



SCIENCE AND TECHNOLOGY

SOUTH AFRICA
YEARBOOK

2010/11

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The science and technology (S&T) sector is replete with examples of excellence and has immense potential to support South Africa in responding to a wide range of challenges while also advancing the country in innovation and technology-based business development.

The aim of the Department of Science and Technology is to realise the full potential of S&T in social and economic development, through the development of human resources (HR), research and innovation.

In April 2010, the department presented its budget vote to Cabinet. Some of the work being supported by the Department of Science and Technology included its operation in a wide range of fields from aerospace to palaeoanthropology, stem-cell research to nanotechnology, reviving African identity to understanding social change and advancing excellence in health and agriculture. The department has also contributed to the development of South Africa's first electric car, the Joule.

The 2009/10 financial year was an active and productive year for the department. It participated in shaping government's agenda for growth and industrial development, while also acting on its intention to establish a robust and productive system of innovation.

South Africa has created a radio astronomy reserve in the Karoo, west of the small town of Carnarvon in the Northern Cape.

In 2009/10, work was underway to develop the MeerKAT radio telescope array, which when it starts operations by as late as 2015, will be the largest radio telescope in the southern hemisphere and one of the biggest and most important such instruments in the world.

In addition, the country also bid to host the international US\$2-billion Square Kilometre Array (SKA) radio telescope, which, if the local bid is successful, will also be sited in the Karoo reserve with remote stations in eight African countries (Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia).

On 19 February 2010, the Minister of Science and Technology, Ms Naledi Pandor, declared the whole of the territory of the Northern Cape, excluding Sol Plaatje Municipality, as an astronomy advantage area for radio-astronomy purposes in terms of Section Five of the Astronomy Geographic Act, 2007 (Act 21 of 2007).

The Karoo Core Astronomy Advantage Area was declared on 20 August 2010. The area consists of three pieces of farming land of 13 407 hectares in the Kareeberg and Karoo Hoogland municipalities purchased by the National Research Foundation (NRF).

The Karoo Core Astronomy Advantage Area will contain the MeerKAT radio telescope and the core planned SKA radio telescope that will be used for the purposes of radio astronomy and related scientific endeavours.

South Africa was already reaping the benefits of creating the Radio Astronomy Reserve in 2010, attracting two other radio-astronomy projects to South Africa. These are the southern hemisphere antennas for the international C-Band All Sky Survey, involving institutions from the United States of America (USA), the United Kingdom (UK) and South Africa, and for the Precision Array for Probing the Epoch of Reionisation, which is led by the University of California, Berkeley.

South Africa's investment in the MeerKAT, SKA and the locally built low-orbit satellite SumbandilaSat reflects government's commitment to large-scale projects that promise social and economic rewards well into the future.

Legislation

Parliament has approved several laws, including the Intellectual Property Rights from Publicly Financed Research and Development (IPR) Act, 2008 (Act 51 of 2008), and the South African National Space Agency (Sansa) Act, 2008 (Act 36 of 2008).

The National Space Agency Act, 2008 provides for the establishment of a national space agency, in line with the space S&T challenge, while the IPR Act, 2008 promotes the protection and commercialisation of intellectual property derived from publicly



South African astronomy celebrated a major milestone in May 2010 as the first four telescopes of the MeerKAT radio telescope array (KAT-7) were linked together as an integrated system to produce Africa's first "interferometric" image of an astronomical object.

"Interferometry" refers to a technique in which radio signals collected at the same time by a system of networked radio telescopes are processed into a single high-resolution image.

financed research and development (R&D) for the benefit of all South Africans.

It establishes the National Intellectual Property Management Office and provides for the establishment of offices of technology transfer at institutions.

The Technology Innovation Agency (TIA) Act, 2008 (Act 26 of 2008), provides for the establishment of the TIA to help stimulate scientific innovation in the country.

Policy framework

The Department of Science and Technology's 2002 National Research and Development Strategy (NRDS) and its 10-year Innovation Plan of 2007 remain the basis for its interventions.

In mid-2010, the department was developing an integrated R&D strategy document drawing on these two important strategic policies. This will ensure that it has a coherent strategic framework.

The 10-year plan focuses on five priority areas, while also integrating research areas that are elaborated in the NRDS.

Ten-Year Innovation Plan

Since 2008, the Department of Science and Technology has focused primarily on implementing the Ten-Year Innovation Plan, while continuing with the implementation of the NRDS of 2002.

The main aim of the plan is to assist in establishing 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.

Its success will be measured by the extent to which S&T contribute towards enhancing productivity, economic growth and socio-economic development.

The department has five strategic goals, namely to:

- develop the innovation capacity of the science system and thereby contribute to socio-economic development
- develop South Africa's knowledge-generation capacity
- develop appropriate human capital for research, development and innovation
- build world-class RDI infrastructure
- position South Africa as a strategic international RDI partner and destination.

Expenditure on research and development

South Africa has maintained a steady growth in its R&D expenditure over the past decade,

with gross expenditure of R&D (Gerd) growing five-fold from about R4 billion in 1997/98 to about R21 billion in 2008/09.

The ratio of Gerd as a percentage of gross domestic product (GDP) also expanded over this period, indicating a growing role of R&D within the South African economy.

This is according to the *National Survey on Research and Experimental Development* on the 2008/09 financial year, undertaken by the Centre for Science, Technology and Innovation Indicators of the Human Sciences Research Council (HSRC) on behalf of the Department of Science and Technology.

Between 2007/08 and 2008/09, total R&D expenditure in South Africa increased from R18,633 billion to R21,041 billion, representing a nominal annual increase of R2,4 billion (or 12,9%). This is 2,2% in real terms, when the effects of price increases are removed from the equation.

The ratio of Gerd as a percentage of GDP, however, showed a decline for the second year in succession, from 0,93% in 2007/08 to 0,92% in 2008/09. This percentage was 0,95% in 2006/07.

The slowing rate of R&D intensity in the economy is an indication that R&D expenditure has not grown at the targeted rate. The 1% target of Gerd as a percentage of GDP by 2008/09, as envisaged in the NRDS, has not yet been achieved.

The Department of Science and Technology aims to work with partners in the system to analyse the constraints to expansion and will sharpen strategies and plans to raise the level of R&D expenditure.

The spread of R&D activities performed in South Africa has remained similar to that found in previous surveys:

- The business sector has consistently performed the bulk of R&D over the years (an average of about 58% for the past five measurements). Public-sector R&D, which includes government, science councils and the public higher education (HE) sector, performs about 41% of R&D. The non-profit sector performed about 1,1% of total R&D in 2008/09.



South Africa has one of the highest proportions of female researchers in the world. The *2008/09 Research and Development Survey* shows that women comprise 39,7% of total researchers, compared with 13% in Japan and 33,4% in Norway.

In developing countries, Argentina leads the way, with 51,5% female researchers.

- Most of the R&D is performed in the field of the engineering sciences, and as a proportion of total R&D expenditure, this field has increased from 22,5% in 2007/08 to 24,4% in 2008/09. This is followed by the natural sciences with 20,6%, and medical and health sciences with 14,6%. Other major fields of research in which R&D is conducted in South Africa are information and communication technologies (ICTs) (13,1%); social sciences and humanities (12,5%); applied S&T (9,1%); and agricultural sciences (5,5%)

Human-capital development

The Department of Science and Technology's Human Capital and Science Platforms (HC&SP) Subprogramme conceptualises, formulates and implements programmes aimed at the development and renewal of science, engineering and technology (SET) human capital to promote knowledge generation, protection and exploitation.

The subprogramme also develops science platforms that leverage South Africa's geographical advantages; and promotes SET, Mathematics and innovation literacy and awareness.

In its quest to bring unemployed SET graduates back into the mainstream economy, the department placed 470 unemployed SET graduates in SET-related institutions through the Department of Science and Technology and the NRF Internship Programme.

The 2009 cohort comprised 160 interns who were placed in over 40 institutions, including science councils, universities and industry to gain relevant work experience. The absorption of the interns into tenured employment within the host institutions has been around 70%.

The National Youth Service Programme, initiated in October 2003 as a special Presidential programme to address high levels of youth unemployment by creating opportunities for voluntary service and skills development for young people, saw 160 unemployed SET graduates deployed at 22 science centres countrywide.

The National Science Week (NSW) 2010 was launched by Minister Pandor at the University of Fort Hare, Alice, in July 2010. The NSW is an opportunity for young people (and their parents) to explore SET.

The United Nations declared 2010 the International Year of Biodiversity, and NSW 2010 had activities to tie in with the year-long focus on biodiversity.

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In May 2010, the South African Astronomical Observatory in Cape Town won a bid to host the International Astronomical Union's (IAU's) Office for Astronomy Development, which will play a key role in taking astronomy to the developing world.

The office will play a central role in coordinating and managing all IAU educational activities, as well as in recruiting and mobilising volunteers.

South Africa was chosen as the winner from about 20 countries that submitted proposals.

A number of activities aimed at the successful implementation of the Youth into Science Strategy (YiSS) took place during 2010.

In supporting new and emerging researchers, the department's HC&SP Subprogramme supported 43 postdoctoral students under its Postdoctoral Programme. A number of postdoctoral students received funding through centres of excellence (CoEs) and the South African Research Chairs Initiative (SARChI).

The SARChI is proving to be an effective instrument for developing human capital.

During 2009/10, the number of research chairs increased from 72 to 82 with the appointment of 10 new research chairs in August 2009.

The number of students and postdoctorates supported under the research chairs grants grew from 392 in 2007 to 514 in 2009.

In addition to students supported through research chairs' grants, a number of students with other sources of funding are supervised and mentored by research chairs.

These students grew from 252 in 2007 to 397 in 2009/10, thus bringing the total number of students supervised and mentored by research chairs to 644 and 911 in 2007 and 2009, respectively.

The research chairs supervised and mentored an average of more than 10 students per operating research chair in 2009, including students funded from other sources.

The number of publications in peer-reviewed journals increased from 162 in the 2008/09 financial year to 477 in 2009/10. During the same period, the number of books published by research chairs increased from four to 10, and the number of book chapters increased from 13 to 62.

The Department of Science and Technology has secured an additional allocation of R50 million for the research chairs over the next three years.

The CoE instrument has been very successful in marshalling all the available

human capital, infrastructure, and financial resources into fostering focused multi- and interdisciplinary research projects that are locally relevant and internationally competitive.

The number of postgraduate students supervised and concomitantly receiving grant-holder-linked financial support under the CoE Programme grew from 284 in 2005 to 507 in 2008. In 2009, there were 52 Master's graduate students and 22 PhD graduates.

A number of research grants were made to researchers in areas in which South Africa enjoys a geographic advantage.

Indigenous knowledge systems (IKS)

The importance of identifying and protecting indigenous knowledge is receiving increasing attention from policy-makers the world over.

South Africa's IKS policy was approved by Cabinet in 2004, and in 2006 the national IKS Office was established to foster a better understanding of the interface between culture and S&T, as well as between indigenous and Western knowledge systems. The Ministerial Advisory Committee for IKS was established.

To give greater meaning to the legislative framework for the protection of indigenous knowledge and its associated biological resources, indigenous knowledge will be collected through the National Recordal System.

The National Recordal System, a large fingerprint initiative of the Department of Science and Technology, will document, record and store indigenous knowledge for the benefit of the communities of South Africa.

The system also aims to collect grassroots community experiences in local languages. This flagship project creates a platform for the documentation of unrecorded and oral forms of indigenous knowledge for posterity.

The National Recordal System will be developed in phases. In 2010, the department tested the cataloguing system as it documented indigenous knowledge at six sites spread across four provinces.

As part of Phase One, the University of Zululand is working with the communities of Nkandla, Mhlab'uyalingana and Mkhwanazi, testing the cataloguing system before it is rolled out incrementally across the country.

The National Recordal System will be the first in the world. Once completed, it will be a legacy project for future generations.

The department has begun to put instruments in place to generate strong socio-economic benefits from this indigenous knowledge base.

The establishment and management of the Bio-Prospecting and Product Development Platform, under the auspices of the National IKS Office, focuses on research into the country's rich plant biodiversity to promote the pharmaceutical industry.

Related to this, the African Traditional Medicine Project, led by the University of KwaZulu-Natal, is conducting cutting-edge bioprospecting research to provide natural solutions to the country's four priority diseases, namely diabetes mellitus, tuberculosis (TB), HIV and AIDS and asthma.

The Cosmeceuticals Flagship Project, led by the University of Pretoria, has identified 11 positive leads for the treatment of skin problems, mouth infections and male balding. An indigenous plant oil *agathosma betulina* has proven effective in treating hyper-pigmentation and in slowing the ageing process.

The Nutraceuticals Flagship Project, led by the Council for Scientific and Industrial Research (CSIR), which conducts research into traditional South African foods, has found that the amaranthus vegetable contains three times the Vitamin K content of commercial cabbages.

The Department of Science and Technology 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.

The fund is open to all South African researchers whether they are based in higher institutions of learning or in communities. In addition to funded research, the department has a vision of growing a new generation of researchers in the field of indigenous knowledge.

Two indigenous knowledge research chairs have been awarded as part of the SARChi. The first was awarded to the University of KwaZulu-Natal for work in the field of traditional medicines.

The second chair in indigenous knowledge has been awarded to the Walter Sis-

ulu University. These two chairs represent significant injections into the development of national research capacity in IKS.

The Department of Science and Technology also established an indigenous knowledge studies centre of excellence.

The centre will play a defining role in generating highly qualified HR capacity in IKS.

In collaboration with the South African Qualification Authority, it has developed and registered the Bachelor of IKS Degree, which is a four-year degree covering a range of knowledge fields – mainly S&T and innovation.

Science bodies

These include the:

- TIA
- Sansa
- National Advisory Council on Innovation (Naci).

Technology Innovation Agency

TIA was formed from a merger of seven organisations funded by the Department of Science and Technology, including the Advanced Manufacturing Technology Strategy, Biotechnology Partnerships and Development, Cape Biotech, Innovation Fund, LIFElab, PlantBio and Tshumisano, and is mandated to stimulate and intensify technological innovation to improve economic growth and the quality of life of all South Africans.

The agency is set up to be a world-class innovation organisation that supports and enables technological innovation to achieve socio-economic benefits for South Africa through leveraging strategic partnerships.

The agency seeks to build on the achievements of its forming entities, by continuing to support innovation and product development in the sectors it operates within.

Among the key projects and initiatives that receive support from TIA is the Centre for the AIDS Programme of Research in South Africa 004 trial of the Tenofovir microbicide gel, for the prevention of HIV infection in women. The results of the trial were announced at the 18th International AIDS Conference in Vienna.

The microbicide containing 1% Tenofovir, an antiretroviral drug widely used in the treatment of HIV, was found to be 39% effective in reducing a woman's risk of becoming infected with HIV during sex and 51% effective in preventing genital herpes infections in the women participating in the trial. The study involved 889 women at high

risk of HIV-infection at an urban and a rural site in KwaZulu-Natal.

TIA holds a royalty-free licence agreement for the manufacture and distribution of the final product once all trials and regulatory procedures have been completed.

In May 2010, TIA became the world's first government agency to join in the Pool for Open Innovation (Pool) against Neglected Tropical Diseases. The agreement gives TIA researchers and associates the opportunity to be associated with world-renowned players in the drug discovery and development field.

The signing of a memorandum of understanding for the Pool provides a framework that will assist TIA with knowledge transfer, capacity-building and development; and commercialisation of new and improved medicines to address neglected tropical diseases.

TIA intends to use intellectual property and expertise from the Pool to accelerate its efforts to grow the South African drug discovery and development sector; and enhance the quality of life of those affected by neglected tropical diseases. Initially, TIA will focus on research in TB and malaria.

National Advisory Council on Innovation

The Naci Act, 1997 (Act 55 of 1997), mandates the council to advise the Minister of Science and Technology, and through the Cabinet, on the role and contribution of innovation (including 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:

- coordinating and stimulating the National System of Innovation (NSI)
- promoting cooperation within the NSI
- structuring, governing and coordinating the S&T system
- revising the innovation policy
- strategies for the promotion of all aspects of technological innovation
- identifying R&D priorities
- funding the S&T system.

South African National Space Agency

The National Space Strategy and Sansa were launched in December 2010.

Sansa will be responsible for implementing the country's National Space Strategy. Its mandate is to promote the peaceful use of space, foster research in space science and communications navigation and promote international cooperation in space-related activities.

Research areas Biotechnology

South Africa's research institutions and universities are conducting biotechnology research to increase production of crops suited to local conditions, enhance crop nutritional value and improve preservation and processing methods resulting in novel and improved food products.

Research is being conducted on understanding the nutritional components of food indigenous to South Africa, with the aim of making those with a high nutritional value available and accessible to the majority of people.

South Africa is classified as one of the 14 mega biotech countries in the world, and the only one in Africa. These countries, including South Africa, have a special responsibility to ensure that the potential impact of genetically modified organisms on human or animal health; on the environment; together with their probable socio-economic impact, are carefully measured, assessed and estimated before they are released. A favourable risk-benefit ratio can only be ensured in this way.

The objective of the Department of Science and Technology, as articulated in the Biotechnology Strategy, is to establish a sustainable and competitive biotech industry, which will result in the development of safe and beneficial products.

The biotechnology sector is attracting a fast-growing portion of R&D funding. South

Africa is also committed to developing biotechnology in Africa. In August 2005, the CSIR initiated a southern regional hub of the New Partnership for Africa's Development's (Nepad) African Biosciences Initiative.

Research related to agriculture, human and animal health, environment and industry is being prioritised. Other initiatives include the establishment of biotechnology regional innovation centres (Brics), namely the Biopad, Cape Biotech, LIFELab and the Plant Biotechnology Innovation Centre. Brics were created as instruments for implementing the National Biotechnology Strategy (NBS), and cover a wide spectrum of subdisciplines in biotechnology. These include human and animal health, biopharmaceuticals, industrial bioprocessing, mining biotechnology, bioinformatics and plant biotechnology.

TIA has absorbed the Brics and will significantly expand on the innovation development portfolios of those entities.

The Department of Science and Technology has launched the Public Understanding of Biotechnology Programme to ensure a clear and balanced understanding of the scientific principles, related issues and potential of biotechnology, and to stimulate public debate around its applications in society.

Some highlights in 2010 included the following:

- more media round tables were hosted by selected science centres
- basic biotech workshops for teachers and subject advisers were conducted
- the Old Mutual MTN Science Centre ran the Basic Biotech Workshops for learners
- the Critical Thinker Session was hosted.

Biosafety

In February 2010, the Deputy Minister of Science and Technology, Mr Derek Hanekom, launched Biosafety South Africa at Lourensford Wine Estate in Somerset West.

By then, the South African Government had invested over R900 million in biotechnology.

The aim is to make South Africa one of the top three emerging economies in the world in terms of the pharmaceutical, nutraceutical, flavour, fragrance and biopesticide industries by 2018.

Biosafety relates to the avoidance of risk to human and animal health, safety and prosperity, and to the environment, when researching, developing and commercialising the products of modern biotechnology.



South Africa's all-electric car, known as the "Joule", was on show in April 2010 at the Geneva Motor Show in Switzerland, one of Europe's most important automotive industry events.

The plug-in, zero-emission vehicle gave designers an idea of the final design and layout of the car when it goes on sale early in 2013.

However, South African motorists expected Joule on the country's roads earlier, as a fleet was mobile to gather technical feedback on the car and to gauge public response. These cars, like the show car, would be hand-built in Port Elizabeth.

The car was conceived by Cape Town-based Optimal Energy and originally designed by South African-born Keith Helfet.

The vision of Biosafety South Africa is to support innovation in biotechnology by ensuring the development of safe, sustainable biotechnological products. It promotes the biosafety of biotechnological products through the delivery of value-adding services and investment in strategic biosafety research.

Biosafety South Africa has:

- established firm collaborative partnerships with various international role players in biosafety, including the International Centre for Genetic Engineering and Biotechnology, the Biosafety Resource Network of the Donald Danforth Plant Science Centre and the Nepad's African Biosafety Network of Expertise
- developed and commissioned a wide range of strategic biosafety research projects and committed more than R5 million over the 2011 to 2013 period to strategic biosafety research
- established new capacity in South Africa for biosafety research by investing in research groups that had not previously undertaken any biosafety research, and funded 11 postgraduate bursaries.

In the delivery of the NBS, the Department of Science and Technology has set up the necessary instruments to drive biotechnology commercialisation, a series of technology platforms to enable biotechnology development, and a range of capacity development initiatives to ensure there is human capital for the growing sector.

Astronomy

South Africa continues to promote high-technology investment to ensure that local researchers and students are able to participate in international astronomy. A key result was the launch of the Southern African Large Telescope (Salt) in November 2005, in Sutherland in the Northern Cape.

This is a multimillion-rand project involving Germany, Poland, the USA, New Zealand and the UK. It is the largest single optical telescope in the southern hemisphere.

South Africa has been shortlisted, along with Australia, as a possible host for the biggest radio telescope ever built, the SKA. A final decision in this regard is expected in 2012/13. The SKA will be the only instrument able to answer the most basic questions of the origin of the universe and the birth and evolution of stars and galaxies. It will be used to investigate the origin of magnetism in the universe and will be the most powerful instrument ever to search for extraterrestrial intelligence.

In October 2010, South African astronomy received a major boost, in the form of a R100-million, ultra-high speed broadband link between the Northern Cape sites of the Salt and SKA and the South African National Research Network in Cape Town.

The link will enable local and international researchers to process data from the Salt and the SKA in near real time, and significantly boost South Africa's bid to host the SKA.

The 62nd International Astronomical Congress will be held in Cape Town in October 2011.

Space science

South Africa's 10-Year Innovation Plan identifies space S&T as one of five priority areas.

The Sansa Act, 2008 aims to promote the peaceful use of outer space; foster research in astronomy, Earth observation, communications, navigation and space physics; foster international cooperation in space-related activities; and advance scientific, engineering and technological competencies through human-capital development and outreach programmes.

Nanotechnology

Known as "the technology of the very small" (that is about 1/80 000 of the diameter of a human hair), nanotechnology comprises a wide range of technologies, techniques and multidisciplinary research efforts for application in a range of cross-cutting industries and activities.

These include aerospace, manufacturing and automotive industries; energy conversion, storage and distribution; the hydrogen economy; chemicals; electronics and information processing; as well as biotechnology and medicines.

The Department of Science and Technology has established nanotechnology innovation centres based on a triangular model, involving HE institutions, government and some industry players. This ensures the concurrent realisation of human-capital development and nanotechnology innovation.

The South African Government has been promoting the need to involve industry in nanotechnology development. The department drafted a nanotechnology research plan that will guide development efforts to ensure that strategic objectives are met.

As with all new technologies, nanotechnology holds potential risks to health, safety and ethical practices. The National

Nanotechnology Strategy requires that the Department of Science and Technology considers these vitally important areas, and the department is working to provide a platform for the proactive identification and mitigation of risks. Through the establishment of the Nanotechnology Ethics Committee and the Nanotechnology Health, Safety and Environmental Research Platform, efforts are being made towards ensuring the responsible development and application of nanotechnology.

The department intends to establish a world-class high-resolution transmission electron microscopy centre at the Nelson Mandela Metropolitan University. The process for the acquisition of the system was well underway in mid-2010, and it was expected that the system would be commissioned in November 2011.

The department also established a nanoschool in partnership with the University of the Western Cape. This is part of its suite of human capital-development programmes, and is aimed at contributing towards the creation of a pool of properly equipped researchers in the field of nanotechnology. As an international school, it offers an opportunity to network and form partnerships with researchers from other parts of the globe.

The Department of Science and Technology drafted a nanotechnology public engagement plan to promote public awareness and create a platform for meaningful debate about the nanotechnology. Modelled around a framework developed by the Organisation for Economic Cooperation and

Development, this engagement plan should enable the public to make informed choices about nanotechnology.

In 2010, the department appointed 82 nanoresearch professors. A total of five nanotechnology research chairs were appointed. Their contribution to human-capital development is commendable, with about 60 postgraduate students being trained and 110 publications produced through this programme by September 2010.

The department has flagship nanoprojects that are aimed at demonstrating the benefits of nanotechnology within a reasonable time. The most significant of these is the CSIR's TB project.

The focus of the project is on the encapsulation of existing TB drugs, using nanopolymer and ensuring the slow release of drugs in the system. If successful, the project will help reduce the frequency of the intake of drugs and the quantities concerned. The project was in the preclinical phase and the preliminary data obtained were already showing promising results by mid-2010.

In addition, the Department of Science and Technology supports seven other flagship projects.

Information and communications technology

The Centre for High-Performance Computing (CHPC) in Cape Town was the first of its kind in South Africa. Hosted by the University of Cape Town and managed by the CSIR's Meraka Institute, the CHPC is making scientific supercomputing a reality for South Africa.

It supports a diverse base of researchers and scientists, and facilitates the collaboration and multidisciplinary approach needed to solve complex computational problems, advancing South Africa's research capabilities in areas such as advanced manufacturing, space science and research into infectious diseases.

The high-speed computational infrastructure had 50 terabytes of storage space and 160 computer nodes (640 processors) in a clustered architecture. It had a peak performance of around 2,5 teraflops per second.

The second phase of the CHPC was installed by the end of June 2009. The peak performance of the new stage is about 30 teraflops per second, with a predictable storage capacity of more than 400 terabytes.

The South African National Research Network (SANReN), which is responsible

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The Minister of Science and Technology, Ms Naledi Pandor, launched a multimillion-rand programme in March 2010, in a bid to improve the technology base of 28 companies that manufacture casting material in South Africa.

Driven by the Department of Science and Technology, the Technology Localisation Programme (TLP) is in line with government's Competitive Supplier Development Programme, which is aimed at increasing the competitiveness of the local supply base through a range of demand- and supply-side measures.

This will assist local companies to leverage procurement opportunities from the Government's large-scale infrastructure recapitalisation programme over the next 20 years.

The initiative is also linked to high-level government initiatives such as the Industrial Policy Action Programme, developed to help South Africa reduce its trade deficit while improving its long-term manufacturing capacity.

Through the TLP initiative, foundries will be able to access expertise from the Department of Science and Technology's activities in advanced manufacturing and light metals.

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).

A major achievement for SANRen was the completion of the national backbone network, which connects all major metros in the country with a 10 gigabyte per second link.

International science and technology cooperation

South Africa increased its participation in multilateral organisations and enhanced its impact in the region and globally. Winning the bid to host a new Nepad water initiative; co-chairing the steering group for the Organisation for Economic Cooperation and Development (OECD)'s Global Science Forum Project on S&T cooperation between developed and developing countries; and serving on the OECD's Committee for Scientific and Technological Policy Steering Group on Science, Technology and Innovation (STI) cooperation to address global challenges, are a few examples of this increased participation.

During South Africa's chairpersonship of the Southern African Development Community (SADC) in 2009, and following the secondment of an official and the launch of the SADC STI Desk, South Africa was mandated to lead four regional projects (SADC STI policy management training and capacity-building; the SADC Women in SET Programme in consultation with member states; hosting a workshop on intellectual property rights; and developing modalities for the implementation and launch of the 2009 SADC SET Week).

South Africa's bilateral relations in Africa were enhanced through the funding of joint bilateral projects with Kenya, while an expression of interest with Namibia was finalised in March 2010.

South Africa continued its active engagement with the European Union (EU), having established policy dialogue on space science, energy and social sciences and humanities, which resulted in specific EU Framework Programme calls for proposals aimed at addressing South African and African challenges. The ongoing dialogue under the African Union-EU partnership resulted in the first EU Framework Programme Africa call, where significant research funds were allocated to S&T research on the continent.

In 2009/10, the implementation of the Finnish-South African innovation partnership programmes were well underway, having already supported emerging entrepreneurs and built innovation capacity in South Africa, including in poor provinces and rural areas.

Joint research projects have been completed with several partners in 2009/10, including those within the India-Brazil-South Africa (IBSA) framework in areas such as nanotechnology, biotechnology, and polar and oceanographic research. Bilateral engagements in areas such as space, energy, ICT, advanced manufacturing and science for sustainability have been completed or adapted to be in support of the Ten-Year Innovation Plan.

Flagship projects falling in this joint research projects category include Biota South, aimed at capacity development in mapping biodiversity, and Inkaba yeAfrica, a multidisciplinary project that surveys a cone-shaped sector of the Earth from core to space, gathering data that will facilitate future planning.

Discussions to establish the possible reconfiguration of these projects in support of both the Ten-Year Innovation Plan and the NRDS have been initiated.

Other activities in 2009/10 included the following:

- Bilateral STI relationships with Switzerland, Flanders, Germany, Norway, France, India, Algeria, Egypt, Mozambique, Kenya, Namibia and IBSA were deepened.
- The Department of Science and Technology's leadership role in South-South cooperation was recognised in the successful hosting of a third World Academy of Sciences General Conference in Durban in October 2009. South Africa was elected as vice-president of the Non-Aligned Movement S&T Bureau for the next four years.
- The department successfully leveraged R178 million in official development assistance funding from partners such as Canada, the EU, Finland, Germany, Japan

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In August 2010, the Deputy Minister of Science and Technology, Mr Derek Hanekom, launched the Africa Centre for Climate and Earth Systems Science (Access), which is hosted by the Council for Scientific and Industrial Research. The event was held at the University of the Western Cape.

Access provides a novel platform on which global and regional environmental challenges can be investigated, with resultant useful products for decision-makers.

and the USA with a further R11 million leveraged for human capital-development initiatives from partners such as Australia, Canada, France, Germany and Japan.

National Research Foundation

As an independent government agency, the NRF promotes and supports research in all fields of knowledge. It also conducts research and provides access to national research facilities.

The NRF provides services to the research community, especially at HE institutions and science councils to promote high-level human-capital development.

It aims to uphold excellence in all its investments in knowledge, people and infrastructure.

The NRF's three main functions are to:

- support research and innovation, through its agency, Research and Innovation Support and Advancement (Risa)
- encourage an interest in S&T through its business unit, the South African Agency for Science and Technology Advancement (Saasta)
- facilitate high-end research through its national research facilities.

Funding from the NRF is largely directed towards academic research, developing high-level HR and supporting the nation's national research facilities. Funding opportunities cover the full spectrum of beneficiaries: from students and researchers through to institutions and staff, and from scientists involved in bilateral and multilateral joint research projects to private individuals or companies and science councils.

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In October 2010, five years before South Africa's MeerKAT telescope becomes operational, more than 43 000 hours of observing time (adding up to about five years) had already been allocated to radio astronomers from Africa and around the world, who have applied for time to do research with this instrument. Surveys of radio pulsars and hydrogen gas in the deep universe came out on top in the first round of allocating MeerKAT's observing time.

Following an invitation to the world's radio astronomers to apply for telescope time to perform large survey projects, 21 proposals were received, involving more than 500 astronomers from around the world, 59 of them from Africa.

MeerKAT is South Africa's precursor telescope to the Square Kilometre Array and will consist of 64 dishes, each 13,5 m in diameter. It will be built in the radio astronomy reserve near Carnarvon in the Northern Cape over the next five years. An engineering test bed of seven dishes (KAT-7) is already complete.

Through Risa, the NRF:

- invests in knowledge, people and infrastructure
- develops the workforce, particularly previously disadvantaged men and women, to help all researchers unlock their full creative potential
- facilitates partnerships and knowledge networks
- supports and provides S&T information to guide and steer strategic decisions.

Through Saasta, the NRF:

- steers young minds towards careers in STI
- interacts with the public on SET issues
- communicates the advances of S&T to the public.

Through the national research facilities, the NRF:

- provides access to unique technologies, research methods and information
- provides state-of-the-art research platforms
- offers access to networking opportunities and international collaboration.

The objectives of the NRF Strategic Plan, NRF Vision 2015, include:

- promoting internationally competitive research as the basis for a knowledge economy
- growing a representative S&T workforce in South Africa
- providing cutting-edge research, technology and innovation platforms
- operating world-class evaluation and grant-making systems
- contributing to a vibrant national innovation system.

The National Research Foundation's role in the National System of Innovation (NSI)

The NRF performs a dual function in the NSI: as an agency that steers the system according to strategic policies, and as a research performer. The following are some of the areas it is involved in:

- The NRF supports the Department of Science and Technology's Youth into Science Strategy. This strategy promotes S&T literacy among the public in general, and the youth in particular. Through Saasta, the NRF supports competitions, camps and olympiads, all of which aim to identify those who have talent and potential from an early age and encourage the country's youth to participate in science.

- The South African Nanotechnology Strategy aims to increase the number of nanotechnology characterisation centres in South Africa. The Nanotechnology Equipment Programme that resides in the NRF, provides the infrastructure that forms the foundation of nanotechnology flagship research projects.
- The departments of labour, of basic education, of higher education and training, and of science and technology are responsible for ensuring that training in scarce skills takes place, especially in the fields of S&T. The NRF manages the funds allocated for this purpose.

The NRF contributes to the Department of Science and Technology's 10-year Innovation Plan through developing:

- knowledge capital
- human capital
- knowledge infrastructure.

Business units Research and Innovation Support and Advancement

Risa is the intermediary between government strategies, research institutions and researchers. Its key objectives are to ensure appropriately qualified people and high-level infrastructure necessary to produce the knowledge that makes South Africa a global competitor.

It disburses funding from various sources, such as the funds:

- allocated to the NRF via the Parliamentary core grant
- received from various government departments.

These ring-fenced and contract funds are disbursed according to strict criteria laid down by the respective sponsors.

Risa's investment in knowledge, people and infrastructure focuses on seven areas:

- established researchers
- human-capital development and unrated researchers
- strategic knowledge fields
- strategic platforms (including research at the national research facilities)
- international initiatives
- applied and industrial research and innovation
- research on community engagement in SET.

South African Agency for Science and Technology Advancement

Saasta promotes and communicates the value and impact of STI for a dynamic knowledge economy. In the process, these

activities contribute to building an SET HR base, which is integral to the involvement of science promotion from school level to the broader public. Saasta also provides the infrastructure and competency platform to spread the message about science to learners, educators and the public. These initiatives and the platform that Saasta creates are aimed at increasing the number of previously disadvantaged learners who enrol for and perform in Mathematics and Science.

The objective of Saasta is to increase public awareness of, and the HR capacity for, S&T advancement. It achieves its objective by exposing people to the wonders of science and engaging with them about the relevance of SET in their everyday lives.

Saasta pursues its goals through:

- science education – developing curriculum support and material for educators and learners, mainly in Mathematics and Science, and exposing learners to career opportunities in SET
- science communication – providing relevant information about South Africa's SET achievements through science and media events, a variety of innovative communication tools and science communication capacity-building
- science awareness platforms – providing multi-user science advancement platforms in collaboration with the national research facilities, a network of science centres, HE institutions, science councils and international networks.

National research facilities

The seven 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 performs fundamental research in astronomy and astrophysics at national and international level. It is the national facility for optical and infrared astronomy



Two South African scientists were honoured at the inaugural African Union Scientific Awards. The awards programme was launched in September 2009, and the laureates were announced early in 2010.

Professor Diane Hildebrandt of the University of the Witwatersrand and Professor Patrick Eriksson of the University of Pretoria were singled out for the prestigious honour from 48 entries sent in from all over Africa. Eriksson won in the Life and Earth Sciences Category, while Hildebrandt won in the Basic Science, Technology and Innovation Category.

in South Africa and is also responsible for managing the operations of the Salt.

Hartebeesthoek Radio Astronomy Observatory (HartRAO)

The HartRAO has been established as the national facility for radio astronomy research in South Africa. Its primary function is to support research and training in radio astronomy and space geodesy.

Hermanus Magnetic Observatory (HMO)

The HMO is part of a worldwide network of magnetic observatories that monitor and model variations of the Earth's magnetic field. It also performs fundamental and applied space physics research, and provides geomagnetic field-related services on a commercial basis.

South African Institute for Aquatic Biodiversity (Saiab)

The Saiab serves as a research hub for aquatic biodiversity in southern Africa by housing and developing the National Fish Collection and associated resource collections as research tools and sources of aquatic biodiversity data.

It also generates knowledge on aquatic biodiversity through interactive and collaborative scientific research, and disseminates scientific knowledge at all levels.

South African Environmental Observation Network (Saeon)

The Saeon establishes and maintains nodes (environmental observatories, field stations or sites) linked to an information-management network. These nodes serve as research and education platforms for long-term studies of ecosystems that aim to advance the understanding of ecosystems and enhance the ability to detect, predict and react to environmental change.

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More companies have become aware of the Research and Development (R&D) Tax Incentive Programme, and the volume of enquiries received by the Department of Science and Technology has increased substantially.

By the end of October 2009, the department had received a total of 301 submissions, indicating R&D expenditure of about R3,2 billion.

The programme is intended to promote R&D by helping to reduce the costs of product development for companies, and increase the profits resulting from new, innovative ideas, thus boosting the economy.

National Zoological Gardens (NZG)

The NZG plays a major role in the ex-situ conservation of wildlife, maintaining one of the largest animal collections on the continent, made up of over 7 000 individual animal specimens representing over 600 species.

These are managed across four sites stretching into the provinces of Gauteng, Limpopo and North West. The animal collection comprises about 70% African and 30% global species.

As a member of the World Association of Zoos and Aquaria, the NZG participates in several dozen endangered species management programmes and successfully breeds several endangered species of both continental and global significance.

iThemba Laboratory for Accelerator-Based Sciences (Labs)

The iThemba Labs provides advanced, viable, multidisciplinary facilities for training, research and services in the fields of subatomic nuclear science and applied radiation medicine.

Science councils

The statutory science councils are a key part of South Africa's NSI. Through them, government is able to directly commission research in the interest of the nation, and support technology development in its precompetitive phase.

Agricultural Research Council (ARC)

The ARC conducts fundamental and applied research with partners to generate knowledge, develop human capital, and foster innovation in agriculture by developing technology and disseminating information. It also commercialises research results.

The following six objectives form the basis of its strategic plan:

- to generate, develop and apply new knowledge, S&T for agriculture to meet the demands for increased food production, food security and poverty alleviation
- to promote the sustainable use and management of natural resources to ensure a competitive agriculture sector and increase wealth for people and industries dependent on natural resources-based agriculture
- to improve nutrition and food security and safety by improving crop and livestock

production systems, including seed security

- to provide information and technical solutions that enable the agriculture sector to manage and mitigate agricultural risks, including threats to the agricultural production value chain from natural disasters, diseases, pests and agricultural practice
- to disseminate information and transfer technology emanating from R&D
- to achieve organisational growth and sustainability.

Since 2007/08, the council and the Onderstepoort Veterinary Institute have focused on developing new laboratory-based diagnostic technologies to accurately identify animal pathogens.

In 2008/09, researchers made advances in developing and implementing technologies for diagnosing several high-priority diseases affecting the agro-economy of South Africa. Focusing on these diagnostic tools has been a priority over the medium term.

The ARC is primarily funded from a transfer from the Department of Agriculture, Forestry and Fisheries. Additional revenue is received from the provision of research services to external clients.

Council for Scientific and Industrial Research

The CSIR's mandate is stipulated in the Scientific Research Council Act, 1998 (Act 46 of 1988), as amended by Act 71 of 1990, Section Three.

The aim of the CSIR is, through directed and particularly multidisciplinary research and technological innovation, to foster industrial and scientific development, either by itself or in cooperation with principals from the private or public sectors, thereby

contributing to the improvement of the quality of life of the people of South Africa.

The CSIR is one of the leading S&T, R&D and implementation organisations in Africa. The CSIR's main site is in Pretoria, and the organisation is represented in other provinces of South Africa through regional offices.

The CSIR transfers the knowledge generated through research activities by means of technology and skilled people.

The generation and application of knowledge resides at the core of the CSIR.

These take place in domains such as biosciences; the built environment; defence, peace, safety and security; materials science and manufacturing; modelling and digital science; and natural resources and the environment.

Emerging research areas

These are areas of 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.

National research centres

The CSIR houses specialist facilities of strategic importance for African science. These include ICTs, and laser and space-related technology.

Research and development outcomes

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

The CSIR has a group of facilities that manages standard technology-based services. The experts in this group use the value of CSIR knowledge-application activities by providing specialised consulting, analysis and testing services to address the clients' needs.

Services include forensic fire investigations, food and beverage analysis, environmental consulting and laboratory services, engineering forensics, wire-rope testing, mechanical testing, fires and explosion tests, self-contained self-rescuer testing, sports technology and analysis, and project management.

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In August 2010, two African women became the first recipients of the Google Anita Borg Memorial Scholarship for outstanding contribution and leadership in computer science.

South African Sinini Ncube, a Master's student at Rhodes University, and Kenyan born Shikoh Gitau, a doctoral candidate at the University of Cape Town, each received a cash prize of R67 000 and an opportunity to visit Google's engineering facility in Zurich.

Ncube and Gitau were the first sub-Saharan students to receive the award, which is open to applicants from Europe, the Middle East and, for the first time in 2010, Africa – provided they are women. Ncube and Gitau shared the award with 23 others from Russia, Israel, Romania, Morocco, France, Switzerland, the Netherlands, Austria, Germany, the United Kingdom, Ireland, Italy, Denmark, Turkey, Qatar and Sweden.

Supporting national imperatives

South Africa's national imperatives and global challenges provide the macro-strategic framework within which the CSIR conducts its research.

In an effort to help place Africa on a path of sustainable growth and development, the organisation supports and participates in Nepad.

The CSIR contributes to the national programme of development by:

- building and transforming human capital
- strengthening the SET base and performing relevant R&D
- transferring technology and skilled human capital.

Operations

The CSIR receives an annual grant from Parliament, through the Department of Science and Technology, which accounts for about 40% of its total income.

The remainder is generated from research contracts with government departments at national, provincial and municipal levels; the private sector; and research-funding agencies in South Africa and abroad. Additional income is derived from royalties, licences and dividends from IP management and commercial companies created by the CSIR.

The Parliamentary Grant is focused on the knowledge base and facilities in the CSIR to ensure that these stay at the leading edge of technological development. It is invested in developing new areas of expertise, undertaking "pre-competitive" research too risky for the private sector to fund, and for training young researchers.

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 R&D 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 Minerals and Energy. About 35% of the annual budget of R290 million is funded by the State Science Vote, with the balance provided by contract R&D, sales of products and services, technology licensing agreements, and joint-venture private-sector companies. Mintek has about 780 perma-

nent staff members, more than half of whom are scientists, engineers and other technical R&D specialists.

Mintek's key objectives include:

- developing efficient mineral-processing technologies and sustainable value-added products and services
- Second-Economy interventions
- human and organisational development
- good governance.

The amount of R165 million has been allocated to Mintek for 2010/11 for R&D aimed at supporting and expediting South Africa's mineral-beneficiation programme.

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, involved in cutting-edge research in areas that are crucial to development.

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, of which the most notable are poverty reduction through economic development, skills enhancement, job creation, education, the well-being of children and families, the elimination of discrimination and inequalities, and the promotion of effective service delivery.

Another large research area covers the behavioural and social aspects of HIV and AIDS.

The HSRC's collaborative approach to research enables productive and beneficial interaction with research experts in South Africa, SADC, elsewhere in Africa, as well as outside the continent.



In April 2010, a South African-led team of scientists announced the discovery of a new hominid species at the Cradle of Humankind World Heritage Site outside Johannesburg.

Two skeletons were unearthed at Gladysvale and were named *Australopithecus sediba*, an entirely new hominid species.

The University of the Witwatersrand, led by professors Lee Berger and Paul Dirks, discovered the new species, dating back 1.9 million years. Berger is a palaeoanthropologist and Dirks a geologist based at James Cook University in Australia.

The HSRC's research outputs include reports for users, occasional papers and scholarly articles in peer-reviewed journals and books. These are disseminated in print through the HSRC Press, through policy briefs aimed at government and policy-makers, and through the media, conferences and extensive research networks.

The 150 dedicated professional researchers, located in four provinces in South Africa, undertake between 180 and 200 research projects per year, as well as various other activities, such as conferences, seminars and public lectures.

The research staff is supported by a strong physical and institutional infrastructure, including technical and support positions, deployed countrywide to enable the organisation to respond efficiently and comprehensively to research needs.

On another level, the HSRC seeks to serve as a knowledge hub to bridge the gap between research, policy and action, thereby increasing the impact of research.

This role is implemented through collaboration with key constituencies, including government and other research organisations, multinational agencies, universities, and non-government, donor and development organisations.

Four integrated research programmes have been established within the HSRC:

- Child, Youth, Social and Family Development
- Democracy and Governance
- Education, Science and Skills Development
- Social Aspects of HIV and AIDS and Health.

The programmes provide a firm foundation for the undertaking, promoting and coordinating of research efforts in the social sciences and humanities.

They also allow the HSRC to provide single points of entry – complete with a critical mass of researchers – for interdisciplinary and problem-orientated research in these areas.

Two cross-cutting units exist to facilitate the mobilisation and coordination of resources:

- knowledge systems
- policy analysis and capacity enhancement.

These cross-cutters ensure the availability of the requisite knowledge and support for addressing national and institutional priorities.

Three research centres serve as “innovation incubators”, where multidisciplinary

teams conduct longitudinal, research-based demonstration projects, focusing on national priority areas. They are the:

- Centre for Education Quality Improvement
- Centre for Poverty, Employment and Growth
- Centre for Service Delivery.

The research centres generate research-based information, provide support to decision-makers and enable government to scale up and implement successful models that focus on cross-cutting research themes.

Medical Research Council (MRC)

The MRC is an SET institution and was established in 1969 by an Act of Parliament. Since then, it has earned its place as one of Africa's top science councils. While the MRC is largely funded by the Government, it earns about half of its income from contracts and grants. It reports directly to the Department of Health.

The mandate of the MRC is legislated in terms of the MRC Act, 1991 (Act 58 of 1991).

The MRC's task is to improve the health and quality of life of all South Africans. It does this by discovering solutions to health problems through scientific research. The MRC's researchers include people with unique skills and very specific training – all focused on the health priorities of South Africa.

The MRC provides decision-makers in government with policy recommendations on issues such as alcohol or tobacco misuse, intestinal parasites in children, and specific information regarding the rates of crime, violence and injury in South Africa.

Council for Geoscience (CGS)

The CGS is the legal successor of the Geological Survey of South Africa, which was formed in 1912 by the amalgamation of three former surveys, the oldest of which –

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In May 2010, the Department of Science and Technology earmarked R2 million to be disbursed over the next three years for the National Zoological Gardens.

Most of the funds will go to the organisation's new Centre for Conservation Science. This modern facility was opened in March 2009 by the Minister of Science and Technology, Ms Naledi Pandor, and aims to become a recognised centre of excellence in the spheres of conservation biology and science.

the Geological Commission of the Cape of Good Hope – was founded in 1895.

The Geoscience Act, 1993 (Act 100 of 1993), established the CGS in its present form. The council is a modern institution, boasting excellent facilities and expertise, ranking among the best in Africa.

The Geoscience Bill aims to amend the Geoscience Act, 1993 to mandate the 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.

A state-of-the-art electronic corporate relational database, which integrates dedicated modular databases for specific applications such as mineral deposits, boreholes, geochemistry and engineering geology into a comprehensive Geographic Information System, has been developed.

The drawing office produces a wide variety of geoscientific maps, using both conventional and electronic cartographic technologies.

The Seismology Unit studies the regional seismicity of southern Africa through the operation and maintenance of the South African National Seismograph Network, and various other seismological stations in eastern and southern Africa. These stations provide information on the occurrence of earthquakes and enable assessment of the seismic hazard in the subcontinent.

The Geophysics Unit specialises in conducting and interpreting airborne geophysical surveys. The unit also develops and maintains a geophysical testing site where geophysical instruments can be calibrated and students can acquire practical experience in the use of various geophysical instruments.

The National Geoscience Library contains a comprehensive collection of geoscience publications in South Africa, consisting of about 17 000 books and more than 2 800 journal titles.

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In March 2010, researchers at the Council for Scientific and Industrial Research (CSIR) demonstrated a world-first laser cladding system that offers a permanent solution to sealing leaks and repairing cracks at power stations.

According to the CSIR, the provisionally patented laser beam-welding and leak-sealing technology was developed for Eskom in collaboration with Eskom's welding engineers.

The Map Library has a collection of more than 14 000 sheet maps, with a large portion of this collection devoted to maps of Africa.

The CGS maintains a prospecting borehole-log collection of over 72 000 borehole logs acquired from prospecting and mining companies.

The Geoscience Museum provides educational facilities and information to scholars, tourists and members of the public in the form of displays, multimedia kiosks, rock-, mineral- and fossil-identification services, brochures and worksheets. The museum's gem, mineral, meteorite and rock collection is recognised as one of the best of its kind in Africa.

The National Core-Library contains a large collection of borehole cores and cuttings from South African geological strata, collected over a period of more than 25 years.

South African Bureau of Standards (SABS)

The SABS is a statutory body that was established in terms of the Standards Act, 1945 (Act 24 of 1945), and continues to operate in terms of the latest edition of the Standards Act, 2008 (Act 29 of 2008), 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 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 know-

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In August 2010, a group of students from the Tshwane University of Technology (TUT) showcased their hydrogen-powered bicycle, known as "A hi fambeni", at the second annual Resource-Driven Technology Concept Centre (Retecza) Conference in North West.

The bicycle, translated as "let's go", is made up of cutting-edge light and strong material. The design is meant to accommodate the transport needs of people living in rural areas.

It was developed by the TUT students, in partnership with the Department of Science and Technology, as well as Hydrogen South Africa. Retecza is a non-profit-organisation whose vision is to be a leading technology concept centre on clean energy, transport and water.

ledge 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.

Other scientific and research organisations and structures Eskom

Eskom's Technology Services International group is a multidisciplinary industrial laboratory and consulting organisation. It undertakes testing, investigation studies, project management, engineering services and applied research for Eskom and other customers.

Sasol

Sasol's culture of innovation began in the 1950s when it developed its unique blend of coal gasification and Fischer-Tropsch (FT) technology for its original coal-to-liquids (CTL) 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.

Another feature of its R&D work was the opening, in June 2009, of the Sasol Fuels Application Centre in Cape Town, where Sasol carries out thorough emissions testing.

Sasol Technology's Fuels Technology division carries out fuels, lubricants, heating-fuel and road-binding material R&D

and new-product formulation and testing at Sasolburg.

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.

ArcelorMittal

ArcelorMittal is a global steel-maker, with an industrial presence in 27 countries. ArcelorMittal is the leader in all major global markets, including automotive, construction, household appliances and packaging.

The group is a leader in R&D and technology, holds sizeable captive supplies of raw material, and operates extensive distribution networks.

National Health Laboratory Service (NHLS)

The NHLS forms a national network of integrated pathology laboratories throughout the country that use common laboratory management systems and transport networks to facilitate the transport of specimens, referral of tests to reference laboratories, and delivery of results.

The NHLS has 265 laboratories and employs about 6 500 people. Their activities comprise diagnostic laboratory services; research, teaching and training; and producing sera for anti-snake venom, reagents and media. All laboratories provide laboratory diagnostic services to the Department of Health, provincial hospitals, local authorities and medical practitioners.

Research conducted by the NHLS covers a wide spectrum of activities in all pathology disciplines. Grants in support of research

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In September 2010, Sasol flew the world's first passenger aircraft using the company's own-developed and internationally approved 100% synthetic jet fuel.

Sanctioned by the global aviation fuel specification authorities, the fuel, produced by Sasol's proprietary coal-to-liquids process, is the first fully synthetic fuel to be approved for use in commercial airliners. This marks significant development in the adoption of clean burning alternate fuels for the aviation industry.

The fuel is the product of over 15 years of work, driven by South African scientists, using home-grown technology. The historic flight, from Lanseria Airport in Gauteng to Cape Town, also kicked-off Sasol's 60th birthday celebrations and staged fly-pasts at the opening of the Africa Aerospace and Defence 2010 Exhibition at Cape Town's Ysterplaat Air Force Base.

are made by the MRC, the Cancer Association of South Africa, the South African Sugar Association, Poliomyelitis Research Foundation, pharmaceutical companies, private donors and a number of overseas institutions, among others. A large part of the research programme is financed by the NHLS itself from the earnings of its laboratory services.

Bureau for Economic Research (BER)

The BER at the University of Stellenbosch, Western Cape, is an independent economic research organisation. It renders a service to organisations ranging from small one-person businesses to policy-makers at the highest level of government.

National Institute for Tropical Diseases

The National Institute for Tropical Diseases in Tzaneen, Limpopo, is responsible for the ongoing assessment of malaria-control programmes carried out by various authorities in South Africa.

Control methods are assessed and recommendations made to the appropriate authorities regarding equipment, insecticide usage and application. A malaria-reference service is also provided. Malaria tests are carried out by the institute, and statistical analyses of data pertaining to the programme is undertaken.

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 on 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)

As a leading African human security research institution, the ISS works towards a stable and peaceful Africa characterised by sustainable development, human rights, the rule of law, democracy, collaborative security and gender mainstreaming. The ISS realises this vision by:

- undertaking applied research, training and capacity-building
- working collaboratively with others
- facilitating and supporting policy formulation
- monitoring trends and policy implementation
- collecting, interpreting and disseminating information
- networking on national, regional and international levels.

Africa Institute of South Africa (AISA)

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

The AISA has long been at the forefront of research and training on African affairs. The AISA has contributed to fostering a new generation of research specialists, and has also been able to produce some of the finest research on contemporary African affairs by having its researchers conduct field research every year throughout the African continent.

The AISA is involved in community outreach programmes, providing maps and other resources to underprivileged schools in rural South Africa.

General research areas Mine-safety research

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 subcommittee of the Mine Health and Safety Council. It has a per-

i The Council for Geoscience has completed and published the one in two-million scale geological map for the entire Southern African Development Community (SADC) region.

This map is a benchmark product because it is the first integrated geological map for the region that will provide a common understanding of the geology between all the SADC countries.

The map is proving useful in the search for groundwater and minerals in the region. As Africa unravels its geological complexity, additional potential for further mineral development is increased, which could address the socio-economic plight of the host countries.

manent research-management office managing the rock engineering, engineering and mine occupational health fields of research.

Energy research

South Africa's National Energy Research Institute (Saneri) is the public entity entrusted with the coordination and undertaking of public interest energy research, development and demonstration. Saneri was established in October 2004 as a subsidiary of the Central Energy Fund (CEF) (Pty) Ltd, the state energy company in South Africa.

The Department of Science and Technology, together with the departments of mineral resources and of energy, are joint custodians of Saneri and assist in providing political and strategic focus for the company.

Agricultural research

Agricultural research is conducted by the ARC, several universities and various private-sector organisations. Provinces are responsible for farm management and technological development. These activities are aimed at improving managerial efficiency on farms.

The Directorate: Scientific Research and Development in the Department of Agriculture, Forestry and Fisheries coordinates all agricultural R&D activities.

The National Agricultural Research Forum (NARF) coordinates agricultural R&D within the national agricultural research system. The NARF also provides a platform for stakeholder consultations on R&D matters.

Biannual meetings are held to debate and agree on research needs, programmes and budgeting. Efforts are made to ensure that the bulk of research serves the needs of small-scale producers.

Research initiatives have been integrated into the various industries in line with the overall objectives of each agricultural sector.

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In September 2010, South Africa donated replicas of the country's fossil find, *Australopithecus sediba*, to two museums in China, spreading awareness of the country's fossil heritage.

Reproduced in the palaeoscience laboratories at the University of the Witwatersrand, the replicas are on display at the Museum of Natural History in Shanghai and the Institute of Vertebrate Palaeontology and Palaeoanthropology in Beijing.

This initiative of the Department of Science and Technology formed part of the "heritage" theme portrayed at the South African Pavilion at the Shanghai World Expo during the same month.

Water research

The Water Research Commission (WRC) was established in 1971 through the Water Research Act, 1971 (Act 34 of 1971), following a period of water shortages. The WRC is responsible for:

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

The WRC functions as a "hub" for water-centred knowledge. This is reflected in the WRC's mission, which provides the organisation with a framework for its strategic and operational initiatives. The WRC functions as a networking organisation, linking the nation and working through partnerships. Being an innovation organisation, it is continuously providing novel (and practical) ways of packaging and transferring knowledge into technology-based products for the water sector and the community at large, both locally and globally.

Many decades of R&D and science-based knowledge have provided the basis for the development of policies and strategies that allow for the sustainability of South Africa's water resources.

This emphasises not only the important role that water-centred knowledge has played in the past, but also its increasingly important role in providing South Africa with knowledge, which will allow it to deal successfully with the many new challenges that will face the limited water resources in future years. The WRC plays a crucial role in this regard. It leads and coordinates research, which, in turn, creates the knowledge that facilitates the judicious management of water quantity and quality, in order to achieve sustainability.

The Water Research Act, 1971 established the Water Research Fund, which derives income primarily from levies on water consumption.

In supporting the creation, dissemination and application of knowledge, 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 WRC also calls for specific mechanisms to address key strategic issues of national importance. These issues are dealt with in four cross-cutting domains:

- water and society
- water and the economy
- water and the environment
- water and health.

The organisations that participate in water research are:

- universities and universities of technology
- professional consultants
- science councils
- water and waste utilities
- non-governmental organisations (NGOs).

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.

The Division: Water, Environment and Forestry Technology (Environmentek) of the CSIR specialises in research into water quality, including technology to meet effluent and water-quality standards, and to establish reclaimed water as an additional water source.

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In August 2010, the Minister of Science and Technology, Ms Naledi Pandor, acknowledged the country's leading female scientists through the annual Women in Science Awards.

The 2010 Women in Science Awards were part of the department's efforts to increase the number of female scientists and researchers in the country.

The awards were also created to increase women's access to research professions in the country as well as profile successful scientists and researchers as role models for younger women and girls. Categories and winners were as follows:

- **Distinguished Woman Scientist in the Life Sciences:**

Winner: Prof. Jill Farrant

- **Achiever Award for a Woman Innovator in Indigenous Knowledge Systems:**

Makgoshi Masipa

- **Distinguished Woman Scholar in the Social Sciences or Humanities:**

Joint winner: Prof. Stella Nkomo

Joint winner: Prof. Clair Penn

- **Distinguished Young Woman Scientist in the Life Sciences:**

Winner: Prof. Alta Schutte

- **Distinguished Young Woman Researcher in the Social Sciences or Humanities:**

Winner: Prof. Michelle Kelly-Louw.

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In November 2010, Eskom joined forces with the Water Research Commission in conducting research on climate change, water-resource availability and accessibility, water quality, water conservation and acid mine drainage. The two parties signed a memorandum of agreement and formed a joint research committee. Research will also be conducted on other subjects of interest, such as water conservation, water-demand management and technology development. The two organisations will collaborate in implementing research findings from laboratory to demonstration plant.

Environmentek is a world leader in research into activated sludge processes and the biological monitoring of water to detect potentially toxic substances. It is also involved in research into the effects of afforestation and veld management on the quantity and quality of catchment water-yield.

Institute for Water Research (IWR)

The IWR is a multidisciplinary research department of Rhodes University. Its main objective is to contribute to sustainable water-resources 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.

Environmental research

The Department of Environmental Affairs annually finances several research and monitoring programmes.

The programmes comprise subjects such as waste management and pollution, nature conservation, river management, coastline and marine environment, and the atmosphere.

Some programmes are conducted in collaboration with the NRF, while others are undertaken on behalf of the department by the CSIR and universities. Research into human-environment interaction, sponsored by the department, is coordinated by the HSRC.

In addition, institutes of the ARC are concerned with environmental research insofar as environmental problems impact on agriculture or are caused by agricultural practices.

The South African Weather Service (SAWS) is a statutory body functioning

under the Department of Environmental Affairs.

The SAWS delivers public-good services, mainly for the protection of life and property, as well as commercial services to the private sector, as stipulated in the Weather Service Act, 2001 (Act 8 of 2001).

Among other activities, the SAWS runs the Global Atmospheric Watch Programme, which measures and monitors greenhouse gas datasets. The SAWS has also rolled out a number of ozone-monitoring stations in the SADC region.

The NRF directs the multidisciplinary Conservation and Management of Ecosystems and Biodiversity Focus Area, primarily in collaboration with universities and museums, to promote and support research into living resources and terrestrial, freshwater, marine, coastal and atmospheric ecosystems.

South African National Biodiversity Institute (Sanbi)

Sanbi's biodiversity research comprises collaborative programmes set up to promote and catalyse knowledge about biodiversity.

The broad scope of research includes the origins, composition, and functioning of biodiversity, its conservation and sustainable use, ecosystem services, and biodiversity responses to major drivers such as climate change. The research is organised into three divisions:

- Applied Biodiversity Research
- Biosystematics Research and Biodiversity Collections
- Climate Change and Bio-Adaptation.

Fisheries research

Research into South Africa's fish resources, and their conservation and judicious exploitation, is carried out by research personnel of the Chief Directorate: Marine and Coastal Management, a division of the Department of Environmental Affairs, and by several universities and NGOs.

Research is designed to provide parameters for estimates of stock sizes and sustainable yields for the different fisheries.

Coastal and marine 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.

The NRF supports marine and coastal research in partnership with the Department of Environmental Affairs and the South African Network for Coastal and Oceanic Research.

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 overseas developments.

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 syn-

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In June 2010, South African laser physicist Dr Christine Steenkamp was honoured at the fourth General Assembly and International Conference of the Organisation for Women in Science for the Developing World (OWSDW).

The theme of the conference that took place in Beijing was *Women Scientists in a Changing World*. The conference and general assembly had a number of joint aims, among them, to promote interaction and exchange between female scientists in the South; to boost awareness of OWSDW activities; and to increase assistance from national and international organisations for research projects carried out by female scientists.

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- thetic 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 (development of electronic instruments)
 - Rembrandt Group (development and improvement of tobacco and liquor products)
 - South African Pulp and Paper Industries (wood technology, paper manufacturing and water treatment)
 - Standard Telephones and Cables SA (long-distance transmission of information and lightning protection).

Acknowledgements

BuaNews
Council for Geoscience
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Human Sciences Research Council
Medical Research Council
National Health Laboratory Service
National Research Foundation, Business Plan 2010 – 2013
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