How does the government fund science and innovation?

Report on the 2018/19 Survey of Government Funding for Scientific and Technological Activities

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

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ABBREVIATIONS

ARC	Agricultural Research Council
ASSAf	Academy of Science of South Africa
CGS	Council for Geoscience
CHPC	Centre for High Performance Computing
CSIR	Council for Scientific and Industrial Research
ECSP	Economic Competitiveness Support Package
ENE	Estimates of National Expenditure
GBARD	government allocations for R&D
GERD	Gross Expenditure on Research and Development
HEI	higher education institution
HSRC	Human Sciences Research Council
MCM	Marine and Coastal Management
MTEF	Medium Term Expenditure Framework
NDP	National Development Plan
NSI	National System of Innovation
Necsa	South African Nuclear Energy Corporation
NHLS	National Health Laboratory Services
NRF	National Research Foundation
OECD	Organisation for Economic Cooperation and Development
PRI	Public Research Institution
RA-BDAP	Radio Astronomy Big Data Africa Programme
R&D	Research and Development

S&T	Science and Technology
SAMRC	South African Medical Research Council
SANBI	South African National Biodiversity Institute
SANEDI	South African National Energy Development Institute
SANSA	South African National Space Agency
SAPS	South African Police Service
SARChI	South African Research Chairs Initiative
SEO	Socio-Economic Objective
SEDA	Small Enterprise Development Agency
STA	Scientific and Technological Activity
STET	Scientific and Technical Education and Training
STI	Science, Technology and Innovation
STS	Scientific and Technological Service
TIA	Technology Innovation Agency
TVET	Technical Vocational Education and Training
WACS	West African Cable System
WRC	Water Research Council

TERMINOLOGY USED

The concept of **scientific and technological activities (STAs)** was developed by the United Nations Education, Scientific and Cultural Organisation's Institute of Statistics (UNESCO-UIS) to describe a set of activities relating to building and exploiting scientific and technological (S&T) capabilities.[1]

Scientific and technological activities (STAs) are systematic activities that are closely concerned with the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of science and technology. STAs are found in the domains of natural sciences, engineering and technology, the medical and the agricultural sciences, as well as the social sciences and humanities.

Three types of STAs are research and experimental development (R&D), scientific and technical education and training (STET), and scientific and technological services (STS).

Research and development (R&D) are creative activities undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of people, culture and society, and the use of this stock of knowledge to devise new applications.

Scientific and Technical Education and Training (**STET)** includes specialised non-university higher education and training, higher education and training leading to a university degree, postgraduate and further training, and organised lifelong training for scientists, engineers and technologists. These are activities directly related to human capital development.

Scientific and technological services (STS) include activities involving the application of scientific and technical knowledge, such as patenting, geological surveys, the generation of standards, and the operation of libraries and national scientific databases. These are scientific services mostly run by specialised government agencies.

Intramural STAs are those performed in-house by the funding department.

Extramural STAs are those performed outside the funding department.

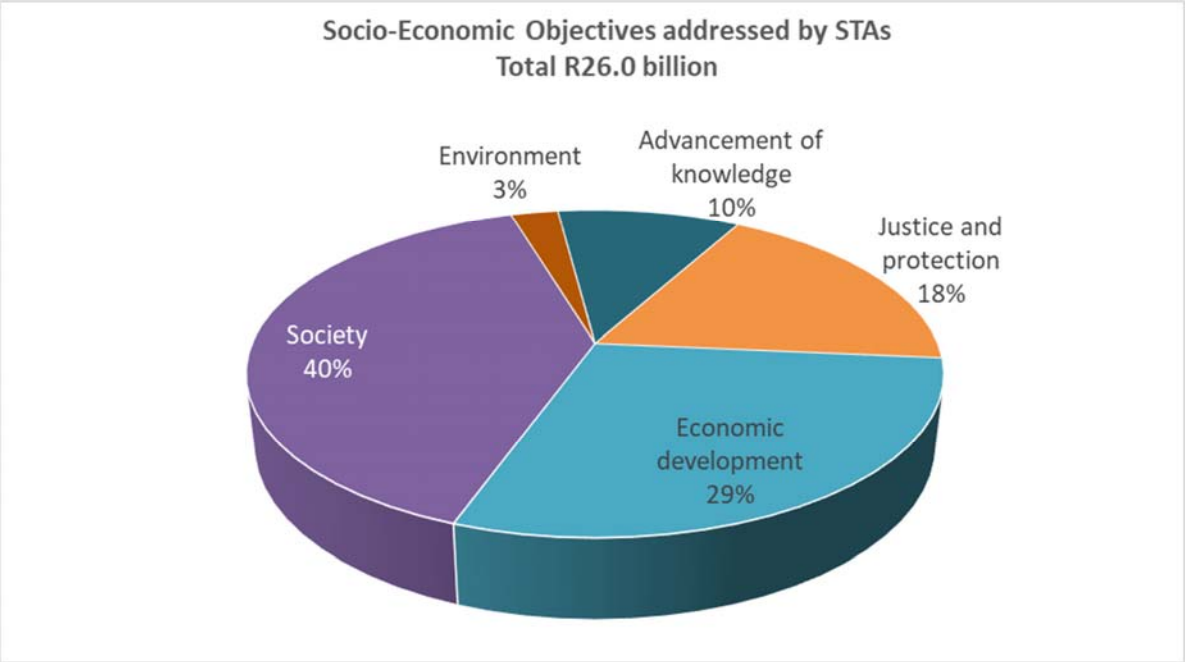
[1] Refer to Annexure B: Methodology for more details.

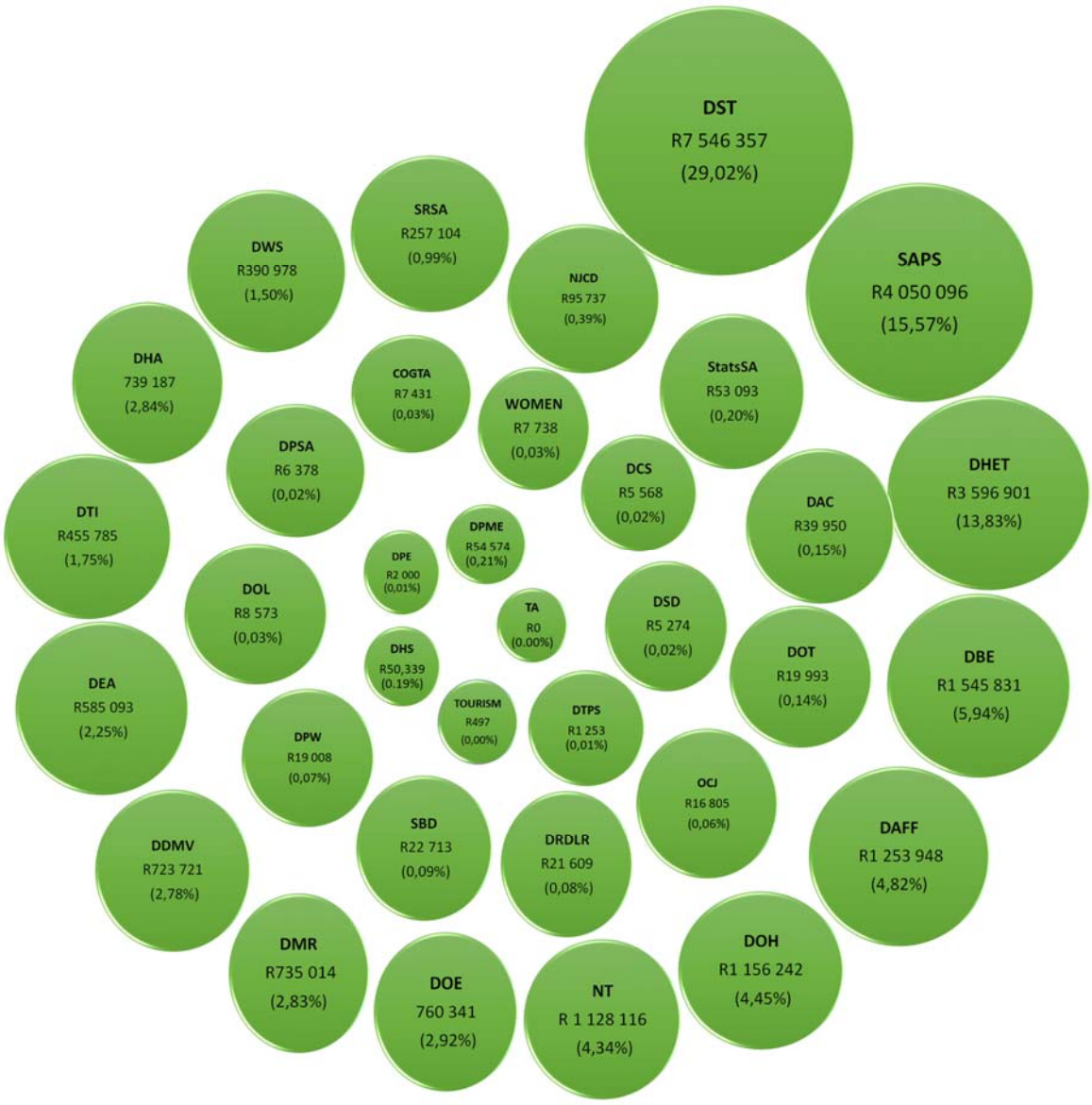
2018/19 STA funding in summary

34
National departments confirmed budget allocations for scientific and technological activities in 2018/19

Scientific and technological activities
R26,0 billion

- Research and development **R14,1 billion (53,5%)**
- Scientific and technical education and training **R4,4 billion (16,9%)**
- Scientific and technological services **R7,7 billion (29,6%)**





Notes:

(a) The chart is based on STA funding totalling R26,0 billion for the 2018/19 financial year. The size of each bubble represents the amount of funding, i.e. the bigger the bubble, the bigger the amount of STA funding.

(b) In May 2019, with the reconfiguration of national government departments, the names of some departments changed. This report uses the names of national departments consistent with the structure of the budget in 2018/19.

1. EXECUTIVE SUMMARY

The government and its agencies have for a long time played a crucial role in the advancement of scientific research and technological development in South Africa. There are economic and strategic reasons for this. Continued public investment helps achieve public missions, opens up opportunities in areas where private sector and other actors have limited incentives to invest, and builds platforms to improve the innovation ecosystem.

This report complements existing evidence on government funding for STI in South Africa. Scientific and technological activities (STAs) involve more than just funding research and development (R&D), but cover a range of activities from the generation of knowledge to the diffusion and use of scientific and technological knowledge, as well as building and exploiting S&T capabilities.

STAs cut across a range of government functions, including education, health, water, minerals, energy, agriculture, economic development and the environment, and various government departments therefore fund STAs. This report gives an aggregated sense of how STAs are funded across government, how they feature in the overall government budget, and how they address a range of policy objectives.

In the 2018/19 financial year (1 April 2018 to 31 March 2019), government allocated about R26 billion to STAs. This amount is based on reports from for 34 national government departments that confirmed their budgeting for STAs in that period.[2] The total reflects an increase of 7,5% (R1,8 billion) in nominal terms from the 2017/18 to 2018/19 financial year. At constant 2010 rand prices, and removing the effect of inflation from the equation, the increase is 4,3%. Total STA allocations constituted 1,8% of the total government budget in 2018/19.

This report divides STAs into research and development (R&D), scientific and technological services (STS) and scientific and technical education and training (STET). Of the three STA types, the largest proportion of funding in 2018/19 went to

[2] This report uses the names of national departments that existed in 2018/19. In May 2019 there was a reconfiguration of national departments and some departments have changed as a result.

R&D (R13,9 billion or 53,5%). STS followed with R7,7 billion or 29,6%, and STET with R4,4 billion or 16,9%.

The ongoing fiscal pressures have affected publicly funded STI programmes. At a point, the budget cuts assist in improving efficiencies, especially where they force prioritisation and eliminate instances of poor spending. On the other hand, there are serious negative implications, which hamper the introduction of new programmes and possibilities for scaling up certain well-functioning programmes as well as the non-income generating activities of science councils.

The data to assess the extent to which budget cuts affect S&T programmes is still being collated. From 2016/17 through to 2021/22, funding for STAs has declined as a proportion of overall government budget. This, combined with the need to address urgent developmental challenges, increases pressure on various components of government to pursue even greater efficiencies with what is available.

National government departments do not necessarily perform the STAs themselves. The bulk of total STA funding in 2018/19 (R17,5 billion or 67,3%) was for transfers and subsidies, implying that most implementation activities are located outside national and provincial departments and are performed by public research institutions or science councils, universities, provinces and consultants. The remainder of 32,7% (R8,5 billion) was spent within national departments. Of the transfers and subsidies, R8,4 billion (48,0%) was parliamentary grant funding for science councils.

Using the nomenclature of socio-economic objectives (SEOs), it is possible to disaggregate total STA funding by "targeted areas of use" or government policy intentions when committing funds for STAs. Five major divisions are distinguished (namely, improvement of society, economic development, justice and protection, advancement of knowledge, and environment). In 2018/19 an estimated R10,4 billion (34%) of total STA expenditure was allocated to the improvement of society in the areas of health, education and training, and social development. This was followed by R7,6 billion (29%) for economic development, with agriculture (plant and animal production) contributing the most in this division. The other SEOs fund the remaining 37%.

Going forward, priorities may shift as the focus turns to the implementation of the 2019 White Paper on STI. Greater gains can be realised with better coordination of activities across departments (and across national, provincial and local government levels) to pool resources, reduce duplications and leverage resources and capabilities by partnering with actors in the private sector, civil society and the international community.

2. INTRODUCTION

This report presents information about how government funds scientific and technological activities (STAs). The Department of Science and Innovation, formerly the Department of Science and Technology, produces this survey annually as part of a series of reports on the investments and performance of the national system of innovation (NSI). This report gives an aggregated sense of how much government allocates to STAs, how the allocations are spread across departments and functions, and which policy objectives of government are addressed by these allocations.

In this report, STAs are categorised as research and development (R&D), scientific and technical education and training (STET) and scientific and technological services (STS), the last-mentioned being scientific services run by specialised agencies, e.g. forensic laboratories, work with critical genetic resources, earth observations, geological surveys, weather services, standards generation.

Information for this report on the funding or performance of STAs is drawn from administrative records on the budget allocations of national departments. Relevant officials in each department are requested to confirm this information.

The next section of this report provides some context on the need to monitor government funding for STAs.

This is followed by the presentation of key findings from the survey covering the 2018/19 financial year. Summary indicators have been developed to aid the analysis and provide answers to government and stakeholder questions. The information on the estimates of the level and extent of funding lays an important foundation for understanding what value is being derived or the returns on public STI investment, how publicly driven science and innovation programmes are affected by fiscal pressures, and what new priorities should be considered going forward.

The National Integrated Cyberinfrastructure System (NICIS) is used in this report to illustrate the value of public investment in major scientific programmes (see p 24). Beyond this particular example is the evidence from recent evaluations, which indicate

important successes in the area of science and innovation, as well as limitations and a great scope for tapping onto STI potential to support South Africa's growth and development.

Standard tables with more details about the information in the report are presented in the annexures.

3. WHY MONITOR GOVERNMENT STA FUNDING?

Scientific research and technological development programmes are diverse, ranging from activities with immediate results to riskier, long-term ones. Longer-term projects require a secure source of funding over a period of years to enable proper planning for building critical national capabilities, or to secure strategic independence.[3] On the other extreme are specific technology solutions that are ready for deployment to meet specific needs, some only requiring minimal investment, to help improve service delivery or functioning of the public sector.

For a developing country like South Africa, the requirement for government funding for STI is even greater given the development gaps and the need to establish new capabilities for long-term competitiveness.[4]

The government, given its role, faces constant pressure to demonstrate tangible progress in a wide range of areas. The National Development Plan (NDP) is clear about the need for increased investment in scientific and technological capabilities to advance national development aims. In this regard, there are government strategies to, among other things, expand human capital and increase productive investment, industrialisation and the competitiveness of key sectors – all of which are to be achieved in the setting of inclusive growth and development.[5] The theory of change

[3] Grilliches Z (1958) Research cost and social returns; Hall BH and Van Reenen J (2009) Measuring the returns to R&D; Veugelers R (2016) Getting the most from public R&D spending in times of austerity; The World Bank (2014) Public Expenditure Reviews in Science, Technology, and Innovation.
[4] The 2019 White Paper on Science Technology and Innovation.
[5] National Development Plan 2030: Our Future – Make it Work. 2019-2024 Medium Term Strategic Framework. Presentations on the Reimagined Industrial Strategy by the Department of Trade and Industry (DTI).

for government investments in R&D is presented in Figure 1 to illustrate the results chain and intended outcomes for socio-economic progress.

South Africa has international obligations with respect to the Sustainable Development Goals (SDGs)[6], and must also take advantage of opportunities presented by megatrends and technological changes.[7]

The 2019 White Paper on Science, Technology and Innovation (STI) emphasises how science and technology should contribute to these imperatives by shaping the policy approach going forward. A target for R&D investment is included in the 2019-2024 Medium Term Strategic Framework (MTSF), indicating the importance of government as a whole to creating an enabling environment for innovation and increased investments from the public sector, private sector and the international community.

There are many existing STAs in government contributing to the achievement of the MTSF goals prioritised in government plans and strategies[8], for example on food security, health, nutrition, cleaner technologies, transport systems, water, energy resources, mathematics and science training, and safety and security. All these areas require constant input of a scientific and technological nature in order to progress.

Important questions in this regard include whether the current efforts, in various individual areas and as a whole are adequate. How much more could be achieved with the resources available, given the fiscal constraints? What new areas require (increased) government attention? Are there opportunities to do things differently? What opportunities are there to support private sector investment?

The annual Survey on Government Funding for Scientific and Technological Activities (STAs) contributes to the evidence needed to answer these questions. Information

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[6] Sustainable Development Goals (SDG) Indicators Baseline Report 2017 – South Africa, Statistics South Africa http://www.statssa.gov.za/MDG/SDG_Baseline_Report_2017.pdf

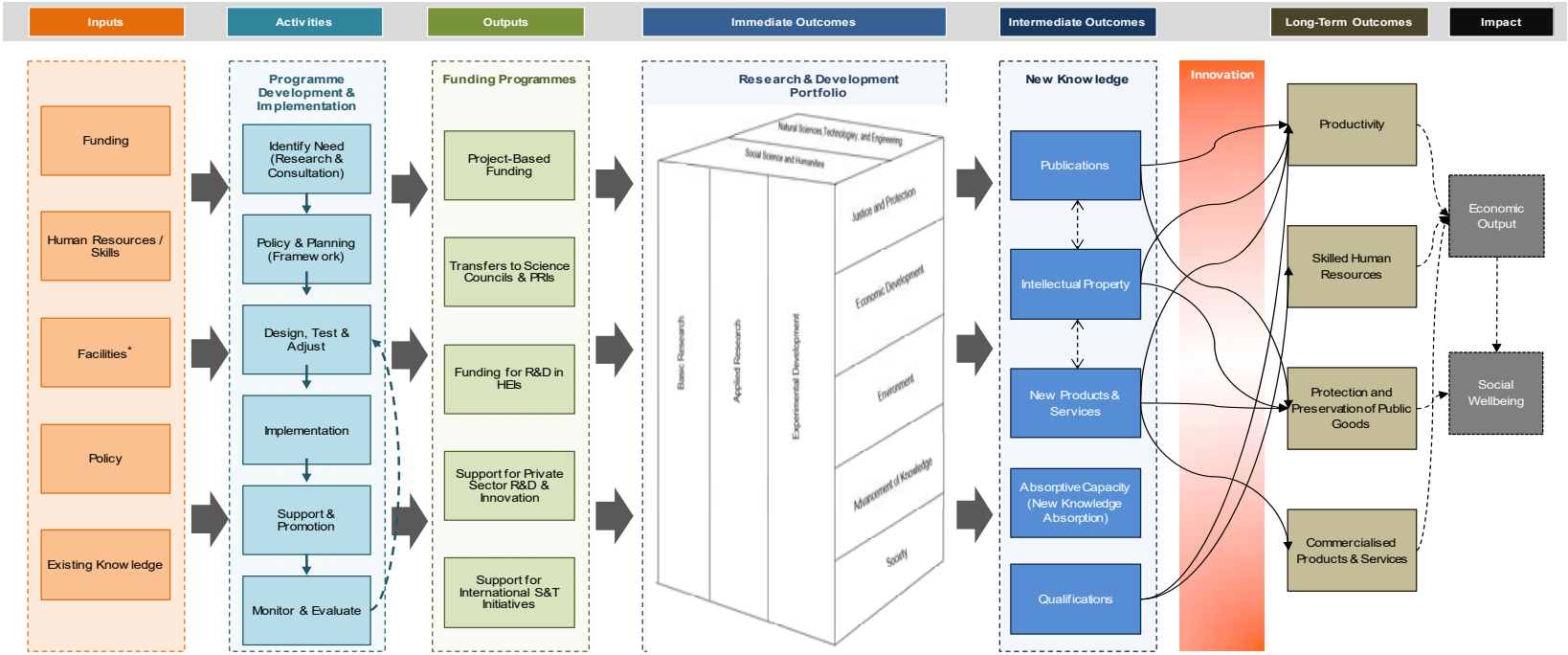
[7] The 2019 White Paper on Science Technology and Innovation makes reference to megatrends and technological changes.

[8] 2019-2024 Medium Term Strategic Framework. The 2015-2020 strategic plans of departments, e.g. Department of Agriculture, Forestry and Fisheries; Department of Health; Department of Home Affairs; Department of Energy; South African Police Service; Department of Higher Education and Training; Department of Basic Education.

presented in this report is intended to be used in conjunction with other forms of evidence to inform policy decisions. This report is therefore an important source of information on how budget appropriations for STAs are set out to support various functional areas of government – giving an indication of the extent to which STA budgeting and spending aligns with the policy priorities. This should inform choices about prioritisation and budget allocations going forward.[9]

[9] Budget decisions are facilitated by the National Treasury, among other factors, considering the priorities, spending patterns and efficiencies. Strategic and annual plans of individual departments and agencies indicate programmatic areas and how funds are to be used.

Figure 1: Illustration of theory of change on government funding of R&D



4. KEY FINDINGS

4.1 How much funding does the government allocate to STAs?

In 2018/19, the government allocated R26,0 billion to STAs. This amount is reported for 34 national government departments that confirmed budgeting for STAs in that period.[10] The amount reflects an increase of 7,5% (R1,8 billion) in nominal terms from the R24,2 billion reported in 2017/18. In real terms (amounts stated in constant 2010 rand prices), STA funding in 2018/19 was down by 4,3% from the previous year. This trend is associated with the fiscal consolidation measures that continued into 2018/19, with widespread budget cuts, cost-reduction measures and the reprioritisation of budgets across government.

The Medium Term Expenditure Framework (MTEF) appropriations indicate that STA funding will increase to R32,2 billion by 2021/22. However, outer-year allocations are not guaranteed budgets, but may be revised as the government adapts its budget to emerging fiscal possibilities.

Total funding for STAs made up 1,9% of total government budget in 2018/19. This ratio shows a decline from the 2016/17 through to the medium term (i.e. 2019/20 to 2021/22).

The largest proportion of funding for STAs in 2018/19 went to Research and Development (R&D) with R13,9 billion or 53,5%, followed by Scientific and Technological Services (STS) with R7,7 billion or 29,6%, and then Scientific and Technical Education and Training (STET) with R4,4 billion or 16,94%.

As explained on pp iv and vii, STAs cover a range of activities, including the generation, diffusion and use of S&T knowledge, and activities for building and exploiting (S&T) capabilities. The government funds not only R&D but also other STAs, namely training and development and specialised scientific services. The scope of the

[10] In May 2019, with the reconfiguration of national government departments, the names of some departments changed. This report uses the names of national departments consistent with the structure of the budget in 2018/19.

government role covers the funding of public research institutions and R&D programmes, investments in modernising research infrastructure and growing the high-level human capital base, funding for technology transfer activities and the specialised scientific facilities (e.g. laboratories) that support service delivery, as well as incentives to encourage business sector R&D and innovation, and leveraging international STI resources.

Figure 2: Total funding for STAs (2016/17 to 2021/22)

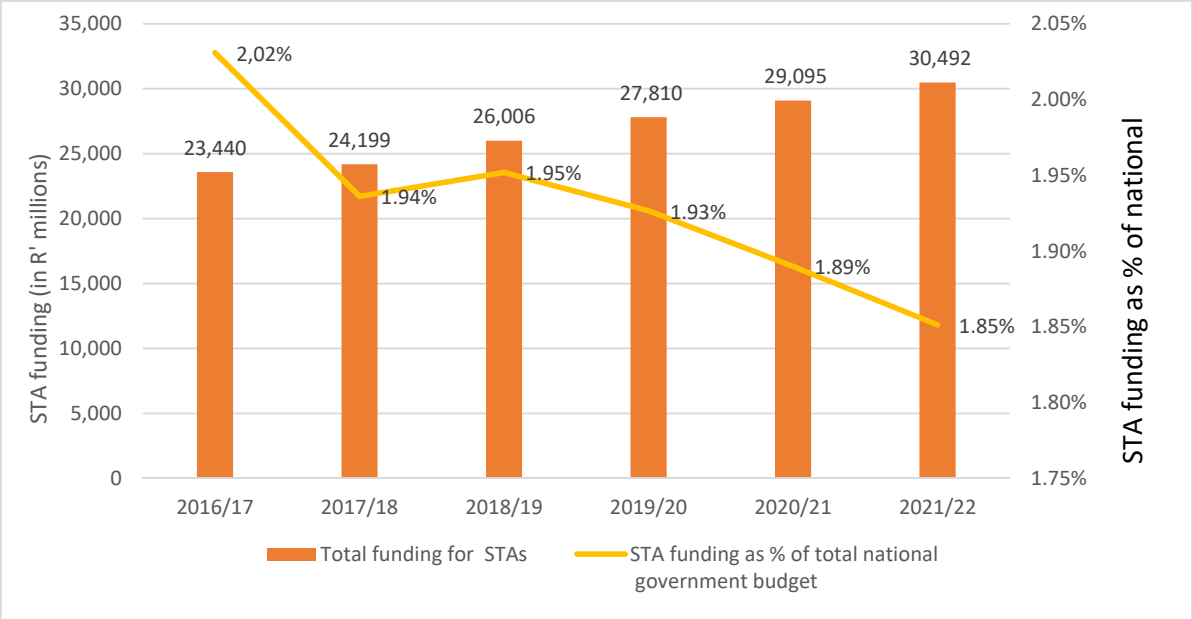
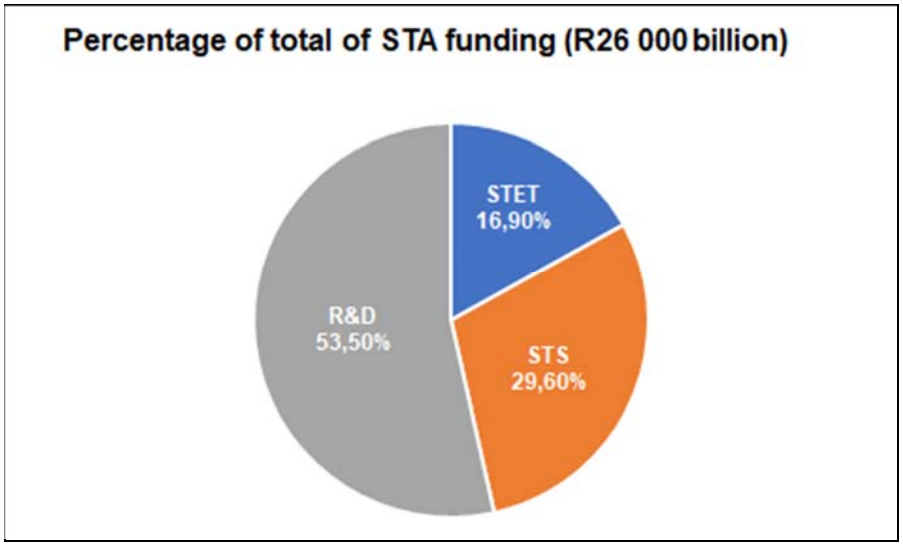


Figure 3: Funding for STAs by types



4.2 How is STA funding spread across government departments?

Various components of government play different but interconnected roles in STAs. The 2004 Cabinet-approved Strategic Management Model for the Public Science and Technology System in South Africa and, more recently, the 2019 White Paper on STI, has shaped the cross-cutting focus areas of the Department of Science and Technology, while other sector departments focus mostly on sector-based activities, the application of mature technology, and sector-based scientific and technological services. In other words, in their overall portfolio, sector departments are more involved in the deployment and utilisation of technology than in early-stage or basic research, which they drive only to a limited extent. Basic research is mostly the responsibility of the DST. In the whole mix, higher education institutions and science councils play a big role in performing research and engaging in technological development, including facilitating collaborative work with actors in the private sector and international arena.

The DST, because of its mandate, contributed the most to total government funding for STAs (29% in 2018/19). Other science-intensive departments were significant contributors to STAs funding; after the DST, the four departments that made the highest contributions to total STA funding were the South African Police Service (with 15,6%), Higher Education and Training (13,8%), Basic Education (5,9%), and Agriculture, Forestry and Fisheries (4,8%). Collectively, these five departments contributed about 53% to total STA funding in 2018/19. The STA spending of a further three departments, namely, Health, the National Treasury and Energy, make up another 28% of the total STAs.

Table 1 lists the departments that are at the top of STA funding in terms of two criteria, namely, the amount of STA funding and the proportion of departmental budget allocated to STAs. Departments that have a significant requirement for scientific and technological input tend to allocate a larger proportion of their budgets to STAs. A complete set of departments funding STAs is presented in Annexure A1.

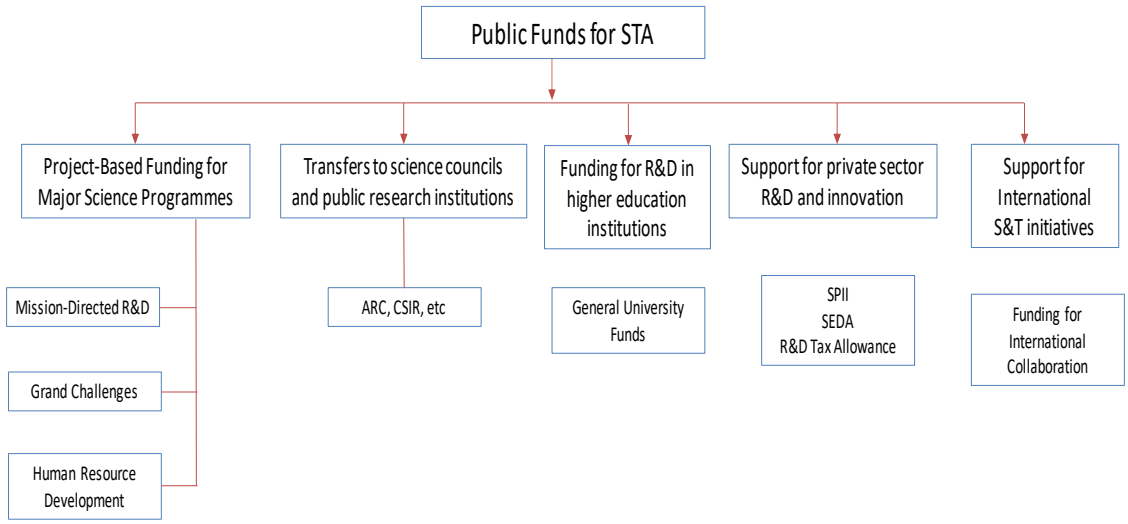
Table 1: Top departments by STA funding and by proportion of budget (2018/19)

Department	Amount of STA funding (in R millions)	STA funding as % of departmental budget
Science and Technology	7 546	96,9%
Mineral Resources	735	38,9%
Sport and Recreation South Africa	257	23,6%
Agriculture, Forestry and Fisheries	1 254	17,5%
Energy	760	10,8%
Home Affairs	739	9,3%
Environmental Affairs	585	8,2%
Basic Education	1 546	6,8%
Planning, Monitoring and Evaluation	55	5,9%
Trade and Industry	456	4,8%
South African Police Service	4 050	4,4%
Higher Education and Training	3 597	4,0%
National Treasury	1 128	3,8%
Health	1 156	2,5%

4.3 What are the channels for funding STAs?

Figures 3 provides an indication of the major channels through which funding for STAs is deployed in South Africa.

Figure 4: Flows of government funding for STAs



Note: Abbreviations are presented on pages iii and iv of this report.

Overall, STAs in South Africa are undertaken outside national and provincial government departments, by research entities, higher education institutions and private sector consultants. There are specific exceptions, with some departments having internal branches that actually perform these activities, for example, the Department of Environmental Affairs and the Department of Agriculture, Forestry and Fisheries.

STAs performed in-house by the funding department are categorised as intramural in this document, while extramural STAs are those performed outside the funding department. Extramural STAs can be further divided into extramural government STAs, for which the government provides funding with the expectation of ownership

of the resulting output; and extramural non-government STAs, for which the government provides funding for the purpose of advancing national priorities, without expecting ownership of the resulting output. The latter category includes funding support for the private sector in order to encourage R&D and technological innovation, both directly through funding grants and indirectly through such instruments as the R&D tax incentive.

Table 2: Intramural and extramural STA allocations (2018/19)

Allocations	R&D	STS	STET	Total
		R million		
Intramural	2 267	6 214	14	8 496
Extramural, of which –	11 644	1 477	4 390	17 511
Government STAs	6 450	1 340	4 224	12 013
Non-governmental STAs	5 194	137	166	5 497
Total	13 911	7 691	4 405	26 006
% of total funding	R&D	STS	STET	Total
Intramural	8,7%	23,9%	0,1%	32,7%
Extramural, of which –	44,8%	5,7%	16,9%	67,3%
government STAs	24,8%	5,2%	16,2%	46,2%
non-governmental STAs	20,0%	0,5%	0,6%	21,1%
Total	53,5%	29,6%	16,9%	100,0%

Transfers and subsidies made up 67,3% (R17,5 billion) of total STA funding in 2018/19, indicating that most implementation activities are located outside the national and provincial departments and are performed by public research institutions, science councils, higher education institutions and consultants. The remaining 32,7% (R8,5 billion) of STA funding was spent within national departments. This distribution has remained constant over the years.

There is a diversity of roles among the government entities. Some entities perform scientific research activities, while some entities fund scientific research activities, and others, like the National Research Foundation (NRF) and the South African Medical Research Council (SAMRC), do both. The NRF performs research through national facilities (e.g. the South African Astronomical Observatory, the iThemba Laboratory for Accelerator-Based Sciences and the South African Institute for Aquatic

Biodiversity) and is also a major funding agency responsible for distributing funding to the research community, mostly for human capital development and infrastructure initiatives.

The character of these flows and channels tends to evolve over time to reflect the policy approach of the country in question.[11] In spite of specific limitations within the South African STI investment landscape, the value derived from government funding of STAs was captured in a 2007 OECD report and, more recently, in 2016, a Synthesis Report on the Review of the 1996 White Paper on Science and Technology.[12]

A case of the National Integrated Cyberinfrastructure System (NICIS) is used in the text box below to explain how a country draws value from public investment in major scientific programmes.

The National Integrated Cyberinfrastructure System: A case for deriving value from public investment in scientific programmes

Scientific research and industrial development require high-performance computing capability. This is why South Africa is investing in the National Integrated Cyberinfrastructure System (NICIS).

The project was initiated in around 2006/07 with the establishment of the South African National Research Network (SANReN), a national broadband network that facilitates high-speed connectivity for the research and education community.

To build a national capability of scale, SANReN was integrated with three other complementary initiatives to form NICIS:

- The Centre for High Performance Computing (CHPC), which provides high-performance computational instruments and resources to support cutting-edge research.
- The Data Intensive Research Initiative for South Africa (DIRISA), which provides advanced capability for managing very large data sets.
- The South African GRID computing initiative, which facilitates the sharing of decentralised, autonomous computing facilities across participating institutions.

[11] OECD Science, Technology and Innovation Outlook 2018 (Chapter on "New trends in public research funding").

[12] Evaluations reports include the OECD Review of Innovation Policy https://www.oecd.org/southafrica/oecdreviewsofinnovationpolicysouthafrica.htm]: South Africa (2007); Synthesis Report on the Review of the White Paper on Science and Technology and High Level Framing for a New Decadal Plan (2016). http://www.naci.org.za/STIForesight2018/index.php/relevant-documents/policies-strategies-roadmaps-plans-sa/the-south-african-nsi/574-walwyn-2016-synthesis-report/file

- The fourth component, human capital development, focuses on e-skills to train data scientists, and e-science that is research specific to NICIS offerings.

Programmes like these are expensive and require long periods of investment and capacity building before they can show real returns. Public investment in the NICIS collective is estimated at R3,2 billion for the period 2006/07 to 2018/19, and was crucial in getting the project off the ground to where it is today.

At the outset, at policy level, South Africa's 2002 National Research and Development Strategy identified ICT as one of the key technology missions that would bring about improved quality of life and build South Africa's economy through an inclusive information society. This is because large-scale processing capability, high speed connectivity, collaboration, low bandwidth cost, data repositories and reliability are key success factors for modern industry and academic research.

With the NICIS initiative, the country has achieved some important milestones in the cyberinfrastructure field:

- **Connectivity speed** – As at 31 March 2019, NICIS had a Total Available Broadband Capacity (TABC) of about 3 557 Gigabits per second (Gbps).
- **Number of sites** – As at 31 March 2019, NICIS had connected a total of 236 sites to the SANReN network from various science, research, higher education and innovation institutions as well as entities in support of science and education. This includes sites from all 236 South African public universities, most science/research councils, and various national facilities and institutions, academic hospitals, national museums, national libraries and grand science projects like the SKA).
- **Availability of broadband networks** – The terrestrial SANReN network is connected to Europe through four undersea cables. These are the West Africa Cable System (WACS), SEACOM, Eastern Africa Submarine Cable System (EASSy) and South Atlantic 3 (SAT-3). The national backbone connects the metropolitan areas of Tshwane, Johannesburg, eThekwini, East London, Cape Town, Bloemfontein, and Pietermaritzburg. It is envisaged that by 2022, that all Technical and Vocational Education and Training (TVET) colleges will have been connected to SANReN. . Presently, the network provides services to approximately 1,2 million users daily, within its beneficiary community.
- **Scientific collaborations** – The system serves as an important platform for research collaboration among local researchers, as well as with partners globally. Programmes such as the SADC Cyberinfrastrcuture Framework, supported by all ministers within the SADC region, has brought the region together in support of collaboration to advance regional development. This collaboration was extended to African SKA partner countries, to strengthen the African big data initiative.
- **Computing capability** – Expansion of high-performance computing from 2,5 TFlops in 2007 to 61,4 TFlops in 2015. In the next years, this project aims to increase computing capability to 10 PFlops, which will cater for various HPC requirements of scientists around the country. It is envisaged that corresponding long-term data storage will increase to close to 60 Petabytes, excluding

the astronomy data. Since 2009, the CHPC HPC systems were rated among the Top 500 supercomputers globally, as a confirmation of world-class computing facilities.

- **Reduction in bandwidth cost** – Low bandwidth for higher education and research communities – from R43 000 for Mbps per month to R6 000 for 1 Gbps per month for local connectivity; and from R52 425 to R800 per month for 1 Mbps for international connectivity.
- **Resource for the SKA** – NICIS strengthened the SA business case to host the SKA, by demonstrating the country's processing capability and ability to transport large amounts of data around the world. The visibility and capability of South Africa's HPC systems and connectivity (alongside the high-end skills of South African scientists in modelling and simulation of material properties for mineral beneficiation) that multinational companies such as Johnson Matthey moved their research to South Africa.
- **Support for research capacity** – High-end skills are available as a result of targeted human capital in this specialised area. South African students, through the CHPC, have demonstrated world-class skills in HPC, between 2013 to 2019 winning the international student cluster challenge four times, coming second twice and third once. These skills are important for the support of institutions, government and industries requiring HPC.
- **Support of CERN:** South Africa is currently running a Tier 2 service of CERN supporting the ALICE and ATLAS experiments and producing close to 2 000 jobs per day, enabled by reliable computing infrastructure and ease of connectivity.

4.4 Which government objectives are addressed by the funded STAs?

There are different ways of measuring how much governments spends on R&D.[13] The STA survey uses a funder-based approach and applies a concept of government allocations for research and development (GBARD). The performer-based approach is used in the National Survey of Research and Experimental Development (R&D survey).[14] The amounts for R&D indicated par. 4.3 above are consistent with the concept of GBARD, which represents all appropriations allocated to R&D undertaken within national departments, transfers made for government-financed R&D carried out by government entities and entities outside government, and direct government financial support for R&D carried out by the business, higher education, and private non-profit sectors. What appears in the government budget appropriations may not necessarily match what is ultimately reported in the R&D survey, for various reasons, such as timing between appropriations and actual spending. The R&D survey collects data from R&D performing units across five institutional sectors, namely, government, science councils, higher education institutions, business enterprises and the not-for-profit institutions. The R&D survey counts the amounts declared by R&D performing units in all five of these sectors as government-funded R&D.

Of the two approaches for estimating government R&D spend, a funder-based approach offers an advantage of timeliness because budget data becomes available sooner than data from a survey of R&D performers. It is also far easier to link the budget information with policy considerations through classification of the data by socio-economic objective (SEOs). The SEO classification is useful for indicating targeted areas of use and the policy intentions of the government, as a funder, when committing funds for STAs.

Table 3 disaggregates total STA funding using the SEO classifications. For the purposes of this classification, each responding department was asked to indicate the

[13] The Frascati Manual (2015) distinguishes between funder-based and performer-based approaches for measuring government spending on R&D. The Frascati Manual is published by the Organisation for Economic Cooperation and Development (OECD) as an international guideline for producing R&D statistics.
[14] The National Survey of Research and Experimental Development (R&D survey) produces R&D statistics in South Africa.

primary SEO purpose for which their STA allocations were intended. These were then aggregated and used to estimate the expenditure devoted to each SEO. There are five major divisions of SEO, namely, justice and protection, economic development, improvement of society, the environment, and advancement of knowledge.

In 2018/19 an estimated R10,4 billion (34%) of total STA expenditure was allocated to the improvement of society in the areas of health, education and training, and social development. This was followed by R7,6 billion (29%) for economic development, with agriculture (plant and animal production) contributing the most in this division. An estimated R4,7 billion (18,0%) went to justice and protection, which includes defence and policing, while R2,6 billion (16%) was allocated to the advancement of knowledge. The remaining R699 million (2,9%) went to the environment.

Table 3 further illustrates the SEO Justice and Protection which includes, Defence (15,6%) and South African Police Service (2,8%). Economic Development (29%) includes elements of Energy, Transport, Manufacturing and Natural Resources. Society (24%), Health, Education and Training, Social Development and Community Service. The environment (3%) which includes Environmental Knowledge, Environmental Aspects of Development, and Environmental Management. Lastly, the Advancement of Knowledge (16%) includes Natural Technologies and Engineering, Social Sciences and Humanities.

As illustrated in Figure 5, there have not been any major shifts in the distribution of STA funding per SEO over the three measurement periods leading to 2018/19. Continued monitoring of these trends will in due course show whether the priorities of the 2019-2024 MTSF period caused any major changes in the distribution.

Table 4 maps the SEOs against the NDP chapters and the 2014-2019 MTSF outcomes, as well as the departments that contribute in those areas.[15] While this is only illustrative, it does indicate a level of alignment at a broad level. Precise

[15] The delineations in Table 4 are derived in part from 2018 Medium Term Expenditure Committee technical guidelines that were issued to national departments by the National Treasury.

articulation of the alignment requires a much deeper analysis of projects and their specific activities.

Table 3: STA funding per categories of socio-economic objectives

Major SEO divisions	STA funding per major SEO		SEO classification	STA funding per SEO	% of total
Justice and Protection	4 774	18,4%	Defence	724	2,8%
			Police	4 050	15,6%
Economic development	7 573	29,1%	Energy	905	3,5%
			Agriculture (plant and animal production	1 327	5,1%
			Transport	2	0,0%
			Economic Framework	1 159	4,5%
			Commercial Services	665	2,6%
			Mineral Resources (excluding Energy)	735	2,8%
			Manufacturing	210	0,8%
			Construction	410	1,6%
			Information and Communication Services	2 159	8,3%
			Natural Resources	0	0,0%
Society	10 354	39,8%	Health	1 276	4,9%
			Education and Training	8 744	33,6%
			Social Development and Community Services	333	1,3%
Environment	678	2,6%	Environmental Knowledge	0	0,0%
			Environmental Aspects of Development	93	0,4%
			Environmental management and other aspects	585	2,2%
Advancement of Knowledge	2 628	10,1%	National Sciences, Technologies and Engineering	2 236	8,6%
			Social Sciences and Humanities	392	1,5%
Total	**26 006**	**100%**		**26 006**	**100%**

Figure 5: STA funding patterns per socio-economic objectives (2016/17 to 2018/19)

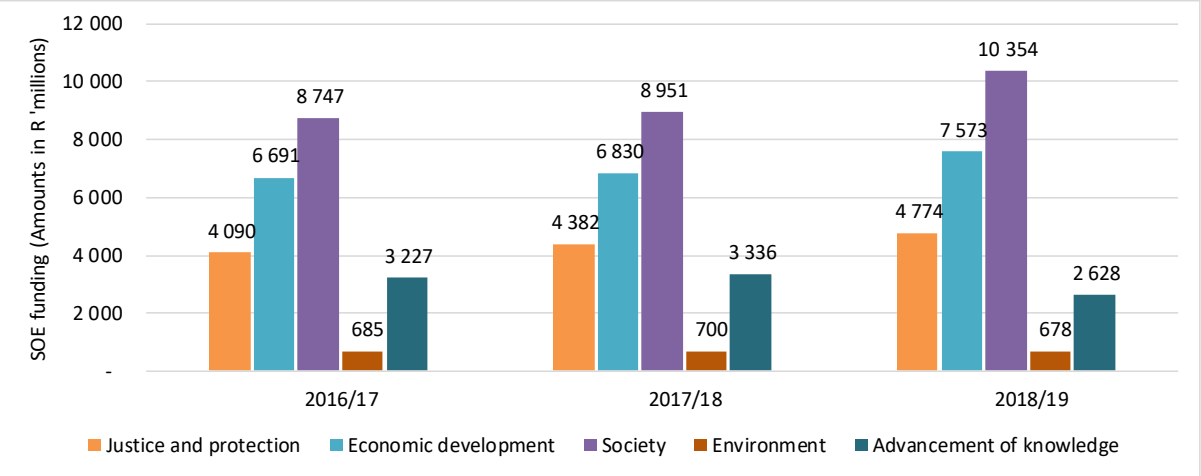


Table 4: Linking STA funding with NDP chapters and the 2014-2019 MTSF

National Development Plan	MTSF 2014-2019 Outcomes	SEO major divisions	Relevant national departments
Chapter 9: Improving education, training and innovation	(1) Quality basic education (5) A skilled and capable workforce to support and inclusive growth path	**Society**	Arts and Culture Basic Education Health Higher Education and Training Social Development Sports and Recreation
Chapter 10: Promoting health Chapter 11: Social protection	(2) A long and healthy lifestyle (13) An inclusive and responsive social protection system		
Chapter 15: Transforming society and uniting the country	(1) Quality basic education (14) Nation building and social cohesion		
Chapter 12: Building safer communities Chapter 14: Promoting accountability and fighting corruption Chapter 3: Economy and development	(3) All people in South Africa are and feel safe (11) Create a better South Africa, Africa and world	**Justice and Protection**	Correctional Services Defence and Military Veterans Justice and Constitutional Development Office of the Chief Justice South African Police Service
Chapter 3: Economy and development	(4) All people in South Africa are and feel safe	**Economic Development**	Agriculture, Forestry and Fisheries

National Development Plan	MTSF 2014-2019 Outcomes	SEO major divisions	Relevant national departments
Chapter 5: Transition to a low-carbon economy	(5) A skilled and capable workforce to support and inclusive growth path (10) Create a better South Africa, Africa and world		Environmental Affairs Labour Mineral Resources Science and Technology Small Business Development Tourism Trade and Industry
Chapter 4: Economic infrastructure Chapter 6: Integrated and inclusive rural development	(6) An efficient, competitive and responsive economic infrastructure network (7) Vibrant, equitable, sustainable rural communities contributing towards food security for all (9) Responsive, accountable, effective and efficient developmental local government (11) Create a better South Africa, Africa and world	**Community Development**	Energy Human Settlements Rural Development and Land Reform Telecommunications and Postal Services Transport Water Affairs and Sanitation
Chapter 13: Building a capable state Chapter 12: Aims to eliminate poverty and reduce inequality by 2030 Chapter 3: Economy and development	(3) All people in South Africa are and feel safe (4) Decent employment through inclusive growth (8) Sustainable human settlements and improved quality of household life (9) Responsive, accountable, efficient and effective developmental local government (12) An efficient, effective and development-oriented public service	**Environmental Affairs**	Cooperative Governance Home Affairs National Treasury Planning, Monitoring and Evaluation Human Settlements Public Enterprises Public Service and Administration Public Works Statistics South Africa Traditional Affairs Women

4.5 What are the trends in the funding of science councils?

There are different types of funding modes for science councils (and public research institutions in general). Core funding for science councils is done through a parliamentary grant process, which is an annual budget vote allocation that is meant to facilitate the fulfilment of the primary public mandates of these institutions. Such funding is reported as "income" in the books of science councils. The parliamentary grant consists of baseline funding to support the institutions' existence and ring-fenced allocations targeting major objectives within the institutions' missions. Ring-fenced or programmatic funding is for specific government programmes and allocated based on institutional specialisation or relevance to the task at hand.

Figure 6 presents the 2018/19 parliamentary grant funding for the 11 science councils covered in this report. Table 5 presents these allocations for 2018/19, and Figure 6 shows the allocations over the medium term (2015/16 to 2021/22).[16] Figure 7 shows the trend of overall allocation in nominal and in constant 2010 rand terms.

Parliamentary grant funding in 2018/19 was R8,4 billion, an increase of 3,1% from R8,1 billion reported for 2017/18. The amount will increase to R9,9 billion in 2021/22. Expressed in constant 2010 rand terms, total parliamentary grant funding for the 11 science councils has remained constant for three years (2016/17 to 2018/19).

Over the years, the NRF has had the highest parliamentary grant allocation, followed by the Council for Scientific and Industrial Research (CSIR) and then the Agricultural Research Council (ARC). This was also the case in 2018/19. The differences in allocations are related to the institutions' relative size and the scope of their mandate. The CSIR and the Academy of Science of South Africa reported declines in parliamentary grant funding from 2017/18 to 2018/19. The allocation for the Council for Geosciences (CGS) for 2021/22 shows a significant reduction, which is due to the no budget within the baseline for SAF or STI focus areas.

[16] The 2018/19 STA report has updated the figures for parliamentary grant that were reported in the 2017/18 STA report by including the amount for capital expenditure that were omitted in the previous report.

Figure 6: Parliamentary grant funding per science council in 2018/19

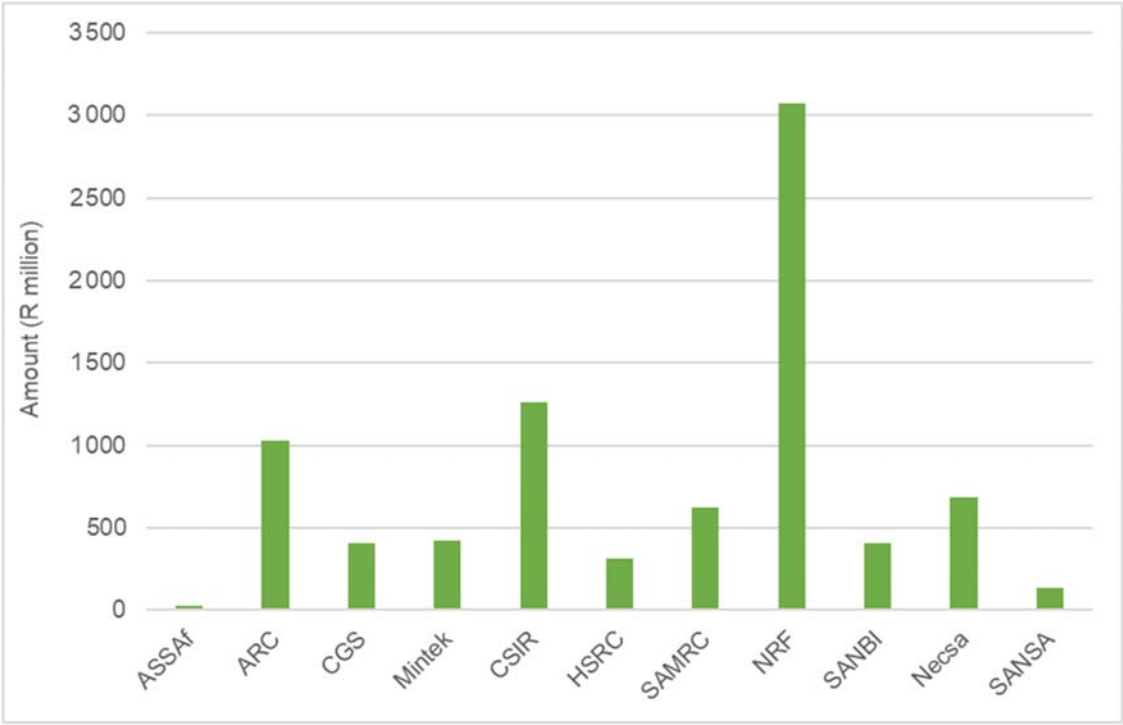
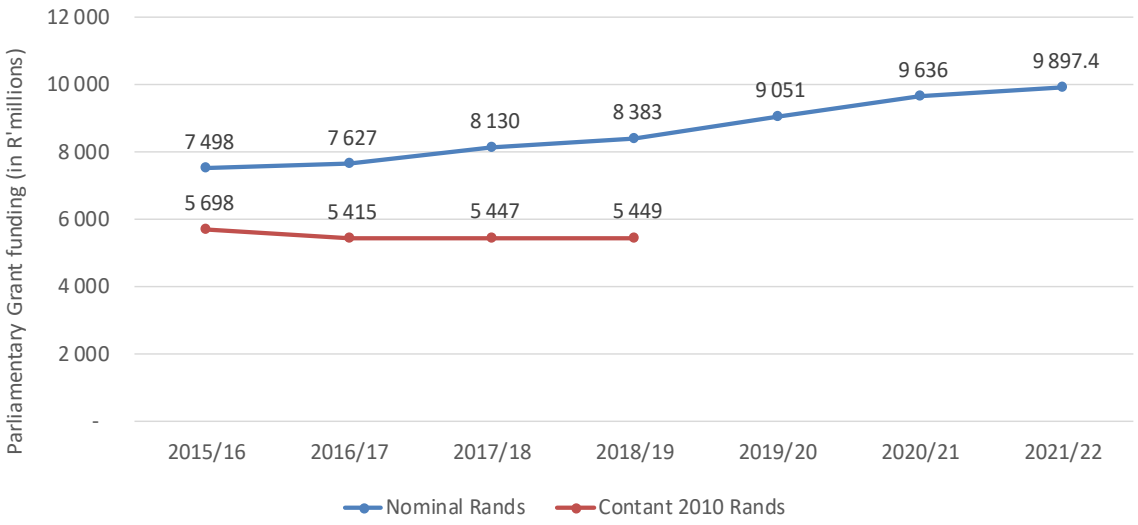


Table 5: Parliamentary grant funding per science council (2015/16 to 2021/22)

Science council	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
				R million			
ASSAf	23	25	38	26	27	28	37
ARC	804	813	975	1 031	1 224	1 294	1 347
CGS	343	379	367	406	414	436	251
Mintek	415	356	367	420	436	460	485
CSIR	1 034	1 087	1 357	1 263	1 278	1 348	1 401
HSRC	294	290	312	314	326	344	361
SAMRC	624	661	619	625	687	723	759
NRF	2 952	2 942	2 973	3 072	3 199	3 450	3 611
SANBI	304	319	328	405	427	461	495
Necsa	580	599	664	683	890	939	991
SANSA	124	155	131	138	143	151	157
Total	**7 498**	**7 627**	**8 130**	**8 383**	**9 051**	**9 636**	**9 897**

Figure 7: Trend of parliamentary grant funding for science councils (2015/16 to 2021/22)



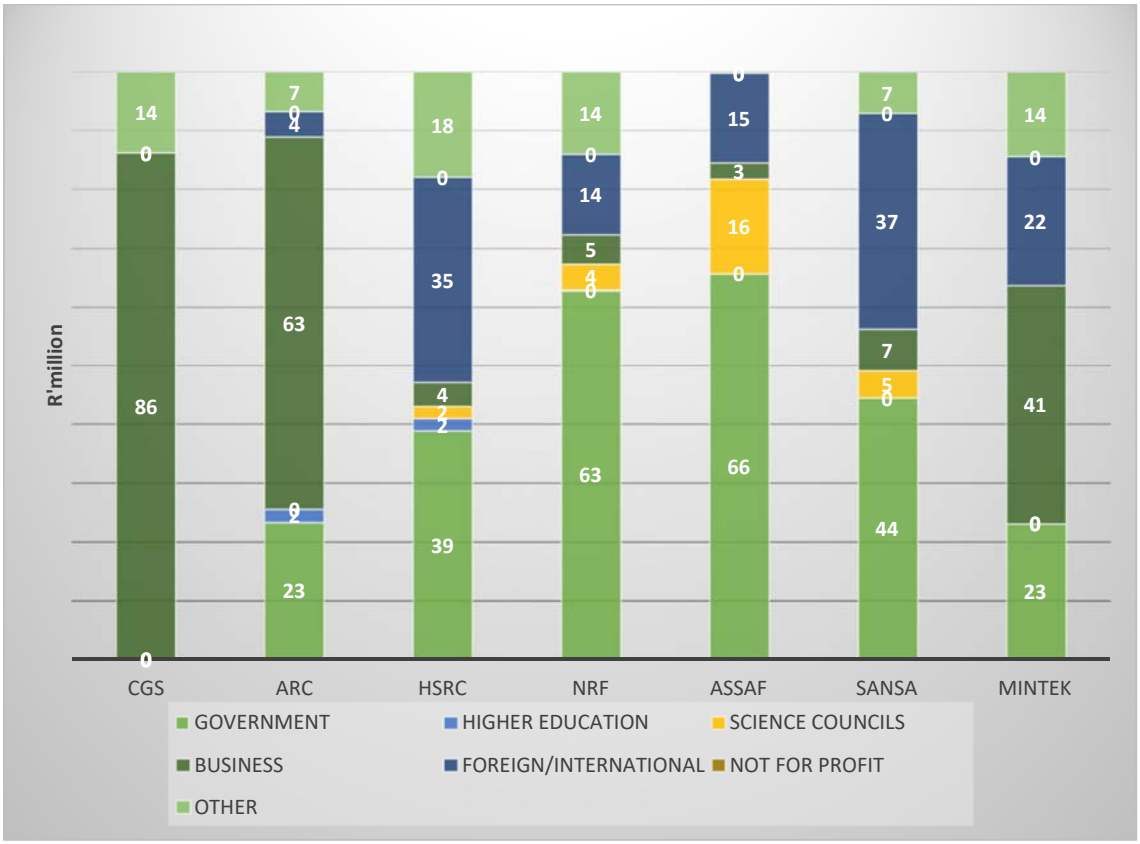
The funding models of the institutions differ, enabling them to access funding from various sources, within and outside government. Each science council is different and therefore has its own income structure. The ratio of government versus non-government income gives an indication of the extent to which a particular institution depends on government funding.

Public research institutions receive income through other modes, such as programmatic funding, which is allocated competitively on the basis of project proposals submitted to meet objectives specified in a call for such submissions; various kinds of contract research from government, the private sector or international sources; and then income from royalties, licences and the sale of technology packages, as well as dividends from spin-off companies. The weight of these sources of income differs across public research institutions. Institutions have varying abilities to access these sources of income. A range of factors such as the objectives of funders, fields of research, industry specialisations and affiliations also influence funding allocations. Furthermore, the funding environment changes, and an increased range of funding modes can be seen in many countries, including hybrids of the examples provided above, public-private financing and venture funding.[17]

[17] Fonseca & Pinheiro-Veloso (2018), The practice and future of financing science, technology and innovation. *Foresight and STI Governance*, 12(2); OECD STI Outlook 2018 (Chapter on "New trends in public research funding").

To demonstrate the different modes of funding across institutions, Figure 8 presents the sources of income for the seven science councils whose data was sourced and validated during the STA survey data collection process. The 2019/20 STA survey will continue collecting data on sources of income for science councils in order to enable a fuller analysis.

Figure 8: Sources of income for science councils other than parliamentary grants in 2018/19



4.6 How are key S&T programmes affected by the fiscal pressures?

In the past few years, there have been budget cuts and reprioritisations across government. The National Treasury issues instructions to departments and their agencies, which must then decide how these cuts can be effected. Data to properly

assess the extent to which the budget cuts affect S&T programmes has been collected, but is not sufficient for a useful analysis.[18]

At an aggregated level, overall funding for STAs has remained constant in real terms, and declined as percentage of total government budget. Data that was collated using the MTEF allocation letters and the Estimates of National Expenditure (ENE) documents shows that at least R700 million was cut from nine science council budgets for the period 2014/15 to 2019/20. Where ENE data was used, the amounts identified do not necessarily represent the full amounts cut by the relevant science councils; they have been estimated by subtracting actual audited outcomes from earlier budget appropriations.

The continuous cuts on science councils and their heavy reliance on contract income raises questions about the sustainability of the non-income-generating portion of these institutions' mandates. The potential erosion of the baseline budgets of these important institutions will have negative implications, compromising their ability to scale up programmes that are working well. Major recent changes include restructuring in some entities with reductions in staff headcount, most notably at the CSIR and the CGS, and the decline in research grants from the NRF.[19] There is a risk of underperforming on the NDP targets that rely on publicly led scientific and technological inputs. It is possible that budget cuts may have assisted by forcing prioritisation and improving efficiencies across the system, but further examination of specific cases is needed for a proper diagnosis of the effects of the budget cuts.

5. CONCLUSION

This report is an important source of information on how budget allocations for STAs are made to support various functional areas of government – giving an indication of the extent to which STA budgeting and spending aligns with policy priorities. This should help to inform choices about prioritisation and budget allocations going forward.

[18] With the time allocated for this survey, it was only possible to gather data on budget cuts of nine science councils whose data could be sourced from the ENE and/or from the funding allocation letters issued by the Department of Science and Innovation. The nine science councils are ASSAf, CSIR, HSRC, NRF, SANSA, ARC, Necsa, SAMRC and Mintek.

[19] 2018/19 CSIR Annual Report, 2018/19 CGS Annual Report.

Thirty-five national government departments were contacted for this survey. These are the same departments that reported STAs in previous recent years. The extent of the survey is party influenced by how different departments express STA concepts in their financial records.

In real terms, government funding for STAs has remained flat, partly due to ongoing fiscal constraints. Across government departments and science councils there is an increasing need to use what is available optimally, forcing decision-makers to improve efficiency and prioritise. On the other hand, fiscal constraints make it difficult to initiate new programmes and scale up or even sustain existing programmes. The evidence in this report shows that there is an erosion of the baselines of some science councils, which could weaken their focus on public missions.

Despite the reality of fiscal pressures, government funding for STAs remains crucial in the context of the NDP. The government is still the largest funding source for R&D in South Africa. Over and above direct funding for R&D programmes, the government also has to leverage investment from other actors, such as private companies, not-for-profit organisations and the international community. This is important given the increasingly cooperative and networked nature of certain STI activities. The government also administers policies and programmes to improve the environment for investment and innovation.

The introduction of the 2019 White Paper on Science, Technology and Innovation and the new MTSF period (2019-2024) open up a space for reviewing priorities and establishing new plans. Foresight exercises undertaken separately by the Department of Planning, Monitoring and Evaluation and the National Advisory Council on Innovation will inform planning for the medium to long term to ensure that South Africa takes advantage of megatrends. A whole-of-government approach to STA priority setting and budget allocation is required if resources are to be optimised in the next planning period.

Owing to resource constraints, there will be increased competition for budgetary allocations across government departments and different STI domains. Policy

experimentation using mission-oriented planning and sector masterplans offers possibilities for optimising resources by connecting sectoral objectives with STI capabilities in pursuing some higher-order outcomes.

Acknowledgements

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An electronic copy of the report is available at www.dst.gov.za/index.php/resource-centre/strategies-and-reports.

Annexures A: Statistical tables on government funding for STAs

A1. Funding of STAs by national government departments (2013/14 to 2021/22)

National government Deartments	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Total National government funding for STAs:	**23,840,835**	**21,134,597**	**23,372,867**	**23,440,306**	**24,199,136**	**26,006,358**	**27,810,422**
Agriculture, Forestry and Fisheries	1,018,461	1,138,325	1,194,726	1,253,948	1,274,898	1,253,948	1,316,645
Arts and Culture	33,058	35,069	36,235	38,047	39,950	39,950	42,267
Basic Education	1,003,102	1,058,681	1,338,269	1,406,055	1,460,937	1,545,831	1,630,852
Cooperative Governance	565,401	596,699	617,298	649,971	7,431	649,819	682,310
Correctional Services	4,298	1,815	1,643	5,814	3,746	5,568	4,441
Defence and Military Veterans	505,171	613,959	613,630	601,125	632,690	723,721	637,143
Energy	726,526	923,363	645,219	619,963	810,525	760,341	802,884
Environmental Affairs	476,816	505,425	530,696	557,231	557,711	585,093	619,028
Health	3,740,164	693,976	1,137,271	1,156,242	1,155,172	1,156,242	1,155,172
Higher Education and Training	2,743,149	3,003,557	3,261,381	3,413,554	3,363,822	3,596,901	3,805,522
Home Affairs	125,729	442,164	219,108	413,640	518,915	739,187	781,039
Human Settlements	18,446	-	-	-	55,019	50,339	54,450
Justice and Constitutional Development		-	-	-	95,737	96,460	102,976
Labour	4,274	4,345	8,165	8,573	5,485	8,573	9,002
Mineral Resources	612,741	663,693	757,656	735,014	734,244	735,014	733,244
National Treasury	-	692,497	654,643	508,971	817,733	1,128,116	1,027,918
Office of the Chief Justice	-	-	-	-	19,800	16,805	28,176
Planning, Monitoring and Evaluation		-	-	-	567	54,574	59,714
Police	3,704,057	3,625,723	3,876,052	3,489,261	3,749,510	4,050,096	4,272,852
Public Enterprises	-	63,141	33,106	-	2,658	2,000	1,000
Public Service and Administration	-	3,050	5,785	5,706	6,233	6,378	6,748
Public Works	-	-	-	14,800	18,000	19,008	20,072
Rural Development and Land Reform	10,245	18,716	18,447	19,451	20,424	21,609	22,797
Science and Technology	6,943,155	6,479,890	7,482,120	7,429,000	7,557,200	7,546,357	7,916,000
Small Business Development	490	-	-	-	18,350	22,713	762,899
Social Development	490	5,097	5,034	4,843	4,873	5,274	5,580
Sport and Recreation South Africa	51,456	43,982	61,377	209,871	253,058	257,104	271,244
Statistics South Africa	27,753	42,479	49,672	46,681	50,834	53,093	56,066
Telecommunications and Postal Services	916,995	8,867	3,593	5,865	1,253	1,253	2,319
Tourism	300	451	315	497	695	497	695
Trade and Industry	215,495	224,725	451,386	455,785	531,094	455,785	536,454
Traditional Affairs	-	-	-	-	-	-	-
Transport	14,104	17,308	15,411	18,037	33,963	19,993	21,106
Water and Sanitation	378,959	227,600	354,629	372,360	390,978	390,978	413,655
Women	-	-	-	-	5,630	7,738	8,152

A2. Percentage contribution to STAs by national government departments (2013/14 to 2021/22)

National government Deartments	2013/14	2014/15	2015/16	2016/17	2017/18	Medium Term Expenditure Estimates 2018/19	2019/20
Total National government funding for STAs	**102%**	**97%**	**98%**	**100%**	**100%**	**100%**	**100%**
Agriculture, Forestry and Fisheries	4,3%	5,4%	5,1%	5,3%	5,0%	4,8%	4,7%
Arts and Culture	0,1%	0,2%	0,2%	0,2%	0,2%	0,2%	0,2%
Basic Education	4,3%	5,0%	5,6%	6,0%	6,1%	5,9%	5,9%
Cooperative Governance	2,4%	2,8%	2,6%	2,8%	0,0%	2,5%	2,5%
Correctional Services	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Defence and Military Veterans	2,2%	2,9%	2,6%	2,6%	2,6%	2,8%	2,3%
Energy	3,1%	4,4%	2,7%	2,6%	2,6%	2,9%	2,9%
Environmental Affairs	2,0%	2,4%	2,2%	2,4%	2,3%	2,2%	2,2%
Health	16,0%	3,3%	4,7%	4,9%	4,7%	4,4%	4,2%
Higher Education and Training	11,7%	14,2%	13,6%	14,6%	14,3%	13,8%	13,7%
Home Affairs	0,5%	2,1%	0,9%	1,8%	2,2%	2,8%	2,8%
Human Settlements	0,1%	0,0%	0,0%	0,0%	0,2%	0,2%	0,2%
Justice and Constitutional Development	0,0%	0,0%	0,0%	0,0%	0,4%	0,4%	0,4%
Labour	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Mineral Resources	2,6%	3,1%	3,2%	3,1%	3,2%	2,8%	2,6%
National Treasury	0,0%	3,3%	2,7%	2,2%	3,9%	4,3%	3,7%
Office of the Chief Justice	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,1%
Planning, Monitoring and Evaluation	0,0%	0,0%	0,0%	0,0%	0,2%	0,2%	0,2%
Police	15,8%	17,2%	16,2%	14,9%	15,7%	15,6%	15,4%
Public Enterprises	0,0%	0,3%	0,1%	0,0%	0,0%	0,0%	0,0%
Public Service and Administration	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Public Works	0,0%	0,0%	0,0%	0,1%	0,1%	0,1%	0,1%
Rural Development and Land Reform	0,0%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%
Science and Technology	29,7%	27,6%	31,2%	31,7%	31,2%	29,0%	28,5%
Small Business Development	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	2,7%
Social Development	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Sport and Recreation South Africa	0,2%	0,2%	0,3%	0,9%	1,0%	1,0%	1,0%
Statistics South Africa	0,1%	0,2%	0,2%	0,2%	0,2%	0,2%	0,2%
Telecommunications and Postal Services	3,9%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Tourism	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Trade and Industry	0,9%	1,0%	1,9%	1,9%	1,9%	1,8%	1,9%
Traditional Affairs	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Transport	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%
Water and Sanitation	1,6%	1,0%	1,5%	1,6%	1,6%	1,5%	1,5%
Women	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

A3. Funding of STAs as percentage of departmental budgets (2018/19)

Department	STA funding (R'000)	Total government budget (R'000)	% of STA funding to total budget	% Cotribution to Total STA Budget
Agriculture, Forestry and Fisheries	1,253,948	7,164,998	17,50%	**4,82%**
Arts and Culture	39,950	4,372,264	0,91%	**0,15%**
Basic Education	1,545,831	22,722,437	6,80%	**5,94%**
Cooperative Governance	649,819	83,651,888	0,78%	**2,50%**
Correctional Services	5,568	23,848,510	0,02%	**0,02%**
Defence and Military Veterans	723,721	47,949,743	1,51%	**2,78%**
Energy	760,341	7,045,017	10,79%	**2,92%**
Environmental Affairs	585,093	7,112,532	8,23%	**2,25%**
Health	1,156,242	47,142,866	2,45%	**4,45%**
Higher Education and Training	3,596,901	89,950,026	4,00%	**13,83%**
Home Affairs	739,187	7,915,439	9,34%	**2,84%**
Human Settlements	50,339	32,355,716	0,16%	**0,19%**
Justice and Constitutional Development	96,460	19,264,964	0,50%	**0,37%**
Labour	8,573	3,292,243	0,00%	**0,03%**
Mineral Resources	735,014	1,890,661	38,88%	**2,83%**
National Treasury	1,128,116	29,358,400	3,84%	**4,34%**
Office if the Chief Justice	16,805	2,141,838	0,78%	**0,06%**
Planning, Monitoring and Evaluation	54,574	927,351	5,88%	**0,21%**
Police	4,050,096	91,834,161	4,41%	**15,57%**
Public Enteprises	2,000	273,914	0,73%	**0,01%**
Public Service and Administration	6,378	956,656	0,67%	**0,02%**
Public Works	19,008	7,453,326	0,26%	**0,07%**
Rural Development and Land Reform	21,609	10,425,243	0,21%	**0,08%**
Science and Technology	7,546,357	7,790,488	96,87%	**29,02%**
Small Business Development	22,713	1,488,453	1,53%	**0,09%**
Social Development	5,274	172,901,587	0,00%	**0,02%**
Sport and Recreation South Africa	257,104	1,090,777	23,57%	**0,99%**
Statistics South Africa	53,093	2,271,699	2,34%	**0,20%**
Telecommunications and Postal Services	1,253	923,407	0,14%	**0,00%**
Tourism	497	2,261,817	0,02%	**0,00%**
Trade and Industry	455,785	9,462,611	4,82%	**1,75%**
Transport	19,993	59,808,494	0,03%	**0,08%**
Water and Sanitation	390,978	15,571,518	2,51%	**1,50%**
Women	7,738	230,207	3,36%	**0,03%**

A4. Funding of STAs per type by national department (2018/19)

Department and STA category	Appropriation	Medium-term expenditure estimate		
	2018/19	2019/20	2020/21	2021/22
	R'000			
Agriculture, Forestry and Fisheries	**1 253 948**	**1 393 010**	**1 469 626**	**1 550 456**
GBARD	1 220 028	1 355 329	1 429 872	1 508 515
STET	10 300	11 442	12 072	12 736
STS	23 620	26 239	27 683	29 205
Arts and Culture	**39 950**	**44 591**	**47 044**	**47 044**
GBARD	39 950	44 591	47 044	47 044
STET	0	0	0	0
STS	0	0	0	0
Basic Education	**1 545 831**	**1 615 573**	**1 704 865**	**1 818 621**
GBARD	0	0	0	
STET	0	1 615 573	1 704 865	1 818 621
STS	1 545 831	0	0	0
Cooperative Governance	**649 809**	**4 653**	**7 543**	**803 475**
GBARD	7 175	4 653	7 543	8 449
STET	2 779	0	0	3 273
STS	639 855	0	0	791 753
Correctional Services	**5 568**	**5 188**	**5 473**	**6 127**
GBARD	5 568	5 188	5 473	6 127
STET	0	0	0	0
STS	0	0	0	0
Defence and Military Veterans	**723 721**	**687 543**	**697 741**	0
GBARD	612 977	564 508	568 549	0
STET	42 491	46 705	49 046	0
STS	68 253	76 330	80 146	0
Energy	**760 341**	**904 508**	**947 762**	**1 073 605**
GBARD	760 341	904 508	947 762	1 073 605
STET	0	0	0	0
STS		0	0	00

Department and STA category	Appropriation	Medium-term expenditure estimate		
	2018/19	2019/20	2020/21	2021/22
	R'000			
Environmental Affairs	**585 093**	**619 028**	**653 074**	**688 994**
GBARD	585 093	619 028	653 074	688 994
STET	0	0	0	0
STS	0	0	0	0
Health	**1 156 242**	**1 290 506**	**1 361 484**	**1 362 660**
GBARD	1 088 101	1 215 642	1 282 502	1 283 679
STET	19 220	20 259	21 373	21 373
STS	48 921	54 605	57 608	57 608
Higher Education and Training	**3 596 901**	**3 767 240**	**3 955 708**	**4 196 234**
GBARD	3 542 518	3 747 985	3 935 384	4 132 153
STET	36 348	175	174	42 803
STS	18 035	19 081	20 149	21 278
Home Affairs	**739 187**	**579 757**	**612 223**	**646 508**
GBARD	0	0	0	0
STET	0	0	0	0
STS	739 187	579 757	612 223	646 508
Human Settlements	**50 339**	**54 450**	**58 068**	**58 068**
GBARD	0	0	0	0
STET	2 039	2 150	2 268	2 268
STS	48 300	52 300	55 800	55 800
Justice and Constitutional Development	**96 460**	**102 976**	**109 910**	**116 065**
GBARD	0	0	0	0
STET	5 760	6 076	6 410	6 769
STS	90 700	96 900	103 500	109 296
Labour	**8 573**	**19 135**	**20 797**	**10 617**
GBARD	0	0	0	00
STET	1 421	15 255	16 413	1 673
STS	7 152	3 880	4 384	8 944
Mineral Resources	**735 014**	**851 971**	**899 743**	**818 440**
GBARD	735 014	851 971	899 743	818 440

Department and STA category	Appropriation	Medium-term expenditure estimate		
	2018/19	2019/20	2020/21	2021/22
	R'000			
STET	0	0	0	0
STS	0	0	0	0
National Treasury	**1 128 116**	**1 097 207**	**1 158 651**	**1 226 356**
GBARD	52 526	58 799	62 092	60 439
STET	0	0	0	0
STS	1 075 590	1 038 408	1 096 559	1 165 917
Office of the Chief Justice	**16 805**	**17 721**	**19 224**	**31 129**
GBARD	0	0	0	0
STET	1 637	1 721	1 824	1 844
STS	15 168	16 000	17 400	29 285
Planning, Monitoring and Evaluation	**54 574**	**674**	**714**	**71 159**
GBARD	0	0	0	0
STET	1428	674	714	1 682
STS	53146	0	0	69 477
Public Enterprises	**2 000**	**1 000**	**1 000**	**1 115**
GBARD	0	0	0	0
STET	0	0	0	0
STS	2 000	1 000	1 000	1 115
Public Service and Administration	**6 378**	**9 707**	**10 332**	**7 511**
GBARD	0	0	0	0
STET	0	0	0	0
STS	6 378	9 707	10 332	7 511
Public Works	**19 008**	**20 072**	**21 197**	**22 384**
GBARD	0	0	0	0
STET	19 008	20 072	21 197	22 384
STS	0	0	0	0
Rural Development and Land Reform	**21 609**	**22 797**	**23 371**	**25 422**
GBARD	11 890	12 544	12 544	13 988
STET	0	0	0	0

Department and STA category	Appropriation	Medium-term expenditure estimate		
	2018/19	2019/20	2020/21	2021/22
	R'000			
STS	9 719	10 253	10 827	11 434
Science and Technology	**7 548 169**	**8 351 862**	**8 811 215**	**8 814 168**
GBARD	4 406 566	4 929 127	5 200 229	5 203 183
STET	2 704 654	2 935 241	3 096 679	3 096 679
STS	436 949	487 495	514 307	**514 306**
Small Business Development	**22 713**	**762 899**	**805 802**	**850 927**
GBARD	0	739 075	780 463	824 169
STET	313	324	339	358
STS	22 400	23 500	25 000	26 400
Social Development	**5 274**	**5 580**	**5 887**	**6 211**
GBARD	5 274	5 580	5 887	6 211
STET	0	0	0	0
STS	0	0	0	0
South African Police Service	**4 050 096**	**4 272 852**	**1 177 587**	**4 764 811**
GBARD	0	0	0	0
STET	0	0	0	0
STS	4 050 096	4 272 852	1 177 587	4 764 811
Sport and Recreation South Africa	**257 104**	**277 691**	**292 999**	**286 114**
GBARD	257 104	277 691	292 999	286 114
STET	0	0	0	0
STS	0	0	0	0
Statistics South Africa	**53 093**	**57 097**	**57 097**	**62 521**
GBARD	53 093	57 097	57 097	62 521
STET	0	0	0	0
STS	0	0	0	0
Telecommunications and Postal Services	**1 253**	**2 130**	**2 247**	**1 581**
GBARD	300	-	-	334
STET	953	1 075	1 134	134
STS	0	1 055	1 113	1 113

Department and STA category	Appropriation	Medium-term expenditure estimate		
	2018/19	2019/20	2020/21	2021/22
	R'000			
Tourism	**695**	**776**	**820**	**791**
GBARD	0	0	0	0
STET	0	0	0	0
STS	695	776	820	791
Trade and Industry	**455 785**	**567 569**	**598 785**	**630 155**
GBARD	256 305	271 170	286 085	301 820
STET	0	0	0	0
STS	199 481	296 398	312 700	328 335
Traditional Affairs	**0**	**0**	**0**	**0**
GBARD	0	0	0	0
STET	0	0	0	0
STS	0	0	0	0
Transport	**19 993**	**38 281**	**39 951**	**23 496**
GBARD		15 123	15 952	
STET	12 268	15 263	16 102	14 420
STS	7 725	7 895	7 896	9 076
Water and Sanitation	**390 978**	**436 406**	**460 409**	**460 409**
GBARD	390 978	436 406	460 409	460 409
STET	0		0	0
STS	0	0	0	0
Women	**7 738**	**8 152**	**8 066**	**0**
GBARD	00	0	0	
STET	238	252	266	281
STS	7 500	7 900	7 800	8 237
TOTAL	**26 006 358**	**27 890 604**	**26 046 415**	**30 483 174**

Annexure B: Methodology

Background

The Survey on Government Funding of Scientific and Technological Activities (STAs) is conducted annually by the Department of and Innovation (DST). The survey collects data from national government departments that either perform STAs or have a budgetary allocation to fund them in order to produce key indicators for how government invests in science and innovation. Regular monitoring of public investment in the national system of innovation is required in order to inform policies for ensuring well-being and prosperity through science, technology and innovation.

The STA concept was developed by the United Nations Education, Scientific and Cultural Organisation's Institute for Statistics (UNESCO-UIS) to describe a set of activities relating to building and exploiting scientific and technological (S&T) capabilities. The concept comes from UNESCO's 1978 "Recommendation Concerning the International Standardization of Statistics on Science and Technology". The definition was updated in 1984 through the UNESCO *Manual for Statistics on Scientific and Technological Activities*. The latest update, in 2016, aligns the R&D definition with that of the *Frascati Manual 2015: Guideline for Collecting and Reporting Data on Research and Experimental Development*, published by the Organisation for Economic Cooperation and Development (OECD). In October 2017, UNESCO published two technical papers for consultation on revision, one on *Measuring Scientific and Technological Services* (STS), and the other on *Measuring Scientific and Technological Education and Training* (STET).

Scope, sampling and data collection process

The survey identified 35 national departments from which data had to be collected. A list of these departments is provided Annexure A. This survey focuses on the budgets and projections allocated for STAs by national departments.

This report uses the 2018/19 Estimates of National of Expenditure (ENE) departmental names, which were also used for the data collection. The departmental names brought in after the May 2019 reconfiguration of national departments will be used once the ENE is changed to reflect those names.

Of the 35 departments, 34 confirmed that they had budgeted for or performed STAs.

The process of data collection entails filling the data collection tool with preliminary data obtained from various departmental documents (i.e. National Treasury's ENE, departmental strategic plans and departmental annual reports).

The following data sources were used to source the data and for purposes of validating and for imputing data where there were data gaps.

- The scientific and technological activities questionnaire, which is completed by responding national departments.
- National Treasury's ENE.
- National departments' annual reports.
- National Treasury's Budget Review document (for data on the R&D tax incentive).
- The annual reports of science councils and other public research institutions, as well as information from the relevant officials.

Following this, the tool was sent to the departments for verification and validation of departmental data. This was important to ensure the accuracy of the information. The information for each department was then signed off by its director-general. Nine departments verified and validated their data, at first level, within the targeted time frame. Of the total STA data, 75% was imputed/estimated.

National government department	Contact person	Information validated and signed off by DG
Energy	Stefan van der Walt	Yes
National Treasury	Thabo Mankga	Yes
	Malapateng Teka	
Defence and Military Veterans	Colonel FF Chamberlain	Yes
Home Affairs	Phindiwe Mosia	Yes
Correctional Services	Peter Leslie	Yes
Office of the Chief Justice	Desmond Moekoa	Yes
Agriculture, Forestry and Fisheries	Mathala Mokwele	Yes
Tourism	R Ackermann	Yes
Transport	Jabulile Mahamba	Yes
Higher Education and Training	Ivy Moloisi	No
Labour	Tendani Ramulondo	No
Mineral Resources	Aluwani Vhudele	No
Sports and Recreation South Africa	Kenetswe Mosenogi	No
Science and Technology	Mavis Anim	No
Basic Education	Koena Juliet Matjiu	No
Environmental Affairs	Veronica Steyn	No
	Sekgabo Maloka	No
National Treasury	Thabo Mankga	No
	Malapateng Teka	No
Trade and Industry	Mandla Khoza	No
	Nkosibona Zungu	
	Reshni Signh	
Statistics South Africa	Bheki Mathunjwa	No
Planning, Monitoring and Evaluating	Solomon Mphiwa	No
Health	Muthibi Tshilidzi	No
Corporate Governance	Ando Donkers	No
Public Enterprises	Phelisiwe P Lukhele	No
Traditional Affairs	Ando Donkers	No
Human Settlement	Jimmy Mokolo	No
South African Police Service	Nelson Johan	No
	K Moipolai	

Telecommunications and Postal Services	Tebogo Mathebula	No
Public Works	Aaron Mazibuko	No
Rural Development and Land Reform	Matlakala Mosane	No
Water and Sanitation	Gloria Nengovhela	No
Art and Culture	Ntombi Skhosana	No
Social Development	Leon Swartz	No
Small Business Development	Tiny Makana	No
Women	No official nominated	No
Justice and Constitutional Development	No official nominated	No

Nine of the 35 national government departments approached ((25,7%) verified their data and were signed off by their directors-general. Twenty-six (74,29%) did not validate their data.

The response rate covered 42,4% of the total STA appropriation; the other 63,6% was estimated.

Two additional processes were introduced during the current survey process. A quality reference group consisting of officials from the DST and representatives of the Centre for Science, Technology and Innovation Indicators (CeSTII) and a process of sharing the draft report with stakeholder departments for further verification was established to assist with assessing certain aspects of data quality in the report.

Error, fault detection and revision

Errors were manually checked as and when the data collection tools were received from the responding departments. The data collection tools were then consolidated into a single analysis spreadsheet, which allowed for further error detection.

The STA data for the year in consideration was compiled using appropriations from departmental sources. The data was subject to revision as and when audited or actual expenditure data becomes available.

Data processing, analysis and report writing

A database containing historical data on STA funding has been developed. The responses from departments were used to compute aggregates of key indicators of government funding for STAs. Responses were checked against the figures from previous financial years and, where necessary, verified with the department concerned. Standard data tables and graphs were developed and used in preparing the report and analysing historical and medium-term trends.

Reliability of the data and data accuracy

In the case of departments that did not verify their data, data was imputed based on the projections that the departments provided in the 2017/18 survey, with adjustments for inflation. All possible errors and outliers were verified and validated. The sign-off by directors-general was introduced during the 2015/16 survey as recommended by the recommendation of the Economic Sectors, Employment and Infrastructure Development (ESEID) Cluster, now the Economic Sectors, Investment, Employment and Infrastructure Development (ESIEID) Cluster.

Dissemination and use of results

This report is published both in print and on the DST website for use by the government and other interested parties. The information on government STA funding is of great value to policy makers and decision makers. An annual workshop is held with government departments to discuss the content and implications of the survey's findings, which are also submitted to Cabinet and presented to various government clusters.

Evaluation of quality indicators per cluster

	Economic Sectors, Employment and Infrastructure	Governance and Administration	Social Protection, Community and Human Development	International Cooperation, Trade and Security	Justice, Crime Prevention and Security	Total
Number of units investigated	12	5	10	3	5	35
Number of units surveyed	12	5	10	3	5	35
Responses	5	2	3	1	3	14
Non-response	7	3	7	2	2	21
Questionnaire response rate	0	0	1	0	1	2
Imputation rate	41,7%	40,0%	33,3%	33,3%	75,0%	42,4%
Total	**58,3%**	**60,0%**	**77,8%**	**66,7%**	**50,0%**	**63,6%**

Annexure B: STA survey questionnaire

Funding for Scientific and Technological activities						
	2017/18	2018/19	2019/20	2020/21	2021/22	Notes* (it is mandatory to provide narratives to go with each entry)
	Audited Outcome	Appropriation	Medium-Term Estimates			
	Amount (R'000)					
Government Budget Allocations for Research and Development (GBARD)	–	–	–	–	–	
Current Payments	–	–	–	–	–	
Compensation of employees	–	–	–	–	–	
directly working with Research, Science and Technology (RST)	–	–	–	–	–	
indirectly working with Research, Science and Technology (RST)	–	–	–	–	–	
Goods and services						
Transfers and subsidies						
Provinces and municipalities						
Departmental agencies and accounts (Please specify)						
Universities and technikons						
Public corporations and private enterprises						
Other (Please specify below)	–	–	–	–	–	
>	–	–	–	–	–	
>	–	–	–	–	–	
Payments for capital assets	–	–	–	–	–	
Buildings and other fixed structures(Please specify)	–	–	–	–	–	
Machinery and equipment	–	–	–	–	–	
Other (Please specify below)	–	–	–	–	–	
>	–	–	–	–	–	
Scientific and Technical Education and Training (STET)	–	–	–	–	–	
Current Payments	–	–	–	–	–	
Compensation of employees	–	–	–	–	–	
directly working with Research, Science and Technology (RST)		–	–	–	–	
indirectly working with Research, Science and Technology (RST)	–	–	–	–	–	
Goods and services		–	–	–	–	
		–	–	–	–	
Transfers and subsidies					–	
Provinces and municipalities	–	–	–	–	–	
Departmental agencies and accounts						
Universities and technikons						
Public corporations and private enterprises						
Other (Please specify below)						
Households		–	–	–	–	
>	–	–	–	–	–	
Payments for capital assets	–	–	–	–	–	
Buildings and other fixed structures	–	–	–	–	–	
Machinery and equipment	–	–	–	–	–	
Other (Please specify below)	–	–	–	–	–	
>	–	–	–	–	–	
>	–	–	–	–	–	
Scientific and Technological Services (STS)	–	–	–	–	–	
Current Payments						
Compensation of employees						
directly working with Research, Science and Technology (RST)						
indirectly working with Research, Science and Technology (RST)	–	–	–	–	–	
Goods and services	–	–	–	–	–	
		–	–	–	–	
Transfers and subsidies	–	–	–	–	–	
Provinces and municipalities	–	–	–	–	–	
Departmental agencies and accounts		–	–	–	–	
Universities and technikons	–	–	–	–	–	
Public corporations and private enterprises	–	–	–	–	–	
Other (Please specify below)	–	–	–	–	–	
>	–	–	–	–	–	
>	–	–	–	–	–	
Payments for capital assets	–	–	–	–	–	
Buildings and other fixed structures	–	–	–	–	–	
Machinery and equipment	–	–	–	–	–	
Other (Please specify below)	–	–	–	–	–	
>	–	–	–	–	–	
>	–	–	–	–	–	
Grand Total	–	–	–	–	–	