

A photograph showing a close-up view of a sophisticated industrial machine or reactor. It features several large, blue cylindrical valves with yellow identification tags. A white cylindrical container with a blue and red label sits on a metal frame. Numerous silver-colored pipes and valves are visible in the background, creating a complex network of machinery.

South Africa Yearbook 2015/16

Science and Technology

The Department of Science and Technology (DST) executes its mandate through the implementation of the 1996 *White Paper on Science and Technology*, the national research and development strategy and the Ten-Year Innovation Plan (TYIP). The plan aims to make science and technology a driving force in enhancing productivity, economic growth and socio-economic development.

The department's strategic goals are to:

- develop the innovation capacity of the national system of innovation 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 science, technology and innovation sector to meet the needs of society
- build world class infrastructure in the science, technology and innovation sector to extend the frontiers of knowledge, train the next generation of researchers, and enable technology development and transfer as well as knowledge exchange
- 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 national system of innovation (NSI).

Legislation

The DST is governed by the following legislation:

- Intellectual Property Rights from Publicly Financed Research and Development (IPR) Act, 2008 (Act 51 of 2008): Provides for the more effective use of intellectual property emanating from publicly financed research and development, through the establishment of the National Intellectual Property Management Office (NIPMO), the Intellectual Property Fund, and offices of technology transfer at institutions.
- Technology Innovation Act, 2008 (Act 26 of 2008): Intended 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 (TIA).
- 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 to the development of space technologies by industry.
- 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.
- National Research Foundation (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.
- National Advisory Council on Innovation (NACI) Act, 1997 (Act 55 of 1997): Establishes the NACI to advise the Minister of Science and Technology on the role and contribution of science, mathematics, innovation and technology in promoting and achieving national objectives.
- 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.
- 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 research and development for socio-economic growth in areas including the built environment, defence, the environmental sciences, and biological, chemical and laser technologies.
- 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 (CGS) 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.

- 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)
- 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.

Policy mandate and strategies

The DST's major policy documents are the *White Paper on Science and Technology* of 1996, the 2002 National Development Research Strategy (NRDS), the New Strategic Management Model for South Africa's Science and Technology System (2004) – with its Policy on Governance Standards for Science, Engineering and Technology Institutions and Framework for the Development of a National Science and Technology Expenditure Plan – and the 2007 TYIP.

The DST is the custodial coordinator for the development of the NSI and influences this system through key strategies such as the NRDS and the TYIP. The latter, particularly, seeks to contribute to the transformation of the South African economy into a knowledge-based economy, in which the production and dissemination of knowledge will lead to socio-economic benefits and enrich all fields of human endeavour.

National Research and Development Strategy

The NRDS as the basis for the NSI and requires performance and responses in three key areas, enhanced innovation; providing science, engineering and technology Human Resources (HR) and transformation; and creating an effective government science and technology system.

A prime objective of the NSI was to enhance the rate and quality of technology transfer from the science, engineering and technology sector by providing quality HR, effective hard technology transfer mechanisms, and creating

more effective and efficient users of technology in the business and government sectors.

The White Paper also set out the institutions to be established to promote the development of a well-functioning NSI. These were to be the national Ministry and DST, the National Advisory Council on Innovation, the NRF, the Innovation Fund, and national research facilities managed by government.

The NRDS is aimed at being a key enabler of economic growth alongside other strategies, such as the HR Development Strategy, the Integrated Manufacturing Strategy and the Strategic Plan for South African Agriculture.

Ten-Year Innovation Plan

The TYIP, launched in 2008, aims to assist the establishment of a knowledge-based economy for South Africa, in which the production and dissemination of knowledge lead to economic benefits and enrich all fields of human endeavour.

The missions and platforms under the NRDS were expanded under the TYIP to include grand challenges in space science and technology, energy security, human and social dynamics in development, global change, and the bio-economy.

The responsibility for addressing the grand challenges is spread across many government departments.

The TYIP also sets long-term goals based on the grand challenges it identified. They included:

- becoming one of the top three emerging economies in the global pharmaceutical industry, based on innovative use of South Africa's indigenous knowledge and rich biodiversity
- deploying satellites that provide a range of scientific, security and specialised services for all spheres of government, the public and the private sector
- achieving a 25% share of the global hydrogen and fuel cell market with novel platinum group metal catalysts
- becoming a world leader in climate science and responding effectively to the multiple challenges associated with global and climate change.

National Nanotechnology Strategy (NNS)

The year 2016 marked 10 years since the launch of the NNS in 2006. The NNS was implemented to ensure that South Africa is ready to optimally use nanotechnology to enhance global competitiveness and sustainable economic growth.

Nanotechnology promises smaller, cheaper, lighter and faster devices with greater functionality, using fewer raw materials and consuming less energy.

The strategy strengthens the integrated industrial focus of government and advances the national technology missions that have been identified in the National Research and Development Strategy.

Nanotechnology cuts across biotechnology, technology for manufacturing and information technology in order to improve our natural resources sectors and technology to reduce poverty.

The DST, in partnership with the NRF, and the South African Agency for Science and Technology Advancement (SAASTA) hosted the Nanotechnology Symposium in June 2016 at the CSIR International Convention Centre in Pretoria.

Themed 'Realising the Potential of Nanotechnology in South Africa', the symposium's objectives were to:

- Showcase the achievements of the DST-NRF investment within the Nanotechnology Flagship Project (NFP) by engaging with the grant holders in their research activities relating to the six focus areas
 - Share the successes and challenges experienced by national and international researchers in undertaking nanotechnology or nanoscience-based research
 - Introduce the Nanotechnology Code of Ethics
 - Provide a platform for nurturing and encouraging partnerships between industry partners and NFP grant holders in advancing nanotechnology development and innovation in line with the objectives set forth in the NNS.
- The DST in partnership with the NRF seeks to promote nanotechnology research through the NFP.
- The flagship project aims to ensure that South Africa is able to optimally use nanoscience and nanotechnology to enhance the nation's global competitiveness and to promote innovation and economic growth.

IThe 2016 Edinburgh Medal was jointly awarded to Kevin Govender from the Cape Town-based Office of Astronomy for Development and the International Astronomical Union (IAU) on 30 March at the 2016 Edinburgh International Science Festival. The award recognises the organisation's wide-reaching contributions to science. It is the first time in its history that this award comes to a South African. It is awarded jointly for the creation and practical establishment of the IAU, which integrates the pursuit of scientific knowledge with social development for those in need.

Nanotechnology Flagship Project

The NFP was established with the objective of accelerating national efforts in order to build the excellence pipeline in research and development capacity by attracting and retaining young scientists and professionals of the highest calibre.

Since the inception of the NFP funding instrument in 2007, there has been an investment of R57 million in 25 research grants, comprising 13 full grants and 12 development grants.

The rationale for introducing the development grants was to strengthen the nanotechnology research track record of emerging researchers.

The development grant afforded the emerging researchers in this field opportunities to receive mentorship and to access research infrastructure based at the Nanotechnology Innovation Centre at the CSIR.

The investment in the NFP has yielded locally relevant and internationally competitive outputs in pursuit of research excellence and capacity development.

In 2015, research outputs exceeded targets and reached the following milestones: 464 postgraduate students were trained; 92 postdoctoral fellows were supported; 326 collaborations were established; 352 research articles were published in International Scientific Indexing journals; 80 conference proceedings were recorded; and 17 patents were registered.

The NFP is geared towards demonstrating the benefits of nanotechnology and its impact on some of the key challenges facing South Africa, which relate to the areas of: energy security; improved healthcare; water purification; mining and minerals; and advanced materials and manufacturing.

National Bio-economy Strategy

The science-based Bio-economy Strategy replaced the National Biotechnology Strategy which had been in place since 2001.

Through the Bio-economy Strategy, bio-innovation is used to generate sustainable economic, social and environmental development. The DST is aiming to have biotechnology make up 5% of the country's gross domestic product by 2050.

The Bio-economy Strategy focuses on three important economic sectors likely to benefit from key drivers on implementation, namely: agriculture; health and industry; and environment.

The strategy also focuses on the coordination of numerous committees government

departments, research and development agencies, the private sector, public programmes, and funding bodies to achieve its goals.

Budget and funding

The DST's budget allocation for 2015/16 was R7,482 billion. A sum of R 2,534 billion from the budget was allocated to parliamentary grants for the following institutions:

- The CSIR – R827,7 million
- The NRF – R885,9 million
- The HSRC – R288,7 million
- The Technology Innovation Agency – R385,2 million
- SANSA – R124,4 million
- The Academy of Science of South Africa (ASSAf) – R22,991 million.

Role players

Academy of Science of South Africa

ASSAf was inaugurated in May 1996 by the former President of South Africa and patron of the academy, Nelson Mandela. It was formed in response to the need for an academy of science congruent with the dawn of democracy in South Africa – activist in its mission of using science for the benefit of society.

The mandate of the ASSAf encompasses all fields of scientific enquiry and it includes the full diversity of South Africa's scientists. The Parliament of South Africa passed the Academy of Science of South Africa Act, (Act 67 of 2001), which came into operation in May 2002.

ASSAf represents the country in the international community of science academies.

Since its inception, ASSAf has grown from a small, emergent organisation to a well-established academy.

In January 2015, ASSAf launched a consensus study, the State of Green Technologies in South Africa. The overall aim of the study, which was commissioned by the DST, is to document green technologies being used in South Africa; to identify gaps in and opportunities for the use of these technologies; and to make recommendations to promote the growth of green technologies.

Transitioning to a green economy is one of the key imperatives of government, as highlighted in the NDP. The use of green technologies is an integral part of the green economy, making this study both timely and important.

The ASSAf celebrated 20 years in the service of society in 2016.

The academy was launched in May 1996

and was formed in response to the need for an activist in the mission of using science and scholarship for the benefit of society.

The Parliament of South Africa passed the Academy of Science of South Africa Act, 2001 (Act 67 of 2001), which came into force on 15 May 2002.

This made ASSAf the only academy of science in South Africa that was officially recognised by government.

The academy represents South Africa in global academic dialogues.

Africa Institute of South Africa

AISA was first established in 1960 as a non-profit organisation. It is a statutory body following the AISA Act, 2001 (Act 68 of 2001).

South Africa and Africa have undergone fundamental changes in the past decade and AISA has been at the forefront of research and training on African affairs. Through the AISA campus, an annual training programme that educates students from universities in research methodologies, AISA has contributed to fostering a new generation of research specialists. AISA has also been able to produce some of the finest research on contemporary African affairs by having its dedicated and highly qualified researchers conduct field research every year throughout Africa.

This means that all research output is based on first hand empirical evidence.

AISA has also become involved in community outreach programmes by doing all it can to provide maps and other resources to underprivileged schools in rural South Africa. AISA has undertaken to promote knowledge creation as a fundamental part of development and growth for Africa and as such aims to encourage research as a career choice for young people as they leave school.

As Africa changes and development becomes ever more important, especially in the globalised world economy, AISA will continue to produce research of the highest standard.

By working with the best researchers and guided by the highest standards, AISA will contribute to development and knowledge creation for all Africa.

Council for Scientific and Industrial Research

The CSIR is one of the leading science and technology research, development and implementation organisations in Africa. The

CSIR's main site is in Pretoria, Gauteng, and it is represented in other provinces of South Africa through regional offices. I

The generation and application of knowledge reside at the core of the CSIR. This takes place in domains such as biosciences; the built environment; defence, peace, safety and security; materials science and manufacturing; and natural resources and the environment.

Emerging areas of research include science, explored by the CSIR, that could be unique to local circumstances or successful internationally and need to be established for local competitiveness. Examples include nanotechnology, synthetic biology and mobile autonomous intelligent systems.

The CSIR houses specialist research facilities of strategic importance for African science. These include information and communications technology (ICTs); laser technology, and space-related technology.

Research and development activities include intellectual property (IP) management, technology transfer (for commercial gain as well as for social good), knowledge dissemination and impact assessment.

Consulting and analytical services include forensic fire investigations, food and beverage analysis, environmental testing, engineering forensics, wire rope testing, mechanical testing, fire and explosion tests, sports technology and analysis, and project management.

Human Sciences Research Council

The HSRC was established in 1968 as South Africa's statutory research agency and has grown to become the largest dedicated research institute in the social sciences and humanities on the African continent, doing cutting-edge public research in areas that are crucial to development.

Its mandate is to inform the effective formulation and monitoring of government policy; to evaluate policy implementation; to stimulate public debate through the effective dissemination of research-based data and fact-based research results; to foster research collaboration; and to help build research capacity and infrastructure for the human sciences.

The Council conducts large-scale, policy-relevant, social-scientific research for public sector users, non-governmental organisations and international development agencies.

Research activities and structures are closely aligned with South Africa's national development priorities.

The HSRC's integrated research programmes provide single points of entry – complete with a critical mass of researchers – for interdisciplinary and problem-orientated research.

National Advisory Council on Innovation

The National Advisory Council on Innovation Act, 1997 (Act 55 of 1997) mandates NACI to advise the Minister of Science and Technology and, through the Minister, the Cabinet, on the role and contribution of innovation (including science and technology (S&T)) in promoting and achieving national objectives. These national objectives include the improvement of the quality of life of South Africans, the promotion of sustainable economic growth and international competitiveness. The advice should be directed at, among other things:

- coordination and stimulation of the NSI
- promotion of cooperation within the NSI
- structuring, governance and coordination of the S&T system
- revision of the innovation policy
- strategies for the promotion of all aspects of technological innovation
- identification of R&D priorities
- funding of the S&T system.

National Research Foundation

The NRF is an independent statutory body established through the National Research Foundation Act, 1998 (Act No 23 of 1998), following a system-wide review conducted for the then Department of Arts, Culture, Science and Technology.

The entity incorporates the functions of research-funding agencies that were previously servicing various sections of the research community, namely: the former Centre for Science Development of the HSRC; and the former Foundation for Research Development which comprised several national research facilities.

As a government mandated research and science development agency, the NRF funds research; and the development of high-end human capacity and critical research infrastructures to promote knowledge production across all disciplinary fields.

The goal of the NRF is to create innovative funding instruments, advance research career development, increase public science engagement and to establish leading-edge research platforms that will transform the scientific landscape.

The NRF promotes South African research interests across the country and internationally. Together with research institutions, business, industry and international partners, the NRF builds bridges between research communities for mutual benefit.

South African National Space Agency

SANSA was created to promote the use of space and cooperation in space-related activities while fostering research in space science, advancing scientific engineering through the development of South Africa's human capital and providing support to industrial development in space technologies.

The objectives of SANSA are to:

- promote the peaceful use of space
- support the creation of an environment conducive to industrial development in space technology
- foster research in space science, communications, navigation and space physics
- advance scientific, engineering and technological competencies and capabilities through human capital development outreach programmes and infrastructure development
- foster international cooperation in space-related activities.

SANSA continues to provide state-of-the-art ground-station services to many globally recognised space missions, such as the Nasa and Indian Space Research Organisation Mars missions, and Nasa's Orbiting Carbon Observatory-2, which is giving scientists a better idea of how carbon is contributing to climate change, answering important questions about where carbon comes from and where it is stored.

The first remote sensing atlas to be launched in South Africa was launched by SANSA in May 2016.

The atlas can be defined as the collection of data about an object from a distance.

Earth scientists use the technique of remote sensing to monitor or measure phenomena found on earth's surface and atmosphere, through satellite and camera technology.

The atlas was developed to cater for a wide range of audiences and has been simplified in

such a way that it is easy to understand while getting the message cross.

The 40-pages atlas covers broad areas such as history of space technology in South Africa, local satellites, application of satellite images, geology, mining, agriculture, woody-cover mapping, water quality, urban planning, urban development and post-floods analysis.

Technology Innovation Agency

The TIA is a national public entity which serves as a key institutional intervention to bridge the innovation gap between research and development from higher education institutions, science councils, public entities, and the private sector.

The mandate of the TIA is derived from the provisions of the Technology Innovation Act, 2008 (Act 26 of 2008), which established TIA to support the State in stimulating and intensifying technological innovation in order to improve economic growth and the quality of life of all South Africans by developing and exploiting technological innovations.

National Intellectual Property Management Office (NIPMO)

NIPMO provides support to the offices of technology transfer at publicly-funded research institutions. This has led to significantly improved intellectual property management in State universities and other research institutions.

NIPMO has systematically refined the South African intellectual property management regime since 2011. It was initially set up as an interim office within the DST.

On 13 December 2013, NIPMO was established as a Specialised Service Delivery Unit (SSDU) within the department.

The organisational form of the SSDU, the first one ever established by the South African government, provides NIPMO with the ability to perform its operational functions set out in the Intellectual Property Rights from Publicly Financed Research and Development 2008 (Act 51 of 2008). The act allows NIPMO to function independently of the department but operate as a sub-programme within the department in terms of support functions such as human resources and information technology.

Agricultural Research Council (ARC)

The ARC was established in 1990 through the Agricultural Research 1990 (Act 86 of 1990), as amended by Act 27 of 2001, and it is the principal

i South Africa was ranked number 30 out of 56 countries in terms of its domestic policies that support global innovations according to data released by the global technology think tank called the Information Technology and Innovation Foundation. South Africa and Kenya were the only African countries to have been featured. The authors of the report looked at elements including supportive tax systems.

agricultural research institution in South Africa.

It is a schedule 3A public entity in terms of the Public Finance Management 1999 (Act 1 of 1999), as amended by Act 29 of 1999.

Its core mandate is to act as the principal agricultural research institution in South Africa in order to conduct research, drive research and development, drive technology development and the dissemination of information in order to:

- Promote agriculture and related industries
- Contribute to a better quality of life
- Facilitate/ensure natural resource conservation
- Alleviate poverty.

The ARC's main functions are to:

- Undertake and promote research, technology development and technology transfer
- Utilise the technological expertise in its possession and make it generally available
- Publish information concerning its objectives and functions, and establish facilities for the collection and dissemination of information in connection with research and development
- Publish the results of research
- Establish and control facilities in the fields of research, technology development and technology transfer
- Cooperate with departments of government, institutions, persons and other authorities for the promotion and conduct of research, technology development and technology transfer
- Promote the training of research workers by means of bursaries or grants-in-aid for research, technology development and technology transfer, and contribute financially
- Research, development and technology transfer programmes
- Hire or let out facilities
- Cooperate with persons and authorities in other countries conducting or promoting research, technology development and technology transfer in agriculture.

Mintek

Mintek, South Africa's national mineral research organisation, is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas. Working closely with industry and other research and development institutions, Mintek provides service testwork, process development and optimisation, consulting and innovative products to clients worldwide.

Mintek is an autonomous statutory organisation, which reports to the Minister of Mineral

Resources. About 35% of the annual budget is funded by the State Science Vote.

As a global leader in minerals and metallurgical innovation, Mintek provides world-class R&D expertise, testwork, and process optimisation for all mineral sectors at international level.

The activities range from initial bench-top investigations to full process flow sheet development, pilot and demonstration plant design and optimisation of industrial plants.

Mintek employs about 700 staff, which include qualified and experienced engineers and scientists who are leaders in their fields of specialisation.

Medical Research Council (MRC)

The MRC is an independent statutory body that coordinates health and medical research activities throughout South Africa. The MRC's objectives are:

- promoting the health and quality of life of the population of South Africa
- performing such functions as may be assigned to the MRC by or under the MRC Act, 1991 (Act 58 of 1991).

The scope of the organisation's research projects includes tuberculosis, HIV/AIDS, cardiovascular and non-communicable diseases, gender and health, and alcohol and other drug abuse.

By analysing the causes and categories of death, data would become available to formulate suitable interventions to either prevent diseases in a certain population group or improve the standard of living of people living with existing medical conditions.

In addressing the ills of the people, the MRC, has set up a dedicated funding department to pay for the development of novel treatment regimens, especially vaccines, as well as improved diagnostic tools.

This project is intended to localise the production of new drugs and devices, and thereby allow the South African economy to grow.

The MRC awards scientific excellence with its annual Scientific Merit Awards Gala Ceremony.

These awards acknowledge the contributions of established scientists as well as fresh scientists with ground-breaking efforts in their individual fields of science, engineering and technology.

Council for Geoscience

The CGS is one of the National Science Councils of South Africa and is the legal successor of the Geological Survey of South Africa, which was

formed in 1912 by the amalgamation of 3 former Surveys, the oldest of which - the Geological Commission of the Cape of Good Hope - was founded in 1895. The Geoscience Act, Act 100 of 1993, established the CGS in its present form. The Act was later amended in 2010 to establish the Geoscience Amendment Act (Act No. 16 of 2010).

As a scientific research council, the CGS is mandated to provide for the promotion of research and the extension of knowledge in the field of geoscience as well as the provision of specialised geoscientific services. The Council has a national footprint in the country, with the Head Office located in Silverton, Pretoria and various other Regional Offices located in Polokwane (Limpopo), Cape Town (Western Cape), Pietermaritzburg & Durban (Kwazulu Natal), Port Elizabeth (Eastern Cape) and Upington (Northern Cape). Today, the Council is a modern institution, boasting excellent facilities and expertise, ranking among the best in Africa. The CGS provides the following substantially different professional services:

- Geophysical Airborne and Ground Surveys,
- Geophysical data acquisition, processing and interpretation (Airborne and Ground),
- Engineering Geosciences (including Geotechnical Services),
- Mineral Resources Development including Mining and Minerals Services,
- Water Geoscience/Hydrological Services,
- Environmental Management and Rehabilitation,
- Marine Geology including Port Surveys,
- Spatial Data and GIS Services; and
- Regional Geological Surveys and Map compilations including Core Drilling Services

As the custodian of South Africa's geoscience data the Council for Geoscience has regional aeromagnetic, radiometric and gravity coverage of the country. The Council for Geoscience is involved in collaborative research projects that form part of its annual programme. These projects keep the Council for Geoscience abreast with developments in the geosciences field.

South African Bureau of Standards (SABS)

The SABS is a statutory body that operates as the national institution for the promotion and maintenance of standardisation and quality in connection with commodities and the rendering of services. The SABS:

- publishes national standards, which it prepares through a consensus process in technical

i The Mathematics, Science and Technology grant was funded R347 million for 2015/16 in an effort to provide support and resources to selected public schools, teachers and learners for the improvement of Mathematics, Sciences and Technology.

committees

- provides information on national standards of all countries as well as international standards
- tests and certifies products and services to standards
- develops technical regulations (compulsory specifications) based on national standards, and monitors and enforces compliance with such technical regulations
- monitors and enforces legal metrology legislation
- promotes design excellence
- provides training on aspects of standardisation.

To maximise its service delivery to the industries it serves, the SABS aligned its activities with seven different industry sectors, each housing the whole range of the SABS services pertinent to a particular industry.

This change ensures easy access to products, faster reaction and turnaround times, and the creation of centres of knowledge excellence that will be easily available to clients.

The seven industry sectors are:

- chemicals
- electrotechnical
- food and health
- mechanical and materials
- mining and minerals
- services
- transportation.

Eskom

The electricity supply industry in South Africa consists of the generation, transmission, distribution and sales, as well as the importing and exporting of electricity. Eskom is a key player in the industry, as South Africa operates most of the base-load and peaking capacity. The enterprise sells electricity to a variety of customers, including municipalities, who distribute power to end users under licence.

Sasol

Sasol's culture of innovation began in the 1950s when it developed its unique blend of coal gasification and Fischer-Tröpsch (FT) technology for its original coal-to-liquids operations at Sasolburg. It has since evolved these operations into fully fledged R&D facilities that form the

heart of the Sasol technology R&D group.

Focused FT R&D in the 1980s and 1990s led to the development of the low temperature FT Sasol Slurry Phase process used at Sasolburg, and the high-temperature Sasol Advanced Synthol process used at Secunda.

Sasol Technology's Fuels Technology Division carries out work concerning fuels, lubricants, heating-fuel and road-binding material, research and development, and new product formulation and testing.

In addition, Sasol opened the Sasol Fuels Application Centre (SFAC), a state-of-the-art engine and exhaust emission testing and research facility in Cape Town. The SFAC enables Sasol to conduct sea-level engine and emission tests in line with international standards.

In June 2015, phase I of Sasol's Fischer-Tropsch Wax Expansion Project (FTWEP) was successfully commissioned at its Sasolburg Operations in South Africa.

There were 450 engineers and approximately 5 500 construction workers on site of phase 1, where 7200 tons of steel were erected and some 600 kilometres of piping was used.

Phase II of FTWEP has commenced and is expected to be commissioned in the first half of 2017.

The entire project will see Sasol invest R13,6 billion in the South African economy.

In February 2016, Sasol obtained approval from the Mozambique Council of Ministers for its field development plan that will see further hydrocarbon resources developed to support Southern Africa growth.

To be developed in phases, the first phase of the Production Sharing Agreement licence area development proposes an integrated oil, LPG and gas project adjacent to Sasol's existing Petroleum Production Agreement (PPA) area.

The PPA area is where natural gas from the Pande and Temane fields is currently produced and processed in a central processing facility before being transported via an 865-kilometre pipeline to gas markets in Mozambique and South Africa.

The Mozambican gas industry is playing an increasingly important role in the regional energy landscape, and this project represents a major milestone in further developing natural resources, which will significantly benefit Southern Africa.

ArcelorMittal

ArcelorMittal is a global steel-maker and with

some 210,000 employees across 60 countries, the organisation is considered the world's leading steel and mining company.

ArcelorMittal is also the leader in all major global steel markets including automotive, construction, household appliances and packaging, with leading research and development and technology, sizeable captive supplies of raw materials, and outstanding distribution networks.

The company has five main operations in South Africa.

In 2015, their mines and strategic contracts produced 73.7 million tons of iron ore and met 62% of the company's iron ore requirements.

National Health Laboratory Service (N HLS)

The N HLS is the largest diagnostic pathology service in South Africa with the responsibility of supporting the national and provincial health departments in the delivery of healthcare. The N HLS provides laboratory and related public health services to over 80% of the population through a national network of laboratories. Its specialised divisions include the National Institute for Communicable Diseases, National Institute for Occupational Health, National Cancer Registry and Antivenom Unit.

The National Health Laboratory Service is a public health laboratory service with laboratories in all nine provinces, employing 6,700 people. Its activities comprise diagnostic laboratory services, research, teaching and training, and production of sera for anti-snake venom, reagents and media.

Bureau for Economic Research (BER)

The BER monitors and forecasts macroeconomic economic and sector trends, and identifies and analyses local and international factors that affect South African businesses.

The organisation has built up and continues to expand its business tendency surveys and macroeconomic forecasting capabilities. Both are used for analysing and projecting South African macroeconomic trends. The BER uses a variety of internationally accepted methodologies and econometric models for the generation and analysis of the data, as well as techniques developed specifically for the unique South African environment. Other activities include commissioned research, courses, conferences and training.

The BER's respected economic analysis and forecasting services are used by a wide range of

clients, ranging from small to medium sized firms up to very large JSE listed companies, as well as public sector bodies and NGOs. Financial and investment companies, local and overseas banking groups, multilateral organisations and academic bodies, all make use of the impartial economic information available from the BER.

Although the BER is part of Stellenbosch University, it has to fully fund all its expenses (such as salaries, a university levy, office rent, travel costs and other) from the sale of forecasts, sponsorships and customised research.

National Institute for Communicable Diseases (NICD)

The NICD, is a major global player in infectious disease intelligence. It is a resource of knowledge and expertise in regionally-relevant communicable diseases to the South African Government, to SADC countries and the African continent.

The NICD assists in the planning of policies and programmes and supports appropriate responses to communicable disease problems and issues.

Control methods are assessed and recommendations are made to the appropriate authorities regarding equipment, insecticide usage and application.

Institute for Economic Research on Innovation (IERI)

IERI was established as a public-good research organisation with a core competence in the analysis of systems of innovation. Its mandate is to provide research, capacity-building and community engagement in this field of study. Its tasks involve:

- conducting research into the political economy and policy dimensions of innovation and development
- contributing thought-leadership on the relationship between knowledge and development across economic, social and political domains
- building capabilities and competencies in the understanding of the political economy and policy dimensions of innovation and development
- focusing across local, provincial, national, regional and international geographies.

Institute for Security Studies (ISS)

The ISS is a leading African organisation that enhances human security to enable sustainable development and economic prosperity in Africa. It works across the continent, doing authori-

tative research, providing expert policy advice and delivering practical training and technical assistance.

The ISS has established a niche in Africa. It provides a unique package of services to governments, intergovernmental organisations and civil society by combining research with an ability to convene key decision makers to discuss policy options and partner on capacity building.

The ISS invests in a collaborative approach to fulfil its vision of a peaceful and prosperous Africa for all its people.

The ISS achieves its goal through the work of the following divisions and projects.

The divisions are:

- Governance, crime and justice promotes democratic governance and helps reduce corruption through better accountability and respect for human rights. It assists African governments to develop evidence-based policies that improve the performance of their criminal justice systems and reduce violence.
- Conflict prevention and risk analysis helps prevent conflict by improving the understanding of the latest human security developments on the continent.
- Peace operations and peacebuilding enhances peace operations and peacebuilding by assisting governments, as well as regional and international institutions, to improve their policy and implementation.
- Transnational threats and international crime helps African inter-governmental organisations, national governments and civil society to respond more effectively and appropriately to transnational threats and international crimes.

The projects comprise:

- African Futures and Innovation produces policy analysis on possible trajectories for human security, development, economic growth and socio-political change in Africa. The project enables decision makers to test the implications of policy choices well into the future.
- The African Centre for Peace and Security Training enables government officials, journalists, human rights activists and the private sector to understand and implement human security policy through in-depth training courses. An influential alumni network encourages cooperation between countries and sectors.
- The maritime safety and security project enhances Africa's blue economy through

raising awareness and assisting the African Union, Regional Economic Communities and states with policy and strategy development.

- The migration project looks critically at the causes, catalysts and consequences of mass migration from and within Africa. The issue is under-researched and while its impact is known, responding effectively will require informed policies and strategic responses.

The ISS is registered as a non-profit trust in South Africa and is accountable to a board of trustees. An international advisory council meets annually to advise the ISS on strategic policy and management issues.

South Africa's National Energy Development Institute (Sanedi)

The DST and the Department of Energy are joint custodians of Sanedi and assist in providing political and strategic focus for the company.

The institute is entrusted with the coordination and undertaking of public interest energy research, development and demonstration.

As such, it is responsible for enabling and implementing the energy technology roadmaps, which support long-term energy policies developed by the Department of Energy.

Safety in Mines Research Advisory Committee

The activities of the Safety in Mines Research Advisory Committee are aimed at advancing the safety of workers employed in South African mines.

The committee is a statutory tripartite committee of the Mine Health and Safety Council.

It has a permanent research-management office managing the rock engineering, engineering and mine occupational health fields of research.

National Agricultural Research Forum (NARF)

The mission of the NARF is to facilitate consensus and integrate coordination in the fields of research, development, and technology transfer to agriculture in order to enhance national economic growth, social welfare and environmental sustainability.

NARF's activities are implemented by the NARF Secretariat who is situated in the national Department of Agriculture.

The NARF Secretariat is responsible for providing sectoral support to the NARF Plenary and Steering Committee, composed of representatives of NARF's stakeholders headed by a chairperson who, in turn, is responsible to

the NARF Plenary session.

The Plenary is the highest organ of the NARF.

Water Research Commission (WRC)

The WRC was established in 1971 following a period of water shortages. The WRC is responsible for:

- promoting coordination, cooperation and communication in the area of water research and development
- establishing water-research needs and priorities
- stimulating and funding water research according to priority
- promoting the effective transfer of IT
- enhancing knowledge and capacity-building within the water sector.

The WRC focuses on five key strategic areas:

- water-resource management
- water-linked ecosystems
- water-use and waste management
- water use in agriculture
- water-centred knowledge.

The main areas of research are surface hydrology, groundwater, hydrometeorology, agricultural water use, water pollution, municipal effluents, industrial water and effluents, drinking water, membrane technology, water ecosystems, hydraulics, mine-water management, water policy, developing communities and the transfer of technology.

Institute for Water Research

The Institute for Water Research is a multidisciplinary research department of Rhodes University in the Eastern Cape. Its main objective is to contribute to sustainable water-resource management in southern Africa.

This is achieved through scientific research into the structure and function of aquatic ecosystems; the application of research through specialist consultancy services; tertiary-level teaching and training; capacity-building for community development; and service on national and international management and policy-making committees.

South African National Biodiversity Institute (SANBI)

SANBI leads and coordinates research, and monitors and reports on the state of biodiversity in South Africa.

The institute provides knowledge and information, gives planning and policy advice and pilots best-practice management models in partnership with stakeholders.

SANBI engages in ecosystem restoration and rehabilitation, leads the human capital development strategy of the sector and manages the National Botanical Gardens as 'windows' to South Africa's biodiversity for enjoyment and education.

South Africa is one of the most biologically diverse countries in the world, after Indonesia and Brazil. South Africa is surrounded by two oceans, occupies only about 2% of the world's land area, but is home to nearly: 10% of the world's plants; 7% of the reptiles, birds and mammals and 15% of known coastal marine species. The country has nine biomes, three of which have been declared global biodiversity hotspots.

Coastal and marine research

The NRF supports marine and coastal research in partnership with the DEA and the South African Network for Coastal and Oceanic Research.

The Chief Directorate: Marine and Coastal Management advises on the use of marine living resources and the conservation of marine ecosystems, by conducting and supporting relevant multidisciplinary scientific research and by monitoring the marine environment.

Sustainable use and the need to preserve future options in using marine ecosystems and their resources are guiding objectives in the research and advice provided by the chief directorate.

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 NRDS.

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.

South African Astronomical

Observatory (SAAO)

The SAAO is a national facility of the NRF and the national centre for optical and infrared astronomy in South Africa. Its primary function is to conduct fundamental research in astronomy and astrophysics. SAAO oversees SALT, located at its site near Sutherland, on behalf of an international consortium and promotes astronomy and astrophysics in Southern Africa.

Hartebeesthoek Radio Astronomy

Observatory (HartRAO)

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 Bio-diversity (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 of 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.

Programmes and projects

Alternative energy solution

In November 2014, the DST officially launched the innovative 2,5 kW hydrogen fuel cell power generator prototype unit at the University of the Western Cape (UWC).

The generator demonstrates South Africa's innovative capabilities in the emerging hydrogen and fuel cell technologies space.

The prototype was developed by the HySA Systems Integration and Technology Validation Centre of Competence (HySA Systems) in collaboration with Hot Platinum (Pty Ltd), a local company involved in power management and control electronics.

The partners have been testing the unit at the Cape Flats Nature Reserve, on the UWC campus in Bellville.

All electrical power used in the reserve is generated from a bank of hydrogen cylinders, instead of from the national grid. The cylinders release hydrogen in the presence of a platinum catalyst (mined in North West) and a series of proton exchange membranes.

The hydrogen fuel cell power generator unit uses hydrogen to generate electrical power, with water vapour the only by-product. In this way electricity is produced in an environmentally friendly way without pollution or noise.

Furthermore, hydrogen can be used to produce electricity in remote areas that do not have access to the national grid. The decentralisation of energy generation by using hydrogen fuel cell systems is one of the few possibilities for providing efficient and cost-effective access to electricity.

The South African Government has rolled out several energy and energy-efficiency programmes and initiatives, such as HySA, with an emphasis on alternative energy opportunities and off-grid renewable energy solutions.

South Africa is one of the primary suppliers of platinum group metals to the world, but not much beneficiation is being done in the country.

The rise of hydrogen fuel cell technologies in

various markets is about to change the global platinum landscape with the anticipated increase in platinum usage in this emerging market. There were significant opportunities for South Africa to partner with international fuel cell producers. These partnerships have the potential to make the country an established hub for the production of fuel cell components.

Subprogrammes

The DST also has a number of subprogrammes that play a pivotal role in ensuring that the department meets its targets. They are:

- Human Capital and Science Promotion: formulates and implements policies and strategies that address the availability of human capital for science, technology and innovation, and provides support for research activities.
- Science Missions: promotes the development of research, the production of scientific knowledge, and the development of human capital within science areas in which South Africa enjoys a geographic advantage.
- Basic Science and Infrastructure: facilitates the strategic implementation of research and innovation equipment and infrastructure to promote knowledge production in areas that are of national priority and to sustain innovation led by research and development.
- Astronomy: supports the development of astronomical sciences around a research strategy on multi-wavelength astronomy, provides strategic guidance and support to relevant astronomy institutions in the implementation of the department's astronomy programmes.
- Sector Innovation and Green Economy: provides support in policy, strategy and direction setting for research and development led growth in strategic sectors of the economy; and supports the transition to a green economy.
- Innovation for Inclusive Development: supports the development of science and technology based innovations for tackling poverty, including the creation of sustainable jobs, sustainable human settlements, and the enhanced delivery of basic services.
- Science and Technology Investment: leads and supports the development of indicators and instruments for monitoring investments in science and technology and the performance of the NSI, as well as ways of strengthening policy in relation to the NSI.
- Technology Localisation, Beneficiation and Advanced Manufacturing: advances strategic

medium and long term priorities for sustainable economic growth and sector development, and public service delivery.

Research, Development and Innovation (RDI)

This is at the heart of the department's efforts to drive innovation in scientifically strategic areas. The programme has five subprogrammes:

- space science and technology
- hydrogen and energy
- biotechnology and health innovation
- innovation planning and instruments
- radio astronomy advances.

Space science and technology

Square Kilometre Array

The SKA Project could act as a catalyst for science, technology and engineering business opportunities, jobs and innovation, and has the potential to put Africa on the map as a world Big Data and Analytics Hub.

The multibillion rand SKA, to be hosted in South Africa and Australia, will 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 should 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 IBM 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 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, maths and engineering skills to support the project. Because the SKA is a long-term project over decades, its effect will increase.

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.

Since 2005, the African SKA Human Capital Development Programme has awarded close to 400 grants for studies in astronomy and engineering from undergraduate to post-doctoral level, while also investing in training programmes for technicians.

Astronomy courses are also being implemented in other African countries, including Kenya, Mozambique, Madagascar and Mauritius. Career opportunities will increase substantially and new business opportunities will emerge.

Space science

Space Science supports the creation of an environment that is conducive to the implementation of the national space strategy and the South African earth observation strategy, which address the development of innovative applications and human capital to respond to national priorities.

Through SANSA, the country's capacity to design, build, maintain and possibly even launch satellites is being developed. As part of the four-country African Resource Management Constellation, South Africa has begun work on the ZA-ARMC1 satellite; R232 million has been budgeted over the next three years for this project. This satellite will enhance Africa's ability to monitor and manage its precious natural resources.

In January 2014, the DST paid the second tranche of the purchase price for satellite company Sunspace, bringing to an end the embattled company's ordeal to pay creditors.

Sunspace's employees moved to Denel, which has created a unit to host the intellectual property and capabilities, based in Stellenbosch.

Denel has since created Spaceteq, incorporating Sunspace, which aims to develop a multispectral, high-resolution Earth-observation satellite called EO-Sat1, for operation by 2017.

Information and communications technology

The DST is leading the implementation of the national ICT RDI Strategy. Its main purpose is to create an enabling environment for the advancement of ICT RDI in South Africa.

South Africa's research capacity in the ICT field has become a strong competitive advantage.

The ICT RDI Strategy aims to achieve a marked increase in advanced human resource capacity, promote world-class research and build robust innovation chains for the creation of new high-tech ICT small enterprises. Implementing the strategy demands partnership involving government, the private sector, higher education institutions and science councils.

The Meraka Institute of the CSIR manages and coordinates the implementation of the strategy. An important envisaged outcome is a vibrant, sustainable and innovative indigenous ICT industry that addresses a significant portion of the country's ICT needs and attracts investments by overseas-based multinational ICT corporations in RDI 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 cyber-infrastructure that the DST supports. Hosted by the University of Cape Town 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 South Africa.

A major project for Sanren is the national backbone network, which aims to connect all major metros in the country with a 10 gigabyte per second link. On completion, the network will reach about 200 sites. The overall network architecture will consist of a national backbone connecting Durban, Pretoria, Johannesburg, Bloemfontein, Cape Town, Port Elizabeth and East London; with metro rings in Johannesburg, Tshwane, eThekweni and Cape Town.

Indigenous knowledge systems (IKS)

The Indigenous Knowledge System 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 DST 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 how, with funding from the NRF, the MRC is developing the Moritela Tshwene Tea Project near Zeerust in North West, with the aim of producing a nutritional herbal tea for the commercial market.

The DST has put in place validation systems within its science system to ensure that indigenous knowledge products are safe and backed by the best science in the world.

To give further impetus to these critical initiatives, the department has set aside a dedicated fund to support research into indigenous knowledge.

Two indigenous knowledge research chairs have been awarded as part of the country's Research Chairs Initiative (SARChI).

The DST also established indigenous knowledge studies CoEs at the universities. The CoEs will play a defining role in generating highly qualified HR 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 more important ones are the:

- Anglo American Corporation of South Africa (applied metallurgy, processing of precious metals, base metals and coal)
- Agricura (synthesis and testing of veterinary remedies, insecticides, herbicides and entomology)
- Cullinan Holdings (refractories and electrical porcelain)
- De Beers Industrial Diamond Division (manufacturing and application of synthetic diamonds and other super-hard material)
- Johannesburg Consolidated Investment Company (metallurgy, mineralogy, chemistry and chemical engineering)
- National Chemical Products (chemistry, microbiology and animal nutrition)
- Metal Box Company of South Africa (corrosion mechanisms and microbiology)
- Tellumat (develops electronic instruments)
- Rembrandt Group (develops and improves tobacco and liquor products)
- South African Pulp and Paper Industries (wood technology, paper manufacturing and water treatment)
- Standard Telephones and Cables South Africa (long-distance transmission of information and lightning protection).

Natural-resource development

South Africa has the world's largest reserves of fluorspar, with estimated reserves of 41 million tons. They currently supply and estimated 10% of the fluoride requirements to R233,6 billion annual global fluorochemicals industry.

Human-capital development

The DST's Human-Capital and Science Platforms Subprogramme conceptualises, formulates and implements programmes aimed at developing and renewing science, engineering and technology human capital to promote knowledge generation, protection and exploitation.

South African universities train more and more scientists each year, with whose help the country will be able to spend R45 billion on research and development by 2014, thus reaching its target for gross expenditure on research and development of 1,5% of GDP.

Food security and access to clean water remain among government's top priorities – the department is therefore also focusing on using science and technology to ensure that existing water supplies are clean and is playing an active role in ensuring food security into the future.

To this end, seven of the 60 new research chairs initiated by the department will serve the areas of rural development, food security and land reform, bringing the total of such chairs to 10.

International Cooperation and Resources

The DST is not only entrusted with the overall coordination of national research and innovation initiatives in South Africa, but is also responsible for overseeing and facilitating South Africa's international scientific and technological cooperation.

The International Cooperation and Resources Programme's purpose is to:

- Strategically develop, promote and manage international partnerships that strengthen the NSI
- Enable an exchange of knowledge, capacity and resources between South Africa and its international partners, with a focus on supporting science, technology and innovation capacity building in Africa
- Support South African foreign policy through science diplomacy
- Complement South Africa's national

investments in science technology and innovation, including access to resources for department initiatives that require external investment, by securing international funds of R1,4 billion by 31 March 2018

- Maintain the total number of researchers awarded research grants through NRF-managed programmes at 13 617 by the end of 2016
- Maintain the number of ISI-accredited research articles published by NRF-funded researchers at 21 000 in the period under review
- Strategically develop priority science areas in which South Africa enjoys a competitive advantage.

African Network on Drugs and Diagnostics Innovation (Andi)

Andi is based in Addis Ababa, Ethiopia, at the UN offices of the Economic Commission for Africa. Its board agreed that five regional hubs were to be created to support regional research initiatives, with South Africa offering to host the southern hub.

Andi evaluated African research initiatives on drugs and diagnostics, and identified 35 CoEs throughout Africa that were to receive priority attention. Fifteen of these are in South Africa.

All the centres are tasked with researching responses to the most intractable health burdens of the continent, from malaria and tuberculosis to river blindness. Many of these are diseases of the poor and invisible. Their researchers do not receive funding or intellectual support from established agencies – Andi's aim is to reverse this.

It provides support to innovation in quality water provision that is community-led and -based through various agencies. It supported the development and use of new energy-efficient and attractive construction materials through the CSIR-led infrastructure innovation programme – 410 houses were built in Kleinmond, creating an integrated suburb.

It supports rural-based poverty alleviation initiatives in Limpopo, the Eastern Cape and KwaZulu-Natal. Another facet of Andi is the Ketlaphela/Lonza initiative that built a plant to manufacture active pharmaceutical ingredients for antiretroviral (ARV) production.

The departments of science and technology, trade and industry, economic development and health collaborated on this initiative to secure a significant proportion of the ARV market for local producers.

Women in Science Awards

Top South African women scientists were honoured at the Women in Science Awards ceremony held Johannesburg in August 2015.

The DST hosts these awards annually to reward outstanding female scientists and researchers, and encourage younger women to follow their example. The winners of the 2015 Women in Science Awards are as follows:

- Professor Maureen Coetzee – Distinguished Woman Scientist.
- Professor Marla Trindade – Distinguished Woman Scientist.
- Professor Lindiwe Zungu – Distinguished Woman Researcher.
- Dr Gina Zier vogel – Distinguished Woman Researcher.