSA.
Assumptions	None
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Non-cumulative

Indicator Title	Outcome of annual audit by AGSA.
Reporting Cycle	Annually
Desired Performance	Clean Audit awarded
Indicator Responsibility	CFO

Programme 2

Indicator Title	Number of public engagements with and in science interventions.
Definition	The indicator measures the public engagements with and in science interventions, such as: National Science Week, festivals, public-viewing, ministerial Imbizos, and others, which are designed to contribute to the achievement of a society that is knowledgeable about science, able to form independent opinions about science issues, and scientifically literate.
Source of Data	Records of interventions.
Method of Calculation / Assessment	A simple count of public engagements with and in science interventions.
Means of Verification	Records of interventions management – including any combination of the following: third-party reports or approved plans, evidence of implementation, participating entities, beneficiary group/s, location, dates of activities, beneficiaries that actually received services and proof that this was offered where practically and reasonably available.
Assumptions	Factors that are accepted as true and certain to happen without proof.
Disaggregation of Beneficiaries (where applicable)	Statistics of disaggregation of beneficiaries indicating District Municipalities, Metros and Provinces covered, as well as according to gender (Male or Female), will be collected and reported as required.
Spatial Transformation (where applicable)	Geographical spread of implemented projects according to District Municipalities, Metros and Provinces and investment
Calculation Type	Not applicable
Reporting Cycle	Quarterly
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Indicator Title	Number of interventions supporting the development of skills for the future of work.
Definition	The indicator measures number of interventions or activities implemented to support learners in preparing for careers that will be required by the economy of the future. The interventions assist to identify and nurture talent in STEMI fields and to expand the STEMI education pipeline. The focus should be on interventions that advance fields of science areas that contribute to development of skills required in the society of the future.
Source of Data	Records of interventions.
Method of Calculation / Assessment	A simple count of interventions for supporting learners.

Indicator Title	Number of interventions supporting the development of skills for the future of work.
Means of Verification	Proof of execution of interventions, which can take different forms such as audio, video records, attestation by beneficiaries.
Assumptions	Reliability of data related to race and disability status of beneficiaries is dependent on disclosure by the applicant.
Disaggregation of Beneficiaries (where applicable)	Statistics of disaggregation of beneficiaries indicating district municipalities, metros and provinces covered, as well as according to gender (Male or Female), will be collected and reported as required.
Spatial Transformation (where applicable)	Not applicable.
Calculation Type	Cumulative
Reporting Cycle	Quarterly.
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Indicator Title	Number of interventions to build SE capacity across the system.
Definition	The indicator measures the activities that are implemented as interventions that seek to ensure that science is communicated in a simplified manner and languages that are understood by specific audiences to enable participation of the public in scientific dialogues. This includes the provision of training of Scientists and Journalists to capacitate them to undertake science engagement activities including science communication skills; and the use of a variety of platforms such as Imbizos, Public Lectures, Workshops, Conferences, Media platforms, etc. for public dialogue and knowledge sharing.
Source of Data	Records on interventions.
Method of Calculation / Assessment	Count the number of capacity development interventions.
Means of Verification	Proof of execution of interventions, which can take different forms such as audio, video records, attestation by beneficiaries.
Assumptions	Reliability of data related to race and disability status of beneficiaries is dependent on disclosure by the applicant.
Disaggregation of Beneficiaries (where applicable)	Statistics of disaggregation of beneficiaries indicating district municipalities, metros and provinces covered, as well as according to gender (Male or Female), will be collected and reported as required.
Spatial Transformation (where applicable)	Not applicable.
Calculation Type	Cumulative.
Reporting Cycle	Quarterly.
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Programme 3

Indicator Title	Number of NRF-funded postgraduate students.
Definition	• The indicator measures the number of NRF-funded postgraduate students with specific annually set targets for each year of the MTEF period. • Postgraduate students for the purpose of this indicator refers to an NRF-funded individual who is registered for a postgraduate qualification with an academic institution at the level of honours, masters, and doctoral studies.
Source of Data	NRF Grants Management and Systems Administration (GMSA).
Method of Calculation / Assessment	• The count of all NRF-funded postgraduate students who have been registered on the NRF GMSA system. Students funded through funding policies directed at internal NRF employee development initiatives are excluded from the count. • A postgraduate student will be recognised as funded when the funding support to the postgraduate student is expensed or in the case of a postgraduate student supported by a Centre of Excellence and operationally similar instruments, the grant to the centre is expensed. In determining the full count of NRF-funded postgraduate students in any one year, each student must only be counted once, regardless of the number of sources of funding received from the NRF, except on a few occasions where a postgraduate student completes one qualification and starts another within one academic year. • Academic year 2023 performance will be reported in the 2023/24 reporting year.
Means of Verification	Portfolio of evidence includes records supplied by students or education institutions and kept by the NRF related to the application for funding (e.g. copy of applicants' IDs and/or passports), funding awards and applicant acceptance, as well as expenses against allocations.
Assumptions	Reliability of data related to race and disability status is dependent on the disclosure by the applicant.
Disaggregation of Beneficiaries (where applicable)	In determining the disaggregation of funded-postgraduate students into designated groups, the profile of postgraduate students who are South African citizens and permanent residents is considered. Target for Women: 55% Target for Black: 90% Target for Persons living with Disabilities: 1%.
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative within the reporting period.
Reporting Cycle	Quarterly.
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Indicator Title	Number of NRF-funded researchers.
Definition	• This indicator measures the number of NRF-funded researchers (including postdoctoral fellows) with specific annual MTEF targets set for this number. • Researchers are those designated as such by research-based institutions and organisations and are eligible to receive research grants or make use of Research Infrastructure Platforms or test results or research information generated or held by the NRF. Researchers also include postdoctoral fellows, staff of research institutions designated as researchers or delegated as users of test results or research information.
Source of Data	NRF Grants Management and Systems Administration (GMSA).
Method of Calculation / Assessment	The count of all NRF-funded researchers (including postdoctoral fellows). A researcher will be counted as funded when the funding support for the researcher is expensed. In totalling NRF-funded researchers in any one year, each researcher must only be counted once, regardless of the number of grants received.
Means of Verification	Portfolio of evidence includes records supplied by researchers and kept by the NRF related to application for grants (e.g. copy of applicants' IDs and/ or passports), grant awards and applicant acceptance, as well as expenses against allocations.
Assumptions	Reliability of data related to race and disability status of beneficiaries is dependent on the disclosure by the applicant.
Disaggregation of Beneficiaries (where applicable)	The profile of researchers to be reported include proportions for all groups that constitute the full profile of all NRF-funded researchers expressed as % Target for Women = 49% Target for Black = 58% Target for People living with disabilities = 2%.
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative within the reporting period.
Reporting Cycle	Quarterly.
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Indicator Title	Number of rated researchers.
Definition	This indicator measures the total number of researchers rated through the NRF system.
Source of Data	NRF Data System for Rating.
Method of Calculation / Assessment	The count of researchers that has a valid rating (in accordance with NRF-rating requirements) in the performance year regardless of when it was granted.
Means of Verification	The portfolio of evidence made of records for application, rating decisions and awards to researchers.

Indicator Title	Number of rated researchers.
Assumptions	Reliability of data related to race and disability status of beneficiaries is dependent on the disclosure by the applicant.
Disaggregation of Beneficiaries (where applicable)	Statistics on the disaggregation of beneficiaries covering race, gender, age and disability, will be kept and reported as required.
Spatial Transformation (where applicable)	Reflect on contribution to spatial transformation priorities. Reflect on the spatial impact area
Calculation Type	Non-cumulative.
Reporting Cycle	Annually.
Desired Performance	Actual performance in line with targeted performance.
Indicator Responsibility	DCEO – RIISA

Programme 4

Indicator Title	Total foreign income (*Rand million*) derived from NFs activities or operations.
Definition	Measures the income derived from the sale of products and/or services to clients abroad and foreign investment leveraged for the operations and projects of the NFs. This excludes the in-kind work where there is no direct payment made to the NFs.
Source of Data	Finance and operational records from each business unit.
Method of Calculation / Assessment	Sum of all Foreign income reflected in the banking/financial records/ statements of the NFs.
Means of Verification	Primary data, as relevant, in the form of: • Financial/banking or accounts/statements of the NFs. • Engineering reports. • Invoices. • Work packages, signed contracts, and cash flows emanating from these contracts. • Agreements/contracts – records of the relevant transactions
Assumptions	The value and timing of the awards and commencement of contracts at annual planning stage is not certain.
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative.
Reporting Cycle	Quarterly.
Desired Performance	In line with annual targets.
Indicator Responsibility	DCEO of NRIP

Indicator Title	**Number of patient doses generated from radioisotopes produced by iThemba LABS.**
Definition	Measures the number of patient doses generated from radioisotopes produced by iThemba LABS. The patient dose for each isotope is defined as follows: • For Iodine-123, 5 millicurie = 1 patient dose: (A production batch size of 250 millicurie will therefore be administered to 50 patients. • For 18F-FDG: 10 millicurie = 1 patient dose: (A production batch size of 250 mCi dispatched, will be administered to 25 patients). • For the 68Ge/68Ga Generator: A typical 50 mCi generator will be administered to 300 patients during a 9-month shelf-life. • For the 82Sr/82Rb Generator: A typical 100 mCi generator will be administered to 300 patients during a 4-week shelf-life (12 patients x 5 days x 4 weeks).
Source of Data	Production and delivery records in database of information from Radioisotopes Department of iThemba LABS.
Method of Calculation / Assessment	Sum of the number of patient doses for each isotope (as per definition), from radioisotopes produced by iThemba LABS, and delivered to be administered to patients.
Means of Verification	• Examination of iThemba LABS production and sales records of radioisotopes. • Approved acceptance reports, payment or similar.
Assumptions	Assumes that the doses delivered to clients will be administered to patients.
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative.
Reporting Cycle	Quarterly.
Desired Performance	In line with the annual target.
Indicator Responsibility	DCEO of NRIP

Indicator Title	Number of technical/policy briefs produced by the NFs.
Definition	The number of Technical and Policy briefs produced or published by RIPs in the reporting period. A Technical Brief is a publication or official document providing scientific/technical synthesis on a specified topic which provides advice or recommendations about the positioning of a knowledge area or technical application either locally, nationally or globally. A Policy Brief is a formal document or publication that provides specific advice or recommendations to policy/decision-makers at an institutional, local/ provincial/national government level based on the synthesis and analysis of the latest science/technological applications.
Source of Data	Document management systems of the business units.
Method of Calculation / Assessment	A count of stand-alone copies of technical or policy briefs.
Means of Verification	The actual stand-alone copies of the technical or policy briefs and proof that the copy was shared (via email or any other means) with the relevant stakeholder or its representative.
Assumptions	A technical or policy brief will be the interpretation of peer-viewed academic outputs into a format that will facilitate uptake into planning and policy documents. Authors will declare affiliations with the NFs to publishers accurately and consistently.
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative.
Reporting Cycle	Quarterly.
Desired Performance	In line with annual target.
Indicator Responsibility	DCEO of NRIP

Indicator Title	Number of active intellectual property products.
Definition	Intellectual property products such as patents, copyright, protected disclosures, proprietary know-how developed/under development or registered by NFs.
Source of Data	Records in the document management systems or repositories by business units.
Method of Calculation / Assessment	Count the number of intellectual property products (physical, electronic, documented), that have been developed/or are under development/ registered within the reporting period.

Indicator Title	Number of active intellectual property products.
Means of Verification	Inspection of records of the primary data, as relevant, in any of the forms listed: i. Technology register. ii. Collaboration agreements. iii. Joint development agreements. iv. Funding agreements. v. Licensing agreements. vi. Patent applications. vii. Invention disclosures viii. Documented proprietary know-how.
Assumptions	• Technologies have been developed. • Internal resources and/or external partners are available for technology development, customisation and/or optimisation. Funding is available for preliminary technology development, customisation and/or optimisation.
Disaggregation of Beneficiaries (where applicable)	N/A
Spatial Transformation (where applicable)	N/A
Calculation Type	Cumulative
Reporting Cycle	Quarterly.
Desired Performance	In line with annual target.
Indicator Responsibility	DCEO of NRIP

Notes

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