2019/20 SOUTH AFRICA YEARBOOK

Education, Science and Innovation

Education

The Constitution of the Republic of South Africa, 1996 declares basic education as an inalienable basic human right for all South Africans. In 2015, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) adopted the global education agenda, Education 2030, which is part of the 17 United Nations Sustainable Development Goals (SDGs) that make up the Agenda 2030 for sustainable development. SDG 4 calls for an "inclusive, quality and equitable education and lifelong opportunities for all".

The National Development Plan (NDP) states that by 2030 South Africans should have access to education and training of the highest quality, leading to significantly improved learning outcomes. The education system will play a greater role in building an inclusive society, providing equal opportunities and helping all South Africans to realise their full potential.

Education is governed by two national departments namely; the Department of Basic Education (DBE), which is responsible for primary and secondary schools, and the Department of Higher Education and Training (DHET), which is responsible for tertiary education and vocational training.

Accessibility to education has improved significantly over the years ensuring that South Africans are exposed to education in all levels to ensure that socio-economic challenges in the country are addressed.

The Inclusive Education system plays a major role in ensuring that there is access to quality basic education for leaners with special needs. This system contributes immensely towards the achievement of an inclusive economy and inclusive society.

The Early Childhood Development (ECD) programme has ensured that early child development is expanded to all socio-economic levels of society. This programme ensures that school readiness is a priority among South Africans and equal basic education is achieved by the government.

Evaluation and research has been a serious deficiency in the country and the education sector, but over the years, with the introduction of Monitoring, Research and Evaluation in the sector, performance has also improved. There is substantial research conducted within the sector which assists in identifying gaps and also creates a platform to monitor the sector through evidence-based evaluations.

Basic education

The DBE is mandated to monitor the standards of education provision, delivery and performance across South Africa, annually or at other specified intervals, to assess compliance with provisions of the Constitution and national education policy.

The functions of the DBE include:

- managing the development, evaluation and maintenance of policy, programmes and systems for ECD in the reception years;
- developing, evaluating and maintaining an accreditation system for providers and trainers;
- developing and maintaining policy concerning programmes, qualifications and assessment for early childhood development; and;
- rendering support to qualifications and quality assurance authorities concerning early childhood development.

Schooling 2025, the overarching plan for the basic education sector, encapsulates the long-term vision of education priorities, targets and programmes articulated for the sector in the NDP. Over the medium term, the DBE will continue to focus on improving school infrastructure; providing high-quality learner and teacher support materials; developing skills for a changing world; planning for the migration of the ECD function from the social development sector to the basic education sector; providing support to improve matric completion rates; facilitating the increase in supply of quality teachers; and providing nutritious meals for learners through the National School Nutrition Programme.

Improving school infrastructure

The DBE is committed to improving the physical infrastructure and environment at every public school in the basic education sector. To this end, spending on the Education Infrastructure Grant and the School Infrastructure Backlogs Grant in the Planning, Information and Assessment programme accounts for 51% (R41.4 billion) of the department's total budget over the Medium Term Expenditure Framework (MTEF) period.

The Education Infrastructure Grant is allocated R35 billion over the MTEF period, which is transferred to provinces as a supplementary conditional grant for the provision of school infrastructure. Funds from this grant are intended to assist in accelerating the construction, maintenance, upgrading and rehabilitation of new and existing infrastructure in the basic education sector, including district and circuit accommodation. Cabinet has approved reductions on the grant amounting to R1.9 billion over the medium term. Although the reductions are not expected to affect existing projects, provinces will be required to revise their infrastructure plans going forward.

Funds from the School Infrastructure Backlogs Grant are intended to provide water, sanitation and electricity to schools that do not have these basic services; and replace schools that are constructed with inappropriate materials such as mud, wood and tin. Of the grant's R6.5 billion allocation over the MTEF period, R2.8 billion is allocated for the provision of appropriate sanitation facilities. In 2020/21, the DBE plans to spend R1.7 billion of the grant's allocation to build 31 new schools, provide sanitation to 691 schools and water to 125 schools, thereby ensuring that all schools have access to water by the end of 2020/21. Cabinet has approved reductions on the grant, amounting to R122.8 million over the medium term. These reductions could result in delays in the completion of projects.

The Policy on Screening, Identification, Assessment and Support (SIAS) was developed over a period of 10 years through a rigorous process of field testing and consultation. It aims to ensure that all children of school-going age who experience barriers to learning, including people with disabilities, will be able to access inclusive, quality, free, primary and secondary education on an equal basis with other young people in the communities in which they live.

The policy aims to standardise procedures to identify, assess and provide programmes for all learners who require additional support to enhance their participation and inclusion in school, making teachers and parents central to the support processes.

The successful implementation of the SIAS Policy will be an important step towards meeting the obligations of government in respect of the UN Convention on the Rights of Persons with Disabilities as ratified by Cabinet in November 2007, in terms of ensuring an inclusive education system at all levels.

Providing high-quality learner and teacher support materials

Over the the medium term, the DBE will continue ensuring that learners have access to quality learner and teacher support

materials by providing workbooks to learners in grades R to 9. The DBE expects to print and deliver an estimated 58 million workbooks for learners in grades R to 9 in each year over the medium term in life skills, languages and mathematics. These workbooks are expected to be distributed to more than 24 000 public schools across South Africa. To this end, R3.7 billion over the MTEF period is allocated in the Curriculum and Quality Enhancement programme, a subprogramme in the Curriculum Policy, Support and Monitoring programme. The DBE has set aside R6.9 million over the MTEF period in the same programme to introduce a planning and monitoring system to ensure that the correct number and type of workbooks and learner-teacher support materials are delivered to the correct schools. Life skills workbooks for grades 1 to 3 will not be provided to quintiles 4 and 5 schools, due to Cabinet having approved reductions amounting to R93 million over the MTEF period on allocations for workbooks.

Developing skills for a changing world

To prepare learners for jobs in a changing and increasingly digitised world, the DBE plans to enhance the curriculum by introducing new technical subjects. These new subject choices include coding, robotics and data analytics at primary school level. Several public ordinary secondary schools will be transformed into focus schools over the MTEF period. In addition to prioritising mathematics, science and aviation, new technology subjects and specialisations will be introduced at these focus schools. This initiative will be funded through the Maths, Science and Technology Grant, which will also provide resources for workshops and laboratories, information and communications technology (ICT) equipment and support to 1 000 schools, including 200 technical high schools and 300 primary or feeder schools over the same period. The grant has a total allocation of R1.3 billion over the medium term.

Planning for the migration of the ECD function

The NDP envisions quality ECD as a priority for South Africa to improve the overall quality of education and the long-term prospects of its future generations. In line with this vision, President Cyril Ramaphosa announced, in the 2019 State of the Nation Address, that South Africa will proceed towards implementing two years of compulsory preschool for all children before they enter Grade 1. Accordingly, over the medium term, the DBE will work closely with the Department of Social Development and other partners to oversee the migration of the responsibility for ECD from the social development sector to the basic education sector, and the process of introducing two years of compulsory preschool for all children before they enter Grade 1. In 2020/21, the DBE plans to conduct an ECD audit to determine the need across all affected age groups, as well as the quality of provision of these services.

Providing support to improve matric completion rates

In response to the NDP's call to reduce the learner drop-out rate, the Second Chance programme provides support to matric learners who do not meet the pass requirements of the National Senior Certificate (NSC) examinations. Over the MTEF period, the programme's new policy priority will be to include learners with disabilities. Accordingly, the DBE will use the existing 23 special schools for the blind and 43 schools for the deaf as sites of support for learners with disabilities in the Second Chance programme. In addition, as a measure to support the performance of all learners, the DBE will develop a web-based system that will allow multiple users to upload subject support for learners to access. The programme will provide support in subjects such as mathematics, science, accounting and languages; and will facilitate the establishment of 80 face-to-face centres, and appoint more than 800 teachers and 80 centre managers to teach after school hours and over weekends. The programme is allocated R183.2 million over the medium term. However, Cabinet-approved reductions on the Second Chance programme amounting to R67 million over the MTEF period are likely to affect its expansion.

Facilitating an increase in the number of quality teachers

Over the medium term, the DBE plans to continue facilitating an increase in the number of newly qualified teachers in mathematics, science and technology in various phases. This is expected to be achieved by providing 37 500 Funza Lushaka bursaries to prospective teachers. The number of bursary awards is expected to be maintained at 12 500 per year over the MTEF period. This is on condition that general increases in university costs do not exceed average annual increases in allocations to the bursary scheme of approximately 5% over the same period. While prospective Funza Lushaka bursary recipients may qualify for fee-free funding at universities, the DBE expects the demand for Funza Lushaka bursaries to remain unchanged as the guarantee of employment provided by the bursary's work-back provision remains a strong incentive. The bursary scheme is allocated R4.1 billion over the MTEF period.

Providing meals for learners

The National School Nutrition Programme is directly aligned with the NDP's priority of eliminating poverty and supporting food security. Accordingly, in each year over the medium term, nine million learners in 19 950 quintile 1 to quintile 3 schools, as well as identified special schools, will be provided with meals through the programme. The programme is funded through the National School Nutrition Programme Grant, which is allocated R24.3 billion over the MTEF period. The decrease in schools covered by the programme over the medium term is mainly due to the closing and merging of small schools. Reductions approved by Cabinet on the grant amounting to R123.1 million over the medium term will not affect the current provision of meals to learners in quintile 1 to quintile 3 schools. However, the programme's extension to include breakfast and provide meals to selected learners in quintile 4 and quintile 5 schools will be slower.

Legislation

The DBE derives its mandate from the following legislation:

- the National Education Policy Act, 1996 (Act 27 of 1996), which inscribed into law the policies, legislative and monitoring; responsibilities of the Minister of Basic Education, and the formal relations between national and provincial authorities;
- the South African Schools Act, 1996 (Act 84 of 1996), which promotes access to quality education and democratic governance; in the schooling system, and makes schooling

compulsory for children aged seven to 15 to ensure that all learners have access to quality education without discrimination; and
- the Employment of Educators Act, 1998 (Act 76 of 1998), which regulates the professional, moral and ethical responsibilities of educators, as well as the competency requirements for teachers.

Budget

The DBE was allocated R24.5 billion for the 2019/20 financial year. Allocations to the department are set to increase at an average annual rate of 5.3%, from R24.5 billion in 2019/20 to R28.6 billion in 2022/23. Transfers and subsidies account for the bulk of the department's expenditure, increasing at an average annual rate of 5.4%, from R20.1 billion in 2019/20 to R23.5 billion in 2022/23.

Entity

South African Council for Educators (SACE)

The SACE aims to enhance the status of the teaching profession through registering educators appropriately, managing professional development and promoting a code of ethics for all educators. It was established in terms of the SACE Act, 2000 (Act 31 of 2000).

Before their employment, educators are required to register with the SACE, which has a register of about 500 000 educators. The council has strengthened entry requirements by checking applicants' professional standing.

The SACE has a number of programmes that promote the development of educators and enhance the status and image of the teaching profession. These include:
- the Professional Development Portfolio Project, which aims to encourage educators to reflect on their practice and take responsibility for their own professional development;
- teacher education and development research activities;
- setting up the Continuing Professional Teacher Development (CPTD) System;
- celebrating World Teachers' Day to acknowledge the work of educators; and ensuring that educators adhere to the SACE Code of Professional Ethics, and
- the CPTD System, which recognises professional development undertaken by educators on their own initiative. The council's total budget for 2020/21 was R107.3 million.

Role players

Provincial departments of education

The role of the DBE is to translate government's education and training policies and the provisions of the Constitution into a national education policy and legislative framework.

The DBE works closely with the provincial education departments (PEDs) to ensure that provincial budgets and strategies are in line with and support national policies.

The national department shares a concurrent role with the PEDs for basic schooling and ECD, but it is the responsibility of each PED to finance and manage its schools directly.

District offices are the PEDs' main interface with schools. Not only are they central to the process of gathering information and diagnosing problems in schools, but they also perform a vital support and intervention function.

This includes organising training for personnel; dealing with funding; resourcing bottlenecks; and solving labour-relations disputes. District offices are key to ensuring that school principals remain accountable to PEDs and that accountability lines within the school to the principal and to the school governing body are maintained.

Equity in education expenditure between and within provinces is achieved through the equitable division of national revenue between provinces, making use of the Equitable Shares Formula, the National Norms and Standards for School Funding, and the national post-provisioning norms.

The norms are progressive, with 60% of a province's non-personnel expenditure going to the poorest 40% of learners in public schools. The poorest 20% of learners receive 35% of non-personnel resources, while the richest 20% receive 5%.

Council of Education Ministers (CEM)

The CEM, comprising of the Ministers of Basic Education, and Higher Education and Training as well as the nine provincial members of the executive councils for education, meets regularly to discuss the promotion of the national education policy, share information and views on all aspects of education in South Africa and coordinate action on matters of mutual interest.

Heads of Education Departments Committee (HEDCOM)

The HEDCOM comprises the Director-General (DG) of the DBE, the deputy DGs of the national department and the heads of provincial departments of education.

The purpose of the committee is to facilitate the development of a national education system, share information and views on national education, coordinate administrative action on matters of mutual interest and advise the DBE on a range of specified matters related to the proper functioning of the national education system.

Umalusi Council for Quality Assurance in General and Further Education and Training

The council sets and maintains standards in general, and further education and training, through the development and management of the sector's qualifications sub-framework.

It is tasked with the certification of the following qualifications:
- Schools: NSC.
- Technical and Vocational Education and Training (TVET) colleges: the National Technical Certificate (Level N3) and the National Certificate Vocational.
- Adult learning centres: the General Education Training Certificate – Adults.

To issue learners with certificates that are credible, the council:
- develops and evaluates qualifications and curricula to ensure that they are of the expected standard;
- moderates assessment to ensure that it is fair, valid and reliable;
- accredits providers of education and training, as well as assessment;
- conducts research to ensure educational quality; and
- verifies the authenticity of certificates.

National Education Evaluation and Development Unit (NEEDU)

The NEEDU ensures effective evaluation of all educators based on the extent to which learner performance improves. Its core responsibilities include:

- providing the Minister of Basic Education with an independent account of the state of schools, including the quality of teaching and learning in all schools;
- providing an independent account on the development needs of the school education system;
- accounting for the attainment of the standards by all schools through a monitoring and evaluation system;
- identifying, on a systemwide basis, the critical factors that inhibit or advance school improvement and making focused recommendations for redressing problem areas that undermine school improvement;
- proposing appropriate sanctions to ensure that schools offer effective education for all learners;
- strengthening internal evaluation capacity within schools in ways that inform and complement external evaluation;
- monitoring the different levels of school support and the extent action is considered on proposed interventions, whether in the form of developmental support or disciplined action;
- reviewing and assessing existing monitoring, evaluation and support structures and instruments regularly, to ensure clarity and coherence in the way schools and teachers are assessed and supported;
- providing schools with evidence-based advice on how to pursue school improvement in their particular context; and
- promoting school improvement through the dissemination of good practice.

The NEEDU completed its first five-year cycle of systemic evaluations by identifying, on a system-wide basis at school, district and provincial levels, the factors that inhibit or advance school improvement. The findings were in the following areas:

- Reading: Teachers in the 134 rural schools visited did not have a good method to teach foundational level learners how to read. Actions taken include a Reading Advisory Committee to advise on reading matters, prioritising reading support in the provinces, and piloting the Early Grade Reading Assessment.
- Curriculum delivery: Gaps such as the development and implementation of Provincial Literacy and Numeracy were observed in curriculum delivery. Actions taken included asking for learners' books to monitor quality of writing and held school management teams and principals accountable for curriculum delivery.
- Use of learning and teaching support materials: Most learners in primary schools did not have sufficient learning and teaching support materials as well as textbooks for Mathematics and languages due to an ineffective retrieval system from previous learners. Actions taken included developing policies that ensured that textbooks were retrieved from schools that did not have a good retrieval system.
- Time management: Many schools experienced time management issues such as tardiness and absenteeism by learners and teachers; and teachers did not follow the time allocated to subjects on the timetable. Actions taken included monitoring of time management in schools by district and provincial officials. The DBE and the Minister of Basic Education engaged district and provincial officials in a discourse on time management.
- Assessment: Teachers in most schools were not able to construct/set assessment items of good quality. Learners perform "well" in school-based assessments but poorly in common and international assessments. Teachers assess what they have taught, not what they ought to have taught. Few schools had school improvement plans that were informed by assessments. Actions taken by the DBE included aligning PED school improvement plans with DBE plans. Subject committees and school-based assessment workshops were conducted in provinces to train advisors in setting up quality tasks.
- Special schools: The preliminary findings indicated that special schools did not have a systemic way of admitting learners and different curricula were used in each special school. Findings at the school level were presented to districts and PEDs to take necessary actions.

During the second five-year cycle (2017 – 2021), the focus shifted to development to ensure the system-wide impact of the NEEDU's findings.

Education Labour Relations Council (ELRC)

The ELRC serves the public education sector nationally. It is a statutory council, initially established by the Education Labour Relations Act, 1993 (Act 146 of 1993), but draws authority from the Education Labour Relations Act, 1995 (Act 66 of 1995).

The main purpose of the council is to maintain labour peace within public education through processes of dispute prevention and resolution.

These include collective bargaining between the educator unions and the DBE as the employer. The ELRC also conducts various workshops to increase the level of awareness and understanding of sound labour-relations procedures.

Educator unions

Educators are organised into six educator unions:

- National Professional Teachers' Organisation of South Africa.
- National Teachers' Union.
- South African Teachers' Union.
- Professional Educators' Union
- Cape Professional Teachers' Association.
- South African Democratic Teachers' Union.

A labour-relations framework was agreed on by the then Ministry of Education and the unions. This encompasses both traditional areas of negotiation and issues of professional concern, including pedagogy and quality-improvement strategies.

An agreement was reached on the Framework for the Establishment of an Occupation-specific Dispensation (OSD) for educators in public education. The OSD provides for dual career paths, where educators and specialists in classrooms can progress to levels where they earn salaries that are equal to or higher than those of managers without moving into management/supervisory posts.

It also provides for a new category of posts for teaching and learning specialists and senior learning and teaching specialists, as well as the creation of a cadre of education managers at school and office level.

Education during COVID-19

The COVID-19 pandemic brought heightened uncertainly in the education space. The government set out an evolving plan

of action to ensure that the academic year was not lost. This included a phased approach to opening schools which were closed in March 2020, the postponement of the May/June examinations and digital curriculum support.

Back to school phased approach

The closing of schools in March 2020, due to the COVID-19 pandemic, necessitated the need for government to revise the original school calendar which would have ended on 4 December 2020.

The education sector, health experts and the Coronavirus National Command Council worked together to ensure that the DBE complied with set COVID-19 protocols before schools could reopen. These included sanitation measures, availability of water, provision of masks and social distancing in the schools.

Once schools were given the greenlight for compliance, learners would return to the classroom in a phased and staggered approach, starting with the exit stage grades, which are grades 7 and 12. The return of learners was dependant on the preparedness of schools. The DBE also postponed the May/June Matric rewrite examinations, which were due to be written by more than 350 000, mainly part-time candidates, from 4 May 2020.

The DBE had not been able to complete its preparations, which included the printing and distribution of question papers, the appointment of invigilators, markers and the general readiness in marking centres, due to lockdown restrictions.

The 2020 May/June examinations were expected to be merged with the November examinations. The DBE estimated that over one million candidates would sit for the end-of-year matric examinations in this merged format, which included the Amended Senior Certificate and NSC. This would be the biggest matric examination ever seen in the country.

Home learning

According to the Social Impact of COVID-19 (Wave 3): Mobility, Migration, and Education in South Africa Survey by Statistics South Africa, 72.9% of children were participating in home learning during COVID-19 restrictions – a national lockdown period which began on 26 March 2020 where all South African residents, except a few categories of essential workers, had to stay home.

Home learning was also mostly supervised by mothers (59%) and 75.9% indicated that they had smart phones that could be used for this educational purpose, 36.1% had access to tablets, 61.2% to laptops and 6.1 % reported not having access to the internet. The survey also highlighted that 68.4% of children had difficulty in adapting with the new mode of learning. In addition, one out of four respondents thought it was safe for children to attend school, whilst eight out of 10 said attending school posed a risk to children.

Teacher Connect application

In September 2020, the DBE launched the Teacher Connect application (app) – a free real-time based mentorship platform available via WhatsApp. The app allows users to connect, be a helpdesk, and provide learning and mentoring through real-time dashboards. The app is also integrated with Health Check – a COVID-19 digital risk assessment and mapping tool that enables the Department of Health (DoH) to track and monitor potential cases.

The platform offers a one stop digital solution for teachers and learners in the time of COVID-19 pandemic. It was expected to assist in the phased reopening of schools. The tool is also expected to help the government to align with the DoH's protocols on screening, testing and linkages to care. It also places non-pharmaceutical measures in the hands of the schooling community, teachers, non-teaching staff, parents and learners.

To make use of the app, teachers, parents and learners can log into the platform to answer a few questions relating to COVID-19 symptoms and risk. Teachers and the school communities are required to do the health screen test all the time. Before entering the school premises, learners and staff should show that they have completed the daily health check and are cleared to continue to the school premises. Those classified as moderate or high risk are entered into the DoH's tracking and tracing process.

The app was endorsed by the director of the UNESCO regional office for Southern Africa Professor Hubert Gijzen – an important factor in light of the global education coalition, a flagship intervention driven by the UNESCO, which is aimed at protecting the right to education, under unprecedented disruption and beyond. The endorsement by the UNESCO confirms that South Africa is on the right track to protecting and supporting the most powerful influence on education – the teachers.

To access the app, teachers, parents and learners should save the Teacher Connect app number: 060 060 3333.

Higher Education, Science and Innovation

The DHET and the Department of Science and Innovation (DSI) now report to the Minister of Higher Education, Science and Inovation, but will still exist as separate votes. The two departments agreed that the DSI will carry the costs of the office of the Minister of Higher Education, Science and Innovation, and the DHET will carry the costs of the office of the Deputy Minister in the 2019/20 financial year.

Higher Education and Training

The NDP envisages that by 2030, South Africans should have greater access to post-school education and training opportunities through a system that is responsive to their needs. This is supported by Priority 2 (education, skills and health) of government's 2019 – 2024 Medium Term Strategic Framework. Over the medium term, the DHET will aim to give expression to these guiding policies by focusing on transforming universities and increasing student financial aid; expanding access to TVET colleges and improving their performance; developing artisans; and strengthening the governance of the community education and training sector.

The objective is to develop and support a quality higher and vocational education sector, and promote access to higher education, vocational education and skills development training opportunities.

Transforming universities and increasing student financial aid

Over the medium term, the DHET will focus on transforming the higher education sector into a high quality, demographically

representative system that provides students and staff with opportunities for access and success. To support transformation in the sector, the department will implement the University Capacity Development programme at a projected cost of R1.1 billion in 2020/21, the Historically Disadvantaged Institutions Development programme at a projected cost of R536.3 million in 2020/21, and the Infrastructure and Efficiency programme at a projected cost of R2.8 billion in 2020/21. These programmes are intended to increase student access; enhance staff development, particularly in teaching, research and leadership; and enhance management and curriculum development in priority areas in the university system by increasing allocations to universities with a high proportion of students and staff from historically disadvantaged population groups.

Ensuring that universities have adequate infrastructure for learning and student accommodation is pivotal for the sector over the medium term. However, spending in this regard has been slow due to delays in procurement, and poor performance by contractors and implementing agents. The DHET will prioritise the resolution of these issues over the medium term through the implementation of the Macro Infrastructure Framework to improve the delivery of infrastructure within the sector. Despite Cabinet approving reductions of an estimated R621.3 million over the MTEF period on allocations for university infrastructure in the University Education programme, R8.8 billion is allocated in the University Subsidies subprogramme for spending on university infrastructure. This allocation is expected to contribute to the department's aim of developing 200 000 new university beds by 2026.

The University Education programme constitutes 68.3% (R252.6 billion) of the department's budget over the medium term. Transfers of government subsidies to 26 universities through grants constitute the bulk of spending in this programme, and are projected to increase at an average annual rate of 5.3%, from R42.4 billion in 2019/20 to R49.4 billion in 2022/23. These transfers are intended for operational costs such as compensation of employees and the maintenance of assets related to university teaching, and learning and research activities. Transfer payments to the National Student Financial Aid Scheme (NSFAS) for bursaries to support undergraduate students from poor and working-class backgrounds in universities and TVET colleges are expected to amount to R109.6 billion over the medium term. These are set to increase at an average annual rate of 7.7%, from R30.5 billion in 2019/20 to R38.2 billion in 2022/23, despite R899.2 million of Cabinet's approved reductions to the programme being on the scheme's allocation for TVET colleges.

Expanding access to TVET colleges and improving their performance

Expanding access to skills programmes that address the labour market's need for intermediate skills that include practical components is one of the DHET's key mandates. Over the medium term, the department will work towards improving the quality of the post-school education and training system by establishing more entrepreneurship hubs to enable TVET college students to realise their potential and become actively engaged in the economy, either through employment in the labour market or self-employment. To facilitate this, teaching and learning support plans will be implemented in TVET colleges. Transfer payments to 50 colleges, in the TVET System Planning and Institutional Support subprogramme, are projected to increase at an average annual rate of 6.5%, from R11.6 billion in 2019/20 to R14 billion in 2022/23. This increase is despite Cabinet's approved reduction on allocations to the TVET programme of R2.6 billion over the MTEF period. The transfers include R1.2 billion for the operationalisation of three new TVET college campuses and R2.9 billion for the TVET Infrastructure Efficiency Grant.

Spending on compensation of employees accounts for an estimated 52.8% (R23.1 billion) of the TVET programme's budget of R43.7 billion over the medium term, increasing at an average annual rate of 5%. The TVET component accounts for an estimated 57.4% (more than 19 000) of the total number of personnel in the DHET.

Developing artisans

Over the medium term, the DHET aims to improve the public skills development system by managing the performance of service-level agreements with Sector Education And Training Authorities (SETAs) more effectively, and by providing funding to trade and quality assurance institutions for occupational qualifications. These institutions play a pivotal role in increasing the number of qualified artisans by rolling out skills programmes, learnerships, internships and apprenticeships, and by establishing partnerships with TVET colleges, universities and the labour market to provide opportunities for workplace experience.

Through the SETAs, over the medium term, 93 000 new artisans are expected to be registered for training and 75 000 artisan learners are expected to qualify. For this purpose, R347.8 million over the medium term is allocated.

Income generated through the skills development levy, which is collected from employers by the South African Revenue Service (SARS) and transferred to SETAs and the National Skills Fund (NSF) as a direct charge against the National Revenue Fund, contributes significantly to key performance areas of the public skills development system, including artisan development. This transfer is in the Skills Development programme, and is projected to increase at an average annual rate of 5.8%, from R18.6 billion in 2019/20 to R22 billion in 2022/23.

In August 2020, the Department of Public Works and Infrastructure signed a training agreement following the provision of R66 million to the Agricultural Sector Education Training Authority (AgriSETA) to train 400 Expanded Public Works Programme (EPWP) participants to become artisans. This was part of the NSF to provide training through the EPWP on skills programmes, learnerships and artisan development programmes over a multi-year period.

AgriSETA was responsible for sourcing relevant workplaces for all 400 trainees in artisan development, as well as to certify all accreditation requirements of training and appointment of service delivery agents for the duration of the project.

The project aligns to the National Skills Development Strategy (NSDS) 3 and the National Skills Development Plan 2030 which prioritise artisan development programmes to address technical skills shortages.

Strengthening governance of the community education and training sector

The DHET recognises that improving the community education and training sector is key for development as it has the potential to provide students with access to a comprehensive range of programmes that lead to part and full qualifications and employment opportunities, including entrepreneurial opportunities. To ensure that the sector rises to its potential, the DHET will continue to prioritise the development and training of lecturers in community education and training colleges and learning centres by enabling them to upgrade their qualifications, with a particular focus on mathematics and science. The DHET has also strengthened its recruitment policies so that only qualified lecturers are employed in the sector.

Expenditure in the Community Education and Training programme is expected to increase at an average annual rate of 9.1%, from R2.1 billion in 2019/20 to R2.8 billion in 2022/23, with 93.4% of this spending earmarked for compensation of employees. About 39.2% of the department's personnel, mainly community education and training educators, are in this programme, in 3 276 community learning centres throughout the country.

Legislation

Key policies and legislation relating to Higher Education and Training in South Africa include:

- the Continuing Education and Training Act, 2006 (Act 16 of 2006), which provides for the regulation of continuing education and training, the establishment of governance structures for and the funding of public TVET colleges and community education and training colleges, the registration of private colleges, and the promotion of quality in continuing education and training;
- the Higher Education Act, 1997 (Act 101 of 1997), which provides for a unified national system of higher education;
- the National Qualifications Framework (NQF) Act, 2008 (Act 67 of 2008), which provides for the NQF, the South African Qualifications Authority and quality councils for the issuing and quality assurance of qualifications required by the sub-frameworks of the NQF.
- the NSFAS Act, 1999 (Act 56 of 1999), which provides for the granting of loans and bursaries to eligible students attending public higher education and training institutions, and the subsequent administration of such loans and bursaries;
- the Skills Development Act, 2008 (Act 37 of 2008), which enables the creation of the National Skills Authority, sector education and training authorities, the establishment of the Quality Council for Trades and Occupations, and the regulation of apprenticeships, learnerships and other matters relating to skills development; and
- the Skills Development Levies Act, 1999 (Act 9 of 1999), which provides for the imposition of skills development levies.

Budget

The DHET was allocated R107.8 billion for the 2019/20 financial year. It has a total budget of R369.5 billion over the medium term, of which 90.6% is earmarked for transfers and subsidies mainly to departmental agencies and accounts, and higher education institutions. Cabinet has approved budget reductions amounting to R4.5 billion over the MTEF period to be effected mainly on transfers and subsidies in the University Education programme and the TVET programme; a technical inflation adjustment amounting to R62.2 million in 2020/21 and R66.2 million in 2021/22 on compensation of employees across programmes; and R60.1 million on compensation of employees and goods and services as a result of the consolidation of the offices of the Ministers and Deputy Ministers of the DHET and the DSI through the 2019 National Macro Organisation of Government.

National Skills Development Strategy

The key driving force of the NSDS 3 (2011 – 2020) was improving the effectiveness and efficiency of the skills development system. It promotes the linking of skills development to career paths, career development and promoting sustainable employment and in-work progression. The emphasis is particularly on people who do not have relevant technical skills or adequate reading, writing and numeracy skills to enable them to find employment.

The development strategy promotes partnerships between employers, public education institutions, TVET colleges and universities and private training providers to ensure that cross-sectoral and intersectoral needs are addressed.

The NSDS 3 is guided by, and measured against, several key developmental and transformation imperatives, such as race, class, gender, geographic considerations, age differences, disability, and HIV and AIDS.

The NSDS 3 addresses the scope and mandate of the SETAs. The SETAs are expected to facilitate the delivery of sector-specific skills interventions that help achieve the goals of the strategy, address employer demand and deliver results. They must be recognised experts in relation to skills demand in their sectors.

The strategy emphasises the relevance, quality and sustainability of skills training programmes focusing on eight goals, namely:

- establishing a credible institutional mechanism for skills planning, and ensuring that the national need in relation to skills development is researched, documented and communicated to enable effective planning across all economic sectors;
- increasing access to occupation-specific programmes targeting intermediate and higher-level professional qualifications;
- promoting the growth of a public TVET college system that is responsive to sector, local, regional and national skills needs and priorities;
- addressing the low level of youth and adult language and numeracy skills to enable additional training;
- encouraging better use of workplace-based skills development;
- encouraging and supporting cooperatives, small enterprises, worker-initiated non-governmental organisation and community-training initiatives;
- increasing public-sector capacity for improved service delivery and supporting the building of a developmental state; and
- building career and vocational guidance.

Entities

National Skills Fund

The NSF was established in 1999 in terms of Section 27 of the Skills Development Act, 1998 (Act 97 of 1998).

The fund focuses on national priority projects identified in the NSDS, projects related to the achievement of the purposes of the Act, as determined by the DG of Higher Education and Training, and any activity undertaken by the Minister of Higher Education, Science and Innovation to achieve a national standard of good practice in skills development.

To create greater opportunities for young people who are out of school, the fund will invest in skills development initiatives in areas of national priority such as artisan development. The fund will also continue to provide training opportunities through work-integrated learning programmes at public and private institutions for learners to acquire skills, and provide financial support for bursaries and infrastructure to grow and enhance the quality of the post-school education and training system.

Over the MTEF period, the fund aims to contribute to the development of skills for 3 300 small, medium and micro enterprises (SMMEs) and cooperatives; facilitate the acquisition of various skills for 31 500 learners through community-based skills development initiatives; fund education and training for occupations in high demand for 111 000 learners; fund education and training programmes for 106 200 learners from rural areas; and pursue priority projects such as the development of infrastructure at TVET and community colleges aimed at expanding, integrating and improving the effectiveness of the post-school education and training system. To fund these skills development and infrastructure initiatives, total expenditure over the medium term is projected to be R16.1 billion, increasing from R4.3 billion in 2019/20 to R5.2 billion in 2022/23 at an average annual rate of 6.4%.

To improve its reporting on performance and financial management over the medium term, the fund will prioritise the implementation of a new ICT system funded from its administration budget, which is set to increase from R279.8 million in 2019/20 to R315.8 million in 2022/23 at an average annual rate of 4.1%.

The fund is set to derive an estimated 86.4% (R12.4 billion) of its total revenue over the medium term through the Skills Development Levy, which is collected from employers by the SARS and transferred to the fund as a direct charge against the National Revenue Fund. This transfer is projected to increase at an average annual rate of 5.8%, from R3.7 billion in 2019/20 to R4.4 billion in 2022/23.

National Student Financial Aid Scheme

The NSFAS was established in terms of the NSFAS Act of 1999. The scheme is responsible for providing loans and bursaries; developing criteria and conditions for the granting of loans and bursaries to eligible students in consultation with the Minister of Higher Education, Science and Innovation; raising funds; recovering past loans; maintaining and analysing a database of funded students; undertaking research for the better use of financial resources; advising the Minister on matters relating to student financial aid; and undertaking other functions assigned to it by the Act or the Minister.

Over the MTEF period, the scheme will continue to provide financial assistance to undergraduate university and TVET college students from households with a combined annual income of less than R350 000, and students with disabilities from households with a combined annual income of less than R600 000. To ensure that this core function is fulfilled, over the medium term, the scheme will focus on reviewing the business processes necessary for it to function optimally and improving efficiency. Funding for these activities over the medium term is within operational transfers from the DHE of R943.7 million and administration fees from stakeholders of R144.8 million.

The scheme aims to support an estimated 945 854 undergraduate students in universities and 871 401 students in TVET colleges over the MTEF period. Due to a lower than anticipated intake of students at TVET colleges, Cabinet has approved a reduction of R899.2 million over the medium term on the allocation for TVET student bursaries. Despite these reductions, the scheme's allocation from the DHET is set to increase at an average annual rate of 7.7%, from R30.8 billion in 2019/20 to R38.5 billion in 2022/23.

Transfers from the DHET for student funding constitute an estimated 91.5% (R109.6 billion) of the scheme's total projected revenue over the period ahead. The balance of R10.2 billion is derived mainly through transfers from the DBE, the NSF and SETAs; fees charged for administering bursaries; and interest on funds held in call accounts prior to disbursement.

Strengthening governance and administration

When the NSFAS was put under administration in 2018/19, it responded by focusing on disbursing funds to qualifying students instead of securing new funding. Since then, significant effort has been directed towards maintaining stability through making systematic monthly payments to institutions and students, rebuilding relationships across the sector, increasing the scheme's visibility, providing hands-on support at institutions across the country to expedite the resolution of queries that halted the flow of student funding, and restoring public trust. The re-establishment of the scheme is expected to be completed over the MTEF period through the institutionalisation of sound governance and management structures. This will be followed by the appointment of a new executive team, a focus on hiring technical human capital, and the transfer skills from consultants and advisers to permanent staff. Although the number of personnel in the scheme is set to decrease from 529 in 2019/20 to 509 in 2022/23, mainly due to planned retirements and the conclusion of contracts, spending on compensation of employees is set to increase from R220.1 million in 2019/20 to R252.2 million in 2022/23 at an average annual rate of 4.6%.

Improving efficiency

There has been a stagnation in recoveries since the announcement of free higher education and the settlement of historic debt. This has implications for the sustainability of the scheme's funding model. To address this, the NSFAS will focus on recovering loans from existing debtors through obtaining deduction agreements from public and private sector employees in terms of the National Credit Act, 2005 (Act 34 of 2005). As a result, the principal repayment of loaned funds is projected to be R2.7 billion over the medium term, increasing from R675.4 million in 2019/20 to R980.8 million in 2022/23 at an average annual rate of 13%. Based on these estimates, spending on debt collection is set to increase from R28.8 million in 2019/20 to R37.9 million in 2022/23.

In line with National Treasury's guidelines, the scheme has implemented a number of cost-containment measures that are not expected to have a negative impact on service delivery.

The payment of allowances for books, food, accommodation and transport directly into students' bank accounts instead of to institutions is expected to result in a decrease of R33 million in projected expenditure on administration fees over the medium term. Spending on consultants is expected to decrease from R40.6 million in 2019/20 to R12.6 million in 2022/23 due to the completion of forensic investigations and the integration and streamlining of data systems and processes. Further, by making better use of meetings, spending on workshops and conferences, and travel and subsistence is expected to be contained to an average annual rate of only 1.9% over the medium term, from R18.6 million in 2019/20 to R19.7 million in 2022/23.

Sector education and training authorities

The Skills Development Act of 1998 mandates SETAs to implement national, sector and workplace strategies to develop and improve skills in the South African workforce, provide learnerships that lead to recognised occupational qualifications, and fund skills development. The authorities derive their objectives directly from the NSDS, which aims to increase access to occupationally directed programmes, promote the growth of public TVET colleges, address low levels of youth and adult literacy and numeracy skills, and encourage the better use of workplace-based skills development.

Over the medium term, the authorities' core focus will be on strengthening and delivering relevant priority skills to South Africa's labour market, with particular emphasis on artisan development; apprenticeships; learnerships; internships; bursaries; partnerships with TVET colleges, universities and the market; improved institutional research capacity, monitoring and evaluation; and the development of SMMEs to provide work experience opportunities. Over the medium term, R29.5 billion from the Skills Development Levy Discretionary Grant is expected to fund the awarding of 45 529 bursaries to unemployed people and 32 763 bursaries to workers to attain higher education and training qualifications. An estimated 476 861 people are expected to enter skills programmes funded through payments made to employers for training and developing the skills of their workers or of unemployed people.

The authorities are expected to derive 88.3% (R49.6 billion) of their revenue over the MTEF period through the skills development levy, which is collected from employers by the SARS and transferred to the authorities as a direct charge against the National Revenue Fund. Levy payments are expected to increase at an average annual rate of 5.8%, from R14.9 billion in 2019/20 to R17.6 billion in 2022/23.

Universities

South Africa's higher education landscape comprises the following institutions:

- Cape Peninsula University of Technology
- Central University of Technology, Free State
- Durban Institute of Technology
- Mangosuthu University of Technology
- National Institute for Higher Education, Northern Cape
- National Institute for Higher Education, Mpumalanga
- Nelson Mandela Metropolitan University (NMMU)
- North-West University (NWU)
- Rhodes University
- Sefako Makgatho Health Sciences University
- Sol Plaatje University, Northern Cape
- Tshwane University of Technology
- University of Cape Town (UCT)
- University of Fort Hare
- University of the Free State
- University of Johannesburg
- University of KwaZulu-Natal
- University of Limpopo
- University of Mpumalanga
- University of Pretoria
- University of South Africa
- University of Stellenbosch
- University of Venda (UNIVEN)
- University of the Western Cape
- University of the Witwatersrand (Wits)
- University of Zululand
- Vaal University of Technology
- Walter Sisulu University, Eastern Cape

Science and Innovation

The DSI derives its mandate from the *1996 White Paper on Science and Technology,* which introduced the concept of the National System of Innovation (NSI), a set of interacting organisations and policies through which the country creates, acquires, diffuses and puts into practice new knowledge to help achieve individual and collective goals. A coordinated and efficient NSI will help South Africa achieve its national development priorities by promoting change through innovation, enabling all South Africans to enjoy the economic, sociopolitical and intellectual benefits of science, technology and innovation (STI).

The NDP also identifies STI as primary drivers of economic growth, job creation and socio-economic reform. Central to this identification is the emphasis of the *2019 White Paper on Science, Technology and Innovation* on the themes of inclusivity, transformation and partnerships. The White Paper is aimed at improving policy coherence, developing human capabilities, expanding knowledge, improving innovation performance and increasing investment. The work of the DSI is pivotal in realising these goals, particularly the initiatives it champions for innovation in the challenging fields of energy, food security, poverty alleviation and health care.

The DSI's strategic goals are to:

- develop the innovation capacity of the NSI to contribute to socio-economic development;
- enhance South Africa's capacity for generating knowledge to produce world-class research outputs and turn some advanced findings into innovation products and processes;
- develop appropriate human capital in the STI sector to meet the needs of society;
- build world-class infrastructure in the STI sector to extend the frontiers of knowledge, train the next generation of researchers, and enable technology development and transfer as well as knowledge exchange; and
- position South Africa as a strategic international research and development, and innovation partner and destination through the exchange of knowledge, capacity and resources between South Africa and its regional and other international partners, thus strengthening the NSI.

Over the medium term, the DSI will focus on developing human capital, generating and exploiting knowledge and innovation, and building and maintaining infrastructure for research and innovation.

Developing high-end human capital

High-end, innovative human capital is key to the development of a globally competitive, expanded and transformed NSI that is responsive to South Africa's developmental needs, in line with the imperatives articulated in the *2019 White Paper on Science, Technology and Innovation.* Accordingly, R15.3 billion over the medium term is allocated to the Research Development and Support programme for the development of human capital through the provision of postgraduate bursaries and scholarships, internships,support for emerging and established researchers, and strategic instruments such as the South African Research Chairs Initiative. This expenditure is designed to attract and retain talent in research and innovation at South African public universities and centres of excellence, which act as hubs to tackle persistent and emerging challenges in critical areas such as health, food security, human development, energy and biodiversity.

To date, the DSI has established 239 research chairs and 14 centres of excellence. Included in the programme's allocation is a transfer of R6.3 billion over the medium term to the National Research Foundation (NRF). This transfer is aimed at awarding 20 600 bursaries to postgraduate (bachelor of technology, honours and master's) students and 7 400 bursaries to doctoral students, mainly in the fields of science, engineering and technology, as part of programmes to prepare them for work; and improving the foundation's infrastructure.

Generating and exploiting knowledge and innovation

In its efforts to generate and exploit knowledge and innovation that is in line with government's priorities for inclusive economic growth, the DSI plans to invest R5.8 billion over the medium term in the development of industry, particularly in high-potential fields such as aresospace, advanced manufacturing, chemicals, advanced metals, mining and ICT; the creation of instruments to increase the competitiveness of SMMEs; and youth, by fully funding and co-funding 1 454 master's and doctoral students, and 590 interns over the medium term.

An estimated R3.4 billion of this amount, in the Sector Innovation and Green Economy subprogramme, is earmarked for advancing technology-based interventions intended to enhance South Africa's economic competitiveness and increase exports. The DSI plans to do this by creating an environment in which government can effectively partner with industry to co-fund research, development and innovation. Of this R3.4 billion, R123.6 million is expected to be invested in a range of ICT initiatives such as artificial intelligence, nanotechnology, quantum computing and biotechnology. Activities related to advancing the development of a joint industry-government mining R&D hub will be funded through an allocation of R1.2 billion over the medium term.

The DSI is set to receive an additional R1.2 billion over the medium term to set up the Sovereign Innovation Fund, which is expected to leverage co-investment by the public and private sectors to address gaps in technology commercialisation. The fund will be designed to complement and enhance existing funding instruments, and provide large-scale funding for the development and maturation of radical innovations and emerging industries.

Investing in infrastructure for research and innovation

The DSI's research infrastructure roadmap is intended to provide a strategic framework for planning, implementing, monitoring and evaluating the provision of research infrastructure necessary to create and maintain a competitive and sustainable NSI. Accordingly, the department aims to improve the outcomes and quality of research by providing and increasing access to research equipment and facilities through an allocation of R3.4 billion over the medium term in the Basic Science and Infrastructure subprogramme. A significant portion of this investment is earmarked for the ongoing implementation of roadmap projects in the thematic areas of humans and society; health, biological and food security; earth and environment; materials and manufacturing; energy; and physical sciences and engineering.

The national integrated cyberinfrastructure system supports the successful and sustainable implementation of national projects such as the MeerKAT and the Square Kilometre Array (SKA), as well as large research infrastructure required for the processing and transmission of large amounts of data dependent on the presence of a robust cyberinfrastructure system. To complete the installation of receivers on the MeerKAT project; maintain the MeerKAT telescope and operations; expand the MeerKAT telescope; and continue with strategic interventions such as the SKA, the human capital development bursary programme, and science outreach and socio-economic projects, the Astronomy subprogramme is allocated R2.6 billion over the MTEF period.

For scientific research in strategic research areas defined by South Africa's geographic advantage, such as palaeosciences, astronomy, climate change, indigenous knowledge, and marine and polar research, R782.5 million over the MTEF period is allocated to the Science Missions subprogramme.

Legislation

The DSI is governed by the following legislation:

- the Intellectual Property (IP) Rights from Publicly Financed Research and Development Act, 2008 (Act 51 of 2008), provides for the more effective use of IP emanating from publicly financed research and development (R&D), through the establishment of the National Intellectual Property Management Office (NIPMO), the Intellectual Property Fund, and offices of technology transfer at institutions;
- the Technology Innovation Act, 2008 (Act 26 of 2008), intends to promote the development and exploitation in the public interest of discoveries, inventions, innovations and improvements, and for that purpose establishes the Technology Innovation Agency;
- the South African National Space Agency (SANSA) Act, 2008 (Act 36 of 2008), establishes the SANSA to promote space science research, cooperation in space-related activities and the creation of an environment conducive for the development of space technologies by industry;
- the Natural Scientific Professions Act, 2003 (Act 27 of 2003), establishes the South African Council for Natural Scientific

Professions, and legislates the registration of professional natural scientists, natural scientists-in-training, natural science technologists and natural science technologists-in-training;

- the NRF Act, 1998 (Act 23 of 1998), establishes the NRF to promote basic and applied research, as well as the extension and transfer of knowledge in the various fields of science and technology;
- the National Advisory Council on Innovation (NACI) Act, 1997 (Act 55 of 1997), establishes the NACI to advise the Minister of Science and Innovation on the role and contribution of science, mathematics, innovation and technology in promoting and achieving national objectives;
- the Africa Institute of South Africa (AISA) Act, 2001 (Act 68 of 2001), establishes the AISA to promote knowledge and understanding of African affairs by encouraging leading social scientists;
- the Human Sciences Research Council (HSRC) Act, 2008 (Act 17 of 2008), provides for the HSRC, which carries out research that generates critical and independent knowledge relative to all aspects of human and social development;
- the Scientific Research Council Act, 1988 (Act 46 of 1988), refers to the activities of the Council for Scientific and Industrial Research (CSIR), one of the leading scientific and technological research, development and implementation organisations in Africa, which undertakes directed R&D for socio-economic growth in areas including the built environment, defence, the environmental sciences, as well as biological, chemical and laser technologies;
- the Astronomy Geographic Advantage Act, 2007 (Act 21 of 2007), provides for the preservation and protection of areas in South Africa that are uniquely suited to optical and radio astronomy, and for intergovernmental cooperation and public consultation on matters concerning nationally significant astronomy advantage areas;
- the Geoscience Amendment Act, 2010 (Act 12 of 2010), amends the Geoscience Act, 1993 (Act 100 of 1993), to mandate the Council for Geoscience to be the custodians of geotechnical information; to act as a national advisory authority in respect of geohazards related to infrastructure and development; and to undertake exploration and prospecting research in the mineral and petroleum sectors;
- the South African National Research Network (SANReN), which is responsible for the roll-out of a high-speed broadband network to all academic and research institutions in the country, was awarded a private electronic communications network licence exemption under the Electronic Communications Act, 2005 (Act 36 of 2005); and
- the Science and Technology Laws, Amendment Act, 2014 (Act 7 of 2014), seeks to, among other things, streamline the process for the nomination and appointment of members of the boards or councils of such entities as well as the filling of vacancies on the boards.

Budget

For the 2019/20 financial year, the DSI was allocated R8.1 billion. It plans to direct its allocation of R27.9 billion over the medium term towards investment in its key focus areas of developing human capital, generating and exploiting knowledge and innovation, and building and maintaining infrastructure for research and innovation. As the work of fostering, promoting and supporting innovation in scientific research and technology is conducted primarily by the department's entities, universities and non-profit organisations, transfers account for an estimated 92.6% (R25.9 billion) of the department's total budget over the MTEF period. Overall expenditure is expected to increase at an average annual rate of 5.8%, from R8.2 billion in 2019/20 to R9.7 billion in 2022/23. Compensation of employees is the second-largest spending item in the DSI, accounting for an estimated 4.8% (R1.3 billion) of the total expenditure over the medium term, increasing at an average annual rate of 6.4% mainly due to the expected filling of critical posts.

Cabinet has approved reductions to the department's baseline of R460.9 million over the medium term to be effected mainly on discretionary transfers and non-core goods and services. As such, these reductions are not expected to affect service delivery. An additional R1.2 billion over the medium term is allocated to set up the Sovereign Innovation Fund to ensure more effective technology commercialisation; R185 million to the CSIR to invest in infrastructure aimed at improving the efficiency and competitiveness of scientific research; and R100 million to the SANSA to invest in its space science programme. This allocation is expected to enable the agency to contribute to a range of national priorities, including job creation.

Entities

Council for Scientific and Industrial Research

The CSIR was established in 1945 and is governed in terms of the Scientific Research Council Act of 1988. The council fosters industrial and scientific development in the national interest through multidisciplinary research and technological innovation to improve the ability of the State to efficiently deliver basic services, in fields such as health, education, social security, energy and shelter, to all South Africans, and in so doing, reduce inequality. Over the medium term, the council will focus on conducting high-quality and relevant research, pursuing technological innovation to foster industrial and scientific development, and building on industrial development opportunities in fields such as pharmaceutical innovation and agro-processing.

The council's ability to generate revenue directly relates to its ability to attract and retain the requisite expertise to deliver favourable research outcomes. Competitive remuneration is a vital enabling factor for the retention of critical skills. As such, spending on compensation of employees accounts for an estimated 56.6% of the council's total expenditure over the medium term, increasing at an average annual rate of 6.8%, from R1.7 billion in 2019/20 to R2.1 billion in 2022/23. To retain a high calibre of staff, the council also offers nonmonetary employee benefits, such as training and exchange programmes, to strengthen its value proposition.

Transfers from the DSI of R2.4 billion over the medium term account for an estimated 23.7% of the council's total revenue over the period. Included in this amount is an allocation of R185 million for investment in infrastructure to improve the efficiency and competitiveness of scientific research. The council generates the remainder of its revenue through services rendered, such as contract research and development, income from IP, proceeds from technology transfer, and royalties. Total revenue over the MTEF period is expected to be R10.4 billion.

National Research Foundation

The NRF is mandated to support research through funding, the development of human resources and the provision of research facilities to enable knowledge creation, innovation and development in all fields of science and technology. It is also mandated to promote indigenous knowledge.

Over the medium term, the foundation will focus on the implementation of its 10-year strategy: Vision 2030. This will entail interventions to catalyse transformation in the science and technology system through measures such as creating grant-funding instruments that focus on women and black researchers, and fast-tracking black women doctoral graduates towards obtaining their foundation rating. The NRF aims to invest 19.1% (R2.5 billion) of its estimated total expenditure over the MTEF period to develop the next generation of researchers by providing free-standing scholarships, grant holder-linked bursaries and academic development programmes to honours, master's, doctoral and postdoctoral students. This investment is expected to support 3 770 master's and 2 987 doctoral students in 2020/21, although these numbers are likely to decrease in 2021/22 in line with the increase in fees for the 2021 academic year.

Total expenditure over the MTEF period is expected to be R13.8 billion, with spending on transfers and subsidies accounting for 60%. Estimated capital expenditure of R644 million over the medium term is earmarked primarily for the SKA, specialised equipment at iThemba Laboratory for Accelerator-Based Science for the isotope facility project, and the South African Radio Astronomy Observatory for the MeerKAT extension, comprising 20 antennae.

The foundation receives funding through the parliamentary grant, transfers from the DSI, contract funding for specific projects and programmes from other government departments and entities, and income generated through sales and interest earned. The Parliamentary Grant, which accounts for an estimated 91.7% (R12.5 billion) of projected revenue over the MTEF period, is used primarily to fund the foundation's programmes and operational activities. Due to Cabinet's decision to reduce expenditure across government, transfers from the DSI are projected to increase from R4 billion in 2019/20 to R4.2 billion in 2022/23, due to the completion of Phase 1 of the SKA.

The NRF Strategy 2020 will enable the organisation to intensify and strengthen African and global networks to position South Africa in the international arena in order to drive the knowledge economy.

In identifying a five-year strategy that supports the execution of its mandate, the organisation took stock of past performance and the realisation of its previous strategy, the NRF Vision 2015. In the NRF Strategy 2020, the organisation places renewed emphasis on the agency function of the NRF and its role as a policy implementer within the NSI. Playing a critical integration role across the National Science System, the NRF has the ability to catalyse societally beneficial R&D in support of knowledge generation, human capacity development and innovation.

Through the NRF Strategy 2020, the organisation will:

- continue to stimulate transformation across the sector through the use of targeted funding instruments;
- continue to support excellence with relevance – support knowledge generation that continues to have a positive impact on the quality of life of the people of South Africa;
- leverage off the NRF brand to accelerate engagement between countries on the African continent and globally; by funding human capacity development and knowledge generation for the benefit of Africa and the world; and
- practice the highest standards of corporate governance, fiscal management and compliance, whilst ensuring business efficacy. The core intent will remain an unwavering commitment to the transformation of the research landscape and a focus on excellence, thereby ensuring global relevance.

The foundation approaches the implementation of the NRF Strategy 2020 as an evolutionary process and will continue to develop customised instruments to address new challenges. In doing so, the NRF will engage within and beyond government-funded programmes and include the private sector in its endeavours to address the planned initiatives as set out below.

Role player

South African Council for Natural Scientific Professions (SACNASP)

The SACNASP's mandate is to provide a credible professional registration and regulatory body that allows natural scientists to establish, direct, sustain and ensure a high level of professionalism and ethical conscience in the natural scientific professions sector. The council will develop strategic priority science areas in which South Africa enjoys a competitive advantage through promoting research and training activities and outputs by installing eight large survey projects correlators in 2019/20, and 64 S-band science mode receivers on the MeerKAT telescope by 2020/21.

Policy mandate and programmes

The DSI derives its mandate from the *1996 White Paper on Science and Technology*, which introduces the concept of the NSI – a set of interacting organisations and policies through which a country creates, acquires, diffuses and puts into practice knowledge to help achieve individual and collective goals. A coordinated and efficient NSI will help the country achieve its national development priorities by promoting change through innovation, enabling all South Africans to enjoy economic, socio-political and intellectual benefits of STI.

The department supports the NSI in a number of ways, including:

- coordinating the development and implementation of country-level policies and strategies;
- creating systems and structures to coordinate the science, technology and innovation related work of government departments and agencies;
- developing measurement systems and undertaking analyses to create an evidence base for improving the performance of the NSI; and
- optimising the governance of publicly funded STI institutions to support government's priority outcomes.

Technology Innovation

The programme aims to enable R&D in space science and technology, energy security and the bioeconomy, and in the emerging and converging areas of nanotechnology, robotics, photonics and indigenous knowledge systems (IKS), to promote the realisation of commercial products, processes and services. It also promotes the protection and utilisation of intellectual property, technology transfer and technology

commercialisation through the implementation of enabling policies and interventions along the entire innovation value chain. Its subprogrammes include:

- Space Science, which supports the creation of an environment conducive to the implementation of the national space strategy and South African earth observation strategy, and that addresses the development of innovative applications and human capital to respond to national priorities and support socio-economic development.
- Hydrogen and Energy, which provides policy leadership in research, development and innovation initiatives in the energy sector. This subprogramme plays a key role in developing a sustainable and globally competitive South African energy knowledge base and industry.
- Bio-innovation, which leads the implementation of the national bio-economy strategy.
- Innovation Priorities and Instruments, which supports and strengthens the innovation policy package aimed at creating and sustaining an enabling environment for innovation, technology and development, and the commercialisation of publicly funded R&D initiatives.
- NIPMO – the implementing agency established to provide for the more effective use of IP emanating from publicly financed research and development.

International Cooperation and Resources

The programme strategically develops, promotes and manages international partnerships that strengthen the NSI. It enables an exchange of knowledge, capacity and resources between South Africa and its international partners, with a focus on building capacity to support STI in Africa. It also supports South African foreign policy through science diplomacy. Its subprogrammes include:

- Multilateral Cooperation and Africa, which advances and facilitates South Africa's participation in bilateral STI cooperation initiatives with other African partners; in African multilateral programmes, especially those of the Southern African Development Community and African Union; and in broader multilateral STI and innovation partnerships, with a strategic focus on South-South cooperation.
- International Resources, which works to increase the flow of international funding into South African STI initiatives, as well as African regional and continental programmes, through concerted efforts to promote foreign investment and the fostering of strategic relations with partners such as the European Union, as well as foundations and philanthropic organisations and the multinational private sector.
- Overseas Bilateral Cooperation, which promotes and facilitates South Africa's cooperation in bilateral STI agreements with partners in Europe, the Americas, Asia and Australasia, especially for human capital development and collaborative research and innovation; and secures support for joint cooperation with other African partners.

South Africa is regarded by many countries and private sector partners as a preferred and privileged partner for international cooperation in STI. On average, approximately 15% of annual R&D funding in South Africa comes from international investors.

Research, Development and Support

The programme provides an enabling environment for research and knowledge production that promotes the strategic development of basic sciences and priority science areas through the promotion of science human capital development, and the provision of research infrastructure and relevant research support, in pursuit of South Africa's transition to a knowledge economy. Its subprogrammes include:

- Human Capital and Science Promotions, which formulates and implements policies and strategies that address the availability of human capital for STI; provide fundamental support for research activities; and contribute to the development of a society that is knowledgeable about science, critically engaged and scientifically literate.
- Science Missions, which promotes the development of research, the production of scientific knowledge, and the development of human capital in fields of science in which South Africa enjoys a geographic advantage.
- Basic Science and Infrastructure, which facilitates the strategic implementation of research and innovation equipment and facilities to promote knowledge production in areas of national priority, and sustain innovation led by research and development.
- Astronomy, which supports the development of astronomical sciences around a new multiwavelength astronomy strategy, and provides strategic guidance and support to relevant astronomy institutions in the implementation of strategic astronomy programmes.

Socio-economic Innovation Partnerships

The programme enhances government's growth and development priority areas through targeted science and technology-based innovation interventions, and the development of strategic partnerships with other government departments, industry, research institutions and communities. Its subprogrammes include:

- Sector Innovation and Green Economy, which provides policy, strategy and direction for research and the development-led growth of strategic sectors of the economy; and supports the transition to a green economy.
- Innovation for Inclusive Development, which supports the development of science and technology-based innovations for tackling poverty, including the creation of sustainable jobs and human settlements, and the enhanced delivery of basic services.
- Science and Technology Investment, which leads and supports the development of indicators and instruments for monitoring investments in science and technology, the performance of the NSI, and ways of strengthening policy in relation to the NSI.
- Technology Localisation, Beneficiation and Advanced Manufacturing, which funds technology and innovation development programmes to advance strategic, sustainable economic growth for the medium and long term; sector development priorities; and service delivery.

National Research Facilities

The national research facilities managed by the NRF are clustered on the basis of their areas of specialisation aligned to the science missions of the National Research and Development Strategy.

South African Astronomical Observatory (SAAO)

The SAAO is the national centre for optical and infrared astronomy in South Africa. Its prime function is to conduct fundamental research in astronomy and astrophysics by providing a world-class facility and by promoting astronomy and astrophysics in southern Africa.

The SAAO contributes to South Africa's future development by creating and disseminating scientific knowledge, providing research infrastructure and providing an interface between science and society. It is also responsible for managing the operations of the South African Large Telescope.

Hartebeesthoek Radio Astronomy Observatory (HartRAO)

The HartRAO is a national facility of the NRF. Its radio astronomy research focuses on stellar evolution, pulsars and masers; and its Space Geodesy research uses space-based techniques to study the earth. The facility is also used by university students for carrying out research. It also undertakes science awareness programmes for schools and the general public.

South African Institute for Aquatic Biodiversity (SAIAB)

A national facility of the NRF, the SAIAB is famous for its association with the discovery of the enigmatic coelacanth and is internationally recognised for ichthyological research, dynamic research staff and active postgraduate school. The SAIAB provides unique skills and infrastructure support in marine, estuarine and freshwater ecosystems research, molecular research, collections and bioinformatics.

South African Environmental Observation Network (SAEON)

The SAEON is a business unit of the NRF and serves as a national platform for detecting, translating and predicting environmental change through scientifically designed observation systems and research. The SAEON also captures and makes long-term datasets freely accessible, and runs an education outreach programme. The SAEON has six nodes dispersed geographically across the country.

National Zoological Gardens (NZG)

The NZG is a rapidly transforming facility reporting to the NRF. It has an impressive animal collection, conservation centres, a Centre for Conservation Science as well as an NZG Academy. The NZG is well placed as an education and awareness platform for visitors comprising educators, learners, students, special interest groups and the general public.

iThemba Laboratory for Accelerator-Based Sciences

The iThemba Laboratory for Accelerator-Based Sciences is the continent's largest facility for particle and nuclear research as well as one of only a handful of facilities in the world producing radionuclides for commercial, research and medical applications. In addition, its facilities include a full radiotherapy clinic for the treatment of certain cancers using both proton and neutron therapy.

The facilty has secured government support to finance its strategic flagship project, South Africa Isotape Facility (SAIF) – an initiative that seeks to secure future sustainability of the facility by procuring a dedicated 70 MeV cyclotron accelerator to boost the production rate of a range of accelerator-based radioisotopes.

The strategic vision of the facility is to configure its radioisotope production division and establish SAIF in a flagship project geared to triple the current radioisorope income. The move is set to establish the facility as a formidable international entity with a secure market niche in the accelerator-based radiophamarceutical sector. An annual average of more than 155 000 patients worldwide benefit from cancer diagnostic radioisotopes produced using the separated sector cyclotron particle at iThemba Laboratory for Accelerator-Based Sciences.

Projects

Space science and technology

Square Kilometre Array

The multibillion-rand SKA, to be hosted in South Africa and Australia, will eventually extend into eight African countries and will be the world's biggest telescope. It is also one of the biggest-ever scientific projects and multinational collaborations in the name of science.

The radio telescope was expected to be operationally mature by 2020.

With thousands of linked radio wave receptors in Australia and in southern Africa, the SKA radio telescope will constantly scan space and feed the data to astronomers around the world.

The amounts of data being collected and transmitted by the SKA in a single day would take nearly two million years to play back on an iPod. This means the project requires supercomputing power and Big Data Management and Analytics capabilities on an unprecedented scale. The SKA is working with the world's most significant ICT powerhouses on the project.

One aspect of the project will see the Netherlands Institute for Radio Astronomy and the International Business Machines Corporation collaborating to research extremely fast, but low-power exascale computer systems, data transport and storage processes, and streaming analytics that will be required to read, store and analyse all the raw data that will be collected daily.

The SKA project will also have unprecedented data-connectivity needs. Meeting the advanced technological and engineering needs of this project will result in significant local skills development, revolutionise science and technology research and enable innovative new businesses and employment in the science, technology and engineering fields.

Aside from the benefits to African science, Big Data Management and Analytics capabilities could be the biggest spin-off from the SKA project.

The innovations, skills development and commercial potential emerging as a result of the project are huge. The potential is not just academic – the taxpayer-funded IP is developed to a point where it is ready to become commercialised and benefit the economy.

Human capital development is already taking place as a result of the SKA project, with bursaries and scholarships being granted to allow students to learn the necessary cutting-edge science, technology, mathematics and engineering skills to support the project. Because the SKA is a long-term project, over decades its effect will increase.

The Centre for High Performance Computing is a member of the international SKA Science Data Processing Consortium. With funding from the DSI, it is also supporting eight African

The DSI in cooperation with the CSIR, commissioned the set-up of a core situational awareness platform. The centre, led by the DoH, provides near real-time analytics and dashboards on the coronavirus outbreak per province, district, local municipality and ward.The centre is housed in a secure facility at the CSIR in Pretoria and provides a central situational awareness, giving a single view of the reality of the spread of the coronavirus across the country.

The COVID-19 Information Centre is one of several projects the DSI is working on in support of the government's response to the pandemic. Among the centre's capabilities is the Command and Control Collaborator (Cmore) app – a mobile visualisation platform used by community health workers to record screening data and symptoms in the field and transmit the information to the centre.

The Cmore app enables a near-live display of the results of the work being conducted by the government's Household Screening and Testing programme. The data and insights generated by the centre provide significant input for decision-making by the National Coronavirus Command Council.

SKA partner countries through an initiative where they have installed its new supercomputer to provide 1 000 teraflops (1 petaflop) of computing power to researchers. The facility was upgraded to meet the growing demand for use by university and industrial researchers. The SKA remains a major platform for cutting-edge innovation in domains such as supercomputing the high-speed transmission and processing of massive data sets.

Going forward, there will be a strong drive to leverage the SKA as a spearhead for other programmes – including next generation high performance computing challenges and Big Data challenges.

Two engineering consortia have been hard at work at their sites in Murchison, Western Australia and the Northern Cape, South Africa respectively, designing all the essential infrastructure required for the construction of this complex global project to get under way. This includes access roads, power, water and sanitation, buildings, antenna foundations, and the communication, security and site monitoring equipment required to support the SKA telescope.

The South African consortium, Infrastructure South Africa was led by the South African Radio Astronomy Observatory, which designed, built and operates the 64-dish SKA precursor telescope, the MeerKAT.

Following the successful review of the key infrastructure components of the SKA – considered a major engineering victory – the project will now move on to the bridging phase.

Information and communications technology

The DSI is leading the implementation of the national ICT Research, Development and Innovation Strategy. Its main purpose is to create an enabling environment for the innovation and manufacturing facilities and resources in South Africa.

The Centre for High-Performance Computing (CHPC), SANReN and the Very Large Databases are the three pillars of cyberinfrastructure that the DSI supports. Hosted by the UCT and managed by the CSIR's Meraka Institute, the CHPC was the first of its kind in South Africa and is making scientific supercomputing a reality for the country.

A major project for SANReN is the national backbone network, which aimed to connect all major metros in the country with a 10 gigabyte per second link.

SANReN, linking 215 research sites, consists of 1 500 kilometres (km) of dark fibre and 5 000 km of managed bandwidth. This network is complemented by significant international broadband capacity on the West Africa Cable System and the east coast SEACOM system, ensuring that the DSI's projects support competitive research and innovation as it prepares the national innovation system for the future.

SANReN connects more than 200 sites from Thohoyandou to Cape Town, including all the main campuses of all South African universities and most public research institutions, as well as global projects such as the SKA and the MeerKAT.

Indigenous knowledge systems

The IKS Policy serves as a guide for the recognition, understanding, integration and promotion of South Africa's wealth of indigenous knowledge resources.

One of the areas of action identified by the policy is the protection of indigenous knowledge and the holders of such knowledge against exploitation.

This includes ensuring that communities receive fair and sustained recognition and, where appropriate, financial remuneration for the use of this knowledge.

The indigenous knowledge of many communities embodies a deeply spiritualised and ancient relationship with the Earth's systems and cycles.

Traditional songs and languages, clothing, architecture, foods, motifs, daily rituals and mythological epics contain local survival information. Moreover, the diversity of indigenous cultures provides unique insights into how to live harmoniously within nature.

By sharing indigenous stories of vulnerability and adaptation, people learn how communities share ideas on how ancestral wisdom is being incorporated into climatic adaptation strategies.

By cherishing the value of indigenous knowledge, people can discover how best to adapt to a changing climate.

The DSI has three IKS priorities:

- The development of a regulatory environment for the protection of IKS.
- The development of the National Recordal System for the collection, recording, documenting, storage and management and dissemination of IKS in communities in the nine provinces of the country. Until orally transmitted and rapidly disappearing indigenous knowledge is recorded, it will be difficult to protect. The National Recordal System is the largest fingerprint initiative of the region to document and record indigenous knowledge.
- Applied research, specifically bio-prospecting activities. An example would be the Moritela Tshwene Tea Project near Zeerust in the North West.

In April 2020, a team of international astronomers uncovered unusual features in the radio galaxy ESO 137-006 using MeerKAT data. ESO 137-006 is a fascinating galaxy residing in the Norma cluster of galaxies, and one of the brightest objects in the southern sky at radio wavelengths.

The classical picture of a radio galaxy consists of an active galactic nucleus (hosting a growing supermassive black hole), shooting out two jets of plasma filled with particles that move at speeds close to the speed of light. The material within the jets eventually slows down and billows out, forming large radio lobes. ESO 137-006 is characterised by two such lobes of very bright radio emission.

The nature of these unusual features is unclear. It is possible that these features may be unique to ESO 137-006, because of its harsh environment, but it is equally possible that these features are common in radio galaxies but, so far, the team have been unable to detect them due to sensitivity and resolution limits. According to the team that made this discovery, which is composed of collaborators from South Africa and Italy and is partly funded by the European Research Council, further observations and theoretical efforts are required to clarify the nature of these newly discovered features.

A major achievement was to put in place an information infrastructure that would hold IKS in oral format.

In addition, two United Kingdom-South Africa bilateral research chairs have been awarded for research into food security – one co-hosted by the universities of the Western Cape and Pretoria, and the other based at the NMMU.

The DSI has also established indigenous knowledge studies centres of excellence at some of the country's universities. The centres will play a defining role in generating highly qualified Human Resources capacity in IKS.

Private sector involvement

South Africa's gold-mining industry works at deeper levels and under more difficult conditions than any other mining industry in the world.

The research into gold mining conducted by the CSIR's Mining Technology Group is concerned primarily with ensuring the health and safety of the workforce.

It includes those working in the areas of rock engineering and the underground environment.

Mining Technology's coal-mining research takes place on a smaller scale than that of gold mining, because the coal-mining industry is able to make use of various developments overseas.

Areas in which research is undertaken include strata control, mining, maximising the extraction of coal and the underground environment.

Research is also carried out by a large number of industrial companies with facilities to meet their specific needs.

The DSI continues to invest through Pelchem in the Fluorochemical Expansion Initiative.

The Auckland Park-based mining precinct, in Johannesburg, aims to safeguard the future of South Africa's mining industry through developing new people-centred technology and techniques to empower mines and prepare them for modern mining methods.

The mining precinct aims to arrest the current general decline in the local mining industry in south africa and to help it overcome significant obstacles in the future, which stem from narrower ore bodies and mines having to venture to deeper depths to find reserves.

This collaborative effort aims to link to other institutions, such as universities and research entities nationally and internationally.

Natural resource development

To reinvigorate the South African mining sector and to harness the vast amounts of existing and potential opportunities for industrial and manufacturing growth, it is crucial for the country to create the technologies and mining methods to push mining deeper in a commercially viable manner. South Africa needs a competitive mining industry. This will only be possible if science and innovation plays the quintessential role of changing the cost and exploitation horizons of the sector. None of the existing mining stakeholders (publically funded research institutions, private sector companies, universities, unions or government) have the scale to impact the situation alone in the long run. To achieve this, a critical mass of science and knowledge to push the frontiers of mining will require a national effort consisting of deep partnerships and collaborations across institutions and industries.

Women in Science Awards

The 2019 South African Women in Science Awards (SAWiSA) took place at the Boardwalk Hotel in Port Elizabeth. The aim of awards is to recognise the participation of women in research.

The event, which took place on 15 August 2019, was held under the theme, "Making the Fourth Industrial Revolution Work for Women".

The 2019 SAWiSA winners are:

- Distinguished Women Researchers: Natural (Physical and Life) and Engineering Sciences: Professor Michèle Ramsay, Wits.
- Distinguished Women Researchers: Humanities and Social Sciences: Professor Lunic Base Khoza, UNIVEN.
- Distinguished Woman Researchers: Research and Innovation: Professor Tania Samantha Douglas, UCT.
- Distinguished Young Women Researchers: Natural (Physical and Life) and Engineering Scienced: Professor Michéle Ramsay, Wits.
- Distinguished Young Women Researchers: Humanities and Social Sciences: Professor Martinette Kruger, NWU.
- Distinguished Young Women Researchers: Research and Innovation: Dr Sibongiseni Thomasia Tunzelana Thotsejane, UCT.