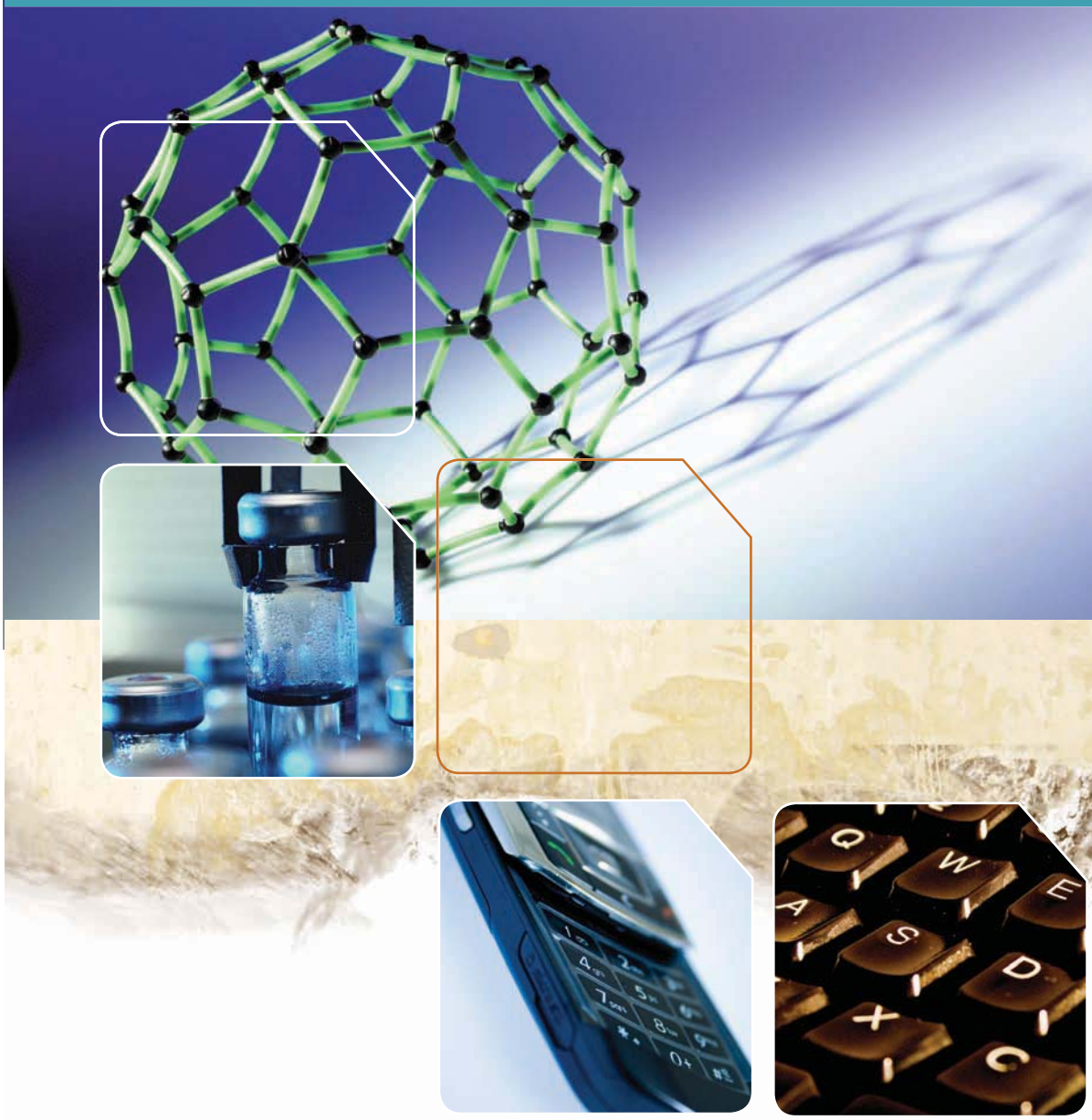

The Department of Science and Technology (S&T) strives towards introducing measures that put S&T to work to make an impact on growth and development in a sustainable manner in areas that matter to all the people of South Africa.

The department primarily focuses on implementing the National Research and Development Strategy (NRDS), which was adopted in 2002. It provides for an integrated approach to human-resource (HR) development, knowledge generation, investment in infrastructure and improving the strategic management of the public S&T system.

These measures include focused interventions, networking and acting as a catalyst for change in terms of both productive components of South Africa's economy, making it competitive in a globally competitive liberalised environment, and also in respect of the huge development backlog existing among the poorest components of society.

The revised strategic-management model for the S&T system enables the department to develop emerging and rapidly changing areas of S&T, and to co-ordinate and support sector-specific S&T activities initiated by other government departments. Expenditure is expected to continue to increase rapidly, to R4,1 billion in 2009/10, representing an average annual increase of 20%.

Most of this expenditure comprises transfers to public entities for S&T initiatives. South Africa has to address what the NRDS identifies as the "innovation chasm", the gap that exists between the knowledge generators and the market. The establishment of the Technology Innovation Agency is expected to narrow this gap.

Once established, the agency will have the competency to assist the National System of Innovation (NSI) to acquire the existing body of knowledge, and to develop technology-based services and products that could be commercialised and diffused through the economy. Legislation in this regard was tabled in Parliament in May 2008.

In July 2007, Cabinet approved the department's plan, Innovation towards a Knowledge-Based Economy. This aims to help drive South Africa's transformation towards a knowledge-based economy in which the production and dissemination of knowledge leads to economic benefits and enriches all fields of human endeavour. To this extent, success will be measured by the degree to which S&T plays a driving role in enhancing productivity, economic growth and socio-economic development.

The plan addresses an array of social, economic, political, environmental, scientific and technological benefits, and is designed to stimulate multi-disciplinary thinking and challenge South Africa's researchers to answer existing questions, create new disciplines and develop new technologies.

It sets core projects, which are summarised as South Africa's "grand challenges" in S&T and include: the farmer to pharma value chain, space and S&T, energy security, S&T in response to climate change and human and social dynamics.

## Legislation

Government plays a formative role in research and innovation by developing and approving policy, legislation and regulatory frameworks; setting the overall national agenda; and creating an enabling environment for research and innovation to thrive. Since 1994, government has put forward a range of mechanisms to encourage innovation in the private sector, government research institutes and the Higher Education (HE) sector.

The Joint Initiative for Priority Skills Acquisition (Jipsa) and the sector education and training authorities (Setas) are other strategies and tactics used to increase various skills in South Africa. In particular Jipsa, as a framework, is aimed at addressing the shortage of urgently needed skills. It targets and mobilises unemployed graduates, and retired and foreign experts for deployment into the economy.

Through this process, knowledge is shared and transferred.

The department is determined to realise its mission to develop, co-ordinate and manage an NSI that will help achieve a critical mass of the required human capital, realise sustainable economic growth and improve the general quality of life of the people of South Africa and of the people in neighbouring countries.

As part of developing the NSI, all programmes and initiatives are carried out in partnership with business, labour, academia, research councils, HE institutions and other knowledge producers.

## National System of Innovation

The *White Paper on S&T* (1996) introduced the NSI as the basis of the S&T interventions in the South African economy.

Aligned with South Africa's national develop-mental priorities and programmes, such as, among other things, the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and the National Spatial Development Programme, substantial progress has already been made in this regard. The Department of Science and Technology's budget allocation of R3,7 billion for the 2008/09 financial year brought national spend on research and development (R&D) to 0,9% of gross domestic product. The department aimed to see this grow to 1% by the end of 2008/09.

Some R195 million was set aside for the strengthening of the scientific capacity of HE institutions. This included increasing the number of research chairs by 30% over the next three years.

This investment is in line with the department's NRDS, which places enormous value on human capital and skills development.

The Department of Science and Technology is providing resources and co-operating with universities and the National Research Foundation (NRF) to use a licensed information technology (IT) platform to gather and make available information on research activity within tertiary education institutions.

The largest share of the department's budget over the medium term, about R323 million, has been allocated to the Human Capital and Knowledge Programme, which addresses the adequate development and renewal of human scientific resources. It will strengthen current programmes, which include the:

- Research Professional Development Programme, which targets young Science, Engineering and Technology (SET) masters and doctoral students
- Postdoctoral Fellowship Programme
- Centres of Excellence (CoE) Programme.

The Technology Innovation Agency (TIA) Bill calls for the creation of an agency that will stimulate the development of technology-based products and services and technology-based public and private enterprises, and help grow a technology base for South Africa's economy.

The primary objective of the agency will be to stimulate and intensify technological innovation for the purposes of improving South Africa's economic growth, thereby enhancing the quality of life of South Africa's people. The agency is intended to develop and support local technological inventions and innovations, and create an enabling environment for their commercialisation.

The Bill further provides for the appointment of the TIA Board, the CEO and staff, and sets out the powers and functions of the agency, which will include, among other things, to:

- provide financial assistance to people, consortia or enterprises to enable them to develop and commercialise their technological innovations and inventions
- draw together and integrate the management of disparate technological innovation initiatives that are specifically at the technology development stage.

## Innovation Fund (IF)

The IF promotes technological innovation through investments into novel technologies that will lead to established successful companies or the expansion of industrial sectors. To give effect to this, the IF has a series of investment instruments structured to fund end-stage R&D, commercialisation, start-up companies and intellectual property management.

The IF addresses serious problems that could impede socio-economic development or affect the country's ability to compete in products and services. Through the IF and the Bioregional Innovation Centres (Brics), the department is focusing its efforts on establishing the institutional infrastructure, legislation and policy framework needed to integrate the process of knowledge creation and its subsequent commercialisation for national benefit.

Among other things, the fund promotes technological innovation through consortia of expertise drawn from both public and private sectors.

The instruments of the IF are specifically tailored to foster the pursuit of high-risk technologies by business entities, by creating partnerships that draw on technical expertise in the public research enterprise. The incentive to the business partners is the equal sharing of the R&D costs of the market-oriented research agenda.

The IF is managed by the NRF. It provides funding to near-market and end-stage research, which produces new intellectual property (IP) and commercial enterprises, and expands existing industrial sectors.

HE students, particularly first-degree engineering students, can take advantage of the fund by developing, as part of their final-year work, projects resulting in the creation of new IP or the establishment and/or expansion of commercial enterprises.

The NRF claims a management and administration fee from the allocated budget for support services rendered.

## Promoting niche areas

### Astronomy

Through the Astronomy Geographical Advantage Programme, South Africa continues to promote high-technology investment in space science 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.

The Salt is a multimillion rand project involving Germany, Poland, the United States of America (USA), New Zealand and the United Kingdom (UK). The Salt is the largest single optical telescope in the southern hemisphere.

South Africa has been shortlisted, along with Australia, as one of the sites for the world-class radio telescope, the Square Kilometre Array (SKA). A final decision in this regard is expected in 2011.

The SKA will be the biggest telescope ever built, the only one of its kind worldwide, and 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 investigate the origin of magnetism in the universe and will be the most powerful instrument ever to search for extraterrestrial intelligence.

South Africa has assembled a team to build the Karoo Array Telescope (Kat). The Kat team and researchers in the UK, the Netherlands, Australia and the USA are developing digital signal processing for the telescope, and software and innovative telescope antennas, using composites.

The SKA and Kat projects are important for developing high-level skills and expertise in South Africa.

The MeerKat radio telescope is both an SKA "pathfinder telescope" and an indigenous initiative to build a hi-tech, world-leading centimetre-wave radio telescope that will set a standard for many years.

South African scientists and engineers began the design, development and construction of MeerKat four years ago, in collaboration with the universities of Cambridge, Oxford, Manchester, California, Caltech, the Netherlands Institute for Radio Astronomy and others.

MeerKat will be complete and in service by late 2012 and will consist of up to 80 12-metre antennas. The final number of antennas to be built remains subject to budget constraints.

Preparatory construction work is underway at a site near Carnarvon, in the Northern Cape, that will host the first phase of the MeerKat radio telescope project by the end of 2009.

The Department of Science and Technology has provided funding for graduate study associated with these projects.

This programme is being extended to South Africa's partners in the SKA bid – Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique and Namibia.

The 2007/08 Budget allocated R500 million, both for the SKA and for the construction of the Kat, which will in turn provide the means to train scientists and engineers to acquire relevant capabilities and skills.

The Kat team has been recognised for its competence and is being called upon to assist and advise the international SKA project office on system engineering, costing and other key technology areas.

A survey by the Human Sciences Research Council (HSRC) found that South Africa spent at least R16,5 billion on research and development (R&D) in 2006/07, an indication that the country is progressing towards being a knowledge-based economy.

The purpose of the survey, conducted by the HSRC's Centre for Science, Technology and Innovation Indicators, found that R&D expenditure had increased from R14,1 billion in 2005/06.

### Space science

In the Department of Science and Technology's Ten-Year Innovation Plan, the development of space S&T has been identified as one of five priority areas.

The National Space Agency Bill was signed into law in January 2009. The agency will promote the peaceful use of outer space; foster research in astronomy, Earth observation, communications, navigation and space physics; foster international co-operation in space-related activities; and advance scientific, engineering and technological competencies through human-capital development and outreach programmes.

The agency must facilitate the development of space missions, develop technology platforms and acquire, assimilate and disseminate space satellite data for any organ of state.

It will also implement the National Space Strategy, which was approved by Cabinet in December 2008, to stimulate the capability to place South Africa among the leading nations in the innovative use of space S&T.

## Biotechnology

The National Biotechnology Strategy (NBS) sets the agenda for the development of South Africa's biotechnology industry.

AsgiSA has identified biofuels as a potential contributor to rural development. This includes the establishment of sustainable rural jobs, both in the agricultural sector and in the processing of biofuels. Efforts are underway to examine the introduction of biofuels in the commercial transport sector, as a way of stimulating a biofuels industry in South Africa.

However, such a strategy needs to be complemented by other biofuels-related initiatives that will enable the products to be used beyond the commercial transport fuel sector. One such initiative is the local production of biofuels for local users. Internationally, this has taken the form of the development of a local biofuels industry that supplies fuel for running public transport.

This project will explore the potential of such an approach through the deployment of appropriate technology and initiation support for R&D activities. Results of this project should serve as a benchmark and model for public transportation.

The biotechnology sector is attracting a fast-growing portion of R&D funding. The department is also committed to developing biotechnology in Africa. In August 2005, the Council for Scientific and Industrial Research (CSIR) initiated a southern regional hub of the New Partnership for Africa's Development's (Nepad) African Biosciences Initiative.

In 2008, the Centre for Proteomic and Genomic Research (CPGR), the first of its kind in South Africa, opened at the University of Cape Town's medical campus, giving local researchers a powerful new tool for combating a variety of diseases.

The centre is, among other things, engaged in researching a new and improved molecular diagnostic marker of diseases such as malaria, leukaemia and colorectal cancer; is conducting a search for markers of pathogen resistance in maize; and is assessing the possible health risks associated with the development of genetically modified plants.

The centre combines an integrated technological approach with a strong focus on translating information-rich discoveries into practical applications.

The centre will provide advanced biological solutions and project support to the country's scientific community, as well as high-quality analytical services to academia and industry.

Research related to agriculture, human and animal health, environment and industry is being prioritised. Other initiatives include the establishment of Brics, namely: Biotechnology Partnership for Africa's Development (Biopad), Cape Biotech, LIFElab and the Plant Biotechnology Innovation Centre.

Brics were created as instruments for implementing the NBS. Their focus areas cover a wide spectrum of subdisciplines in biotechnology. These include human and animal health, biopharmaceuticals, industrial bioprocessing, mining biotechnology, bio-informatics and plant biotechnology.

One of the challenges facing the South African biotechnology sector is the public's lack of understanding and knowledge of biotechnology applications and benefits.

As a result, the Public Understanding of Biotechnology Programme was initiated to provide South Africans with information, enabling them to participate meaningfully in debates about biotechnology and to make informed decisions in this regard.

In addition, the implementation of the NBS has seen the development of the National Bio-Informatics Network (NBN) at eight universities, investing in technology research and development (R&D), infrastructure and teaching.

The results of biotechnology investments have long lead times, sometimes up to 15 years, yet some success stories resulting from the investments and interventions made by the biotechnology institutions are already being reported.
The goal is to expand the country's biotechnology platform and develop a bio-economy base.

## Indigenous Knowledge System (IKS)

The IKS has had a number of successes since its launch in 2004.

This includes the timely establishment of the Ministerial Advisory Committee, which assists in establishing IKS chairs to be located within HE institutions, based on nationally prioritised areas such as traditional medicines, knowledge studies and indigenous food security.

Government plans to develop IKS databases, following an audit of those residing at various institutions. It is also envisaged that a hardware multimedia recording system to capture documentation, such as the registration of holders of indigenous knowledge, interviews and satellite-information linkages, will be developed.

## Public funding

The provision of public funding is a key component of government's responsibility of creating an enabling environment for R&D. To track investments, government has initiated a process whereby a national R&D survey is conducted every year. The link between government and industry is crucial. Current human-capital programmes have introduced research chairs with industry partnerships to strengthen this linkage.

The need to attract and retain more talented recruits to the sciences stimulated a number of human-capital programmes, such as the CoEs and the South African Research Chairs Initiative (Sarchi). More than 72 research chairs have been established at HE institutions, 16 of which are in new disciplines. The target is to establish 210 research chairs by 2010 to contribute to the growth of high-level research capital and production capacity in the academic and industrial sectors.

Working with the National Advisory Council on Innovation (Naci), the department has produced a comprehensive report on the infrastructure requirements for both science and innovation. This will form the basis of a long-term infrastructure plan for S&T.

Other infrastructure projects that government is expected to benefit from include the Centre for High Performance Computing (CHPC), nanotechnology characterisation centres, astronomy and space science.

Regarding nanotechnology and nanoscience, government is in the process of creating the physical infrastructure that will enable first-class basic research, exploration of applications, the development of new industries and the commercialisation of innovations.

In April 2008, the South African National Research Network (Sanren) reached a significant milestone when the first four research infrastructure sites went live in Johannesburg, representing a major step forward in the creation of an information and communications technology platform for South African research.

Teams from the Tertiary Education Network, the University of the Witwatersrand, the University of Johannesburg and the second landline operator Neotel worked together to deploy the network.

The Sanren project is sponsored by the Department of Science and Technology and managed by the Council for Scientific and Industrial Research's Meraka Institute, while Sanren is providing the network equipment and Neotel is providing the optical fibre circuit to ensure a high capacity backbone for the Johannesburg ring.

## Policy and initiatives

### National Research and Development Strategy

The NRDS is an enabling framework for South Africa's innovation system to prioritise economic sectors with growth potential, such as biotechnology, nanotechnology, IT and space technology. The strategy has enabled government to increase investment in human capital to transform and fill the skills gaps identified in key sectors.

More focused sector strategies, such as the Biotechnology Strategy, the Advanced Manufacturing Technology Strategy (AMTS) and the Nanotechnology Strategy, were formulated.

A need was identified to enhance the research infrastructure to create a knowledge workforce for advanced technology businesses, and so support the country's future competitiveness and its ability to achieve an improved quality of life.

The NRDS focuses on three broad areas:

- Innovation, primarily through technology missions: The emphasis is on technological innovation, demonstrating technology, incubating new technology-based businesses and enhancing networks of knowledge workers and organisations in specific areas of technology.
- Strengthening SET, HR and transformation: The emphasis is on establishing CoEs, founding and funding networks for Nepad and the Southern African Development Community (SADC), strengthening global science networks, formulating strategies aimed at sourcing new finance for R&D equipment, strengthening institutional and individual research capacity in science focus areas through the NRF, and increasing public understanding and engagement.
- Creating an effective government S&T system: A clear distinction needs to be drawn between the roles of line-function departments and the integrative role of the Department of Science and Technology. This focus area is involved in generating three-year R&D plans for science councils in line with the Medium Term Expenditure Framework (MTEF) process, developing standard-reporting frameworks and a performance-management system for all institutions, and giving the department central responsibility for producing an integrative budget for all S&T initiatives.

The seven CoEs are:

- biomedical tuberculosis (TB) research
- invasion biology
- strong materials
- birds as keys to biodiversity conservation at the Percy Fitzpatrick Institute
- catalysis
- tree health biotechnology at the Forestry and Agricultural Biotechnology Institute
- epidemiological modelling and analysis.

## Advanced Manufacturing Technology Strategy

The AMTS guides efforts in the manufacturing sector, including the aerospace industry. The AMTS strives to:

- develop technology platforms that increase current and create new competitive advantages
- establish partnerships and human-capital development.
- enhance the knowledge base and intensity of South Africa's manufacturing sector.

In 2006, the Department of Trade and Industry launched the National Aerospace Centre of Excellence, located at the University of the Witwatersrand.

The Centre for Innovation, focusing on craft and design, opened in Cape Town in July 2006. The centre was the first of its kind in the world and a state-of-the-art resourced venue aimed at promoting innovative design, product development and process technologies for crafters and designers.

The Cape Craft and Design Institute (CCDI) spearheaded the creation of the centre, together with the Western Cape Provincial Government and the AMTS.

The Centre for Innovation incorporates a fabrication laboratory, sponsored by the Massachusetts Institute of Technology (MIT). The centre's activities are linked to the CCDI's small, medium and micro-enterprise (SMME) development and market-access support programmes.

Government has set aside R16 million to establish 10 fabrication laboratories (FabLabs) around the country, providing disadvantaged communities with opportunities in the design, testing and fabrication process.

FabLabs form part of the department's goal of providing SET platforms for social development, while benefiting private-sector competitiveness and growth. Advanced manufacturing technology is brought to ordinary people as an accessible platform to empower them by hands-on participation in an environment that enables the freedom to experiment, and encourages peer-to-peer learning. FabLabs are also sponsored by the MIT's Centre of Bits and Atoms.

In 2007/08, six FabLabs were operational throughout South Africa, in Pretoria, Soshanguve, Cape Town, Bloemfontein, Potchefstroom and Kimberley.

The Department of Science and Technology is leading a number of strategic interventions to assist young people to take science-based career directions. These interventions take place under the auspices of the Youth into Science Strategy, which was launched in 2007.

The Department of Science and Technology established the National Indigenous Knowledge Systems Office (NIKSO) to, among other things, increase public awareness, understanding, knowledge and appreciation of the Indigenous Knowledge System (IKS).

NIKSO has created an appropriate platform through the Interdepartmental Committee on IKS to co-ordinate and promote the work of different departments. The inaugural IKS Expo took place in 2008 and primary objectives were to:

- raise awareness of IKS
- demonstrate the richness of South Africa's IKS
- showcase innovation emerging from IKS
- highlight the interrelatedness of IKS with other disciplines.

## South African National Energy Research Institute (Saneri)

Saneri is the public entity entrusted with the co-ordination and undertaking of public-interest energy research, development and demonstration.

Saneri was established by the then Minister of Minerals and Energy in October 2004, as a subsidiary of the Central Energy Fund (Pty) Limited (Ltd), the state energy company in South Africa. The Department of Science and Technology and the Department of Minerals and Energy are joint custodians of Saneri and assist in providing political and strategic focus for the company.

Saneri's main aim is to build research capacity by funding research at universities and in the science councils.

Allocations for the 2008 MTEF period are R44,3 million, R46,3 million and R49,3 million, respectively.

Saneri, through R&D, provides for:

- cost-effective and efficient energy generation, transformation, transport, end-use and decision-support technologies
- energy-technology innovation
- sustainable development and use of energy resources
- improving the quality of life of all South Africans
- promoting and conducting training of energy researchers
- establishing and expanding industries in the field of energy
- commercialising energy technologies resulting from its R&D and innovation programmes.

Saneri established the Renewable and Sustainable Energy Research and Development Hub at the University of Stellenbosch. The hub will support the development of a vibrant renewable and sustainable energy-supply industry in South Africa.

## Pebble Bed Modular Reactor (PBMR)

PBMR (Pty) Ltd of South Africa develops and markets small-scale, high-temperature reactors, both locally and internationally. The 700-member PBMR project team is based in Centurion, near Pretoria.

The PBMR is a high-temperature reactor, with a closed-cycle, gas-turbine power-conversion system. The South African project is internationally regarded as the leader in the power-generation field. PBMR (Pty) Ltd's current investors are the South African Government, Eskom, the Industrial Development Corporation of South Africa and the United States (US) nuclear company Westinghouse. The PBMR Programme represents a significant development for South Africa in the field of nuclear S&T.

## National Advisory Council on Innovation

Naci is appointed by the Minister of Science and Technology to advise on the role and contribution of innovation, including S&T, in promoting and achieving national objectives. These include:

- improving and sustaining the quality of life of all South Africans
- developing HR for S&T
- building the economy
- strengthening the country's competitiveness in the international sphere.

Naci membership is broadly representative of all sectors and is constituted to ensure a spread of expertise and experience regarding national and provincial interests, scientific and technological disciplines, innovation regarding the needs and opportunities in different socio-economic fields, and R&D in all sectors.

## Public Understanding of Science, Engineering and Technology

The Department of Science and Technology's efforts in engineering and technology include:

- the South African Reference Group on Women in S&T, which is a ministerial body that advises on ways to increase the visibility and development of women, and on making science more relevant to the needs of society by incorporating women's needs and expectations
- the Women in Science Awards, first awarded in 2003, which honour female scientists and their achievements
- National Science Week, which is an annual week-long event aimed at persuading the youth to pursue careers in SET, while highlighting the important role that science plays in everyday life.

## National Nanotechnology Strategy

The National Nanotechnology Strategy recognises the needs of local industry and focuses on the essential building blocks of nanoscience, namely synthesis, characterisation and fabrication.

The strategy positions South Africa as a global player in this emerging area and seeks to strengthen government's integrated development focus.

The strategy aims to:

- support long-term nanoscience research that will lead to a fundamental understanding of the design, synthesis, characterisation, modelling and fabrication of nanomaterial
- support the creation of new and novel devices for application in various areas
- develop the required HR and supporting infrastructure
- stimulate new developments in technology missions, such as advanced material for advanced manufacturing, nanobiomaterial for biotechnology, precious metal-based nanoparticles for resource-based industries and advanced material for information and communications technologies (ICTs).

The strategy is aimed at increasing the number of nanotechnology characterisation centres in South Africa. In 2007, National Treasury allocated R450 million to implement the strategy over the next three years.

The country's first two nanotechnology innovation centres, based at Mintek and the CSIR, were established in 2007. These centres play a central role in the implementation of the Nanotechnology Strategy and are expected to provide a platform for world-class research in the fields of nanoscience and 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.

South African industry and researchers have been involved in nanotechnology and the practical application of nanoscience for several years; for example, Sasol's chemical processing by catalysis.

New generations of emerging nanotechnology-based products require that South Africa develops its ability to derive more benefits from global advances in this area.

In this regard, human-capital development also forms a very strong and integral component of the National Nanotechnology Strategy. For this reason, the development of a highly trained HR base with R&D expertise will encourage the private sector to develop nano-based products and services.

The country's human-capital development programmes include the use of the Department of Science and Technology's Sarchi postgraduate programmes, as well as bursaries for students.

## Information and communications technology

South African researchers now have the advantage of using massive computing power in their quest for new knowledge and application.

The CHPC in Cape Town is the first of its kind in South Africa. Initiated by the Department of Science and Technology, 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.

The CHPC supports a diverse base of researchers and scientists, and facilitates the collaboration and multidisciplinary approach needed to solve complex computational problems.

In October 2008, the Minister of Science and Technology, Mr Mosibudi Mangena, unveiled the world-class locally developed electric car in Paris, France. Appropriately named Joule, after British scientist James Prescott Joule (1818 to 1889) the zero emission car made its global debut at the Paris motor show.

Joule is a six-seater MPV (multipurpose vehicle) designed by Optimal Energy in association with South African-born automotive designer, Keith Helfet. Optimal Energy was capitalised with a R50-million investment from the Innovation Fund (IF). The shareholders in Optimal Energy comprise executive management, the IF and the Industrial Development Corporation.

The centre advances South Africa's research capabilities in areas such as advanced manufacturing, space science and research into infectious diseases.

The high-speed computational infrastructure comprises 160 computer nodes (640 processors) in a clustered architecture. It is rated to have a peak performance of around 2,5 teraflops (2,5 million mathematical operations) every second.

It is complemented by 50 terabytes of storage space. To maximise the benefit and use of this infrastructure, the research communities in South Africa are self-assembled into 10 special-interest groups, and the CHPC adds significant computational power to accelerate the research agenda of these groups.

The CHPC and the South African Research Network are the backbone of an emerging cyber infrastructure in South Africa that will support research initiated in other elements of the country's S&T infrastructure, such as the SKA, the National Bioinformatics Network and the Global Earth Observation System of Systems (GEOSS).

The GEOSS aims to enable globally co-ordinated Earth observations across a number of domains, to provide better and more reliable data in areas of benefit to society, including agriculture, weather, climate, water, disasters, health, energy, biodiversity and ecosystems.

## Tshumisano

Tshumisano was established in 2002, with the mandate to provide support for the SMME sector through its Technology Stations Programme.

One of the aims of this programme is to strengthen technological innovation activities and related skills upgrading, to increase the relative competitiveness of SMMEs in targeted sectors.

These sectors include automotive, agrifood processing, electronics, metal value-adding, chemicals, metal casting, and composite and moulded plastics.

Technology stations are based at various universities of technology across the country.

The number of technology stations has expanded rapidly over the past few years to support previously underserviced provinces, from the original three in 2002 to 12 in 2007.

The stations increased assistance to SMMEs by more than 37% in 2006/07. The trust has also rolled out three institutes for advanced tooling in Soshanguve (training and SMME development), East London (design) and Stellenbosch (R&D).

The approach is a two-way learning process in which SMMEs improve their operations through technology assimilation and by upgrading their innovation capabilities.

This process enriches the teaching and learning activities of universities of technology by improving their equipment and their real-world understanding of the industry challenges.

The Tshumisano Trust, a joint venture between government, the German Agency for Technical Co-operation and the Committee of University of Technology Principals, is generating stronger working relationships between the departments of science and technology and labour.

Technology stations that fall under the control of the trust are listed below, along with the relevant host institution:

- Tshwane University of Technology (TUT): Electronics and Electrical Engineering, complemented by IT
- Central University of Technology: Metals Value-Adding and Product Development
- TUT: Chemistry and Chemical Engineering
- Mangosuthu Technikon: Chemistry and Chemical Engineering
- Vaal University of Technology: Material and Processing Technologies
- Nelson Mandela Metropolitan University: Automotive Components
- Nelson Mandela Metropolitan University: Downstream Chemicals
- Cape Peninsula University of Technology: Clothing and Textiles
- University of Johannesburg: Metal-Casting Technology
- Durban Institute of Technology: Reinforced and Moulded Plastics
- Cape Peninsula University of Technology: Agri-Food Processing Technologies.
- University of Limpopo: Limpopo Agrifood Technology Station.

It was estimated that in 2007/08, the trust assisted 570 SMMEs.

## Poverty reduction

The Department of Science and Technology believes in a multipronged approach to fighting poverty.

Its poverty-alleviation projects are having positive outcomes in businesses and co-operatives and focus on, among other things, beekeeping, paper-making, incorporating African design in clothing and textiles based on natural fibres, and indigenous cattle production. These projects are concentrated in the poverty nodes as identified by government's Integrated Sustainable Rural Development Strategy.

## Internship Programme

The department and the NRF jointly manage a programme to provide work experience for unemployed graduates by providing them with practical and accelerated learning programmes towards building workplace competencies.

## Youth into Science Strategy

The Youth into Science Strategy's primary objective is to contribute towards the development of the priority skills base.

Through this programme, the department is recruiting young people to pursue careers in areas of scarce skills. Its targets include doubling S&T

At the end of February 2008, the Research Information Management System (RIMS) was launched by the Minister of Science and Technology, Mr Mosibudi Mangena, at the Innovation Hub in Pretoria.

The RIMS is a strategic tool that will be completely integrated with other existing systems at institutional level. It provides real-time information on human resources for science, engineering and technology, research and development (R&D) capacity and technology improvement and innovation.

The RIMS provides government with the necessary tools to obtain a detailed, holistic understanding of where its R&D funds are invested, and how much it is spending on each area of science and technology.

Until then, data on government-funded R&D was compiled retrospectively, using traditional survey techniques.

Government has set aside more than R40 million for the development and implementation of the RIMS Project.

literacy among the youth and nurturing more than 5 000 young people with talent and potential in SET by 2010.

## National Information Society Learnership Programme

This programme aims to contribute towards building an information society and promoting greater and more efficient use of IT.

## International science and technology co-operation

The strategy to use southern Africa's local (geographical) advantages and efforts to attract large international science-based investments is paying off. Examples of these investments include the construction of the High-Energy Stereoscopic System (Hess) observatory in neighbouring Namibia and the Salt in Sutherland in the Northern Cape, as well as winning the bid to host the European Developing Countries Clinical Trials Partnership (EDCTP). Added to this are bold efforts to bolster South Africa's bid to host the SKA in South Africa.

International breakthroughs include South Africa's leading role in the European Union's sixth framework programme, and in implementing Africa's Consolidated S&T Plan of Action.

South Africa is involved in developing an S&T platform in the subregion through the SADC Ministers' Council on S&T, which is developing a SADC protocol to guide the implementation of the subregional S&T plan.

Developing a high-speed broadband network in the region is a flagship project of the Department of Science and Technology. The UbuntuNet Project is set to link through the South African National Research Network to Europe, via the Geant connection, to give South Africa and its research community a high-speed network. The first phase of implementing this network began with funding of R178 million over the MTEF.

The department has successfully leveraged human-capital support through international S&T agreements. This has resulted in jointly funded projects with 16 countries in areas such as agriculture, manufacturing and biotechnology.

South Africa's role at the forefront of the New Partnersip for Africa's Development (Nepad) is, to a significant extent, based on its ability to deploy scientific knowledge and technological solutions on the continent.

The International Council for Science (Icsu) established four regional offices in 2002 in the developing world. In September 2005, the council's Regional Office for Africa was launched in Pretoria. South Africa hosts the office at the premises of the NRF. The Department of Science and Technology leads the international process to establish the GEOSS. Acting through the department, South Africa participated in developing the 10-year implementation plan and was elected co-chair of the GEOSS.

South Africa is hosting the Nepad focal points such as the African Laser Centre (ALC), the African Institute for Mathematical Sciences (Aims) and the biosciences initiatives. Every two years, the ALC hosts summer schools co-funded by the US-based National Science Foundation, and Aims is establishing a network of institutes on the rest of the continent. South-South co-operation has been strengthened and enhanced by fostering partnerships with the countries of the south, and in particular African countries. South Africa is spearheading a number of bids to host significant international facilities in Africa and is doing so in collaboration with its partner African countries.

Government decided to host the regional offices of the World Association for Industrial and Technical Research Organisations, Icsu, the third component of the International Centre for Genetic Engineering and Biotechnology and the EDCTP. The HIV and AIDS, TB and Malaria clinical trials (ATM) Registry was launched in May 2007.

The ATM Registry is a global resource for researchers, clinicians, policy-makers and the public, by:

- providing a source of reliable information on the efficacy and safety of prevention and treatment measures
- identifying research gaps that should be addressed in future trials
- providing a laboratory for studying the scope, quality and funding patterns of trials
- keeping track of ongoing trials.

## National Research Foundation

The NRF is a key public entity responsible for promoting and supporting the development of HR for research, technology and innovation in all fields of S&T. The NRF carries out its responsibilities by:

- providing seven unique national research facilities
- promoting science awareness through the South African Agency for Science and Technology Advancement (Saasta )
- making and managing merit-based grants and co-operative agreements with individual

researchers, research groups and institutions locally, regionally and internationally (through the Research and Innovation Support Agency [Risa])
- delivering unique knowledge-management services to the research community.

The NRF focuses on contributing to government's strategy to create wealth and improve the quality of life of all citizens.

Doctoral graduates are the platform upon which social and technical progress, innovation and business performance can flourish.

The key driver for all the NRF's activities is the production of large numbers of highly skilled people who can generate new knowledge, develop and use new technologies and innovate and drive the competitiveness of the country in international world markets.

The NRF regards HR development as a long-term investment in growing the pool of resources by drawing in learners who will become scientists and innovators.

Science-advancement programmes within the NRF reside under three interdependent strategic areas:
- building the supply of tomorrow's scientists and innovators through education-related programmes
- celebrating South African achievements in S&T and building the public's appreciation of the benefits of science through science communication
- using interactive exploration, engagement and exhibitions to instil enthusiasm about the wonder and application of SET, while encouraging greater public engagement in SET issues.

Through a series of integrated programmes, Saasta is developing an infrastructure that supports high-impact activities and science-promotion sites.

The NRF manages the following research facilities:

## South African Astronomical Observatory (SAAO) and Southern African Large Telescope

The SAAO is the national research facility for optical/infrared astronomy in South Africa. Its primary function is to further fundamental research in astronomy and astrophysics at national and international level.

The Salt is the largest single optical telescope in the southern hemisphere, with a hexagonal mirror array 11 metres across. Although very small, similar to the Hobby-Eberly Telescope in Texas, USA, Salt has a redesigned optical system using more of the mirror array. It is able to record distant stars, galaxies and quasars a billion times too faint to be seen with the unaided eye.

## Hartebeesthoek Radio Astronomy Observatory (HartRAO)

HartRAO is responsible for research and training in radio astronomy and space geodesy in South Africa. The 26-m diameter radio telescope is available for research either as a single, independent instrument or in global networks of radio telescopes, using the technique of very long baseline interferometry (VLBI).

HartRAO is one of only six permanent fundamental space geodesy stations worldwide and participates in geodetic VLBI, through the International VLBI Service, in satellite laser ranging (through the International Laser Ranging Service), and in the Global Navigating Satellite System (GNSS) (through the International GNSS Service). The data is available to the international community.

The radio astronomy group is part of the National Astrophysics and Space Science Programme for postgraduate students.

It is involved in developing the SKA and its South African prototype, Kat. Research collaborations are in place with southern African countries and overseas institutions.

## Hermanus Magnetic Observatory (HMO)

The HMO functions as part of the worldwide network of magnetic observatories. Its core

In 2008, the Department of Science and Technology in partnership with Engen SA, donated more than 30 computers to Kgwaratlou Secondary School at GaMphahlele.

The hand-over formed part of the department's aim to expose as many young South Africans as possible to science and technology, and to bridge the digital divide. All of the donated computers were installed with open-source software to enable learners and educators to change and improve the software applications in a manner that meets their specific needs and curriculum objectives.

This was in support of the national objective to improve Grade 12 results and to enable more young people to study Science, Technology and Engineering at tertiary level. These programmes include the Department of Science and Technology/Thuthuka youth camps, National Science Week as well as a number of science festivals for the youth.

function in this regard is to monitor and model variations of the Earth's magnetic field. The scope of the HMO's activities also includes fundamental and applied space-physics research, science outreach and the provision of geomagnetic field-related services on a commercial basis. To facilitate achieving its objectives, the HMO is structured into three operational groups: Geomagnetism, Space Physics and Technology. Science outreach falls under the Space Physics Group.

The objectives of the HMO include:

- providing geomagnetic field data and information in accordance with intermagnet standards
- providing ionospheric and space-environment data in accordance with international benchmarks
- being at the forefront of space-physics research
- developing human capacity
- providing quality-controlled magnetic-field-related services to clients in the defence and aerospace industries.

## South African Institute for Aquatic Biodiversity (Saiab)

Saiab is an interactive hub, focused on serving the nation by generating, disseminating and applying knowledge towards understanding and solving related conservation problems and the wise use of African fish and aquatic biodiversity. Saiab is the custodian of the National Fish Collection, generates knowledge through research on aquatic biodiversity in Africa and trains and educates knowledge workers in aquatic biodiversity.

It addresses national and international issues in aquatic biodiversity, through the priorities set by national and international funding agencies.

The collection consists of about 80 000 fish specimens (containing at least 650 000 individual fish specimens) from southern Africa and surrounding oceans, and from elsewhere in the world. It is the world's largest collection of southern African fishes.

As well as adult and larval specimens preserved in propanol and ethanol (the vast majority), the collection and associated material consist of preparations of genetic material, cleared and stained preparations, dry skins and skeletons, otoliths, X-rays, photographs, drawings and paintings of fishes.

About 7 500 species in about 400 families are represented in the collection, depending on which classification is used.

Science challenges for Saiab include building the flagship African Coelacanth Ecosystem Project, developing biosystematic capacity and developing an effective and integrated information-management system. Saiab has an active rural outreach programme, the Bright Spark Club, which identifies high-potential candidates for science careers and gives them career-forming experiences over one year.

## South African Environmental Observation Network (Saeon)

Saeon generates and archives reliable long-term information, relevant to the sustainable management of natural resources and habitat, over a range of ecoregions and land uses. These include pristine (wild) landscape, partially pristine (managed) landscape, agriculturally (rural) transformed landscape and urban transformed landscape.

Saeon establishes innovative research platforms and information-management systems for long-term multidisciplinary, multi-institutional and participatory ecosystem studies, with strong regional and global linkages. These research platforms are co-ordinated as nodes, with the first one – the Ndlovu Node – established during 2004 in Phalaborwa.

The second, the Elwandle Node, covers the coastal-inshore zone and was established in 2006 in Grahamstown, Eastern Cape.

The launch of the saeon fynbos, the marine-offshore, the arid lands and the grasslands/ forests/ wetlands mosaic nodes are in the pipeline. Saeon is founded on three pillars, namely observation sciences, information-management systems and science-education outreach. It also runs an innovative education-outreach programme that focuses on educators, learners and postgraduate students.

## National Zoological Gardens (NZG)

The NZG in Pretoria was declared a national research facility in April 2004. It has since been engaged in a strategic reorientation process to align with, and contribute to, the NRF's core missions and strategic priorities.

The NZG aims to undertake strategic, innovative short- and long-term interdisciplinary basic and applied research aggregated into core research programmes and knowledge hubs in co-operation with other zoological gardens, conservation agencies and academic and other institutions to contribute to viable wildlife populations within the biodiversity conservation landscape.

The NZG houses one of the largest animal collections in the world. It operates two biodiversity-conservation centres (in Lichtenburg and Mokopane) and a second zoo and game park in Vanderbijlpark. Including the NZG in Pretoria, the area managed by the NZG totals 7 730 hectares. The NZG is well placed as an education platform, receiving close to 600 000 visitors a year. (See Chapter 8: *Environmental affairs and tourism*.)

## iThemba Laboratory for Accelerator-Based Sciences (iThemba Labs)

iThemba Labs is a multidisciplinary research centre and provides facilities for:

- basic and applied research using particle beams
- particle radiotherapy for the treatment of cancer and other life-threatening lesions
- the supply of accelerator-produced radioactive isotopes for nuclear medicine and research.

iThemba Labs brings together people working in the medical, biological and physical sciences who are interested in using accelerated particle beams, by providing opportunities for research and postgraduate training in these separate disciplines, and also by stimulating mutual interest in interdisciplinary areas.

iThemba Labs has an "open-door" policy towards training postgraduates and in-service trainees.

While postgraduates from universities all over South Africa use the facilities, iThemba Labs proactively participates in building research and postgraduate capacity at historically disadvantaged institutions.

## Research and Innovation Support Agency

Risa aims to support and promote research and research-capacity development in all fields of knowledge and technology, including the natural sciences, social sciences, humanities, law, engineering, technology and IKS.

This is done by:

- investing in knowledge production and promoting basic and applied research, technology development and innovation
- developing research capacity and advancing equity and redress to unlock the full creative potential of the research community
- investing in research infrastructure
- facilitating strategic partnerships and knowledge networks.

Much effort has been directed towards ensuring that Risa-supported research focuses on areas that are relevant to South Africa's developmental challenges, in a rapidly changing, highly competitive and knowledge-driven environment.

### Support functions

Risa's granting functions are focused on:

- advancing and strengthening strategic knowledge
- identifying distinct South African research opportunities
- conserving and managing ecosystems and biodiversity
- promoting economic growth and international competitiveness
- advancing education and the challenges for change
- supporting IKS
- advancing ICT in South Africa
- establishing the socio-political impact of globalisation and the challenge for South Africa
- eradicating poverty.

Within these focus areas, knowledge fields that may be weak are developed in conjunction with the research community. Research agendas are established through interaction with the research community and collaboration between disciplines is promoted.

Risa implements the following interventions to achieve its goals:

- Student support through a range of different offerings:
  - Block grants are provided to HE institutions to be distributed to worthy postgraduate students who meet certain performance targets. This mode of operation is used to ensure the speedy delivery of funds to students, who are the lifeblood of the research system.
  - Two complementary programmes of postgraduate student support exist, namely free-standing scholarships, awarded directly to postgraduate students for studies locally and abroad; and grantholder-linked bursaries, granted to researchers within their NRF support package, and which may be awarded to students selected by the NRF grantholder.
- The Department of Labour, in conjunction with the departments of education and science and technology, is responsible for ensuring HE training in scarce skills. The Department of Labour

allocates resources from the National Skills Fund to the NRF for bursaries and scholarships. The NRF created the Scarce Skills Fund to promote and support students who study at postgraduate levels in areas where skills are scarce. This fund also provides funds to postgraduate students with disabilities.

- Support of postdoctoral fellows through a range of different offerings, including the:
  - Innovation Postdoctoral Fellowship Programme
  - NRF Postdoctoral Programme, which supports and encourages doctoral candidates to embark on further research.
- Staff development at HE institutions is promoted through the Thuthuka Programme, which provides support for researchers in training, women in research and the Research Development Initiative for Black Academics.
- The Institutional Capacity-Development Programme focuses on linking and assisting institutions committed to research through institutional interventions and through funding finely focused research areas at these institutions.
- Within the focus-area programmes, researchers or teams of researchers can obtain up to two-year or five-year grants, depending on their individual ratings in an open competition.
- Sarchi aims to free academics to focus on research, thus increasing the number of world-class researchers and their output, to make South Africa internationally competitive. Up to R2,5 million a year can be awarded to a chair to cover salaries, postdoctoral and student awards, running costs and small equipment purchases. The aim is to support 210 chairs by 2010.
- The CoE Programme supports strategic, long-term research by providing secure and stable funding to outstanding researchers and their research groups when undertaking multi-institutional and cross-disciplinary research.
- The Technology for Human Resources for Industry Programme (Thrip) supports projects that address the technology and HR needs of the industry on a cost-sharing basis with industrial partners. The programme focuses on increasing participation by SMMEs, Black Economic Empowerment (BEE) entities, and black and female researchers and students, as well as encouraging collaboration between small and large firms.

  Thrip fosters industry-academia collaboration by subsidising industry research conducted by students. Many successful enterprises have been created through this programme. Not only has Thrip brought more money for university research, it has also successfully funded hundreds of postgraduate students.

  Thrip is making an important contribution to skills development, supporting on average 2 400 tertiary students each year. Its funding has reached the billion Rand mark, an amount that has been matched and exceeded by industry.
- The IF invests in technologies at various stages of development. Some of the funding instruments of the IF fund the "proof of concept" phase of projects. The IF also provides seed-funding for commercialising IF projects and establishing technology-based start-up companies. The IF offers commercialisation advice to potential entrepreneurs, and promotes and stimulates the patenting of technologies and products.
- The S&T Agreements Fund supports agreements that facilitate international research collaboration, specifically with African countries. The Department of Science and Technology is responsible for negotiating binational or multilateral agreements with international partners, and for drafting framework programmes. The NRF also has an independent responsibility for negotiating bilateral agreements with counterpart agencies. These agreements develop relations between the research communities of the intergovernmental and interagency signatories, and establish long-term co-operation between researchers.
- Equipment grants allow HE institutions, museums and government-supported research institutions, such as science councils, to acquire research equipment, either of a general nature or in focused fields, such as nanotechnology and laser technology.
- Mobility grants afford students and researchers the opportunity to obtain access to equipment at other local and international HE institutions. Support is also given to the in- and outbound travel expenses of researchers for participation in international conferences, and the limited sponsorship of various scientific events.
- Risa also works in partnership with various organisations to support their research needs. Examples of these include:
  - Initiatives linked to the biodiversity science thrust of the NRDS include the South

African Biodiversity Initiative and the South African Biodiversity Information Facility. Risa manages the Sea and Coast Programme, with the Department of Environmental Affairs and Tourism as a co-investor.

- The NRF also manages the provincial research projects of the Marine and Coastal Management Branch of the Department of Environmental Affairs and Tourism. These projects have a strong applied-research focus, feeding into the management of marine and coastal resources, including resource allocations for the fishing industry.
- The South African National Antarctic Programme aims to create a demographically balanced Antarctic research programme that strives for high-quality international research, and links to other African countries and interdisciplinary research.

### Promotion functions

The promotion of research and research-capacity development also involves a number of separate initiatives. Knowledge fields that may be weak or underdeveloped are encouraged and stimulated in partnership with the relevant research community. Research agendas are established through interaction with the research community, and collaboration between disciplines is promoted.

Risa offers a performance-assessment service to the research community. This service assesses the quality of individual researchers from all fields of scholarly pursuit.

The so-called "rating system" uses international peer review to benchmark the quality and impact of previous research output, and assigns one of six ratings to individual researchers.

These ratings qualify applicants for extended periods of research support and, in limited cases, guaranteed support. They are also used by HE institutions in the development of staff members.

Another promotional service offered by Risa is the evaluation of research programmes or even research disciplines. This service is achieved through the facilitation of independent and informed assessment of the quality and value of programmes through peer review. The outcomes of the assessments, which normally contain recommendations for improvement of the programmes, are given to the relevant authorities to act upon, for the good of the entire research and innovation system.

Risa also generates, acquires and provides information that is useful for the production of new knowledge, such as the:

- Nexus Database System, which is a database of current and completed research projects and contains abstracts on 137 000 projects, in all science domains, from the year 1900 onwards
- Research Organisations' Database
- Professional Associations' Database
- conference website
- Women-in-Research Database
- NRF-funded Projects Database
- South African Data Archive, which is a large data archive of computerised social-science data.

## 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 to support technology development in its precompetitive phase.

## Agricultural Research Council (ARC)

The ARC is a statutory body established in terms of the Agricultural Research Act, 1990 (Act 86 of 1990). It comprises research institutes that were previously part of the Department of Agriculture, the oldest of which dates back to 1902.

As the principal agricultural research institution in South Africa, the ARC is committed to agricultural research, technology development and technology transfer within the macroframework of the agricultural sector, thereby contributing to the quality of life of South Africans.

The ARC's research goals are aligned with the objectives of the Strategic Plan for South African Agriculture.

The ARC's research activities address major government priorities, namely integrated rural development, natural-resource management, job creation, regional integration, urban renewal, HR development, crime prevention, farmer settlement, support-service improvement, infrastructure development, food security, and trade development and support.

The ARC comprises the following business units described below.

### Natural Resource and Engineering Business Division

#### ARC-Institute for Soil, Climate and Water (ARC-ISCW)

The ARC-ISCW (in Pretoria, Gauteng) is a leading

centre of expertise in the fields of soil science, agrometeorology, spatial modelling, soil-water science, geoinformatics (remote sensing, geographic, spatial and other information systems) and analytical services.

It is committed to improving rural livelihoods and agricultural productivity, and to the sustainable use of natural resources, soil, climate and water. The ARC-ISCW is the custodian of the Soil Information Systems, the Agrometeorological Climate Network and Databank, and the Coarse Resolution Satellite Imagery Database.

### ARC-Institute for Agricultural Engineering (ARC-IAE)

The ARC-IAE fulfils an indispensable role in agriculture, as almost no agricultural activity can be undertaken without some sort of equipment, system or facility that is supported by engineering technology. Situated in Pretoria, Gauteng, the institute undertakes R&D and technology transfer in the following fields:

- agricultural mechanisation
- water resources and conservation
- renewable energy
- precision agriculture and automation
- value adding
- agricultural infrastructure and structures.

The institute also has world-class laboratories where irrigation and agricultural equipment is tested.

With the vision "to be the centre of excellence for appropriate agricultural engineering technology in Africa", the research undertaken and services rendered by the institute are directed at the public sector, private-sector customers and international customers. A wide range of publications is available dealing with various topics.

### ARC-Plant Protection Research Institute (ARC-PPRI)

The ARC-PPRI addresses agricultural and environmental concerns, through research aimed at promoting economic and environmentally acceptable pest-management strategies.

Fields of expertise include:

- biosystematics, ecology and epidemiology of invertebrates, fungi, pathogenic and useful bacteria and viruses
- the use of integrated pest management in the control of pests, diseases and invasive weeds
- beneficial organisms such as biological control agents, nitrogen-fixing bacteria, insect pollinators and bees.

The institute is mandated to address plant-protection issues that cut across commodities, affecting many crops and regions. Its research impacts on all South Africa's provinces and addresses the needs of many African countries.

Research is directed at commercial and resource-poor farmers to address current and anticipated threats. It also provides support for the benefit of researchers, agricultural industries and governments to carry out their statutory obligations.

## Grain and industrial crops

### ARC-Grain Crops Institute (ARC-GCI)

The ARC-GCI (in Potchefstroom, North West) is responsible for research on improving and cultivating grain crops such as maize, sorghum and millet, as well as oil and protein seeds such as sunflower, groundnuts, soyabeans, dry beans, cowpeas, sweet white lupin and bambara. Research activities involve plant breeding, evaluation of cultivars and grain quality, plant physiology, plant pathology, nematology, entomology and tillage.

### ARC-Small Grain Institute (ARC-SGI)

The ARC-SGI (in Bethlehem, Free State) concentrates on improving and cultivating small grain crops such as wheat, barley, oats, triticale and rye.

Research activities include breeding new cultivars with better resistance to diseases and pests, the national evaluation of cultivars and grain quality, plant physiology, tillage, weed science, plant pathology, entomology and yield potential.

The ARC-SGI is the only institute of its kind that offers one-stop small-grain information, not only to the commercial farmer but also to new, emerging and small-scale farmers.

### ARC-Institute for Industrial Crops (ARC-IIC)

The ARC-IIC (in Rustenburg, North West) is involved in fundamental and applied research in the interest of the cotton and tobacco industries. Research is also conducted on other fibre crops such as hemp, sisal and flax, as well as on finding indigenous fibre crops with economic potential as new alternative crops in rural areas.

Likewise, certain crops are being investigated for their potential as sources of essential oils or household utilities. Research on cassava is directed at its potential as an alternative food source, and source of starch for industrial use. Research on pigeonpea and the promotion of this crop as an additional source of protein is being widely conducted in rural areas.

## Horticulture

### ARC-Institute for Tropical and Subtropical Crops (ARC-ITSC)

The ARC-ITSC (in Nelspruit, Mpumalanga) is responsible for research on all aspects of the cultivation of tropical and subtropical fruit.

Other crops on which production research is conducted include coffee, herbs and spices, medicinal plants, and pecan, macadamia and cashew nuts. Lesser-known exotic crops being evaluated are pitanga, feijoa, annona types, carambola and jaboticaba.

### ARC-Roodeplaat Vegetable and Ornamental Plant Institute (ARC-VOPI)

The ARC-VOPI (near Pretoria) concentrates on a wide range of horticultural crops. Research is conducted on commercial vegetables such as onions, potatoes and sweet potatoes. Traditional and indigenous vegetables receiving attention include amaranthus, cassava, plectranthus, Zulu round potato, pigeon peas, cowpeas and bambara. Research on the production and development of ornamentals and indigenous flora, such as fynbos, woody ornamentals and bulbs, has led to a new growth industry.

### ARC-Infruitec/Nietvoorbij (Institute for Fruit, Vine and Wine)

The ARC-Infruitec/Nietvoorbij (in Stellenbosch, Western Cape) does R&D and transfer of technology pertaining to the following commodities: deciduous fruit (apples, pears, peaches, plums, apricots and nectarines); grapes (wine, table and raisin); alternative temperate climate crops (cherries, mushrooms, nuts, olives, persimmons, figs, berries and others); brandy; dried fruit and processed fruit.

Increasing attention is also being devoted to indigenous crops (honeybush tea, rooibos tea and kei-apple) and their general use, processing and health-promoting abilities.

The breeding and evaluation of new stone and pome fruit, as well as table-grape cultivars, are a major research effort. Progeny from the various breeding programmes continue to succeed on the local and export markets.

Traceability and authenticity have become major concerns in modern trade, particularly for sophisticated markets in the first world. Developing the ability to analytically prove the authenticity of South African wine and brandy is the goal of a second major research intervention.

Data from isotopic and trace-element analyses will be used to compile reference databases for use in authentication and fraud detection.

## Livestock

### ARC-Onderstepoort Veterinary Institute (ARC-OVI)

The ARC-OVI (north of Pretoria) is responsible for the prevention and control of animal diseases. It also provides a public-health service regarding food safety and security.

The institute conducts research and diagnostic and new-generation vaccine development of livestock diseases.

It has six reference laboratories approved by the *Office International des Epizooties*, namely rabies, lumpy skin disease, Rift Valley fever, African horse sickness, African swine fever and bluetongue. The Exotic Diseases Division is a high-containment facility for diseases such as foot-and-mouth disease and African swine fever. The institute is also the Food and Agricultural Organisation collaborating centre in Africa for transboundary diseases.

### ARC-Livestock Business Division: Animal Production (ARC-LBD: Animal Production)

The ARC-LBD: Animal Production (in Irene, outside Pretoria) comprises seven units, which assist the animal production and products industry to stay abreast of global competition. Animal Genetics and Biotechnology employs DNA technology, genetic characterisation and accelerated reproduction technology to conserve, maintain and enhance genetic variation. Together with the Animal Recording and Improvement Unit, this has assisted livestock producers in breeding seed-stock material to the benefit of genetic resources worldwide.

Cattle breeds such as the Bonsmara and Nguni, Dorper sheep, boer goat, Fowls for Africa, South African ostrich and the indigenous Kolbroek pig have become highly sought after in breeding programmes abroad.

The Production Systems Unit deals with cattle, small stock, pigs and poultry. The Range and Forage Unit assists in the effective use of rangeland and forage production.

## Council for Scientific and Industrial Research

The CSIR performs multidisciplinary research and technological innovation, with the aim of contributing to industrial development and the quality of life of people of South Africa – and increasingly on the wider continent.

The council employs people who are experts in their fields and passionate about creating a better future through science.

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.

## Core focus on science

The CSIR transfers the knowledge generated through research activities by means of technology and skilled people. The generation and application of knowledge reside 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, laser technology, and space-related technology.

## Research and development outcomes

Activities include 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 needs of clients.

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.

## 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 contribute to placing 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.

## Clients

The CSIR has clients in both the private sector (micro, small, medium and large enterprises;

formal and informal), as well as in the public sector (national, provincial and local government). The organisation also deals with public enterprises and institutions, national safety and security establishments and development structures. Regionally and abroad, the CSIR fosters partnerships and a network of clients and partner organisations as part of a global sphere of influence on matters of technology. The CSIR liaises closely with tertiary education institutions.

With a strong emphasis on relevant and developmental work, it also has strong roots in various communities, and collaborates with a wide range of donors and funding agencies.

## Mintek

South Africa's national mineral-research organisation, Mintek, 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, consultation and innovative products to clients worldwide.

Mintek is an autonomous statutory organisation that reports to the Minister of Minerals and Energy. About 30% of the annual budget is funded by the State Science Vote, with the balance provided by contract R&D, sales of services and products, technology-licensing agreements and joint-venture operating companies.

Mintek's objectives are to research, develop and transfer to industry, novel and improved technologies to optimise processing, extracting, refining and using minerals and mineral products, to:

- enhance the competitiveness of South Africa's minerals industry in the global market
- assist local mining and engineering companies to expand internationally
- promote job creation, economic growth and regional development.

Specific goals of the organisation include:

- promoting increased beneficiation of South Africa's minerals and mineral commodities by developing competitive and innovative processing technology and equipment
- strengthening South Africa's international position as a supplier of mineral technologies, capital goods and services
- developing regional strategies for the mineral-processing sector, concentrating on value-addition, capacity-building and broad-based development.

Mintek's activities include:

- providing essential services (information, consulting and experimental)
- increasing the competitiveness of the industry by developing appropriate technology to cut costs and improve and optimise recoveries
- developing breakthrough process technologies and novel uses for metals and their products
- marketing its commercial products and technologies to industry
- establishing strategic partnerships and joint ventures
- participating in regional development initiatives and SADC activities and projects
- maintaining and expanding international scientific links
- developing the HR potential of the region through education and training activities.

Mintek offers a complete range of process-development services, from preliminary bench-scale investigations to large-scale piloting and integrated flowsheet development in support of bankable feasibility studies. Engineering design, plant construction and commissioning are conducted in conjunction with international partners.

Comprehensive laboratory and piloting facilities for sample preparation, milling, flotation, physical separation, smelting, leaching, pressure leaching, and metal recovery and purification are supported by internationally accredited analytical laboratory and mineralogical services.

Mintek's R&D activities are focused particularly on mineral commodities that are important to the South African economy:

- Gold-improving technologies, such as biotechnology and ion-exchange processes are developed and introduced to simplify processing and increase recoveries, particularly from ores that are difficult to treat. A major joint venture with industry and other research groups is exploring new industrial uses of gold in the fields of catalysis, nanotechnology and biomedicine.
- Platinum-group metals' (PGMs) R&D is aimed at increasing the cost-effectiveness of PGM production and stimulating industrial demand for these metals.
- Ferrous-metal products and technical services are developed to increase the cost-effectiveness of ferro-alloy production, as well as stainless steels and other alloys with improved properties.
- Mintek has conducted a large amount of work for non-ferrous metals, such as new copper,

nickel and cobalt, through projects in southern and central Africa. Processes are also developed for aluminium, lead, magnesium and zinc. The major emphasis is on the introduction of cleaner technologies.
- R&D includes the beneficiation and processing of industrial minerals, including commodities such as heavy mineral, chromite, iron and manganese ores, andalusite, phosphates, fluorite and diamonds.
- With the upswing in the uranium market, Mintek has re-established itself as one of the foremost uranium laboratories in the country, and has played a significant role in developing and optimising several new projects on the African continent.

## Minerals policy and development

Mintek conducts surveys, evaluations and commodity and market studies to support initiatives by governmental, international, regional or industry associations. It also identifies and evaluates potential development projects, assesses and provides technology, and conducts feasibility studies.

The organisation co-operates with industry and other research institutions and academia to maintain and enhance the mineral sector's contribution to society, by providing strategic direction and procedures that promote value addition and sustainable development in the mining industry.

Mintek is frequently called upon to support strategy and policy issues at all levels in South Africa, including participation in Nepad and the African Mining Partnership, through research into BEE-development issues around mining and minerals.

Mintek is growing its capacity to lead and support multiple initiatives in small-scale mining and beneficiation. It is well positioned to lead projects that will benefit economies on the African continent and support government initiatives to create employment in mining, manufacturing and agriculture at local and rural levels.

## Environment

Mintek continues to focus on developing environmentally responsible technologies for the recovery and recycling of metals from metallurgical residues. A major programme is in place to monitor cyanide species in various locations around gold plants, from both an environmental and a processing point of view. Mintek's environmental-management system is certified as meeting the requirements of the International Organisation for Standardisation (ISO) 14001.

## Education

The development of appropriate HR is crucial for the long-term sustainability of the minerals industry. Mintek's education and training initiatives focus on developing and training South Africans from historically disadvantaged communities as technicians, technologists and engineers. Training programmes include:
- artisanal and small-scale mining training
- jewellery-manufacturing training
- upgrading Mathematics and Science skills
- science promotion through participation in various SET initiatives (sponsored by the departments of science and technology and minerals and energy), corporate events, university open days and the Minquiz national schools' science competition
- corporate social investment/responsibility through Mintek's Adopt-a-School Programme and Grade 11 and 12 Learner Programme
- undergraduate and postgraduate bursary schemes
- in-training programmes for recently qualified engineers and technicians
- specialised advanced technical programmes.

## Promoting industrial growth

Mintek is promoting a number of major new industrial projects based on mineral beneficiation, using existing and newly developed technologies. These include the recovery of PGMs from metallurgical waste material, ferro-nickel production and the establishment of a local magnesium industry using a novel thermal production route.

# Human Sciences Research Council (HSRC)

South Africa's statutory research agency, the HSRC, conducts research that generates critical and independent knowledge, relative to all aspects of human and social development.

Poverty alleviation and public policy development and implementation are central to all its research activities. Its research extends beyond South African borders through projects and collaborations in other African countries and abroad.

As a national public entity, the HSRC adheres to best-practice requirements in relation to its corporate governance as well as financial and performance reporting. The HSRC reports annually to Parliament.

The HSRC is committed to making a difference in the quality of life of all South Africans and is often commissioned to undertake large-

scale research on behalf of government departments at national, regional and local levels. The organisation also serves the research needs of parastatal organisations, the private sector and local and international development agencies to track service delivery, evaluate performance and measure the efficacy of interventions.

The HSRC's collaborative approach to research provides a platform for interaction with research experts in South Africa, elsewhere in Africa, and internationally. The organisation proactively disseminates its research findings in peer-reviewed and other publications, and through seminars, invited lectures and media briefings.

Functioning as a knowledge hub, the HSRC contributes to bridging the gap that so often exists between research, policy and action.

## Mission

The HSRC is a non-partisan organisation that provides critical information to different role-players, whether in policy development, media analysis, advocacy or in debates. It aims to be an instrument for providing independent information, free from political, religious and/or racial bias. The HSRC generates scientific knowledge through its research and analytical work in the social and human sciences.

## Research focus

The research capabilities have been aligned into the following interdisciplinary, problem-orientated, research programmes:

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

The former national initiatives have now become centres of excellence. Additionally, a former research programme, Urban, Rural and Economic Development, has been unbundled to become a centre for service delivery.

Centres of excellence at the HSRC include the:

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

In addition, a number of cross-cutting research initiatives support the work of the HSRC as a whole, its research programmes, as well as external stakeholders.

Cross-cutting research units include the:

- Research Network (the Social Aspects of AIDS Research Alliance)
- Knowledge Systems
- Policy Analysis and Capacity Enhancement, which consists of:
  - Capacity Development
  - Gender
  - Policy Analysis
  - Centre for Africa's Social Progress.

The Policy Analysis Unit has a dual mandate. The first is to serve as a think-tank and provide a platform for public discourse and critical social issues. The second is to pursue time-limited, multi-year analyses into specific priority areas, namely poverty reduction, employment, quality education, HIV and AIDS, and service delivery. The work of the unit is centred upon various crossroads between these policy issues and heuristic parameters drawn from the National Human Resource Development Strategy.

The support functions of the HSRC are primarily intended to support its core activity, namely research, while also ensuring that the organisation complies with regulatory requirements. Support units in the HSRC include Finance (comprising Supply Chain Management and Risk and Compliance), HR, IT, Library and Information Services, Legal Services, Operations, Publishing, Corporate Communication, Business Development, and Secretariat and International Liaison.

## Medical Research Council (MRC)

The MRC's mission is to improve the nation's health and quality of life through promoting and conducting relevant and responsible health research.

Although the MRC is an autonomous body, it reports to the Department of Health and receives 60% of its budget from the Department of Science and Technology. Its head office is situated in Cape Town, with provincial offices in Pretoria and Durban.

The MRC's research activities are aligned with the health priorities of the nation, the national S&T imperatives and the health priorities defined by the Department of Health. Activities are grouped into the national programmes described below.

## National Programme for Research in Molecules to Disease

This programme undertakes research on human and microbial genetics, genomics, bio-informatics, cell and molecular biology, tissue engineering, oesophageal cancer, molecularhepatology, micro-bacteriology, and liver and bone disease.

### National Programme for Health Systems and Policy Research

The scientists in this programme conduct research on health systems, clinical epidemiology, biostatistics, health policy, the burden of disease and telemedicine.

### National Programme for Infection and Immunity Research

The research units in this programme are involved in research into TB, malaria, immunology of infectious diseases, diarrhoeal diseases, inflammation and amoebiasis, genital-ulcer diseases, respiration and meningeal pathogens, and South African traditional medicines.

It also incorporates the MRC National HIV and AIDS Lead Programme, whose divisions coordinate the South African AIDS Vaccine Initiative, various aspects of biomedical research (including mother-to-child transmission and microbicides), and prevention of transmission through behavioural change.

### National Programme for Non-Communicable Disease Research

This programme undertakes research into heart disease (both laboratory, clinical and public-health research), nutritional intervention, diabetes, crime, violence and injury, anxiety and stress disorders, dental issues, medical imaging, chronic diseases of lifestyle and cancer epidemiology.

### National Programme for Environment and Development Research

In this entity, research is undertaken into health promotion, health and development, exercise and sports science, occupational and environmental health, alcohol and drug abuse, and technology transfer.

### National Programme for Women and Child Health Research

This programme undertakes research into many aspects of women's health, including high blood pressure during pregnancy, healthcare strategies in maternal and infant health, perinatal mortality, gender and health, mineral metabolism and nutritional intervention.

### South African National Health Knowledge Network

The South African National Health Knowledge Network was established in 1999 at the MRC with funding from the Government's IF.

The network operates under the trade name SA HealthInfo and is available on the Internet at *www.sahealthinfo.org*. It provides a one-stop interactive forum or resource for quality-controlled and evidence-based health-research information.

## 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 – 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 main functions of the CGS are:

- documenting the surface of the Earth within the borders of South Africa; compiling geological, geophysical, geochemical and other geoscientific information; and publishing this information in the form of maps and documents
- conducting geoscientific research into, among other things, rocks, minerals, ores and fossils in South Africa and publishing research results in national and international journals
- collecting and conserving all geoscientific information and data on South Africa in national collections and electronic databases
- supplying geoscientific services and advice to the national and provincial governments and ensuring informed decisions regarding the optimal and efficient use of the Earth's surface.

The objectives of the CGS are to:

- minimise the geological and geoscientific investment risk for national and international entrepreneurs in the South African mining sector (the quality of available geological information – known as the "geological risk grading" – contributes to about 61% of the investment risk in any country)
- supply the country with basic geoscience data to establish a safe, cost-effective physical infrastructure
- supply basic knowledge to ensure safe, cost-effective and environmentally acceptable urbanisation and housing development
- carry out research into raw material needed to clothe, transport, feed and provide shelter for the nation.

To accomplish these functions and objectives, the CGS maintains a specialised workforce, consisting of Earth scientists supplemented by technical, support and administrative staff at its headquarters

in Pretoria, and at branch offices in the Western Cape, Northern Cape, Limpopo, KwaZulu-Natal and the Eastern Cape.

The CGS maintains the following national institutions:

- The National Geoscience Library in Pretoria is probably the most comprehensive geoscience library in Africa. It includes the Map Library, which contains a collection of South African and African geoscience maps.
- The National Core Library contains a representative stratigraphic-borehole core collection, representing most of the lithological units located within the borders of South Africa. This collection is housed at Donkerhoek, east of Pretoria.
- The Geoscience Museum, in the Transvaal Museum in Pretoria, exhibits rocks and minerals, catering for the Earth-science education of the public, especially schoolchildren.

An extensive laboratory at the CGS head office uses various specialised techniques to analyse rock and soil samples.

Geoscience information and services provided by the CGS are particularly important for the sustainable development of the country. In South Africa's arid regions, the management of groundwater resources (both the quantity and quality thereof) is aimed at providing enough clean water to communities. In addition, the CGS has established the Environmental Geoscience Unit to provide services in this highly competitive and very important field.

Although South Africa is situated on a relatively stable part of the Earth's crust, the CGS maintains a seismic network for recording such events within the national borders and coastal waters off South Africa's coastline. This information is available to interested parties and helps mitigate the problems associated with mining-related seismic events.

The CGS is a world leader in the domain of geophysical surveys, using a detection system deployed on light aircraft. This significantly reduces the cost of very high-resolution geophysical data for mineral exploration. A larger aircraft (a Cessna Caravan 208B) and a helicopter, can carry larger sensors, increasing the CGS' capability to conduct high-resolution geophysical surveys.

The CGS leads an initiative by the Department of Minerals and Energy to assist upcoming mining entrepreneurs, particularly those from historically disadvantaged groups, to exploit South Africa's mineral resources in a cost-effective and environmentally friendly way.

Because the CGS plays a leading role in the SADC, several geoscience publications covering the region have been produced, describing heavy mineral sand, diamond, gold, copper and cobalt, bauxite and dimension-stone deposits in the region. A seismic hazard map of the region, a lithostratigraphic table comparing the geological formations in the region, and maps of the Kalahari Basin have also been produced.

In addition to its national responsibilities, the CGS is also active internationally, mainly in Africa. Geological and metallogenic maps of, among other countries, Angola, the Democratic Republic of Congo, Mozambique, Gabon and Morocco have been produced.

## 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 operates in terms of the latest edition of the Standards Act, 1993 (Act 29 of 1993), as the national institution for the promotion and maintenance of standardisation and quality in connection with commodities and the rendering of services.

The responsibilities of the SABS include:

- publishing national standards prepared through a consensus process in technical committees
- providing information on national standards of all countries and international standards
- testing and certifying products and services to comply with standards
- developing technical regulations (compulsory specifications) based on national standards, and monitoring and enforcing compliance with such technical regulations
- monitoring and enforcing legal metrology legislation
- promoting design excellence
- providing training on aspects of standardisation.

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

This change ensures easy access to products, faster reaction and turnaround times, and the creation of centres of knowledge excellence that are 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

### Biotechnology Partnership for Africa's Development (Biopad)

Biopad is a biotechnology regional innovation centre established by the Department of Science and Technology. The centre, initiated in 2002, aims to boost biotechnology development in the region. The core objective is to implement South Africa's NBS.

### 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 Technology conducts most of its fuel- and chemical-related R&D at Sasolburg in the Free State. It also maintains R&D programmes at external CoEs, including St Andrews University in Scotland, Twente University in the Netherlands and the University of Cape Town in South Africa.

Sasol Polymers operates a polymer technology centre near Johannesburg, and Sasol Nitro and Sasol Wax maintain R&D programmes in South Africa and Germany, respectively.

### ArcelorMittal

ArcelorMittal is the world's number one steel company, with over 320 000 employees in more than 60 countries. It has led the consolidation of the world steel industry and today ranks as a truly 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 techology, holds sizeable captive supplies of raw materials, and operates extensive distribution networks.

### National Health Laboratory Service (NHLS)

The NHLS is a dynamic and focused public health service-provider of cost-effective and professional laboratory medicine through competent, qualified professionals and state-of-the-art technology, suppported by academic and internationally recognised research, training and product development to maximise healthcare-delivery to the nation.

The NHLS is the largest diagnostic pathology service in South Africa, with 265 laboratories serving 80% of the country's population. It conducts health-related research appropriate to the broader population needs, such as HIV and AIDS, TB, malaria, pneumococcal infections. occupational health, cancer and malnutrition.

The NHLS activities comprise diagnostic laboratory services, research, teaching and training, and the production of sera for anti-snake venom and reagents. Laboratories provide diagnostic services to the Department of Health, provincial hospitals, local governments and medical practitioners.

The NHLS trains pathologists, medical scientists, occupational health practitioners, technologists, technicians and occupational health practitioners in pathology disciplines.

Its specialised divisions comprise the:

- National Institute for Communicable Diseases, whose research expertise and sophisticated laboratories make it a testing centre and resource for the African continent, particularly in relation to several of the rarer communicable diseases
- National Institute for Occupational Health, which investigates occupational diseases and has laboratories for occupational environment analyses
- National Cancer Registry, which provides epidemiological information for cancer surveillance.

### 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.

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

### Energy research

The Chief Directorate: Energy of the Department of Minerals and Energy manages a policy-directed research programme. This includes transport energy, renewable energy, energy for developing areas, coal, electricity, energy efficiency, energy economy and integrated energy-policy formulation.

### 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, co-ordinates all agricultural R&D activities.

The National Agricultural Research Forum (NARF) co-ordinates 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.

### 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 co-ordination, co-operation 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 IT
- 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 innovative 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 has 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 has played a crucial role in this regard. The WRC leads and co-ordinates research, which, in turn, creates the knowledge that facilitates the judicious management of water quantity and quality and, in so doing, 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.

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.

## Environmental research

The Chief Directorate: Environmental Management of the Department of Environmental Affairs and Tourism 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 co-ordinated 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 and Tourism.

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).

The implementation of NiNjo, the new forecasting workstation, will be a major step towards improving the quality of forecasting products and services. The SAWS will be the first national meteorological service in the southern hemisphere to have access to this state-of-the-art technology, which presents product development and research opportunities for South Africa's forecasters and researchers.

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.

Some 170 projects are approved annually, and global issues such as climate change and biological diversity are also included. The sustainable use of natural resources is a priority area, resulting in an increase in projects relying on sociology and the humanities. The NRF also supports a range of environmental research network organisations, such as the Arid Zone Ecology Forum, the Fynbos Forum, the Indigenous Plant-Use Forum and the Savanna Ecology Forum.

## Fisheries research

Research into South Africa's fish resources, and their conservation and judicious exploitation, is

The South African Government is offering generous tax incentives to encourage the private sector to invest in research and development (R&D) activities in the country, in terms of Section 11(d) of the Income Tax Act, 1962 (Act 58 of 1962).

The incentives consist of a deduction of 150% in respect of expenditure on eligible scientific or technological R&D undertaken by enterprises or individuals within South Africa, and an accelerated depreciation of assets used for purposes of scientific and technological R&D over three years at the rate of 50:30:20, starting from the year of assessment in which the asset is brought into use.

carried out by research personnel of the Chief Directorate: Marine and Coastal Management, a division of the Department of Environmental Affairs and Tourism, 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 Tourism, 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 can 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 synthetic diamonds and other super-hard material)
- Johannesburg Consolidated Investment Company (metallurgy, mineralogy, chemistry and chemical engineering)
- National Chemical Products (chemistry, microbiology and animal nutrition)
- Metal Box Company of South Africa (corrosion mechanism 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

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Medical Research Council
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National Research Foundation
Water Research Commission
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