

Annual Performance Plan 2019/20–2021/22

ADVANCING KNOWLEDGE - TRANSFORMING LIVES - INSPIRING A NATION.





“The object of the National Research Foundation (NRF) is to support and promote research through funding, human resource development and the provision of the necessary research facilities in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge, and thereby contribute to the improvement of the quality of life of all the people of the Republic.”

It is hereby certified that this Annual Performance Plan:

- Was developed by the management of the National Research Foundation under the guidance of the NRF Board;
- Takes into account all the relevant policies, legislation, plans and mandates applicable to the National Research Foundation; and
- Accurately reflects the strategic outcome-orientated goals and objectives that the National Research Foundation will endeavour to achieve over the period 2020–2022 covered by the Plan (with a particular focus on 2019/20 financial year).



Mr Bishen Singh
Chief Financial Officer



Dr Molapo Qhobela
Chief Executive Officer

The Board of the National Research Foundation hereby tables the Annual Performance Plan of the National Research Foundation for the period 2019/20–2021/22 for approval.



Dr Nompumelelo Obokoh
Chairperson of the Board



Mmamoloko Kubayi-Ngubane (MP)
Minister of Science and Technology

FOREWORD BY THE CHAIRPERSON OF THE NRF BOARD



Dr Nompumelelo Obokoh
Chairperson of the NRF Board

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The world is moving into an age where “the internet of things” is setting off multiple, non-linear development paths that present opportunities for developing countries to bridge the gap between their lower capital endowment and demands for speedy and sustained resolution to the crisis of poverty and inequality. These opportunities are made possible by affordable superfast data processing and transmission networks and devices with the potential to impact how economic value is created and distributed in societies. However, there are also strong global and domestic interests that contest this phase of industrial revolution, as nations that are highly invested in the current status quo seek to defend or defer the erosion of their inherited strategic advantage.

South Africa is a young democracy, with high potential that is socially and geographically uniquely positioned to leverage new capabilities provided by the fourth industrial revolution to ameliorate its socio-economic challenges caused by years of neglect and underdevelopment inherited from colonial and apartheid rule.

This Annual Performance Plan (APP) is being developed at a time when the country celebrates 25 years of democracy and the National Research Foundation (NRF) celebrates its 20th year since its establishment. All these events coincide with the final year of the NRF Strategic Plan, *NRF Strategy 2020*. Combined, these important milestones provide us with an opportunity to reflect on how the organisation has contributed to development, to transformation and also give an outlook of its potential to expand and increase the value and societal impact of its services.

The NRF is looking forward to the promulgation of the NRF Amendment Act and the new White Paper on Science and Technology. These will provide an enabling legal and strategic framework for the organisation to further contribute meaningfully to the development of the National System of Innovation (NSI) and realise development dividends from science for the Country.

“The world is moving into an age where “the internet of things” is setting off multiple, non-linear development paths that present opportunities for developing countries to bridge the gap between their lower capital endowment and demands for speedy and sustained resolution to the crisis of poverty and inequality. ”

I take this opportunity to thank the Honourable Minister of Science Technology, Ms Mmamoloko Kubayi-Ngubane MP, and the officials of her department for her support of the NRF and its work. As a newly appointed board, we look forward to working with her to advance the development of our Country through the power of science and technology.

I also wish to thank my fellow board members, the executive management, and all employees of the NRF for their dedication and contribution to the success of the organisation.

OVERVIEW OF THE CHIEF EXECUTIVE OFFICER



Molapo Qhobela PhD
Chief Executive Officer

It is my pleasure to present the Annual Performance Plan (APP) of the National Research Foundation (NRF) for the period 2019/20–2021/22. The Plan was developed under the leadership and guidance of the NRF Board and reflects the continued commitment of the organisation to contribute to a vibrant and globally connected National System of Innovation (NSI).

The APP coincides with the final year of the *NRF Strategy 2020*; the celebration and commemoration of 25 years of Freedom; as well as 20 years of the existence of the NRF. We can be proud of the strides and achievements of our national science system, which, during this time, and with the support of the NRF, has contributed major scientific achievements of national and global significance such as:

- The commissioning of the MeerKAT radio telescope and the Southern African Large Telescope (SALT), which contributed to the birth of a new science, multi-messenger astronomy. SALT provided one of the first spectra of the merger of two neutron stars providing the first gravitational wave observation confirmed by non-gravitational means and observing in real time the creation of new elements such as gold and platinum;

- New major discoveries of hominid fossils in the form of *Australopithecus sediba* and *Homo naledi* at the Cradle of Humankind. Both discoveries have advanced our understanding of human evolution; and
- Discovery of the gene mutations responsible for causing the life threatening heart disease, arrhythmogenic right ventricular dysplasia. This discovery is regarded as one of the most important medical advances in South Africa since the first human heart transplantation.

In addition to these momentous discoveries and innovations, our national science system has continued to advance knowledge that has transformed our economy and society. The research undertaken is intended to find solutions to vexing national problems such as the burden of disease, poverty, inequality and unemployment; improved educational outcomes; access to and security of water and energy; and climate change, among others. Over the Medium-Term Expenditure Framework (MTEF) period, the NRF will continue to serve the national agenda of realising a knowledge economy by achieving the goals of the National Development Plan (NDP) 2030.

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South Africa is currently facing a constrained fiscal environment, in part due to the slowdown in the global economy. These conditions necessitate all public institutions to be reflective of the demands placed on the fiscus and be innovative in their response. In this regard, the NRF will continue to be disciplined, frugal and strategic in the use of scarce public resources while responding to government priorities and delivering on its mandate.

To this end, the NRF will fund 4 040 researchers and 1 1780 postgraduate students in the 2019/20 financial year. These initiatives will be guided by the goal of realising a fully representative science and technology workforce whose research, teaching and engagement efforts impact positively on society. In the coming year, the NRF will be seized with the development of the NRF Strategy 2025 while preparing for the implementation of the new policy for funding postgraduate students to enhance equity of access, success and throughput. Other key initiatives include the development of a programme for exceptional early career researchers and the revision of the resourcing model in consultation with the DST.

On behalf of the executive management team of the NRF, I wish to thank the NRF Board under the guidance and stewardship of its Chairperson,

Dr Nompumelelo Obokoh. I also wish to thank the Honourable Minister of Science and Technology, Ms Mmamoloko Kubayi-Ngubane, MP and the entire leadership of her Department for their constructive engagements with the Board and the executive management of the NRF. I similarly, wish to acknowledge and appreciate the rigorous engagements with the Parliamentary Portfolio Committee for Science and Technology, under the leadership of the Honourable Mrs Lindiwe Maseko in the exercise of their oversight role. Lastly, I wish to thank the entire management and staff of the NRF for their contribution towards the success of the organization in contributing to national development.



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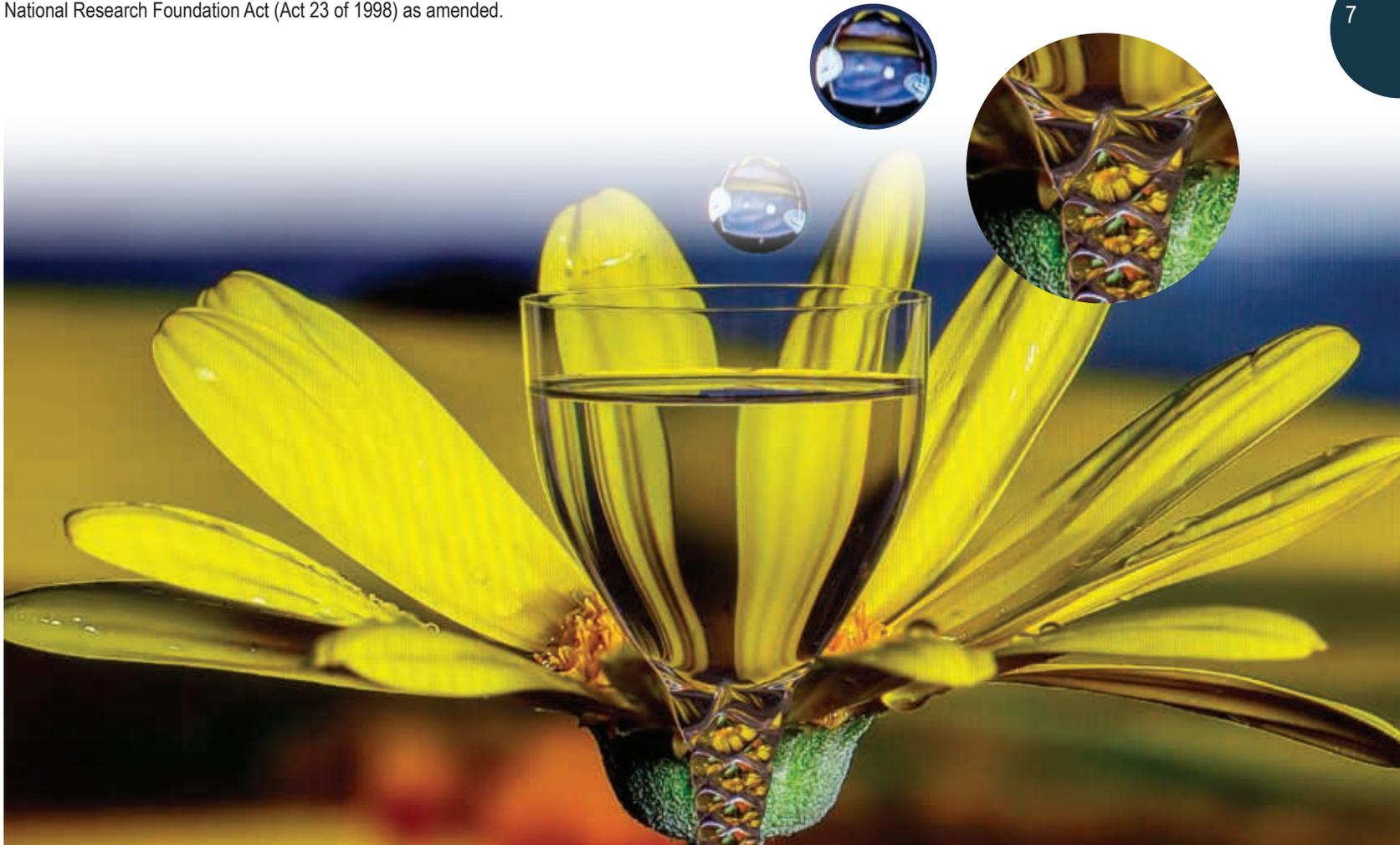
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INTRODUCTION

The National System of Innovation (NSI) is a set of functioning institutions, organisations and policies that interact constructively in pursuit of a common set of goals and objectives. These goals and objectives are articulated in a range of policies and strategies, in particular the NDP 2030 vision. These include an improved quality of life for all South Africans, underpinned by a robust democracy and just society. In this context, research and innovation are key enablers in achieving these goals. It is further expected that increased public and private sector investment in research and innovation should contribute to improved social and economic development in the country.

The NRF is a Schedule 3A public entity that is established through the National Research Foundation Act (Act 23 of 1998) as amended.

The major challenge currently facing the organisation and the country is the ongoing need to accelerate the transformation of the research and innovation system in the context of diminishing resources. In this regard, the NRF has identified the need to pursue transformation beyond representivity. To this end, the NRF has prioritised its transformation agenda to focus on four main areas, namely the transformation of the equity profile of postgraduate students and researchers; the knowledge enterprise; the relationship between science and society; and the organisation itself. The success of these endeavours will require, among others, changes in policy, as well as a significant increase in public and private investment in the Research and Development (R&D) system.





PART A: STRATEGIC OVERVIEW

1 STRATEGIC DIRECTION

1.1 MANDATE OF THE NRF

The National Research Foundation Act (Act 23 of 1998), as amended, sets out the mandate of the organisation as follows:

“...to support and promote research through funding, human resource development and the provision of the necessary research facilities in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge and thereby to contribute to the improvement of the quality of life of all the people in the Republic.”

1.2 VISION AND MISSION

The vision and mission of the NRF set out in its *Strategy 2020* are supported by four core tenets, namely: transformation, sustainability, excellence and a strong service culture. These are informed by a set of organisational values that shapes the delivery of the strategic outcomes and objectives.

The NRF vision is:

... catalysing knowledge production for societal benefit.

The organisation's mission is:

... to contribute to the knowledge economy in South Africa by attaining at least 1% of the global R&D output by 2020.

As we approach the 2020 milestone, South Africa's proportion global R&D output was 0.79 in 2017, up from 0.57 in 2011.

1.3 ORGANISATIONAL VALUES

The NRF values are grounded on inclusivity and a tapestry of individual, cultural and societal values and ethics, and promote strength in diversity, equality, equity, community and sustainability. These values cited in Figure 1 below, are built on the foundation of the four core tenets of the NRF business ethos, namely: transformation, excellence, sustainability and service culture.

Figure 1: NRF values

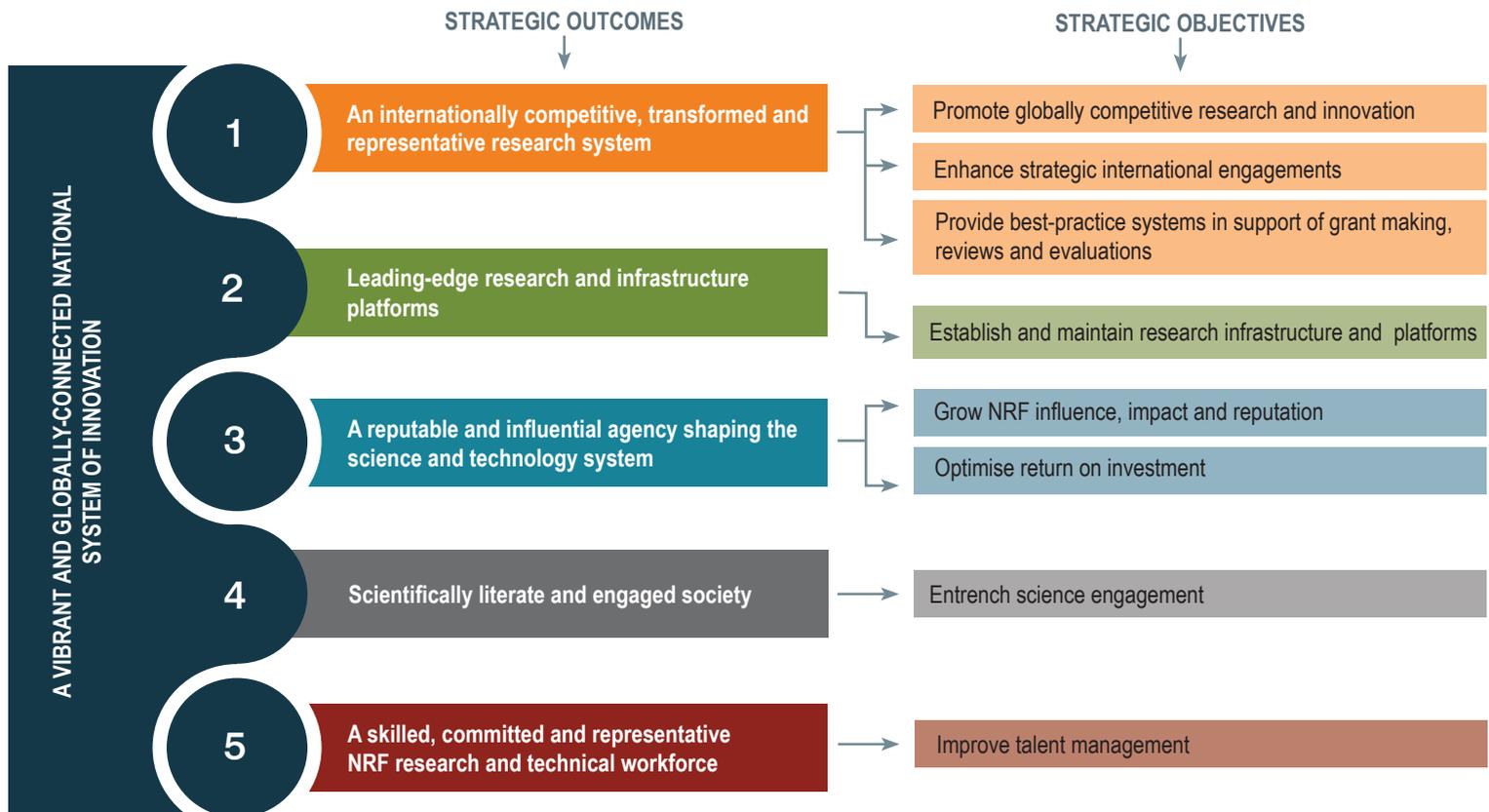


1.4 STRATEGIC OUTCOMES AND OBJECTIVES

The strategic outcomes and objectives have been developed to enable the organisation to contribute to a vibrant and globally competitive and contextually relevant NSI. The NRF is a diverse organisation that leverages on the complementarity of its various and geographically diverse business units. The strategic outcomes and objectives enable the organisation to contribute to creating sustainable livelihoods and improved quality of life for all South Africans. They all individually and collectively provide the generic contribution of science to the NDP 2030 Vision of reducing unemployment,

poverty and inequality. By virtue of its mandate, the NRF's objectives integrate seamlessly with the objectives of the DST and complement the objectives of the Department of Higher Education and Training (DHET) and other government departments.

The strategic objectives have been mapped against the five strategic outcomes reflected below. The NRF programmes contribute collectively or individually to all and specific objectives. Performance is aggregated across the organisation to provide a consolidated view of performance over the Medium-Term Expenditure Framework (MTEF) period.



2 SITUATIONAL ANALYSIS

In support of a knowledge economy, the South African Government has targeted to almost double the gross expenditure in R&D (GERD) to 1,5% of gross domestic product (GDP) by 2019/20. Currently, some 40% of the DST budget is earmarked to deliver on the NRF mandate while the NRF Board directs 20% of the total budget of the NRF towards achieving its mandate.

The mandate is executed while taking cognisance of the NDP 2030, the Medium-Term Strategic Framework (MTSF) priorities and the ongoing commitment to contribute to addressing the triple challenges of unemployment, poverty and inequality. Mandate execution is also informed by the White Paper on Science and Technology and the National Research and Development Strategy (NRDS). The NRF also welcomes the publication of the 2018 draft White Paper on Science, Technology and Innovation, Inclusive Development through Science and Innovation, as it has been 21 years since the publication of the 1996 White Paper. We look forward to the revision and finalisation of this important policy document, since it will inform the future work of the NRF.

This APP marks the final year of implementation of the *NRF Strategy 2020*, 20 years since the establishment of the NRF and 25 years since the establishment of the country's democracy. This milestone, thus, requires a reflection on the successes and challenges over the 20-year period, especially the last four years of the *NRF Strategy 2020*. In this regard, while the NRF has, among other things, been able to increase the number and diversity of students and researchers supported significantly, the organisation has been faced with a number of environmental challenges in the recent past, which include but are not limited to –

- the ever-evolving local and international science and research environment;
- the constrained fiscal environment; and
- the dynamic and fluid higher education and science, technology and innovation (STI) environment.

In this context, the NRF Board and management have diligently and proactively initiated several interventions to ensure the NRF's ability to deliver on its mandate within a framework that is operationally and financially

sustainable. These include leveraging on strategic partnerships, significant cost containment and austerity measures without compromising the core mandate of the organisation, and reprioritisation, where feasible.

2.1 SERVICE DELIVERY ENVIRONMENT

The NRF works closely with all research institutions, specifically universities and science councils, as well as with public and private partners both locally and abroad. Key strategic partners include the DST, DHET, the Department of Trade and Industry (the *dti*), all public universities and the science councils. Broader stakeholders within the NSI include the National Student Financial Aid Scheme (NSFAS), the Council on Higher Education (CHE), the National Advisory Council on Innovation (NACI), and others.

2.2 RESOURCING OF THE NRF MANDATE

The current resourcing model for the NRF is not ideal to enable the organisation to deliberately direct the effective delivery of service to achieve expected outcomes from its mandate. The current NRF funding model leaves little room for the organisation to respond to emerging and long-term priorities. The NRF has initiated a process of developing a more appropriate framework for funding the NRF mandate in consultation with the DST and National Treasury.

2.3 PROGRESS ON THE NRF STRATEGIC PLAN

The overall performance trend is positive against commitments in the current *NRF Strategy 2020*. Based on audited performance against predetermined objective results of the past three years, the percentage of performance indicators with targets that were met and/or exceeded increased from 52% in 2016 to 69% in 2018, while those that were missed by more than 5% declined from 28% in 2016 to 23% in 2018. More details on the targets for 2019/20 and their implication on the strategic plan targets are discussed in subsequent sections.

2.4 ORGANISATIONAL RISKS

The NRF manages risks in accordance with the Public Finance Management Act (PFMA) (Act 1 of 1999) as amended and informed by the King IV Report on Corporate Governance through a board-approved Enterprise Risk Management (ERM) Charter and related policies. The Board, through the Audit and Risk Committee, monitors and reviews strategic risks actively. Some of the NRF top risks are summarised in Table 1, and will be monitored over the MTEF and beyond. These strategic risks and their mitigation actions will undergo a substantive review as part of the development of the NRF 2025 Strategic Plan.

Table 1: NRF Risk Register

No.	Strategic Objective link	Risk Description	Current controls / Mitigation Activity
1	Improve talent management	Ageing research and technical workforce	<ol style="list-style-type: none"> 1. Succession plans, diagnostics and training plans. 2. Management structures to oversee National Facilities. 3. Adequate skills acquisition and operational continuity. 4. Design and implement <i>improved equity profile of the NRF technical and managerial layers</i>.
2	Grow NRF influence, impact and reputation + Entrench science engagement	Setting up the new consolidated portfolios / Structures	<ol style="list-style-type: none"> 1. NRF Amendment Bill. 2. Concluded effective transfer of the NZG to SANBI. 3. Clustering and consolidation of National facilities with appropriate management structures. e.g .SARAO. 4. Plan for extended scopes fir Science Engagement (SAASTA); SAEON new nodes; Strategy, Planning & Partnerships (SPP); 5. Ensure implementation of <i>Embedding public engagement with science policy</i>.
3	Establish and maintain research infrastructure and platforms	Ageing research Infrastructure	<ol style="list-style-type: none"> 1. Monitoring and adequate response plan for failure of the Cyclotron (Business Continuity Plan). 2. Implementation of long term strategy for iThemba Labs incl. 70 MeV Cyclotron. 3. New infrastructure provision.
4	Grow NRF influence, impact and reputation	Operational & Financial Sustainability	<ol style="list-style-type: none"> 1. Rationalise the activities and look at external income generation. 2. Secure sustainable funding to further the NRF Mandate. 3. Develop aligned responses for growing investments in the sector into the future. 4. Ensure strategic engagement on the issues outlined in various NSI documents and the new DST White Paper. 5. Revised <i>framework for resourcing of the NRF mandate</i>.
5	Promote globally competitive research and innovation	Rate of system-wide Transformation	<ol style="list-style-type: none"> 1. Monitor existing post-graduate student cohort support programmes performance. 2. Implement <i>the PG student funding policy</i>. 3. Develop <i>a programme for exceptional early career researchers</i>. 4. <i>Improved equity profile of the researcher community</i>.

Table 1: NRF Risk Register (continued)

No.	Strategic Objective link	Risk Description	Current controls / Mitigation Activity
6	Improve talent management	Rate of internal Transformation	<ol style="list-style-type: none"> 1. Implement <i>Improved equity profile of the NRF technical and managerial layers</i>. 2. Monitor performance to HR targets and attracting and retaining black professionals within the organisation. 3. Fast-track eligible employees, development opportunities from skills pool and competencies. 4. Analyse ageing cohort of expert researchers (high-end skills) for knowledge production and excellence.
7	Establish and maintain research infrastructure and platforms	Lack of confirmation of project acceptance methodology and lifecycle management	<ol style="list-style-type: none"> 1. MeerKAT launch completed and Science ready. LSPs approved. SKA Phase 1 anticipated, SKA IGO nearing finalisation. 2. Consider future projects if lifecycle funding and fit alignment and/or transfer cost elsewhere in NSI is established. 3. Develop <i>NRF research agenda</i>. 4. Prevent scope creep, ensure goodness of fit and perform capability tests for projects under consideration. 5. Ensure governance is embedded in processes.
8	Provide best practice systems in support of grant making, reviews and evaluations	Service culture in and relevance of RISA	<ol style="list-style-type: none"> 1. Improve organisational control and ability to collect system intelligence. 2. Reduce the administrative burden both internally and in the stakeholder community. 3. Improve processes by rationalising application templates and progress reports to reduce the number of Calls. 4. Implement key systems such as the ERP and Enterprise Architecture. 5. Re-scope the current Grants Management System as part of the ERP system. 6. Implement alumni database (tracking system) to determine the long-term impact of the investment. 7. Finalise <i>Framework for enhancing Research Excellence</i>. 8. Implement <i>the PG student funding policy</i>. 9. Develop <i>a programme for exceptional early career researchers</i>.
9	Enhance strategic international engagements	SKA SA failure to comply with hosting requirements and facilitate international cooperation	<ol style="list-style-type: none"> 1. SKA international and AGA programme. Approval and implementation of AMA Business Plan incl. enforcement and prosecution framework. 2. SARA0 has concluded the land procurement required for the hosting of the SKA Phase One. 3. The SKA SA Design Phase has largely been concluded with the procurement phase of the SKA Telescope being initiated in 2019. 4. AVN activities: The second engineering phase on the Ghana telescope continues. 5. Conclude memorandums of Understanding and co-management agreements with stakeholders. 6. Implement alternative communications strategy and Business Model. 7. Establish RFI monitoring infrastructure and processes. 8. Implement SKA social upliftment strategy and plan.

Table 1: NRF Risk Register (continued)

No.	Strategic Objective link	Risk Description	Current controls / Mitigation Activity
10	Optimise Return on Investment	Failure of controls and progress on unresolved audit findings	<ol style="list-style-type: none"> 1. Implementation of risk based audit plan. 2. Amendment of APP / Strategy targets and approval. 3. Recalibration of performance indicator descriptions to improve objectivity of performance information 4. Conduct a Governance Review. 5. Obtain financially unqualified audit opinion from Auditor General.
11	Optimise Return on Investment	Loss of network connectivity and adequacy of information security to prevent Business Interruption and Cyber attacks	<ol style="list-style-type: none"> 1. Data management and handling policies, data redundancy and back-up protocols and Standard Operating Procedures. 2. Security Community of Practice and common incident reporting structure and threat identification procedure. 3. Use of Intranet in support of 'One NRF' in a way not to create more vulnerabilities. 4. Improve cyber security approach, strategies, plans, capacity, capability and focus. Ensure cyber security risk mitigation plan incl. Framework; Incident Response, decommissioning and technology replacement roadmap, cyber insurance. 5. Implement next generation firewall and data loss prevention tools.

3 REVISIONS TO LEGISLATIVE AND OTHER MANDATES

The mandate of the NRF is being amended in terms of the National Research Foundation Amendment Bill 2016, to read as follows:

The object of the NRF is to contribute to national development by –

- supporting, promoting and advancing research and human capacity development (HCD) through funding and the provision of the necessary research infrastructure to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including humanities, social sciences and indigenous knowledge;
- developing, supporting and maintaining National Research Facilities;

- supporting and promoting public awareness of, and engagement with, science; and
- promoting the development and maintenance of the national science system and supporting government priorities.

The organisation also supports the constitutional commitment to “improve the quality of life of all citizens and free the potential of each person”.

The NRF has thoroughly prepared for the implementation of the NRF amendment Bill in 2019.



4 STRATEGIC PRIORITIES FOR THE MTEF

The NRF has identified a number of initiatives to advance its mandate that go beyond the MTEF cycle, as discussed below.

4.1 ADVANCING TRANSFORMATION

In the period since the commencement of the *NRF Strategy 2020*, the NRF has developed a holistic approach to contributing to the transformation of the science system. In this regard the NRF transformation framework was approved by the Board as a “living” document in 2017, based on corrective action with a broad social justice framework. It intends to achieve transformation beyond, and in addition to improving race, gender, disability and class representivity, by addressing systemic barriers that hinder equity of opportunity, success and impact of science on society. The framework is also informed and driven by the mandate of the organisation and is holistically integrated across all NRF divisions and business units. This is anchored on 4 pillars, being – transforming the knowledge workforce; the knowledge enterprise; the relationships between science and society and building diverse & inclusive learning organisation.

In the current MTEF, the following will continue to be the transformation priorities of the NRF:

- Implementation of the new NRF student funding policy in the 2021 academic year to enhance equity of access, success and throughput of postgraduate students. In addition to setting strong equity targets, the policy will result in improved funding for financially needy students.
- Development of a programme for exceptional black and women early career researchers
- Development of an NRF Research Agenda to ensure that investment is informed by predetermined research priorities
- Embedding public engagement with science and science with society
- Developing a revised framework for resourcing of the NRF mandate
- Building diverse & inclusive learning organisation
- Improving the equity profile of NRF staff at technical and managerial levels

4.2 ENTERPRISE RESOURCE PLANNING (ERP)

Historically, NRF systems were procured in response to specific business unit or functional requirements. The information technology (IT) platforms evolved as a product of the support requirements of the systems as opposed to a deliberate technology strategy. The risks associated with the disparate systems informed the initiation of a business-process-mapping exercise with a view to optimising process and system efficiencies. To this end, the NRF has embarked on a process to procure and implement a fit-for-purpose ERP System aimed at integrating the various business systems on a single, consolidated information and communication technology (ICT) platform.



5 LINK WITH OTHER PLANS AND MANDATES

5.1 EXECUTION OF THE MANDATE

The NRF executes its mandate through a five-year strategy, the *NRF Strategy 2020*, and annual performance plans. The NRF plays a critical integration role across public entities in line with government priorities. This allows the organisation to catalyse focused, societally beneficial R&D in support of knowledge generation, human capacity development (HCD) and innovation. The *Strategy* and plans take cognisance of national challenges such as unemployment, poverty and inequality, as well as national and relevant international policies and strategies as exemplified in Figure 2 below:

Figure 2: NRF policy environment



5.2 CONTRIBUTORS TO THE NRF MANDATE

The policy environment of the NRF is influenced by applicable national policy, plans and strategies, as well as by cross-cutting, government-level policies.

5.2.1 National Strategies

The following national strategies are considered in the execution of the mandate of the NRF.

The National Development Plan (NDP) 2030

The NDP 2030 endeavours to “...chart a new course and write a new story” for South Africa by recognising the transformative potential of key role-players in the national system. The DST and the DHET contribute to the national vision of a technically skilled and transformed workforce, the development of a knowledge economy through the translation of basic research to applied research and the development of new knowledge that stimulates the discourse of an innovative society. Supported by the NRF, the DST and DHET aim to address the challenges of:

- Increasing the proportion of academic staff at universities with doctoral qualifications from 34% to 75% by 2030;
- Increasing the proportion of postgraduate enrolments at universities from 16% to 25% or more by 2030; and
- Growing the number of doctoral graduates per annum from 2 000 to 5 000 by 2030.

The National Research and Development Strategy (NRDS)

The NRDS highlights the importance of globally competitive and contextually relevant research outputs in addressing the needs of the country. These are expressed through the geographic and knowledge advantage areas identified in the Strategy.

National Plan for Higher Education

The Plan provides an implementation framework for realising the objectives of Education White Paper 3 on transforming the higher education system to meet the social and economic development needs of the country.

The Human Resources Development Strategy (HRDS)

The HRDS recognises the need to implement a systemic strategy for human resources (HR) development to address the disparities between wealth and poverty through the institutionalisation of HR development planning and implementation, as well as the effective monitoring of progress against national targets.

5.2.2 Science and Technology Strategies and Policies

The DST has developed and implemented a number of strategies and policies to guide the development of our science system. These include:

- The Ten-year Innovation Plan (TYIP) of 2007;
- The Strategy for Human Capacity Development (HCD) for Research, Innovation and Scholarships;
- The Ministerial Guidelines for Improving Equity in the Distribution of DST/ NRF Bursaries and Fellowships;
- The DST Science Engagement Framework;
- The South African Research Infrastructure Roadmap (SARIR); and
- Discipline-specific strategies and plans such as the National Strategy for Multiwavelength Astronomy (MWLA), the South African Marine and Antarctic Research Strategy (MARS) and the Palaeoscience Strategy.

5.2.3 International Strategies and Treaties

South Africa is signatory to a number of international treaties. In this regard, there are a number of international strategies informing the work of the NRF. These include the following:

- The African Union's Vision – Agenda 2063.
- The Science, Technology and Innovation Strategy for Africa (STISA) 2024, of the African Union.
- The Southern African Development Community (SADC) education and training protocol.
- The Sustainable Development Goals of the United Nations (UN).

5.3 ORGANISATIONAL STRUCTURE

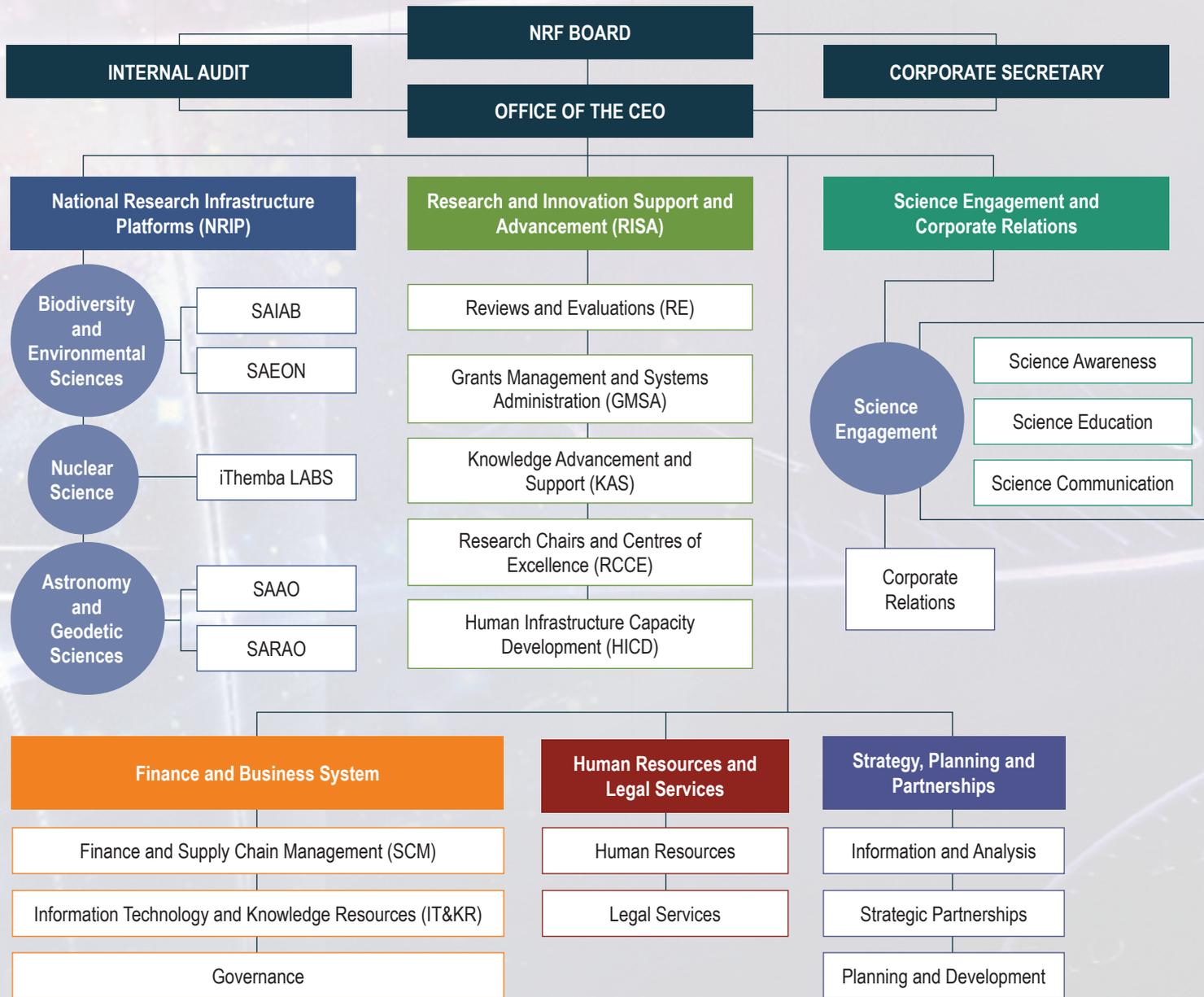
As a public entity, the NRF functions within the parameters set out by relevant legislation and applicable best practice. The NRF is committed to entrenching a culture of excellence, high performance, transparency, ethical behaviour, fiscal prudence and accountability, thereby enhancing stakeholder confidence and ensuring public trust.

The accountability structures of the NRF include systems through which the organisation is directed, managed and held accountable. These systems are determined by legislative policies based on the National Research Foundation Act (Act 23 of 1998), the PFMA (Act 1 of 1999), the National Treasury Reporting Framework, the Governance Framework for Public Entities and the South African Companies Act (Act 71 of 2008). In addition, the NRF also subscribes to the requirements of the King Report on Corporate Governance for South Africa (King IV).

Parliament, through the Parliamentary Portfolio Committee (PPC) on Science and Technology of the National Assembly, maintains high-level oversight of the entity, while the Executive Authority (the Minister of Science and Technology) and the Accounting Authority of the NRF (the NRF Board) are accountable for the entity.

The organisational structure of the NRF, as shown in Figure 3 on the next page, was optimised to manage and coordinate the functions of the NRF organised into programmes designed to achieve the NRF strategic direction and mandate:

Figure 3: NRF organisational structure



6 FINANCIAL OVERVIEW

The income of the NRF is received primarily through four income streams, namely parliamentary grant, DST contract funding, other contract funding and sundry income.

Over the MTEF period the NRF parliamentary grant, which is appropriated for the delivery of the organisational mandate, is set to increase on average by 4.3%, which is an effective decrease of 1% in real terms. This will require ongoing focus and monitoring of the organisations financial and operational sustainability. In addition, the current NRF funding model has resulted in 77% of the total budget coming from DST and other contracts. In this regard, the NRF has initiated a process of developing a more appropriate funding framework in consultation with the DST and National Treasury as discussed in section 2.2 above.

The 2018/19 projected income has been adjusted to accommodate the transfer of the NZG to SANBI. The total income is set to remain stable in the first year of the MTEF period in nominal terms. DST contract income, excluding funds carried forward, increases by 10% in 2019/20 as a result of investment in human resource development, mainly for bursaries, research grants and the South African Research Chairs Initiative (SARChI). In addition, the NRF will receive R 150 million for the National Equipment Programme (NEP), as this programme is funded in alternate years. The NRF received a cut of R82 million in 2019/20 against the Square Kilometre Array (SKA) project which will be absorbed through re-alignment of project payments against deliverables.

Table 2 is an indication of the parliamentary grant allocation split over the three-year MTEF period.

Figure 4: Comparison of sources of funding 2017/18–2021/22

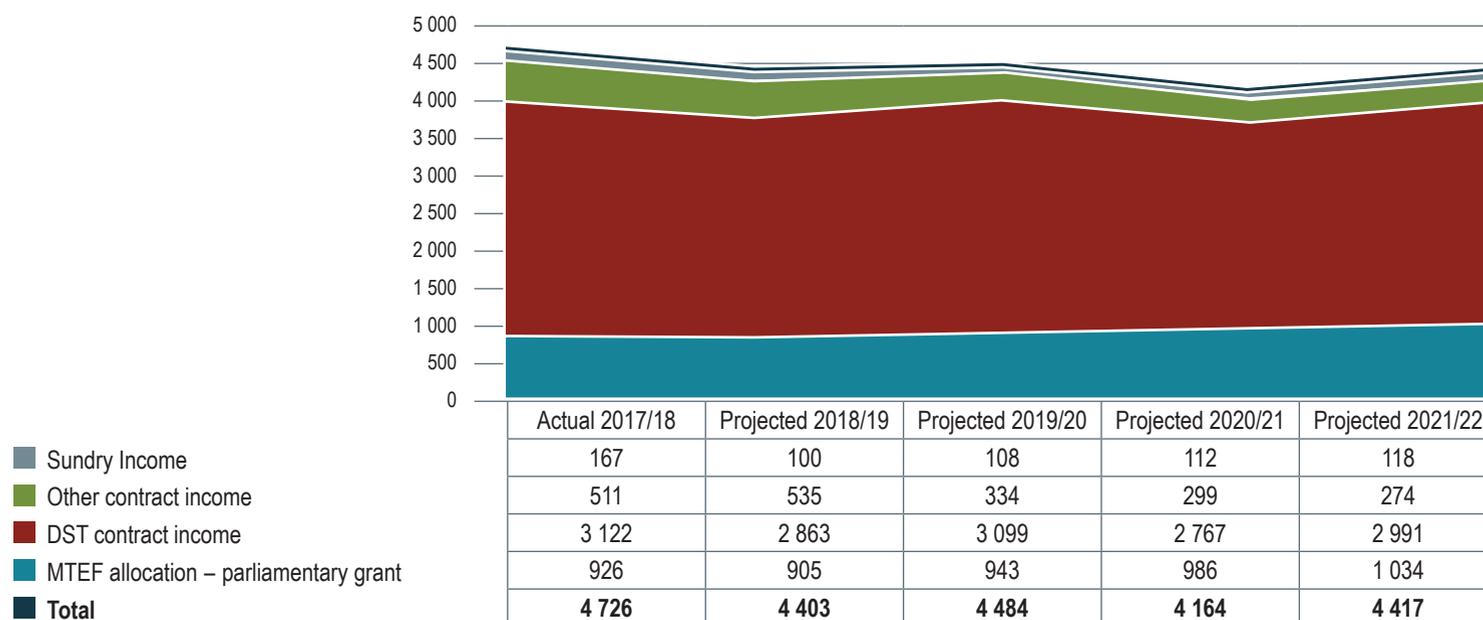


Table 2: Three-year projection of the NRF MTEF parliamentary grant allocation

Programme	NRF baseline allocation from the DST	2018/19	2019/20	2020/21	2021/22
		R'000	R'000	R'000	R'000
1	Corporate services	95 252	97 646	102 668	107 030
2	Science advancement	25 022	26 366	27 817	28 900
3	RISA	483 612	502 107	519 358	548 506
4	National Research Facilities*	300 866	317 266	335 970	349 305
	Total NRF parliamentary grant	904 752	943 385	985 813	1 033 741
	Year-on-year baseline movement	5,2%	4,3%	4,5%	4,9%

* National Research Facilities figure includes SAEON pending its declaration as a national research facility

Of the total MTEF allocation from the DST in 2019/20, contract income represents 75% whilst the baseline allocation equals to 25%.

Table 3: Three-year projection of the DST contract funding allocation

Programme	NRF contract income allocation from the DST	2018/19	2019/20	2020/21	2021/22
		R'000	R'000	R'000	R'000
2	Science awareness	57 006	62 579	62 579	62 579
3	HR development	1 397 703	1 498 421	1 573 920	1 624 649
3 & 4	Research development infrastructure	161 960	290 737	138 012	283 170
3 & 4	Science missions	222 772	240 426	42 992*	51 485*
4	SKA project	709 412	686 974	812 139	856 807
	Total MTEF contract income allocation	2 548 853	2 779 137	2 629 642	2 878 690
	Year-on-year DST contract movement	-3.8%	9%	-5.4%	9.5%

* No allocation has been made for science missions in the outer years of the MTEF period.

The implication of the reduction of the Science Missions funding in the outer years has been factored against Programme 3 (RISA) and Programme 4 (SAEON and SAIAB).

Other contract income includes contracts with other public entities, private companies and international organisations including government departments such as the DHET, the **dti** and the Department of Agriculture, Forestry and Fisheries (DAFF).

Sundry income consists mainly of interest earned and income generated through the sale of isotopes at iThemba Laboratory for Accelerator-based Sciences (iThemba LABS).

6.1 NRF INVESTMENT PRINCIPLES

The demand for research funding far exceeds the funding available to the system. The organisation applies a set of principles to guide its investment decisions across the range of its interventions, functions, facilities and programmes.

The NRF allocates available resources:

- In support of achieving the organisational mandate, which includes the transformation of the science system;
- In alignment with the rolling operational and financial sustainability plan;
- In accordance with the core principles of equity, fairness, transparency and accountability;
- Informed by rigorous, quality peer review applied to all grant and bursary funding applications; and
- In line with a balanced strategy-driven approach, rather than a demand-pull or push approach.

6.2 SAVINGS, EFFICIENCY MEASURES AND LEVERAGING FROM STRATEGIC PARTNERSHIPS

Over the years, the NRF has designed and implemented various austerity measures in an attempt to be fiscally prudent and improve operational

efficiencies. Such measures are deliberately intended not to compromise the execution of the core mandate, namely research support. In this regard, travel has been reduced through the use of video-conferencing, the use of transversal contracts and competitive bidding as a cost-effective procurement modality, leveraging off economies of scale through demand management, increased use of owned versus leasehold office space, and the introduction of an integrated, enterprise-wide performance management system, including rigorous implementation of National Treasury's cost containment measures.

Management recognises the fine line between effective austerity measures and optimal productivity that have been implemented over several years now. In this regard, there is a concern that further austerity measures will start to erode viability and the productivity of the organisation.

The NRF established a new division for Strategy, Planning and Partnerships (SPP) in 2017. It is created in part to use evidence-informed strategic planning, policy experimentation and development, and strategic partnering, as levers to advance the object of the NRF. The SPP division has three directorates: Planning and Development; Information and Analysis; and Strategic Partnerships. The latter develops, nurtures and directs strategic partnerships locally and internationally to leverage additionality. Such additionally is financial and in-kind support. The priority is to advance the transformation agenda of the organisation, in particular to increase support for postgraduate students and early career researchers. Some of our strategic partners include, the National Student Financial Aid Scheme (NSFAS), the Ikusasa Student Financial Aid Programme (ISFAP), First Rand Foundation (FRF), SASOL and SANParks and internationally, they include Fulbright, Carnegie, DAAD of Germany, NUFFIC of the Netherlands, IDRC of Canada and Swiss Aid.

6.3 DETAILED BUDGETS AND EXPENDITURE

Detailed NRF budgets have been prepared, taking into account all sources of income and with due regard for efficiency savings and operational effectiveness. Table 4 presents the abridged financial projection of the NRF for the 2019/20 financial year, and Table 5 provides a summary of the projected financial statements for the MTEF period 2019/20–2021/22 aligned with the annual plans. Table 6 represents the summary of projected expenditure per programme for the year.

Table 4: Abridged financial projection for the year ending 31 March 2020

BUDGET 2019/20	Programme 1 Corporate R'000	Programme 2 Science Advancement R'000	Programme 3 RISA R'000	Programme 4							Total 2019/20 R'000	Consolidated budget (excl. internal transfers) 2019/20 R'000	Consolidated projection (excl. internal transfers) 2018/19 R'000
				Biodiversity, environmental, conservation and nuclear sciences National Facilities				Astronomy and geodetic sciences National Facilities					
				NRIP R'000	iTHEMBA LABS R'000	SAIAB R'000	SAEON R'000	SARAO					
								SKA R'000	HartRAO R'000	SAAO R'000			
Budgeted unspent funds/ (deficit) at beginning of year	-	-	-	-	-	-	-	-	-	-	-	-	2 561
MTEF allocation – parliamentary grant	97 646	26 366	502 107	6 952	186 000	25 250	12 664	-	29 125	57 275	943 385	943 385	904 753
DST contract income	8 448	62 579	1 914 525	3 540	17 500	9 000	66 321	686 974	-	10 250	2 779 137	2 779 137	2 525 541
DST and other contract income carried forward	1 630	3 178	124 245	-	-	(289)	18 106	178 755	2 068	7	327 700	327 700	489 453
Other contract income	-	263	272 213	-	720	2 348	18 345	-	1 690	31 546	327 125	327 125	383 390
Internal income	22 998	-	-	-	13 829	28 194	5 592	-	8 461	24 908	103 982	-	-
Other income	4 286	4 104	12 724	-	69 585	2 190	4 262	5 098	1 651	3 995	107 895	107 895	99 667
Total income	135 008	96 490	2 825 814	10 492	287 634	66 693	125 290	870 827	42 995	127 981	4 589 224	4 485 242	4 405 365
Grants and bursaries	-	(27 468)	(2 575 112)	(3 540)	(3 150)	(7 409)	(3 825)	(73 141)	(1 626)	(1 000)	(2 696 271)	(2 696 271)	(2 659 234)
Operating expenditure	(40 298)	(37 631)	(76 970)	(1 432)	(120 308)	(24 547)	(46 338)	-	(20 704)	(46 086)	(901 618)	(901 618)	(802 721)
Salaries	(86 428)	(31 336)	(124 000)	(5 520)	(169 508)	(29 535)	(45 295)	(292 223)	(22 848)	(73 652)	(880 345)	(880 345)	(755 496)
Internal expenditure	(7 494)	(1 648)	(61 804)	-	(8 998)	(752)	(7 124)	(12 413)	(1 251)	(2 498)	(103 982)	-	-
Total expenditure	(134 220)	(98 083)	(2 837 886)	(10 492)	(301 964)	(62 243)	(102 582)	(865 081)	(46 429)	(123 236)	(4 582 216)	(4 478 234)	(4 217 451)
Net unspent funds/(deficit) for the year	788	(1 593)	(12 072)	-	(14 330)	4 450	22 708	5 746	(3 434)	4 745	7 008	7 008	187 914
Transfer from Infrastructure fund	2 750	-	-	-	-	910	-	-	-	-	3 660	3 660	6 672
Capital expenditure	(3 538)	(112)	(6 338)	-	(15 229)	(16 303)	(30 407)	(101 979)	(4 361)	(13 791)	(192 058)	(192 058)	(362 991)
Non-cash flow items – depreciation	-	1 705	18 410	-	29 559	10 943	7 699	96 233	7 795	9 046	181 390	181 390	168 405
Unspent funds/(deficit) at end of the year	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5: Abridged projected financial statements for the MTEF period 2019/20–2021/22

STATEMENT OF FINANCIAL PERFORMANCE			
CATEGORY	Projected 2019/2020	Projected 2020/21	Projected 2021/22
	R'000	R'000	R'000
MTEF allocation – parliamentary grant	943 385	985 813	1 033 741
DST contract income	3 099 429	2 765 936	2 990 247
Other contract income	334 534	299 498	274 157
Interest received	36 665	36 862	38 970
Other income	71 229	75 054	79 881
Total income	4 485 242	4 163 163	4 416 996
Grants and bursaries	2 696 271	2 463 200	2 669 637
Operating expenditure	901 618	828 028	870 420
Salaries	880 345	947 745	1 003 855
Total expenditure	4 478 234	4 238 973	4 543 912
Income set aside for capital acquisitions	7 008	(75 810)	(126 916)
Less: Net capital expenditure	(10 668)	72 560	124 567
Net budgeted deficit for the year	(3 660)	(3 250)	(2 349)
Transfer from Infrastructure Development Fund	3 660	3 250	2 349
Accumulated funds for the year	-	-	-

STATEMENT OF FINANCIAL POSITION			
CATEGORY	Budget 2019/2020	Budget 2020/21	Budget 2021/22
	R'000	R'000	R'000
Property, plant and equipment; intangible assets and heritage assets	2 950 690	2 878 130	2 753 563
Inventory	3 300	3 200	3 250
Receivables and prepayments	846 353	831 753	824 000
Cash and investments*	420 000	400 000	361 000
Total assets	4 220 343	4 113 083	3 941 813
Accumulated Fund and SALT Fund	14 000	12 000	11 000
Capital Fund and Infrastructure Fund	3 013 236	2 937 426	2 810 510
Income received in advance	1 094 332	1 066 582	1 026 033
Payables and provisions	98 775	97 075	94 270
Total liabilities	4 220 343	4 113 083	3 941 813

* Cash holdings represent commitments for designated programmes and projects.

Table 6: Projected expenditure per programme for the year ending 31 March 2020

EXPENDITURE FOR THE YEAR ENDING 31 MARCH 2020 PER PROGRAMME						
CATEGORY	Programme 1	Programme 2	Programme 3	Programme 4		TOTAL
	Corporate	Science engagement	RISA	Biodiversity, environmental and nuclear sciences	Astronomy and geodetic sciences	
	R'000	R'000	R'000	R'000	R'000	R'000
Grants and bursaries	-	29 843	2 574 562	17 923	73 943	2 696 271
Operating expenditure	40 298	44 449	76 970	190 491	549 410	901 618
Salaries	86 428	44 996	124 000	244 556	380 365	880 345
Net capital expenditure	3 537	(1 536)	(12 070)	13 721	7 016	10 668
Total expenditure	130 263	117 752	2 763 462	466 691	1 010 734	4 488 902

Figure 5: Total projected expenditure, including capital 2019/20

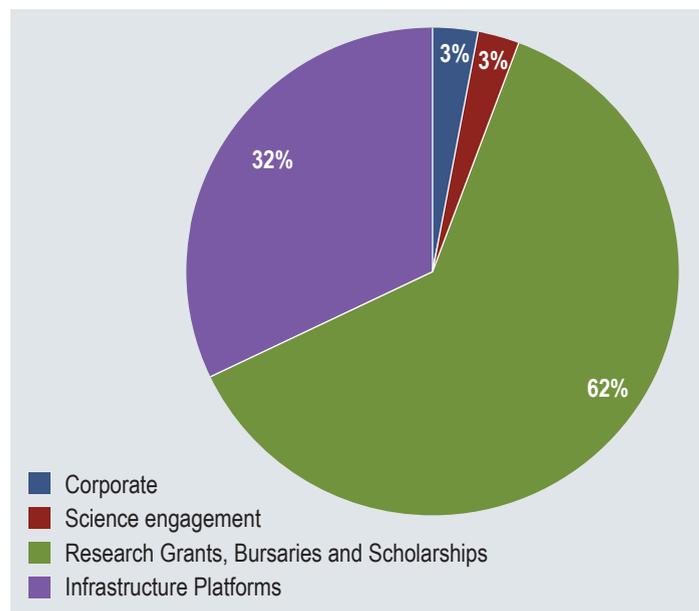


Figure 5 is a graphical representation of the distribution of projected expenditure across the organisation in the 2019/20 financial year. Research grants and bursaries account for 62% of the total NRF expenditure, which is invested at universities through various funding instruments.

Capital expenditure declines significantly in 2019/20 with the final commissioning of the MeerKAT radio telescope. Grants and bursaries are directly linked to the movement in funding and subsequently to movements in performance targets. This expenditure has remained fairly stable, except for the movement in the DST contract income allocation for scientific equipment (refer income section). No funding was allocated for 2018/19 and 2020/21 and science missions and the national equipment programme. Operating expenditure in 2019/20 remained constant in line with inflationary increases, except for that of SARAO, which significantly increases from 2019/20 onwards due to increased operational activity following the final commissioning of MeerKAT.

Employee remuneration is projected to increase in line with a cost-of-living adjustment. National Treasury has implemented budget cuts through wage freeze for senior officials in 2019/20, which has been factored into the budgets. The budgets include vacancies and staff requirements for the SARIR and SKA Phase 1 projects. The abridged projected financial statements 2019/20–2021/22 (page 24) provide a summary of the projected financial statements for the period aligned with the annual plan.

Figure 6: Projected expenditure by category for 2019/20–2021/22

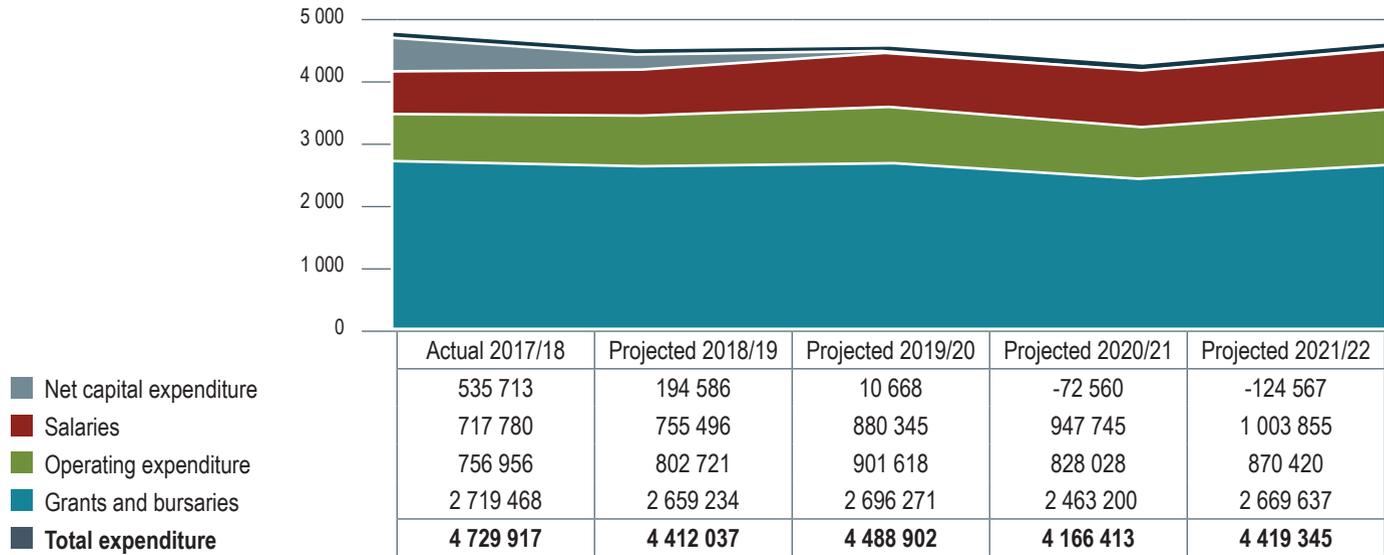


Table 7: Long-term infrastructure and other capital plans (2019/20–2021/22)

No.	Business division	Description	Outputs	Estimated project costs	Project duration		2017/18	2018/19	2019/20	2020/21	2021/22	Additional infrastructure/capital
				R'000	Start	Finish	R'000	R'000	R'000	R'000	R'000	
1	National Facilities	Upgrade and replacement of scientific equipment	Access to state-of-the-art research equipment and facilities	N/A	Based on ongoing review and availability of funds		130 501	130 369	75 730	25 629	20 506	iThemba LABS submitted a business case to National Treasury for the purchase of a new 70 MeV cyclotron for the SAIF Project at an estimated cost of R580 million. National Treasury approved R168 million. The purchase will progress once the remainder of the funding has been secured.
2	SAASTA	Computer and office equipment	Enhanced working environment to enable delivery on various contract projects	N/A		1 846	8 197	112	371	378	Pending a national strategy on science advancement, the SAASTA Johannesburg Observatory site may require R60 million for upgrades.	
3	RISA	Computer, office equipment and building refurbishment	Enhanced working environment and improved efficiency	N/A		3 217	5 475	6 338	6 063	6 064		
4	Corporate	Computer, office equipment and building construction	Enhanced working environment and improved efficiency	N/A		8 879	14 445	3 538	3 641	2 559		
5	SARAO, including the SKA project	Construction of KAT7 and MeerKAT comprising 64 radio antennae	World-class telescope for many years based on mission-driven innovation enabling South Africa to undertake cutting-edge research into deep space	3 700 000		2002/03	2018/19	548 562	204 505	106 340	83 506	49 205
							693 005	362 991	192 058	119 210	78 712	

* Additional infrastructure and capital plans: The additional infrastructure and capital plans are dependent on the approval of additional funding by National Treasury.

7 NRF RESPONSE TO NATIONAL STRATEGIES AND PLANS

The NRF responds to the priorities and strategies of Government by supporting research, HCD, platform provisioning and science engagement in all knowledge fields.

7.1 CONTRIBUTING TO THE NDP 2030 – MTSF PRIORITY OUTCOMES

The goals and objectives of the NRF are in alignment with the outcomes of the NDP 2030 (MTSF Priority Outcomes). For a detailed alignment of NRF strategic outcomes with the NDP 2030 and DST outcomes, please refer to page 103. The NRF aims to support the creation of a knowledgeable, scientifically-engaged and socially-cohesive society through supporting the engagement between science and society that underpins the commitment to the betterment of society. In this respect, knowledge creation and dissemination become integral components of the strategy towards a knowledge economy.

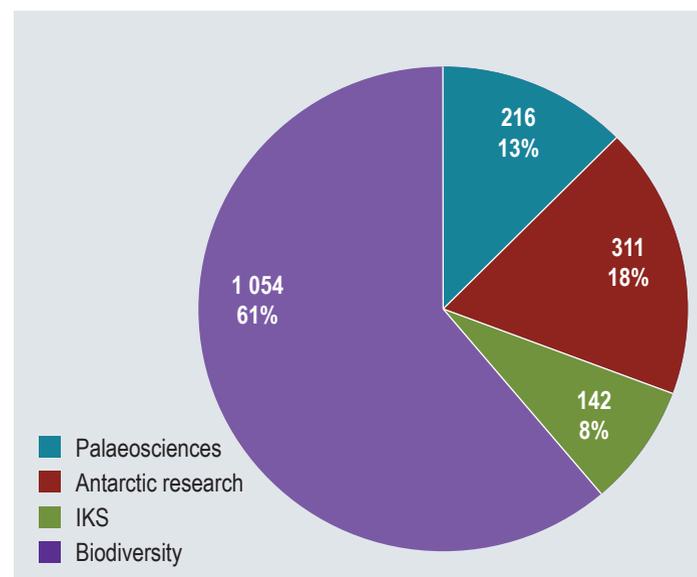
The NRF supports postgraduate students and researchers by providing grants, bursaries, scholarships and fellowships, as well as professional development programmes (PDPs) for research and instructional staff at higher education institutions (HEIs) and staff at National Research Facilities. The targeted strategic investments in areas relevant to the needs of society ensure that the national knowledge base contributes to the development of solutions, knowledge and innovations that address socio-economic challenges to benefit society. An ongoing challenge is the need to increase the success, throughput and progression rates along each development phase of the HCD path through appropriate funding levels for bursaries, scholarships for example.

7.2 THE NATIONAL RESEARCH AND DEVELOPMENT STRATEGY (NRDS)

The NRDS highlights the importance of globally competitive and contextually relevant research outputs in addressing the needs of the country. HCD and knowledge generation in strategic domains are the key outcomes of the *Strategy*. The domains are expressed through the geographic and knowledge advantage areas, namely palaeosciences; antarctic research; indigenous knowledge systems (IKS) related to Southern Africa; biodiversity; and

astronomy. The investment trends and budget estimates for these particular advantage areas (excluding astronomy) are represented in Figure 7.

Figure 7: Average investment in the geographic advantage areas 2015/16–2021/22



7.3 THE TEN-YEAR INNOVATION PLAN (TYIP)

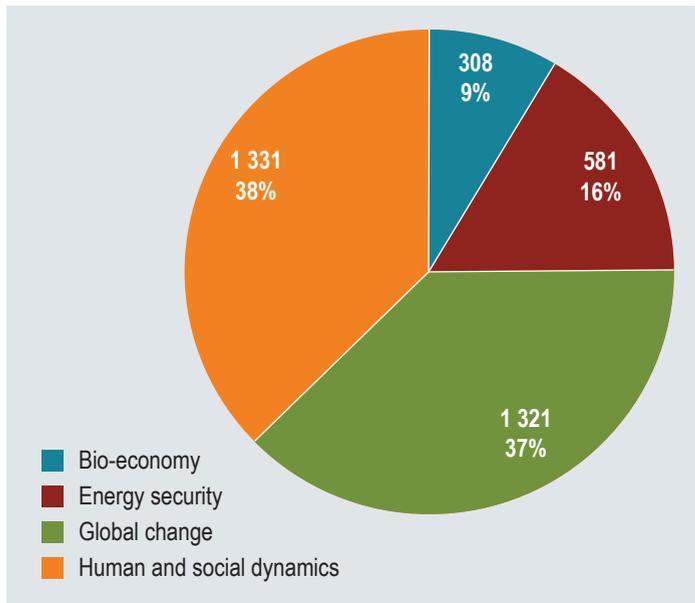
The TYIP utilises the knowledge and human capacity developed through science and technology research to enhance socio-economic benefits. The Plan identifies five grand challenges, namely the bio-economy; energy security; global change; human and social dynamics; and astronomy. The key principles of the Plan are to:

- Support strategic decision making to enable Government to make informed decisions;
- Pursue competitive advantage – ensuring that investment is made in areas with the highest return;

- Create critical mass – the investment strategy should support the creation of critical mass in high-yield areas; and
- Scale up sustainable R&D.

Figure 8 reflects the investment in the grand challenges. Astronomy is recognised as both a grand challenge (space science) and a geographic advantage area and is discussed in detail in section 7.4.

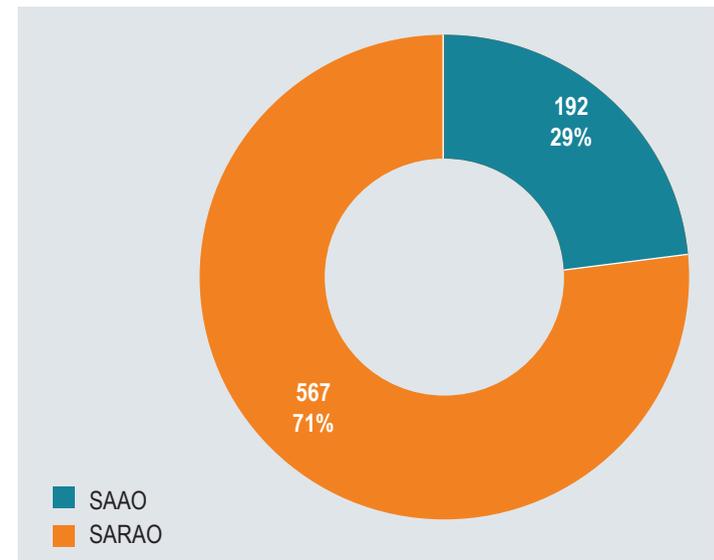
Figure 8: Investment in the grand challenges (excluding astronomy) 2015/16–2021/22



7.4 ASTRONOMY AND GEODETIC SCIENCES

The NRF provides grants, bursaries and scholarships in this area, and supports two National Research Facilities, namely the South African Astronomical Observatory (SAAO) and SARA0. Figure 9 is an indication of the investment in optical and radio astronomy during the five-year period of the current NRF Strategic Plan.

Figure 9: Investment in astronomy 2015/16–2021/22





PART B: PROGRAMME PLANS

30

8 PROGRAMME 1 – CORPORATE

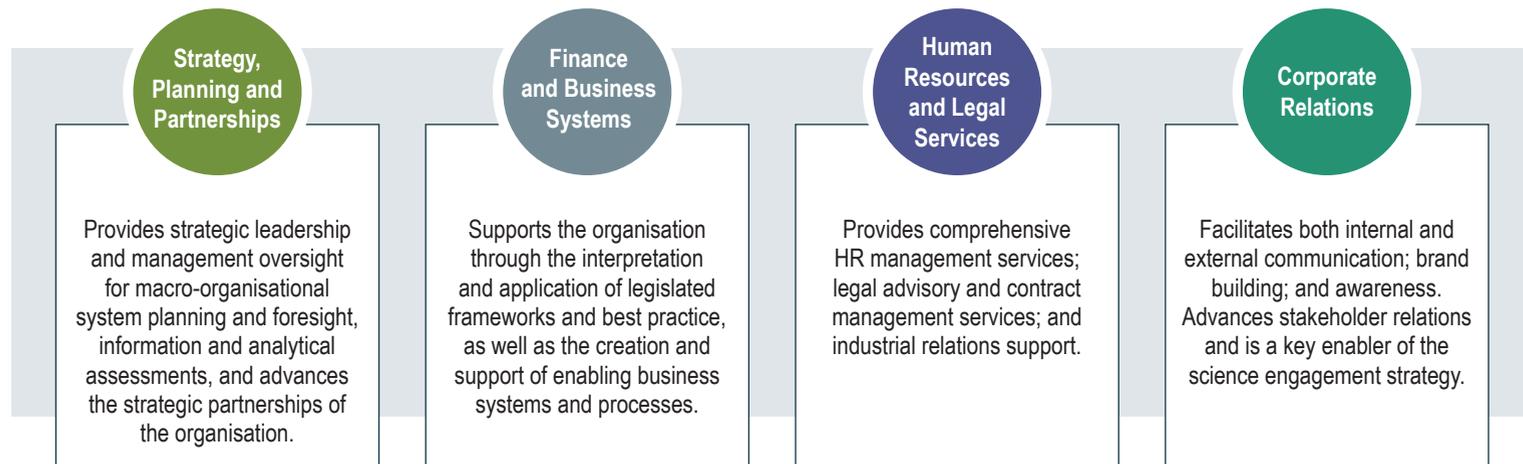
8.1 SITUATIONAL ANALYSIS

The key objective of Programme 1 is the provision of cross-cutting support functions to enable operations of the organisation on a shared services model. The Programme sets the tone for organisational strategy, policy, planning, information sharing and good governance by assuring statutory compliance and execution of the mandate.

8.2 CONTRIBUTIONS TO STRATEGIC OBJECTIVES

Programme 1 directly contributes to Strategic Objectives 5 and 6, and indirectly to all other objectives through its cross-cutting mandate. Programme 1 consists of the four divisions as shown in Figure 10.

Figure 10: Programme 1 – Corporate



8.2.1 Strategic Objective 5: Grow NRF Influence, Impact and Reputation

To contribute successfully to Strategic Objective 5, the Programme must:

- Provide system-level intelligence that informs organisational and national policy and strategy;
- Facilitate and lead policy development, system-wide planning and the periodic monitoring and evaluation of their implementation;
- Communicate science and research achievements;
- Build the NRF brand through proactive leadership, consistent service excellence and stakeholder relations; and
- Leverage the NRF reputation through strategic public and private partnerships in support of the execution of the NRF mandate.

Promote Strategic Engagements and Partnerships

A. Strategic Partnerships

During the MTEF, there will be continued leveraging off additional resources to drive the system and forge networks and partnerships with Government, the private sector, research performing institutions, development partners and other stakeholders. This will position the NRF as a partner of choice to support and facilitate South Africa's engagement in the global science system. Specific activities include the following, among others:

- Identify a suite of core strategic partners in collaboration with HEIs in South Africa to implement an enabling and robust HCD programme abroad. Specific emphasis will be placed on PhD students and early-career researchers to increase the supervisory capacity and international exposure of the country's young researchers;
- Finalise efforts based on a strategic framework that has been developed for a comprehensive industry-linked programme to further support opportunities for early-career researchers and their institutions; and
- The OR Tambo Africa Research Chairs co-funded by the Canadian International Development Research Centre with potential co-investment by private sector partners on the continent. The programme is linked to The Strengthening Higher Agricultural Education in Africa (SHAEA) Project of the World Bank and Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), co-led by the NRF, as well as to the Africa Research University Alliance (ARUA).

B. Planning and Development

Strategic leadership and management oversight for macro-organisational system planning and foresight to build a framework to inform the organisation's five- to ten-year strategy will be maintained. This will serve as input towards the development of the five-year strategy to 2025 and towards 2030. Macro-organisational policy development, long-term planning, including monitoring and evaluation of the implementation of the policies, will be provided. The Strategy, Planning and Partnerships (SPP) division works in concert with all business units of the NRF to lead thought processes on strategic policy formulation to support delivery on the NRF mandate in support of the NRF's transformation agenda.

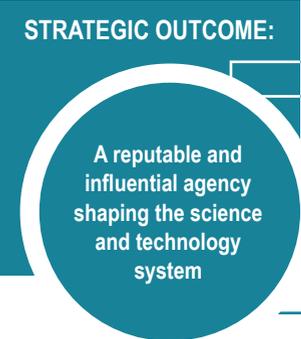
Provide System-level Intelligence

C. Information and Analysis

Optimal and effective business intelligence systems (BISs) that are scalable and abreast with the changing technological landscape will be maintained and developed continuously to provide credible business intelligence, both internally and externally. This will enable growth of the influence, impact and reputation of the NRF throughout the entire NSI. The following initiatives will be carried out during the MTEF:

- The Information and Analysis division will develop an NRF Data Management Framework. The aim of the Framework will be to:
 - guide the NRF's information and analysis service offering;
 - provide guidance to all users of the NRF BISs on research data management;
 - provide standard operating procedures on data management; and
 - strengthen strategic partnerships to enhance the NRF's data and information management capability.
- Access to external data will either be fostered through partnerships resulting in data sharing or the provision and hosting of functional systems. In the case of the latter, the Research Output Submission System (ROSS) will be maintained through gathering additional meta-data during the institutional submission process that will link higher education publication data with data in publication and bibliometric databases.
- The NRF will import data from the Higher Education Information Management System (HEMIS) into the NRF BIS platforms will be maintained to perform in-depth analysis of data on higher education staff, student registration and graduation.
- A process to resource and expand the Qlickview internal BIS will be carried out.

Table 8a: Programme 1 – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 6

STRATEGIC OUTCOME: 	STRATEGIC OBJECTIVE 5	Grow NRF influence, impact and reputation
	OBJECTIVE STATEMENT	Contribute to building the NRF brand through the provision of consistently excellent customer-centered service offerings.
	CRITICAL IMPLEMENTATION ACTIVITIES	<ul style="list-style-type: none"> • Provide system intelligence that informs strategy and policy; • Communicate science and research achievements (including Mzansi for Science); • Build NRF brand through partnerships and service excellence; and • Leverage off the NRF reputation through strategic public, private sector, and international partnerships.
	LINKS TO MTSF	NRF Objective 5 links to: <ul style="list-style-type: none"> • MTSF Priorities 11 and 14.

INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of internal and external users of the NRF business intelligence systems	-	74	129	150	85	150	160	160
BUDGET (R million)		Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22		
Information and Analysis	-	3.216	10.446	12 865	13 085	13 902		

Table 8b: Programme 1 – Quarterly targets for 2019/20 – Strategic Objective 5

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of internal and external users of the NRF business intelligence systems	Annually	150	-	-	-	150

Building a Positive Reputation for the NRF and Communicate Science and Research Achievements

A. Corporate Relations

The Corporate Relations function is responsible for communication within the NRF. That includes communicating science and research achievements to society. Over the MTEF period, the NRF Corporate Relations unit will launch a number of focused strategic initiatives and sustain other initiatives launched in preceding years. These initiatives include:

- **Building brand ambassadorship (“One NRF”):** partnerships with relevant stakeholders to devise and launch a programme aimed at building an organisational culture and orientation centred on the principle of the “One NRF” brand ambassadorship.
- **Science-society interactions:** will provide successful platforms for the communication of research and engagement with public audiences. The initiative has grown over the last few years and currently enjoys positive partnerships with scientists and researchers, as well as with participating HEIs and science councils. Over the MTEF, the NRF will continue to explore avenues to increase its reach and introduce additional formats and categories of speakers, which may involve the inclusion of Nobel laureates and other scientists of stature in the speaking engagements.

8.2.2 Strategic Objective 6: Optimise NRF Return on Investment

To contribute successfully to Strategic Objective 6, Programme 1 provides a system of shared services to all the business units, allowing the NRF to, efficiently and effectively:

- Promote good governance as a strategic asset;
- Provide leading-edge business systems and operational processes; and
- Provide effective combined assurance to the accounting and executive authorities.

Promote Good Governance

A. Corporate Governance

The Governance directorate is responsible for the establishment and support of internal structures and processes within the control environment of the business to enable employees to discharge their duties effectively. Refer to page 106 for a summary of the key legislation and codes of best practice applicable to the operations of the NRF.

The Governance directorate consists of a number of compliance and assurance-based business functions that support an enabling structure against which the organisation maintains and measures its compliance in terms of regulations and best practice. Over the MTEF period, the directorate will:

- Continue to prioritise the principles of good corporate governance to support compliance and respond to shifts in the system of binding and non-binding rules applicable to the public entity;
- Adopt a consistent and appropriate approach to the application of safety, health and the environment with regard to principles, policies and procedures across the business to support the combined assurance process;
- Continue to translate statutory reporting requirements and integrate these with business processes to support a meaningful planning process, while ensuring that organisational reporting remains a value-add at all levels; and
- Continue to provide an advisory service to the business units of the NRF to ensure that governance remains a strategic asset.

B. Corporate Finance

The mandate of the Corporate Finance directorate includes the management and control of the financial processes of the organisation through the provision of business systems, management accounting support, policy development, financial change management, statutory reporting, work-flow development and financial control. The unit provides the frameworks, tools and systems that enable prudence, optimisation and accountability. Over the MTEF period, the NRF will continue to meet all the statutory obligations of a Schedule 3A public entity. The NRF is committed to the achievement of an unqualified audit opinion annually. The office of the Auditor-General of South Africa introduced the Clean Audit Outcome, which is achieved through the submission of:

- Financial statements that are free from misstatements (unqualified audit opinion);
- No material finding on the audit of predetermined objectives; and
- No non-compliance with legislation.

C. Supply Chain Management (SCM)

SCM has been identified as a strategic priority across the public sector. To this end, enterprise-wide demand management has the potential to reduce operational costs. The spectacular success of MeerKAT as a precursor to SKA1&2 changes the procurement landscape, particularly with the proposed international involvement going into the future. The role of an international governmental organisation as part of that process will require alignment of SCM processes driven by negotiated outcomes and contracted member country arrangements.

The SCM function initiates legislative processes after adopting a risk and change management approach appropriate to the timing and nature of implementation. Over the MTEF period, the function will:

- Support the execution of the organisational demand plan in line with National Treasury regulations;
- Support business units with procurement matters; and
- Support the Bid Award Committee (BAC) administratively with bid management processes.

Other priorities include the annual verification of the Broad-Based Black Economic Empowerment (BBBEE) rating of the NRF, as well as the integration of Government's Central Supplier Database (CSD) with the NRF's financial system and the roll out of the workflow system.

Provide Leading-edge ICT

IT is recognised as a key business driver and accelerator underpinned by appropriate and relevant technological infrastructure, systems and processes. Knowledge resources (KRs) in the NRF focuses on the collection, organisation and control of information from one or more sources, and the distribution of that information to one or more audiences. In this regard, the NRF recognises that information is a corporate asset and it is necessary to manage, control

and share information within specific parameters. Knowledge management (KM) principles aligned with relevant legislation support the development of a system of rules that govern the collection, sharing and control of information. This function comprises the following service units:

- Information Communications Technology
- Digitisation and Content Curation Management
- Records and Documents Management

This cross-cutting corporate function is responsible for the creation of systems that support the effective and efficient collection, management and sharing of NRF information, including research information as a product of NRF funding. Ultimately, the directorate contributes to Strategic Outcomes 2 and 3 through:

- Provision of key data platforms in support of and use by the research community;
- Provision of stable, fit-for-purpose ICT applications and platforms in support of NRF business; and
- Development and implementation of compliant policies and procedures governing the management of internal and external information and knowledge generated as a product of NRF funding.

Enterprise Resource Planning (ERP)

The NRF will embark on a project to procure and implement an ERP system during the MTEF period to create synergy and integration of the various business functions on a single consolidated ICT platform. This is a multi-year project and will integrate across various business domains as follows:

Initiatives that will be carried out during the MTEF in preparation of ERP are as follows:

- **IT resilience and cyber security:** review of existing IT capabilities to identify gaps in an effort to address cyber risks sequenced into revision and update of an IT Service Continuity Plan parallel to ERP. This will culminate in implementation of infrastructure technologies to improve cyber security resilience.
- **IT best practice process review, formalisation and implementation:** review and realignment of existing IT operational processes for optimal

performance and implementation of a workable service desk system that conforms to Information Technology Information Library (ITIL) requirements.

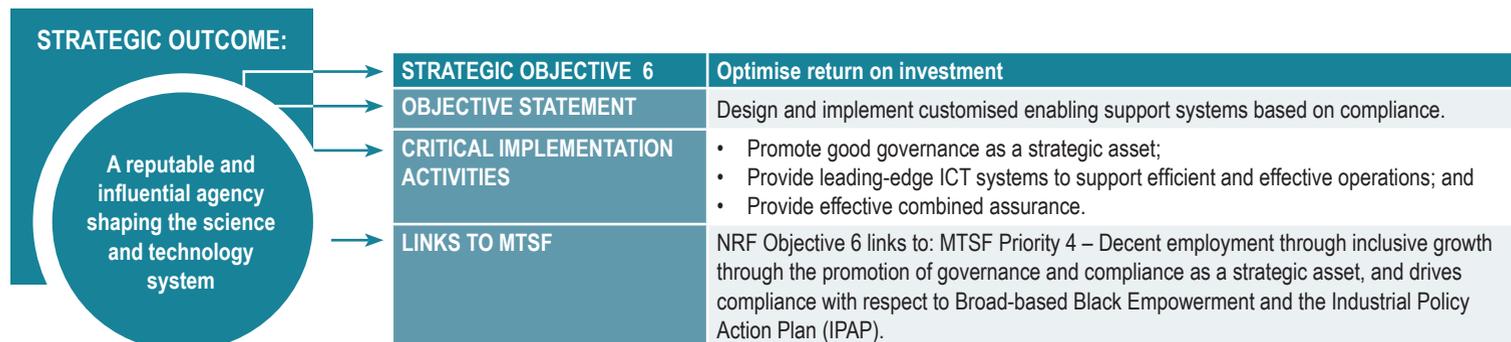
- **Skills Review and Plan:** development of a skills set roadmap and implementation plan in preparation of an ERP system and structure work packages accordingly.
- **Security, identity and access management:** implementation of an NRF-wide access monitoring solution in preparation of an ERP system.
- **Application performance monitoring:** identification and implementation of an application performance monitoring solution for the effective monitoring of IT infrastructure components in preparation of an ERP system.
- **Technology refresh:** implementation of a new data centre and service cluster.
- **NRF Online Submission Review:** activities will involve architecture and data access review, including front-end module identification and implementation.
- **Desktop standardisation:** review of current IT equipment to customise desktops in preparation of the ERP system.

Provide Effective Combined Assurance

The customised, combined assurance model for the NRF ensures optimal coverage of the day-to-day risks facing the organisation to management and to internal and external assurance providers. The coordination of the combined assurance model will continue to be an area of priority over the MTEF period.



Table 9a: Programme 1 – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 6



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Corporate overheads: calculated as a percentage of total expenditure	1.4%	1.4%	1.8%	<3%	<3%	<3%	<3%	<3%
Organisational overheads: calculated as a percentage of total expenditure	-	6%	6.2%	<10%	<10%	<10%	<10%	<10%
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
NRF Corporate	131 349	107 258	86 427	112 954	121 904	127 662	134 683	

Table 9b: Programme 1 – Quarterly targets for 2019/20 – Strategic Objective 6

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Corporate overheads: calculated as a percentage of total expenditure	Annually	<3%	-	-	-	<3%
Organisational overheads: calculated as a percentage of total expenditure	Annually	<10%	-	-	-	<10%

Figure 11: HR&LS activities

Talent sourcing

- Ensure that the organisation attracts, retains, develops and trains the right number and quality of staff.
- Improve the quality and efficiency of the recruitment, selection and placement processes.
- Pay particular attention to the attraction, development and retention of scarce skills categories.

HR systems and processes

- Develop and implement improved and sustainable HR and payroll management systems and processes.
- Contribute to improvements in employee performance and productivity.
- Ensure that the organisation has a robust system of policies and processes to manage its employee pipeline in the short and long term.

Training and organisational development

- Implement internal organisational development initiatives to encourage and sustain the 'Living the NRF values' campaign.
- Ensure that staff are aware of and able to adapt to change and transformation to deliver on the NRF's mandate and the country's transformation objectives.
- Contribute to the development of a team-based organisation culture through appropriate and relevant development interventions and programmes.
- Build, embed and maintain positive staff perceptions of the NRF.

Legal and employee relations services

- Support the business of the NRF through drafting, vetting, negotiating, reviewing and advising on all types of contracts managed by the NRF's various business units.
- Manage litigation by or against the NRF in the various legal forums (courts, CCMA, ADR).
- Provide robust legal opinions and advice in support of NRF business.
- Provide support in matters pertaining to employee grievances and disciplines, and manage relations with labour unions.
- Create and maintain a harmonious and stable labour relations environment.
- Manage the NRF's intellectual property portfolio.

8.2.3 Strategic Objective 8: Improve NRF Talent Management

Talent management includes the successful attraction, placement, retention and continuous development of a skilled and engaged staff cohort across the NRF.

Provide Policy Direction and Strategy for Effective HR Management and Legal Support Services

The HR and Legal Services (HR&LS) division provides policy direction and strategy execution guidelines for effective HR management to further the organisation's overall transformation framework and mandate. The division leads, promotes and coordinates organisation-wide activities to enhance organisational effectiveness, productivity and interactions with internal and relevant external stakeholders. As a corporate function, the scope of activities cuts across all business units of the NRF.

In discharging its mandate, the division is supported and assisted by other NRF business-enabling functions, such as ICT and finance. The key HR&LS activities are set out on the following page.

Alignment with Codes, Legislation, Practices and Standards

The HR&LS function complies with – and ensures adherence to – a range of legislation, codes, and standards as set out on page 107.

Employment Equity and Transformation

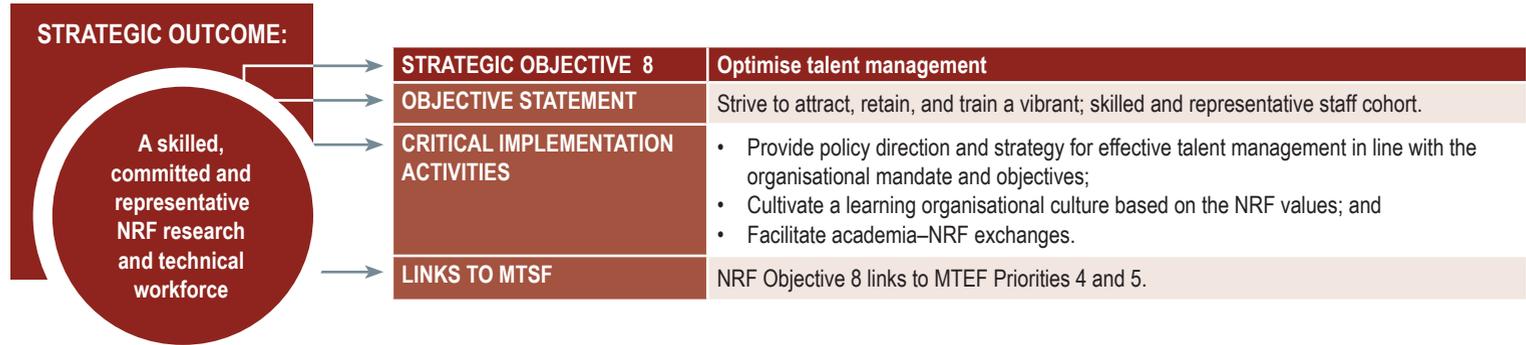
The NRF has a diverse workforce and is progressing steadily towards the *NRF Strategy 2020* demographic targets. These goals will be achieved through concerted recruitment efforts, effective retention of employees from designated groups and succession planning, where feasible. Gender representation in top and senior management, as well as in the technical/scientific categories, and racial representivity, specifically in the technical/scientific categories, will receive focused attention.

The organisation experiences challenges due to scarcity of and competition concerning highly specialised skills required in some business areas of the NRF. In addition, the remoteness of certain NRF sites makes it difficult to

recruit and retain employees from designated groups for jobs at those sites. However, interventions will be put in place to improve on these challenges. The anticipated interventions include professional development and internal staff rotation to increase exposure and experience, as well as staff secondments to and from HEIs and similar institutions to broaden staff skills and experience. Over the MTEF period, the NRF will implement a range of strategic policy and process adjustments. These include:

- Refinement of the Performance Management Framework and associated reward mechanisms to meet the organisation's performance delivery expectations;
- Stabilisation of the newly declared National Research Facility, SARAO, within the NRF governance and management structures;
- Rolling out of the contract management policy and implementation of the contract management system for existing and new NRF contracts;
- Re-conceptualisation and automation of the grievance and disciplinary case management system;
- Management of intellectual property endeavours in compliance with regulatory requirements;
- Implementation of renewed Management Development (MDP) and New Managers Development Programmes (NMDP);
- Facilitation of customised training and development programmes;
- Implementation of innovative recruitment and selection tools;
- Review and alignment of policies with business needs, legislative requirements and prescripts;
- Interventions to improve organisational climate and culture, as well as the creation of a supportive work environment;
- Continued and focused implementation of the Diversity Management Programme to drive transformation; and
- Increased staff retention efforts to achieve the desired transformation objectives through:
 - skills development initiatives that target technical, scientific, managerial and leadership skills at appropriate levels;
 - absorption of skilled bursary, scholarship and internship candidates into the organisation, wherever possible;
 - improvement of succession planning initiatives by identifying candidates and adopting focused mentorship and other training interventions and plans to increase the competency levels of such candidates; and
 - adoption of targeted recruitment initiatives to ensure fair representation of gender, race and people with disabilities.

Table 10a: Programme 1 – Strategic plan and medium term KPIs and budget (2019/20–2021/2022) – Strategic Objective 8



INDICATORS		Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
		2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Percentage of South Africans from designated groups in top management, senior management and professionally qualified and experienced specialists/ mid-management, including the SKA (three top occupational levels)	Black	275	287	277	265	306	56.0%	62.0%	65.0%
	Female	195	198	185	190	240	34.0%	39.0%	42.0%
% staff turnover		10.5%	7%	8.5%	6%	6%	6%	6%	6%

BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22
Investment in staff training and professional membership fees (R million)	4 543	2 648	4 395	5 685	5 786	5 786	5 786

Table 10b: Programme 1 – Quarterly targets for 2019/20 – Strategic Objective 8

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets				
			1 st	2 nd	3 rd	4 th	
Percentage of South Africans from designated groups in top management, senior management and professionally qualified and experienced specialists/ mid-management, including the SKA (three top occupational levels)	Black	Annually	56.0%	-	-	-	56.0%
	Female	Annually	34.0%	-	-	-	34.0%

9 PROGRAMME 2 – SCIENCE ENGAGEMENT

9.1 SITUATIONAL ANALYSIS

Science and its benefits are seen as central to national, economic and social prosperity, and one of the prerequisites for an effectively functioning NSI is a society that is aware of the value and potential dangers and challenges of science; is able to evaluate the products of science; uses 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 (Draft White Paper, 2018). In this context, there must be a growing awareness of the changing relationship between science and society, one which has been shaped in recent times, for example, by the rise of social media, increasing demands for open access and open data, as well as the demands for increased evidence-based policy making that is connected to wider public dialogue and debate and the building of trust and openness. From a policy perspective, the NDP 2030 also focuses extensively on the application of science and technology in the transition towards such a knowledge economy. It emphasises the effective application of science literacy as follows:

“...to promote technological advances, developing countries should invest in education for youth ... and should ensure that knowledge is shared as widely as possible across society”.

A dynamic relationship between science and society is therefore a strategic priority and public engagement with science has been incorporated into the National Research Foundation Amendment Bill (2016) that will, once finally approved, legislate the importance of science engagement for the NRF, setting the parameters for the establishment of the NRF as leader in science engagement. For the NRF, this means considering how public engagement will deliver systemic value to other core areas of the mandate. This, currently, includes reflections on ‘the contribution that public engagement makes to quality research over any and all stages of the research process; the pathways it provides to economic and societal benefits; the opportunities it provides for researchers to develop transferable and career-enhancing skills; and its value in inspiring the next generation of scientists and researchers’ (adapted from Research Councils UK, RCUK). In addition, the science engagement work of the NRF will be shaped by the

imperatives of the national Science Engagement Strategy (SES) with its four main goals to:

- Popularise STEMI as attractive, relevant and accessible to enhance scientific literacy and awaken interest in relevant careers;
- Develop a critical public that actively engages and participates in the national discourse on science and technology to the benefit of society;
- Promote science communication that will enhance science engagement in South Africa; and
- Profile South African science and science achievements domestically and internationally, demonstrating their contribution to national development and global science, thereby enhancing their public standing.

Through its commitment to developing a society that is informed, literate and critically engaged with science and its impacts, the leadership of and coordination of science engagement by the NRF will thus be guided by a) the institutionalisation of public engagement and its professional academic field; b) within a social justice framework (inclusive); c) across all scientific disciplines (multidisciplinary); while d) being respectful of the public(s) and its (their) knowledge-base and d) mindful of societal impact.

The NRF, in relation to its science engagement mandate, aims to:

- Deepen, in partnership with leading national and international institutions, ongoing intellectual engagement with and understanding of science among the public;
- Promote and support:
 - collaborative and co-produced research initiatives facilitated through a research culture and research infrastructure platforms that are supportive of public engagement; and
 - the implementation of a programme of science engagement and awareness initiatives to meet the objectives of the SES
- Strengthen and build science engagement capacity through training, skills development and sharing best practice;
- Consolidate science engagement planning and reporting, especially in terms of information and analysis of science engagement performance data; and
- Coordinate the above, both internally and externally, through the South African Agency for Science and Technology Advancement (SAASTA), the NRF business unit tasked with leading science engagement.

South African Agency for Science and Technology Advancement (SAASTA)

As part of its core business, SAASTA will perform the following key initiatives related to its broader leadership and coordination role during the MTEF period:

- Ensure that the necessary systems are in place to enable SAASTA to fulfil its role as a national coordinator of the SES. The programme will utilise the existing NRF IT systems, such as the grants management system, to coordinate these efforts. This must be supported by the improved planning of an annual call schedule that starts to systematise science-engagement activities for the participating institutions. The contract funding situation will thus be addressed to allow for this longer-term planning;
- On an ongoing basis, develop an extensive and innovative suite of science engagement programmes that will develop and support a stimulated and engaged society around science, engineering, technology and innovation (SETI). The aim will be to profile innovations across the science R&D sector to effectively raise awareness of South African scientific activities, research and technological innovations. This effort will include continued development of the science/media interface and related interventions;
- Use the media, scientists and industries to enable SAASTA to drive science advancement in communities, especially in rural areas and previously-disadvantaged HEIs, in collaboration with RISA and National Research Facilities;
- Develop a key research agenda for public engagement with science that will also include developing the requisite research capacity to undertake audience analyses, public surveys and indicators for international benchmarking. Collaboration with the SARChI in Science Communication will be essential in this instance;
- Increase quality programmes and resources that will assist in growing a representative science and technology workforce in South Africa by identifying and nurturing talent in science, engineering and technology (SET). This will increase the pool of learners who will further their SET studies at HEIs and provide career education and role modelling across all scientific disciplines. Media and a conveyance of ICT will be used to profile the numerous concerns and research opportunities available; and
- Build new partnerships within the science community involved in science engagement nationally and internationally, while increasing its footprint across the globe.

The finalisation of the new funding framework for science engagement funding by the DST will result into the expansion of existing Programmes initiatives. These may include:

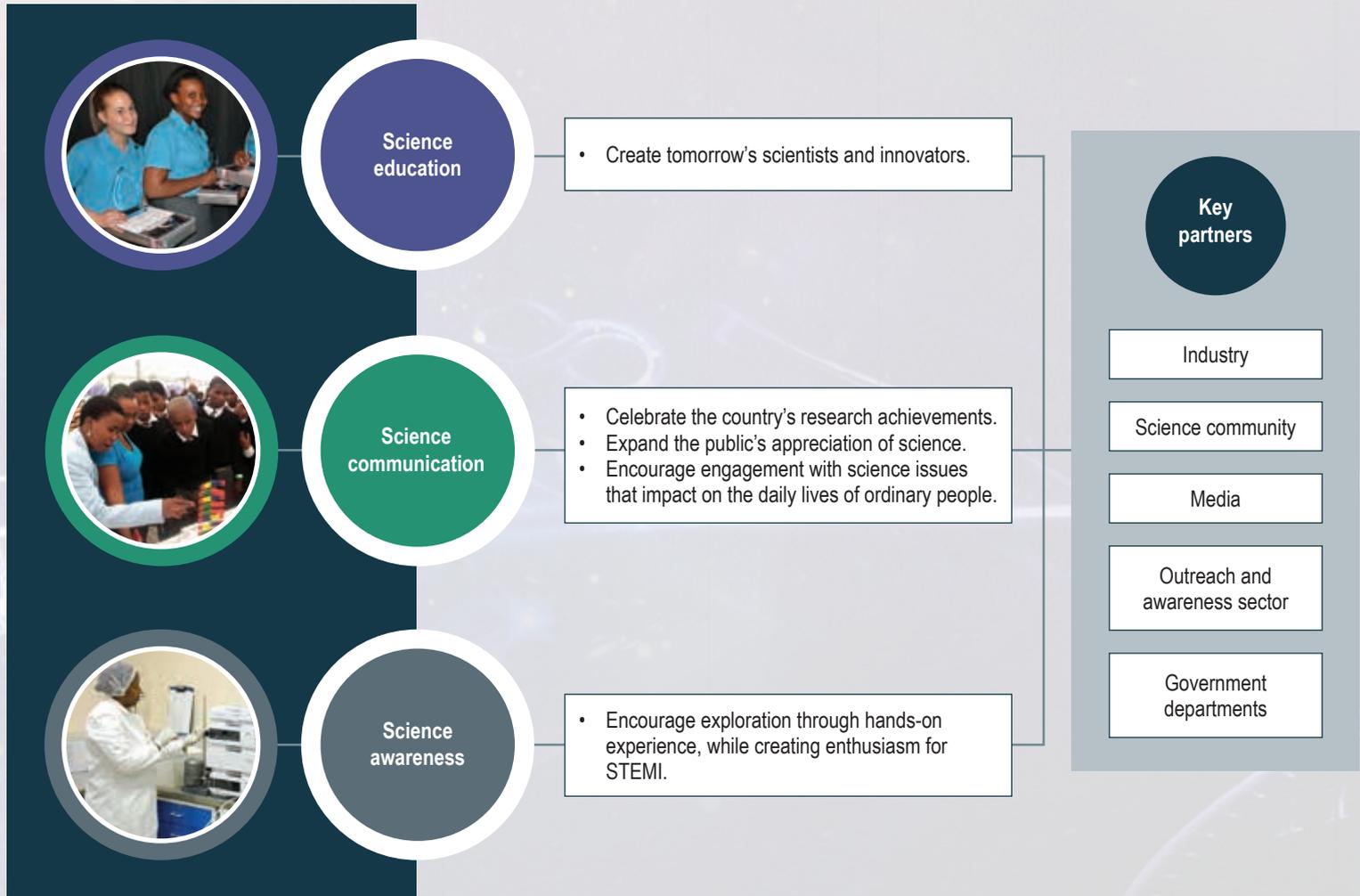
- Journalism Programme – Post internship support (micro enterprise support: support science engagement companies and building capacity) to pursue the communication of science in all 11 official languages;
- STEM – increase the reach and identification of talent in deep rural areas to address transformation;
- Science Festivals – growth of a provincial network of science festivals to increase the public reach across the country;
- Science Centres – increase financial and infrastructural support (logistics and human capacity) to the network of science centre and facilitate the accreditation of more science centres; and
- Increase curriculum support to learners and educators.

In 2019/20, the NRF will collaborate with the DST in finalising the SAASTA business plan that articulates SAASTA's operating model and resource requirements. The business plan will be implemented in 2020/21, coinciding with the implementation of the new science engagement funding model that the DST has put in place to enable SAASTA to play its science engagement agency role, as well as to resource the revamped science engagement programme guided by the Science Engagement Strategy and its implementation plan. While the development of the SAASTA business plan is underway, it will receive R62 579 000 from the DST for 2019/20 based on the old model and as per the existing consolidated contract.

The consolidated contract comes to an end in 2020/21 and the new contract will then be based on the SAATA business and resources model.

Beyond 2019/20, increased funding will be required to support a revised and/or new science engagement programme portfolio, that may include, amongst others, developing the early work on Responsible Research and Innovation that has started, both locally and in collaboration with international partners; Science meets Parliament interventions rolled out; ensuring that science engagement becoming a mandatory part of all NRF grants and using targeted grants to drive connections between science and art, science and industry etc. The definition of a revised programme portfolio will include key role players and will continue throughout 2019.

Figure 12: Science-engagement focus areas



9.2 CONTRIBUTIONS TO STRATEGIC OBJECTIVES

Entrenching science engagement throughout the NRF and within the broader society is one of the five key strategic goals of the *NRF Strategy 2020*. The envisaged outcome of this strategic goal is to create and promote a “scientifically literate and engaged society”. To achieve this, the NRF adopted an integrated science-engagement approach through which SAASTA, the science engagement units at all NRF Research Facilities and RISA business divisions are involved in science engagement.

The process of aligning science engagement across the NRF forms an integral part of its commitment to the nurturing, promotion and development of knowledge while ensuring active public participation in the process and thus promoting an interface between science and society. This public engagement with science in the NRF is driven through Programme 2 (Science Engagement) by means of a clearly articulated implementation plan to ensure delivery.

Over the next few years, the NRF, through SAASTA, will work towards embedding science engagement more holistically within the core business of the NRF and coordinating the implementation of the SES across the NRF and other DST entities. Within the NRF, all science-engagement activities have been consolidated under three focus areas: science education, science awareness and science communication. These three areas are interdependent, each enhancing the effectiveness of the other, while accommodating different target audiences and creating opportunities for joint initiatives across several government departments, HEIs, science councils, science centres and other science agencies.

9.3 STRATEGIC OBJECTIVE 7: ENTRENCH SCIENCE ENGAGEMENT

Science Education

Learner Support

Through this focus area, a variety of programmes are developed, implemented, managed and coordinated to complement learning and teaching in the critical areas of mathematics, sciences, life orientation and

technology, by supplementing the curriculum through career profiling; role modelling; teaching and learning resources; Olympiads and competitions; science camps and workshops; and visits to the various science platforms. These initiatives are implemented by the NRF through SAASTA, the National Research Facilities and RISA in collaboration with institutions such as the Centres of Excellence (CoEs) and SARChI programmes.

Educator Support

The role of an educator is imperative in the nurturing of a learner’s evident or latent talent. To ensure that learner performance in the critical areas of SETI improves, continuous educator development is vital. Through this focus area, partnerships are formed with the Department of Basic Education (through mathematics, science and technology 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 resources development, and for distribution across the country. Some of the key activities are as follows:

STEMI Olympiads and competitions

- National Science Olympiad™
- Natural Science Olympiad™
- AstroQuiz™
- ASTEMI Olympiads and competitions
- National school debates
- National Science Lens Competitions™
- Young Science Communicators Competition™
- Famelab

IMPACT programmes

- Educator workshops
- Techno Youth™
- Science camps for learners with potential
- Science clubs

Science education plans over the MTEF are as follows:

- Programmes/activities that support improvement in both participation and performance in mathematics, physical sciences, life sciences and natural sciences. This will be achieved through curriculum-aligned workshops targeting both educators and learners in these critical subjects during camps by providing educational resource materials, interaction with role models and participation in SET Olympiads and competitions.
- Enrichment programmes focusing more on longer-term performance impact that target learners and educators and include workshops and other initiatives focusing on content and methodology in mathematics, physical sciences, life sciences, natural sciences and life orientation.
- Increased learner exposure to SET-based careers through exposure to career opportunities in SET. The objectives will be achieved through participants' interaction with role models in SET, visits to industries, workshops on career guidance for life orientation educators, and provision of career guidance resources.

South African Astronomical Observatory (SAAO)

Science education remains one of the key pillars of the education and outreach programmes of SAAO to improve learner participation and performance in the science and technology learning areas. Teacher development and learner support will continue to take place through the outreach programme in collaboration with provincial departments of education.

South African Environmental Observation Network (SAEON)

The science engagement programme of the SAEON will focus on exposing school learners to the science of environmental observation, data collection, analysis, reporting and dissemination of findings. School learners are exposed to exploration, discovery and scientific adventure through enquiry-based teaching and learning to demonstrate the value of long-term and large-scale environmental observation and monitoring. The projects will target mainly schools in previously disadvantaged communities by, among other things, providing them with equipment that they would otherwise not be able to afford to conduct research. Awareness platforms such as science expos, exhibitions and career days provide opportunities for SAEON personnel to interact with large audiences of learners, educators and the general public to raise awareness about the scientific research that SAEON undertakes. The integration of scientists in the environmental science engagement programmes provides rare opportunities for learners and educators to interact with and learn from active scientists.

iThemba Laboratory for Accelerator Based Sciences (iThemba LABS)

The science engagement programme of iThemba LABS is composed of teacher and learner workshops, and science and mathematics competitions, including science camps and excursions. Educator and learner assistance will continue to be offered through science workshops and lectures by staff and volunteers. Educator manuals to assist with relevant information and practical work guidelines will be issued to schools on a regular basis. Participation of learners in competitions such as Science Olympiads and AstroQuiz will be enhanced through collaboration with SAASTA. Science camps and excursions will be continued to instill a love of science and mathematics in learners at an early age.

Science Awareness

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 resource availability and the requirements of a skilled labour force mean that broader awareness and understanding are increasingly required about why science, research and innovation are critical in developing a knowledge society. Members of the public are generally engaged through science festivals, exhibitions and facility tours at the National Research Facilities. Some of the facilities also offer internships and/or job-shadowing opportunities. It is imperative to ensure that public awareness initiatives extend to rural communities. Current initiatives include the following:

Awareness programmes

- National Science Week
- Science festivals and international days
- Exhibits, Imbizos and events

Other programmes

- National Youth Service Programme
- Youth Science Journalism Programme
- Programmatic Support Grant Intervention (science centres)
- Science Centre Accreditation
- Science Centre Capacity Building

Science awareness plans over the MTEF are as follows:

- Participation and awareness programmes that include educators,

learners and the public. The objective is to stimulate communication about SET and provide access to relevant scientific and technological information through exhibits, the creation of platforms and the distribution of relevant resources.

- Implementation of programmes that contribute to the support of science centres through the distribution of science engagement grants. This is intended to improve the infrastructure of science centres, support activities implemented by the science centres and enhance capacity through job-shadowing programmes.

South African Radio Astronomy Observatory (SARAO)

Science engagement initiatives that SARAO will participate in include existing platforms such as science festivals, science centre events and SAASTA projects such as school debates, AstroQuiz, FameLab, World Space Week and the National Science Week. Other science engagement initiatives will be carried out through the African Very Long Baseline Interferometry (VLBI) Network (AVN) communication strategy and associated activities.

South African Astronomical Observatory (SAAO)

Stargazing sessions and other activities will continue to be held at the Cape Town and Sutherland sites to reach disadvantaged members of the community. The indigenous astronomy project will continue to be held in collaboration with the DST and stargazing sessions will be held with amateur astronomy groups in the townships as a science awareness requirement.

Science Communication

Science communication 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. Discipline-specific communication areas currently include biotechnology, nanotechnology, hydrogen fuel cell technology, space science, the palaeosciences and Antarctica. In addition, science communication in scientific disciplines such as astronomy, biodiversity, conservation and nuclear science is also undertaken by the various National Research Facilities.

The NRF offers a variety of interventions to improve capacity in quality science communication. Two SARChI Chairs in Science Communication are funded

and fully active and will provide leadership in the discipline over the MTEF. Researchers are encouraged to participate in science engagement and their contributions will be factored into their annual performance reports. Science engagement with society is also promoted through an established Science for Society lecture series, held each year in collaboration with various universities and researchers, especially those from the CoE and SARChI programmes.

In general, activities will include:

- Competitions;
- Workshops for science communication skills development among scientists and researchers;
- Promotion of science journalism;
- Partnerships with community media to promote science in indigenous languages;
- Increased media placement of science-related material;
- Translation of scientific information into audience-specific resources (this incorporates the science editing, production and ICT functions), for example, fact sheets, posters, media-friendly articles, communication products, booklets, career brochures and information videos; and
- Information dissemination on key science and technology areas.

South African Institute for Aquatic Biodiversity (SAIAB)

The multidisciplinary and multi-institutional research paradigms carried out by the SAIAB on inland fisheries, freshwater ecology, changing coastal systems and movement of marine fisheries necessitate societal understanding of the management of and knowledge about these essential natural resources. This will be performed through the Margaret Smith Library, which is an information hub on aquatic biodiversity literature and is accessible to the public and students. Other platforms such as social media and the SAIAB website will be utilised for science communication purposes.

iThemba LABS

Science communication will be carried out through contributions to press releases and magazines, including online and social media platforms. Profiling of researchers, experimental setups, as well as current and future research to introduce researchers affiliated to iThemba LABS to the wider public will also be undertaken. This will be especially important in growing the public's understanding of the significance of the South African Isotope Facility (SAIF) project for South Africa.

Table 11a: Programme 2 – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 7

STRATEGIC OUTCOME: 	STRATEGIC OBJECTIVE 7	Entrench science management
	OBJECTIVE STATEMENT	Science engagement with society for the promotion of a vibrant national research culture through the implementation of effective science awareness, science education and science communication activities.
	CRITICAL IMPLEMENTATION ACTIVITIES	<ul style="list-style-type: none"> • Cultivate science awareness through education and communication, as well as implementation of effective science engagement initiatives; • Implementation of science engagement in RISA; and • Implementation of science engagement in Programmes 4.
	LINKS TO MTSF	<ul style="list-style-type: none"> • NRF Objective 7 links to MTSF Priorities 1 and 14.

INDICATORS		Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
		2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of members of the public reached through NRF science awareness activities		1 013 716	1 084 760	1 191 892	1 090 000	1 090 000	680 300	682 150	683 300
Interactions focusing on educator development and learner performance in mathematics, technology and science	Educators reached	19 410	17 997	2 741	3 000	16 000	1 347	1 337	1 353
	Learners reached	371 624	374 457	119 315	225 000	385 000	186 370	199 379	201 890
BUDGET (R million)		Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Science Engagement		179,362	174,826	126,144	139 552	100, 901	101 403	106 850	

Table 11b: Programme 2 – Quarterly targets 2019/20–2021/22) – Strategic Objective 7

INDICATORS		Reporting period	Annual target 2019/20	Quarterly targets			
				1 st	2 nd	3 rd	4 th
Number of members of the public reached through NRF science awareness activities		Quarterly	680 300	205 000	280 100	490 150	680 300
Interactions focusing on educator development and learner performance in mathematics, technology and science	Educators reached	Quarterly	1 347	200	800	900	1 347
	Learners reached	Quarterly	186 370	32 000	70 000	120 000	186 370



10 PROGRAMME 3 – RISA

10.1 SITUATIONAL ANALYSIS

Programme 3, RISA, executes the central granting function of the NRF. The division supports and promotes research through the development of human capacity, the generation of knowledge and the provision of, and access to, cutting-edge research infrastructure. Structuring of the Programme is flexible and responsive to adapt seamlessly to the varying needs of the NSI. The business of Programme 3 is informed by a range of national government policies, strategies and priorities, including the strategy for HCD for research, innovation and scholarships, and the 2013 Ministerial Guidelines for Improving Equity in the Distribution of DST/NRF Bursaries and Fellowships. RISA contributes to a sustainable and globally relevant NSI by:

- Promoting international competitive research as the basis for a knowledge economy;
- Providing cutting-edge research, technology and innovation platforms; and
- Operating a world-class granting, review and evaluation system.

A range of national policies on science and technology, meant to shape the future landscape of the science system, informs RISA's strategic choices. In making these choices, RISA is also guided by several strategy and policy documents of the NRF, underpinned by the NRF Transformation Framework

The NRF will continue to align its funding investments to national research priorities. RISA executes its grant-making function through the following sponsor domains:

- **Human and Infrastructure Capacity Development (HICD)** focuses on developing individual research capabilities by supporting next-generation and emerging researchers and institutional research capabilities through the provision of and access to research infrastructure;
- **Knowledge Advancement and Support (KAS)** facilitate, promote, advance and support knowledge production and application through funding and other interventions, and in the process support the development of related human capacity; and

- **Research Chairs and Centres of Excellence (RCCE)** manages two strategic funding instruments, viz. the SARChI and the CoE programmes. The primary aims of the SARChI are to strengthen and improve South Africa's international competitiveness in research and innovation, while also responding to the social, economic and transformation imperatives of the country. It also aims to provide HCD opportunities by producing high-quality masters and doctoral graduates. CoEs are physical or virtual centres of research that concentrate existing capacity and resources to enable researchers to collaborate across disciplines and institutions on long-term projects that are locally relevant and internationally competitive to enhance the pursuit of research excellence and HCD.

The above-mentioned directorates are supported by other administrative directorates or divisions.

- **RISA Finance and Administration** provides the full financial and administrative support functions for the RISA business division of the NRF, as well as to the NRF Corporate Office;
- **Grants Management and Systems Administration (GMSA)** performs and coordinates all grants management activities and manages funding processes; and
- **Reviews and Evaluations** facilitates peer evaluations and reviews in support of granting decisions.

Transformation of the Science and Technology Landscape

A core tenet of the *NRF Strategy 2020* is transformation by promoting the diversification of the research cohort, with particular emphasis on persons from designated groups, thereby transforming the research workforce. The NRF will, through a variety of interventions, catalyse the transformation of the science and technology system. These include, among others, targeted grant-funding instruments that focus on women and black researchers, and the fast-tracking of black female doctoral graduates in becoming established researchers and in obtaining their NRF rating.

Through RISA, the organisation will continue to focus on and implement targeted funding instruments in support of students, emerging researchers

and established researchers. A particular focus will continue to be placed on developing sustainable, long-term participation by persons from designated groups in the HCD pipeline, in particular emerging researchers. Interventions include:

- The **Thuthuka Research** programme, which was implemented in collaboration with co-funding from HEIs to enhance, redress and increase access to funding opportunities by emerging researchers. This instrument supports the development of emerging researchers holding academic positions at universities or research positions at public research institutions, thus enabling the transition to the established researcher cohort as evidenced through the NRF ratings;
- The **PDP** for the placement of doctoral students and postdoctoral researchers at the National Research Facilities, science councils and other public research institutions;
- An expanded NRF **postdoctoral fellowship** that supports recent doctoral graduates to broaden their experience to become established researchers;
- A partnership with **Sasol Foundation** for the co-funding of honours, masters and doctoral studies at previously disadvantaged universities;
- The **South African Systems Analysis Centre (SASC)** to provide an opportunity for doctoral candidates and emerging researchers to advance their research in systems analysis and modelling;
- **Sabbatical grants** that enable academic staff from designated groups to complete their doctoral degrees. The new partnership between the First Rand Foundation (FRF) and the NRF will focus on South African and African emerging researchers and persons with disabilities; and
- Funding to NRF **Y-rated researchers**, especially those from the designated groups, to ensure that they develop into established researchers.

In addition, the NRF will continue to ensure that there is continuous transformation within the NRF Specialist Rating Committees and among reviewers by actively identifying and appointing excellent researchers from designated groups. Customised interventions for those institutions that require research and researcher development through targeted capacity-building initiatives will be undertaken. The focus will be on historically disadvantaged individuals (HDIs) and rural-based universities and universities of technology. Tailor-made institutional interventions will be

implemented to increase the number of black and women rated researchers via a partnership model with the NRF.

10.2 CONTRIBUTIONS TO STRATEGIC OBJECTIVES

To improve its operations and ensure efficiency, RISA has embarked on the One Call for Proposals project to rationalise and reduce the number of calls for research grants, scholarships, bursaries, etc. and eventually the number of Funding Instruments. This will:

- Reduce complexity;
- Improve organisational control over the achievement of specific objectives;
- Improve the ability to collect system intelligence to support evidence-led decision making;
- Ensure optimal monitoring and evaluation to track performance and impact; and
- Advance proactive grant-making strategies and reduce the administrative burden, both internally and for the stakeholder community.

The One Call for Proposals project envisages to reduce approximately 80 calls contained in four contracts to possibly one granting call with staggered closing dates and two non-granting calls.

The granting calls will be divided into the following five Funding Instrument categories:

- **Research grants** aimed at enhancing the efficiency of the NRF to drive transformation consistently and strategically through supporting research as the foundation of knowledge production. These will include international grants aimed at collaborative research with researchers in another country that is a signatory to a binational/tri-national agreement or an agency in another country;
- **Bursaries and scholarships** aimed at developing institutional research capabilities with the appropriate human capital to drive the R&D strategies within the NSI. The grants offer support to the next generation and emerging researchers, namely those who seek to engage in postgraduate

studies (honours, masters, doctoral and postdoctoral degrees) and are on the path to becoming established researchers;

- **Infrastructure grants** aimed at providing cutting-edge equipment for research and technology infrastructure at institutions to ensure the competitiveness of the South African research community. This investment in research equipment aims to accelerate innovation and to improve the quality of research conducted; expand on existing institutional capacity and on research and training; and promote national as well as regional collaborations in line with national research priorities;
- **Institutional grants** are strategic interventions of the South African Government aimed at increasing scientific research capacity through the production of new knowledge and innovations. These grants are given to HEIs that have pockets of excellence and enable researchers to collaborate across disciplines and institutions; and
- **Travel grants** offered to researchers to fund local or international travel, and to support the hosting of events such as conferences or symposia. These include mobility grants to support local or international travel for research or training on specific equipment that is not available in South Africa.

The two non-granting calls are:

- **The evaluating-and-rating-of-individuals call** is the ex-post evaluation by experts of a researcher's relative position among his/her peers. It is a tool for benchmarking the quality of the country's researchers against the best in the world. It originated from the need to create a mechanism to ensure that the training of the next generation of researchers (postgraduate students) was entrusted to capable academics. It was also intended to be a mechanism for the recognition of the achievement of researchers and assist them in maintaining their levels of research excellence through benchmarking; and
- **The internship call** that aims to attract and retain skilled human capital within the NSI through mentorship programmes to develop skills and competencies among the next generation of academics and researchers in South Africa. This internship programme enables young, unemployed graduates and postgraduates in the SET fields to enhance their skills

and competencies by facilitating one-year employment at national organisations/companies.

The first phase of the One Call for Proposals project is envisaged to be completed in the 2019/20 financial year.

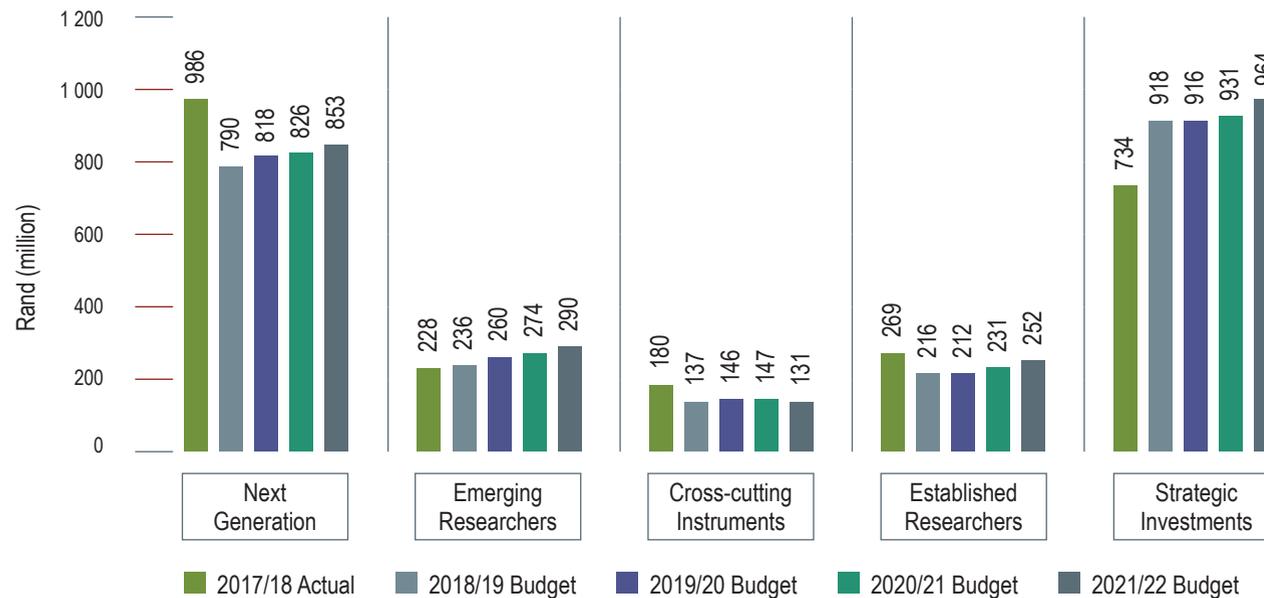
10.2.1 Strategic Objective 1: Promote Globally Competitive Research and Innovation

The NRF provides support across the full spectrum of the careers of current and future knowledge workers. This is achieved through an HCD pipeline, as illustrated in Figure 13, which informs the support for next-generation researchers from honours to doctoral level, emerging researchers from postdoctoral level, and established researchers. In facilitating and supporting research and HCD, the NRF uses a range of instruments such as the Thuthuka programme, the CoEs and the SARChI, which offer focused, multidisciplinary and transdisciplinary research environments that support innovative, solutions-orientated research in societally relevant fields.

Funding is provided through a variety of strategic instruments that cover different modalities, focus areas, subject areas, priority areas, values, geographical areas, designated groups, strategic choices and other relevant considerations. The categories can be defined as:

- Next generation – postgraduate students (honours, masters, doctoral);
- Emerging researchers – early-career researchers, including postdoctoral fellows, active researchers without doctoral degrees and individuals who have yet to establish themselves;
- Established researchers – individuals who have an established track record of undertaking independent research;
- Cross-cutting instruments – other funding opportunities for both postgraduate students and researchers;
- Strategic investments – SARChI Chairs and CoEs; and
- The NEP and the Strategic Research Equipment Programme (SREP).

Figure 13: HCD investment projections 2017/18–2021/22



Budget assumptions that underpinned the *NRF Strategy 2020* targets for the number of postgraduate students from designated groups did not keep up with expectations because of revised bursary values. The numbers of grant-holder-linked bursaries and fellowships will drop as a consequence of the drop in the numbers of researchers funded, due to a reduced pool of applicants and research funding available. This has resulted in the NRF not being able to meet the five-year targets as indicated in the *NRF Strategy 2020*. Hence, the 2019/2020 targets have been revised accordingly.

DST-NRF Internship Programme

This Programme will support 1 995 interns over the MTEF. In line with the DST TYIP, the scope of the Programme was expanded to include graduates

in the humanities and social sciences. An amount of R171 million will be spent during the MTEF in this regard.

Next-generation Researchers

The investment in next-generation researchers is through the competitive awarding of free-standing scholarships, grant-holder-linked bursaries and academic development programmes aimed at honours and final-year B Tech, masters and doctoral students. These awards are made in accordance with the Ministerial Guidelines on equity and redress. It is acknowledged that meaningful and fundamental transformation must include and extend beyond demographics of the knowledge workforce and take account of other aspects of the knowledge enterprise. The current priority of the transformation agenda

is to ensure a representative workforce at both student and researcher level. The NRF has developed a postgraduate funding policy that is aimed at enhancing equity in postgraduate student access, success and throughput, using funding to give effect to the Ministerial Guidelines.

There is currently significant disparity in the national academic performance of postgraduate students. Some key challenges include low enrolment rates, low progression rates from honours to masters and doctoral studies, long time to completion and advanced age at completion. These challenges are most pronounced for blacks (Africans, Coloureds and Indians), women, particularly black women, and postgraduate students from poor and working-class backgrounds. Failure to address these challenges will result in an exclusion of a wide talent pool and compromise the ability of the NRF to deliver on its mandate of a transformed and representative research workforce. Systems and processes will be established during 2019/20 for implementation from 2020/21.

On average, the NRF invests 36% of the total HCD pipeline budget on next-generation researchers, which translates to a total investment of around R900 million over the MTEF period. This represents a modest increase in nominal terms but actually a decrease in real terms.

Postgraduate bursaries awarded by the NRF are supported mainly by funds derived from the DST, the National Skills Fund (NSF) managed by the DHET and the *dti* funded Technology and Human Resources for Industry programme (THRIP).

Migration of the THRIP from the NRF to the *dti* has reduced the NRF total spend on postgraduate support. The allocation for postgraduate bursary support from the NSF to the NRF declined from R265 092 880 in 2017/18 to R151 993 000 in 2019/20 having a significant impact on the number of postgraduate bursaries that could be funded by the NRF. Over the same period, the NSF allocation for supporting the National Student Financial Aid Scheme (NSFAS) pipeline honours students more than halved from R75 116 880 to R32 759 040 while the bursary values increased.

The higher than projected number of PhD students supported is accounted for by the increase in the support for continuing masters and doctoral students. In addition, as the number of active SARChI Chairs increased, the number of

masters and doctoral students supported increased. This is in alignment with the NDP strategy of increasing the number of doctoral students per million of the population.

The bulk of postgraduate student training is and will continue to be supported through HICD, while KAS and RCCE will continue to provide grant-holder-linked bursaries and fellowships. This will contribute towards HCD and ensure that researchers supported by the NRF commit to training graduate students. The main funding instruments within KAS that support the bulk of students with grant-holder-linked bursaries are the Competitive Programme for Rated Researchers (CPRR) and the Competitive Support for Unrated Researchers (CSUR) Programme. Other grant-holder-linked bursaries are funded through contract and designated funding of strategic fields such as global environmental change, IKS and palaeosciences, including marine and ocean sciences.

The establishment of new Research Chairs in 2019/20 will lead to an increase in SARChI-funded Chairs to over 233, with postgraduate student numbers to over 1 808. Funding for existing CoEs will continue and a call for three new CoEs focusing on human settlements, water and nuclear medicine will be made during the 2019/20 financial year. The future of the first cohort of CoEs beyond the 15 years of funding support related to their fit and future structure is being led by the DST and it is expected that business plans will be finalised during the 2019/20 financial year for implementation in 2020. Postgraduate student numbers are expected to fluctuate due to the stagnant income of the first cohort of CoEs and student graduations, with nominal increments in the second cohort aligned to the 5% annual grant increment.

The NRF will immediately only accept nominations of eligible students from designated groups, until the 80% targets for blacks (inclusive of African, Coloured and Indian/Asian South Africans) and 55% for women are reached. In addition, the NRF is now enforcing that all service level agreements with CoEs and SARChI holders comply with the Ministerial guidelines at all levels of postgraduate studies.

With effect from 2020/21, when implementing the new NRF Postgraduate Funding Policy, the NRF will no longer award grant-holder-linked bursaries as a component of the research grant. Researchers will be expected and required to identify potential graduate students whom they will work with

and/or supervise, and encourage these students to apply for free-standing bursaries/fellowships through the NRF processes. However, it will be important to ensure that the NRF processes are adjusted so that researchers will be able to work with/supervise students that they would have identified, while at the same time meeting the Ministerial guidelines.

Emerging Researchers

Postdoctoral fellows, researchers and academics who have not yet obtained a research doctorate are considered as emerging researchers and constitute the future of South Africa's knowledge enterprise. The NRF has therefore developed a range of targeted funding instruments to facilitate their transition to becoming established researchers and supervisors of postgraduate students. Even though the NRF is expecting a nominal annual increase in investment in this cohort over the MTEF period, this increase will translate into a net decrease in real terms. This investment will not meet the demands of the large emerging researcher cohort and cannot, in fact, sustain the desired growth rates in support of this cohort, as had been projected from the previous MTEF planning cycle. This situation will unfortunately also constrain the ability of the NRF to provide targeted support for black and female research and instructional staff with doctoral degrees towards becoming established researchers. For this reason the NRF is, in parallel with other initiatives, considering reprioritisation of investments in an attempt to serve this cohort better. Part of the rationale for revising the Incentive Funding for Rated Researchers (IFRR) was to redirect a portion of these funds to support emerging researchers. However, the impact of this approach will only become evident in 2019/20, given that the revision to the IFRR only commenced in 2018 and is expected to be phased in over two years.

Specific initiatives over the MTEF period will include:

- The ***NRF-FRF Sabbatical Grant***, which is a directed intervention aimed at promoting the development of academics who are black African South African citizens and academic staff with disabilities by accelerating their training as doctoral and postdoctoral candidates to enhance their progression to become established researchers;
- The ***Thuthuka Initiative***, which supports emerging researchers from designated groups employed at public research institutions. Investment

has been devoted to doctoral and postdoctoral training, as well as to researchers on fast-track for applying for NRF rating; and

- The ***Customised Intervention Grant***, which has been established to accelerate the development of researchers who are black and especially women. It includes assisting these researchers with PhD qualifications to obtain an NRF rating. Each of the candidates will be matched with an established mentor who is an existing NRF-rated researcher in his/her respective field.

In addition to the interventions discussed, the NRF has developed other interventions that support HCD to address systemic needs. Those targeted interventions are as follows:

- ***NRF-FRF Black Academics Programme***: The NRF and the FRF have partnered to pursue the goal of increasing the proportion of suitably qualified black academic staff and academic staff with disabilities at South African public universities. The co-funded NRF-FRF Sabbatical Grant funding instrument will accelerate training of doctoral and postdoctoral candidates to progress in becoming established researchers with an NRF rating. Funding will be awarded for a maximum period of three years for the Doctoral Sabbatical Grant and two years for the Postdoctoral Sabbatical Grant. For the 2018 academic year, there were 38 awardees and it is envisaged that 50 new grant awards will be made on average each year over the MTEF;
- ***nGAP***: The New Generation of Academics Programme (nGAP) recruits new academics and is supported through the DHET and the DST-NRF partnership. The programme is geared towards providing holistic and complementary support for career development among emerging researchers by focusing on teaching, learning, research and postgraduate supervision. The nGAP scholars may apply for competitive funding such as the Thuthuka grant for emerging researchers. Candidates in the doctoral or postdoctoral track are supported with a Research Development Grant from the NRF for the first two years to facilitate their research or research proposal development; and
- ***PDP***: This programme aims to accelerate the development of research professionals in key research areas by providing doctoral scholarships, as well as three-year, fixed-term employment contracts for postdoctoral fellows with the host institution. The programme focuses on early-career researchers conducting research at science councils, National Research

Facilities and other public research institutions. It is tailored to accelerate the development of black and female scientists and researchers who are poised to contribute to South Africa's R&D workforce.

Established Researchers

The investment in established researchers is essential for enhancing research productivity, as well as training and mentoring of the next generation of researchers. The investment must respond to the need for training and mentoring of postgraduate and postdoctoral candidates to meet both the NDP targets and the NRF's research productivity target of 1% of the global research output. Lastly, the investment must make allowance for the growth in the number of established researchers that will progress from the emerging-researcher category.

Over the MTEF period, the investment in this area will be R660 million. A series of funding instruments that provide for self-initiated, discipline-based and/or bottom-up research projects are made available through RISA. Primary among these are the CPRR and the CSUR. CPRR and CSUR are discipline-based funding instruments that support basic research as a foundation of knowledge production in all disciplines, including the humanities and the social, natural and physical sciences, through which approximately 3 300 researchers will be supported.

The specialised community engagement investment dedicated to the field of knowledge production through community engagement, awarded every second year, will fund up to 15 new projects. Further research support in specific fields and/or disciplines such as IKS; earth systems science; human and social dynamics; marine and coastal research; and Antarctic and southern oceans research will be continued through existing contract-funded instruments. On average, 10 to 20 researchers will be funded in each of these areas. The value of the grants relative to the cost of undertaking research remains a challenge.

Other instruments include national/local, collaborative international and Africa collaborative grants to support knowledge production and mobility for knowledge exchange. The funding instruments for supporting research are sourced through core parliamentary contracts and international collaboration.

Strategic Investments

The SARChI aims to increase the scientific research and innovation capacity of the NSI by attracting and retaining established researchers who are considered global experts at local HEIs, science councils and National Research Facilities. The SARChI builds a critical mass of supervisory capacity, equipment, researchers and students around the research chair in support of domain-specific research where the domains are selected with consideration given to socio-economic needs and global research trends.

The establishment of new SARChI Chairs in 2019/20 will increase the cumulative number of awarded Chairs to over 233. Thus, the postgraduate numbers within the SARChI funding instrument will also increase to over 1 808.

Funding for the existing 15 CoEs, including the National Institute of Theoretical Physics (NITheP), will continue until at least the end of 2019/20. Depending on DST approval and the availability of additional funding, a call for three new CoEs (respectively focusing on human settlements, water and nuclear medicine research) is planned during 2019. The future of the first cohort of CoEs beyond the 15 years of funding support related to their fit and future structure is being led by the DST and it is expected that business plans will be finalised by mid-2019 for implementation by April 2020. Postgraduate student numbers are expected to fluctuate due to the stagnant income of the first cohort of CoEs and student graduations, with nominal increments in the second cohort aligned to the 5% annual grant increment.

Classification of current CoEs by Grand Challenges are:

- Bio-economy: health innovation – CBTBR; SACEMA and human immunodeficiency virus (HIV) prevention;
- Energy security – CIMERA;
- Human and social dynamics – human development and food security.
- Palaeontology – palaeosciences;
- IKS – CoE in IKS; and
- Biodiversity – birds as key to biodiversity, tree health and invasion biology.
- Mathematical and physical sciences – strong materials, catalysis MaSS and NITheP.

To facilitate the advancement of existing knowledge and develop new fields of knowledge, RISA will survey the research landscape within the NSI,

perform an analysis of existing research areas, track and analyse research trends globally and review the needs within the NSI continuously. Most of the knowledge-generating funding instruments within the NRF serve a dual function: to generate new knowledge and/or grow the existing knowledge base; and to train and develop the next generation of researchers.

Achieving targets for 2019/20

The NRF will attempt to meet the targets set for the number of researchers from designated groups in 2019/20 through the Thuthuka programme, the Black Academics Advancement Programme (BAAP) and the nGAP Research Development Grants. These are designed to support emerging researchers and grants are awarded predominantly to black researchers. Over the past five years all fundable Thuthuka applications from black applicants have been prioritised for funding.

In addition, the following funding grants, namely: the CPRR, the CSUR and the Knowledge Interchange Collaboration (KIC) grants are key contributors to the number of researchers supported. These grants funded through the NRF core parliamentary grant are highly competitive. It must be noted that the pool of applicants for CPRR funds are restricted to NRF-rated researchers only and these grants are not intended as developmental grants, unlike the Thuthuka and BAAP.



Table 12a: Programme 3 – Strategic plan and medium term KPIs and budget (2019/20-2021/22) – Strategic Objective 1



INDICATORS		Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
		2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of NRF-funded researchers from designated groups	Black	1 355	1 563	1 698	2 182	2 438	2 154	2 295	2 368
	Female	1 610	1 699	1 786	1 520	2 650	1 579	2 020	2 100
Number of postgraduate students funded per designated group (D+M+PD+BTech-4)	Black	8 980	10 747	11 328	9 350	11 360	9 157	9 675	5 885
	Female	7 032	8 017	8 266	7 119	9 280	6 300	6 786	4046
Number of NRF-rated researchers from designated groups	Black	866	970	1 069	1 026	1 120	1 120	1 337	1 512
	Female	1 054	1 176	1 285	1 292	1 400	1 365	1 499	1 638
Number of masters and doctoral students funded per level	Masters	4 853	4 995	5 435	4 582	-	3 586	3 770	2 289
	Doctoral	3 181	3 363	3 519	3 066	-	2 855	2 987	1 813

Table 12b: Programme 3 – Quarterly targets for 2019/20 – Strategic Objective 1

INDICATORS		Reporting period	Annual target 2019/20	Quarterly targets			
				1 st	2 nd	3 rd	4 th
Number of NRF-funded researchers from designated groups	Black	Quarterly	2 154	1 035	1 720	2 090	2 154
	Female	Quarterly	1 579	856	1 292	1 349	1 579
Number of postgraduate students funded per designated group (D+M+PD+BTech-4)	Black	Quarterly	9 157	5 253	7 789	8 555	9 157
	Female	Quarterly	6 300	3 636	5 359	5 841	6 300
Number of NRF-rated researchers from designated groups	Black	Annually	1 120	-	-	-	1 120
	Female	Annually	1 365	-	-	-	1 365
Number of masters and doctoral students funded per level	Masters	Quarterly	3 586	2 171	2 978	3 299	3 586
	Doctoral	Quarterly	2 855	1 669	2 398	2 855	2 855

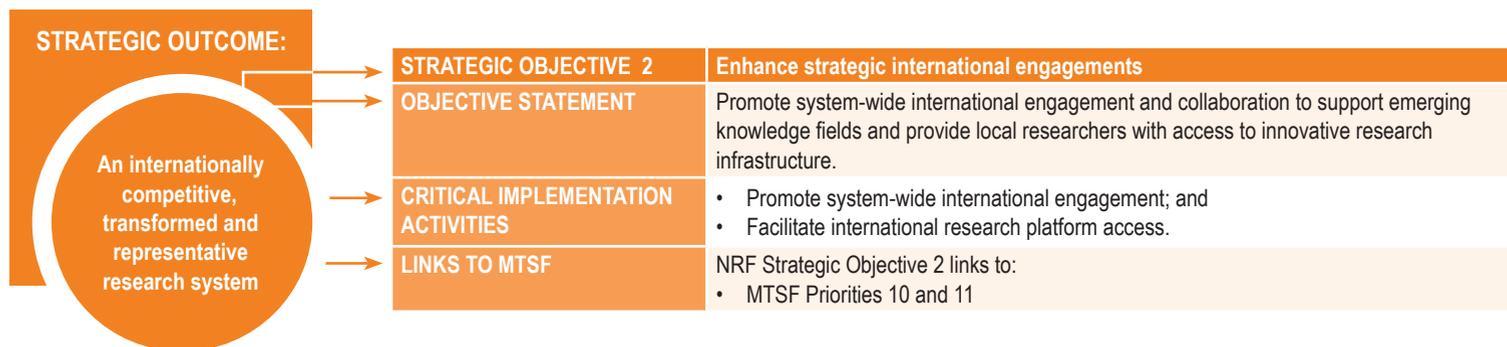
10.2.2 Strategic Objective 2: Enhance Strategic International Engagements

International strategic partnerships remain a vehicle for the advancement of research and HCD. Through the strategic partnerships managed through the SPP division, system-wide international engagement and access to local and international research platforms are facilitated and negotiated. RISA will implement a range of global agreements through various funding initiatives such as:

- **The Newton Fund**, which is a five-year initiative aimed at developing science and innovation partnerships between South Africa and the United Kingdom (UK). Scholarships will be supported under this partnership in the areas of aerospace engineering, nanotechnology, law, political studies, development economics and education and occupational studies;

- **NRF and Stichting Nuffic** (the Dutch Organisation for Internationalisation in Education) launched an inaugural call for doctoral candidates to either study in the Netherlands or obtain joint doctoral degrees based on partnerships between South African and Dutch universities. This partnership will strengthen cooperation between Dutch HEIs and partner universities in South Africa through joint supervision of South African doctoral candidates; and
- **The World Academy of Sciences (TWAS) and German Academic Exchange Service (DAAD)** will contribute to effective science collaborations on the African continent and globally. The NRF-TWAS partnership enables pursuance of this goal through the establishment of doctoral scholarships from Africa and other emerging economies that will be funded per annum for a maximum of three years for full-time research training in South Africa.

Table 13a: Programme 3 – Strategic plan and medium term KPIs and budget (2019/20-2021/22) – Strategic Objective 2



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of active grants emanating from binational, multinational, as well as agency-to-agency agreements	-	1 008	996	990	1 699	945	950	955

Table 13b: Programme 3 – Quarterly targets for 2019/20 – Strategic Objective 2

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of active grants emanating from binational, multinational, as well as agency-to-agency agreements	Quarterly	945	500	760	850	945

10.2.3 Strategic Objective 3: Provide Best-practice Systems in Support of Granting, Reviews and Evaluations

To contribute successfully to Strategic Objective 3, RISA pursues effective and efficient granting, evaluation and rating systems through:

- A system of planning, evaluation and review in support of researcher ratings;
- Institutional and programme reviews;
- The assessment of funding proposals; and
- An effective and efficient granting system.

Planning, Evaluations and Reviews

The Reviews and Evaluations directorate is the custodian of the planning process, evaluations and reviews and will:

- Coordinate tracking and reporting on the implementation of NRF management initiatives in response to the findings and recommendations of the 2015 five-year evaluation of the NRF;
- Manage peer evaluators/reviewers with due consideration of good training and preparation; early planning; appropriate matching; demographic balance; avoiding fatigue; and optimising support;
- Coordinate peer review evaluations;
- Coordinate cyclical evaluations of funding instruments; and
- Streamline all processes through the use of fit-for-purpose IT platforms.

An Effective and Efficient Granting System

RISA leverages economies of scale, improves efficiencies and adopts effective, efficient and auditable business processes to support and enhance:

- The grant management processes providing efficient and seamless quality of service and reduced turnaround times;
- Clustering and reducing similar funding instruments to reduce the number of calls made for funding and annual progress reports;
- The engagement with key stakeholders (the HEIs) to actively drive the

process of institutions drawing down on their grants in an efficient and timely manner; and

- The support of the BIS unit as the custodian of key business systems in the NRF. The support will include the development of an online call provisioning platform to reduce turnaround times on calls, continuous business process and IT-related engagement to improve efficiencies and reduce administrative burdens without compromising the integrity of the process.

The NRF disburses in excess of R1bn per annum towards postgraduate bursaries and postdoctoral fellowships. The DST has tasked the NRF to develop an alumni-tracking system to enable the organisation to track the career trajectory of funded students and determine the long-term impact of the investments. The system workflow will include the ability to draw student information from the NRF grant system. The system automates the process of contacting funding recipients and presents a web interface where alumni can update their profiles, which are pre-populated as far as possible based on data provided through the granting process. The NRF Alumni Database (AD) team has tested and demonstrated the system to the DST. It is the NRF's view that a fully functional tracking system would only be possible if the South African Revenue Services (SARS) grants the NRF access to specific information on tax-registered beneficiaries on an annual basis. In this regard, the DST has contacted SARS requesting an engagement with them together with the NRF.

The NRF has since updated all student agreements, master funding agreements and conditions of grants to ensure that the beneficiaries grant the NRF consent to use their personal information for purposes of tracking their study/career activities. This is a sign of commitment by the DST and the NRF to safeguard and use the data of beneficiaries in line with the Protection of Personal Information Act (POPI). Following further testing, the AD is planned to be deployed to the wider research community by the end of the financial year.

Table 14a: Programme 3 – Strategic plan and medium term KPIs and budget (2019/20-2021/22) – Strategic Objective 3



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Total number of researchers rated through the NRF system	-	3 663	3 885	3 750	4 000	3 900	4 050	4 200

Table 14b: Programme 3 – Quarterly targets for 2019/20 – Strategic Objective 3

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Total number of researchers rated through the NRF system	Annually	3900	-	-	-	3 900

10.2.4 Strategic Objective 4: Leading-edge Research and Infrastructure Platforms

Creation of wealth through jobs and poverty alleviation is dependent on the nation's ability to develop new products, technologies and services through research and innovation. This can only be achieved if the nation possesses the required human capital capable of generating new knowledge and technologies through research in an environment with quality research infrastructure.

Appropriate and relevant research infrastructure is a necessary requirement in conducting research and the training of postgraduate students. World-class research equipment can also constitute large or specialised pieces of equipment that are needed to catapult research and student training to new levels of achievement.

Access to Global Research Infrastructure

The NRF brokers agreements to access global research infrastructure that enables the collaboration and knowledge generation of local and global researchers. Over the MTEF period, the NRF, through Programmes 3 and 4, will continue to support the provision of, and access to, R&D infrastructure across the NSI, as well as support access to global research infrastructure such as:

- The European Synchrotron Radiation Facility (ESRF);
- The European Organisation for Nuclear Research (CERN) – including the Large Hadron Collider (LHC); and
- The Joint Institute for Nuclear Research (JINR).

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 twenty-first century.

The National Equipment Programme (NEP)

The NEP makes funds available for the acquisition, upgrade or development of state-of-the-art research equipment to South African public research institutions. This investment is a critical enabler for internationally competitive research in South Africa.

Strategic Research Equipment Programme (SREP)

The Strategic Research Equipment Programme (SREP) funding instrument 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. The funding instrument is intended to complement the NEP and SARIR in providing appropriate levels of strategic research equipment and infrastructure.

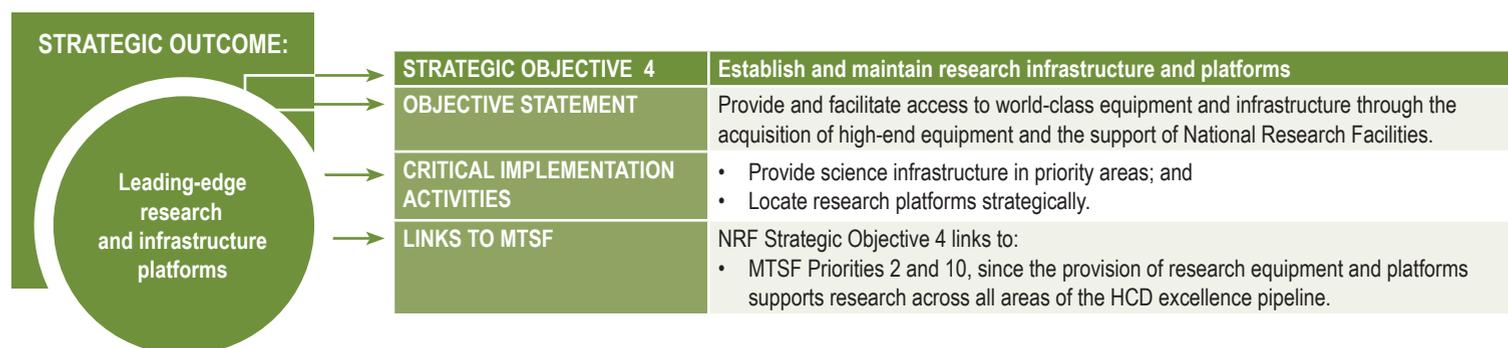
The NRF approved the first grant funding of R35 million to a consortium led by the University of the Western Cape (UWC) for a nuclear spectrometer named GAMKA to be built and hosted at iThemba LABS. The acronym GAMKA stands for Gamma-ray spectrometer for Knowledge in Africa and is also the Khoisan word for "lion." The spectrometer provides state-of-the-art equipment that will allow the consortium members, viz., Stellenbosch University, University of the Western Cape, the University of the Witwatersrand (Wits), University of Zululand and iThemba LABS, as well as other researchers across the country, to study a wide range of nuclear properties and phenomena at a level that will allow for major contributions to the field of nuclear physics and astrophysics. Construction of the GAMKA spectrometer will commence in the 2019/20 financial year.

Over the MTEF, the NRF will invest an amount of R354 million in the provisioning of cutting-edge research equipment and access to international research infrastructure platforms. As a result of a zero allocation for NEP and SRE in the 2018/19 financial year, the NRF was unable to make new awards for 2018/19. The impact of these reductions on the research enterprise would have been substantial as the NRF is only able to service 41% of the demand

for equipment support. However, a reprioritisation of unspent infrastructure funds by the DST in February 2019, enabled the NRF to award 27 new NEP grants in the 2018/19 financial year. The 2019/20 allocation has therefore become available for the NRF to open a call for NEP and SRE applications in

the 2019/20 financial year. The awards made in 2018/19 will have a positive impact on the Key Performance Indicator (KPI) achievements over the 2020/21 to 2025/26 financial years.

Table 15a: Programme 3 – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 4



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of users of equipment that were funded by the NEP and NNEP programmes	2 360	2 950	2 881	2 641	2 300	2 252	2 014	1 976
Number of publications emanating from the usage of equipment funded by the NEP and NNEP programmes	1 105	779	908	695	2 900	593	530	520
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Platform and infrastructure provision	251.516	345.366	255.792	77.875	170.0	90.0	94.5	

Table 15b: Programme 3 – Quarterly targets for 2019/20 – Strategic Objective 4

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of users of equipment that were funded by the NEP and NNEP	Annually	2 252	-	-	-	2 252
Number of publications emanating from the usage of equipment funded by the NEP and NNEP	Annually	593	-	-	-	593

11 PROGRAMME 4 – NATIONAL RESEARCH INFRASTRUCTURE PLATFORMS

11.1 SITUATIONAL ANALYSIS

The European Union Commission defines research infrastructure as “...facilities, resources and services used by the science community to conduct scientific research and foster innovation”. The reference to research infrastructure platforms conceptually emphasises the connections between physical, intellectual and process (such as networking) elements of infrastructure. Providing access to adequate and relevant research infrastructure platforms is a key enabler of globally competitive research, development and innovation. Programme 4 supports and coordinates the provision, by the NRF, of research infrastructure platforms to the South African research community via a variety of modalities. This enables the optimisation of synergies, collaborations and shared services (where appropriate) across the various research infrastructure platforms. National Research Facilities are mandated to provide infrastructure that is unique, requires highly-qualified operators and is beyond the capacity (financial and/or technical) of an individual university or public research-performing organisation.

11.1.1 RESEARCH INFRASTRUCTURE AND CORRESPONDING PLATFORMS

Figure 14 is a schematic of the research infrastructure and corresponding platforms related thereto as adopted in the South African Research Infrastructure Roadmap (SARIR) initiative. SARIR, drawing from international experience classifies infrastructure into four broad categories, namely:

- Single-sited global research infrastructures are unique, geographically-localised facilities where governance is fundamentally international in character. The NRF enables access to single-sited research infrastructures through:
 - the brokering of bilateral and multilateral agreements with the support of the DST;
 - supporting inter-institutional collaborative agreements; and
 - the provisioning of mobility grants to allow dynamic exchange among local and international researchers and postgraduate students.

- Globally distributed research infrastructures constitute national or institutional nodes that are part of a global network where governance is fundamentally international in character. While there is an element of mobility, the primary commodity is access to and exchange of data. In this context, the NRF supports the sharing of collection and observation data with global science networks through the research infrastructure platforms it either hosts or supports financially; and
- National facilities of global interest are facilities with unique capabilities that are significant contributors to the global research network. The NRF is mandated to support and maintain the National Research Facilities in South Africa as declared under the National Research Foundation Act (Act 23 of 1998) as amended.



Figure 14: Research infrastructure platforms in the context of global collaboration



11.1.2 Research and Data Platforms

In a technologically advanced and connected world, the use of advanced ICTs to support research (referred to as e-Research) is necessarily obvious and mandatory. e-Research makes research processes much more collaborative, efficient and effective, particularly through the creation, analysis and sharing of data. The creation, analysis and sharing of data is made possible through the establishment and maintenance of Data Platforms that are enabled by:

- Networking infrastructure;
- Computational infrastructure;
- Data pipeline management infrastructure; and
- Staging and analytical infrastructure and interfaces.

Research conducted by large-scale infrastructure platforms generates very large volumes of data. It is therefore becoming essential to manage the protocols of hosting, securing, accessing and preserving such data to provide researchers with findable, accessible, interoperable and re-usable (FAIR) data, ideally in support of open science.

Over the MTEF period, the NRF, through its various business units, will facilitate and participate in dialogues and initiatives aimed at continuing the development of the requisite capacity, expertise and infrastructure towards the establishment of national e-Research and Data Platforms. In this respect, for example, SRAO has been working on data solutions to process the vast quantities of data produced by MeerKAT and later the SKA. This is being done in collaboration with and participation in the Inter-University Data Intensive Astronomy Initiative (IDIA). The creation of the data pipeline and the processing of the data therein requires very high-performance, central supercomputing, for which SRAO collaborates with the Centre for High Performance Computing (CHPC).

11.1.3 National Research Facilities

Of the modalities of support for research infrastructure platforms provided by the NRF and as described above, the support and maintenance of the National Research Facilities represents the most extensive, complex and resource-intensive aspect.

In terms of the proposed amendments in the NRF Amendment Bill 2016, a National Research Facility is an institution that provides unique and substantial infrastructure, capabilities and services for competitive research, innovation and HCD in Science Engineering and Technology (SET). The main criteria for the evaluation and establishment of National Research Facilities are:

- A unique position in South African knowledge production;
- The offer of core technologies, research methodology or data pools/collections that should live up to international standards;
- Goals that are well-aligned with the overall objectives of the NSI, especially with regard to the diffusion of new knowledge;
- A critical mass of equipment, skills and users;
- Potential for networking and for attracting international collaborators to South Africa;
- The ability to provide opportunities for HR development, with special efforts to involve researchers from formerly disadvantaged communities; and
- The ability to provide opportunities for the advancement of science and for the interface between science and society.

National Research Facilities are expected to provide research infrastructure that is unique, requires highly qualified operators and is beyond the capacity (financial or technical) of an individual university or public research performing organisation/institution.

The NRF currently supports and maintains a suite of National Research Facilities clustered according to the following areas:

- Nuclear science cluster as represented by iThemba LABS;
- Biodiversity and environmental science cluster represented by SAIAB and SAEON; and
- Astronomy and geodetic sciences cluster represented by SAAO and SRAO.

11.2 NUCLEAR SCIENCE

iThemba LABS is the multidisciplinary nuclear research facility on the African continent that is based on development, operation and use of particle accelerators and related research equipment. The accelerators are used to accelerate charged particles and ions for basic nuclear and hadron physics research, and radioisotope R&D. This includes the production and supply of radioisotopes to the medical sector, radiobiology research related to particle therapy and applications such as radiation hardness testing for the testing of electronic components used in satellites and for detector calibrations.

The research agenda off iThemba LABS is underpinned by a number of research platforms driven by particle accelerators, which include:

- **Nuclear Physics and Nuclear Medicine Laboratory** utilises the accelerated particle beams from the separated sector cyclotron (SSC) that provides for a wide variety of nuclear physics, nuclear astrophysics research and radioisotope production. The laboratory also makes use of the 11 MeV cyclotron, which is dedicated to the production of the radioisotope Fluorine-18 for supply to local nuclear medicine facilities;
- **Accelerator Mass Spectrometry Laboratory** utilises an EN Tandem accelerator for accelerator mass spectrometry (AMS), ion beam analysis

(nuclear microprobe and a spectrometer for heavy ions), as well as a beam-line devoted to low-energy nuclear reaction physics and astrophysics undertaken with radio-carbon, beryllium-10 and aluminium-26 analyses; and

- **Materials Research Laboratory** utilises a 3 megavolt (MV) tandem accelerator equipped with end stations for ion beam analysis techniques to conduct research mainly on nanoscience and nanotechnology, using material characterisation and modification with radiation and scanning probe microscopy.

Over the MTEF period, iThemba LABS will focus on the implementation of a Long-Range Strategy Development Plan to enhance capabilities as follows:

- Establishment of new research infrastructure and capabilities, part of which is referred to as the South African Isotope Facility (SAIF), consisting of two components, namely:
 - the Accelerator Centre for Exotic Isotopes (ACE Isotopes) dedicated to isotope production and research related to production and use of radioactive isotopes; and
 - establishment of a Rare Ion Beam (RIB) facility, the Accelerator Centre for Exotic Beams (ACE Beams).
- Upgrading the AFRODITE array with 17 new Clover High-Purity Germanium and BGO (Bismuth Germanate) detectors, which will be acquired by 2019.

Figure 15: iThemba LABS research infrastructure platforms



The ACE Isotopes require the acquisition and installation of a new 70 MeV cyclotron to enable more beam time for research and to contribute towards the diagnosis and control of cancer, which will have societal impact.

The establishment of an RIB facility will realise the iThemba LABS strategy to build a Low-energy Rare Ion Beams (LERIB) facility that will produce low-energy, radioactive ion beams. LERIB will allow astrophysics research to be carried out to understand the strong interaction and nucleosynthesis to complement observational studies carried out by the SKA. LERIB is expected to be commissioned by 2021 and ACE Isotopes in 2022. This will complete phase 1 of SAIF. Phase 2 will commence in 2023 or later, depending on funding.

11.2.1 Nuclear Science Contribution to Strategic Objective 1: Promote Globally Competitive Research and Innovation

The unique capabilities of iThemba LABS position it to be a contributor to world-class, multidisciplinary research, including a myriad of training opportunities to South Africans in a wide range of accelerator-based science fields. iThemba LABS collaborates with 19 of the 25 universities in South Africa and is the point of coordination for a number of significant global collaborations, including the agreements with CERN and JINR.

Increase and Provide Support for HCD

During the MTEF period, staff at iThemba LABS will supervise or co-supervise, on average 120 postgraduate students per year from South African universities, the rest of the continent and all over the world. A South African Institute of Nuclear Technology and Science (SAINTS) will be established to consolidate all the training initiatives driven by iThemba LABS. Staff learning and development initiatives; courses for masters and doctoral programmes; short courses for professional development; and international schools and workshops will be coordinated under the umbrella of SAINTS. iThemba LABS will collaborate with the French National Institute for Nuclear Science and Technology (INSTN) to develop training courses for SAINTS.

The iThemba LABS masters programme in nuclear and material sciences (MANuS/MatSci Programme) in partnership with UWC and UniZulu, will be expanded to include the Botswana International University of Science and

Technology. As the premier African facility for sub-atomic physics, opportunities to expand training opportunities to the rest of the continent are explored continuously. The new tandemron accelerator will provide another opportunity for postgraduate student training projects across Africa.

Research staff at the facility present lectures on radiation oncology and radiation biology, as well as courses for radiographers and medical physicists at HEIs. Opportunities are also provided to students enrolled at Technical and Vocational Education and Training (TVET) colleges. Training initiatives include domains such as engineering, IT, chemistry and radiography. Engagements are underway for the formation of a partnership with the College of Cape Town where iThemba LABS will offer practical experience, with the College providing the theoretical aspects.

Support Multidisciplinary Research and Innovation

This aspect is carried out using accelerated particle beams and associated technologies in materials research, sub-atomic physics and medical radiation biophysics, including Tandem and Accelerator Mass Spectrometry (TAMS).

Sub-atomic physics

The on-going research in this domain includes basic and applied nuclear physics as outlined below:

- The K600 spectrometer concentrates on research that is accessible by studying scattering and reactions produced by light ions at energies of up to 200 MeV/u. The infrastructure investment to improve the K600 spectrometer coupled to the gamma-ray detectors has allowed users to investigate clustering in nuclei and the properties and decay modes of giant and pygmy resonances. The operation of the spectrometer will continue to provide unique opportunities, particularly with the recent addition of the capability to measure in coincidence both particles and gamma rays with high-energy resolution;
- The AFRODITE array of gamma detectors focuses on gamma-ray spectroscopic studies of nuclear structure, typically with heavy ion beams at up to a few tens of MeV per nucleon to focus on nuclear structure of exotic shapes and decay modes in nuclei. The combination of AFRODITE and ALBA arrays coupled to ancillary beam detectors will focus on nuclear

astrophysics studies for the photon strength function to capture cross sections relevant to nucleosynthesis, using normal and inverse kinematic reactions;

- iThemba LABS staff participate in the ALICE collaboration at the CERN LHC where they contribute towards the maintenance and operation of the Forward Muon Spectrometer and related physics topics. These activities fall under the ALICE Physics Working Group. Staff also contribute towards the ALICE-run coordination and central systems at the LHC Point 2 where the ALICE detector is located. The group, furthermore, contributes towards the ALICE upgrade programme, which facilitates technology transfer to scientists and technical staff to implement similar infrastructures locally. The upgraded detector will allow separation of the charm and beauty hadrons at forward rapidity, allowing for exclusive measurement of their yields; and
- Over the reporting period, projects in the environmental radiation laboratory include measurement to determine the amount of uranium in coal mines, using conventional gamma-ray spectrometry and/or neutron activation analysis. Measurement of radon in mines and water from hot water springs, radioactivity levels around nuclear power stations and air pollution studies in and around industrial areas will be carried out throughout the MTEF period.

Nuclear medicine

Research in this domain is driven by the convergence and exploitation of expertise in the fields of radiation biology, medical physics, radiochemistry and applied mathematics for the development of new Theranostics (i.e. combining therapeutic and diagnostic capabilities) radioisotopes. Radiation biophysics research will be done by exposing different biological systems to different biological modalities, with a range of energies providing insights that will be of fundamental importance to a range of applications in hadron therapy and radiation protection. Studies will also be extended on radiolabeled compounds to support the development of novel radiopharmaceuticals with the framework of the SAIF project and existing initiatives such as the Nuclear Technologies in Medicine and Biosciences Initiative (NTeMBI) and the Nuclear Medicine Research Infrastructure (NuMeRI).

The future R&D programme will focus mainly on the development of single-photon emission computed tomography (SPECT) and positron emission tomography (PET) radioisotopes, as well as alpha-particle-emitting isotopes.

iThemba LABS contributes to projects funded by the NTeMBI. These include:

- The development of novel radio-surgical methods to study in vivo radiation damage in small tissue volumes, carried out in collaboration with the Catholic University of Louvain in Brussels, Belgium, and the University of the Free State (UFS);
- The study of radio-sensitisation of neutron and photon cellular damage using gold nanoparticles in collaboration with UWC;
- Investigation of gene mutations in relation to radiation-induced apoptosis by photons and neutrons, and to study DNA repair foci as markers for radiation bio-dosimetry, with the Cape Peninsula University of Technology (CPUT) and North-west University (NWU);
- The study of chromosomal radio-sensitivity in cervical cancer patients, triple negative and young breast cancer patients, and Fanconi anaemia patients, as well as the influence of HIV in human lymphocytes on neutron radiation; and
- Support of radiobiological detection of oncothermia to chemoradiation therapy in HIV-positive cervical cancer patients.

Radioisotope production

Research in the isotope area is based on the development and transfer of technology that involves targetry development and modelling, chemical processing, radiolabeling, production, dispensing and quality control processes together with current good manufacturing practice (cGMP) principles. In this instance, iThemba LABS will perform activities on radioisotope production as follows:

- Development of new tracers with ^{123}I , ^{68}Ga and ^{18}F ;
- Improved and optimal production processes with ^{68}Ge chemical separations and $^{68}\text{Ge}/^{68}\text{Ga}$ generator manufacture; and
- The $^{82}\text{Sr}/^{82}\text{Rb}$ project that involves the development of Rb metal targets and its chemical processing. This project is expected to be completed in the next two years and could realise an increase in revenue relative to current ^{82}Sr sales.

11.2.2 Nuclear Science Contribution to Strategic Objective 2: Enhance Strategic International Engagements

Promote System-wide International Engagement and Exploit International Research Platform Access

iThemba LABS has established collaborative networks with major international laboratories and a number of HEIs formalised through contracts and/or memoranda of understanding. A large number of informal collaboration agreements exist, some supported by NRF and DST bilateral funding programmes. These agreements, that benefit the South African research community, normally serve to fund research visits and collaborative research (from and to South Africa), as well as attendance at international events. These agreements include, among others:

European Centre for Nuclear Research (CERN)

The SA–CERN Consortium (which includes SA collaborators at ATLAS, ALICE, ISOLDE and Theory) collaboration has contributed to the formation of a South African research partnership, effectively creating a distributed research laboratory across South Africa, as well as the establishment of a grid computational network linking all physics institutes. The SA–CERN Consortium continues to strengthen the local research community by creating links between research institutes and academia in South Africa and the rest of the world.

Joint Institute for Nuclear Research (JINR)

The key objectives of this collaboration are the promotion of joint research for SA–JINR researchers, of HCD with emphasis on student training and technology, and knowledge transfer. Due to associate membership at the JINR, South Africa has observer status on the Committee of Plenipotentiaries (CoP) of the governments of JINR member states, which is the highest decision-making body of the Institute. The funding transferred to JINR is used for hosting SA researchers and students in Dubna, Russia; infrastructure development; student practice; and mobility of JINR researchers to SA. The local portion of the SA–JINR budget is used to provide mobility support for SA researchers and students to Dubna, Russia, as well as small research grants for locally-based SA–JINR collaborative projects. iThemba LABS, as the largest research infrastructure in sub-atomic physics on the African

continent, will coordinate the collaboration with JINR on behalf of the African research community.

South African Institute of Nuclear Technology and Science (SAINTS)

iThemba Labs intends to consolidate training programmes by establishing SAINTS. SAINTS will offer taught MSc courses to complement the current MSc programmes at South African universities with the aim of addressing the practical and theoretical skills required for MSc and PhD programmes. iThemba LABS currently collaborates with 13 institutions in Africa. Over the MTEF period, this collaboration will be formalised and supported through SAINTS programmes in which iThemba LABS will play the role of ‘gateway’ to nuclear studies on the continent. Through SAINTS, iThemba LABS will contribute to the objectives of STISA, 2024, for which specific synergies are noted between the science granting councils’ initiatives and the objectives of SAINTS. Over the MTEF period, these synergies will continue to be explored.

11.2.3 Nuclear Science Contribution to Strategic Objective 4: Establish and Maintain Research and Infrastructure Platforms

iThemba LABS is the only accelerator-based nuclear facility in Africa and is classified as providing single-sited global research infrastructure in the context of SARIR. Over the MTEF period, iThemba LABS will continue to provide leading-edge research infrastructure to the continent and the world. In terms of its contribution to strategic objectives, iThemba LABS will:

- Adopt a new strategy for infrastructure provisioning in support of globally competitive research and HCD. This will result in the creation of a South African Isotope Facility based on:
 - the establishment of the ACE Isotopes, which will allow the migration of the radioisotope production programme from the existing particle accelerator (the SSC) to a new cyclotron. This will release capacity on the existing SSC to be entirely devoted to the transdisciplinary research agenda of the facility, thus meeting the requirements of its national and international stakeholders. This will include the supply of isotopes to local and international markets, which will increase fivefold; and
 - the development of the (ACE Beams, which will provide accelerated, artificially produced isotopes for research. The production of these

exotic beams will invigorate basic and applied research from innovative cancer therapy treatment modalities to understanding the origin and creation of chemical elements in the universe.

- The implementation of the strategy requires the acquisition of a dedicated, high-beam current 70 MeV cyclotron. The necessity of a new 70 MeV cyclotron was informed by a robust assessment of the facility operations

and science plan. Over the MTEF period, the facility aims to work towards funding Phase 1 of the project, i.e. ACE Isotopes. In addition, the Rare Ion Beam Target and Ion source, funded from the Strategic Research Infrastructure Grant (SRIG) programme (R32 million), will be installed and developed into a LERIB facility.

Table 16a: Nuclear science – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 1



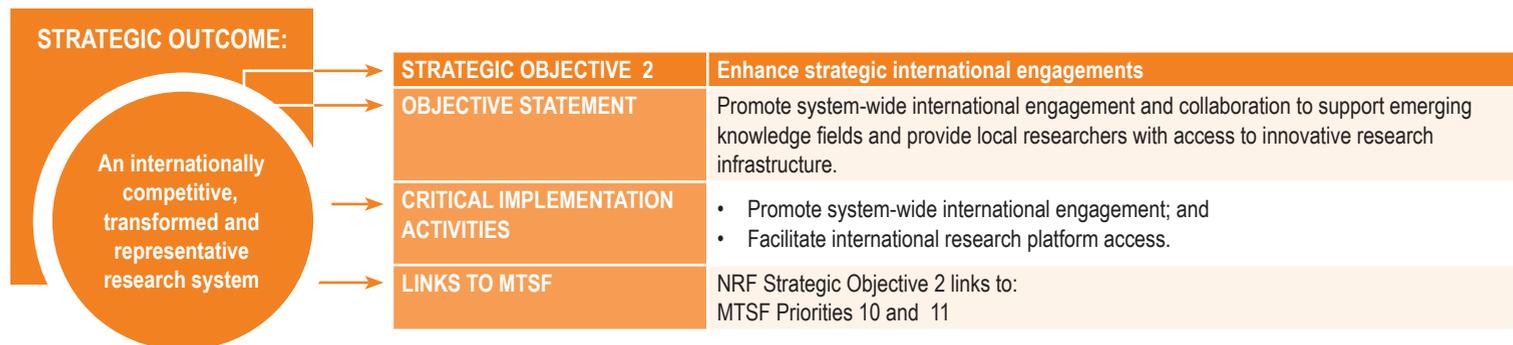
INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of postgraduate students supported by National Research Facilities	-	-	242	289	-	100	175	187
WoS publications at the National Research Facilities	-	-	172	150	-	250	266	277
Number of users of National Research Facilities	-	-	206	505	-	342	363	386
Citation impact of National Research Facility outputs (annual cumulative)	--	--	1.61	1.64	--	1.65	1.67	1.70

BUDGET (R'000)	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22
Competitive research	98 295	86 555	85 600	90 600	96 300

Table 16b: Nuclear science – Quarterly targets for 2019/20 – Strategic Objective 1

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of postgraduate students supported by National Research Facilities	Quarterly	100	92	92	99	100
WoS publications at the National Research Facilities	Quarterly	250	85	150	210	250
Number of users of National Research Facilities	Quarterly	342	280	300	320	342
Citation impact of National Research Facility outputs (annual cumulative)	Annually	1.65	-	-	-	1.65

Table 17a: Nuclear science – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 2



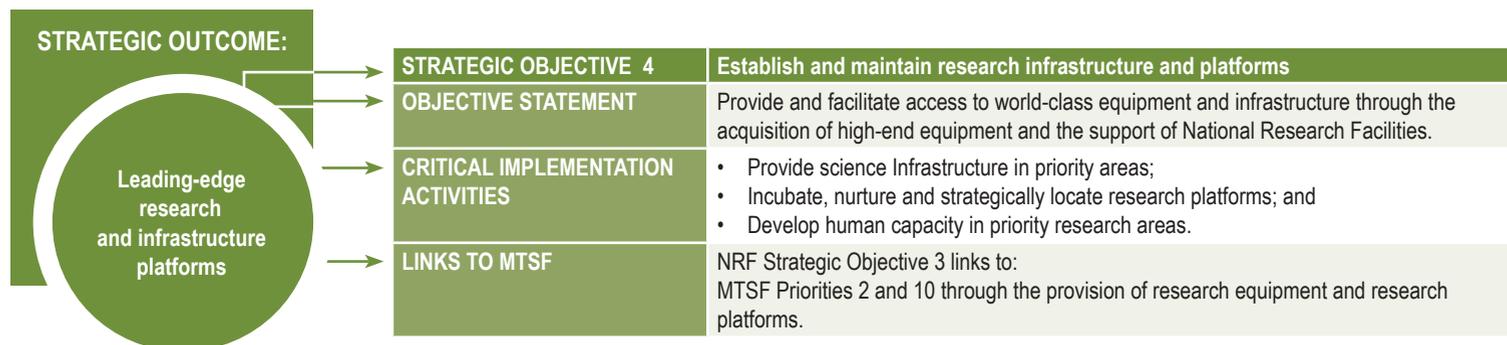
INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of joint international agreements at the National Research Facilities	-	-	25	40	-	20	21	22

BUDGET (R million)	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22
Internationalisation and mobility	11 738	25 492	17 561	18 436	19 446

Table 17b: Nuclear science – Quarterly targets for 2019/20 – Strategic Objective 2

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of joint international agreements at the National Research Facilities	Quarterly	20	19	19	19	20

Table 18a: Nuclear science – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 4



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Total infrastructure investment in National Research Facilities (R'000)	-	-	66 500	45 450	-	183 902	180 881	190 835
BUDGET (R million)	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22			
Platform and infrastructure provisioning	196 954	186 405	183 900	180 900	190 900			

Table 18b: Nuclear science – Quarterly targets for 2019/20 – Strategic Objective 4

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Total infrastructure investment in National Research Facilities (R'000)	Quarterly	183 902	46 075	87 412	115 711	183 902

11.3 BIODIVERSITY AND ENVIRONMENTAL SCIENCES

The NRF has two national facilities operating in this area of research, namely SAIAB and SAEON. The complementary nature of their science agendas and the commonality of purpose allow these facilities to work closely in support of achieving the strategic objectives in this research field.

The NRF has been identified as the most suitable host for the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) and the Shallow Marine and Coastal Research Infrastructure (SMCRI) under the SARIR programme. It is proposed that both be embedded in SAEON, as its existing six nodes overlap with both these infrastructures and will be instrumental in their rapid establishment and running. The NRF will have fiduciary control over both SMCRI and EFTEON through its Board, and the research infrastructures will be required to adhere to its policies and regulations.

EFTEON will provide impetus to SAEON's eco-hydrological research with a focus on monitoring the flow of water in streams and rivers within the major catchments in the country. The programme will establish a South Africa-wide platform for interdisciplinary research on ecohydrology to understand the impact of land use, land management and climate change on the supply of fresh water. Through EFTEON, atmospheric carbon fluxes will also be monitored to gain insight into these cyclical processes.

SMCRI aims to enhance marine ecosystem-wide multidisciplinary research. SMCRI will involve the deployment of a network of oceanographic sensors which, together with the collection of lower trophic data (phytoplankton and zooplankton), will enable researchers to better interpret and contextualise results. Through SMCRI, both SAEON and SAIAB will collaborate with other research infrastructure projects such as EFTEON and the envisaged Marine and Polar Research Infrastructure.

South African Institute for Aquatic Biodiversity (SAIAB)

SAIAB provides scientific leadership and expertise in aquatic biodiversity that is vital to national interests when dealing with issues arising from the exponentially increasing pressures of human population growth and development. The facility focuses on the full spectrum of African aquatic biodiversity, from marine offshore to continental freshwater catchments. The SAIAB research agenda includes:

- Conservation biology and ecology, which focus on understanding aquatic biodiversity to inform the conservation of those resources; and
- Molecular biology and systematics, which is the exploration and description of Southern African biodiversity from the molecular to a faunal level.

SAIAB runs the African Coelacanth Ecosystem Programme (ACEP), which is a marine research platform that provides access to research infrastructure and associated funding to the research community to undertake research along the east coast of South Africa. ACEP is a flagship programme of the DST and the NRF. Its key partners are the Department of Environmental Affairs (DEA) (Oceans and Coasts); DAFF and SAEON. To ensure an open, transparent and competitive funding structure, the NRF distributes an open research call every three years. The ACEP marine platform enables successful applicants to sample the entire coastal ecosystem from physical oceanography, marine geology, phytoplankton and zooplankton to animals burrowing into the marine sediment, fish, marine mammals and birds from near-shore to 40 nautical miles offshore.

SAIAB actively engages in a range of national research interventions and provides research that is relevant to a range of different national priorities in conjunction with provincial conservation agencies, such as Cape Nature and national departments such as DEA (Oceans and Coasts), DAFF and the Department of Water and Sanitation (DWS) through the Water Research Commission (WRC). Recent strategic interventions in which SAIAB has played a significant role are:

- Operation Phakisa – Oceans Economy (DST);
- Formulation of the Marine and Antarctic Research Plan (DEA);
- Drafting of the South African Marine Research Strategy (DEA);
- Steering Committee of SARIR;
- Partner in the SARIR South African Marine and Coastal Research infrastructure programme (SMCRI);
- Partner in the Natural Science Collections Facility (NSCF);
- National Biodiversity Assessment in partnership with SANBI; and
- National Shale Gas Strategic Environmental Assessment (SANBI)

SAIAB's research infrastructure and equipment are clustered into three main areas:

Marine Infrastructure

- **Coastal Craft Fleet:** Specially designed boats (9 – 15m) capable of working in South African marine conditions. The vessels are based in Port Elizabeth, Makhanda (formerly Grahamstown) and Durban. A suite of specialised marine equipment is operated off each of these vessels. The fleet has a highly-trained crew of skippers, instrument operators and deckhands.
- **Marine Remote Imagery Platform (mar-RIP):** A suite of remotely (tethered and untethered) imagery platforms that operate between 1 and 800 m. These units take high-definition pictures and video feed. mar-RIP holds the national archive of images.
- **Acoustic Telemetry Array Platform (ATAP):** ATAP is South Africa's contribution to the international array run through the global Ocean Tracking Network (OTN). The platform is made up of over 100 *in situ* receiver stations on the seabed between the depths of 1m and 80m. The receivers are distributed between Cape Town and Mozambique. ATAP manages the South African database that links with the OTN data system.
- **Marine Geophysics Platform:** A multi-beam sounder for seafloor mapping (5 – 200m) geo-positioning referencing system. Both systems are fitted on the RV Phakisa but can also be used off RV Jahleel.

Collections and Associated Specialist Laboratories

- **National Fish and Diatom Collections:** Fish and diatom collections are housed in a customised facility of international standard. Collections of other taxa are growing. All collections are databased and actively curated.
- **Aquatic Genomics Research Platform (AGRP):** A molecular laboratory that is equipped to do most current genetic and molecular analyses, including next-generation sequencing.
- **Aquatic Ecophysiology Research Platform (AERP):** The ecophysiology laboratory specialises in temperature, salinity and carbon dioxide manipulated physiology studies. The laboratory aims to answer specific climate-change-related questions in respect of organism physiology.

Information Platform

- **IT server backbone:** Server storage space that holds a significant amount of SAIAB research and collections data. This platform is used by various users.
- **Margaret Smith Research Library:** A specialised aquatic science research library and archive.
- **Aquatic Biodiversity Informatics – Databases:** NRF-SAIAB manages and hosts some internationally and nationally important databases, e.g. the national fish collection – specify database; the national telemetry database; and the national aquatic video archive.

South African Environmental Observation Network (SAEON)

SAEON is a comprehensive, sustained, coordinated and responsive national network of *in situ* environmental observatories that delivers long-term reliable data for scientific research, which informs decision making for a knowledge society and improved quality of life. SAEON offers public value through long-term, multi-disciplinary observation programmes, research infrastructure and platforms that are designed to clarify earth system dynamics and changes over multiple scales, and to distinguish between natural and anthropogenic

environmental change. Public value is also created through the development of open-access data systems and tools. The entity is managed as a National Research Facility, though discussions to declare it as such officially are pending.

The mandate of SAEON is to serve as the national platform for detecting and translating environmental change, and for predicting the impact of such change on terrestrial and marine ecosystems. SAEON carries out this mandate by establishing and maintaining state-of-the-art observation and monitoring sites and systems; driving and facilitating research on long-term change in respect of South Africa's terrestrial biomes, coastal and marine ecosystems; developing and maintaining collections of accurate, consistent and reliable long-term environmental databases; promoting access to data for research and/or informed decision making; and contributing to capacity building and education in environmental sciences.

Since the Southern African indigenous biodiversity, landscapes and oceans are continuously changed by diverse and adjoining land uses such as mining, farming, conservation, forestry, urban sprawl, communal resource management and fishing, time-series data covering the spectrum of spatial scales is essential for reliable observation of environmental changes. While some of these are slow, others may be sudden. Further, advanced climate change is already being observed. However, predictive capabilities in respect of impact remain uncertain. Rural communities are particularly vulnerable to climatic variability, which is often aggravated by unsustainable agricultural and fishing practices.

SAEON consists of six geographically dispersed observation nodes as outlined in Figure 17 on the next page.

Figure 16: Examples of SAIAB research infrastructure



Figure 17: SAEON nodes



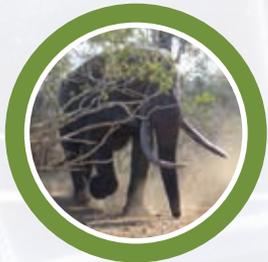
Arid Lands Node

Conducts observations on the ecological effects of global change and land-use changes across the hyper-arid and semi-arid western half of South Africa.



Elwandle Coastal Node

Undertakes long-term monitoring and research on South Africa's coastal zone. The Node works on detecting, understanding and predicting environmental change in South Africa's coastal ecosystems.



Ndlovu Node

Focuses on understanding environmental change occurring in the savanna biome of South Africa. Based in the Kruger National Park at Phalaborwa, the Node runs a number of long-term research projects in the north-eastern part of the country, national parks, private conservation areas, mining areas and rural rangelands



Grasslands-Forests-Wetlands Node

Conducts *in situ* monitoring to detect human-induced global change and understand mechanisms and processes allied to such changes in these biomes and within South Africa. The intention is that this information will provide insight that will improve our understanding of anthropogenic forcing and what it means for society.



Fynbos Node

Aims to understand the impact of global change on the fynbos ecosystem, one of six floral kingdoms in the world. Fynbos ecosystems are critical to society in that they fulfil a number of functions, including carbon storage, nutrient cycling and the interception, retention and filtration of fresh water.



Egagasini Node

Works with a wide range of partners to combine data, resources and knowledge of the oceans surrounding South Africa, their ecosystems and biodiversity to comprehend and fully appreciate their role in climate change and the impact of climate change on the resources of the oceans.

11.3.1 The Contribution of Biodiversity and Environmental Sciences to Strategic Objective 1: Promote Globally Competitive Research and Innovation

Increase and Provide Support for HCD

South African Institute for Aquatic Biodiversity (SAIAB)

One of SAIAB's key successes is its supervision programme in support of postgraduate students. SAIAB has developed a thriving postgraduate school with an average of 50 students being supervised every year. Growth of the school has been significant over the years but it has now reached full capacity, given the size of the facility. The key objective over the MTEF period is to continue to transform the student demographics while continuing to focus on excellence.

Over the MTEF period, SAIAB will focus on the following:

- The ACEP Phuhliisa programme: this is an external transformation initiative that will be driven continuously by SAIAB with historically black universities (HBUs). ACEP has over 70 students registered at HBUs and actively supports 23 supervisors. The programme will be maintained at the four HBUs, namely the University of Fort Hare (UFH), Walter Sisulu University (WSU), UWC and UniZulu.
- The SAIAB postgraduate school: the objective of SAIAB is to continue with transformation of the student demographics and maintain the average number of 60 students being supervised per annum.
- The PDP: the PDP remains a key transformation tool at SAIAB with a focused intake of black students into the doctoral programme.

South African Environmental Observation Network (SAEON)

Postgraduate students at SAEON are engaged through specific internship and training programmes that focus on science, data and information management programmes. Postdoctoral fellows are also supervised under the PDP. The numerous SAEON sites across the country act as living laboratories for postgraduate field schools and field trips. In addition, SAEON's education outreach programme is focused on HCD. The

programme focuses on exposing school learners to the actual science of environmental observation, data collection, analysis, reporting and the dissemination of findings of hands-on projects.

Over the MTEF period, SAEON will focus on the following:

- Continuing with the SAEON education outreach programme; and
- Continuing with the SAEON Graduate Student Network, a structured forum for postgraduate students to facilitate interaction and sharing of ideas by way of multidisciplinary annual research training and conferencing.

Support Multidisciplinary Research and Innovation

For both SAEON and SAIAB to fully interpret the impact of climate and global change, transdisciplinary research across various knowledge domains is required.

South African Institute for Aquatic Biodiversity (SAIAB)

The primary science objective of SAIAB is to develop research projects and programmes on the sustainable management of African aquatic resources. A new science plan called *SAIAB and the National Development Plan (2030)* is being developed for further alignment with national initiatives, such as the DST white paper on science. This will create an emphasis and a closer compact between science and society. During the MTEF, SAIAB will continue to perform research under the three themes of taxonomy and bio-discovery; ecology; and global change. The research strategy is strongly aligned with knowledge requirements and supports several legislative instruments (e.g. the National Environmental Management; Biodiversity Act (Act 10 of 2004); the National Water Act (Act 36 of 1998); and the National Marine Living Resources Act (Act 18 of 1998); as well as policies such as the Small-scale Fisheries Policy and the Inland Fisheries Policy) to enable the country to manage its biodiversity assets in a sustainable manner.

SAIAB research informs research on a number of initiatives and its research outputs are appropriately targeted to deliver information at a national, regional and global level. Aquatic environments being studied by SAIAB span a broad spectrum, from freshwater to marine habitats, and from polar to tropical latitudes. Although there is a great deal of practical overlap and

similarity in the research approach across the range of aquatic systems, the research foci are traditionally often divided between freshwater and marine ecosystems.

Freshwater research

- **Taxonomy and bio-discovery:** An understanding of the diversity, taxonomy and systematics of Southern African freshwater taxa underpins all conservation and management initiatives associated with the taxa. It also provides insight into the drivers and processes that sculpt this rich biological heritage.
- **Ecology:** As societal concern about global biodiversity and food security increases, the conservation of the freshwater ecosystems to safeguard fish and fisheries is increasingly important. This will require proactive conservation and management interventions to be guided by knowledge on the link between aquatic ecosystems and their resilience to these stressors.
- **Global change:** More than 50% of the population in Africa live below the poverty line. Hence, the ecosystem services such as rivers, reservoirs and lakes are becoming increasingly important. Freshwater ecosystems and the services they provide are under increasing pressure from overfishing and human-induced stressors. Research in this realm will be centered on climate change and alien species invasion.

Marine research

- **Taxonomy and bio-discovery:** An understanding of the diversity, taxonomy and systematics of Southern African marine taxa underpins all conservation and management initiatives associated with the taxa. It also provides insight into the drivers and processes that shape this rich biological heritage. The advent of traditional DNA (Sanger) sequencing, genotyping and fragment analyses, and the recent and rapid advances in massive parallel, high-throughput, representative or complete genome sequencing (“Next-generation Sequencing”) have revolutionised biodiversity research. From single marker studies of species delineation and identification, multiple marker assessments of population genetic structure, kinship, genealogy or phylogenetic relationships, technological and bioinformatics advances and the “-omics” age have enabled a truly integrative approach towards an understanding of diversity from the gene to the ecosystem level.

- **Ecology:** While SAIAB’s core research strength remains ichthyology, the Institute does undertake broader aquatic biodiversity and ecology studies. The majority of these studies is linked to the DST’s PDP and thus not only broadens SAIAB’s research focus, but also meets redress and transformation goals. Research in this realm includes broader ecological and biodiversity studies, biotelemetry and fish movements, as well as larval ecology.
- **Global change:** Coastal ecosystems are highly impacted by human habitation and activities such as habitat destruction and overfishing. Africa is identified to be vulnerable to the impacts of climate change and an understanding of the impact of climate change on coastal and estuarine ecosystems is limited. Climate change research is therefore crucial for observations to detect patterns of change related to changing temperature, extreme events and habitat loss.

South African Environmental Observation Network (SAEON)

SAEON’s Core Science Framework guides its scientific outlook. Each of the SAEON nodes has developed its own science to the Core Science Framework. The Framework largely follows the DPSIR model (drivers, pressures, state, impacts and responses), which is a simplification of how the ecosystem changes as a result of cyclic interactions (Figure 19). The observation and monitoring of environmental change provide for incremental advances in the understanding of ecosystems and increase our ability to detect, predict and react to environmental change. The work encompasses intensive field- and oceanographic work by scientists and technologists. Repeated observations at fixed locations on land or moored/drifted instruments at sea are undertaken.

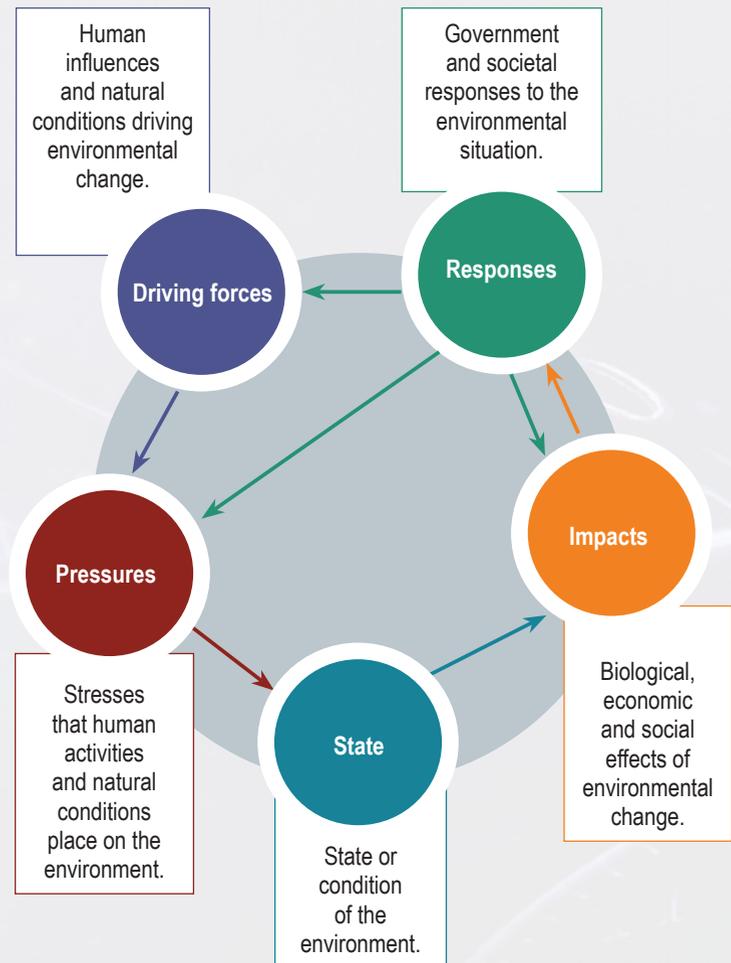
Over the past five years, SAEON has gradually made use of the SRIG to gain experience with a range of instruments that was previously unaffordable. When the SARIR, EFTEON and SMCRI projects were funded from 2017, SAEON was suddenly catapulted into the realm of environmental research infrastructures. The Elwandle Coastal Node was more than ready to adopt this role, given the predominant reliance on instrumentation to monitor physical parameters for oceanography. The terrestrial arm of SAEON, the Egagasini Offshore Node, has also been running the Agulhas Climate

System Array for a few years. SARIR did not award the marine and Antarctic infrastructure programme to SAEON, but SAEON will apply for a continuation of the Agulhas System Climate Array (ASCA) and the Egagasini Node will host the 2 Oceans platform of SMCRI around Cape Town.

In support of this multidisciplinary agenda, the following programmes are offered:

- EFTEON will provide impetus to SAEON's ecohydrological research, which already received a boost from SRIG. The programme focuses on streamflow monitoring and will establish a country-wide platform for interdisciplinary research on the ecohydrology of water catchments to understand the impact of land use, land management and climate change on the supply of fresh water. It will also monitor atmospheric carbon fluxes continuously to gain insight into cycling processes.
- Shallow Marine and Coastal Research Infrastructure will provide a platform to enhance ecosystem-wide research that is multidisciplinary in nature. The sensors that will be deployed by SMCRI are largely oceanographic in nature, which, together with the collection of lower trophic data (phytoplankton and zooplankton), will enable researchers from universities and other research entities to better interpret and contextualise their results.
- The coastal zone is also at the receiving end of terrestrial and offshore inputs, requiring SMCRI to work closely with collaborators and other research infrastructure (EFTEON) active in those domains. To fully understand the impact of climate and global change, transdisciplinary collaboration, especially with socio-economic and socio-ecological scientists and research infrastructure (e.g. health and demography research infrastructure) will be required.

Figure 18: Ecosystem changes as a result of cyclic interactions



11.3.2 The Contribution of Biodiversity and Environmental Sciences to Strategic Objective 2: Enhance Strategic International Engagements

The cluster has established numerous international partnerships, which have greatly facilitated the movement of researchers and students between South Africa and its international partners, thereby ensuring that research activities are at the forefront of the latest developments in these fields of study.

Promote System-wide International Engagement and Exploit International Research Platform Access

South African Institute for Aquatic Biodiversity (SAIAB)

The facility will pursue the following collaborations throughout the MTEF period:

- **Biotelemetry:** SAIAB researchers collaborate with scientists from Norway, Canada, France, Australia, the Seychelles and Mozambique to study the movement patterns and behaviour of many coastal fish species, sharks and stingrays, using acoustic telemetry technology. SAIAB also hosts the national ATAP (a partner of the Canadian-based OTN project) that collects data on aquatic animals tagged by no less than 12 local organisations, which also have global collaborations;
- **Freshwater fish ecology and fisheries:** SAIAB's scientific leadership and expertise in freshwater aquatic biodiversity are vital to the national interest when dealing with issues arising from the exponentially increasing pressures of human population growth and development. SAIAB has provided technical assistance to the Worldwide Fund for Nature (WWF-USA) for the development of a monitoring programme for Lake Niassa/Malawi reserve. SAIAB's freshwater team also cooperates with the Pennsylvania State University to facilitate the implementation of joint research projects on African freshwater fish and the transfer of Lake Malawi fish collections to SAIAB; and
- **Coastal and nearshore processes:** SAIAB has developed long-term collaborations in larval ecology with the University of Hong Kong and the Hakai Institute. This also includes the Sydney Institute of Marine Science, Australia, which coordinates the World Harbour Project – Green Engineering workgroup, including 16 international partners.

South African Environmental Observation Network (SAEON)

The facility has been a member of the International Long-Term Ecological Research Network (ILTER) for more than a decade. Staff at SAEON serve on the ILTER executive and science committees. SAEON envisages expanding its internationalisation and mobility programmes over the MTEF through collaborative research projects, exchange visits and joint publications as follows:

- Through the ILTER profile and the addition of the SARIR projects, founding membership of a Global Environmental Research Infrastructure along with partners from Europe, the United States of America (USA), China and Australia will be pursued.
- SAEON will play a greater role in international programmes such as the International Platform for Biodiversity and Ecosystem Services (IPBES); the Group on Earth Observation-Biodiversity Observation Network (GEOBON) and Future Earth and Africa's Chapter of the Global Earth Observation System of Systems (GEOSS).
- Membership of the ILTER will enable SAEON to expand its global footprint of greater international coherence on earth and environmental data systems.
- The impending membership of the COOP+ Board of Research Infrastructures will enable SAEON to participate in global discussions about alignment of research infrastructure.
- SAEON has not been able to coordinate scientific liaison within the African continent because of funding constraints. The inactive Environmental Long-term Observatories Network of Southern Africa (ELTOSA) will be resuscitated and this activity will be performed under the auspices of the DST. Offers have been received from long-term ecological research (LTER) in France and Portugal to assist with ELTOSA.

11.3.3 The Contribution of Biodiversity and Environmental Sciences to Strategic Objective 4: Establish and Maintain Research and Infrastructure Platforms

Provide Science Infrastructure in Priority Areas

South African Institute for Aquatic Biodiversity (SAIAB)

The facility provides three distinct research platforms to the research community. These are the ACEP Marine Infrastructure Platform; the Collections and Specialised Laboratories Platform (molecular, X-ray, biobank and ecophysiology); and the Information Platform (library and biodiversity informatics unit).

Over the MTEF period, SAIAB will acquire a new coastal research vessel, the RV Jahleel, to expand the established coastal craft fleet to have vessels in Durban, Port Elizabeth and False Bay. This expansion will be completed through SRIG funding.

South African Environmental Observation Network (SAEON)

In terms of its mission, SAEON develops and maintains research infrastructure for environmental observations and offers those as research platforms to users. SAEON will spend an amount of R150 million over the MTEF period to implement two SARIRs, namely EFTEON and SMCRI, as follows:

- EFTEON will give effect to eco-hydrological research that will focus on monitoring the flow of water streams and rivers within the major catchments in the country. This will establish a South African-wide

platform for interdisciplinary eco-hydrological research to understand the impact of land use, land management and climate change on the supply of fresh water. Atmospheric carbon fluxes will also be monitored to gain insight into these cyclical processes; and

- SMCRI aims to enhance the ecosystem through wide, multidisciplinary research that will require deployment of a network of oceanographic sensors that, together with the collection of lower trophic data (phytoplankton and zooplankton), will enable researchers to better interpret and contextualise results.



Table 19a: Biodiversity and environmental sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 1

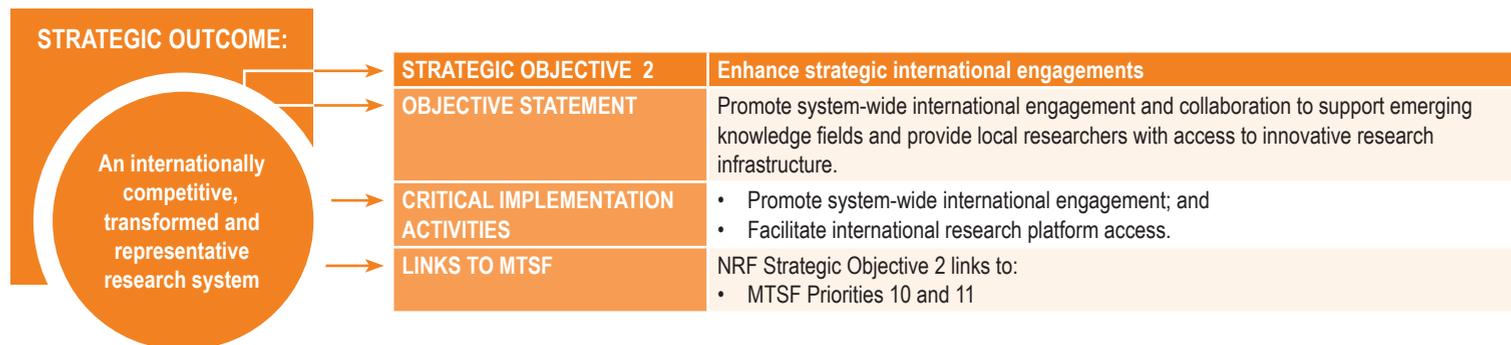


INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of postgraduate students supported by the National Research Facilities	-	-	262	235	-	143	152	162
WoS publications by researchers at the National Research Facilities	-	-	185	105	-	146	154	163
Number of users of National Research Facilities	-	-	495	562	-	390	401	413
Citation impact of National Research Facility outputs (annual cumulative)	-	-	1.29	1.2	-	>1.2	>1.3	>1.3
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Globally Competitive Research	58 781	112 176	128 775	93 605	105 120	97 144	102 487	

Table 19b: Biodiversity and environmental sciences – Quarterly targets for 2019/20 – Strategic Objective 1

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of postgraduate students supported by the National Research Facilities	Quarterly	143	105	120	134	143
WoS publications by researchers at the National Research Facilities	Quarterly	146	59	88	117	146
Number of users of National Research Facilities	Quarterly	390	197	274	321	390
Citation impact of National Research Facility outputs (annual cumulative)	Annually	>1.2	-	-	-	>1.2

Table 20a: Biodiversity and environmental sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 2

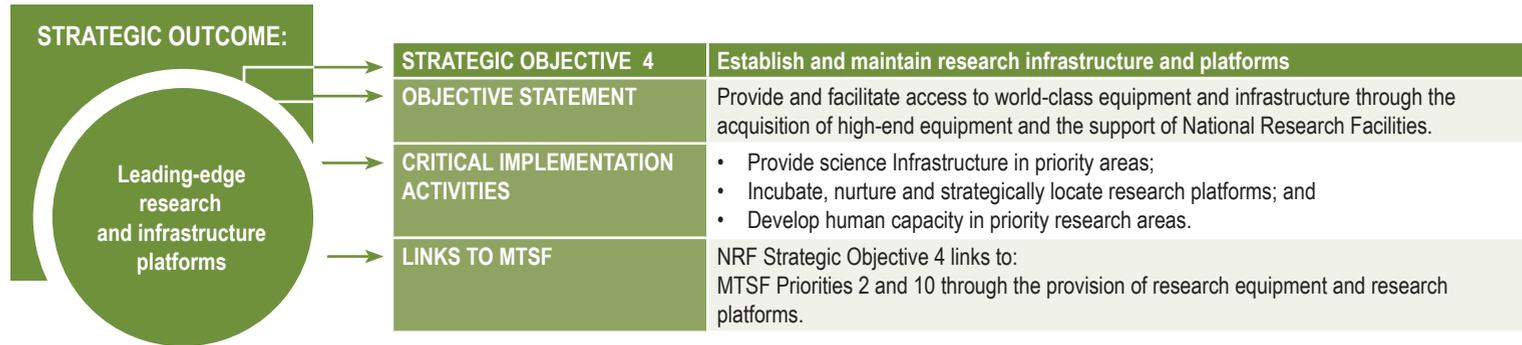


INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of joint international agreements at the National Research Facilities	-	-	16	21	-	22	23	24
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Internationalisation	1 064	311 859	1 108	1 770	1 000	730	770	

Table 20b: Biodiversity and environmental sciences – Quarterly targets for 2019/20 – Strategic Objective 2

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of joint international agreements at the National Research Facilities	Quarterly	22	17	18	21	22

Table 21a: Biodiversity and environmental sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 4



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Total infrastructure investment in the National Research Facilities (R '000)	-	-	56 370	41 000	-	47 220	29 580	28 180
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Platform and infrastructure provision	118 196	637 447	77 877	74 684	52 045	48 045	50 687	

Table 21b: Biodiversity and environmental sciences – Quarterly targets for 2019/20 – Strategic Objective 4

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets				
			1 st	2 nd	3 rd	4 th	
Total infrastructure investment in the National Research Facilities (R'000)	Quarterly	47 220	11 860	28 030	36 120	29 580	28 180

11.4 ASTRONOMY AND GEODETIC SCIENCES

The National Research Facilities in the astronomy and geodetic sciences cluster provide platforms in support of the National Strategy for Multiwavelength Astronomy (MWLA). SAAO provides optical astronomy observation capacity and is the premier optical and infrared facility on the continent. SARAQ is a geographically dispersed observatory focused on radio astronomy and geodesy. Furthermore, the South African Gamma-Ray Astronomy Programme (SA-GAMMA), co-ordinates the activities of South African and Namibian institutions in high-energy astrophysics and gamma-ray astronomy, in particular the participation in the High Energy Stereoscopic System (HESS) near Windhoek, Namibia, and in the preparatory phase of the Cherenkov Telescope Array (CTA).

Optical Astronomy

SAAO is the national centre 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 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. The research agenda at SAAO includes:

- Planetary astronomy, since the geographic position of Sutherland, combined with its high-speed instrumentation capabilities, make it a key location in the global context;
- Studies of interacting binary stars to advance the understanding of this class of object and provide the opportunity to explore a broad range of astrophysical phenomena, the most obvious being accretion;
- Transient events where SALT and the SAAO telescopes take full advantage of the opportunities that transients present from various ongoing and future surveys like Catalina Real-Time Transient Survey (CRTS), Pan-Starrs, Skymapper and the LSST;
- Nearby Milky Way companions – SALT provides unique opportunities to study this area in more detail;
- Galaxy formation and evolution – SALT and the Infrared Survey Facility (IRSF) instruments are used to address the question of how galaxies form and evolve;

- Exoplanets;
- Galaxy clusters – which permit studies on the growth of the most massive structures in the universe;
- Active galactic nuclei – as sources of variable extra-galactic objects; and
- Cosmology – here the work centres on the exploitation of type 1a supernovae discovered as part of international collaborations.

Radio Astronomy

SARAQ is a national facility of the NRF that houses the SKA SA project, Hartbeeshoek Radio Astronomical Observatory and the African VLBI Network (AVN). The SKA SA project is an international effort to build the world's most powerful radio telescope to eventually cover over a square kilometre of collecting area. The scale of the SKA SA represents a huge leap forward in both engineering and R&D towards building and delivering a unique instrument.

MeerKAT is the South African radio telescope constructed in the Northern Cape and consists of 64 receptors with a diameter of 13.5m. MeerKAT is a precursor to the SKA telescope and will be integrated into the mid-frequency component of the SKA Phase 1. The SKA Phase 1 will consist of an additional 133 radio astronomy receptors.

Gamma-Ray Astronomy

The South African Gamma-Ray Astronomy Programme (SA-GAMMA) was established in March 2013 and coordinates the activities of South African and Namibian institutions in high-energy astrophysics and gamma-ray astronomy. The Programme also supports activities related to the Fermi Gamma-Ray Space Telescope and the IceCube and KM3NeT neutrino telescopes. Current member institutions of SA-GAMMA are North-West University (NWU), the University of the Free State (UFS), Wits University, the University of Johannesburg (UJ), and the South African Astronomical Observatory (SAAO) as full members and the University of Namibia (UNAM) as associate member. Funding commitments from the major European partners in HESS have been secured for the 3 years beyond 2019 as CTA is anticipated to commence operations in 2023. Thus the HESS telescope will continue to operate at current levels of funding contributions from non-European partners.

11.4.1 The Contribution of Astronomy to Strategic Objective 1: Promote Globally Competitive Research and Innovation

Increase and Provide Support for HCD

South African Radio Astronomy Observatory (SARAO)

To support its multidisciplinary research, SARAO provides opportunities for postgraduate students to complete their studies, access to high-end research infrastructure and data for users in the science community, including generation of new knowledge in specific domains and dissemination of science to society.

Over the MTEF, the following targets have been set:

Undergraduate and Honours Bursaries: To be awarded 100% to South Africans (including permanent residents), 90% of which to black South Africans and 50% to South African women.

Postgraduate Bursaries: 70% to South Africans (including permanent residents), 50% of which will be to black South Africans and 50% to South African women, with 30% to SKA partner country citizens.

Postdoctoral Fellowships: 40% to South Africans (including permanent residents), with preference given to black South Africans and women.

South African Astronomical Observatory (SAAO)

SAAO provides mentoring to students and exposure to a research environment through programmes that will continue to be implemented throughout the MTEF as follows:

The **DST-NRF Internship Programme** in which science, engineering technology and social science graduates and postgraduates will be afforded an opportunity to acquire practical work experience and improve their competencies, including the **NRF/DST PDP**, which has substantially increased the training capacity of the observatory and continues to contribute immensely to transformation goals.

SAAO, in collaboration with universities and other research facilities, is a major driver, developer and contributor to the National Astrophysics and Space Science Programme (NASSP), which has been highlighted as a benchmark for development to other science fields. NASSP has been successful within the African continent and will assist in addressing transformation challenges and the shortage of astronomers in South Africa. The programme has expanded with two more nodes at NWU, Potchefstroom Campus, and UniZulu, providing better geographical distribution across the country.

South African Gamma-Ray Astronomy Programme (SA-GAMMA)

The SA-GAMMA programme will continue to support post-graduate students as well as post-doctoral fellows. Fifteen (15) postdoctoral fellows, 20 PhD students, 23 masters students and 10 honours students will actively engage in SA-GAMMA research activities. However, the emphasis will be on recruiting black and female students given that currently there are only 1 black post-doctoral (7%), 27 black post-graduates (51%) and 25 female in total (37%).

Support Multidisciplinary Research and Innovation

Over the MTEF period, multidisciplinary research will continue through the projects below.

South African Radio Astronomy Observatory (SARAO)

Research activities in radio astronomy during the MTEF will include the following:

- The first key MeerKAT capabilities that will be released include the pulsar timing and the 32K correlator mode. This will enable the Meertime, LADUMA and MALS Large Survey Projects (LSPs) to start research work;
- The narrow-band fine modes are expected to be developed, allowing MHONGOOSE and Fornax to start their observations. The first scientific article based on full-scale (nominally 64-dish) MeerKAT data will be published;
- Research will focus on Astrophysical Masers, Millimetre Astronomy, Pulsars, Interacting Binary Star Circinus X-1, the next-generation

International Celestial Reference Frame (ICRF-3, high angular resolution observations of new 3FGL sources and radio-loud supernovae and Supernova remnants;

- Single-dish monitoring observations provide high temporal resolution observations at multiple frequencies to radio and high-energy astronomers to complement the high spatial resolution observations from VLBI observations and observations at higher frequencies, such as gamma-rays. SAAO provides the longest baselines and thus the highest spatial resolution for astronomical VLBI observations as a part of international VLBI networks; and
- There is participation in the tracking of spacecraft for positional purposes, for instance the Chinese Chang'e lunar lander and recent first intercontinental VLBI observations of Global Navigation Satellite System (GNSS) satellites.

South African Astronomical Observatory (SAAO)

SAAO research activities in optical astronomy are organised around the following broad topics:

- **Transcient and time-domain astronomy:** some of the classes of transients, such as Tidal Destruction Events and stellar and compact object mergers, are very rare and inherently enigmatic and are, as such, predisposed to new discoveries. Surveys feeding SAAO transient work are from an array of ground-based and space projects, and in the near future MeerKAT and MeerLICHT will be the most important sources of transient detections, succeeded in a few years' time by the LSST and the SKA. This will make transcient science the future of astronomy;
- **Baryon cycle in galaxies:** research in this domain includes the study of nearby Milky Way companions in great detail, thus enabling discovery of highly evolved stars in them, as well as the determination of chemical evolution and star formation histories of dwarf galaxies. SALT and other large telescopes world-wide, including space observatories and radio telescopes, are used to characterise the baryon cycle; gas outflows and accretion; central super-massive black hole growth; and violent star-formation in interacting galaxies; and
- **Exoplanets:** Characterising the population of planets outside the Solar System, and, ultimately, the search for habitable worlds, is the third focus area for SAAO science. SAAO does not have capacity in this area.

However, researchers are already involved with the PLANET microlensing survey in an on-going exoplanets search with the Sutherland-based KELT project. This provides a narrative for the future research agenda of SAAO.

11.4.2 The Contribution of Astronomy to Strategic Objective 2: Enhance Strategic International Engagements

Promote System-wide International Engagement and Exploit International Research Platform Access

South African Radio Astronomy Observatory (SARAO)

There are a number of formal international collaborations that are expected to increase during the MTEF:

- **SKA convention:** during the 2019/20 financial year, it is expected that the convention establishing the SKA observatory will be signed. Various tier 2 and 3 policies, such as procurement, intellectual property, funding schedules and associate membership agreements, will be developed by the council preparatory task force. These documents will be approved by the SKA observatory council meeting scheduled to take place during the 2019/20 financial year and SARAO will play an instrumental role in those developments;
- **Hydrogen Epoch of Reionization Array (HERA):** the objective of HERA is to have 240 antennas installed by the end of the 2018/19 financial year. This will be sequenced by the feeds and science operations that will commence during the 2019/20 financial year;
- **Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX):** the HIRAX launch took place on 17 August 2018. Currently, the process of evaluating antenna options is underway. The site will be established during 2020 and 128 antennas will be installed. It should be noted that SARAO does not drive the schedule on HIRAX;
- **China/South Africa collaboration in Astronomy:** HartRAO and the Shanghai Observatory have signed a collaboration memorandum of understanding. This memorandum involves the proposed installation of a Chinese designed and constructed VLBI in the Geodetic Observing System (VGOS) antenna at Matjiesfontein;
- **HartRAO** will continue a variety of high-impact activities using VLBI

techniques, contributing, among others, to the next-generation International Celestial Reference Frame (ICRF-3) and to the high angular resolution study of sources in support of the NASA Fermi mission. It will also track spacecraft for positional purposes, for instance, GNSS satellites. In addition, an assessment of the impact of current single dish activities (in areas including masers) is underway, and a strategy will be developed to enhance such contributions;

- **African Very Long Baseline Interferometry (VLBI) Network:** the AVN programme and the South African contribution are being re-assessed and the new strategic plan is under review. Mobilisation of additional resources will enable the project plans to be updated accordingly and the team augmented as required. The current funding will enable the SKA-SA AVN team to complete the planned second engineering phase in Ghana during the 2019/20 financial year. The Radio Frequency Interference (RFI) environments at several sites in Botswana have been characterised and depending on the outcomes, one of these sites might be identified as the probable site for the deployment of a new built AVN station. The two antenna training interferometer is at the Botswana International University of Science and Technology (BIUST) and the deployment and roll out of the system will be supported from the South African base. The South African observatory is being assessed and new strategic plans are being developed for the new AVN stations in Namibia and Mauritius; and
- Due to the failure of the Russian satellite late in 2018, the Radioastron Satellite ground control project will be abandoned, and unspent funds will be transferred to other astronomy projects.

South African Astronomical Observatory (SAAO)

The Observatory hosts a number of international facilities at its Sutherland site with a consortium of partners from South Africa, the UK, Poland, India and the USA. Due to the extremely dark skies and the unique geographic location of the Sutherland site, there are ongoing requests to position more facilities there. The following international collaborations are planned for implementation during the MTEF:

- International collaborations are being planned through MeerLicht, a robotic optical telescope that will carry out simultaneous observations

with the MeerKAT radio array. To this end, a partnership between South African, the UK and the Netherlands is being commissioned at Sutherland.

- PRime focus Infrared Microlensing Experiment (PRIME), a new near-infrared telescope with a wide-field imager and near-IR spectrograph, is being built through collaborations with the Japanese and Americans. A node of the ATLAS near-earth asteroid network at Sutherland will be established.
- The Las Cumbres Observatory has expanded its existing facility at Sutherland with new high-resolution spectrographs and additional telescopes. Collaborations with the Inter-University Centre for Astronomy and Astrophysics (IUCAA) to produce a new generation of charge-coupled device (CCD) systems for SALT and SAAO telescopes are being expanded.
- Partnership with the American Transiting Exoplanet Survey Satellite (TESS) project to use the SALT high-resolution spectrograph for exoplanet research is being explored.

11.4.3 The Contribution of Astronomy to Strategic Objective 4: Establish and Maintain Research and Infrastructure Platforms

Provide Science Infrastructure in Priority Areas

Research infrastructure requires regular renewal and enhancement.

South African Radio Astronomy Observatory (SARAO)

Over the MTEF period, the SARAO component will engage in the following activities:

- There have been discussions with the Max Planck Institute for Radio Astronomy (MPIfR) to construct another 20 dishes as a MeerKAT extension and this proposal has been accepted in principle by the SKA Board. It is expected that funding for this will be secured by SARAO, CETC54 and then the MPIfR. Associated agreements will be drawn up to start the project during the 2019/20 financial year, depending on the dish reaching compact disk recordable (CDR) status. Installation of four dishes will be performed during the 2019/20 financial year, with the

remainder being installed during the 2020/21 financial year. Project plans are being conceptualised to this effect; and

- MeerKAT is a precursor to the SKA telescope and will be integrated into the mid-frequency component of the SKA Phase 1. The SKA Phase 1 will consist of an additional 133 radio astronomy receptors.

South African Astronomical Observatory (SAAO)

Over the MTEF period, the following initiatives will be implemented:

- PRIME, a near-IR telescope with wide-field imaging and spectrograph facilities, which will open new opportunities for multi-wavelength observational astronomy to the South African community, will be constructed; and
- A new low-resolution spectrograph for Lesedi, including detectors, optics and computers, is scheduled for completion during the 2019/20 financial year.



Table 22a: Astronomy and geodetic sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 1

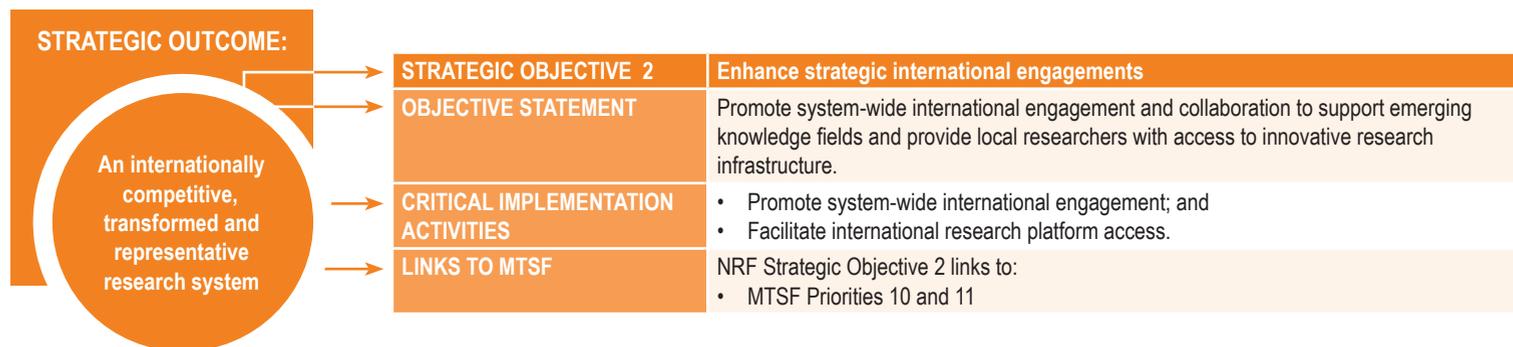


INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of postgraduate students supported by the National Research Facilities	109	118	125	125	144	87	87	87
WoS publications by researchers at the National Research Facilities	136	141	217	142	174	155	155	175
Number of users of National Research Facilities	137	1 293	1 207	1 370	550	1 468	1 468	1 468
Citation impact of National Research Facility outputs (annual cumulative)	1.33	1.32	1.47	>1.32	>2	>1.33	>1.33	>1.33
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Globally competitive research	104 322	117 299	128 775	161 167	170 100	176 600	186 300	

Table 22b: Astronomy and geodetic sciences – Quarterly targets for 2019/20 – Strategic Objective 1

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of postgraduate students supported by the National Research Facilities	Quarterly	87	84	87	87	87
WoS publications by researchers at the National Research Facilities	Quarterly	155	40	75	95	155
Number of users of National Research Facilities	Quarterly	1 468	85	170	255	1 468
Citation impact of National Research Facility outputs (annual cumulative)	Annually	>1.33	-	-	-	>1.33

Table 23a: Astronomy and geodetic sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective 2

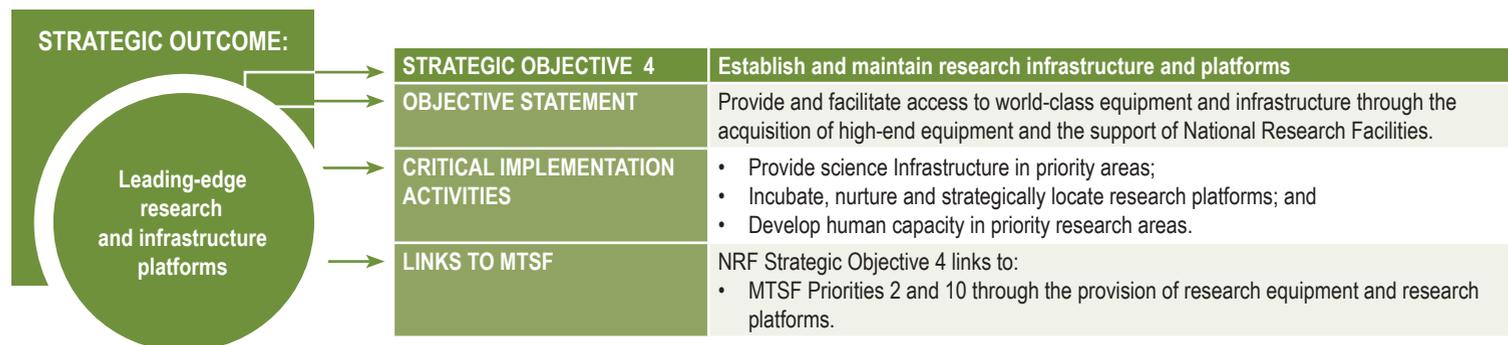


INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Number of joint international agreements at the National Research Facilities	45	48	21	45	44	44	38	38
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Internationalisation	153 486	456 497	378 799	178 039	304 300	301 200	317 700	

Table 23b: Astronomy and geodetic sciences – Quarterly targets for 2019/20 – Strategic Objective 2

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Number of joint international agreements at the National Research Facilities	Annually	44	-	-	-	44

Table 24a: Astronomy and geodetic sciences – Strategic plan and medium term KPIs and budget (2019/20–2021/22) – Strategic Objective



INDICATORS	Audited/Actual performance			Estimated performance 2018/19	Strategic Plan target 2019/20	Medium term targets		
	2015/16	2016/17	2017/18			2019/20	2020/21	2021/22
Total infrastructure investment in the National Research Facilities (R' 000)	372 570	625 590	623 450	315 170	66 170	131 490	95 860	63 890
BUDGET (R million)	Actual 2015/16	Actual 2016/17	Actual 2017/18	Proj. 2018/19	Proj. 2019/20	Proj. 2020/21	Proj. 2021/22	
Platform and infrastructure provision	518 491	637 447	631 901	713 465	437 100	481 200	507 700	

Table 24b: Astronomy and geodetic sciences – Quarterly targets for 2019/20 – Strategic Objective 4

INDICATORS	Reporting period	Annual target 2019/20	Quarterly targets			
			1 st	2 nd	3 rd	4 th
Total infrastructure investment in the National Research Facilities (R'000)	Quarterly	131 490	37 990	71 150	100 750	131 490

11.5 OVERVIEW OF NATIONAL RESEARCH FACILITIES ACTIVITIES

The National Research Facilities mandates call for the provision of research platforms for research/services and products to both internal and external researchers, postgraduates and other stakeholders, such as hospitals and

clients. In addition to the programme performance indicators that contribute to the NRF's Strategic Plan, as enumerated above, the National Research Facilities are monitored through the tracking of facility-specific indicators that are primarily at the operational level. Table 25 below lists the key indicators per facility together with the planned levels of operation for the MTEF period. The progress made on these indicators will be reported on a quarterly basis to present a holistic performance review of the Facilities.

Table 25: Operational indicators

	Unit of measure	Measured function/process/facility	Desired levels during the MTEF		
			2019/20	2020/21	2021/22
iThemba/LABS	Number of patient doses supplied with locally produced isotopes		146330	146470	146500
	Beam time usage relative to total time	SSC (research and isotope production)	68%	68%	68%
		Tandatron (research)	90%	90%	90%
		Tandem (research)	34%	40%	45%
SAAO	Peer-reviewed papers from external users	SAAO	60	60	60
		SALT	50	50	50
	Telescope usable uptime	SAAO	96%	96%	96%
		SALT	96%	96%	96%
SARAO	Science modes installed on MeerKAT		Correlator for the 8 LSPs	S-band receivers available	User equipment integrated into MeerKAT
	% MeerKAT time available for science		35%	40%	45%
SAIAB	Research fleet days at sea (ACEP)		85	90	100
	Number of fixed sites with receivers that are operational (ATAP)		45	50	50
SAEON	Number of written policies and/or environmental management contributions		21	28	29
	Number of long-term field research and/or monitoring sites		26	46	48



PART C:

KEY PERFORMANCE INDICATORS

12 NRF PERFORMANCE INDICATORS

Table 26: Corporate indicators and set targets for the NRF's performance against the strategic goals of the organisation. Performance targets are structured in accordance with the strategic goals of the NRF.

INDICATORS		Actual 2017/18	Target 2018/19	Target 2019/20	2019/20 quarterly milestones			Proj. 2020/21	Proj. 2021/22
					Q1	Q2	Q3		
OUTCOME: An internationally competitive and transformative research system									
STRATEGIC OBJECTIVE 1: Promote globally competitive research and innovation									
Number of NRF-funded researchers from designated groups	Black	1 698	2 182	2 154	1 035	1 720	2 090	2 295	2 368
	Female	1 786	1 520	1 579	856	1 292	1 349	2 020	2 100
Number of postgraduate students funded per designated group	Black	11 328	9 350	9 157	5 253	7 789	8 555	9 675	5 885
	Female	8 266	7 119	6 300	3 636	5 359	5 841	6 786	4046
Number of NRF-rated researchers from designated groups	Black	1 069	1 026	1 120	-	-	-	1 337	1 512
	Female	1 285	1 292	1 365	-	-	-	1 499	1 638
WoS publications published by National Research Facilities		574	397	551	184	313	422	575	615
STRATEGIC OBJECTIVE 2: Enhance strategic international engagements									
Number of active grants emanating from binational, multinational and agency-to-agency agreements		996	990	945	500	760	850	950	955
STRATEGIC OBJECTIVE 3: Promote best-practice systems in support of grant making, reviews and evaluations									
Total number of researchers rated through the NRF system		3 885	3 750	3 900	-	-	-	4 050	4 200
OUTCOME: Leading-edge research and infrastructure platforms									
STRATEGIC OBJECTIVE 4: Establish and maintain research infrastructure platforms									
Number of users of equipment that was funded by the NEP and NNEP programme		2 881	2 641	2 252	-	-	-	2 014	1 976
Number of publications emanating from the usage of equipment funded by the NEP and NNEP programme		908	695	593	-	-	-	530	520
OUTCOME: A reputable and influential agency shaping the science and technology system									
STRATEGIC OBJECTIVE 5: Grow NRF influence, impact and reputation									
Number of internal and external users of NRF business intelligence systems		129	150	160	-	-	-	160	160

Table 26: Corporate indicators and set targets for the NRF's performance against the strategic goals of the organisation. Performance targets are structured in accordance with the strategic goals of the NRF (continued)

INDICATORS	Actual 2017/18	Target 2018/19	Target 2019/20	2019/20 quarterly milestones			Proj. 2020/21	Proj. 2021/22	
				Q1	Q2	Q3			
STRATEGIC OBJECTIVE 6: Optimise return on investment									
Unqualified audit report	Yes	yes	yes	-	-	-	yes	yes	
Corporate overheads: calculated as a percentage of total expenditure	1.8%	<3%	<3%	-	-	-	<3%	<3%	
Total expenditure: calculated as a percentage of total expenditure	6.2%	<10%	<10%	-	-	-	<10%	<10%	
OUTCOME: Scientifically literate and engaged society									
STRATEGIC OBJECTIVE 7: Entrench science engagement									
Number of members of the public reached through NRF science awareness activities	1 191 892	1 080 000	680 300	205 000	280 100	490 150	682 150	683 300	
OUTCOME: A skilled and committed NRF research and technical workforce									
STRATEGIC OBJECTIVE 8: Improve talent management									
Percentage of South Africans from designated groups in top management, senior management and professionally qualified and experienced specialists/mid-management, including the SKA (three top occupational levels)	Black	43.7%	50.8%	56.0%	-	-	-	62.0%	65.0%
	Female	21.5%	30.1%	34.0%	-	-	-	39.0%	42.0%



PART D: SUPPORTING INFORMATION

13 ALIGNMENT WITH DST STRATEGIC OUTCOMES

Table 27: Alignment with MTSF priorities and DST Strategic Outcomes

No.	MTSF Priority Outcomes	Strategic Outcomes	Responding NRF Programme	Initiatives	DST Strategy-orientated Goals
1	Quality basic education	4	Programme 2	SARChI Chairs focusing on mathematics; numeracy education; integrated studies of learning languages, mathematics and science; teacher education; higher education and human development; and work-integrated learning.	HCD
2	A long and healthy life for all South Africans	1	Programmes 3 and 4	<ul style="list-style-type: none"> SARChI Chairs focusing on HIV vaccination translation; detection of cardiovascular diseases; poverty-related diseases; TB biomarkers; malaria, etc. CoEs focusing on epidemiology, HIV prevention and biomedical TB research. iThemba LABS supplying rare isotopes globally for the early detection and treatment of cancers and providing the only cancer treatment facility of its kind on the continent. 	Increased knowledge generation
		2			
3	All people in South Africa are and feel safe				
4	Decent employment through inclusive growth	3	Programme 1	The NRF adhering to fair and transparent procurement and employment practices, and subscribing to the BBBEE Act. Furthermore, the organisation supporting the DST/NRF Internship Programme by training and, where possible, retaining interns in various fields. The PDP supporting the transition of doctoral graduates to positions within the business, with the management development programmes supporting staff in becoming better managers within the NRF.	
		5			
5	A skilled and capable workforce to support an inclusive growth path	1	Programme 3	The NRF providing support for postgraduate studies, assisting researcher development at HEIs (including the provision of targeted grants for this purpose), and supporting internal NRF staff.	Increased knowledge generation
		5	Programmes 1 and 4		
6	An efficient, competitive and responsive economic infrastructure network	1	Programme 3	<p>The NRF funding research in renewable energy solutions through :</p> <ul style="list-style-type: none"> The EHCD&KG programme and the Energy Research Programme. iThemba LABS providing nuclear research infrastructure' <p>The NRF also providing world-class research infrastructure in various science domains.</p>	Increased knowledge generation

Table 27: Alignment with MTSF priorities and DST strategic outcomes (continued)

No.	MTSF Priority Outcomes	Strategic Outcomes	Responding NRF Programme	Initiatives	DST Strategy-orientated Goals
7	Vibrant, equitable and sustainable rural communities contributing towards food security for all	1	Programmes 3 and 4	<ul style="list-style-type: none"> UK-SA SARCHI bilateral research Chairs focusing on food security. SARCHI Chairs focusing on systems biology for food security and phytochemical food networks from a nutrition perspective. CoEs focusing on sustainable food systems to realise food security for poor, vulnerable and marginal populations. 	Increased knowledge generation
8	Sustainable human settlements and improved quality of household life	1	Programmes 3 and 4	The NRF is currently creating a community of practice around human settlements.	Increased knowledge generation
9	Responsive, accountable, effective and efficient local government				
10	Protected and enhanced environmental assets and natural resources	1 2	Programme 3 and 4	<ul style="list-style-type: none"> SARCHI Chairs focusing on environmental research in areas such as agricultural sciences; agro-chemistry; evolution biology; as well as climate change; earth system science; marine ecosystems and paleo-environmental studies. CoEs in biodiversity, conservation, and biotechnology. The National Research Facilities, through SAEON and SAIAB, contributing to national policy development around the protection of environmental assets. 	Responsive, coordinated and efficient NSI, and increased knowledge generation
11	A better South Africa, a better Africa and a better world	3 1	Programme 1 Programmes 3 and 4	The NRF building on its brand and reputation to foster international research partnerships and scientific collaboration on the African continent and globally, thus playing a role in creating a better South Africa and Africa.	Responsive, coordinated and efficient NSI
12	An efficient, effective and development-orientated public service				
13	A comprehensive, responsive and sustainable social protection system				
14	A diverse, socially cohesive society with a common national identity	4 3	Programme 2 Programme 1	The NRF contributing through the effective generation, communication and dissemination of knowledge to society. To this end, the NRF has created SARCHI Chairs in science communication.	HCD



PART E: POLICY FRAMEWORK

14 NRF SUPPORTING POLICY FRAMEWORK

A. THE NRF SUPPORTING POLICY FRAMEWORK

Table 28: The NRF supporting policy framework

Supporting framework	
A	Exemptions granted from the provisions of the PFMA (Act 1 of 1999)
B	Risk Management Plan
C	Fraud Prevention Plan
D	Materiality and Significance Framework
E	Schedule of the NRF Board's main activities
F	Structure and composition of the NRF Board and its committees
G	Employment Equity Plan
H	Business Development Strategy
I	Communication Plan
J	ICT Plans

Policies that form the supporting framework of the operations of the NRF are available on request.

B. APPLICABLE SUSTAINABILITY BEST-PRACTICE CODES AND STANDARDS

Where applicable, the business units subscribe to best-practice codes and standards. SKA SA is in the process of becoming fully ISO 9001 compliant.

Table 29: Applicable and sustainable best-practice codes and standards

Best-practice codes and standards		RISA	SAEON	SAASTA	SAIAB	SARAO	SAAO	iThemba LABS	SKA
1	King IV Code of Corporate Governance for SA	•	•	•	•	•	•	•	•
2	International Financial Reporting Standards (IFRS) for Financial Reporting	•	•	•	•	•	•	•	•
3	ISO 14001:2004 Environmental Management System		•		•			•	•
4	ISO 9001:2008 Quality Management System	•		•	•			•	
5	Current Good Manufacturing Practices (cGMP)							•	
6	International Atomic Energy Agency (AEA) standards							•	

C. CODES, STANDARDS AND LEGISLATION APPLICABLE TO HR&LS

Table 30: Codes, standards and legislation applicable to HR&LS

Codes, standards and legislation applicable to HR&LS	
Constitution of the Republic of South Africa (Act 108 of 1996)	Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993)
Labour Relations Act (Act 66 of 1995)	Pension Fund Act (Act 24 of 1956)
Basic Conditions of Employment Act (Act 75 of 1997)	Medical Schemes Act (Act 131 of 1998)
Code of Good Practice on Dismissals	Income Tax Act (Act 58 of 1962)
Employment Equity Code of Good Practice	Skills Development Act (Act 97 of 1998)
National Research Foundation Act (Act 23 of 1998)	Skills Development Levies Act (Act 9 of 1999)
Occupational Health and Safety Act (Act 85 of 1993)	South African Qualifications Authority Act (Act 58 of 1995)
Employment Equity Act (Act 55 of 1998)	Promotion of Equality and Prevention of Unfair Discrimination Act (Act 4 of 2000)
Broad-Based Black Economic Empowerment Act (Act 53 of 2003)	Promotion of Access to Information Act (Act 2 of 2000)
Unemployment Insurance Act (Act 63 of 2001)	Promotion of Administrative Justice Act (Act 3 of 2000)
Protection of Personal Information Act (Act 4 of 2013)	Employment Services Act (Act 4 of 2014)

Table 31: Priority compliance listing of applicable legislation and best practice

Legislation		RISA	SAEON	SAASTA	SAIAB	SARAO	SAAO	iThimba LABS	SKA
1	National Research Foundation Act (Act 23 of 1998)	•	•	•	•	•	•	•	•
2	Occupational Health and Safety Act (Act 85 of 1993)	•	•	•	•	•	•	•	•
3	National Water Act (Act 36 of 1998)	•	•	•	•	•	•	•	•
4	National Environmental Management Act (NEMA) (Act 107 of 1998)	•	•	•	•	•	•	•	•
5	Public Finance Management Act (PFMA) (Act 29 of 1999)	•	•	•	•	•	•	•	•
6	Companies Act (Act 71 of 2008)	•	•	•	•	•	•	•	•
7	Intellectual Property Rights from Publicly Financed Research and Development Act (Act 51 of 2008)	•	•	•	•	•	•	•	•
8	Skills Development Act (Act 97 of 1998)	•	•	•	•	•	•	•	•

Table 31: Priority compliance listing of applicable legislation and best practice (continued)

Legislation		RISA	SAEON	SAASTA	SAIAB	SARAO	SAAO	iThemba LABS	SKA
9	Employment Equity Act (Act 55 of 1998)	•	•	•	•	•	•	•	•
10	Labour Relations Act (Act 66 of 1995)	•	•	•	•	•	•	•	•
11	Basic Conditions of Employment Act (Act 75 of 1997)	•	•	•	•	•	•	•	•
12	National Environmental Management: Biodiversity Act (Act 10 of 2004)		•		•				
13	National Environmental Management: Biodiversity Act (Act 10 of 2004): Threatened or Protected Species Regulations		•		•				
14	Astronomy Geographic Advantage Act (Act 21 of 2007)					•	•		•
15	Mine Health and Safety Act (Act 29 of 1996)								•
16	Mineral and Petroleum Resources Development Act (Act 28 of 2002)								•
17	Marine Living Resources Act (Act 18 of 1998)				•				
18	National Environmental Management: Air Quality Act (NEM:AQA) (Act 39 of 2004)							•	
19	National Environmental Management: Waste Act (Act 59 of 2008)				•			•	•
20	Promotion of Access to Information Act (Act 2 of 2000)	•	•	•	•	•	•	•	•
21	Occupational Health and Safety Act (Act 85 of 1993): Diving Regulations				•				
22	Occupational Health and Safety Act (Act 85 of 1993): Construction Regulations								•
23	National Radioactive Waste Disposal Institute Act (Act 53 of 2008)							•	
24	National Health Act (Act 61 of 2003)							•	
25	South African National Space Agency Bill (B20 of 2008)					•	•		•
26	Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993)								
27	Animal Protection Act (Act 71 of 1962)		•						

PART F: KEY CONTACT DETAILS

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PART G: LIST OF ACRONYMS

ACE Beams	Accelerator Centre for Exotic Beams
ACE Isotopes	Accelerator Centre for Exotic Isotopes
ACEP	African Coelacanth Ecosystem Programme
AD	Alumni Database
ADR	Alternative dispute resolution
AEA	(International) Atomic Energy Agency
AERP	Aquatic Ecophysiology Research Platform
AGA	Astronomy Geographic Advantage
AGRP	Aquatic Genomics Research Platform
AMA	Astronomy Management Authority
AMS	Accelerator mass spectrometry
APP	Annual Performance Plan
ARUA	Africa Research University Alliance
ASCA	Agulhas System Climate Array
ASTEMI	Association for Science Technology Mathematics and Innovation
ATAP	Acoustic Tracking Array Platform
AVN	African Very Long Baseline Interferometry (VLBI) Network
BAAP	Black Academics Advancement Programme
BAC	Bid Award Committee
BBBEE	Broad-based Black Economic Empowerment
BIS(s)	Business intelligence system/s
BIUST	Botswana International University of Science and Technology
CCD	Charge-coupled device
CCMA	Commission for Conciliation, Mediation and Arbitration
CDR	Compact disk recordable
CEO	Chief Executive Officer
CERN	European Organization for Nuclear Research (Organisation Européenne pour la Recherche Nucléaire)
cGMP	Current Good Manufacturing Practices

CHE	Council on Higher Education
CoE	Centre of Excellence
CoP	Committee of Plenipotentiaries
CPRR	Competitive Programme for Rated Researchers
CPUT	Cape Peninsula University of Technology
CRTS	Catalina Real-Time Transient Survey
CSD	Central Supplier Database
CSUR	Competitive Support for Unrated Researchers
CTA	Cherenkov Telescope Array
DAAD	German Academic Exchange Service
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DHET	Department of Higher Education and Training
DPSIR	Drivers, pressures, state, impacts and responses
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EHCD&KG	Energy Human Capacity Development and Knowledge Generation
ELTOSA	Environmental Long-term Observatories Network of Southern Africa
ERM	Enterprise risk management
ERP	Enterprise resource planning
ESRF	European Synchrotron Radiation Facility
EFTEON	Expanded Freshwater and Terrestrial Environmental Observation Network
FAIR	Findable, accessible, interoperable, and re-usable (data)
FRF	First Rand Foundation
GDP	Gross domestic product
GEOBON	Group on Earth Observation-Biodiversity Observation Network
GEOSS	Global Earth Observation System of Systems
GERD	Gross expenditure in R&D

GMSA	Grants Management and Systems Administration
GNSS	Global Navigation Satellite System
HartRAO	Hartebeesthoek Radio Astrology Observatory
HBU	Historically black university
HCD	Human capacity development
HEI	Higher education institution
HEMIS	Higher Education Information Management System
HERA	Hydrogen Epoch of Reionization Array
HESS	High-energy Stereoscopic System
HICD	Human Infrastructure Capacity Development
HIV	Human immunodeficiency virus
HIRAX	Hydrogen Intensity and Real-time Analysis eXperiment
HR	Human resources
HRDS	Human Resources Development Strategy
HR&LS	Human Resources and Legal Services
ICT	Information and communication technology
IGO	Inter-Governmental Organisation
IUCAA	Inter-University Centre for Astronomy and Astrophysics
IFRR	Incentive Funding for Rated Researchers
IFRS	International Financial Reporting Standards
IKS	Indigenous knowledge systems
ILTER	International Long-Term Ecological Research Network
IPAP	Industrial Policy Action Plan
IPBES	International Platform for Biodiversity and Ecosystem Services
IRSF	Infrared Survey Facility
ISOLDE	On-Line Isotope Mass Separator
IT	Information technology
iThemba LABS	iThemba Laboratory for Accelerator Based Sciences
ITIL	Information Technology Information Library
JINR	Joint Institute for Nuclear Research

KAS	Knowledge advancement and support
KAT	Karoo Array Telescope
KIC	Knowledge Interchange Collaboration
KM	Knowledge management
KPI	Key performance indicator
KR	Knowledge resources
LERIB	Low-energy Rare Ion Beam
LHC	Large Hadron Collider
LSP	Large Survey Project
LSPs	Large Survey Projects
LSST	Large Synoptic Survey Telescope
LTER	Long-term Ecological Research
MANuS	Masters in Accelerator and Nuclear Science
mar-RIP	Marine Remote Imagery Platform
MARS	Marine and Antarctic Research Strategy
MDP	Management Development Programme
MPIfR	Max Planck Institute for Radio Astronomy
MTEF	Medium-Term Expenditure Framework
MTSF	Medium-Term Strategic Framework
MV	Megavolt
MWLA	Multiwavelength Astronomy
NACI	National Advisory Council on Innovation
NASSP	National Astrophysics and Space Science Programme
NDP	National Development Plan
NEMA	National Environmental Management Act
NEP	National Equipment Programme
NeRSuP	National E-Research Support Programme
nGAP	New Generation of Academics Programme
NIThEP	National Institute for Theoretical Physics
NMDP	New Managers Development Programme
NNEP	National Nanotechnology Equipment Programme

NRDS	National Research and Development Strategy
NRF	National Research Foundation
NSCF	Natural Science Collections Facility
NSF	National Skills Fund
NSFAS	National Student Financial Aid Scheme
NSI	National System of Innovation
NTeMBI	Nuclear Technologies in Medicine and Biosciences Initiative
NWU	North-west University
NZG	National Zoological Gardens
OTN	Ocean Tracking Network
PDP	Professional development programme
PET	Positron emission tomography
PFMA	Public Finance Management Act
POPI	Protection of Personal Information Act
PPC	Parliamentary Portfolio Committee
PRIME	PRime focus Infrared Microlensing Experiment
R&D	Research and development
RCCE	Research Chairs and Centres of Excellence
RE	Reviews and evaluation
RFI	Radio Frequency Interference
RIB	Rare Ion Beam
RISA	Research and Innovation Support and Advancement
ROSS	Research Output Submission System
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SAAO	South African Astronomical Observatory
SAASTA	South African Agency for Science and Technology Advancement
SADC	Southern African Development Community
SAEON	South African Environmental Observation Network
SA-GAMMA	South African Gamma-Ray Astronomy Programme

SAIAB	South African Institute for Aquatic Biodiversity
SAIF	South African Isotope Facility
SAINTS	South African Institute of Nuclear Technology and Science
SALT	Southern African Large Telescope
SANBI	South African National Biodiversity Institute
SARAO	South African Radio Astronomy Observatory
SARChI	South African Research Chairs Initiative
SARIR	South African Research Infrastructure Roadmap
SARS	South African Revenue Service
SASAC	South African Systems Analysis Centre
SCM	Supply chain management
SES	Science Engagement Strategy
SET	Science, engineering and technology
SETI	Science, engineering, technology and innovation
SHAEA	Strengthening Higher Agricultural Education in Africa
SKA	Square Kilometre Array
SMCRI	Shallow Marine and Coastal Research Infrastructure
SPECT	Single-photon emission computed tomography
SPP	Strategy, Planning and Partnerships
SREP	Strategic Research Equipment Programme
SRIG	Strategic Research Infrastructure Grant
SSC	Separated sector cyclotron
STEMI	Science, Technology, Engineering, Mathematics and Innovation
STI	Science, technology and innovation
STISA	Science, Technology and Innovation Strategy for Africa
TAMS	Tandem and Accelerator Mass Spectrometry
TB	Tuberculosis
TESS	Transiting Exoplanet Survey Satellite
the dti	Department of Trade and Industry

THRIP	Technology and Human Resources for Industry Programme
TVET	Technical and Vocational Education and Training
TWAS	The World Academy of Sciences
TYIP	Ten-year Innovation Plan
UCT	University of Cape Town
UFH	University of Fort Hare
UFS	University of the Free State
UJ	University of Johannesburg
UK	United Kingdom
UN	United Nations
UNAM	University of Namibia
UniZulu	University of Zululand
USA	United States of America
UWC	University of the Western Cape
VGOS	VLBI in the Geodetic Observing System
VLBI	Very Long Baseline Interferometry
Wits	University of the Witwatersrand
WoS	Web of Science
WRC	Water Research Commission
WSU	Walter Sisulu University
YPDP	Young Professionals Development Programme

PART H: ANNEXURE

ANNEXURE 1: AMENDMENT OF NRF STRATEGY 2020 FOR 2019/2020 PROJECTIONS

INTRODUCTION

NRF Strategy 2020 was developed during 2014 with a strong focus on making a significant shift in the science system culminating in a deliberate upward trajectory in the projected key performance indicators (KPI)'s) and targets. These were premised on resource growth beyond the inflationary funding levels which at that time was around 6%. The set targets were understood to be stretch and aspirational and not absolute.

The NRF funding levels however over the years have been sub-optimal and below inflationary levels with negative real growth of about 1% annually. Operating costs within the science system and higher education sector within which the NRF operates has been higher than inflation for the full duration of the Strategy. The constrained financial environment, coupled with the impact of the dynamic and changing macro-environment and the actual annual and trends in KPI performance necessitated a review of the NRF performance targets for the final year that was set in NRF Strategy 2020 in 2014.

Despite the economic and operational environmental realities, the NRF holds steadfast its unreserved commitment to accelerating its transformation agenda as these form the major suite of the KPI's. This has been a priority of the previous Board and was further confirmed by the current Board at its recent meetings. As previously indicated, the NRF will focus on driving transformation in four main areas namely:

- Transformation of the equity profiles of the South African research workforce;
- Transformation of the knowledge enterprise;
- Transformation of the relationship between science and society; and
- Building a diverse and fully inclusive learning organisation.

Some of the targets included in the NRF Strategy 2020 were intended to provide strategic context in the form of establishing trends to track systemic changes and were not intended to be used as performance indicators, other than where an indicator is specifically identified as a strategy indicator. The key strategy indicators are listed in a separate standalone table in the NRF Strategy 2020 and its associated Annual Performance Plans. However, all the indicators have been treated as important and are subject to scrutiny by the Auditor General (AG) through the Audit of Performance Information (AoPI) by virtue of its inclusion in the strategy. Taking into account the above context and realities, all the KPI performance targets need to be re-considered in developing the 2020 APP.

The current Framework for Strategic Plans and Annual Performance Plans issued in August 2010 by the National Treasury directs that "A Strategic Plan may be changed during the five-year period that it covers. However, such changes should be limited to revisions related to significant policy shifts or changes in the service-delivery environment. The relevant institution does this by issuing an amendment to the existing plan, which may be published as an annexure to the Annual Performance Plan, or by issuing a revised Strategic Plan"

The key adjustments in targets for 2019/20 are mainly attributed to funding levels and significant changes in the service delivery environment of the organisation, of which the following have substantial impact on projections:

- Uncertain human led environment and pipeline that impacts on demand and uptake of support and funding opportunities provided by the NRF, as this is impossible to predict with absolute certainty.
- Consolidation of the science engagement programme and the changing priorities of government such as the transfer of NZG to SANBI.
- Termination of certain funding streams such the THRIP funding from the *dti*.

- The implementation of management actions stemming from AoPI findings for 2017/18 by the AG to improve the Technical Indicator Descriptions (TIDs) to enhance reliability and reporting of performance information. Application of these recommended improvements will result in negative performance variances on certain affected performance indicators for 2018/19 and will need to be addressed going forward.

This review provides reasons and explanations on those KPI that have material differences between projections in NRF Strategy 2020 and Annual Performance Plan for the next financial year 2019/2020. It is necessary to address these now as such KPI's form a baseline for the targets in the subsequent years. The explanations are structured according to the service delivery programmes of the NRF for ease of flow and coherence.

PROGRAMME 1– CORPORATE

1. Proportion of South Africans from designated groups in senior technical and managerial position, including SKA (Peromnes 1-8)

The indicator description should have read exactly the same as the Employment Equity Act (EEA) occupational levels descriptors to ensure articulation and consistency with the NRF Employment Equity plan targets as well as to ensure consistency when reporting to the DST and to the DOL. The same should apply for all other categories to be reported on. The new title for the indicator should therefore read “Percentage of South Africans from designated groups in top management, senior management and professionally qualified & experienced specialists/mid-management, including SKA (three top occupational levels)” Similarly it is also desirable that the targets for this category and others all be expressed as a percentage, again to ensure articulation and consistency in reporting as stated above. Therefore is proposed that the targets for NRF Strategy 2020 for 2019/20 for black employees be amended from 306 (49%, in the initial Strategic Plan 2015/16 to 2019/20) to 56% and similarly for female employees from 240 (37%) to 34%.

PROGRAMME 2– SCIENCE ENGAGEMENT

2. Approximate number of public reached through SAASTA's science awareness activities

Budgetary constraints have emerged over the years which affects the ability to consistently and physically reach larger numbers of public audiences. The ability to validate increasing participation data at public events such as festivals and NSW and public spaces such as malls, museums etc. is becoming increasingly difficult to undertake within the audit requirements of the AG. In order to improve the validity of indicator as well as the reliability and completeness of the count of the number people reached through NRF science engagement it is proposed that the count be limited to activities that can be monitored by the organisation within minimal cost and high degree of certainty. Therefore it is proposed that the targets in the NRF Strategy 2020 for 2019/20 be amended from 1 090 000 to 680 300.

3. Educators and Learners reached

Over the period of the strategy the educator approach has changed from many short interactions and once off interventions (e.g. workshops) to longer and more intensive interventions to enable us to measure the impact of such interventions.

Financial constraints and a focus on more meaningful and impactful interventions such as learner camps, STEMI Olympiads, workshops and provision of educational resources to support improved performance in schools and to improve on tracking of changes which may arise out of such interventions. Hence, the learner numbers are reducing but with a change in the nature of events with increased focus. It is therefore proposed that the target number of educators reached in the NRF Strategy 2020 for 2019/20 be amended from 16 000 to 1 347 and for learners to be amended from 385 000 to 186 370.

PROGRAMME 3– RESEARCH AND INNOVATION SUPPORT AND ADVANCEMENT (RISA)

Absolute numbers are not appropriate strategic performance indicators for a funding institution like the NRF that relies primarily on allocations through the MTEF and other contracts from government, international and local organisations that may not always be linked to the dynamism of the higher education and research institution service delivery environment. As a policy implementing agency, the NRF would be better assessed on the effectiveness of its funding decisions as reflected in the equity profile of funded students, fellows and researchers, recipients' progression rates through the development pipeline, and on outputs of funded projects. Through RISA, the NRF ensures that the funds at its disposal are allocated in line with policies determined by the DST and other funders.

4. Number of NRF funded researchers from designated groups

Black

While the projected absolute number of funded researchers in this group is proposed to be lower for the financial year 2019/20 than currently in the NRF Strategy 2020, the available funds will be allocated as per the Ministerial Guidelines. It is therefore proposed that targets in the NRF Strategy 2020 for 2019/20 be amended from 2 438 to 2 154, to align with decreasing resources and a corresponding high demand for funding.

Female

Similarly, the projected numbers are lower for this category due to budget constraints caused by continued below inflation MTEF allocations in both higher education and research/knowledge enterprise sectors, at levels that are inadequate to meet needs of this group of recipients. The funding will be allocated in accordance with requirements set out in the Ministerial Guidelines. In these circumstances, it is proposed that the target in NRF Strategy 2020 for 2019/20 be amended from 2 650 to 1 579.

5. Number of post-graduate students funded per designated group

The NRF only has an influence on the profile of post graduate student enrolments through terms for awarding grants to researchers. As a result, when fewer researchers hold grants, the NRF's ability to achieve the equity targets for post graduate students, is constrained. The slower growth in budgets for researcher grants in areas with higher potential of student enrolment rates, significantly impacts the projections of the number of students from designated groups. Additionally, the allocation for post-graduate student funding is insufficient given the escalating higher education costs. Overall, the trend is progressive and compares favourably with the direction towards increased diversity of human capital in the knowledge enterprise.

Black

It is therefore proposed that the projected targets for this performance indicator in the NRF Strategy 2020 for 2019/20 be amended from 11 360 to 9 157. These targets will most likely be achieved by robustly adhering to equity funding policy targets set by the Ministerial Guidelines, at 80% black.

Female

Similarly, it is proposed that projections of numbers for these groups in NRF Strategy 2020 for 2019/20 be amended from 9 280 to 6 300. The proposed amended targets will be achieved through funding decisions that are in line with Ministerial Guidelines of 55% for this designated group.

6. Number of NRF rated researchers from designated groups

Based on a reduction in funding, the recent revision to the Incentive Funding for Rated Researchers (IFRR) programme, has impacted negatively on the number of researchers willing to go through the demanding rating process to apply to become rated or to maintain ones rating. Many of the scientists have indicated that the monetary value attached to the rating was an important motivation to undertake the application process. It is anticipated that this revision to IFRR programme will have a negative effect on the number of applications and hence on the projected growth rate.

Female

It is proposed that the projected target number of NRF rated researchers from this designated group in NRF Strategy 2020 for 2019/20 be amended from 1 400 to 1 365. This change is line with the expected impact of the revision to IFRR.

7. Total number of researchers rated through the NRF system

It is proposed that the projected target number of NRF rated researchers in NRF Strategy 2020 for 2019/20 be amended from 4 000 to 3 900. This change is line with expected impact of the revision to Incentive Funding.

8. Number of Masters and Doctoral students funded per level

It is proposed that the projected target number of Masters and Doctoral students funded per level be included in NRF Strategy 2020 for 2019/20 as 3 706 for Masters and 2 941 for Doctoral. This change is line with expected impact of the revision to Incentive Funding.

9. Number of active grants emanating from binational, multinational as well as agency-to-agency agreements

The significant reduction of funding from partnerships, including the removal of the DST top-up funds provided for the past three years through STAF and OBC, as well as the unpredictable timing of funding decisions by some of the international partners, have a negative impact on the target for the number of active grants. It is proposed that the targets for this indicator in NRF Strategy 2020 for 2019/20 be amended from 1 699 to 945.

10. Number of users of equipment that were funded by the NEP and NNEP programmes

Budget cuts for funding of Research Infrastructure and the increase in the cost of research equipment and deteriorating denomination of the Rand/Dollar exchange rate have resulted in fewer grant awards than originally projected, resulting in less new research equipment being funded and commissioned at HEIs and research institutions. Due to longer lead times

required for equipment to be purchased and commissioned, any new allocation for this programme will not yield results in the remaining period of the NRF Strategy 2020.

It is proposed that the projected target for performance indicator in NRF Strategy 2020 for 2019/20 be amended from 2 300 to 2 252.

11. Number of publications emanating from the usage of equipment funded by the NEP and NNEP programmes

The reduction in funding for research equipment supported through the national equipment programme has also required a revision of two indicators, namely the number of users of equipment that was funded by the NEP and NNEP programme and the number of publications emanating from the use of the funded equipment. It is proposed that the target for this indicator in the NRF Strategy 2020 for 2019/20 be amended from 2 900 to 593.

PROGRAMME 4– NATIONAL RESEARCH INFRASTRUCTURE PLATFORMS

The relevance of National Research Facilities is measured by their demand among the scientific community to conduct research, contribution to the development of a pipeline of future researchers and their facilitation of access to related facilities and resources by entering into agreements with complementary partners. It is also proposed that programmes 4 and 5 be combined into a single programme since both programmes comprise of national research facilities, and performance indicators be split between three areas/fields of science, namely, biodiversity and environmental sciences, nuclear science, astronomy and geodetic sciences. The discussion in this proposed amendments to the targets will be structured as per the NRF Strategy 2020, however targets for Astronomy are assumed to apply to astronomy and geodetic sciences.

12. Number of postgraduate students supported by the National Research Facilities

Researchers at the National Research Facilities are a critical resource that ensures that the platforms maintain their competitive capabilities for producing cutting edge research and future talent for the growing knowledge economy. Therefore, the researchers at the National Facilities provide post graduate support by becoming supervisors. When projections for targets in NRF Strategy 2020 were set, it was assumed that the students that make use of the National Facilities, even when not formally supervised by a researcher employed by the NRF could be counted amongst the supported students.

However, this line of reasoning could not be sustained during the recent AoPI by the AG, and therefore the students who were not supervised nor financed by the National Facilities were excluded from the number of postgraduate students supported by the National Facilities. Therefore, it is proposed that the projected targets for this indicator in NRF Strategy 2020 for 2019/20 be amended from 480 to 243 (National Research Facilities., excl. Astronomy) and from 144 to 87 (Astronomy).

13. ISI publications by researchers at the National Research Facilities

It is proposed that reference to “ISI” be changed to “WoS” in order to reflect the commonly used name for this database. This change does not have any impact on the level of planned performance. It is also further proposed that the target for this indicator in the NRF Strategy 2020 for 2019/20 be amended from 174 to 155 (Astronomy).

14. Number of users of National Research Facilities

During the recent AoPI by the AG, it was found that users of auxiliary services located on the facilities were sometimes included in the count for projected targets and actual reported figures in accountability documents, APP and APR. The Technical Indicator Description (TID) in this regard has since been adjusted to improve its reliability and remove ambiguity. As a result, it is proposed that the projected target for this indicator in the NRF Strategy 2020 for 2019/20 be amended from 1 337 to 732 (National Research Facilities., excl. Astronomy) and from 520 to 1468 (Astronomy), with the maturation of the optical and radio astronomy infrastructure.

15. Number of joint international agreements at the National Research Facilities

Similarly, some audit findings were made by the AG on the requirements for agreements that can be counted when reporting progress on the NRF performance information disclosed in APR. Several agreements have not been formally renewed whilst others have lapsed. In order to ensure relevance and to ensure strict application of the TID's, it is therefore proposed that the targets for this indicator in the NRF Strategy 2020 for 2019/20 be amended from 71 (National Research Facilities., excl. Astronomy) to 20 (Nuclear Sciences) and 22 (Biodiversity and environmental sciences).

16. Citation impact of national research facility outputs (annual cumulative)

Citation index will decline in the near future because publications over the past 5 years have increased substantially in comparison to the years that are

being replaced in the rolling 10 year calculations. These new publications are therefore in the system for a shorter period and therefore citations are relatively low compared to a paper that is in the system for over 5 years. The targets set in the NRF Strategy 2020 were therefore too ambitious as reflected in their continuous non-achievement since the beginning of the planning period. It is proposed that the projected target for this indicator in the NRF Strategy 2020 for 2019/20 be amended from >2 to >1.2 for National Research Facilities., excl. Astronomy as well as from >2 to >1.33 for Astronomy.



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