to contribute to the improvement of the quality of life of the people

2012/13 ANNUAL REPORT

CSIR

our future through science

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The Council for Scientific and Industrial Research (CSIR) was established on 5 October 1945. The CSIR's mandate is as stipulated in the Scientific Research Council Act (Act 46 of 1988, as amended by Act 71 of 1990), section 3: Objects of CSIR:

"The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act."

The CSIR's Executive Authority is the Minister of the Department of Science and Technology.

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

CSIR
our future through science

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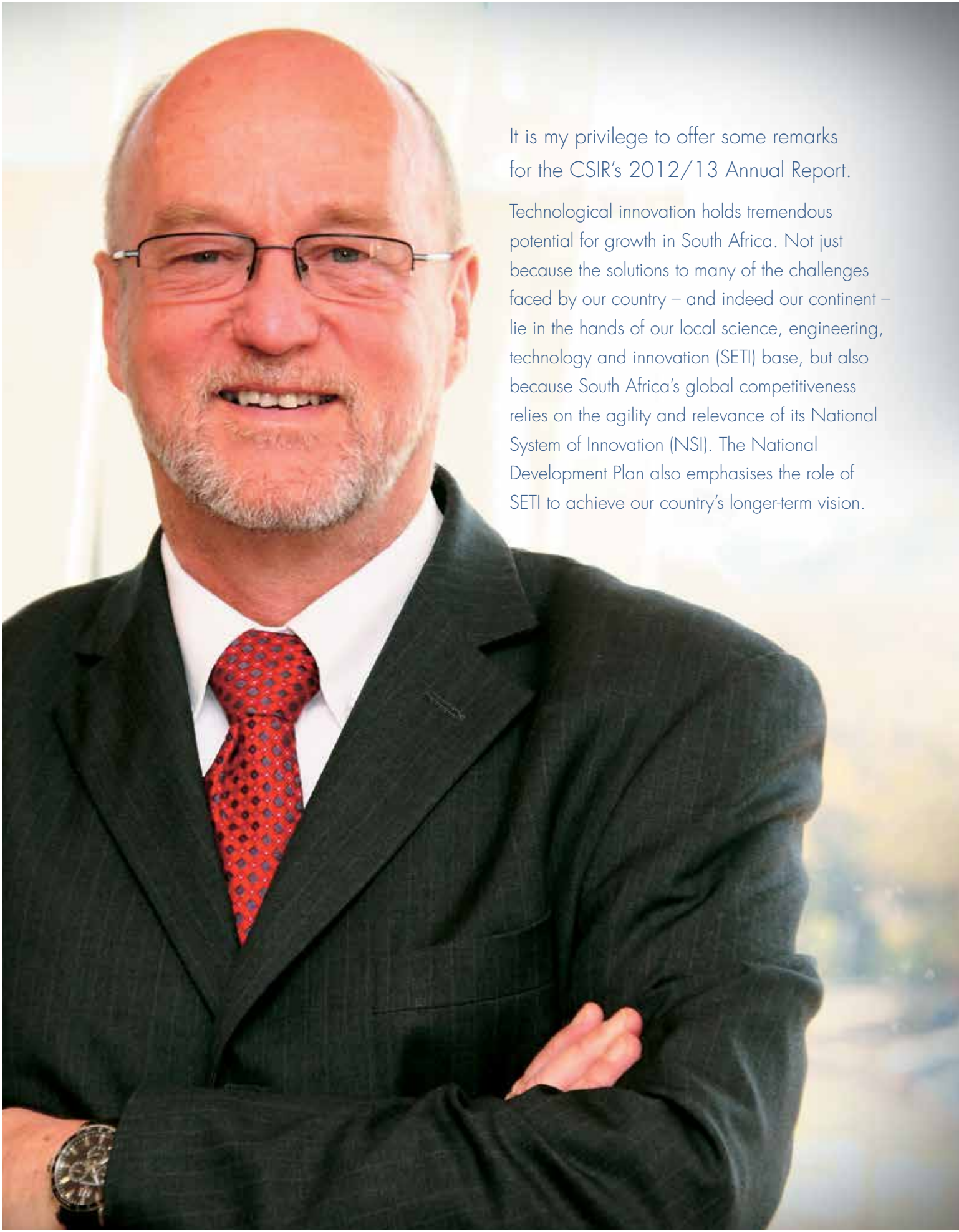


It is my privilege to offer some remarks for the CSIR's 2012/13 Annual Report.

Technological innovation holds tremendous potential for growth in South Africa. Not just because the solutions to many of the challenges faced by our country – and indeed our continent – lie in the hands of our local science, engineering, technology and innovation (SETI) base, but also because South Africa's global competitiveness relies on the agility and relevance of its National System of Innovation (NSI). The National Development Plan also emphasises the role of SETI to achieve our country's longer-term vision.

Foreword

BY THE MINISTER OF SCIENCE AND TECHNOLOGY

The CSIR is a key role player in the NSI. The organisation is one of the two main implementation partners of the Department of Science and Technology's (DST) Socio-Economic Partnership programme. In short, this programme's objective is to apply SETI to improve the lives of South Africans and to develop partnerships to optimise opportunities for competitiveness of our economy – mainly by establishing niche industries.

The mandate of the CSIR places it in the ideal position to deliver on both of these objectives. In information and communications technology (ICT), a key growth sector, the CSIR has been instrumental in bringing the 10-year ICT Research, Development and Innovation Roadmap to bear. This roadmap was approved by Cabinet at the end of April this year.

Another industry holding great promise for economic competitiveness and social upliftment through job creation is the titanium industry. A titanium pilot plant was opened at the CSIR recently and forms part of the bigger Titanium Industry Development Initiative. The DST is investing a significant amount of funding in the Titanium Centre of Competence hosted by the CSIR and we will track the progress of this new industry.

The CSIR is also part of an intergovernmental collaboration, led by the Department of Science and Technology, to explore innovative ways to improve the quality of learning and teaching in rural schools. The pilot project in the Cofimvaba District in the Eastern Cape involves 26 schools, with the CSIR responsible for connecting these schools to the Internet using its wireless mesh network technology, and introducing tablets to learners and teachers.

As the world changes, technology must ensure that citizens benefit from the advances of science. The pressure is on organisations like the CSIR to ensure that they remain relevant. Not only should the CSIR's work respond and seek solutions to the many developmental challenges facing the country, but it should do so in partnership with others.

I am satisfied that the CSIR's work remains focused on the priorities set by government to add measureable value to sectors such as infrastructure development, sustainable natural resources, innovations in the health field, industrial competitiveness, and a safe and secure South Africa.

Over the past year, the CSIR has actively worked to either establish or enhance existing relationships with stakeholders in the public and private sectors – examples include formalised collaborations with the likes of Transnet and Boeing. The CSIR's approach of looking at challenges from a systems or whole-environment point of view means that it can draw successfully from its multidisciplinary base to deliver a holistic solution as opposed to addressing only symptoms.

It has always been my belief that stronger linkages between science and industry are necessary and I would like to encourage the CSIR to continue on this path to ensure that its world-class SETI work is taken up and implemented. Public and private sector partnerships have the potential to be a force magnifier in placing South Africa and the continent on an inclusive and powerful growth trajectory.

I would like to commend the CSIR on its performance for 2012/13 and wish it – and its partners – well in its endeavours to shape a better future through science.

MR DEREK HANEKOM


The CSIR has once again had a commendable overall performance, having demonstrated research excellence, a solid financial output and good corporate governance for the 2012/13 period.

Chairman's overview

True to its mandate, the CSIR has continued to harness its multidisciplinary capabilities in science, engineering and technology (SET) for the benefit of society.

A steady growth in the number of contracts with the public sector over recent years demonstrates that extensive collaboration with government at the local, provincial and national levels continues to be a key focus area to proactively respond to national challenges. This synergy is crucial in that supporting government to be more efficient translates into improved service delivery, while increased economic growth bodes well for creating job opportunities and the ever important need to develop appropriately skilled human capital.

Collaboration with other partners in the National System of Innovation (NSI) remains vital to ensure that the CSIR is able to play its part in addressing priority issues through building and transforming human capital, transferring technology, strengthening the SET base, and performing relevant research and development.

To this end, successful and robust strategic partnerships with higher education institutions (HEIs) and other science councils remain high on the agenda. In terms of HEIs, human capital is developed through joint research, supervision of students and the exchange of staff. The CSIR supports its staff to train at HEIs and also supports students at universities who work on CSIR projects as part of their postgraduate training.

The CSIR's capabilities, infrastructure and facilities can be pooled with those of its partners to improve the overall impact. Collectively, the NSI will respond to the country's development priorities, which include improving health, supporting sustainable resource management, and strengthening skills.

There is still some scope for the CSIR to strengthen its partnerships with industry because of the significant contribution that SET can make to industrial development. As such, partnering with industrial partners will remain a key priority for the organisation.

The application of the enabling processes that the CSIR has in place for transferring technology to the private sector is one way of bolstering this relationship and fostering a new landscape of competitive industries. A case in point is the work done in establishing the CSIR's titanium pilot plant, which will undoubtedly be a catalyst in the development of various economic sectors in the country.

The CSIR is also set to embark on an international benchmarking study – which will be integrated with the organisation's own impact assessment matrix – that will determine the extent of the impact of its research outputs. The benefit of this study is twofold: It will enable us to compare the CSIR's performance with that of institutions that operate in similar environments; and it will also reveal the extent to which the focus and impact of the organisation's research and technology output needs to be improved.

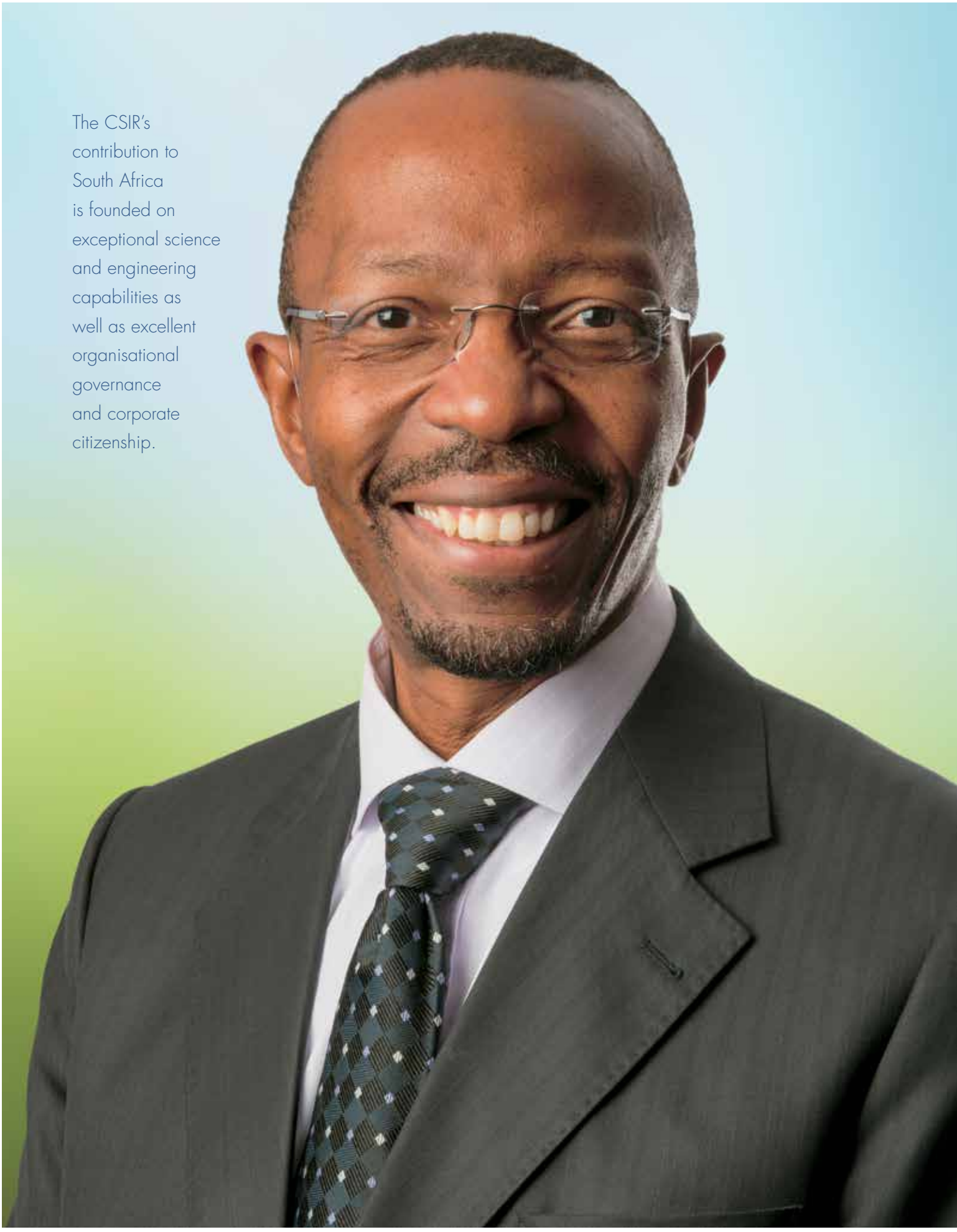
Furthermore, as mentioned in last year's annual report, the CSIR will continue to engage in effective and appropriate communication with its varied stakeholder base to raise the profile of the exceptional work that the organisation consistently performs.

To this end, the organisation has refined a targeted and prioritised stakeholder strategy that enables increased opportunities for dialogue between itself and its stakeholders; it is also streamlining business and stakeholder engagement processes to make doing business with the CSIR easier.

Financial sustainability, good corporate governance and citizenship remain crucial factors that ensure that the CSIR's mandate is executed successfully. This is evidenced by the organisation receiving an unqualified audit from the Auditor-General for the past number of years.

The CSIR's ability to align to national priorities is largely due to its positive relationship with the Department of Science and Technology. I wish to express my gratitude to the department and its Minister, Mr Derek Hanekom, for their unrelenting support they have afforded the CSIR. The dedication of the Board, as well as the CSIR Executive team is highly appreciated and I thank all of them for their commitment to the organisation.

PROFESSOR FRANCIS PETERSEN


The CSIR's
contribution to
South Africa
is founded on
exceptional science
and engineering
capabilities as
well as excellent
organisational
governance
and corporate
citizenship.

CEO's introduction

Strong foundation

The CSIR mandate is the blueprint underpinning all our work. It tells us what we are to do and why: to promote scientific development and stimulate industrial growth for the betterment of our society and economy. This includes the development and application of technology in existing and new industry sectors, service delivery support as well as suitably informed policy development and decision-making. In pursuit of these goals, we draw upon our multidisciplinary strengths, often in partnership with other public and private sector institutions.

Clichéd though this may sound, any institution is ultimately as good as its people. Every day at the CSIR, nearly 2 500 employees use their expertise to promote the developmental challenges of our nation through science, engineering and technology.

It is the passion and commitment of our people that breathe life and energy into our mandate and allow the organisation and its partners to provide relevant solutions to real problems – the ultimate difference that we seek to make.

Focus and impact

Beyond good research and good governance, we continually strive to enhance the impact of our work in industrial development (manufacturing, knowledge and service industries) and society through our contribution to service delivery (notably 'utility' services such as water, power, sanitation etc.), better health, education and so forth. Hence, in addition to sustaining the research and development (R&D) base necessary to keep feeding the innovation pipeline, we increasingly seek to pilot new technologies to evaluate their industrial viability or service delivery relevance.

We have accordingly embarked on 'flagship' programmes expressly chosen to test industrial viability and service delivery impact. The CSIR's water flagship programme, for example, appreciates that access to sufficient good quality water is a basic requirement for socio-economic development. Yet, inadequate wastewater infrastructure planning, failing wastewater treatment works and a lack of reliable monitoring systems at these plants, threaten the environment, the wellbeing of communities and the requirements for economic growth. We are pooling our resources and those of our partners to look at this challenge comprehensively.

The National Development Plan states that, "Primary health care emphasises globally endorsed values, such as universal access, equity, participation and an integrated approach. Critical elements of primary health care include prevention and the use of appropriate technology."

In response to this challenge, one of the projects in the CSIR's health flagship programme seeks to obtain accurate data for planning purposes and to reach people who do not have easy access to clinics or health information. With more than three quarters of South African households having access to mobile phones, the CSIR's pursuit of a mobile health platform for the communication of health information to remote areas, has the potential for massive impact.

One example in the industrial context is that of titanium beneficiation. As part of the bigger Titanium Industry Development Initiative, the CSIR hosts the Titanium Centre of Competence and has recently launched a pilot plant to test the scale-up of a novel process to produce titanium powder.

Partnering for increased impact

Partnerships are fundamental to all the work described above. Of particular significance is the relationship with the Department of Science and Technology (DST) as our 'line department' and partner in identifying strategic areas of activity. For example, value addition to our country's resources has long been recognised by DST as a key element of a national R&D strategy; the titanium example described above is a consequence of such a strategy.

Our partnerships are not only important during the needs assessment and subsequent R&D phases; they are vital for uptake and implementation of new innovation. The breadth of our value chain is illustrated by the fact that more often than not the end user is unaware that they are benefiting from a CSIR-developed technology because of all the other players in the value chain from, perhaps, the commercialisation partner to the manufacturer to the implementer or marketer.

In the state-owned enterprises sector, we are particularly pleased about our growing partnerships with Transnet and Eskom. Partnerships enhanced during the past year in the private sector include those with Airbus and Boeing; we continue to seek stronger and more strategic partnerships with the private sector. We are also steadily growing our relationships with provincial and local government.

As I look back at the 2012/13 financial year, I want to thank our partners and stakeholders for robust discussions and dynamic programmes targeting our nation's most pressing challenges. I wish to thank the CSIR Board and my Executive team for their support and input and, again, I wish to thank Team CSIR for their dedication in providing viable solutions to real problems.

DR SIBUSISO SIBISI

project highlights

Guided by our research impact areas, and drawing on our multidisciplinary competence base, the CSIR continues to make an impact through innovation. We are vigilant about ensuring that our research and development remains relevant in the South African context and supportive of national priorities.

This section features a small selection of work undertaken during the past financial year. In addition to research and development activities to impact in the natural and built environments; industry; health, defence and security; and energy, we also show how information and communications technology is contributing towards the aim of creating an inclusive information society.

The organisation's response to the call for the creation of decent employment through poverty reduction and the development of sustainable rural communities is featured through its enterprise creation for development activities.


new marine protected area


waste management on the research agenda

RESEARCH, DEVELOPMENT AND IMPLEMENTATION FOR THE

natural environment

The country must now find a way to use its environmental resources to support an economy that enables it to remain competitive, while also meeting the needs of society. Thus, sustainable development is not only economically and socially sustainable, but environmentally sustainable as well.

– The National Development Plan 2030

Tackling South Africa's wastewater issues from all angles

IN BRIEF

Access to sufficient good quality water is a basic requirement for economic and social development. Yet, inadequate wastewater infrastructure planning, failing wastewater treatment works and a lack of reliable monitoring systems at these plants, threaten the environment, the wellbeing of communities and the requirements for economic growth. A CSIR water sustainability flagship programme focusing on wastewater solutions is being implemented.

A CSIR researcher sampling river water.

A biodigester which breaks down biological waste.

Water samples stored for testing.

A real-time monitoring system for wastewater.

THE CHALLENGE

A stark wastewater reality

South Africa's water resources are limited, but have to support a growing economy.

Locally, poor governance, failing infrastructure and inadequate investment have pushed many municipal water services to the brink of collapse and led to complaints in both affluent and poor sectors of society about pollution and poor service provision.

Government's 2011 green drop report, which assessed 821 municipal wastewater systems, found that only 40 were in excellent condition. A total of 78 were in good condition, 243 were average, 143 performed poorly and 317 were in a critical condition.

THE RESEARCH, DEVELOPMENT AND IMPLEMENTATION

Improvements in water sustainability will rely on an integrated approach in which infrastructure, planning, governance and monitoring are addressed. The aim is to achieve better water quality, less pollution and a decreased health risk in the regions where the implementation takes place. Initial work has focused on wastewater treatment plants at a metropolitan municipality in Gauteng and a district municipality in Limpopo.

Planning and governance

During the first year of the project, CSIR researchers completed an upgrade of the CSIR urban dynamics platform, software which models future human settlement patterns in Gauteng and extends the capability to make long-term water and infrastructure demand forecasts.

Environmental researchers have completed preliminary assessments of the vulnerability of communities and ecosystems downstream of water treatment plants in the Limpopo district selected to pilot the intervention.

Water samples taken from rivers downstream from the treatment works have shown high levels of bacteria rendering the water unsuitable for consumption. Tests were done upstream and at the outflow at the plants, confirming that the wastewater treatment works contribute to the eutrophication of the river.

According to anecdotal evidence from communities who live downstream, they use the river water when piped water supply is disrupted with critical health consequences.

Further quantitative studies will follow and researchers will assess the efficacy of policy and regulatory instruments to establish whether these are sufficient to control the impact of the failing water treatment facilities.

Using waste for energy

CSIR researchers have developed biodigesters that work more efficiently than those currently commercially available, thanks to automated processes that optimise temperature, pH levels and loading rates. These parameters assist in the biological breakdown of organic waste. CSIR biodigesters can produce biogas that contains up to 72% methane gas, which can be used for heating or electricity to reduce costs and overload experienced at wastewater treatment works. The technology is designed to be retrofitted to existing digesters.

Real-time monitoring system for wastewater treatment works

While more affluent municipalities are able to establish costly monitoring systems for wastewater quality, the lack of real-time information in poorly resourced areas could hamper effective and efficient responses to problems at the plants. Pollution, due to failures at a plant which are not brought under control, can reach communities downstream with dire consequences.

Researchers have designed a more affordable near real-time monitoring system, which consists of sensing stations and software and which has been installed at the pilot site at a wastewater treatment plant in Limpopo.

Samples of final effluent are pumped through the sensing station at regular intervals, with sensors measuring a number of water quality indicators. These readings are sent in real-time via SMS to a central CSIR database and can be inspected via a user portal.

Systems have also been installed at six wastewater treatment plants on the municipal power grid and a seventh has been adapted for a solar power source. A handheld version is being piloted for treatment plants where sites cannot be secured against theft, and municipal water quality staff will be trained to operate it.

The researchers are also giving input to improve process management, capabilities and infrastructure, hoping to guide the municipality to an acceptable green drop status.

Probing the link between the Southern Ocean's carbon cycle and the global climate

Engineering interns Jean-Pierre Smit and Sinekhaya Bilana inspecting a wave glider.

IN BRIEF

For at least a million years, the Southern Ocean has helped to regulate Earth's carbon cycle through a natural process of carbon dioxide (CO_2) exchange between the deep ocean store of CO_2 and the atmosphere. Scientists predict that climate change will modify this cycle with a potential impact on the ocean's ability to mitigate the impact of CO_2 emitted by mankind. CSIR researchers have embarked on missions with state-of-the-art ocean robots and laboratory infrastructure to collect data, which can improve the accuracy of the models they use to predict this cycle and regional climate change.

A wave glider being hoisted in Table Bay, Cape Town.

CSIR researcher Dr Thato Mtshali analysing the iron concentration in a seawater sample.

THE CHALLENGE

Improved models to predict the impact of climate change on ocean systems

The build-up of CO_2 in the atmosphere drives global warming, but this is substantially mitigated thanks to the ability of our oceans and ecosystems on land to absorb the excess CO_2.

Human activity accounts for 37 billion tonnes of global CO_2 emissions of which half remain in the atmosphere and a quarter each is taken up by the ocean and ecosystems on land.

The ocean's natural pre-industrial CO_2 exchange with the atmosphere is much larger at approximately 330 billion tonnes with inputs balanced by outputs. Even small changes in ocean systems can therefore have a large impact on its ability to sustain the absorption of man-made CO_2.

The Southern Ocean is the only part of the global ocean where CO_2-rich deep waters well up and exchange CO_2 directly with the atmosphere south of the polar front.

Therefore, while it is estimated that half of the man-made CO_2 which is absorbed by the oceans, is taken up by the Southern Ocean, this ocean also has the capacity to reverse this storage capacity in response to climate change. This carbon feedback can cause it to become a source of CO_2 instead of a sink.

Atmospheric CO_2 is thought to be regulated through similar deep ocean-atmospheric exchanges of CO_2 during glacial climate cycles in the past million years. If the ocean responds in this way again, it might be unable to mitigate the effect of man-made CO_2 emissions. The effectiveness of our planned future emission cuts could be at risk.

It is also estimated that 85% of non-polar ocean productivity is supported by nutrients derived from the Southern Ocean. Researchers know little about the sensitivity of these carbon and nutrient fluxes to climate change, partly due to the fact that oceanographic measurements – which relied on ships and satellites – have been limited in space and time. Higher resolution (in space and time) data are needed to improve the models scientists use to predict the impact of the climate change on ocean systems.

THE RESEARCH

Ocean robots leading into the 21st century

In March 2013, CSIR researchers completed a six-month mission during which ocean robotics platforms were deployed from the polar ship SA Agulhas II. These gliders have the ability to collect oceanographic data up to 1 km below the surface and to send it back in real-time via satellite.

The five gliders were fitted with sensors to measure salinity, temperature, depth, dissolved oxygen, light and chlorophyll levels at times and in places far beyond the capacity of ships, while they were remotely navigated from the CSIR and Department of Science and Technology-funded Southern Ocean Engineering Research and Development Centre in Cape Town.

The glider pilots had to deal with strong ocean currents and eddies, which continuously threatened their course. One unit was lost due to suspected mechanical failure, but the other gliders returned with unprecedented data collected for analysis.

Then wave-powered gliders – a second type of newer technology – were test-launched off Cape Town to prepare for a six-month mission to measure CO_2 and oxygen gas exchange through the entire seasonal cycle in the Southern Ocean. This will allow scientists to assess how and why the CO_2 sink in the Southern Ocean might be changing.

The missions form part of the Southern Ocean Seasonal Cycle Experiment, which was designed to measure whether signals of climate change are already reflected in the Southern Ocean's physics, biogeochemistry and carbon cycle.

Testing iron levels

CSIR researchers also undertook experiments to investigate the influence of light and iron supply on phytoplankton productivity.

Phytoplankton grows in the upper layers of the world's oceans, because it needs light for photosynthesis. It absorbs CO_2 and plays an important role in the carbon cycle. Researchers found that phytoplankton does not grow well in the Southern Ocean, which is low in iron. Understanding how climate change will influence the supply of iron is therefore key to improved forecasts in the 21st century.

Seawater samples containing phytoplankton were spiked with iron and incubated at different light and temperature conditions. This enabled researchers to investigate the impact of changing iron concentrations on phytoplankton growth and photophysiology (how they react to light).

The launch of the trace and experimental biogeochemistry clean laboratory at Stellenbosch University enables CSIR scientists to set up and grow specific plankton species using their own prepared trace metal clean seawater solution to measure specific parameters locally, which was not possible before.

THE OUTCOME

Early research results have shown that summer storms play a much larger than previously thought role in sustaining the iron supply to summer plankton blooms in the Sub-Antarctic zone. These findings highlight a new climate sensitivity, which links changes in storm frequency and intensity to changes in ocean productivity that support ocean biodiversity and the carbon cycle.

Scientists have shown that the CO_2 concentration in the ocean has already increased over the past few decades and that it will continue to do so in future.

While we can reduce man-made CO_2 emissions, it will be impossible to regulate the rate at which change occurs once our ocean systems begin to change – which increases the urgency for the effective global mitigation of CO_2 emissions.

Sampling the river fish population.

PROACTIVELY PROTECTING THE WATERBERG

River life in Limpopo's Mokolo River is healthy, including species that are normally sensitive to poor water quality. This is what CSIR researchers found in initial field studies to determine the ecological health of the Waterberg area where extensive industrial development, including new power plants and coal mines, could threaten water resources.

According to the results of CSIR microbiologists, no pathogens, such as those causing cholera or salmonella infection, which normally indicate human pollution, have been found in the two years that the area has been sampled.

The researchers also sampled macroinvertebrates (organisms that are large enough to be seen with the naked eye and lack a backbone), such as larvae, snails and worms. These are good indicators of water quality because they are a critical part of the river food chain and cannot escape pollution. They found damselflies, mayflies, caddisflies and stoneflies at various sites in the Mokolo. These are known to be particularly sensitive to pollution.

According to the researchers, one of the first signs of pollution might be when a specific species of macroinvertebrates, such as some of the freshwater worms which are not sensitive to a stressed ecosystem, begin to dominate. There are no indications that this has happened yet.

Studies show that the fish populations in the river also appear to be in a good condition. Work continues on the long-term seasonal assessments to create a reliable baseline dataset of these species' health, while researchers also study vegetation and groundwater data.

The research team is in the process of analysing data collected and will present their recommendations to key stakeholders. The recommendations will enable the stakeholders to use baseline data to improve ecological best management practices to prevent scenarios such as the ecological deterioration of the upper Olifants catchment areas.

AFIS has evolved to include a smart phone application for iOS and Android platforms.

ADVANCED FIRE INFORMATION SYSTEM SOUTH AFRICA'S FIRST SPACE APPLICATION EXPORT

The CSIR-developed fire-detection system, AFIS, will soon help combat Angola's high incidence of wild fire, becoming South Africa's first space application export. It is one of the early initiatives falling under the auspices of the South African-Angolan science bi-lateral relations, put in place by South Africa's Department of Science and Technology.

AFIS is a satellite-based fire information tool that has the ability to detect, predict, monitor and assess fires, globally. Once a fire has been detected, the AFIS system alerts relevant authorities of the danger via SMS. A new application for smart mobile phones was recently added to complement the browser-based service, allowing fire-fighting authorities to access vital fire information at any time and from any location. The application provides five-day fire danger forecasting, near real-time fire detections, fire reports, as well as other value-added services such as alerting, asset tracking and user-driven fire danger calculations.

MAKING EARTH OBSERVATIONS DISCOVERABLE AND ACCESSIBLE

South Africa is committed to making Earth observations discoverable, accessible and usable at local, provincial and national levels of government, as well as the private sector, academia, science councils, and more recently, to educators and learners.

During 2012, the web-based South African Earth Observation System of Systems (SAEOSS) portal increased its number of datasets to 23 174. Of these, over 20 000 datasets are publicly available, with the remainder requiring systems development or an alternative dissemination channel. The portal offers the local Earth observation community the opportunity to access and analyse Earth observation datasets.

SAEOSS facilitates Earth observation data use to address nine societal benefit areas recognised internationally as critical to people and society. These are disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity.

Data include measurements and monitoring of the Earth; its land surface and what lies beneath it; its water surfaces and what lies below them; its air and air quality; and its atmospheric conditions. These data are used to measure the health of humans, plants and animals within South Africa.

Derived products such as the Advanced Fire Information System and the Risk and Vulnerability Atlas are linked from this portal **http://saeos.dirisa.org/**. Various decision-support systems and models will become available and will cover a range of online resources for planners responsible for resource allocation.

The National Earth Observations and Space Secretariat is responsible for SAEOSS. This secretariat is an initiative of the Department of Science and Technology and is hosted by the CSIR.

SAEOSS
SOUTH AFRICAN EARTH OBSERVATION SYSTEM OF SYSTEMS

RETHINKING THE VALUE OF WASTE – GETTING THE PROFESSIONALS

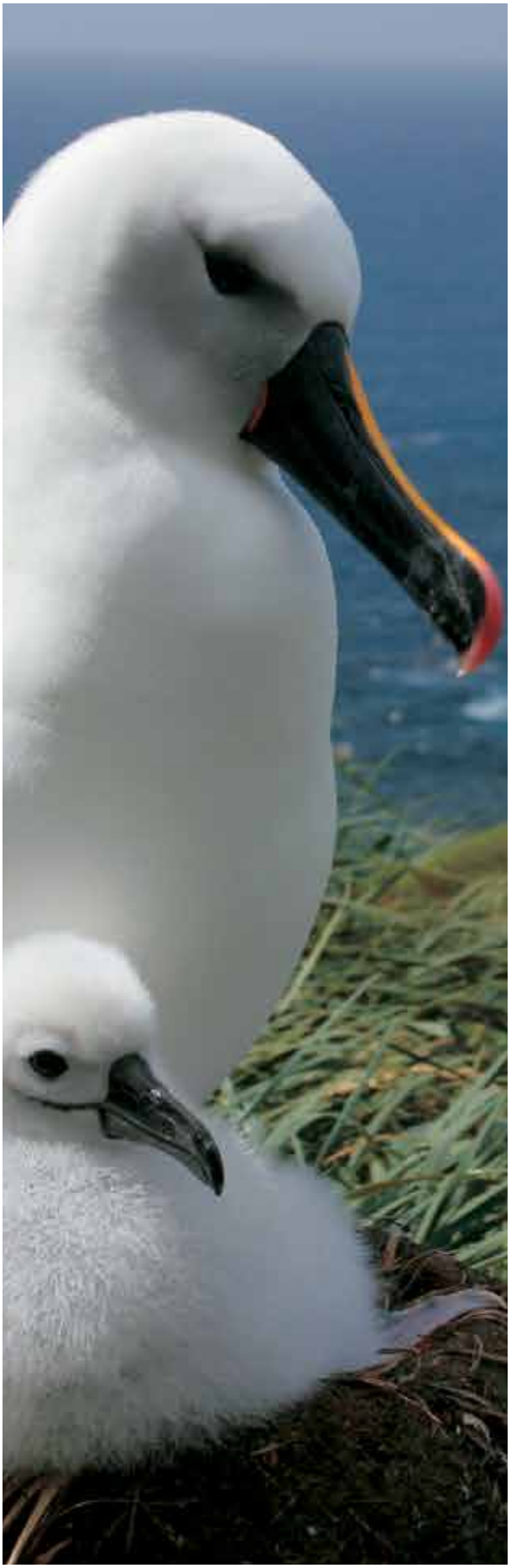
South Africa needs highly trained experts in the field of waste management along with technological and non-technological innovation if the country is to successfully transition towards a green economy. Currently, there are no diploma or degree qualifications purely concerned with waste management in South Africa.

This was found in the first phase of a CSIR research project aimed at developing a National Waste Research, Development and Innovation Roadmap for South Africa.

The National Waste Information Baseline Report, compiled by CSIR researchers and released by the Department of Environmental Affairs in November 2012, showed that South Africa generated 108 million tonnes of waste in 2011. An estimated 98 million tonnes were disposed of in landfills and only 10% of all waste was recycled.

The Department of Science and Technology (DST) has tasked the CSIR to develop the roadmap aiming to stimulate research and development into waste management, human capital and enterprise development, as well as job creation in the waste sector. DST believes that, through the appropriate investment in science and technology, the country can achieve a 20% reduction (by weight) in industrial waste and 60% reduction of domestic waste to landfills by 2022.

Interventions will lie across the waste value chain, from waste minimisation to final disposal, including cleaner production, recycling and beneficiation (the extraction of recoverable material from waste).



Grey-headed albatross tends to her chick.

CONSERVATION PLAN LEADS TO DECLARATION OF PRINCE EDWARD ISLANDS AS A MARINE PROTECTED AREA

Almost nine years after stating the intention to declare the Prince Edward Islands a marine protected area, it was formally gazetted this year, in part thanks to CSIR research efforts.

The Prince Edward Islands comprise two islands, Marion Island (290 km^2) and Prince Edward Island (45 km^2), which are 20 km apart. Situated in the Southern Indian Ocean, 1 770 km southeast of Port Elizabeth, these islands have some of the highest seabird species diversity of any of the Southern Ocean islands and provide habitat for animals and plants that occur nowhere else in the world.

The islands have been managed as a special nature reserve under the Environmental Conservation Act since 1995, but not the marine area around them. This area was exposed to rampant poaching. This has had a significant impact on the fish stocks, especially the Patagonian toothfish, which is regarded as a highly sought-after delicacy, and also poses a large threat to the other species dependent on these fish as a source of food.

The then Minister of Environmental Affairs and Tourism announced the intention to declare a large marine protected area around the islands in 2004. The CSIR and other partners were commissioned to collate decades of data on the species of these islands and to research and analyse the requirements for a comprehensive conservation zoning plan for the seas around these islands. Among others, the researchers recommended boundaries for different categories of reserves and activities allowed in these reserves.

The formal gazetting of this plan and its recommendations sees the culmination of these research efforts and their conversion into legislation and action on the ground.

King penguins roaming the island.

CSIR oceanographer Dr Marjolaine Krug.

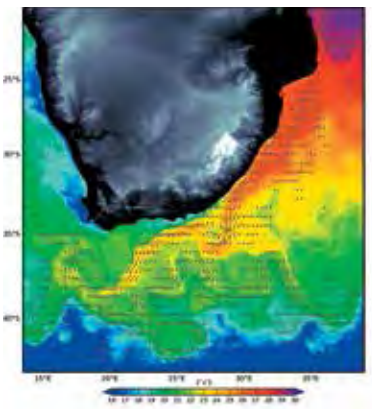
AGULHAS CURRENT ANNUAL CYCLE REVEALED THROUGH OBSERVATION

Researchers' observation of an annual cycle in the Agulhas Current will take scientists a step closer to understanding its impact on the global and regional climate.

The Agulhas Current carries warm water from the equatorial regions down the east coast of the African continent. Oceans and global temperatures are connected, as warm waters create warmer temperatures and vice versa, while salt can change the density of the ocean which in turn impacts on water movement. Less dense water floats on top of more dense water and in the deep ocean, water moves along layers with the same density. It is therefore important that scientists understand the variations in the strength of the currents and, in this case, the resultant heat and salt leakage (flow) from the Agulhas Current to the Atlantic Ocean.

Research findings published by CSIR researchers and collaborators, in the journal *Geophysical Research Letters*, include the detection of an annual cycle in the Agulhas Current, with a stronger flow detected from January to March.

This is the first time that an annual cycle in the Agulhas Current has been shown using satellite observations. The data included 18 years of sea surface heights and seven years of sea surface temperatures measured from satellites. It confirms indications from earlier numerical models.



This map shows sea surface temperature and currents as observed from satellites south of Africa in the middle of January 2011. The Agulhas Current shows as a warm (red/orange) and narrow ribbon of intensified flow along the east coast.

CSIR researcher Arno de Klerk taking samples.

OLIFANTS RIVER – MAPPING THE WAY FORWARD

The CSIR has made several recommendations after completing a three year study which identified acid mine drainage, dysfunctional wastewater treatment works, industrial effluent and agriculture as the main sources of pollution in the Olifants River catchment.

The improved maintenance and operation of wastewater treatment works was identified as a particularly urgent intervention. Monitoring revealed high levels of faecal contamination in the catchment and according to the Green Drop scoring system, 75% of facilities here scored less than 50% for their ability to treat wastewater.

Recommendations also include the rehabilitation and treatment of abandoned mines and the proper planning of mine closures to prevent acid mine drainage.

Aluminium, iron, manganese and zinc derived from acid mine drainage, were metals most often found to exceed guideline values. The bioaccumulation of metals in aquatic life is a health hazard for animals in the rest of the food chain and can also render water and fish unsuitable for human consumption.

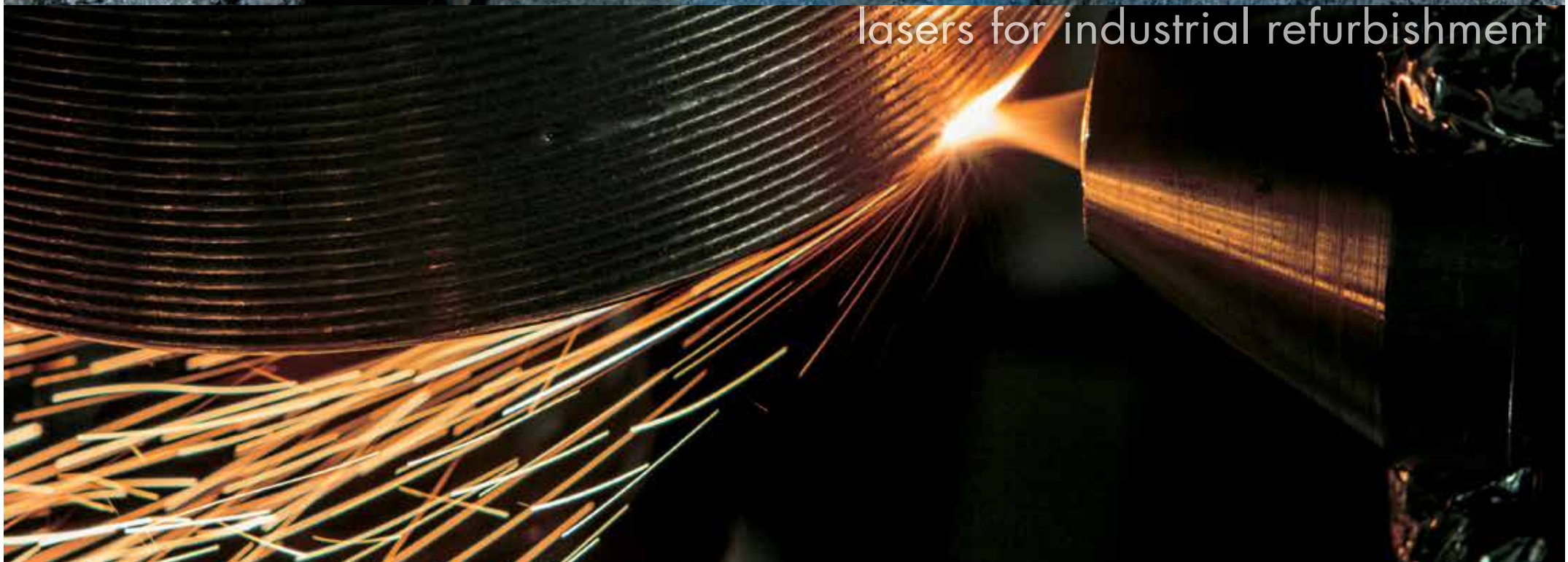
There is an urgent need to refine and implement effective riparian buffer zones (the vegetation interface between rivers and land) along all rivers and watercourses to reduce phosphorus loads being washed into the rivers. The researchers also suggest better protection and rehabilitation of wetlands where plants and soil have a natural ability to trap phosphorus.

Other evidence of pollution included the finding that 59% of collected rainwater samples had a pH value lower than that of natural rain water (<5.6) and could therefore be classified as acid rain.

The need for urgent action is underscored by CSIR research published by Elsevier, which reveals that the polluted water poses an unacceptably high health risk to water users, with communities being exposed to the Norovirus (the cause of gastroenteritis) and immune-compromising metals in the water.

The CSIR is developing a research uptake strategy.

simulated mine stopes to test robots



lasers for industrial refurbishment

helping industry comply with regulation

RESEARCH, DEVELOPMENT
AND IMPLEMENTATION FOR

industry

To stay competitive and to move up the value chain, three interventions are necessary: labour-market reforms aimed at promoting employment, particularly of young people; action to promote productivity gains and new entry by firms; and research and development (R&D) for innovation.

– The National Development Plan 2030

Investing in technology for competitiveness: a national technology localisation drive

IN BRIEF

As part of the effort to develop national infrastructure, state-owned companies (SOCs) have embarked on large capital expansion programmes. Ideally, these SOCs would use competent and competitive local service providers. Technology has a large role to play in ensuring competitiveness. The CSIR was tasked by the Department of Science and Technology (DST) to help implement a national technology localisation plan through the Technology Localisation Implementation Unit (TLIU). The three companies profiled in this article were supported through Technology Assistance Packages (TAPs), with all companies reporting improved competitiveness.

An Eskom service vehicle with standardised toolbox developed by Calculus Products (Pty) Ltd.

BOOSTING LOCAL TRANSFORMER ENGINEERING DESIGN AND MANUFACTURING CAPABILITIES

The short-circuit withstand capability of transformers has been improved following collaborative research and development (R&D) between Powertech Transformers and the University of Pretoria (UP), through the provision of a technology package provided by the TLIU.

As the workhorses of electricity transmission, transformers are complex mechanical structures, consisting of a magnetic core, windings and insulating and cooling mediums. Most outdoor utility and industrial service transformers are filled with transformer oil that both cools and insulates the windings. These windings must have the ability to withstand high mechanical and electrical stresses resulting from short circuit conditions which are the most common cause of power failures.

While the in-house, state-of-the-art integrated design system at Powertech Transformers allows for short-circuit stress calculation, the effects of short circuits on windings require computer modelling. Utilising the Sasol Laboratory for Structural Mechanics at UP, provided laboratory-verified simulations of the effects of short circuits on transformer windings. Knowledge gained through the company's own R&D operations has led to a range of other design improvements.

Powertech Transformers reports that the technology package has enabled it to create 31 new job opportunities and diversify its offerings to the market.

GAINS FOR METAL MANUFACTURER FOLLOWING TECHNOLOGY LOCALISATION ASSISTANCE

Fabrinox, a Western Cape metal manufacturing company, offers complete manufacturing solutions in stainless steel, mild steel and aluminium. To enhance its international credibility, the company has focused on increasing its competitiveness through continuous improvement of its operational systems and investment in technology and quality outputs.

This drive has been supported by the TLIU's Technology Assistance Package which comprised support for quality management through the continuation of ISO 9001 and introduction of ISO 3834; skills training through German company Trumpf; and the introduction of an enterprise resource planning system. This system has benefited the entire operation of the company by providing each function with access to information in real-time.

Strong company results in terms of turnover, margin and higher employment figures are testament to the effectiveness of these interventions. The company is well positioned to take advantage of opportunities offered by SOCs.

SERVICE VEHICLE TOOLBOX FOR ESKOM

A lightweight and cost-effective standardised service vehicle toolbox for Eskom maintenance vehicles in the Western Cape has been produced by Calculus Products (Pty) Ltd, with design assistance from the Institute of Advanced Tooling at Stellenbosch University. No suitable cost-effective product exists on the market. The TLIU supported this project through a Technology Assistance Package.

Calculus specialises in the design and implementation of innovative engineering solutions using standard and non-standard tools for its diverse local and international clients.

The design takes several factors into consideration to ensure functionality for specialised fieldwork and effectiveness in terms of time and costs. Direct access to well laid-out and adequately protected tools is achieved by customised boxes within a lockable canopy, which is weather and dust-resistant. Calculus can perform design adjustments to accommodate different vehicles.

The design cuts both expenditure and manufacturing time, thereby limiting expenditure for Eskom. Improved manufacturing skills are benefits that accrue to Calculus through this project; the project also requires the company to increase jobs.

Eskom is in consultation with Calculus to test the toolbox as a step towards the possible further deployment of this product.

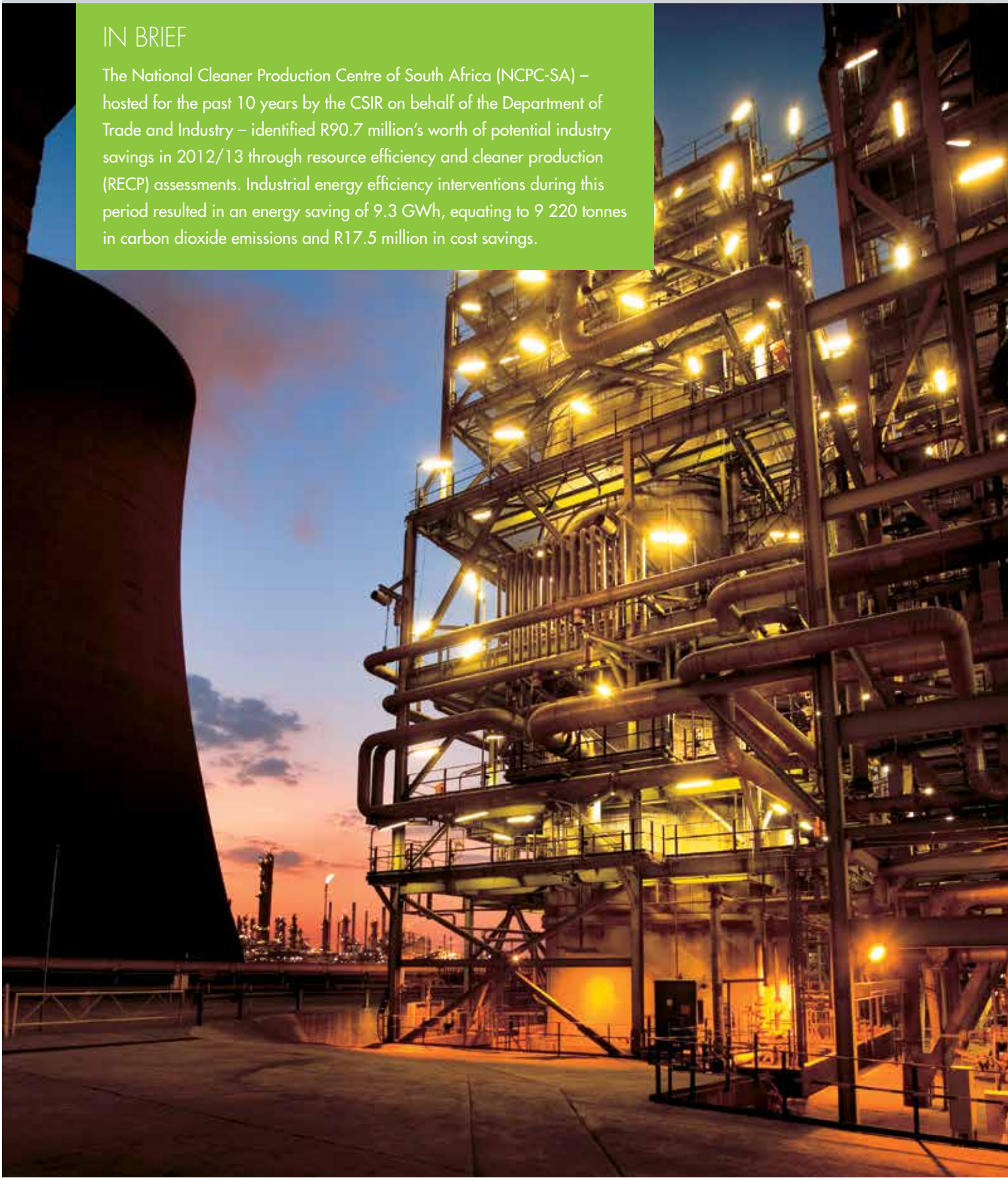
Manufacturing at Fabrinox, where enterprise resource planning has been improved.

The design of power transformers has been improved.

In pursuit of SA industries manufacturing to cleaner, more resource efficient methods

IN BRIEF

The National Cleaner Production Centre of South Africa (NCPC-SA) – hosted for the past 10 years by the CSIR on behalf of the Department of Trade and Industry – identified R90.7 million's worth of potential industry savings in 2012/13 through resource efficiency and cleaner production (RECP) assessments. Industrial energy efficiency interventions during this period resulted in an energy saving of 9.3 GWh, equating to 9 220 tonnes in carbon dioxide emissions and R17.5 million in cost savings.



QUALITY JOBS, ENERGY SAVINGS REALISED AS A RESULT OF NCPC-SA EFFORTS

The aim of the NCPC-SA is a point of convergence between the global goals of carbon emission reduction and the preservation of scarce resources, and the national imperatives of economic growth (to which the centre contributes by enhancing industry competitiveness), job creation and skills development.

The year under review saw a dramatic increase in the impact made by the NCPC-SA. In terms of RECP assessments, over R90 million's worth of potential savings were identified during plant assessments. This compares to around R60 million in each of the previous two years, and a combined total of around R55 million in the preceding seven years, when the focus had largely been on education and awareness creation. With the impact of cleaner production on industry competitiveness now internationally recognised, the NCPC-SA will increase its focus on facilitating implementation of RECP best practices, methodologies and technologies during the next phase.

The onus of implementation of the changes required to realise the savings identified during in-plant assessments is on the participating companies, which may lack the capital and technical know-how to make the required interventions. In 2012/13, only R5.8 million of the R90 million was converted into actual savings through implementations based on NCPC-SA assessments. However, the increase in the number of incentive schemes by government bodes well for an improvement in the uptake of the RECP recommendations and resulting savings by industry in future. The 2012 launch of the Manufacturing Competitiveness Enhancement Programme was a major boost for the funding of RECP interventions and, as awareness grows, industry is making better use of this programme as well as other existing funding schemes.

ENERGY SAVINGS

Due to the energy crisis and ever-rising costs of energy both locally and globally, the NCPC-SA currently has a strong focus on supporting South African industry in managing its energy consumption. Through the Industrial Energy Efficiency (IEE) Improvement Project, the NCPC-SA has facilitated the implementation of energy management systems and energy systems optimisation in a number of small and large companies in energy-intensive sectors such as metals and automotives.

In only two years, companies that implemented these interventions achieved almost R200 million of energy savings.

Industrial energy efficiency training.

From a budget of R900 000 and a staff of three in 2006, the NCPC-SA today operates on a budget of over R40 million, is manned by almost 40 CSIR staff and hosts between 15 and 20 interns at a time.

GREEN SKILLS DEVELOPMENT

Industry will not be able to transition to cleaner, more resource-efficient methods without the oversight and support of suitably skilled individuals. In addition, this new area of expertise opens up opportunities for young graduates and professionals – including consultants contracted by the NCPC-SA to conduct assessments at manufacturing plants – to improve their employability or expand their service offerings to industry.

During 2012/13, over 800 professionals were equipped to implement energy efficiency measures in industry, as part of the IEE Project. The NCPC-SA also runs an internship programme aimed at enhancing the employability of engineering graduates while encouraging RECP adoption by industry. The interns are appointed on six-month contracts by the CSIR and given intense training in identifying and implementing RECP interventions in plants, as well as a number of 'soft skills' required in a professional environment. They are then placed in host companies where they identify savings potential in terms of energy, water and material usage as well as opportunities for improved waste management, and assist in implementing no-cost and low-cost savings options. This is done under supervision and mentorship of industry experts. The 2012/13 intake of 15 interns, who were placed at seven companies, facilitated savings of over R3.8 million in their host companies.

Local manufacture of an airline galley.

LOCAL SMMEs REACH PROFICIENCY IN AIRLINE GALLEY DESIGN AND MANUFACTURING

Local aerospace company, Aerosud Aviation (Pty) Ltd, has successfully transferred the design, certification and production expertise for the manufacturing of the Airbus A320 equipment galley to two South African small, medium and micro enterprises (SMMEs) in the aerospace sector. The galley is a compartment of the aircraft where food is cooked and prepared and it is typically not included in the sale of planes, but furnished by the buyer.

The transfer was supported by the Aerospace Industry Support Initiative (AISI), an initiative of the Department of Trade and Industry hosted and managed by the CSIR.

The opportunity for the SMMEs arose following a decision by Aerosud Aviation to cease supply of this component. Airbus delivered 5 402 of these aircraft early in 1988, with another 3 629 aircraft on firm order up to the end of 2012.

Both SMMEs – Aero Services (Pty) Ltd and Safomar Aviation – are well-established companies operating in the Sub-Saharan aerospace industry. AISI has assisted to ensure the complete adoption and integration of the manufacturing technologies for the two enterprises. Through this project, they are in a position to unlock the market potential internationally through marketing to original equipment manufacturers.

Laser cladding of a roll using laser technology.

LASER PROCESS HELPS SHARPEN LOCAL STEEL-MAKER'S COMPETITIVE EDGE

Laser engineers have developed a unique laser-based process for the ArcelorMittal South Africa continuous caster foot rolls. The process is based on a special alloy developed by laser manufacturing experts and which is laser-cladded on the rolls.

The new layer, which is metallurgically bonded, has much-improved wear and corrosion-resistance properties. Rolls with a longer lifetime result in significant cost savings for a steel mill, but the challenge lies in the harsh operating environments to which these rolls are exposed. Compared to conventional welding typically used to refurbish the rolls, the laser process is faster, and with the customised metal coating and low heat input, it is possible to apply coatings that can extend the operational lifetime of the rolls.

The CSIR has developed the technology over the past five years, but has in the last year installed test rolls at one of the continuous casters at the ArcelorMittal Vanderbijlpark Works to have their performance monitored and documented by welding engineers at the company. Evidence from the operational tests indicates that the process and metallurgy will have a significant contribution in reducing costs. Arcelor South Africa is running similar trials at its other plants across the country.

A new agreement will now see the CSIR continuing its development work on refurbishing worn-out rolls on other sections in the plant, using laser technology.

LASER LEAK-SEALING TECHNOLOGY PROVES ITS METTLE

A laser-welding and leak-sealing technology first developed to seal and repair leaking water coolers at South Africa's power stations has been patented locally and in several countries abroad.

Regarded as a world-first, the laser-based cladding system can seal a crack that is literally spurting liquid. The cracks in the vertical walls of big containers are sealed without first draining the content of the containers at power stations, with obvious benefits in terms of avoiding down-time. The quality and consistency of the welds are assured, owing to the precision associated with laser systems.

CSIR and Eskom engineers first proved the technology during demonstrations, followed by rigorous testing during planned maintenance downtime at an Eskom power station. Eskom's satisfaction with the outcome led to a second set of repairs while the power station was in operation.

Follow-up work on designing a customised laser beam welding unit to address other Eskom engineering challenges is underway. Technologies for the refurbishment of steam turbine blades are also being investigated.

Right: A water storage tank at Koeberg has been repaired with a new laser process, while in use.

Below: The leak-sealing process as seen up close.

Underground mines are not readily accessible for the scientific testing of equipment and technology. The CSIR has constructed its own test environments for mining robotics research.

SIMULATED MINE STOPES CONSTRUCTED TO TEST INNOVATIONS FOR UNDERGROUND MINING

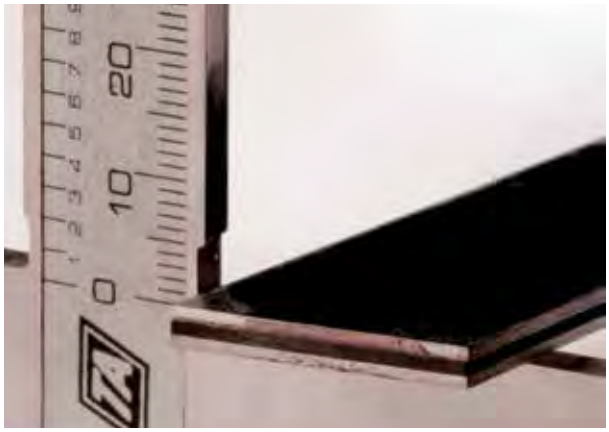
The CSIR has constructed two simulated mine stopes to test various technologies it has developed, such as robotic platforms, sensors and related software.

The two stopes represent different environments in underground mining operations in South Africa. The first represents a gold stope with variable dip up to 30 degrees. The second stope represents a platinum stope.

The stopes were built as part of the mine safety platform project of which the aim is to construct an autonomous vehicle capable of assessing the safety of a mine after blasting and during the period when toxic fumes make it difficult for workers to access the work area.

The first test stope is used for testing the performance of robotic platforms on terrains with variable dipping angles and the performance of roof integrity sensors. The second stope is used to test underground navigation and geo-location software.

The test stopes address the need for facilities to test new equipment and systems for underground operations in South Africa.



Titanium and carbon fibre laminate, 3 mm thick.

CLEVER MATERIAL COMBINATIONS FOR AIRCRAFT

The CSIR is designing new lightweight materials by combining composites and metals (such as titanium), offering the advantages of both types of materials. These newly created materials are both lightweight and extremely damage-resistant.

The research is supported by the Aerospace Industry Support Initiative, a Department of Trade and Industry initiative hosted and managed by the CSIR.

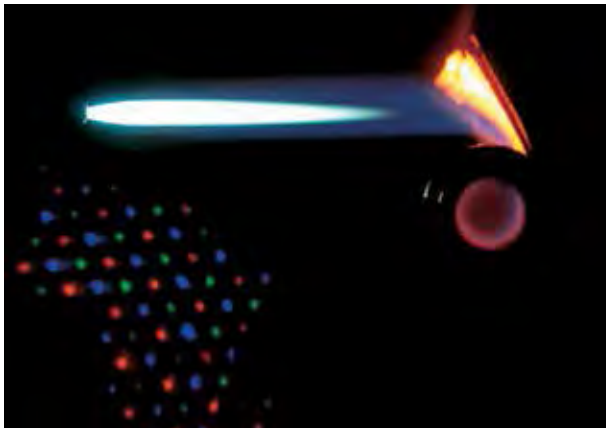
The materials are ideal for the burgeoning Unmanned Aerial Vehicle (UAV) industry. UAVs are a particular subset in the aerospace industry, used for a number of civil applications, including surveillance; disaster and emergency management; industrial applications; and medical transportation.

These aircraft damage easily during normal operation. The hybrid composite and metal materials render UAVs both lighter and tougher.

By optimising the material, it is also possible to apply them in the manufacturing of very high-value, low-volume products for which weight is a critical factor, such as satellites and specific areas on large aircraft, which are prone to fatigue.

As part of the project, the CSIR designed and installed several specific technologies for materials testing as part of its mechanical testing laboratory. Specific software packages for design and structure evaluation were also developed and established.

The University of Pretoria assisted the CSIR to develop the adhesive used to bond the layers of titanium and carbon fibre.



Focusing light with a flame lens.

DEVELOPMENT OF A WORLD-FIRST FLAME LENS MAY CHANGE FIELD OF OPTICS

Researchers have developed a flame lens which uses air to focus and can handle virtually unlimited power. This scientific breakthrough was described in the prestigious journal, *Nature Communications*.

Normal lenses are made of glass and are a ubiquitous optic in any laser system. The problem with these solid-state glass lenses is that they crack when exposed to high-powered laser beams.

For the new lens, a flame is channelled through a pipe, spiralling along the pipe length. Researchers then shoot a laser beam through the same pipe, behind the flame, which focuses the laser beam. The flame lens produces a sharp focus with very little stray light. It achieves a fourfold increase in focal power per unit length over previous gas lenses.

CSIR researchers were dependent on aeronautics know-how to determine and predict precisely how the hot air moved through the pipe. They used computational fluid dynamics, which predicts how gasses behave by solving complex mathematical formulae.

The CSIR's flame lens has a damage threshold that is several orders of magnitude higher than that of most conventional lenses and is immediately repaired after damage, for reuse. This makes it suitable for focusing high-power laser beams that will ultimately benefit the nuclear energy and military industries.

Work on the system continues. CSIR researchers collaborated with Prof Max Michaelis of the University of KwaZulu-Natal.

A 125cc helicopter platform to monitor electricity transmission lines.

SAVING MILLIONS IN POWER LINE INSPECTIONS THROUGH A NEW ROTARY UNMANNED AERIAL VEHICLE

The CSIR, in collaboration with a small, medium and micro-sized enterprise, Aerial Concepts, has developed a rotary unmanned aerial vehicle to monitor electrical transmission and distribution lines.

The new vehicle carries a multi-spectral imaging system (called a MultiCAM), that allows for video footage of overhead power line components to be simultaneously captured in three spectral bands, namely visible, infra-red and ultraviolet. This information is used by electrical utilities such as Eskom, to make decisions on line maintenance schedules.

Eskom has co-funded the development project with the aim of reducing the costs associated with power line inspection. The new unmanned aerial vehicle will replace a conventional helicopter and in doing so, will reduce inspection costs drastically.

Aspects of the development have been funded by the Department of Science and Technology through an unmanned aerial system project.

The 10 000 m^2 radiometric calibration site north of Pretoria.

SOUTH AFRICA COMPLETES SITE TO CALIBRATE SATELLITES

South Africa has completed what is believed to be the only, specifically built and designed satellite sensor radiometric calibration site in the Southern Hemisphere. The site will be used for the vicarious calibration of satellites and airborne sensors.

Vicarious calibration refers to techniques that make use of natural or artificial sites on the surface of the Earth for the post-launch calibration of sensors. Sensors on-board Earth observation satellites need to be calibrated at least twice a year to correct for drift or change in the satellite orbit, changes to the sensor structure itself and the electronic characteristics of the detector arrays.

The Department of Science and Technology funded investigations into the most suitable solutions and the eventual construction of the artificial target reference site.

In setting up the site, various reference targets were considered and characterised, including large surfaces of known surface spectral reflectance, either natural (deserts or salt pans) or man-made. Due to their spectral characteristics, dry salt pans are often the first choice. However, natural targets have unstable reflectance with significant bi-directional effects and generally provide only one light flux level for each calibration that is collected.

The decision was to establish a man-made calibration site at a CSIR site 50 km north of Pretoria. The site comprises an area of 10 000 m^2. Different pavers were tested for durability and spectral characteristics. The pavers were manufactured and cured in a controlled environment to promote uniformity with reference to colour and texture.

The facility contributes to the aims of South Africa's space programme.

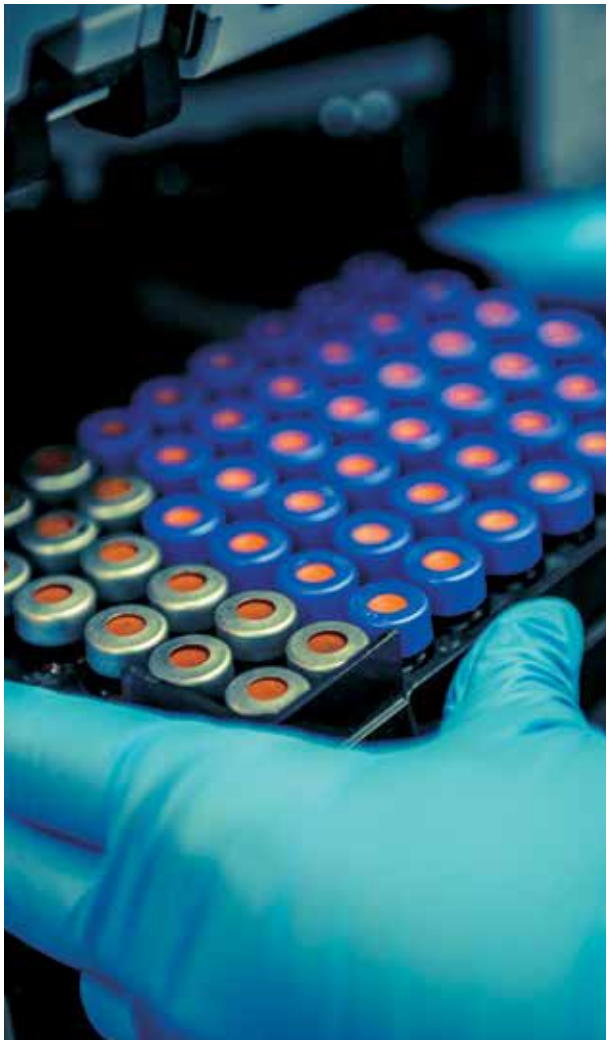
EXPANSION OF ANALYTICAL LABORATORIES HELPS INDUSTRY COMPLY WITH REGULATIONS; TRADE

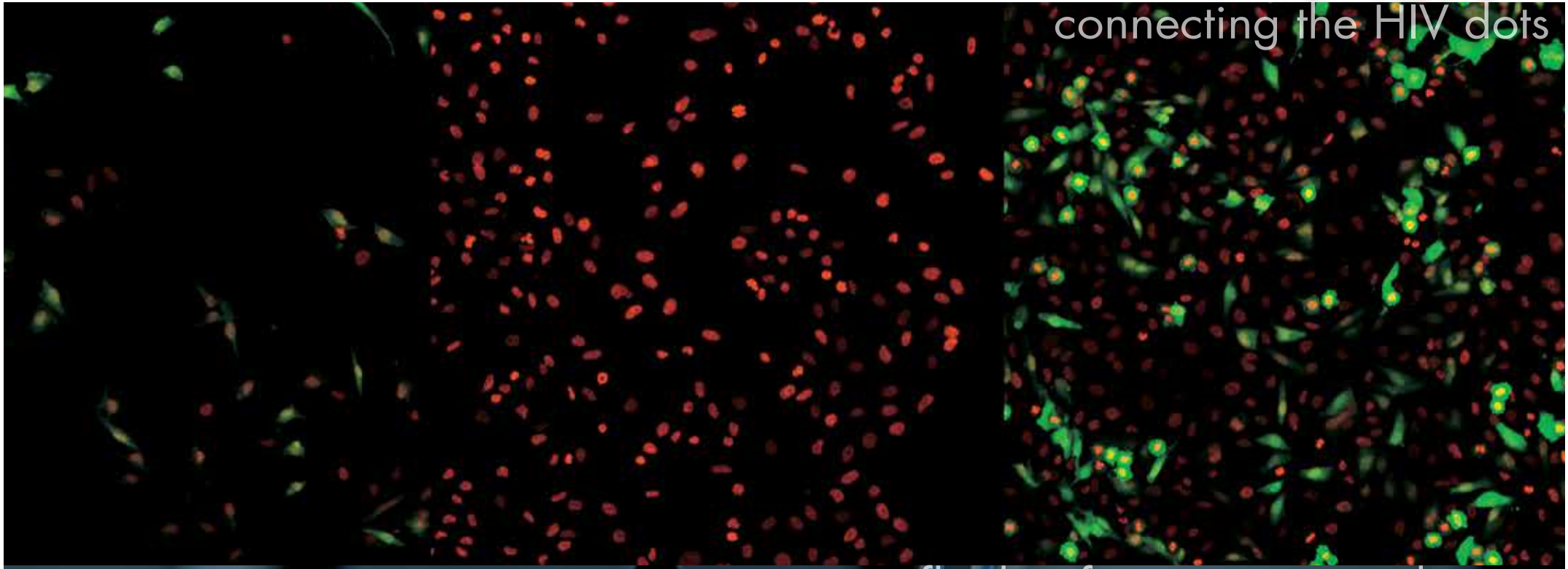
The CSIR has expanded its chemical analytical testing footprint around the country to offer more diversified SANAS-accredited laboratory services to industry sectors nationally. The areas of expertise are: food and beverage; air and dust; environmental and microbiological.

The expansion from four laboratories in two provinces to nine laboratories in four provinces will help ensure support to the various industry sectors in compliance to the relevant regulation or legislation in specific sectors. Compliance with regulation in turn facilitates trade.

In addition to this expansion, the CSIR has, over the past two years, expanded the number of accredited analytical methods.

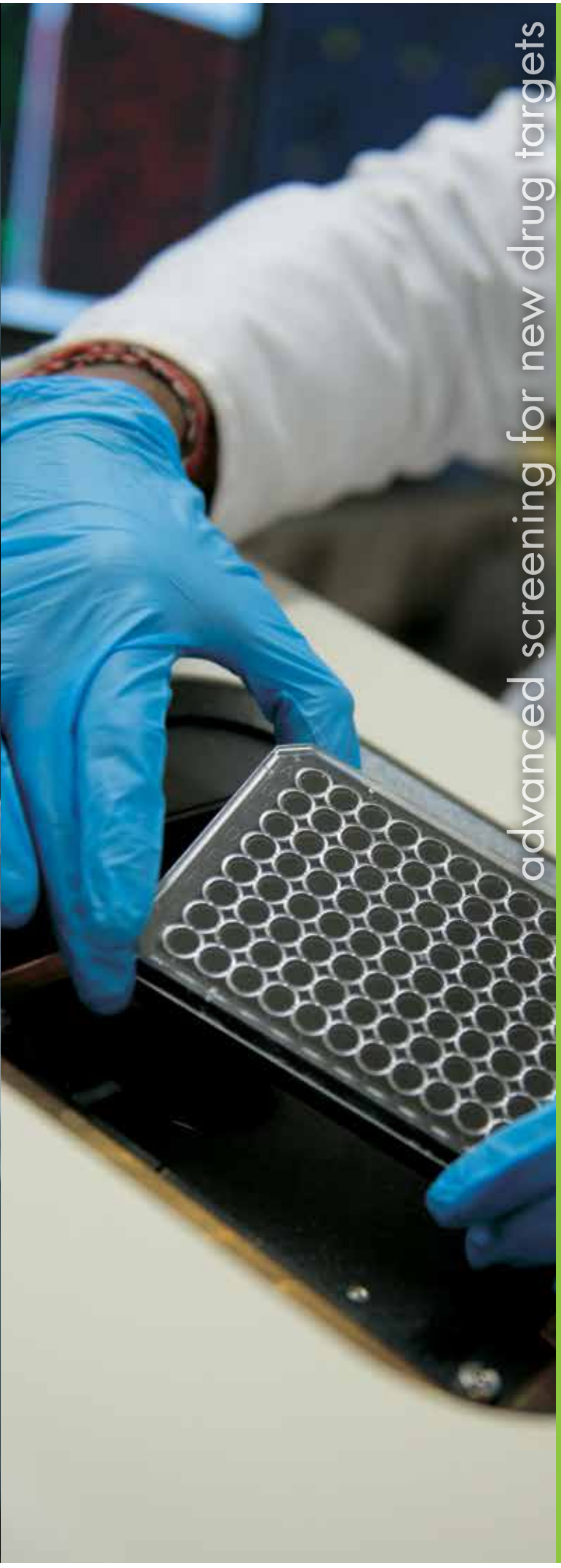
The CSIR's analytical platform has expanded its footprint in KwaZulu-Natal, the Western Cape, Gauteng and the Eastern Cape. Plans are afoot to expand to Limpopo and Mpumalanga.





connecting the HIV dots

microfluidics for enzyme production



advanced screening for new drug targets

RESEARCH, DEVELOPMENT
AND IMPLEMENTATION FOR

health

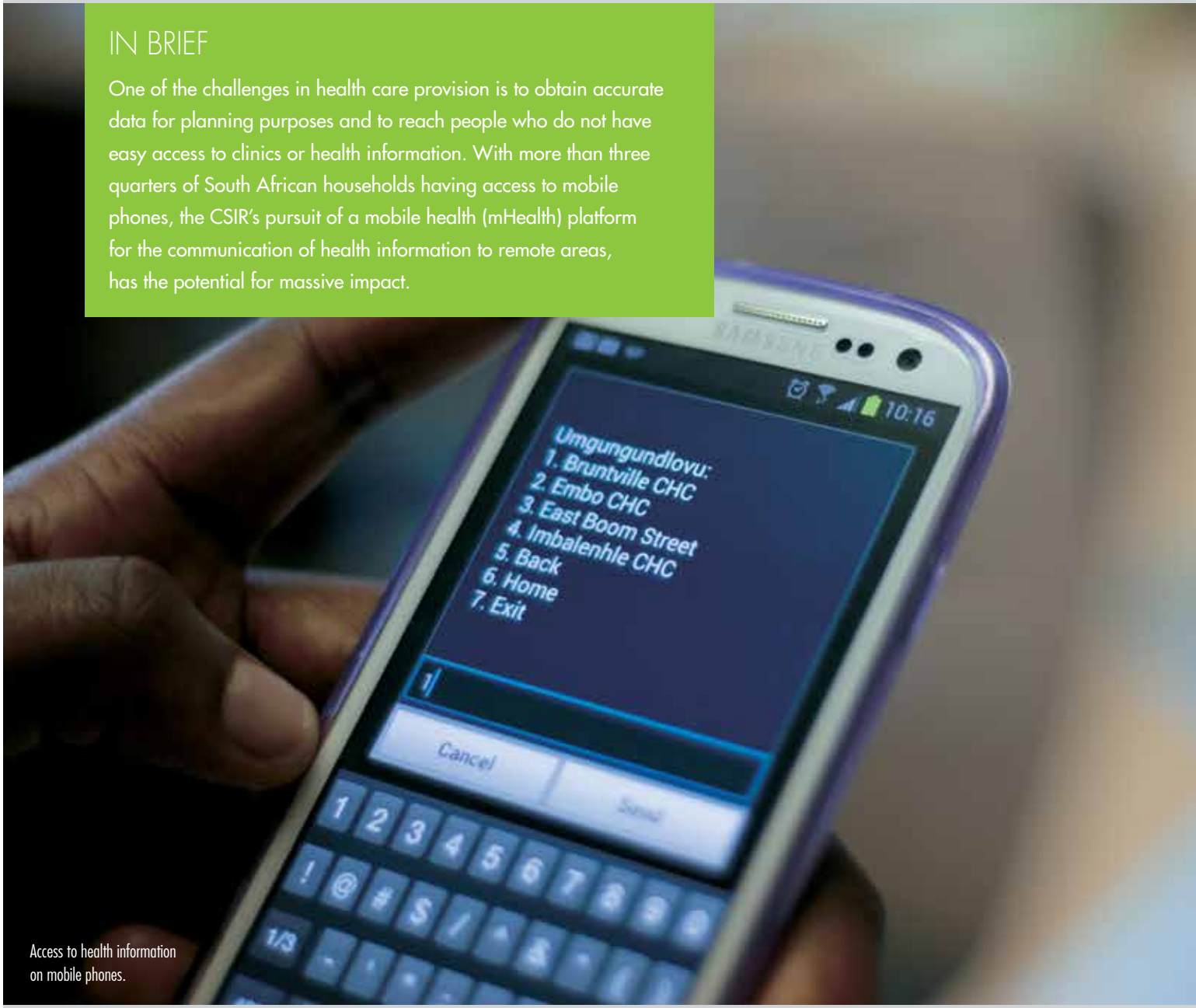
The South African health system is underpinned by the principles of primary health care and the district health system. Primary health care emphasises globally endorsed values, such as universal access, equity, participation and an integrated approach. Critical elements of primary health care include prevention and the use of appropriate technology.

– The National Development Plan 2030

Mobile technology for health in KwaZulu-Natal

IN BRIEF

One of the challenges in health care provision is to obtain accurate data for planning purposes and to reach people who do not have easy access to clinics or health information. With more than three quarters of South African households having access to mobile phones, the CSIR's pursuit of a mobile health (mHealth) platform for the communication of health information to remote areas, has the potential for massive impact.



Access to health information on mobile phones.

In remote villages, limited access to health care services has to be overcome.

CSIR researchers are able to collate health information gathered using digital pens in the field.

THE CHALLENGE

Access hampered by distance and poverty

More than 43% of the population live in rural parts of South Africa, many of them with limited access to health care services.

When illness strikes in a remote village, it often happens that precious time is lost as family members struggle to arrange transport and to obtain information about the appropriate, closest health care facility.

This, coupled with poverty and the disproportionate burden of infectious disease in certain parts, have contributed to the scenario in which a treatable infection like tuberculosis (TB) is currently the top cause of mortality in South Africa.

Innovative technological solutions may help communities to fully benefit from existing health care services and government's envisaged national health insurance system.

THE RESEARCH AND DEVELOPMENT

Integrating and communicating health information

eHealth in KwaZulu-Natal

Researchers from the CSIR have been working with the teleHealth unit of the KwaZulu-Natal Department of Health for more than a year, developing tools to integrate and analyse health information gathered in the field and to communicate preventative messages and other health care information to patients, health workers and government departments there.

More than three quarters of South African households have access to at least one mobile phone, rising to more than 87% in some parts, according to Statistics South Africa's latest data. Researchers needed to take into account, however, that many rural households do not have smart phones and had to develop a mobile communications platform that is user-friendly to those with older 'legacy' technologies.

Mobile reminders for TB patients

One of the projects, set to be piloted in the uMgungundlovu district, uses SMS messages to remind TB patients to take their medication.

Non-adherence to TB treatment regimens can lead to the development of devastating resistance to medicine. Before the sharp increase in TB cases, which was fuelled by HIV/Aids, resistance was mostly confined to patients who did not adhere to treatment. Research has found that extensively drug-resistant (XDR) TB has the ability to spread in communities and it has now been found in most parts of KwaZulu-Natal. It is resistant to at least four TB drugs and kills most people who are infected with it. Treating non-resistant TB requires adherence to medication for at least 6 months. For resistant strains, the treatment period can increase from 9 to 22 months with adherence becoming a bigger challenge.

The pilot project will involve 200 TB patients who live in a catchment area of one of the health clinics in the uMgungundlovu district. Baseline data will be collected to measure patients' adherence to treatment regimens after which the selected group will receive SMS reminders at 19:30 in the evening to take their TB medication between 20:00 and 21:00 as prescribed. It is envisaged that the reminder service will be extended to include information from the whole treatment programme, including monthly clinic visits.

Access to information

Another component of the mHealth platform is the provision of a health information service which can be accessed using Mxit, Unstructured Supplementary Service Data (USSD) and Google Chat.

Users will be able to access information via a menu, for example, the location of health centres or preventative health care information about topics such as diarrhoea, TB or maternal care. This service is still being tested.

The researchers are also developing video-based training sessions for health workers, which will rely on smart phone and tablet access. This technology can adapt to the available bandwidth in an area to make streaming possible.

Interpreting research data

The researchers have developed a platform where household health data, which were collected in the field using a digital pen (developed by XCallibre), could be integrated with other health data, analysed and visualised so that health workers in facilities, district offices or government departments can use it for health care planning.

The digital pen, used for data collection technology, records key strokes on customised questionnaire paper in the field. It was piloted in KwaZulu-Natal in 2012 when community health workers collected household data from 400 households.

THE OUTCOME

The CSIR continues to work with the KwaZulu-Natal Department of Health to explore further options for testing and roll-out of this technology.

Dr Colin Kenyon was called upon to share his knowledge of proteins called kinases.

NEW UNDERSTANDING OF MEMBRANE-BOUND PROTEINS IMPORTANT FOR FUTURE DRUGS

A CSIR biochemist was part of a group of international researchers who elucidated the structure of a bacterial cell membrane enzyme – research which might one day help to unravel new mechanisms to target a variety of diseases.

The human body consists of millions of cells and within each there are tiny proteins which regulate life. They form structures, speed up chemical reactions or play a messenger role, for example. As researchers learn more about these proteins, they are able to develop new drugs which target proteins involved in several medical conditions. Until recently, they were, however, unable to visualise many of the proteins which are situated in the membranes of cells.

Scientists overcame this challenge recently and have started to visualise the structure and function of these membrane-bound proteins one by one. Dr Colin Kenyon contributed to an article titled, *Crystal structure of the integral membrane diacylglycerol kinase,* published in the journal, *Nature*.

Kenyon was approached by Prof Martin Caffrey, an expert in the field of the structure of membrane proteins at Trinity College, Dublin in Ireland. This was on the basis of Kenyon's earlier research which relates to the study of reaction mechanisms of proteins called kinases, and how these proteins use adenosine triphosphate, a molecule which is the energy currency of cells. Kinases play a pivotal role in cellular metabolism and regulation, and therefore represent 20 to 30% of all targets in serious drug discovery programmes, for example, targeting the treatment of cancer and diseases, such as malaria and tuberculosis, and other bacterial infections.

Kenyon and his colleagues were requested to help define the functionality of the newly crystallised diacylglycerol kinase (a bacterial membrane enzyme). The authors of the article presented a crystal structure for three functional forms of the bacterial membrane enzyme.

Children exposed to harsh sun at a South African school.

SOUTH AFRICAN SCHOOLS NOT SUN-SMART

More than a third of learners who participated in a CSIR study reported that they never use sunscreen when they are out in the sun. This is one finding of The SunSmart Schools Research Project, which was co-funded by the Cancer Association of South Africa. In one outcome of the research, CSIR environmental health researchers have drafted a sun protection policy for schools.

Researchers, knowing that 80% of sun-induced skin damage occurs before the age of 18, conducted a study at 24 schools across the country, involving school managers and 707 learners. Only nine schools indicated that they have sufficient seating in the shade for all learners during breaks. Yet, no school had a 'no hat, no play' or 'play in the shade' rule and only three schools required learners to wear sun-protective hats when outdoors in the sun in the first and fourth school terms.

More than 58% of schools encourage learners to avoid excess sun exposure during breaks in the first and fourth school terms, however, most (91%) were unable to schedule breaks to avoid intense sun exposure.

Some 55% of learners responded that they had not had any teaching about sun protection in the previous twelve months. Close to 31% had been sunburnt at least once during the last summer, and 71% had not heard about the UV Index, a measure of the sun's intensity used for public awareness.

The researchers presented a suggested sun protection policy along with the results to each school and to the relevant government departments.

A micro-well plate is loaded into the automated confocal microscope (above), which captures hundreds of images per plate. These images are then analysed by a computer (below). The first image on page 34 shows HIV infection denoted by a green fluorescent signal. Below these are cells protected from HIV infection and cells sensitised to die in response to infection by HIV.

INTELLECTUAL PROPERTY PROTECTION IN PROGRESS FOR POTENTIAL HIV THERAPY TARGETS

Researchers at the CSIR's gene expression and biophysics group have a number of patent applications in the pipeline for genes and regulatory molecules that could serve as targets for anti-HIV drugs. They discovered these targets using, for the first time in HIV infection studies, miRNA-based screening (miRNAs are small molecules that regulate gene expression). The pathways in which these newly discovered target genes and miRNAs are involved were previously only loosely linked to HIV infection, but this new evidence shows direct connections.

The advanced screening technology used by the researchers involved artificially enhancing or suppressing host cell miRNAs and then observing the effect on viral replication using an automated confocal microscope. The microscope acquires thousands of high-resolution images, which are then analysed by a clustered computer that uses a pattern-recognition algorithm to identify miRNAs that either promote HIV infection or protect cells against HIV.

Once miRNAs of interest were identified, the scientists could look at the genes those miRNAs are known to regulate, enabling them to uncover certain molecular pathways involved in HIV infection. Validation studies continue.

The low-cost *E. coli* detection device, ColiSpot.

A PORTABLE, INEXPENSIVE *E. COLI* DETECTION DEVICE RENDERS RAPID RESULTS

The CSIR has developed a portable, inexpensive and easy-to-use disposable device that can detect *E. coli* rapidly and without the need to send samples to laboratories.

Escherichia coli (E. coli) is an important microbial organism in the assessment of water quality. Its presence in water sources typically indicates sewage contamination, and if consumed, can result in severe illnesses and even death.

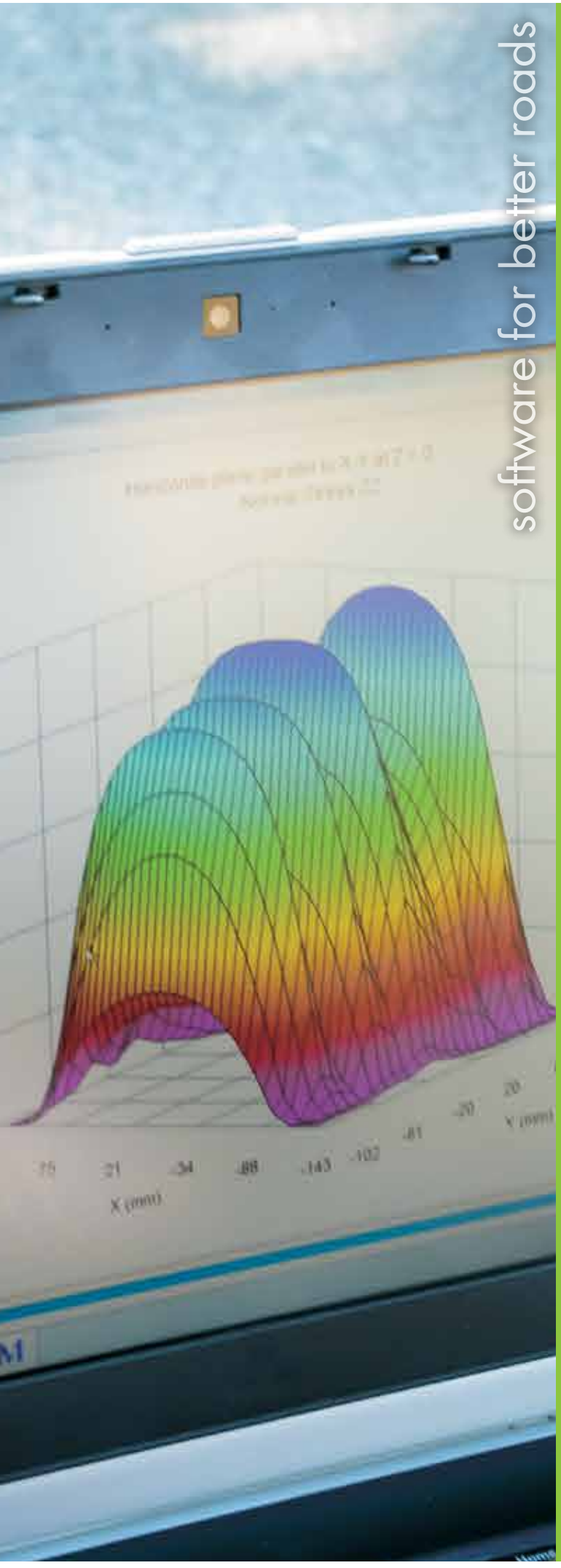
While current *E. coli* detection methods are deemed efficient, they require an incubation period of 18 to 72 hours before results can be obtained. During this long detection period, contaminated water may be consumed by end users as well as discharged into the environment.

The new device makes use of antibodies immobilised on paper-fluidics, similar technology to that used in commercial home pregnancy tests, to spot the presence of *E. coli* in a concentrated water sample. It is able to detect the presence of high concentrations of *E. coli* within 10 minutes using a colorimetric readout. This means that semi-skilled field workers will be able to interpret the results with minimal training.

Work is currently being done on improving the sensitivity as well as adding electronics to make it fully quantitative, rather than relying on user interpretation.


road materials testing


access to remote areas



software for better roads

RESEARCH, DEVELOPMENT AND IMPLEMENTATION FOR THE

built environment

Infrastructure is not just essential for faster economic growth and higher employment. It also promotes inclusive growth, providing citizens with the means to improve their own lives and boost their incomes. Infrastructure is essential to development.

– The National Development Plan 2030

Logistics: connecting neighbours and engaging the world

IN BRIEF

The state and cost of logistics in a country can make or break its business relationships internally, as well as with other countries and across continents. The CSIR and its partners, IMPERIAL Logistics and Stellenbosch University, have published nine annual State of Logistics™ surveys for South Africa, which enable comparisons and trends to be observed. The 9th survey reports that the contribution of transport costs to overall logistics costs in 2012 is pinned at 61%, the highest it has been in the past nine years and far higher than the global average. The theme for the 9th State of Logistics™ is 'Connecting Neighbours – Engaging the World'.

The annual State of Logistics™ survey for South Africa addresses critical research questions through in-depth analyses.

THE CHALLENGE

Achieving growth despite political boundaries

Big business from abroad is turning its attention to emerging markets such as southern Africa for its next growth frontier, with opportunities being meagre in already-developed countries.

South Africa must address critical issues relating to the road freight sector; shift freight from road to rail; and address rampant skills shortages and misalignment in the logistics sector. The Southern African Development Community (SADC) needs governments and the private sector to join hands for ambitious inland corridor initiatives and for developing a world-class maritime transhipment community for trade.

THE OPPORTUNITY

Regional connectivity

SADC could become a world-class transhipment community due to its geographic location. South Africa and Mauritius currently rank 39th and 50th, respectively, out of 157 coastal countries in terms of maritime importance. Immense potential and business opportunities exist in southern Africa in terms of natural resources, low-cost labour and a rapidly growing consumer market. However, the top three constraints to doing business in Africa are: Unavailability of reliable service providers and partners; lack of adequate infrastructure; and long transit times and unreliability.

THE RESEARCH AND DEVELOPMENT

Closing the time-lag

The 9th State of Logistics™ survey marks a milestone, with much effort going into preparing logistics costs and freight flow results for 2011 and 2012, effectively closing the two-year time lag in previous reporting. In addition, the research process was opened to industry feedback through a pre-launch event that provided valuable input during the compilation of the survey articles.

Logistics costs as a percentage of total GDP have risen by 0.7% to 12.6% in 2011 and are estimated to have risen further to 12.8% in 2012. The contribution of transport costs to overall logistics costs in 2012 is pinned at 61%, the highest it has been in the past nine years and far higher than the global average. The vulnerability of transport costs to a volatile cost driver – the price of crude oil – and South Africa's entrenched dependence on road transport do not bode well for the economy.

Cost drivers as a problem

For the survey, data obtained from a broad range of industry and government stakeholders identified the key challenges in the South African road freight sector. Respondents felt that poor road conditions (64%), the cost of fuel (52%) and a lack of law enforcement and prevalent non-compliance (43%) are the top three challenges in the industry.

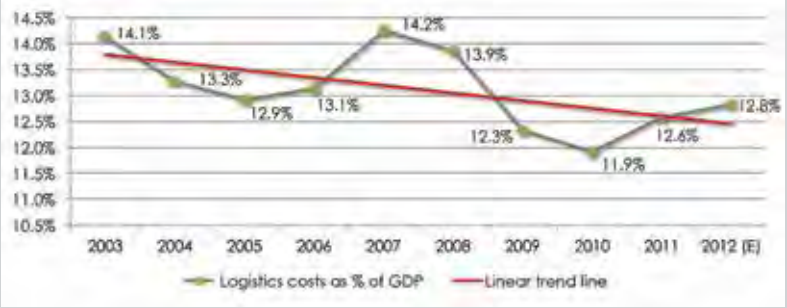
Future investment needed in infrastructure

The National Development Plan states the tremendous challenge the country faces by effectively missing a generation of capital investment in infrastructure. South Africa is not unique in this regard; around the world, inadequate or poorly maintained infrastructure presents major economic challenges, competing for scarce resources from governments already struggling financially.

Public-sector funding for all infrastructure projects is estimated at R844.5 billion for the 2012/13 to 2014/15 period, with Transnet to invest a further R300 billion in rail and port developments over seven years starting in 2012. However, private sector involvement is non-negotiable for the success of transport infrastructure projects – both from a funding and planning point of view.

THE OUTCOME

The survey publications are regarded as premier references for logistics and supply chain practitioners in South Africa and it has become a useful decision-support tool in the sector. The survey opens the floor for vigorous discussion between all parties involved to ensure that South Africa curbs its logistics costs as far as possible, and creates its own opportunities. To view the publication, go to **www.csir.co.za/sol**



South Africa's logistics costs relative to GDP

A rural access road in Limpopo, where CSIR recommendations on rural roads have been implemented.

SUSTAINABLE ROAD ACCESS IN RURAL AREAS

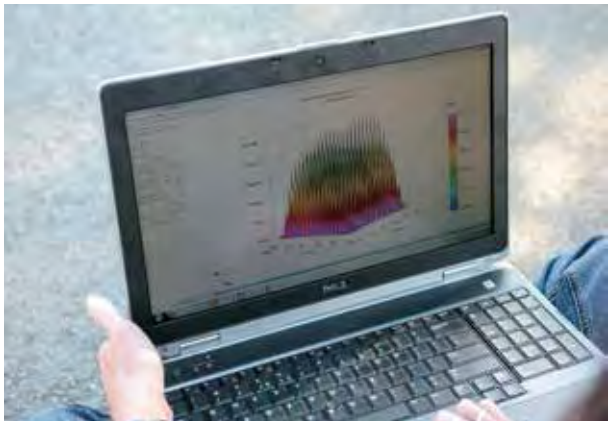
Many of the 600 000 km of unpaved rural roads and roads in small municipalities in South Africa are of a low standard and become impassable when wet. The CSIR undertook a project to synthesise, update and improve the findings of numerous projects by CSIR researchers over the past two decades. A manual has been drafted that summarises the inputs and procedures necessary to upgrade existing roads to an appropriate paved standard with minimal environmental impact and incorporating sustainability principles.

The project is based on the design of paved roads (pavements) using a well-known, but seldom implemented, principle that establishes the existing road structure and environmental conditions, and then optimises the required pavement structure around these characteristics. This can reduce the quantity of imported materials significantly and result in a road using the internationally recognised 'environmentally optimised design' procedure.

The document provides information on the design for such roads with significant cost savings and without marked increases in the risk of premature failure of the roads. The roads do, however, require maintenance, which gives opportunities for local contractors.

The pavement design technique has been developed on the basis of investigating numerous projects using primarily low-cost dynamic cone penetrometer principles (i.e. soil strength assessments) and local materials as far as possible.

Part of the project also included looking at means of improving materials of inadequate quality. These improvements involve cementitious or proprietary alternative stabilisers. Manuals on these two processes have been prepared and are likely to become South African standard guidelines.



One of the software packages developed to improve road data capturing, processing and analysis.

SOFTWARE TO IMPROVE PAVED ROAD 'HARDWARE'

The CSIR has developed four pavement-related software packages which form part of the new South African Pavement Design Method.

In road and airport pavement design, analysis and evaluation, the use of software packages is gaining prominence. Software packages are used to assist with various tasks in the design value chain, including structural and material modelling, structural analysis, as well as integrity. The software reduces manual or user intervention in capturing, processing and analysing pavement-related data. This saves much time and helps road owners and consulting companies in obtaining and using the right information to ensure roads are designed, constructed and maintained properly to improve their lifespan.

Each of the 'big four' pavement-related software packages has been developed to help with specific aspects, including the scientific prediction of remaining road life; planning for repair and maintenance; and achieving optimised pavement design.

The developer of the software, Dr James Maina, received the CSIR CEO award for Excellence in 2012, as well as an award from the National Science and Technology Forum/BHP Billiton as team leader for research leading to innovation.

The CSIR advises municipalities of all sizes on social facility provision.

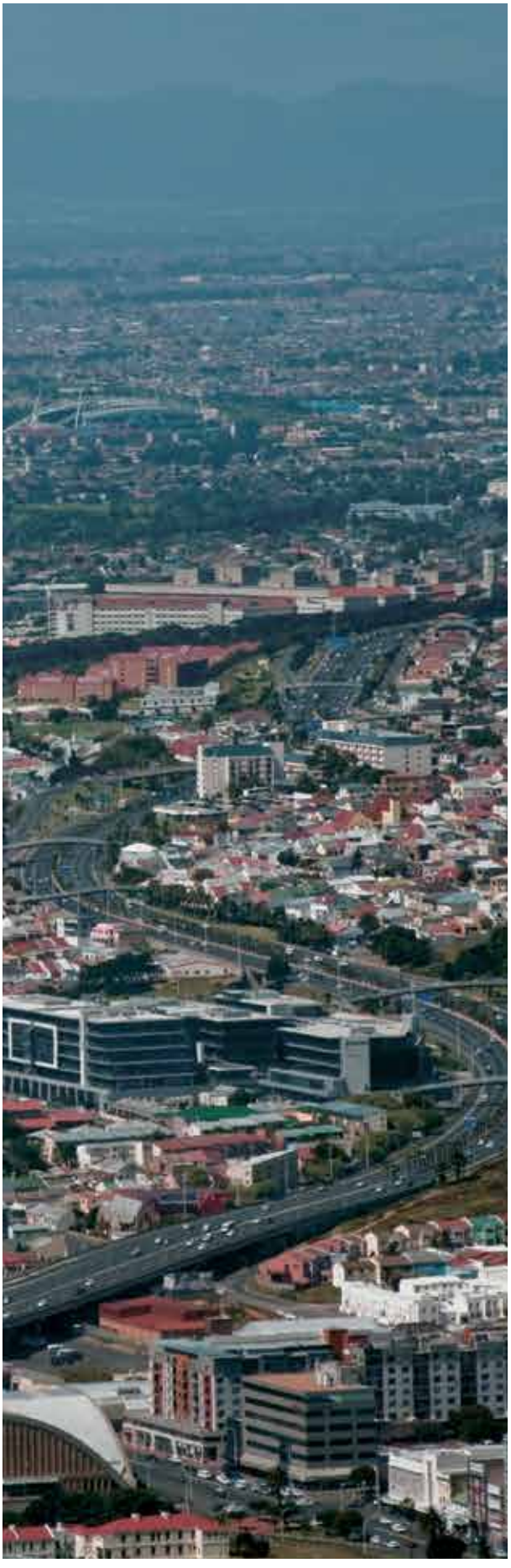
GUIDELINES PUBLISHED FOR SOCIAL FACILITIES IN SOUTH AFRICAN SETTLEMENTS

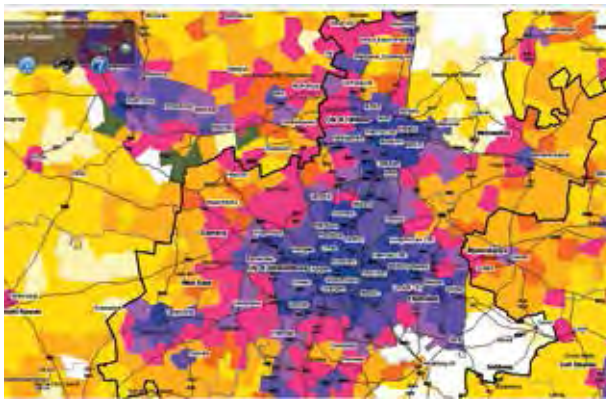
The CSIR has published a set of guidelines that can be used for more focused and needs-based municipal infrastructure spending and the development of adequately provisioned towns and suburbs. The guidelines are a result of several years of work with major municipal metros such as the City of Cape Town and eThekwini.

The guidelines are for planning and developing social facilities in towns, cities and provinces. They apply to a wide range of facilities across many sectors, including health, education, sports, recreation and the public service. They address demand thresholds – the number of people served – and the access norms for a desirable travelling time and distance to and from social facilities. The parameters also differ according to the size and type of settlements.

The practical value of the guidelines has seen the City of Cape Town incorporating a customised set into its spatial development framework, while eThekwini uses its set for forward planning to evaluate development plans of new areas and motivate submissions for funding.

The guidelines publication is available at:
www.csir.co.za/Built_environment/Guidelines_Standards.html





Part of a map that shows the economic output in a part of Gauteng, with dark blue denoting the highest output areas.

MODELLING PLATFORM TO IMPROVE LONG-TERM INTEGRATED PLANNING IN SOUTH AFRICA

A new web-based modelling platform makes available timely, high-quality, long-term, comprehensive geospatial information in an effort to achieve sound decision-making based on integrated planning.

All levels of government can plan more proactively for the long term by understanding future demand patterns for infrastructure, facilities and services for water, electricity, sanitation, schools, clinics and hospitals, as well as public and private transport.

CSIR researchers applied a simulation platform through living laboratory processes established in the metropolitan municipalities of eThekwini, Nelson Mandela Bay and Johannesburg as part of the Integrated Development Planning and Modelling (iPDM) project, funded by the Department of Science and Technology (DST), to find context-specific solutions to spatial planning challenges.

The CSIR conducted collaborative reviews of existing planning approaches. Entities such as the Gauteng Provincial Department of Roads and Transport, East Rand Water Care Company, the South African Cities Network and the Gauteng City-Region Observatory will apply the simulation capability or use the results for proactive long-term planning.

The iPDM project has been transferred to the DST-CSIR co-owned and co-funded national stepSA portal (Spatial and Temporal Evidence for Planning in South Africa).

The CSIR provides open access to integrated planning information via the web-based portal at **www.stepSA.org**, which already has a wide user-base.

CSIR engineer Deon Joubert calibrating a prototype of the visual surveying platform.

NEW TOOL TO HELP ROAD MANAGEMENT AUTHORITIES ADDRESS ROAD DEGRADATION

CSIR engineers have developed an imaging software solution to identify, map and collate vital information on road degradation in South Africa.

The new visual surveying platform collects data using imaging devices. It then analyses the data; detects degradation, such as potholes; and transfers all that data to a database. The software plots each detection onto a map (using co-ordinates from a geo-positioning system) indicating exactly where the degradation is. It then outlines the repair requirements and the cost of restoration. Data can then be sent to the responsible authority, which could be the South African National Roads Agency Limited, the provincial roads departments or the local municipality.

The system was developed for a small enterprise involved in the repair of potholes to make the process of pothole inspection more efficient and to replace the current, tedious manual process. It will enable them to deploy repair teams based on system-generated job cards containing a list of potholes in a selected area as well as their properties.

Data sets are collected using a car, mounted with scanning sensors on the front and rear. Road surfaces are scanned at speeds of up to 80 km/h.

Three prototypes have been manufactured and evaluated in the field. Future work will focus on developing the prototype into an industrial product.

Automated video analytics detecting the road and classifying a pothole.

Visualisation and management tool used for scheduling road repairs.


solving complex optronics


smart systems for security
GD3070

RESEARCH, DEVELOPMENT
AND IMPLEMENTATION FOR

defence and security

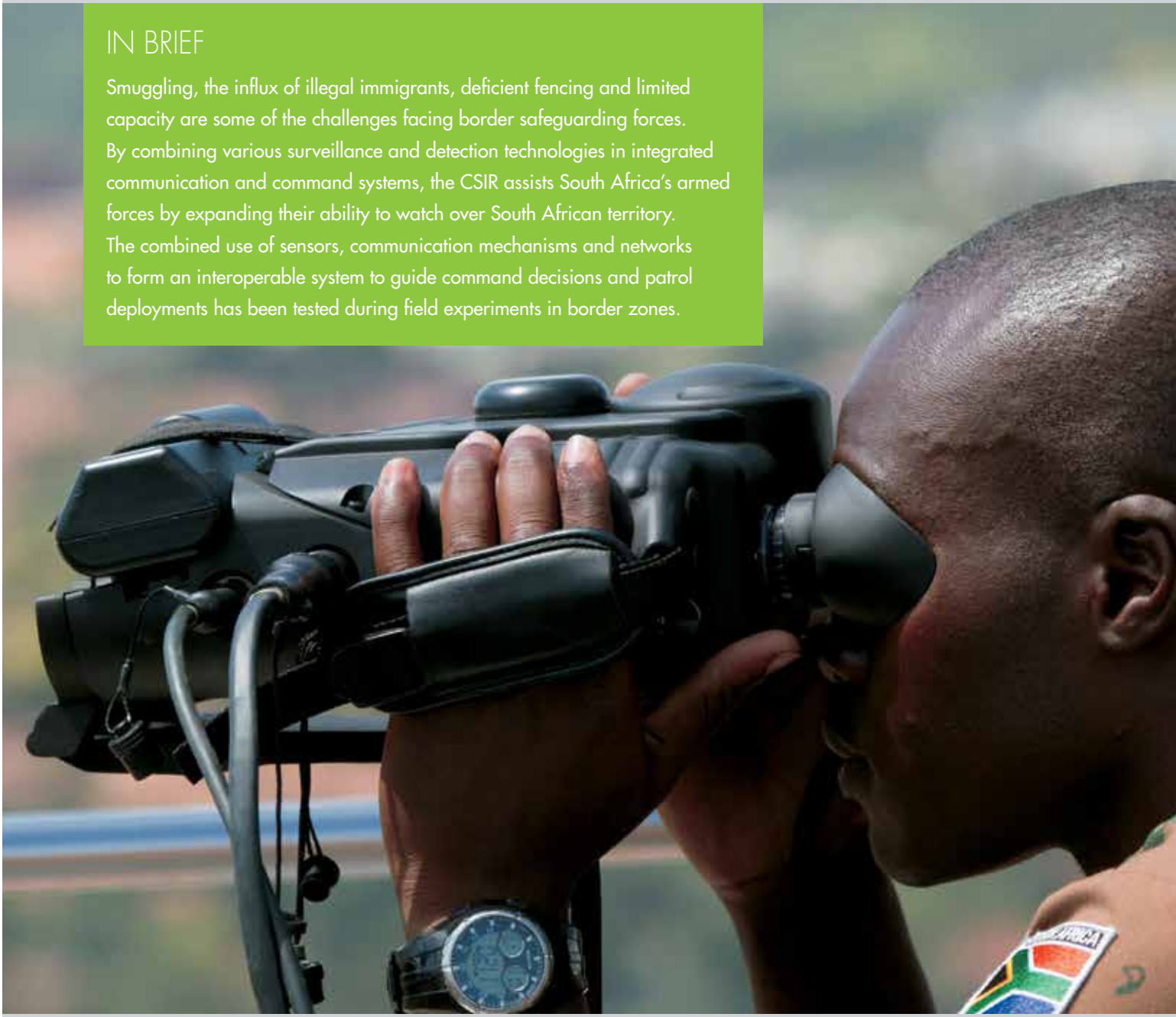
Safety and security are directly related to socioeconomic development and equality. A safe and secure country encourages economic growth and transformation by providing an environment conducive to employment creation, improved education and health outcomes, and strengthened social cohesion.

– The National Development Plan 2030

New approaches for integrative border safeguarding

IN BRIEF

Smuggling, the influx of illegal immigrants, deficient fencing and limited capacity are some of the challenges facing border safeguarding forces. By combining various surveillance and detection technologies in integrated communication and command systems, the CSIR assists South Africa's armed forces by expanding their ability to watch over South African territory. The combined use of sensors, communication mechanisms and networks to form an interoperable system to guide command decisions and patrol deployments has been tested during field experiments in border zones.



Border safeguarding is enhanced by creating means for existing technologies to interface.

THE CHALLENGE

The enormity of border safeguarding in the South African context

For South Africa, border safeguarding entails the challenge of overseeing an extensive borderline and many points of entry. The borderline comprises approximately 2 800 km of coastline, 4 800 km of land border and over 1.2 million square kilometres of air space. There are approximately 730 registered airports of which 10 are recognised international airports, more than 52 formal land border posts, and 111 seaports.

Rich in valuable, sought-after natural assets, from rhino horn to abalone, and located on an increasingly active trade route, the risk for South Africa extends to economic losses through piracy, poaching, smuggling, illegal entry and the potential to unhinge regional safety and security.

Improved border safeguarding requires close cooperation and integration between a number of government departments responsible for defence, immigration, policing, etc. The first field trials involved various platforms and groupings of the South African National Defence Force (SANDF) and local defence industries. These field trials will be expanded to include other role players in border safeguarding.

THE RESEARCH AND DEVELOPMENT

Out in the field: Integrative border safeguarding concepts

Command, control, communication and surveillance technologies are key components in effective border control. With limited scope for technology investment, innovative thinking is required to do more with what exists.

The CSIR designed an integrated concept development and experimentation process specifically to support the SANDF. Practical and affordable, this entails incorporating existing infrastructure, using readily available surveillance technologies and ensuring better integration of different platforms.

Field experiments were conducted in border zones to rigorously test the use of sensors, communication mechanisms and networks in combination. The ultimate aim is to manage a solution as an interoperable system that adds scope to the detection capabilities and provides intelligence to guide command decisions and patrols.

A first experiment in Ladybrand in July 2012 focused on communication infrastructure integration – using largely existing military equipment, better combined for greater patrol coverage and impact.

In February 2013, a follow-up experiment was conducted in Musina focusing on the use of concept command and control applications in a geographically distributed approach. A CSIR-developed, web-based command and control collaborator system – dubbed 'Cmore' – was integrated with smartphone-based mobile applications.

'Cmore' was developed with involvement of Armscor and helps operators better observe activities and incidents in the field. They can observe operator positions (real-time), receive photographic images, receive instant text messages and map positions. When an incident occurs, a unit is dispatched via this system, and its progress is tracked on a screen.

The Musina experiment involved three sites, namely Musina, Polokwane, and Pretoria, with Internet-based links between the sites. The experiment drew on a range of technologies, including unmanned aerial systems capturing video views, cellular telephone intercepts, jamming of global positioning systems, video and audio conferencing and sharing of remote computer desktops.

Although these are not new tools in the military environment, this was the first attempt at collaborative planning using video conferencing and software applications efficiently synchronised between remote sites.

THE OUTCOME

Integration achieved in real-world scenarios

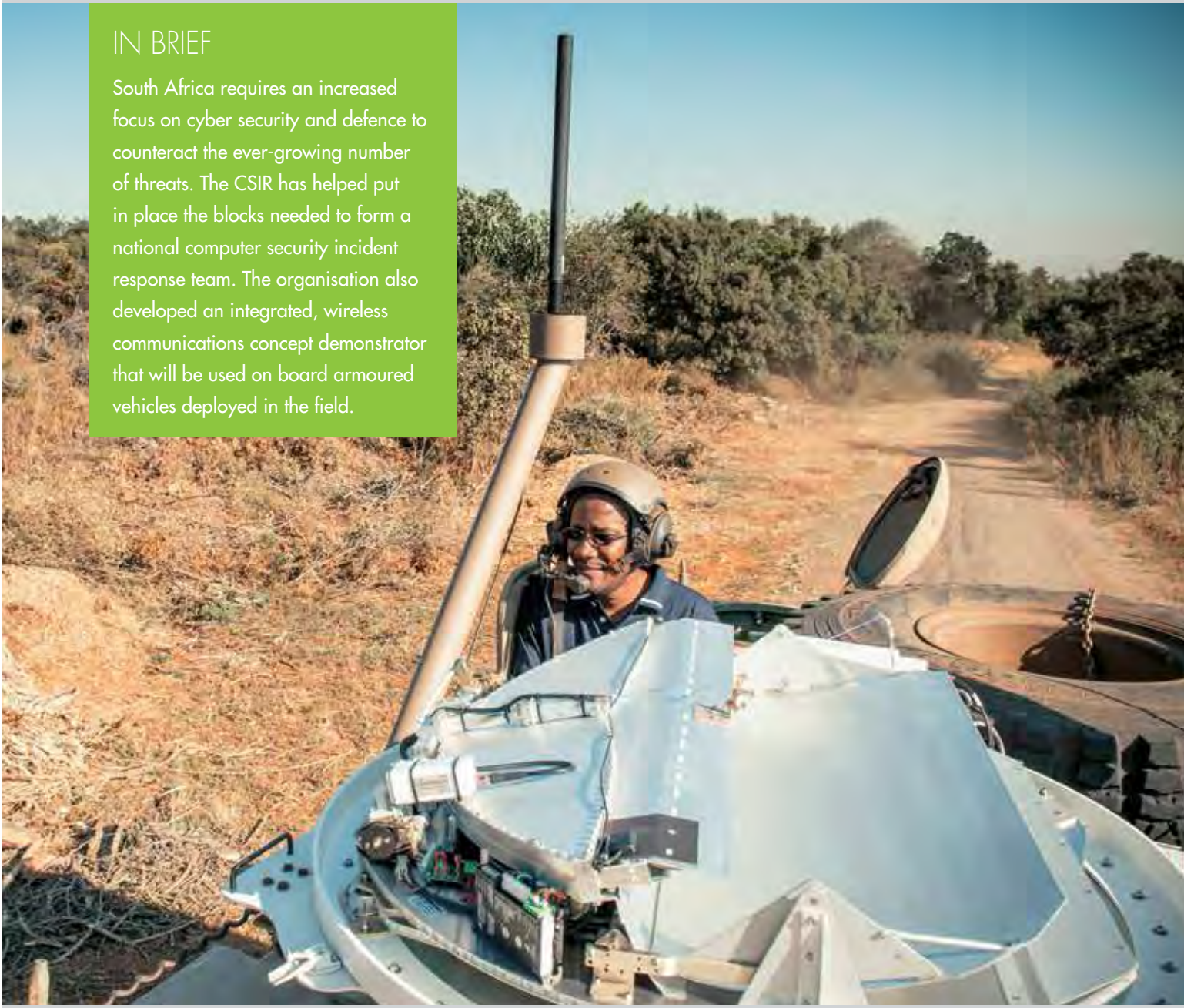
An important shift in focus in this manner of technology development is allowing the armed forces to participate in experiments to experience first-hand what processes and systems can work or must be improved for optimised efficiency, effectiveness and cost.

Follow-up experiments have been scheduled, with extensive defence force involvement, including the deployment of existing operational capabilities – sensors, systems and personnel – in conjunction with concept technologies.

Safe and secure national information and communications capabilities

IN BRIEF

South Africa requires an increased focus on cyber security and defence to counteract the ever-growing number of threats. The CSIR has helped put in place the blocks needed to form a national computer security incident response team. The organisation also developed an integrated, wireless communications concept demonstrator that will be used on board armoured vehicles deployed in the field.



CSIR engineers are developing an integrated, wireless communications system for armoured vehicles to ensure optimal situational awareness.

Cyber crime fighters: CSIR support for a National Cybersecurity Hub.

THE CHALLENGE

Protecting the integrity of South Africa's networks and systems

Interconnected communications systems have become the backbone for national infrastructure in most countries. The integrity of such systems is critical to the economy and security, but is increasingly being threatened by cyber attacks.

Their ability to cross borders in cyberspace and operate anonymously, allows criminals and terrorist groups to launch attacks that could potentially cripple military networks or infrastructure that depend on computer networks.

As a participant in global activities, South Africa requires an increased focus on cyber security and defence to counteract threats to the country's organisational, human, financial, technological and information resources.

Internet penetration is still less than 10% on the African continent, yet people are already affected by online predators, a trend which could worsen as the reach of Internet connectivity broadens.

Information security is also key in a modern-day military context, where an overwhelming volume of information is received from various sources, all of which has to be processed, integrated, interpreted and exploited to ensure situational awareness.

Security solutions technology is often imported from abroad, but such technology may lead to greater vulnerability instead of safeguarding if it is not fully understood or controlled.

South Africa will benefit from strengthening its own technological competence in information security to ensure that the confidentiality, integrity and infrastructure that secure the country's critical information, is well understood and protected.

THE RESEARCH AND DEVELOPMENT

The CSIR's multidisciplinary skills base and its track record in technological interventions for the country's armed forces equip the organisation to support defence-related information and communications technology (ICT), national information warfare and cyber security initiatives.

Establishing cybercrime defences

The CSIR was requested by the Department of Communications to offer support to the National Cybersecurity Policy Framework and the establishment of a National Cybersecurity Hub.

All ICT systems and hardware were procured and set up; the network design was done; and all incident reporting systems were developed and are ready for pilot testing.

Research on ever-emerging cyber security threats and trends is continuously undertaken.

The strategy, governance documents and service packages for the Hub have been put in place. This will put South Africa on par with many other countries by having a national computer security incident response team.

In addition, the CSIR completed the design of a cyber defence system for the hub that will provide operators and management with information relevant to South Africa's cyber domain. The cyber security system can measure the number of Internet-connected devices based on geographic distribution such as province, town or even street level. The system is used to identify the vulnerability of these devices and more accurate statistics can be provided to measure the impact of a potential cybercrime outbreak on the South African economy.

Secure and wireless networks for defence

Commercial, off-the-shelf equipment has become an increasingly prominent feature of the military communications industry as a result of significant investments in research and development by the private industry.

This includes the adoption of new generation telecommunication technologies – or 4G – derived from fourth generation technology networks. The major characteristic of these networks is that they offer high-throughput, low-latency passage for data and other digital applications.

In response to the worldwide trend, the South African Department of Defence pursued technology development to exploit the opportunities and benefits of incorporating the latest 4G technologies and accompanying off-the-shelf equipment, into their communications and networking infrastructure. Aside from the benefits of higher networking speeds, this move will also meet specific mobility and security requirements.

The CSIR was contracted to develop a first, integrated, wireless communications concept demonstrator that will be used on board armoured vehicles deployed in the field. The system will provide a state-of-the-art, communication-on-the-move functionality for the South African National Defence Force, offering voice, data and real-time video functionality.

Depending on the network provider, the communication range of the system is from a 5 km up to a 100 km radius.

A key challenge was integrating the conventional analogue-based military communications systems with state-of-the-art 4G communications technologies.

THE PERFECT BIRD'S EYE VIEW: IMPROVED OPTRONICS VIA HELIKITE

The CSIR successfully integrated a surveillance camera system onto a lightweight air platform. With added, improved stability, streaming and steering, the helikite-based, high-zoom, security camera is remotely controlled. This means the camera's field of view and gaze direction is managed from a distance.

The system is ideal as a situational awareness sensor in cases where, for example, trees or buildings make it difficult to view a large area; or for use in unrest situations or for the observation of long stretches of border. The system provides pan-tilt control relative to feature points in the image, irrespective of the position and pointing drift of the helikite due to wind. This allows the user to follow a specific target of interest and keep it within the field of view. Elevating the vantage point makes it possible to extend the 10 to 100 m range to several kilometres.

In this multidisciplinary development process, image processing algorithms were developed by CSIR optronics expert teams, while control systems experts worked on control signals for the pan-tilt unit from the motion detected in the image.

A laptop is used as a base station and runs the image processing software. The video signal is received and digitised by an analogue video capture device and control commands are provided by a control pad. This enhances and stabilises the image, computes the required pan-tilt control for the low frequency mechanical stabilisation and finally sends commands to the pan-tilt camera via a radio frequency link. Stabilising the image was critical to improve tracking and viewing clarity.

Following favourable feedback from industry, work on a helikite-based security camera continues, with the aim of developing a rugged, field-deployable version.

MULTI-SPECTRAL CAMERA SYSTEM DEVELOPED FOR CLEARER IMAGING

Optronic sensor experts developed a multi-spectral camera system to aid the development and testing of camouflage colours and patterns. The system comprises four separate sensor units and sophisticated software to generate four separate images or one perfectly fused image.

The user has the freedom to select bands and polarisation states by selecting band pass filters or polarising discs.

Based on the spectral band pass filter selection, the camera system can be used for camouflage development, vegetation analysis and forensic investigation.

Currently equipped with red, green, blue and near infrared filters, the system can be expanded by adding ultraviolet, short-wave infrared, medium-wave infrared and long-wave infrared sensor systems.

The system software manages lens control, capturing of video and images, playback and superposition of live or saved image data. Further software refinement will include complex image processing tools for, for example, long-range image enhancement and super resolution.

The multi-spectral camera system has four separate sensor units, each with an optical zoom lens and non-overlapping spectral filters and polarising disks.

Right and below: The human eye is sensitive to a very small portion of the electro-magnetic spectrum. A wealth of information which is not visible to the human eye is present in image scenes captured by the multispectral camera. This information can be used to provide inputs to develop more effective camouflage to protect soldiers.


clean energy from hardy biomass


efficient concentrating solar power

storage options for hydrogen

RESEARCH, DEVELOPMENT
AND IMPLEMENTATION FOR

energy

Increasing diversity in South Africa's energy production mix is important to mitigate climate change while enhancing supply security.

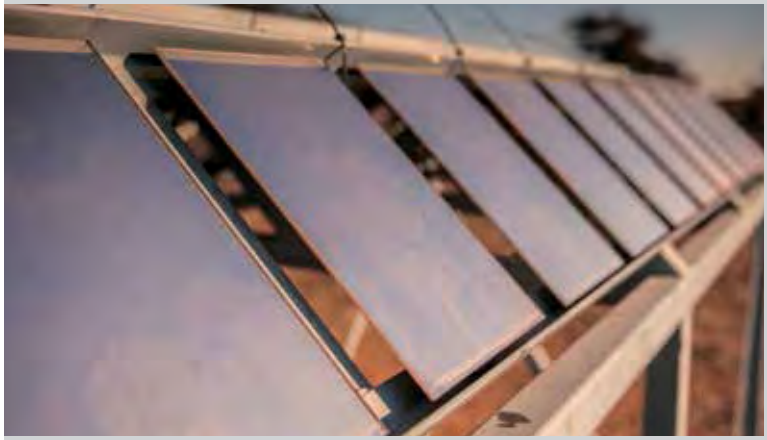
– The National Development Plan 2030

Determining the impact of dust on mirror energy output

IN BRIEF

Concentrating Solar Power (CSP) is emerging as a significant contender in the renewable energy sector. Utility-scale CSP plants require enormous capital investment, which is why government and industry need reliable costing of all factors influencing energy output and operations before they invest in construction. These plants use mirrors to concentrate solar radiation at a receiver from where it is converted to heat to produce electricity. Reflection loss due to dust contamination can have a significant impact on output, which is what CSIR researchers are studying at a site in the Northern Cape.

A custom-made camera captures images of mirror soiling.



Tilted mirror samples.

A sun photometer is used to measure aerosol optical thickness and precipitable water vapour.

THE CHALLENGE

Significant investment requires reliable costing

Renewable power generation can provide access to affordable, clean and reliable energy as a solution to South Africa's sustainable development goals.

Insufficient electricity supply is constraining the significant demand for further mining activity in the Kathu area in the Northern Cape. The site is well located for CSP plants as a result of the intense sunlight, open skies and its access to the national power grid.

The industry has, however, witnessed an example of unforeseen levels of reflectivity loss of up to 5% per day at an international CSP site after construction, mainly as a result of dust and other contaminants. This significantly influenced the cost efficiency of its electricity production.

Factors which influence mirror contamination therefore need to be studied carefully to accurately predict the cost impact of mirror cleaning, which requires the use of reliable stocks of distilled or demineralised water, equipment, vehicles and human resources, taking into account that water resources are scarce in semi-arid regions.

THE RESEARCH AND DEVELOPMENT

The CSIR was commissioned by a CSP project developer to design an experiment at a site near a mine to measure daily mirror reflectivity loss. The purpose of the experiment is to provide guidelines and recommendations which could influence decisions about the future use of CSP for electricity generation in this region.

The researchers installed a rack with mirror samples facing in different directions – to the east and the west and some in the horizontal position. They visited the site regularly to determine the extent of reflectivity loss due to mirror contamination over an extended period. A custom-made camera was used to record images to compare contaminated samples with clean ones.

The dust was also collected on lint free wipes which picked up a red-brown substance consistent with iron oxide. The dust particles at the Kathu site is believed to have a high haematite content, which is the mineral form of iron (III) oxide, generated by activity at the Sishen mine.

The average reflectivity loss over a period of one month of exposure at the site was 0.48% per day during the first year, but the researchers noted that the loss on mirrors in the horizontal position was double the rate of the tilted mirrors.

Reflectivity loss was also worse in the later dry winter months than in the wetter summer months. Heavier rain during the summer performs natural washing of the mirrors, cleans dust particles out of the lower atmosphere and binds the dust on the ground, making it less likely to be swept up by wind.

It was found that light rain conditions can cause heavy episodic soiling (1.4% to 5.3% on a single day) when it wets the mirrors, making them susceptible to particle capture, but not enough to cause natural washing.

Their conclusion was that the direction in which a mirror faces during such episodes could be an important factor to take into account in efforts to limit soiling, for example through mirror rotation away from the wind. If mirror washing is limited to a two-week cycle at a plant with no spare capacity, it can take a plant up to two weeks to recover from one severe soiling episode. The site would have to stock sufficient demineralised water and have staff on standby to deal with the situation quickly. To date, there is no evidence to suggest that such episodes are likely to be more frequent or more intense at the Kathu site than at any other existing or candidate CSP site.

THE OUTCOMES

The research continues into a second year, with the preliminary findings having been presented to the project developer.

The researchers recommended that consideration for mirror reflectivity loss needs to be integrated into any future system engineering process for a CSP plant. This will reduce or prevent unforeseen costs related to mirror cleaning and productivity loss.

Sources of contamination need to be monitored together with wind speed, direction and other environmental factors to assess the risks for reduced reflectivity.

The researchers recommended that mirrors should not be parked in the horizontal position when the plant is not in operation, but rather tilted to the east or west depending on local weather conditions at the time.

Smoke from grass fires and other biomass burning needs to be controlled in certain wind conditions and service roads in the vicinity of the plant need to be tarred or stabilised.

One of the biggest advantages of a CSP plant is the fact that the fuel needed to generate power is the sun's radiation, which is free. The real cost relates to the building and maintenance (e.g. mirror cleaning) of the plant, which is what researchers are looking at in the hope for it to become economically competitive with the burning of fossil fuels, the latter being detrimental to the environment.

Optimal levels of efficiency for a CSP plant must be achieved for it to become an affordable renewable energy solution.

Termites: An unlikely key that may unlock cleaner energy sources

IN BRIEF

In crop farming, termites are notorious pests that cost the sector millions of rands annually in crop damage. Termites are herbivores and it is this reliance on a plant biomass diet that interests scientists. They have set about finding – from the digestive tracks of termites – an enzyme or a combination of enzymes that enables termites to digest hardy biomass and convert it into energy. They are working towards using these enzymes as biocatalysts in a novel approach to breaking down plant waste materials for biofuel production.

THE CHALLENGE

Using hardy plant waste to generate clean energy

Like the rest of the world, South Africa is keen to find a renewable energy solution that would reduce the dependency on fossil fuels. Most of the energy stored by plants is in their actual structure, the fibre or inedible part of the plants. This cellulosic biomass is one of the most underused energy assets in the world – cellulose-containing natural waste is abundant and can be mass produced.

Conversion of biomass to ethanol using chemical processes is an environmental unfriendly undertaking due to the harsh acids and high temperatures required to access and hydrolyse the cellulose molecules. To help solve this problem, researchers are working on identifying, characterising and formulating an enzyme combination that will yield maximal release of simple sugars from cellulosic biomass. Ultimately, they intend to mimic the way termites break down hardy plant biomass to develop a robust technology for converting agricultural biomass to clean burning fuel.

THE RESEARCH AND DEVELOPMENT

Mimicking the way termites break down hardy plant biomass

Plant cell walls are made of at least three major compounds: lignin, hemicelluloses and cellulose, which are held together by strong chemical bonds. The combination of these compounds is what gives the plants structure, rigidity and more importantly, a protective barrier against pathogen invasion and attack. These compounds are very rich in energy, which has been derived from the sun through photosynthesis. Using enzymes, which are the ubiquitous proteins that accelerate chemical reactions, compounds such as hemicelluloses and cellulose can be broken down into simple sugars that can be fermented to produce fuel alcohol.

Termites can convert almost 95% of what they consume in a day into energy. To do this, they rely on bacteria and protozoa that inhabit their digestive tracts. These mutualistic microbes naturally generate a broad range of enzymes that convert the cellulosic materials into fermentable sugars. Researchers are isolating the genes that encode these enzymes. The team is using modern functional metagenomics tools to access these genes.

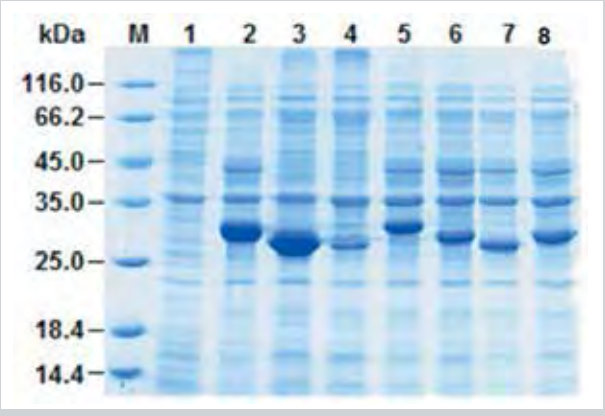
The technology involves isolating a total community DNA from microorganisms that reside in the guts of termites. The isolated DNA is then attached to the carrier DNA molecule before being propagated in a host bacterium. Using a high-throughput screening facility, thousands of recombinant bacteria are screened for enzymes that can hydrolyse plant biomass.

To date, the team has isolated in excess of 30 functional genes related to plant biomass degradation.

THE OUTPUTS

The numbers of enzyme genes isolated to date provide a sound basis for technology development to allow use of the targeted substrate, sugarcane bagasse (a waste by-product from sugarcane processing), in biofuel production.

The challenge going forward is to develop a robust technology that can be scaled up to industrial requirements and is cost effective. To be an industrially attractive technology, the cost of producing these termite-derived enzymes has to be substantially lowered and this can be addressed in part by evaluating the different protein production hosts for better protein yields.



To produce the termite-derived enzymes in large enough quantities, scientists use recombinant DNA technology. The genes of interest from termite hindgut are inserted in a carrier DNA molecule called expression plasmid DNA. The new expression plasmid DNA molecule containing DNA from termites are then put into a host bacterium called *Escherichia coli* (*E. coli*). The *E. coli* bacterium serves as a manufacturing plant where proteins are produced in large quantities using DNA code from termites. Within eight hours, *E. coli* produces milligram quantities of these enzyme proteins (these appear as dark blue bands, lane 2-8). To verify if the correct enzyme proteins are being produced, the commercial proteins of known sizes (also referred to as protein markers, lane M) are used as standards to determine the sizes of newly produced termites' proteins in *E. coli* (*E. coli* cells without termite DNA is also included as a control, lane 1). These enzyme proteins are mixed with woody biomass and yeast to make bioethanol in a process called simultaneous saccharification and fermentation.

Handling moisture-sensitive hydrogen storage materials synthesised at the CSIR.

PROGRESS ON HYDROGEN STORAGE

Noteworthy progress has been made with the synthesis, characterisation and performance testing of candidate hydrogen storage materials.

The use of hydrogen to deliver energy for cars, portable devices and buildings is seen as one of the key steps to reduce emissions of greenhouse gases. South Africa's national hydrogen strategy, HySA, aims to develop and guide innovation along the value chain of hydrogen and fuel cell technologies nationally.

Fuel cell vehicles, powered by hydrogen, have no emissions at the point of use other than water vapour. However, despite hydrogen being an attractive fuel for many reasons, a major stumbling block exists, due to the low volumetric energy density of hydrogen. This makes it very difficult to distribute the fuel and store a sufficient quantity of it on board a vehicle or where it is needed at a remote site, such as a telecommunications tower.

The Department of Science and Technology's HySA Infrastructure Centre of Competence, co-hosted by the CSIR and North-West University, is developing innovative solutions to this challenge. Various hydrogen storage/delivery options are being investigated, including metal-organic frameworks, carbon nanostructures, high-pressure composite cylinders and chemical carriers.

Successful synthesis of metal-organic frameworks has been accomplished and benchmarking results of structure, morphology and low-pressure hydrogen storage capacity have been obtained.

Scaling up of the synthesis procedure has been demonstrated and optimisation is being carried out to reproducibly generate kilogram quantities of the metal-organic framework. The material will undergo further processing, and its engineering properties will be evaluated in order to build prototype hydrogen storage units. The ultimate aim is to develop practical, affordable and safe hydrogen storage systems for use in selected portable, stationary and fuel cell vehicle applications.

Measuring the surface area and pore size of hydrogen storage materials.

Researchers discussing button cell test results.

RESEARCH FINDINGS ON IMPROVED LITHIUM-ION BATTERY PERFORMANCE PROTECTED THROUGH A NEW PATENT

CSIR research findings on improved lithium-ion battery performance have resulted in the filing of a new patent.

The development of high-performance electrochemical energy storage systems, notably lithium-ion batteries, features high on research agendas globally. Lithium-ion batteries have revolutionised many aspects of modern life, including electric vehicles and portable devices such as cell phones, laptops and tablets.

The CSIR battery research group (formerly led by Dr Michael Thackeray, now with Argonne National Laboratory in the United States of America) was a major global contributor to this research field in the early 1980s and registered world-class patents on lithium-ion battery electrode materials such as the lithium-manganese oxide spinel, currently used in electric vehicles such as the Nissan Leaf and Chevy Volt.

Renewed investment into research on new electrode materials for lithium-ion batteries over the past four years is beginning to pay dividends, with research findings on improved lithium-ion battery cathode performance resulting in the filing of a new patent. Innovations on lithium-ion batteries are mostly about the choice of materials or chemicals. Current CSIR research efforts are centred on the production of manganese-based cathode materials for possible e-mobility applications. The choice of manganese stems from its huge abundance in South Africa, as well as its low cost and low toxicity.

Extensive international collaboration is providing unique opportunities for extended research visits of students, specifically to the Argonne National Laboratory and the Solid State Ionics and Advanced Batteries Laboratory of the National University of Singapore. These interactions will contribute to the building of the expertise pool needed to accelerate innovation in this field.

Button cell lithium-ion battery produced at the CSIR.

technology for rural education

internet access

skills for a modern society

RESEARCH, DEVELOPMENT AND IMPLEMENTATION TOWARDS AN

inclusive information society

By 2030, ICT will underpin the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous.

– The National Development Plan 2030

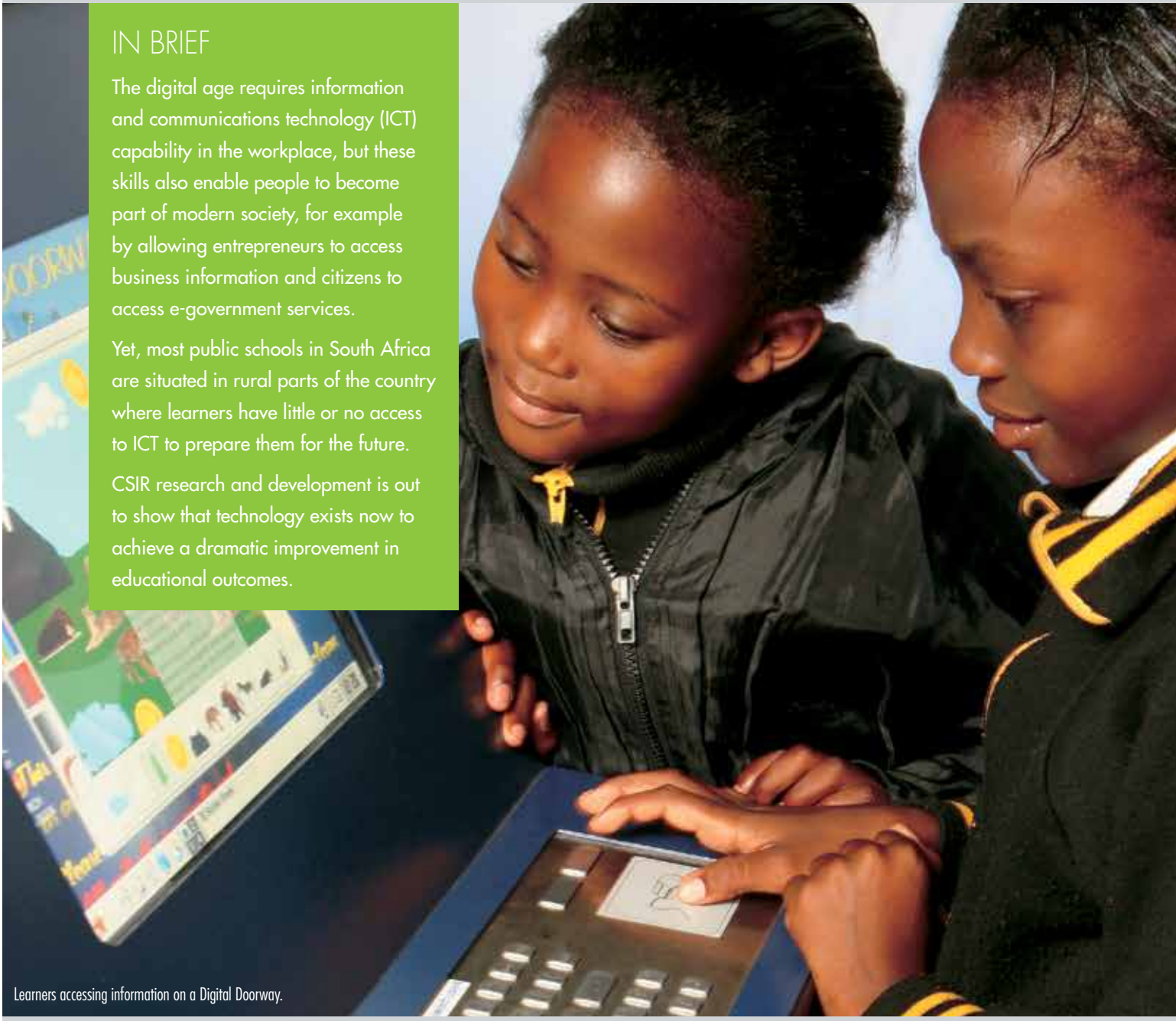
Information and communications technology at work for education

IN BRIEF

The digital age requires information and communications technology (ICT) capability in the workplace, but these skills also enable people to become part of modern society, for example by allowing entrepreneurs to access business information and citizens to access e-government services.

Yet, most public schools in South Africa are situated in rural parts of the country where learners have little or no access to ICT to prepare them for the future.

CSIR research and development is out to show that technology exists now to achieve a dramatic improvement in educational outcomes.



Learners accessing information on a Digital Doorway.

Learners thriving in an Internet-connected educational set-up.

Learners at the Arthur Mfebe Secondary School in the Eastern Cape learning through tablet teaching.

THE CHALLENGE

An estimated 17 000 of South Africa's 26 500 public schools are situated in rural areas with little or no access to the Internet. Many learners have limited access to educational resources compared to their urban counterparts, and their educational prospects are further limited by socio-economic challenges in their communities.

THE RESEARCH AND DEVELOPMENT

Getting connected

It is not economically viable to roll-out traditional broadband infrastructure in remote areas, mainly due to the distances between schools and limited economic activity in the communities.

Researchers at the CSIR have developed a wireless Internet network, and piloted it in Limpopo and Mpumalanga, to connect rural schools and villagers to the Internet as part of the Broadband for All initiative.

The technology consists of high performance nodes placed in clusters in villages for peer-to-peer communication. These are attached to buildings at roof level.

All of these units communicate with each other – the nodes do not necessarily use one route, but are able to relay a message along another node if one node breaks down, for example.

The size of the wireless network clusters varies from 10 to 24 schools, with trained village operators providing support, each assigned to a cluster of schools.

These clusters are connected to a wireless backbone at high sites in the districts. This backbone is connected to the South African National Research Network high-speed data infrastructure.

Since 2009, more than 200 facilities, including at least 170 schools, have been connected, giving Internet access to at least 97 500 learners. The project is funded by the Department of Science and Technology with European Union sector budget support funding.

The CSIR is in the process of establishing similar networks in the Northern Cape and the Eastern Cape.

Mobile learning to improve rural education outcomes

The rapid advance of mobile technology has enabled researchers to roll out a project in a rural part of the Eastern Cape to test the efficacy of teaching and learning with the help of mobile devices.

The Technology for Rural Education Development Project is a joint initiative between the Department of Science and Technology, the Department of Basic Education, the Eastern Cape Department of Education and the Department of Rural Development and Land Reform. The aim is to demonstrate how technology can be used to support rural schools in the Cofimvaba school district and to develop models for implementation and support that can be replicated on a national basis.

The project, which was piloted at the Arthur Mfebe Senior Secondary School in Cofimvaba, will be rolled out to a further 26 schools in the Nciba Schools district.

The school was equipped with a wireless network and a content server. Twenty teachers were provided with Android tablets in 2012 and taught to use the tablets to support teaching and learning in the school. At the beginning of 2013, the matric learners were also supplied with tablets to support their studies. Extensive further rollouts over the next two years are planned.

Online math tutoring

The learners at Arthur Mfebe also benefited from the successful Dr Math project, an online math tutoring service hosted by the CSIR, which has registered users in primary and high schools across South Africa.

Dr Math is accessed through the mobile social networking service Mxit, a South African instant messaging system where text messages are sent immediately between cell phones.

Learners can contact tutors from various universities and academic organisations after school hours, while remaining anonymous. Dr Math is now being redesigned to operate within a cloud environment to achieve greater reach. Dr Math has 40 000 users.

Access to computer self-learning through Digital Doorways

The Digital Doorway project has been running for more than eleven years and entails freely accessible computer equipment and open source software, housed in rugged steel enclosures with vandal-proof metal keyboards, screens protected by plexiglass, webcams, speakers and uninterruptible power supply.

The project is an initiative of the Department of Science and Technology and the CSIR, and is supported by the Department of Rural Development and Land Reform.

The Digital Doorway has seen many product iterations over time, from the original one-seater to three, and four-seater units, and units housed in self-contained solar containers. This year, the researchers redesigned the container units to accommodate printers, tablets, audio-visual equipment and a screen incorporated into one side wall of the container. The solar panels were also upgraded to improve their efficiency on overcast days.

To date, approximately 250 Digital Doorway units have been installed countrywide.

Data from the Department of Basic Education show that more than 110 000 South African learners go to school within walking distance of a Digital Doorway.

The units do not provide Internet connectivity, but are loaded with information about most school subjects.

A publication on the ICT Research, Development and Innovation Roadmap approved by Cabinet in 2013.

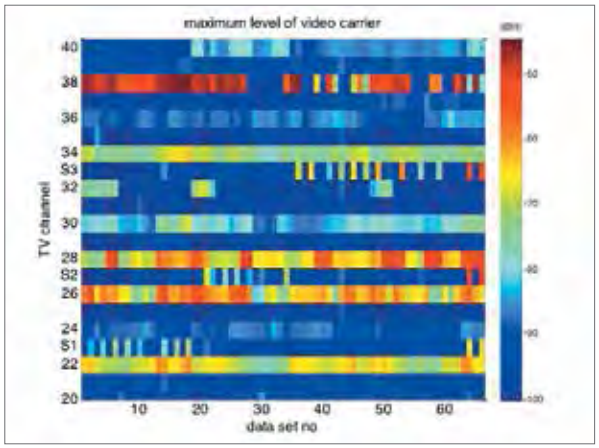
MAPPING THE WAY FORWARD FOR RESEARCH, DEVELOPMENT AND INNOVATION IN ICT

The CSIR worked closely with the Department of Science and Technology to develop the Information and Communications Technology (ICT) Research, Development and Innovation (RDI) Roadmap, a framework that paves the way for growth and development of the local ICT environment.

The ICT RDI Roadmap is the result of an intensive process of desktop research, consultation with experts and workshops that culminated in a strategic national direction, a set of action plans, and an implementation framework to guide, plan, coordinate and manage South Africa's investment in ICT research, technology development and innovation for the next ten years.

In plotting a digital way forward that will benefit the South African economy and the quality of life of all the country's citizens, the ICT RDI Roadmap presents a solid case for increased investment by public and private entities. The Roadmap was approved as a long-term investment and implementation plan for ICT RDI in South Africa by Cabinet in April 2013. The publication is available at: **www.dst.gov.za/images/ICT_RDI_Roadmap.pdf**

Summary of Roadmap opportunity areas.



This plot is based on TV white space research at the CSIR and shows the shared use of the television (TV) frequency spectrum for both broadcasting and TV white space communications at some 66 different points (denoted by dataset number) in Tygerberg, South Africa. Specifically, the TV channels 23, 27 and 33, denoted with S1, S2 and S3, are not used by TV, and therefore are so-called white spaces. In a trial project with Google and TENET, these TV channels are now used to provide Internet to 10 schools. The red represents a strong signal and, for the channels S1-3, indicates which places are reached by this novel type of Internet service. The excellent propagation properties of TV frequencies are well suited for and may target rural communications.

TRIAL INVESTIGATES UNUSED SPECTRUM IN THE TV SPECTRUM BANDS FOR RURAL INTERNET ACCESS

The CSIR and its partners embarked on the first ever trial in Africa to determine the viability of TV whitespaces technology for the delivery of broadband to underserviced communities and rural areas. The trial will provide the Independent Communications Authority of South Africa with the spectrum measurements and interference reports it needs to formulate a policy around the use of television white spaces (TVWS) for broadband Internet access.

The objective of the trial is to show that TVWS can deliver affordable broadband and Internet services without interfering with regular TV reception. The appeal of using TVWS for Internet access is the availability of spectrum, especially in rural areas; its reach (up to ten kilometres from the base stations); and its ability to penetrate buildings. It does not require a line-of-sight position to operate. When digital TV rolls out in South Africa, additional broadcast spectrum will be freed up, thanks to digital's more efficient use of the airwaves.

CSIR researchers developed a telephone-based information management service for the National School Nutrition Programme for learners to give feedback about meals, and for this information to be monitored at district, provincial and national level.

IMPROVED COMPETENCE IN HUMAN LANGUAGE TECHNOLOGIES SEES APPLICATIONS FOR THE SA CONTEXT

Research and development on speech technologies for resource-scarce languages in South Africa, funded by the departments of Arts and Culture as well as Science and Technology, resulted in numerous operational services and an increasingly solid competence base in speech technology at the CSIR. Resource-scarce languages are languages which have an economically disadvantaged user base that is typically ignored by the commercial world.

The first phase of the project, Lwazi I, involved the development of various baseline speech technologies and a telephone-based, speech-driven information system for community development workers. Lwazi II aimed to elaborate on the initial work, and saw the deployment of a number of additional telephone-based services and speech technologies. Automatic speech recognition and text-to-speech systems were improved to the point where these can now be adapted for deployment in real-world applications.

The project culminated in several voice services that demonstrate the potential of human language technologies to improve quality of life for South Africans. These include two voice services for the National School Nutrition Programme of the Department of Basic Education which aid the Department in its efforts to monitor its service delivery. Secondly, two voice services were deployed which aim to improve communication between veterinarians and rural livestock owners in an effort to curb the outbreak of serious livestock diseases.

Mr Samuel Boinyana Sebole, a herbalist from the Bofule village in North West with his collection of plant materials.

A NATIONAL RECORDAL SYSTEM TO PRESERVE SA'S INDIGENOUS KNOWLEDGE SYSTEMS

The CSIR launched the National Recordal System initiative, which aims to protect, preserve and promote South Africa's indigenous knowledge systems (IKS), enabling communities to secure their knowledge and transform it into economic and social benefits, while at the same time saving it for posterity.

The system was established in response to the IKS Policy adopted by Cabinet in 2004 as a means of documenting and recording indigenous knowledge. Central to its success is the National Indigenous Knowledge Management System (NIKMAS) information and communications technology platform of the Department of Science and Technology. NIKMAS is a secure multimedia digital repository that supports the processes of the recordal system, which include the cataloguing of the holders of IK, recording, verification and classification, as well as authentication. It is unique in that it records African indigenous knowledge in its original oral format, links it to a complex metadata model and provides the necessary mechanisms for both positive and defensive protection – a first of its kind internationally.


skilling for diamond cutting and polishing


adding value to buchu cultivation

distillation unlocks essential oils

enterprise creation for development

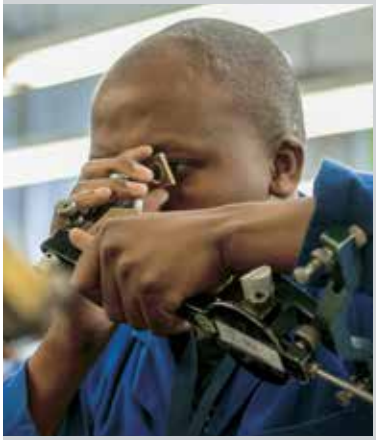
Achieving full employment, decent work and sustainable livelihoods is the only way to improve living standards and ensure a dignified existence for all South Africans. Rising employment, productivity and incomes are the surest long-term solution to reducing inequality. This will be achieved by expanding the economy to absorb labour and improving the ability of South Africa's people and institutions to respond to opportunities and challenges.

– The National Development Plan 2030

Diamonds put the sparkle into a North West business opportunity

IN BRIEF

At the request of the North West Department of Economic Development, Environment, Conservation and Tourism, the CSIR assisted the Borobalo Diamond Cutting and Polishing Primary Cooperative with business planning and implementation of a small, focused diamond cutting and polishing centre in Wolmaransstad. Two men and one woman completed their six months of training as diamond polishers at the Harry Oppenheimer Diamond Training School in Johannesburg and shortly afterwards the Borobalo Diamond Cutting and Polishing Centre commenced its operations. Polished diamonds are sold to jewellery manufacturers.



Examining a diamond with a loupe.

Trainees Dewet Tshonto, Tshidi Lebeko and Timi Leshage of Borobalo Diamond Cutting and Primary Cooperative.

Polishing a diamond.

THE CHALLENGE

Small-scale mineral resource beneficiation in diamond-rich Wolmaransstad

South Africa's province of North West is the national hub of alluvial diamond mining. Wolmaransstad, a town with some 50 000 inhabitants, produces 32% of diamonds in the province and has the highest concentration of small-scale diamond miners in the country. The town's rough diamond trading centre is one of only four in South Africa.

While these conditions would seem ideal for a thriving minerals trade to benefit local economic development, unscrupulous trading activities result in unlawful sales and exploitation of miners. The confluence of several positive developments has, however, catalysed various entrepreneurial opportunities.

National government's commitment to stimulate mineral resource beneficiation includes diamond beneficiation. The recently established State Diamond Trader is mandated to purchase a maximum of 10% of South Africa's rough diamond production for resale to local beneficiating entities.

TECHNOLOGY SOLUTIONS AND ENTERPRISE CREATION

To assist the North West Department of Economic Development, Environment, Conservation and Tourism in assessing the viability of a diamond beneficiation facility in Wolmaransstad, a group of CSIR enterprise development and mining experts set about to confirm the most viable business opportunity and plan.

The CSIR sources technology solutions to help create sustainable rural communities. The organisation rejected the option of alluvial mining following findings that the nature of the geological conformation would require significant mining activities to make this enterprise profitable. Beneficiation was therefore identified as the best business opportunity.

Putting the enterprise pieces into place

All the recognised and necessary aspects for the creation of this enterprise were spelt out in the business plan, notably purchase from two sources (the State Diamond Trader and small-scale alluvial miners); certification of the polished gems by an accredited diamond laboratory to ensure a premium selling price to jewellery manufacturers locally and worldwide; setting up of suitable premises with modern diamond processing equipment; technical training for staff through a suitable diamond training school; and the identification of an experienced technical partner.

How to make the best of rough diamonds

The diamond route to riches is not an easy one, with training of sufficient numbers of diamond cutters being one of the vital prerequisites for this highly skilled trade. Found as rough, unpolished stones, diamonds must be processed into cut gems for sale.

South Africa has only 1 600 diamond cutters. To acquire the necessary skills for cutting and polishing diamonds, trainees must have at least mathematics at Grade 12 level, excellent eyesight and the passion and patience to create a beautiful artefact from a lump of crystals.

The CSIR identified the Harry Oppenheimer Diamond Training School as the best training option for three Borobalo Cooperative members. They joined a class comprising 31 female and 45 male students from Africa, Poland and China.

The diamond polishing course gives its learners knowledge of various aspects of diamond polishing. This entails learning how to cut a 'round brilliant' from so-called makeable rough diamonds, a more advanced skill than cutting rough sawable stones (diamonds that are divided into two more or more pieces). A 'round brilliant' is the most common shape used by manufacturing jewellers, with either 57 or 58 facets or surfaces and the easiest to market.

As the yield from a rough diamond ranges between 40 to 60%, the skill lies in getting the biggest and best quality gem from the rough stone. Trainees were closely monitored to ensure that they comply with strict criteria. Two Borobalo trainees also completed a rough diamond evaluation course to understand the value-determining factors to make meaningful decisions regarding rough diamonds.

Setting up the production facility

After completion of their training, the three Borobalo diamond cutters returned to Wolmaransstad to start operations at their centre. As it takes a diamond cutter an average of 1.5 days to cut and polish a carat, the output for the Borobalo centre is estimated at 480 carats of cut diamonds per year. At an average price of US$2 000 per carat, sales of this output as a small portion of the growing market share bode well for its future.

In partnership with the North West Department of Economic Development, Environment, Conservation and Tourism, the CSIR remains involved with the Borobalo Diamond Cutting and Polishing Centre for the next two years to assist the enterprise to achieve sustainability.

An agro-processing enterprise in Namaqualand.

LOCAL SUCCULENT YIELDS NATURAL, CALMATIVE AGENT

An indigenous medicinal plant, *Sceletium tortuosum* or Kougoed, has been used traditionally as a natural anti-depressant. CSIR natural product chemists and enterprise creation for development experts are investigating cultivation practices for the species to relieve pressure on wild populations; product development processes are also part of this project. This activity is in line with the CSIR's commitment to help create sustainable enterprises in rural communities based on technological solutions.

With funding from the Department of Science and Technology's sustainable livelihoods programme, the Nourivier Medicinal Plants project creates new opportunities for employment and poverty alleviation in this poverty-stricken area in the Kamiesberg region of Namaqualand in the Northern Cape.

The long-term goal is a commercial-scale, community-based agro-processing enterprise based on sustainable cultivation, harvesting and processing of this plant to yield pre-processed 'raw' plant material for the pharmaceutical industry.

The Kamiesberg Local Municipality made agricultural land available next to the Nouriver Dam, a source of perennial water in the area. Approximately 5 000 Kougoed plants grew from cuttings in shade houses under gravity-fed sprinkler irrigation. The site operates solely on solar power.

Agro-processing knowledge is being transferred to rural farming communities. More than 30 people from the local community are employed and 10 staff members received training in basic horticultural techniques and life skills development.

Community access to enterprise information in North West.

ACCESS TO ENTERPRISE INFORMATION NOW A REALITY IN RURAL NORTH WEST

Three villages in rural North West have been equipped with enterprise information centres to empower local communities through access to information for business opportunities, funding, and enterprise creation. The centres also assist learners with enquiries on bursary forms, career guidance, university registration, learnerships, internships and job opportunities.

The establishment of three centres situated in Lebotloane, Logagane and Mokgalwaneng is the outcome of a partnership between the North West Department of Economic Development, Environment, Conservation and Tourism, the Baphuting ba ga Nawa Traditional Council and the CSIR.

The CSIR assisted in setting up the facilities to accommodate the requirements of each centre and in ensuring training for the six information officers.

As information platforms, these centres provide an effective way to resolve local socio-economic hardship and challenges. Villagers are no longer constrained by their rural location and associated travelling time, which made registering new businesses difficult.

Villagers now operate at the interface of society and technology to identity opportunities for local economic development. Access to information has bolstered the role of young people as agents of change through advocacy, and by raising awareness of the possibilities of innovation in sectors such as the green economy, agriculture, the built environment and tourism.

ESSENTIAL OILS PRODUCTION THRIVES IN PIKET-BO-BERG

Located in Piket-Bo-Berg (some 155 km north of Cape Town), Genadenberg Natural Products is a small essential oils production facility with big plans. The well-run production facility, with modern equipment, markets its buchu and lavender oil to companies in the Western Cape. These are used in the international flavour and fragrance industries.

Buchu *(Agathosma betulina)* grows naturally in this mountainous area. Steam-distilled essential oil from Genadenberg's 10 carefully tended hectares of buchu yielded 105 kg of oil in 2012. Its three hectares of lavender yielded 80 kg of oil in the same period. State-of-the-art equipment enables the provision of contract distillation services to farmers in the area.

The technology transfer process will be completed once the enterprise development arm of the Moravian Church of South Africa assumes ownership of the venture. It is an integral part of their long-term development plan encompassing income-generating projects in the area.

Genadenberg Natural Products provides employment opportunities to seven local residents of Piket-Bo-Berg. It evolved from a pilot project with the help of the CSIR and the Department of Science and Technology, as part of efforts to use science and technology as enablers for sustainable rural communities. The Department of Agriculture also provided technical and financial support.

Buchu plants under cultivation.

Operations manager Henry Maans of Genadenberg Natural Products with distilled oil.

knowledge dissemination

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New international patents granted

Patent Title	Country	Patent Number
A Method of Switching from a Source Encoded Video Stream to a Destination Encoded Video Stream	United Kingdom	2475463
Barrier Technology	Japan	5066360
Barrier Technology	United States	8,293,347
Crack Sealing	EPO-European Patent Office	2373456
Crack Sealing	France	2373456
Crack Sealing	Germany	2373456
Crack Sealing	United Kingdom	2373456
Crack Sealing	United States	8,322,008
Dirfinder	Canada	2,579,694
Dirfinder	Malaysia	MY-144235-A
Flagellin - Gram Positive Recombinant Protein Producing Bacteria	Australia	2005/323811
FliD - Production of Heterologous Proteins or Peptides	EPO-European Patent Office	2235045
FliD - Production of Heterologous Proteins or Peptides	France	2235045
FliD - Production of Heterologous Proteins or Peptides	Germany	2235045
FliD - Production of Heterologous Proteins or Peptides	Switzerland	2235045
FliD - Production of Heterologous Proteins or Peptides	United Kingdom	2235045
Hoodia Plant Extract with Improved Flavour	EPO-European Patent Office	2111765

Patent Title	Country	Patent Number
Method for Converting Aloeresin to Aloesin	France	1874751
Method for Converting Aloeresin to Aloesin	Germany	1874751
Method for Converting Aloeresin to Aloesin	Hong Kong	1119169
Method for Converting Aloeresin to Aloesin	Switzerland	1874751
Method for Converting Aloeresin to Aloesin	United Kingdom	1874751
Nano Particle Carriers For Drug Administration	Mexico	300137
Nano Particle Carriers For Drug Administration	Singapore	163927
Nano Particle Carriers For Drug Administration	United Kingdom	2469965
Nucleosides - 5-MU Process	EPO-European Patent Office	2356246
Nucleosides - 5-MU Process	France	2356246
Nucleosides - 5-MU Process	Germany	2356246
Nucleosides - 5-MU Process	Italy	2356246
Nucleosides - 5-MU Process	United Kingdom	2356246
Preventative Treatment and Remission of Allergic Diseases	United States	8,158,165
Spherezymes - Enzyme Immobilisation	Canada	2554033
Spherezymes - Enzyme Immobilisation	China	ZL200580003521.1
Spherezymes - Enzyme Immobilisation	India	252100
Treatment of Erectile Dysfunction and Libido Enhancement	ARIPO-African Regional Intellectual Property Organisation	AP/P/2008/004675

corporate governance

Corporate governance

FRAMEWORK

Corporate governance is formally concerned with the organisational arrangements that have been put in place to provide an appropriate set of checks and balances within which the stewards of the organisation operate. The objective is to ensure that those to whom the stakeholders entrust the direction and success of the organisation act in the best interest of these stakeholders. It is about leadership with integrity, responsibility, accountability and transparency.

The CSIR is committed to principles and practices that will provide our stakeholders with the assurance that the organisation is managed soundly and ethically. We have established a management model that governs and provides guidance for the way that all employees interact with our various stakeholder groups.

The underpinning principles of the Group's corporate governance rest on the three cornerstones of an effective and efficient organisation namely, day-to-day management processes; a long-term strategic planning process; and effective change processes. These processes are supported by systems that are used to plan, execute, monitor and control the strategic and operational domains of the organisation. The supporting infrastructure and its evolution are documented in our management model, which is reviewed and updated regularly.

In accordance with the Scientific Research Council Act (No 46 of 1988), as amended by Act 71 of 1990, the appointment of the CSIR Board is by the Executive Authority. The Board provides strategic direction and leadership; determines goals and objectives of the CSIR and approves key policies. The Board has adopted formal Terms of Reference that are in line with the Scientific Research Council Act and the Public Finance Management Act (PFMA) (No 1 of 1999), as amended by Act 29 of 1999.

The CSIR Board and the CSIR Executive Management Committee believe that the organisation has complied with the relevant principles incorporated in the Code of Corporate Practices and Conduct, as set out in the King III Report.

SHAREHOLDER'S COMPACT

In terms of Treasury Regulations issued in accordance with the PFMA, the CSIR must, in consultation with the Executive Authority, annually agree on its key performance objectives, measures and indicators. These are included in the shareholder's performance agreement (Shareholder's Compact) concluded between the CSIR Board and the Executive Authority.

The compact promotes good governance practices in the CSIR by helping to clarify the roles and responsibilities of the Board and the Executive Authority and ensuring agreement on the CSIR's mandate and key objectives. The chairperson of the Board and the Executive Management Committee hold bilateral meetings with the Executive Authority.

FINANCIAL STATEMENTS

The CSIR Board and the CSIR Executive Management Committee confirm that they are responsible for preparing financial statements that fairly present the state of affairs of the Group as at the end of the financial year and the results and cash flows for that period. The financial statements are prepared in accordance with South African Statements of Generally Accepted Accounting Practice. In addition, the CSIR Board is satisfied that adequate accounting records have been maintained.

The external auditor is the Auditor-General, who is responsible for independently auditing and reporting on whether the financial statements are fairly presented in conformity with South African Statements of Generally Accepted Accounting Practice. The Auditor-General's Terms of Reference do not allow for any non-audit work to be performed.

RISK MANAGEMENT

The CSIR Board is responsible for ensuring that a comprehensive and effective risk management process is in place.

Risk management in the CSIR is an ongoing process, focused on identifying, assessing, managing and monitoring all known forms of significant risks across all operations and Group companies. This has been in place for the year under review and up to the date of approval of the Annual Financial Statements.

A structured process of risk management has been put in place to ensure that the goals and objectives of the CSIR will be attained. CSIR systems have been put in place to review aspects of economy, efficiency and effectiveness. Management is involved in a continuous process of improving procedures to ensure effective mechanisms for identifying, managing and monitoring risks in the following major broad risk management areas: systemic risks, strategic risks and operational risks. The CSIR's ability to anticipate threats, respond and continually adapt is a critical part of the risk management process. The complex nature of the CSIR and diverse operations make this a uniquely challenging and stimulating environment. Cognisance is taken of the fact that the risks identified are inter-linked and cannot be managed in isolation.

Documented and tested processes are in place which will allow the CSIR to continue its critical business operations in the event of a disastrous incident impacting on its activities, and to ensure complete, timely and relevant reporting by management.

Based on the work of internal audit, the organisational results achieved, the audit report on the Annual Financial Statements, and the management report of the Auditor-General, the Board is satisfied that the system of risk management has been effective during the year under review.

SYSTEMIC RISKS

Systemic risks originate from macro-economic and national challenges affecting the National System of Innovation and National Government Business Enterprise space in which the CSIR operates.

Continued evaluation of macro-economic influences, ongoing assessment and engagement with stakeholders remain key in directing research activities towards achieving the CSIR's mandate.

STRATEGIC RISKS

The organisation has effective mechanisms in place for identifying and monitoring strategic risks that impact the CSIR Group's ability to deliver on its mandate. The procedures for implementing a risk management process include a focus on areas such as: Human capital assessment and development; research impact areas; technological development; and business continuity.

OPERATIONAL RISKS

The CSIR endeavours to minimise operating risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout the Group. Key processes employed in managing operating risk include research ethics and good research practices; segregation of duties; transaction approval frameworks; financial and management reporting; and monitoring of metrics which are designed to highlight positive or negative performance across the broad range of key results areas (KRAs). The Operations Committee, which comprises members of the Executive Management Committee, operating unit and centre executive directors, and group managers, oversees operational matters.

GOING CONCERN

The CSIR Board has reviewed the Group's financial budgets for the period 1 April 2013 to 31 March 2014 and is satisfied that adequate resources exist to continue as a going concern for the foreseeable future. The CSIR Board confirms that it has assessed key sustainability risks and there is no reason to believe the business will not be a going concern in the year ahead.

The income streams of the CSIR are detailed in the notes to the financial statements.

INTERNAL CONTROL

The CSIR Board has ultimate responsibility for the system of internal controls. The key controls required to mitigate risk and ensure the integrity and reliability of financial statements have been identified in conjunction with the internal and external auditors. Close cooperation between the internal and external auditors ensures adequate and efficient audit reviews of the proper functioning of these key controls.

The annual audit plan is based on the key risks to the organisation and the results of the risk management process. The work programme that gives effect to the plan is reviewed by the Audit and Risk Committee and approved or modified as required.

Internal financial controls have been assessed as effective to mitigate related risks.

APPROVAL FRAMEWORK AND POLICIES

The CSIR Board has adopted an approval framework that governs the authorisation processes in the CSIR. It deals with, among others, the construction of strategic plans; development of operational plans and budgets; appointment of staff; approval of salaries; intellectual property management and investment in and disposal of property, plant and equipment. It also defines authority levels in relation to organisational positions.

Appropriate controls are in place to ensure compliance with the above framework. A comprehensive set of procedures exists to provide the necessary checks and balances for the economical, efficient and effective use of resources. The essence of this framework is that it is comprehensive, clear and unambiguous, and easy to assimilate and internalise.

All subsidiary companies are under the control of a duly appointed Board of directors.

The Board reserves to itself all matters with potential to have material impact on the operations and reputation of the CSIR.

EMPLOYEE PARTICIPATION

The CSIR strongly encourages effective and modern workplace practices and relationships to foster employee participation and work process involvement as a key practice at all levels in the organisation. Employee participation happens, for example, through self-directed staff sessions; PFMA road shows; formal induction programmes; technical and strategic focus groups and task teams.

CODE OF BUSINESS ETHICS AND ORGANISATIONAL VALUES

The CSIR Board and CSIR Executive Management Committee have approved and adopted a code of ethics which reflects their commitment to a policy of fair dealing and integrity in conducting their operations. The code aligns closely to the CSIR set of values, compliance to laws and regulations and requires all employees to maintain the highest ethical standards, ensuring that business practices are conducted in a manner which is beyond reproach. Monitoring ethical behaviour is devolved to operating unit level and transgressions are addressed by means of procedures detailed in the CSIR Conditions of Service and the PFMA.

Governance structure

THE CSIR BOARD

The responsibilities of the Board are governed by the Scientific Research Council Act and the PFMA. The Board approves the strategy, goals, operating policies and priorities for the organisation and monitors compliance with policies and achievement against objectives.

With the exception of the CEO of the CSIR, all members of the CSIR Board are non-executive. CSIR Board members are actively involved in and bring independent judgement to bear on Board deliberations and decisions. All non-executive Board members have been assessed as independent during the year under review.

The CSIR Board, of which the current number of members adheres to the statutory minimum requirements, meets quarterly. For the year under review, the Board met on 28 June 2012, 13 September 2012, 30 October 2012 (strategy session), 14 November 2012 and 20 February 2013. The Annual Financial Statements for the 2012/13 financial year were approved on 27 June 2013.

The CSIR Board has the following sub-committees: the Human Resources and Remuneration Committee; the Audit and Risk Committee; and the Strategic Review Committee (see pages 98 to 99). These committees are selected according to the skills sets required for the committees to fulfil their functions. For the 2012/13 year, the committees complied with their respective Terms of Reference.

The CSIR Board has adopted formal Terms of Reference reflected in the Board charter, which are annexed in the Shareholder's Compact. For the year under review, the Board has assessed its performance and that of its committees. There are no issues of concern in this regard.

CSIR Board members

1 APRIL 2012 TO 31 MARCH 2013

Prof Francis Petersen

Dean: Faculty of Engineering and the Built Environment, University of Cape Town

Dr Sibusiso Sibisi

Chief Executive Officer: CSIR

Prof Mike Wingfield

Director: Forestry and Agricultural Biotechnology Institute, University of Pretoria

Mr Mclean Sibanda

Chief Executive Officer: The Innovation Hub Management Company

Mr Phillip Benadè

Retired from the Department of Education. Independent financial consultant

Mr Ghandi Badela

Advocate: Duma Nokwe Group

Prof Eugene Cloete

Dean: Faculty of Science, University of Stellenbosch

Dr Philip Goyns

Supply Option Modelling Specialist: Department of Energy

Ms Malebo Mabitje-Thompson

Chief Operations Officer: Department of Trade and Industry

Prof Tebello Nyokong

Professor: Medicinal Chemistry and Nanotechnology, Rhodes University

Ms Swazi Tshabalala

Chief Executive Officer: Industrial Development Group

The Board and all its committees were appointed on 1 January 2012.

SCHEDULE OF ATTENDANCE OF THE CSIR BOARD AND CSIR COMMITTEE MEETINGS (1 April 2012 to 31 March 2013)

Board member	Board meetings (5)	Audit and Risk Committee (4)	Human Resources and Remuneration Committee (4)	Strategic Review Committee (3)
Petersen	5		1*	3
Badela	5	3	3*	2
Benadè	5	4	3*	2*
Cloete	5			3
Goyns	4		3	1*
Mabitje-Thompson	3		2	
Nyokong	3		1*	2
Sibanda	4	4	2	1*
Sibisi	5	4[a]	2[a]	3
Tshabalala	5	4		3
Wingfield	4			1

[a] Attends in capacity as CEO
* Attendance by invitation

EXECUTIVE MANAGEMENT COMMITTEE

The Executive Management Committee has executive responsibility for the CSIR and consists of the following Executive members:

- CEO: Dr Sibusiso Sibisi
- Group Executive, Operations: Dr Hoffie Maree
- Group Executive, Research and Development: Dr Molefi Motuku (appointed 1 June 2012)
- Group Executive, Strategic Alliances and Communication: Dr Rachel Chikwamba
- Chief Financial Officer: Chris Sturdy
- Group Executive, Shared Services: Raynold Zondo

All Executives are employed on a five-year contract basis.

CSIR Executive team, from left: Raynold Zondo, Group Executive: Shared Services; Dr Rachel Chikwamba, Group Executive: Strategic Alliances and Communication; Dr Sibusiso Sibisi, Chief Executive Officer; Dr Molefi Motuku, Group Executive: Research and Development; and Chris Sturdy, Chief Financial Officer.

Dr Hoffie Maree

Group Executive: Operations
(retired 31 March 2013)

CSIR LEADERSHIP TEAM

The CSIR management is responsible for strategy implementation and managing the day-to-day affairs of the CSIR and its operating units in accordance with the policies and objectives approved by the CSIR Board. This leadership team comprises the members of the CSIR Executive Management Committee and operating unit executive directors and centre managers.

Other internal structures that contribute to governance at the CSIR include the Executive, Operations and Strategic Committees, the Strategic Research and Contract Research and Development forums, and the Research Advisory Panels.

BOARD OF DIRECTORS AND GROUP COMPANIES

The CSIR Executive appoints the boards of the various subsidiary companies.

BOARD AND EXECUTIVE MANAGEMENT REMUNERATION

Details of the CSIR Board are set out on pages 95 to 96 of the Corporate Governance Report. The membership and Terms of Reference of each Board Committee are further described on pages 98 to 99.

Remuneration of Board members and the Executive Management is set out in Note 17 of the Annual Financial Statements.

Remuneration of Executive Management is in accordance with the remuneration policy which has been approved by the CSIR Board.

GENERAL

The CSIR acknowledges that systems of corporate governance should be reviewed continuously to ensure that these are sound and consistent with world-class standards relevant to the operations of the Group.

We shall continue to comply with all major recommendations of the Code of Corporate Practices and Conduct as set out in the King Report on Corporate Governance.

PUBLIC FINANCE MANAGEMENT ACT (PFMA)

The PFMA came into effect on 1 April 2000 and has had an impact on governance matters in terms of the regulation of financial management in the public sector.

MATERIALITY FRAMEWORK

The materiality framework for reporting losses through criminal conduct and irregular, fruitless and wasteful expenditure, as well as for significant transactions envisaged per section 52 of the PFMA, has been finalised and incorporated into the Shareholder's Compact. No material losses through criminal conduct and irregular, fruitless and wasteful expenditure were identified as having been incurred during the year.

CSIR Board committees 2012/13

AUDIT AND RISK COMMITTEE

April 2012 to March 2013

Chairperson Mr P Benadè

Members Mr M Sibanda
Ms BS Tshabalala
Mr G Badela

Meetings 28 June 2012
06 September 2012
14 November 2012
14 February 2013

Purpose

- To deal with all matters prescribed by the regulations issued in terms of the PFMA and the King Report on Corporate Governance;
- To perform the final review of the key risk matters affecting the organisation;
- To agree on the scope and review the annual external audit plan and the work of the CSIR internal auditors (including the internal audit charter); and
- To act in an unfettered way to understand the dynamics and performance of the organisation without restrictions.

The Audit and Risk Committee has adopted formal Terms of Reference and is satisfied that it has complied with its responsibilities as set out in the Terms of Reference.

HUMAN RESOURCES AND REMUNERATION COMMITTEE

April 2012 to March 2013

Chairperson Mr M Sibanda

Members Dr PH Goyns
Ms MSM Mabitje-Thompson

Meetings 28 June 2012
02 August 2012
24 August 2012
13 September 2012

Purpose

- To provide a vehicle for the CSIR Board to influence and control human resources and remuneration in the organisation;
- To determine human resources policy and strategy and review remuneration against industry benchmarks; and
- To approve remuneration changes and bonus payments; in addition, it reviews the remuneration of the Executive Management.

The Human Resources and Remuneration Committee has adopted formal Terms of Reference and is satisfied that it has complied with its responsibilities as set out in the Terms of Reference.

STRATEGIC REVIEW COMMITTEE

April 2012 to March 2013

Chairperson	Prof FW Petersen
Members	Prof TE Cloete Prof TA Nyokong Prof MJ Wingfield Ms BS Tshabalala Mr G Badela Dr SP Sibisi
Meetings	21 May 2012 11 October 2012 14 March 2013

Invitation to Strategic Review Committee meetings is open to all Board members.

Purpose

- To provide guidance and advice on the long-term trajectory and composition of the CSIR's science and technology portfolio in the context of the needs of the country; and
- To ensure that key innovation and research processes are conducted effectively and benchmarked against international best practice, and that research outputs, organisational climate and credibility remain congruent with the role and objectives of the institution.

The Strategic Review Committee has adopted formal Terms of Reference and is satisfied that it has complied with its responsibilities as set out in the Terms of Reference.

BOARD AND COMMITTEE MEETING ATTENDANCE (1 April 2012 to 31 March 2013)

Board meetings

Date of meeting	28/06/12	13/09/12	30/10/12	14/11/12	20/02/13
Petersen	Present	Present	Present	Present	Present
Badela	Present	Present	Present	Present	Present
Benadè	Present	Present	Present	Present	Present
Cloete	Present	Present	Present	Present	Present
Goyns	Apology	Present	Present	Present	Present
Mabitje-Thompson	Present	Apology	Present	Present	Apology
Nyokong	Apology	Present	Apology	Present	Present
Sibanda	Present	Apology	Present	Present	Present
Sibisi	Present	Present	Present	Present	Present
Tshabalala	Present	Present	Present	Present	Present
Wingfield	Apology	Present	Present	Present	Present

Audit and Risk Committee meetings

Date of meeting	28/06/12	06/09/12	14/11/12	14/02/13
Benadè	Present	Present	Present	Present
Sibanda	Present	Present	Present	Present
Tshabalala	Present	Present	Present	Present
Badela	Apology	Present	Present	Present

Human Resources and Remuneration Committee meetings

Date of meeting	28/06/12	02/08/12	24/08/12	13/09/12
Sibanda	Present	Apology	Apology	Present
Goyns	Apology	Present	Present	Present
Mabitje-Thompson	Present	Present	Apology	Apology
Badela		Present*	Present*	Present*
Benade		Present*	Present*	Present*
Petersen				Present*
Nyokong			Present*	

* Attendance by invitation • Meetings on 02 and 24 August were special meetings

Strategic Review Committee meetings

Date of meeting	21/05/12	11/10/12	14/03/13
Petersen	Present	Present	Present
Sibisi	Present	Present	Present
Wingfield	Apology	Present	Apology
Nyokong	Present	Apology	Present
Cloete	Present	Present	Present
Badela	Present	Present	Apology
Tshabalala	Present	Present	Present
Benade	Present*		Present*
Sibanda	Present*		
Goyns	Present*		

* Attendance by invitation • Meetings are open for all Board members

Report of the Audit and Risk Committee

For the year ended on 31 March 2013

The Audit and Risk Committee (the committee) is pleased to present its report for the financial year ended on 31 March 2013.

THE COMMITTEE'S RESPONSIBILITY

The committee has adopted formal Terms of Reference approved by the Board. Accordingly, the committee has conducted its affairs in compliance with its Terms of Reference, and has discharged its responsibilities contained therein.

COMMITTEE MEMBERS AND ATTENDANCE

The committee consists of the members as stated on page 98 of this report. In accordance with its approved Terms of Reference, the committee met quarterly during the year under review (i.e. 28 June 2012, 06 September 2012, 14 November 2012 and 14 February 2013). Schedule of attendance is shown on page 100 of this report.

THE EFFECTIVENESS OF INTERNAL CONTROL

The system of internal control applied by the CSIR over financial risk management is effective, efficient and transparent. In line with the PFMA and King III, the internal audit provides the committee and management with assurance that the internal controls are appropriate and effective. This is achieved by means of the risk management process, as well as the identification of mitigating measures and on-going assessment thereof.

From the various reports of internal audit, the audit report on the Annual Financial Statements, and the management report of the Auditor-General of South Africa, it was noted that no matters were reported that include any material deficiencies in the system of internal control or any deviations there-from. Accordingly, the committee can report that the system of internal control over financial reporting for the period under review was efficient and effective.

INTERNAL AUDIT

The Group has an internal audit function that has a direct line of reporting to the committee. Its charter and audit plans are approved by the committee to ensure it operates independently.

The committee is satisfied that the internal audit function is operating effectively and has addressed the risks pertinent to the CSIR through its audits.

RISK MANAGEMENT

The committee is satisfied that the CSIR has a risk management process focused on identifying, assessing, managing and monitoring significant risks across all operations and Group companies. This has been in place for the year under review and up to the date of approval of the Annual Financial Statements.

EVALUATION OF FINANCIAL STATEMENTS

The committee has evaluated the Annual Financial Statements of the CSIR Group for the year ended on 31 March 2013, and based on the information provided, the committee considers that it complies, in all material respects with the requirements of the various Acts governing disclosure and reporting on the Annual Financial Statements.

The committee concurs with the Executive Management that the adoption of the going concern premise in the preparation of the Annual Financial Statements is appropriate. The committee has therefore at its meeting on 26 June 2013, recommended the adoption of the Annual Financial Statements by the CSIR Board.

Phillip Benadè

Chairperson of the Audit and Risk Committee

26 June 2013

Report of the Auditor-General

For the year ended on 31 March 2013

Report of the Auditor-General to Parliament on the Council for Scientific and Industrial Research

REPORT ON THE CONSOLIDATED FINANCIAL STATEMENTS

Introduction

I have audited the consolidated and separate financial statements of the Council for Scientific and Industrial Research and its subsidiaries set out on pages 116 to 159, which comprise the consolidated and separate statements of financial position as at 31 March 2013, the consolidated and separate statements of comprehensive income, statements of changes in equity and the statements of cash flows for the year then ended, and the notes, comprising a summary of significant accounting policies and other explanatory information.

Board of directors which constitutes the accounting authority's responsibility for the financial statements

The Board of directors which constitutes the accounting authority is responsible for the preparation of and fair presentation of these consolidated and separate financial statements in accordance with South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP) and the requirements of the Public Finance Management Act of South Africa, 1999 (Act No. 1 of 1999) (PFMA), and for such internal control as the accounting authority determines is necessary to enable the preparation of consolidated and separate financial statements that are free from material misstatement, whether due to fraud or error.

Auditor-General's responsibility

My responsibility is to express an opinion on these consolidated and separate financial statements based on my audit. I conducted my audit in accordance with the Public Audit Act of South Africa, 2004 (Act No. 25 of 2004) (PAA), the *General Notice* issued in terms thereof and International Standards on Auditing. Those standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the consolidated and separate financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the consolidated and separate financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the consolidated and separate financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the consolidated and separate financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the consolidated and separate financial statements.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

Opinion

In my opinion the consolidated and separate financial statements present fairly, in all material respects, the financial position of the Council for Scientific and Industrial Research and its subsidiaries as at 31 March 2013, and their financial performance and cash flows for the year ended in accordance with SA Statements of GAAP and the requirements of the PFMA.

REPORT ON OTHER LEGAL AND REGULATORY REQUIREMENTS

PAA requirements

In accordance with the PAA and the *General Notice* issued in terms thereof, I report the following findings relevant to performance against predetermined objectives, compliance with laws and regulations and internal control, but not for the purpose of expressing an opinion.

Predetermined objectives

I performed procedures to obtain evidence about the usefulness and reliability of the information in the annual performance report as set out on pages 109 to 110 of the annual report.

The reported performance against predetermined objectives was evaluated against the overall criteria of usefulness

and reliability. The usefulness of information in the annual performance report relates to whether it is presented in accordance with the National Treasury annual reporting principles and whether the reported performance is consistent with the planned objectives. The usefulness of information further relates to whether indicators and targets are measurable (i.e. well-defined, verifiable, specific, measurable and time bound) and relevant as required by the National Treasury Framework for managing programme performance information.

The reliability of the information in respect of the selected objectives is assessed to determine whether it adequately reflects the facts (i.e. whether it is valid, accurate and complete).

There were no material findings on the annual performance report concerning the usefulness and reliability of the information.

Compliance with laws and regulations

I did not identify any instances of material non-compliance with specific matters in key applicable laws and regulations as set out in the *General Notice* issued in terms of the PAA.

Internal control

I did not identify any deficiencies in internal control which I considered sufficiently significant for inclusion in this report.

Pretoria
8 July 2013

executive report

Executive report

INTRODUCTION

On behalf of the CSIR Board, we take pleasure in submitting to Parliament, through the Minister of Science and Technology, this report and the audited Annual Financial Statements of the CSIR Group for the financial year ended 31 March 2013.

In the opinion of the CSIR Board, the financial statements fairly present the financial position of the CSIR Group as at 31 March 2013 and the results of its operations for the year then ended.

STATUTORY BASIS

As a statutory research council established by government, the CSIR is governed by the Scientific Research Council Act (No 46 of 1988). The organisation is listed as a Public Business Enterprise in terms of the PFMA (No 1 of 1999).

THE CSIR MANDATE

The CSIR's mandate is as stipulated in the Scientific Research Council Act (No 46 of 1988):

"The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in cooperation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act."

– Extract from Scientific Research Council Act (No 46 of 1988)

The CSIR addresses priority issues that contribute to the national programme of development for the benefit of all South Africans to achieve its mandate.

INCOME SOURCES

The CSIR derives income from baseline and ring-fenced grants from the Department of Science and Technology (DST), contract research and development (R&D) income from local and international public and private sectors, and income from intellectual property (IP) exploitation and technology transfer.

Grant funding is invested in research programmes and research infrastructure as well as R&D skills development. Processes, policies and guidelines underpin the effective utilisation of grant funding.

STRATEGIC OVERVIEW

The CSIR Growth and Impact Strategy is informed by external environmental drivers including:

- The Millennium Development Goals, and the 2015 targets that dictate agendas worldwide;
- The New Growth Path approved by Cabinet in 2010;
- The 12 South African national outcomes identified by Cabinet in 2010; and
- The National Development Plan accepted by Cabinet in September 2012.

In mapping the potential response to these external drivers, the CSIR identified potential areas of intervention that are in line with its mandate and that build on current organisational competencies and capabilities.

The response to these drivers will build on, and continue with, the current CSIR responses to the DST Ten-Year Innovation Plan and the Department of Trade and Industry Industrial Policy Action Plan.

The CSIR Growth and Impact Strategy is structured around Research Impact Areas (RIAs) and flagship programmes.

The six RIAs forming the building blocks of the Growth and Impact Strategy are: Health; Defence and Security; Built Environment; Natural Environment; Industry; and Energy. The RIAs are supported by core technologies including: Information and Communications Technology, Sensors, Modelling, Photonics, Materials and Robotics, and research facilities.

The RIA strategies continue to mature, informed by stakeholder engagement. The current strategic intent and focus of each RIA is summarised in **Table 1**, but is subject to ongoing development.

Table 1: *Portfolio of CSIR Research Impact Areas*

Research impact area		Key focus areas
Health		• Health care delivery system • Burden of diseases: HIV, TB and malaria • Point-of-care diagnostics
Defence and security		• Information security • Interoperability and standardisation across organs of state tasked with defence and security • Command, control and coordination • Tactical and strategic situation awareness
Built environment		• Sustainable human settlements • Water infrastructure • Transport infrastructure • Logistics and infrastructure operations • Planning support systems
Natural environment		• Assessing and monitoring the state of the natural environment • Support for decision-making and resource planning • Technologies for water, pollution and waste solutions
Industry	Advanced manufacturing	• Titanium industry • Bio-manufacturing industry • Additive manufacturing • Microsystems and micro-manufacturing • Advanced materials and composites for industry
	Mining	• Health and safety • New mining methods • Decision support systems
Energy		• Renewable and alternative energy (under development)

Flagship programmes are being developed and draw on RIA capabilities. The flagships are large, integrated, impact-driven development and innovation initiatives, with clear objectives and intended outcomes that can be achieved within a set time. They are funded initially by the Parliamentary Grant, but partnering with stakeholders to leverage resources and funding is key in pursuing the goals of the programmes.

The CSIR has initiated three flagship programmes:

- Water sustainability;
- Health and nutrition; and
- Safety and security.

The CSIR's role in the National System of Innovation is to focus on strategic basic and directed research, technology development, and technology transfer and implementation for commercial and social benefit **(Figure 1)**.

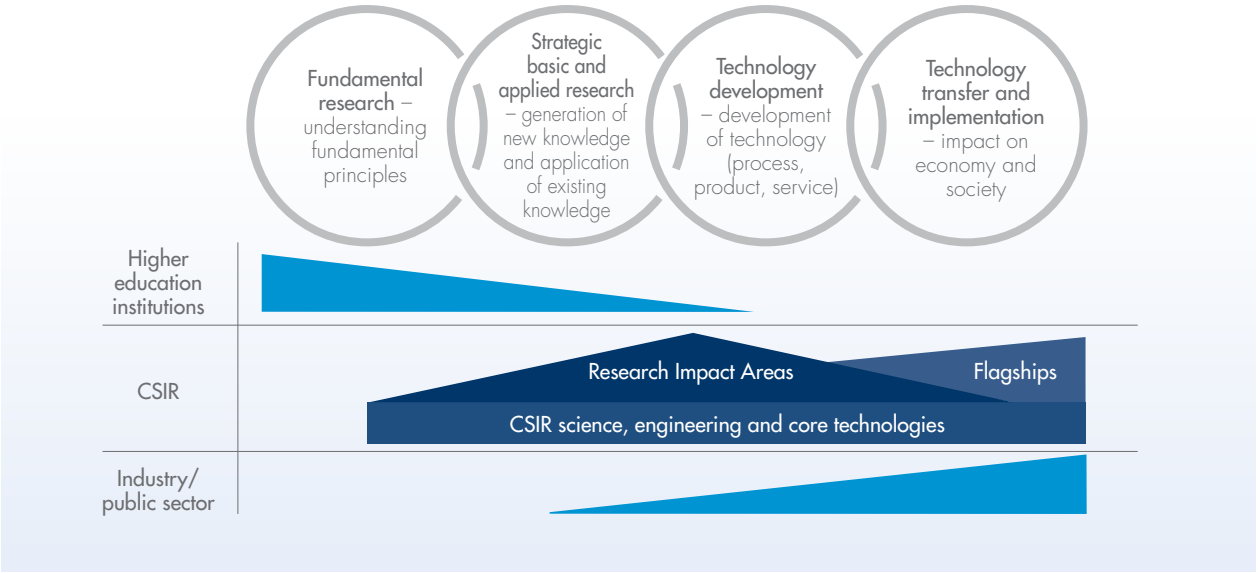

Figure 1: *The CSIR's role within the National System of Innovation (NSI)*

The CSIR supports the attainment of national outcomes through support to and collaboration with national line departments, state-owned enterprises, provincial and local government and the private sector.

SETTING OF KEY PERFORMANCE INDICATORS AND PERFORMANCE REPORTING

The CSIR enters into a Shareholder's Compact Agreement with the DST annually. The compact comprises a rolling three-year strategic plan and an operational plan with very specific key performance indicators (KPIs). Strategic planning in the CSIR is supported by ongoing benchmarking against similar research organisations, and trend analysis of KPIs. Quarterly reports and the annual Science, Engineering and Technology Institution (SETI) scorecard report to the DST address performance in terms of KPIs. The CSIR has a proud record of attaining KPI targets over the past several years.

OVERVIEW OF 2012/13 PERFORMANCE

The CSIR performed very well in attaining the objectives set in its annual Strategic and Operational Plan. Once again, the organisation has demonstrated high standards of science, financial sustainability and corporate governance. The CSIR has delivered positive financial results, with total turnover continuing to grow, and the net margin exceeding target. The value of capital investment in scientific equipment and facilities was in excess of the target as a consequence of additional funding secured to purchase equipment.

Attraction and retention of suitably qualified and capable staff remains an ongoing challenge. However, the CSIR's approach to human capital development (HCD) and human resource (HR) management ensured that the relevant targets were exceeded, with the exception of the number of staff with doctorates. Research outputs in terms of publication equivalents did not meet the target, but new technology demonstrators and new patents were significantly greater than target.

The target contributor level for Broad-based Black Economic Empowerment (BBBEE) was exceeded and the excellent safety record maintained. The target saving in energy consumption was not achieved owing to operational requirements. The CSIR has maintained its record with an unqualified audit report.

KEY PERFORMANCE INDICATORS

The CSIR's KPIs are grouped according to organisational priorities of capacity and enabling conditions that are required as inputs for successful achievement of the CSIR strategy **(Figure 2)**. The achievements in terms of the KPIs are presented as follows within each of the priority areas.

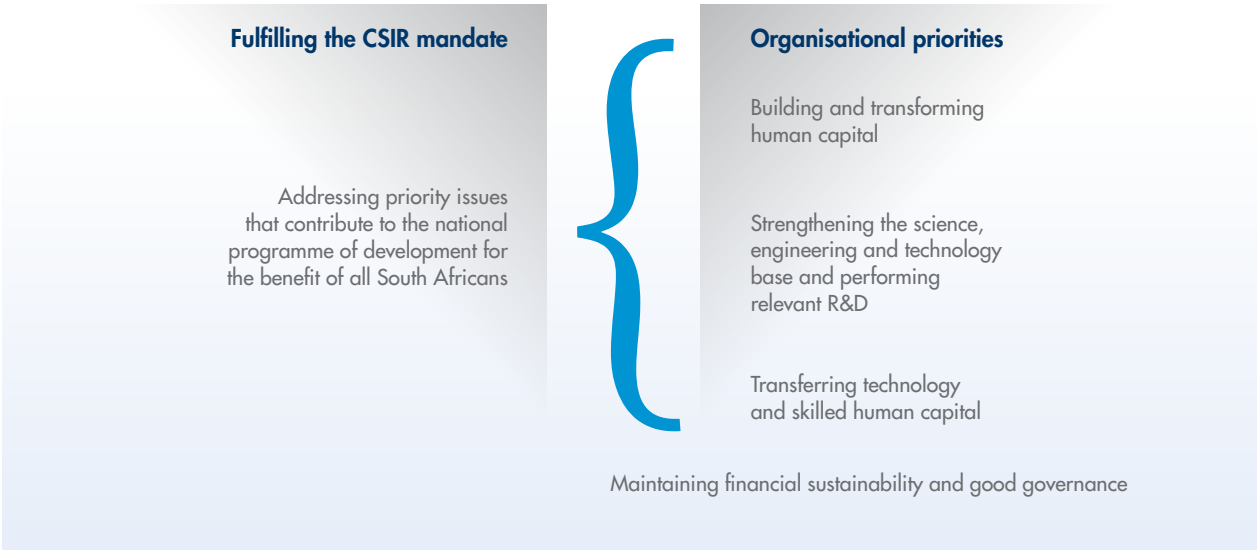

Figure 2: *Organisational priorities*

Priority area:
BUILDING AND TRANSFORMING HUMAN CAPITAL

Human capital development is essential to achieving the CSIR strategic goals and is realised in line with the CSIR HR strategy.

Table 2: *Building and transforming human capital*

Strategic focus area	Key performance indicator	2012/13 Target	2012/13 Actual
Human resource management	Total size of SET base (number, %)	1 540 (64.5%)	1 578 (65.4%)
	% of SET base who are black	48.0	48.6
	% of SET base who are female	32.0	32.1
	Number of staff with doctoral level qualifications	310	301

The SET base measures the number of science, engineering and technology (SET) staff in the organisation, and the percentage this group comprises of total staff is a measure of organisational efficiency. The better than expected growth in SET staff is seen as a very positive indication of growth and was enabled by the sound financial performance. The measures of the SET base who are black and female were redefined when setting the 2012/13 targets to refer to black and female South African citizens only, which reduced the current year targets to below the previous years' performance.

The transformation of SET staff continues to improve **(Table 2).**

The CSIR did not achieve the target for the number of staff with doctoral degrees. This arises in part from the availability of suitably qualified staff and the value placed on qualified CSIR staff in the market. The CSIR is addressing the matter through ongoing recruitment. In addition, 93 permanent staff members were supported in attaining their doctoral degrees; 103 were supported in attaining Master's degrees; and 230 studentships (mainly doctoral students) were supported in the course of 2012/13.

Priority area:
STRENGTHENING THE SET BASE AND PERFORMING RELEVANT R&D

The CSIR achieved very good performance with regard to its objective of strengthening the SET base, when measured against targets set for its key performance indicators **(Table 3)**.

Table 3: *Strengthening the SET base and performing relevant R&D*

Strategic focus area	Key performance indicator	2012/13 Target	2012/13 Actual
R&D outputs	Publication equivalents	575	503
	New technology demonstrators	26	33
	Value of investment in property, plant and equipment	R93.5 m	R130.1 m

The CSIR continues to place emphasis on the quality and quantity of research outputs, especially in scientific journals that undergo a rigorous peer-review process and have good citation indices. However, the target for publications was not achieved. This may have resulted from renewed emphasis on implementation to achieve outcomes and impact, for example, in the flagship programmes and technology development. The excellent performance in developing new technology demonstrators supports this view, as does the performance on new patents reported in **Table 4**.

The value of investment in property, plant and equipment is the amount of funding invested in research infrastructure such as equipment and facilities. This target was exceeded by almost 40%, reflecting focused CSIR investment and success in securing grant funding for equipment.

Priority area:
TRANSFERRING TECHNOLOGY AND SKILLED HUMAN CAPITAL

The CSIR R&D capacity provides value to society through the contract R&D it undertakes and through the commercialisation of formally protected IP **(Table 4)**.

Table 4: *Transferring technology and skilled human capital*

Strategic focus area	Key performance indicator	2012/13 Target	2012/13 Actual
R&D outcomes	New patents granted	15	35
	Royalty and licence income	R10.5 m	R14.8 m
Contract R&D	Contract R&D income[1]	R1 275.8 m	R1 403.1 m
	Private sector and international income[1]	R364.1 m	R364.7 m

[1] This indicator does not include Circular 9 adjustments. The adjusted figures are reflected in note 2 of the Annual Financial Statements (page 129).

The CSIR was very successful in being granted 35 patents against a target of 15, which will support future commercialisation activities. Royalty and licence income exceeded target, owing to a large payment for licensed technology resulting from a lengthy negotiation.

The CSIR was able to secure better than anticipated contract R&D income and exceeded the annual target. The target for the component earned from the private sector and internationally was achieved, representing growth of over 12% in these categories.

Priority area:
FINANCIAL SUSTAINABILITY, GOOD CORPORATE GOVERNANCE AND CITIZENSHIP

The CSIR continued to demonstrate its financial sustainability despite the difficult economic climate. Further details are provided in **Table 5**. The solid performance in achieving corporate governance and citizenship targets was maintained, with the BBBEE contributor level target being exceeded and the excellent safety record maintained. The target saving in energy consumption on the Pretoria Scientia campus was not achieved, despite energy saving initiatives, owing to growth in CSIR business in recent years.

Table 5: *Financial sustainability, good corporate governance and citizenship*

Strategic focus area	Key performance indicator	2012/13 Target	2012/13 Actual
Financial sustainability	Total income	R1.88 billion	R2.02 billion
	Net profit	R38.6 m	R48.4 m
Corporate governance and citizenship	BBBEE rating	Level 3 contributor	Level 2 contributor
	Energy efficiency	Achieve 1.2% reduction in energy consumption on previous year	0.98% increase in energy consumption on previous year
	Disabling injury frequency rate (DIFR)	<0.3	0.04

FINANCIAL PERFORMANCE OVERVIEW

Income

The total operating income of the CSIR increased by 7.5% to an amount of R2 022.8 million (2011/12: R1 881 million) **(Figure 3)**. The CSIR Group's total operating income amounted to R2 027.9 million (2011/12: R1 877.8 million), an increase of 8%. Revenue growth, excluding other income, amounted to 8.6% and 9% for the CSIR and CSIR Group respectively.

The Parliamentary Grant recognised as income in 2012/13 amounted to R594.5 million, an increase of 6.7% from the prior year's amount of R556.8 million.

The CSIR's total contract R&D income increased by 9.1% to R1 389 million (2011/12: R1 273.4 million). This includes a R50.3 million (2011/12: R55.5 million) ring-fenced allocation from the DST. The CSIR Group's total contract R&D income increased by 9.3% to an amount of R1 388.6 million (2011/12: R1 270 million).

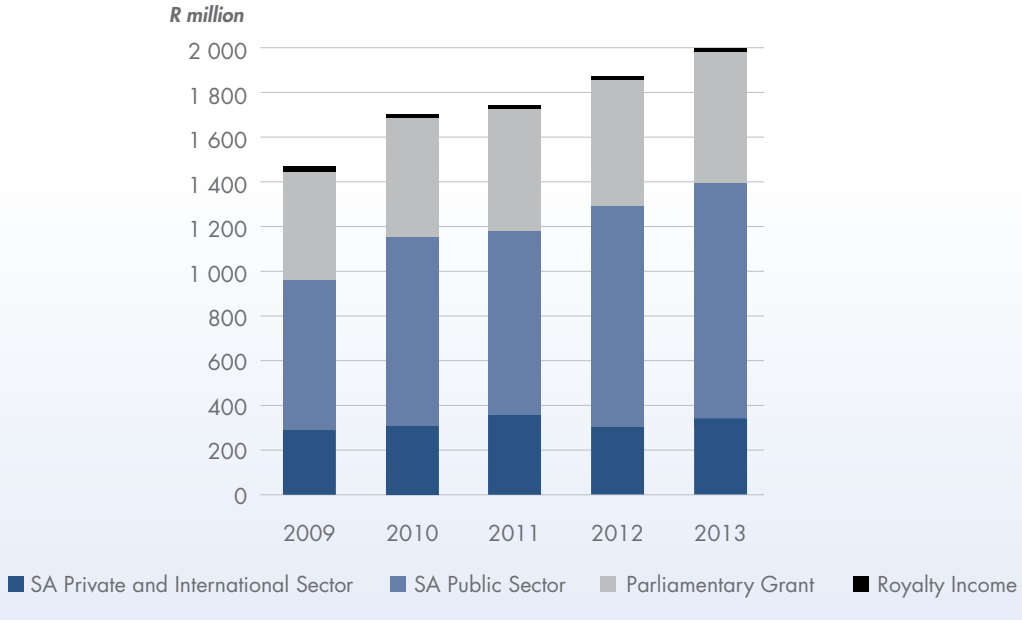

Figure 3: *CSIR income streams for financial years ending 2009–2013*
(The Satellite Applications Centre was transferred to the South African National Space Agency on 1 April 2011, resulting in a reduction in international and public sector income in 2011/12.)

The CSIR's continued alignment with national strategic priorities ensured that a significant part of the contract income was received from the South African public sector. Public sector income amounted to R1 028 million (2011/12: R952.9 million).

Income from the South African private sector and international sector increased by 12.6% to R361 million (2011/12: R320.5 million).

Investment in property, plant and equipment

The continued investment in scientific infrastructure and equipment remains a priority to ensure that world-class facilities and equipment are acquired and maintained. Over the past five financial years, R800.4 million has been invested in property, plant and equipment with R130.1 million invested in the 2012/13 financial year.

Five-year review of income and expense indicators

	2013 R'000	2012 R'000	2011 R'000	2010 R'000	2009 R'000
Total income	**2 069 221**	**1 919 381**	**1 776 827**	**1 748 848**	**1 554 910**
Parliamentary Grant recognised as income	594 478	556 837	535 357	509 122	480 320
Contract income, royalty income, other income and net finance income	**1 474 743**	**1 362 544**	**1 241 470**	**1 239 726**	**1 074 590**
Local private and international sectors	361 018	320 491	354 389	310 949	289 754
Local public sector	1 027 998	952 909	820 705	848 846	661 682
Royalties and other income	39 351	50 771	13 197	11 168	40 516
Net finance income	46 376	38 373	53 179	68 763	82 638
Total expenditure	**2 020 769**	**1 850 383**	**1 741 317**	**1 695 419**	**1 495 442**
Employees' remuneration	1 108 202	1 014 879	940 776	873 445	763 867
Operating expenses	867 680	793 680	759 048	779 832	694 435
Depreciation	44 887	41 824	41 493	42 142	37 140

Net profit and cash flow

The net profit of the CSIR amounts to R48.4 million (2011/12: R69 million). The net profit for the CSIR Group is R53.3 million (2011/12: R65.6 million). Included in the 2011/12 net profit and other income was an amount of R21.9 million attributable to the transfer of a building to the Department of Public Works.

Net cash from operating activities for the CSIR amounted to R130.4 million (2011/12: R78.6 million). The cash and cash equivalent holdings of the CSIR increased to R983.5 million (2011/12: R949.4 million). The current ratio remains the same as the previous financial year at 1.1.

Five-year ratio analysis

	2013 R'000	2012 R'000	2011 R'000	2010 R'000	2009 R'000
Operating expenses					
Remuneration as a percentage of total income (excluding finance income)	**54.8%**	54.0%	54.6%	52.0%	51.9%
Remuneration as a percentage of total operating expenditure	**54.8%**	54.8%	54.0%	51.5%	51.1%
Asset management					
Investment in property, plant and equipment (Rm)	**130.1**	184.2	118.8	179.0	188.3
Investment in property, plant and equipment as a percentage of revenue	**6.5%**	10.0%	6.9%	10.7%	13.0%
Net asset turn	**3.2**	3.3	3.3	3.4	3.4
Current ratio	**1.1**	1.1	1.1	1.1	1.0
Cash flow					
Net cash from operating activities	**130 385**	78 562	299 171	25 967	285 546
Cash and cash equivalents at end of year (including long-term fixed deposits)	**983 511**	949 360	975 755	766 278	834 830

Definitions

Net asset turn: Total revenue (including finance income) divided by net assets
Current ratio: Current assets divided by current liabilities

The post-retirement medical benefit expense and liability and the effects of the adoption of SA GAAP, IAS39: Financial instruments – recognition and measurement have been excluded for the comparison of financial indicators.

annual financial statements

STATEMENTS OF COMPREHENSIVE INCOME

for the year ended 31 March 2013

	Notes	GROUP 2013 R'000	GROUP 2012 R'000	CSIR 2013 R'000	CSIR 2012 R'000
Revenue	2	**2 003 315**	1 837 126	**1 998 305**	1 840 481
Other income		**24 540**	40 632	**24 540**	40 527
Total operating income		**2 027 855**	1 877 758	**2 022 845**	1 881 008
Expenditure					
Employees' remuneration		**1 110 208**	1 015 735	**1 108 202**	1 014 879
Depreciation and amortisation	6 & 7	**44 940**	41 859	**44 887**	41 824
Operating expenses		**866 698**	793 403	**867 680**	793 680
Total operating expenditure		**2 021 846**	1 850 997	**2 020 769**	1 850 383
Finance income	4	**51 965**	44 028	**51 052**	42 792
Finance expense	4	**(4 676)**	(4 419)	**(4 676)**	(4 419)
Share of loss of joint ventures and associates	8	**(34)**	(786)	**–**	–
Profit before income tax	3	**53 264**	65 584	**48 452**	68 998
Income tax expense	5	**–**	–	**–**	–
Profit for the year		**53 264**	65 584	**48 452**	68 998
Other comprehensive income					
Foreign currency translation differences for foreign operations		**–**	(763)	**–**	–
Other comprehensive income for the year		**–**	(763)	**–**	–
Total comprehensive income for the year		**53 264**	64 821	**48 452**	68 998
Profit attributable to:					
Stakeholders of the parent		**53 264**	65 584	**48 452**	68 998
Total comprehensive income attributable to:					
Stakeholders of the parent		**53 264**	64 821	**48 452**	68 998

STATEMENTS OF FINANCIAL POSITION

as at 31 March 2013

	Notes	GROUP 2013 R'000	GROUP 2012 R'000	CSIR 2013 R'000	CSIR 2012 R'000
ASSETS					
Non-current assets		**488 947**	434 332	**503 877**	450 958
Property, plant and equipment	6	**482 007**	428 960	**481 950**	428 924
Intangible assets	7	**–**	–	**–**	–
Interest in joint ventures and associates	8	**6 940**	5 372	**1 270**	1 301
Interest in subsidiaries	9	**–**	–	**20 657**	20 733
Deferred tax asset	12	**–**	–	**–**	–
Current assets		**1 417 297**	1 215 846	**1 393 521**	1 195 911
Trade and other receivables	10	**303 192**	179 250	**297 779**	179 050
Inventory and contracts in progress	11	**112 231**	67 501	**112 231**	67 501
Cash and cash equivalents	22	**1 001 874**	969 095	**983 511**	949 360
TOTAL ASSETS		**1 906 244**	1 650 178	**1 897 398**	1 646 869
EQUITY AND LIABILITIES					
Reserves		**633 422**	580 158	**625 978**	577 526
Retained earnings		**633 422**	580 158	**625 978**	577 526
Non-current liabilities		**10 347**	8 260	**10 347**	8 260
Post-retirement medical benefits	16.4	**10 347**	8 260	**10 347**	8 260
Current liabilities		**1 262 475**	1 061 760	**1 261 073**	1 061 083
Advances received	13	**756 887**	618 620	**756 887**	618 620
Trade and other payables	14	**505 588**	443 140	**504 186**	442 463
TOTAL EQUITY AND LIABILITIES		**1 906 244**	1 650 178	**1 897 398**	1 646 869

STATEMENTS OF CHANGES IN EQUITY

for the year ended 31 March 2013

	Retained earnings R'000	Non-distributable reserve* R'000	Total R'000
GROUP			
Balance at 31 March 2011	540 267	763	**541 030**
Total comprehensive income	65 584	(763)	**64 821**
Profit for the year	65 584	–	**65 584**
Other comprehensive income for the year:			
Foreign currency translation differences for foreign operations	–	(763)	**(763)**
Transfer of the Satellite Applications Centre (SAC) **	(25 693)	–	**(25 693)**
Balance at 31 March 2012	**580 158**	**–**	**580 158**
Total comprehensive income	53 264	–	**53 264**
Profit for the year	53 264	–	**53 264**
Balance at 31 March 2013	**633 422**	**–**	**633 422**
CSIR			
Balance at 31 March 2011	534 221	–	**534 221**
Total comprehensive income	68 998	–	**68 998**
Profit for the year	68 998	–	**68 998**
Transfer of the Satellite Applications Centre (SAC) **	(25 693)	–	**(25 693)**
Balance at 31 March 2012	**577 526**	**–**	**577 526**
Total comprehensive income	48 452	–	**48 452**
Profit for the year	48 452	–	**48 452**
Balance at 31 March 2013	**625 978**	**–**	**625 978**

* The non-distributable reserve consisted of a foreign currency translation reserve. The foreign currency translation reserve comprised all foreign currency differences arising from the translation of the financial statements of foreign operations as well as from the translation of liabilities that hedged the Group's net investment in a foreign subsidiary, if applicable. This reserve is nil as from 31 March 2012 due to the sale of Quotec Limited during the 2012 financial year. Refer to note 25.1.

** Refer to note 24.

STATEMENTS OF CASH FLOWS

for the year ended 31 March 2013

	Notes	GROUP 2013 R'000	GROUP 2012 R'000	CSIR 2013 R'000	CSIR 2012 R'000
Cash flows from operating activities					
Cash receipts from external customers		**1 350 354**	1 257 380	**1 350 927**	1 266 713
Parliamentary Grant received		**601 838**	549 111	**601 838**	549 111
Cash paid to suppliers and employees		**(1 869 364)**	(1 771 027)	**(1 867 474)**	(1 776 877)
Cash generated from operating activities	21	**82 828**	35 464	**85 291**	38 947
Finance income received	4	**50 683**	45 270	**49 770**	44 034
Finance expense paid	4	**(4 676)**	(4 419)	**(4 676)**	(4 419)
Income taxes paid		**–**	–	**–**	–
Net cash from operating activities		**128 835**	76 315	**130 385**	78 562
Cash flows from investing activities					
Acquisition of property, plant and equipment	6	**(99 203)**	(100 684)	**(99 152)**	(100 645)
Proceeds on disposal of property, plant and equipment		**463**	4 343	**463**	4 343
Decrease in subsidiary loans		**–**	–	**–**	500
Decrease/(increase) in interest in joint ventures and associates		**500**	(3 500)	**–**	–
Disposal of interests in subsidiaries	25	**–**	(7 179)	**–**	–
Transfer of the Satellite Applications Centre (SAC)	24	**–**	(11 945)	**–**	(11 945)
Acquisition of intangible assets	7	**(271)**	(448)	**–**	–
Net cash utilised in investing activities		**(98 511)**	(119 413)	**(98 689)**	(107 747)
Cash flows from financing activities					
Decrease in long-term liabilities		**–**	(158)	**–**	(158)
Net cash utilised in financing activities		**–**	(158)	**–**	(158)
Unrealised exchange gains on foreign cash balances		**2 455**	2 948	**2 455**	2 948
Net increase/(decrease) in cash and cash equivalents		**32 779**	(40 308)	**34 151**	(26 395)
Cash and cash equivalents at beginning of the year		**969 095**	1 009 403	**949 360**	975 755
Cash and cash equivalents at end of the year	22	**1 001 874**	969 095	**983 511**	949 360

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES

The CSIR is a national government business enterprise (enacted by The Scientific Research Council Act, Act 46 of 1988) domiciled in the Republic of South Africa. The address of the CSIR's principal place of business is Meiring Naudé Road, Brummeria, Pretoria. The CSIR undertakes directed and particularly multi-disciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic.

The consolidated Annual Financial Statements of the Group as at and for the year ended 31 March 2013 comprise the company and its subsidiaries (together referred to as the Group) and the Group's interest in associates and jointly controlled entities.

Basis of measurement

The consolidated Annual Financial Statements are prepared on the historical cost basis except for financial instruments held for trading which are stated at fair value. The consolidated Annual Financial Statements have been prepared in accordance with statements of South African Generally Accepted Accounting Practice (SA GAAP) and the Public Finance Management Act, Act 1 of 1999 as amended by Act 29 of 1999. The following principal accounting policies have been consistently applied by group entities in all material respects.

The preparation of financial statements requires management to make judgements, estimates and assumptions that affect the application of policies and reported amounts of assets and liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances, the result of which forms the basis of making judgements about carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates.

Estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimate is revised and in any future periods affected.

The consolidated Annual Financial Statements are presented in South African rand (R), which is the CSIR's functional currency, and are rounded off to the nearest thousand.

Basis of consolidation

Interest in subsidiaries

The consolidated Annual Financial Statements incorporate the Annual Financial Statements of the CSIR and the Annual Financial Statements of the entities under its control from the date that control commences until the date that control ceases. Control exists when the CSIR has the power to govern the financial and operating policies of an investee entity so as to obtain benefits from its activities. In assessing control, potential voting rights that are presently exercisable are taken into account.

On acquisition, the assets and liabilities of the relevant subsidiaries are measured at their fair values at the date of acquisition. Non-controlling interests are stated at the non-controlling interests' proportion of the fair values of the assets and liabilities recognised. All significant intercompany balances and transactions between group entities have been eliminated on consolidation.

Any excess of net assets of a subsidiary over the cost of an acquisition is treated in terms of the Group's accounting policy on goodwill.

Investments in subsidiaries are measured at cost less accumulated impairment losses in the CSIR's Annual Financial Statements.

Interest in associates

An associate is an entity over which the Group is in a position to exercise significant influence, but not control, through participation in the financial and operating policy decisions of the investee. The Group's share of the total recognised gains and losses of associates is incorporated in the consolidated financial statements, from the date that significant influence commences until the date that significant influence ceases, using the equity method of accounting.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Interest in associates (continued)

The carrying amount of such interests is reduced to recognise any impairment, other than a temporary impairment, in the value of individual investments.

Where a group enterprise transacts with an associate company, unrealised gains and losses are eliminated against the investment to the extent of the group's interest in the relevant associate company, except where unrealised losses provide evidence of an impairment of the asset transferred. When the Group's share of losses exceeds its interest in an investee, the carrying amount of that interest (including any long-term investments) is reduced to nil and the recognition of further losses is discontinued except to the extent that the Group has an obligation or has made payments on behalf of the investee.

Investments in associates are measured at cost less accumulated impairment losses in the CSIR's Annual Financial Statements.

Interest in joint ventures

A joint venture is a contractual arrangement whereby the CSIR and other parties undertake economic activity, which is subject to joint control.

The Group's share of the total recognised gains and losses of jointly-controlled entities is incorporated in the consolidated financial statements, from the date that joint control commences until the date that joint control ceases, using the equity method of accounting. The carrying amount of such interests is reduced to recognise any impairment, other than a temporary impairment, in the value of individual investments.

Where a group enterprise transacts with a joint venture, unrealised gains and losses are eliminated against the investment to the extent of the group's interest in the relevant joint venture, except where unrealised losses provide evidence of an impairment of the asset transferred. When the Group's share of losses exceeds its interest in an investee, the carrying amount of that interest (including any long-term investments) is reduced to nil and the recognition of further losses is discontinued except to the extent that the Group has an obligation or has made payments on behalf of the investee.

Investments in joint ventures are measured at cost less accumulated impairment losses in the CSIR's Annual Financial Statements.

Loss of control

On the loss of control, the Group derecognises the assets and liabilities of the subsidiary, and non-controlling interests and the other components of equity related to the subsidiary. Any surplus or deficit arising on the loss of control is recognised in profit or loss. If the Group retains any interest in the previous subsidiary, then such interest is measured at fair value at the date that control is lost. Subsequently it is accounted for as an equity-accounted investee or as an available-for-sale financial asset depending on the level of influence retained.

Foreign currencies

Foreign operations

All foreign subsidiaries of the CSIR are foreign operations.

The financial statements of foreign subsidiaries are translated into South African rand as follows:

- Assets and liabilities, including goodwill and fair value adjustments on acquisition, at rates of exchange ruling at the reporting date.
- Revenue, expenditure and cash flow items at the average rates of exchange during the relevant financial year (the average rates approximate exchange rates at the various dates).

Differences arising on translation are recognised in other comprehensive income and presented in equity as non-distributable reserves called a foreign currency translation reserve (FCTR). When a foreign operation is disposed of, in part or in full, the relevant amount in the FCTR is transferred to profit or loss.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Foreign operations (continued)

Foreign exchange gains and losses arising from a monetary item receivable from or payable to a foreign operation, the settlement of which is neither planned nor likely in the foreseeable future, are considered to form part of a net investment in a foreign operation and are recognised directly in other comprehensive income and presented in equity in the FCTR.

Foreign currency transactions and balances

Transactions in foreign currencies are converted to South African rand at the rate of exchange ruling at the date of the transactions. Monetary assets and liabilities denominated in foreign currencies are translated into South African rand using the rates of exchange ruling at the reporting date. The resulting exchange differences are recognised in profit or loss. Non-monetary assets and liabilities measured at fair value are translated at foreign exchange rates ruling at the date the fair value was determined.

Property, plant and equipment

Owned assets

Land is stated at cost less accumulated impairment losses. Buildings, equipment and vehicles are stated at cost less accumulated depreciation and accumulated impairment losses. Cost includes expenditure directly attributable to acquisition.

The cost of self-constructed assets includes the cost of materials, direct labour, the initial estimate, where relevant, of the costs of dismantling and removing the items and restoring the site on which these are located and an appropriate proportion of production overheads.

Where parts of an item of property, plant and equipment have different useful lives, these are accounted for as separate items (major components) of property, plant and equipment.

Gains and losses on disposal of an item of property, plant and equipment are determined by comparing proceeds from disposal with the carrying amount of property, plant and equipment and are recognised in profit or loss.

Subsequent costs

The Group recognises in the carrying amount of an item of property, plant and equipment, the cost of replacing a part of such an item when that cost is incurred, if it is probable that the future economic benefits embodied in the item will flow to the Group and the cost of the item can be measured reliably. The carrying amount of the replaced part is derecognised. The costs of the day-to-day servicing of property, plant and equipment are recognised in profit or loss as incurred.

Depreciation

Depreciation is based on cost less residual value and is calculated on the straight-line method from the day the assets are available for use, at rates considered appropriate to write off carrying values over the estimated useful lives of the assets, except for assets specifically acquired for a contract, which are depreciated over the life of the contract. Land is not depreciated.

The estimated lives of the main categories of property, plant and equipment for the current and comparative period are as follows:

- Buildings: 40 years
- Equipment: 3 to 10 years
- Vehicles: 10 years

Depreciation methods, useful lives and current residual values, if not insignificant, are reassessed annually.

Intangible assets

Research and development

Expenditure on research activities, undertaken with the prospect of gaining new scientific or technical knowledge and understanding, is recognised in profit or loss when incurred.

Development activities involve a plan or design for the production of new or substantially improved products and processes. Development expenditure is capitalised only if development costs can be measured reliably, the product or process is technically and commercially feasible, future economic benefits are probable, and the Group intends to and has sufficient

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Research and development (continued)

resources to complete development and to use or sell the asset. The expenditure capitalised includes the cost of materials, direct labour and overhead costs that are directly attributable to preparing the asset for its intended use. Other development expenditure is recognised in profit or loss when incurred.

Capitalised development expenditure is measured at cost less accumulated amortisation and accumulated impairment losses.

Goodwill

Goodwill arising on the acquisition of subsidiaries, associates or joint ventures represents the excess of the cost of an acquisition over the fair value of the Group's interest in the net assets of the acquired subsidiary, associate or joint venture at the date of the acquisition (refer to basis of consolidation). All business combinations are accounted for by applying the purchase method.

Goodwill arising from the acquisition of a joint venture or an associated company is included within the carrying amount of the joint venture or associated company. Goodwill arising from a subsidiary is presented separately in the statement of financial position and tested annually for impairment and is stated at cost less accumulated impairment losses. Goodwill is allocated to cash-generating units. On disposal of a subsidiary, joint venture or associated company, the attributable amount of goodwill is included in the determination of the profit or loss on disposal.

When an excess arising on an acquisition of a subsidiary is negative (bargain purchase), it is recognised immediately in profit or loss.

Subsequent costs

Subsequent expenditure on capitalised intangible assets is capitalised only when it increases the future economic benefits embodied in the specific asset to which it relates. All other expenditure, including expenditure on internally generated goodwill and brands, is expensed as incurred.

Amortisation

Amortisation is based on cost and calculated on the straight-line method at rates considered appropriate to write off carrying values over the estimated useful lives of the intangible assets with definite useful lives. Intangible assets are amortised from the day they are available for use.

The estimated lives of intangible assets with definite useful lives are as follows:

– Investment in technology: 3 to 10 years

Amortisation methods, useful lives and residual values are reviewed at each reporting date and adjusted if appropriate.

Impairment

Financial assets

A financial asset not classified at fair value through profit or loss is assessed at each reporting date to determine whether there is any objective evidence that it is impaired. A financial asset is considered to be impaired if objective evidence indicates that one or more events have had a negative effect on the estimated future cash flows of that asset.

An impairment loss in respect of a financial asset measured at amortised cost is calculated as the difference between its carrying amount, and the present value of the estimated future cash flows discounted at the original effective interest rate.

Individually significant financial assets and those that have been identified as impaired are tested for impairment on an individual basis. The remaining financial assets are assessed collectively in groups that share similar credit risk characteristics.

All impairment losses are recognised in profit or loss.

An impairment loss is reversed if the reversal can be related objectively to an event occurring after the impairment loss was recognised. For financial assets measured at amortised cost the reversal is recognised in profit or loss.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Non-financial assets

The carrying amounts of the Group's non-financial assets, other than inventories and deferred tax assets, are reviewed at each reporting date to determine whether there is any indication of impairment. If any such indication exists then the asset's recoverable amount is estimated. For goodwill arising from the acquisition of subsidiaries and intangible assets that have indefinite lives or that are not yet available for use, the recoverable amount is estimated at each reporting date.

An impairment loss is recognised if the carrying amount of an asset or its cash-generating unit exceeds its recoverable amount. A cash-generating unit is the smallest identifiable asset group that generates cash flows that are largely independent from other assets and groups. Impairment losses are recognised in profit or loss. Impairment losses recognised in respect of cash-generating units are allocated first to reduce the carrying amount of any goodwill allocated to the units and then to reduce the carrying amount of the other assets in the unit (group of units) on a *pro rata* basis.

The recoverable amount of an asset or cash-generating unit is the greater of its value in use and its fair value less costs to sell. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset.

An impairment loss in respect of goodwill is not reversed. In respect of other assets, impairment losses recognised in prior periods are assessed at each reporting date for any indications that the loss has decreased or no longer exists. An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount.
An impairment loss is reversed only to the extent that the asset's carrying amount does not exceed the carrying amount that would have been determined, net of depreciation or amortisation, if no impairment loss had been recognised.

Non-current assets held for sale

Non-current assets (or disposal groups comprising assets and liabilities) that are expected to be recovered primarily through sale rather than through continuing use, are classified as held for sale. Immediately before classification as held for sale, the assets (or components of a disposal group) are remeasured in accordance with the Group's accounting policies. Thereafter, the assets (or disposal group) are measured at the lower of their carrying amount and fair value less cost to sell. Impairment losses on initial classification as held for sale and subsequent gains or losses on remeasurement are recognised in profit or loss. Gains are not recognised in excess of any cumulative impairment loss.
Once classified as held for sale, property, plant and equipment and intangible assets are no longer depreciated/amortised.

Short-term employee benefits

Short-term employee benefit obligations are measured on an undiscounted basis and are expensed as the related service is provided. A liability is recognised for the amount expected to be paid under short-term cash bonus if the Group has a present legal or constructive obligation to pay this amount as a result of past service provided by the employee, and the obligation can be estimated reliably.

Retirement benefits

Pension fund

The Group operates a defined contribution plan, the assets of which are held in a separate trustee-administered fund. The benefits payable by the fund in the future, due to retirements and withdrawals from the fund, are contributions to the fund together with fund interest at a rate determined by the valuator with the consent of the trustees. The rate is so determined that the value of the total of the fund shall not exceed the value of the total assets of the fund. The Group's contribution to the plan is charged to profit or loss when due.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Post-retirement benefits other than pensions

The Group provides post-retirement medical benefits to qualifying employees, which is deemed to be a defined benefit plan. The expected costs of these benefits are determined using the projected unit credit method, with actuarial valuations being carried out at each reporting date. Contributions are made to the relevant funds over the expected service lives of the employees entitled to those funds. The estimated cost of providing such benefits is charged to profit or loss on a systematic basis over the employees' working lives within the Group.

Actuarial gains and losses are recognised in full in profit or loss in the year when actuarially determined. The amount recognised in the statement of financial position represents the present value of the post-retirement medical aid contribution. Any asset resulting from this calculation is limited to actuarial losses and the present value of available refunds and reductions in future contributions to the plan.

Inventory and contracts in progress

Inventory is measured at the lower of cost and net realisable value. Cost of inventory is determined by the weighted average method. In the case of work in progress, cost includes an appropriate share of production overheads based on normal operating capacity. Net realisable value represents the estimated selling price less all estimated costs to completion and costs to be incurred in selling.

Contracts in progress are stated as a percentage of the sales value of work completed, after provision for losses relating to the stage of completion and any foreseeable losses to completion of the contract, less progress billings.

Income tax

The CSIR is exempt from South African income tax. The income tax expense of subsidiary companies is reflected on Group level.

Income tax expense comprises current and deferred tax. The current tax charge is based on the profit or loss for the year as adjusted for items that are non-taxable or disallowed. It is calculated using tax rates that have been enacted or substantially enacted at the reporting date. Income tax expense is recognised in profit or loss except to the extent that it relates to items recognised directly in other comprehensive income or equity, in which case it is recognised in other comprehensive income or equity.

Deferred tax is recognised in respect of temporary differences arising from differences between the carrying amounts of assets and liabilities in the financial statements and the corresponding tax basis used in the computation of the taxable profit.

Where the tax effects of temporary differences, including those arising from tax losses, give rise to a deferred tax asset, the asset is recognised only if it is probable that future taxable profits will be sufficient to allow the tax benefit of the loss to be realised. Deferred tax assets are reviewed at each reporting date and are reduced to the extent that it is no longer probable that the related tax benefit will be realised. Deferred tax is not recognised for the following temporary differences: the initial recognition of assets or liabilities in a transaction that is not a business combination and that affects neither profit or loss, and differences relating to investments in subsidiaries, associates and jointly controlled entities to the extent that it is probable that they will not reverse in the foreseeable future.

Deferred tax assets and liabilities are offset when there is a legally enforceable right and when these relate to income taxes levied by the same taxation authority and the Group intends to settle its current tax assets and liabilities on a net basis.

Provisions

Provisions are recognised when the Group has a present legal or constructive obligation as a result of past events, for which it is probable that an outflow of economic benefits will be required to settle the obligation, and a reliable estimate can be made of the amount of the obligation. Provisions are determined by discounting the expected future cash flows at a pre-tax rate that reflects current market assessments of the time value of money and the risks specific to the liability.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Provisions (continued)

A provision for onerous contracts is recognised when the expected benefits to be derived by the Group from a contract are lower than the unavoidable cost of meeting its obligations under the contract. The provision is measured at the present value of the lower of the expected cost of terminating the contract and the expected net cost of continuing with the contract. Before a provision is established, the Group recognises any impairment loss on the assets associated with that contract.

Government grants

Government grants that compensate the Group for expenses incurred are recognised as income on a systematic basis over periods necessary to match the assistance with the related expenses it is intended to compensate.

Grants that compensate the Group for the cost of an asset are deducted in arriving at the carrying amount of the acquired asset.

Revenue recognition

Revenue from the sale of goods is measured at the fair value of the consideration received or receivable, net of returns and allowances, trade discounts and volume rebates. Revenue is recognised when the significant risks and rewards of ownership have been transferred to the buyer, recovery of the consideration is probable, the associated costs and possible return of goods can be estimated reliably and there is no continuing management involvement with the goods, and the amount of revenue can be measured reliably.

Revenue from services rendered is recognised in profit or loss in proportion to the stage of completion of the transaction at the reporting date. The stage of completion is assessed by reference to work performed as at the reporting date.

Contract revenue includes the initial amount agreed in the contract plus any variations in contract work, claims and incentive payments to the extent that it is probable that these will result in revenue and can be measured reliably. As soon as the outcome of a contract can be estimated reliably, contract revenue and expenses are recognised in profit or loss in proportion to the stage of completion of the contract.

The stage of completion is assessed by reference to work performed as at reporting date. When the outcome of a contract cannot be estimated reliably, contract revenue is recognised only to the extent of contract costs incurred that are likely to be recoverable. An expected loss on a contract is recognised immediately in profit or loss.

Royalties are accrued based on the stipulations of the applicable contracts.

Finance income/expense

Finance income/expense comprises interest receivable on funds invested, dividend income, fair value adjustments on investments and interest payable on borrowings. Interest income is recognised in profit or loss as it accrues, using the effective interest rate method. Dividend income is recognised in profit or loss on the date that the entity's right to receive payments is established (which is when the dividend is declared). Interest payable on borrowings is calculated using the effective interest rate method.

Expenses

Operating lease payments

Payments made under operating leases are recognised in profit or loss on a straight-line basis over the term of the lease. Lease incentives received are recognised in profit or loss as an integral part of the total lease expense, over the term of the lease.

Finance lease payments

Minimum lease payments are apportioned between the finance charge and the reduction of the outstanding liability. The finance charge is allocated to each period during the lease term so as to produce a constant periodic rate of interest on the remaining balance of the liability.

Financial instruments

Financial instruments are initially measured at fair value plus, for instruments not at fair value through profit or loss, any directly attributable transaction costs, when the Group has become a party to contractual provision of the instrument. Subsequent to initial recognition, these instruments are measured as set out on the following page.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Financial instruments (continued)

Held-to-maturity financial assets

If the Group has the positive intent and ability to hold fixed deposits to maturity, then such financial assets are classified as held to maturity. Held-to-maturity financial assets are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition, held-to-maturity financial assets are measured at amortised cost using the effective interest method, less any impairment losses. Held-to-maturity financial assets comprise fixed deposits.

Loans and receivables

Trade and other receivables

Trade receivables are subsequently measured at amortised cost using the effective interest method less any impairment losses, which approximate the fair value of these due to the short-term nature thereof.

Loans

Loans are measured at amortised cost using the effective interest method less any impairment losses if they have a fixed maturity, or at cost if there is no fixed maturity.

Cash and cash equivalents

Cash and cash equivalents are measured at amortised cost, which is their fair value. Cash and cash equivalents comprise bank balances, cash on deposit and cash on hand.

Financial assets at fair value through profit or loss

Forward exchange contracts

Forward exchange contracts are fair valued and gains and losses are recognised in profit or loss. Hedge accounting is not applied.

Financial liabilities at amortised cost

Trade and other payables and advances received

Trade and other payables and advances received are stated at amortised cost, which approximates the fair value of these due to the short-term nature thereof.

De-recognition

Financial assets (or a portion thereof) are de-recognised when the Group realises the rights to the benefits specified in the contract, the rights expire or the Group surrenders or otherwise loses control and does not retain substantially all risks and rewards of the asset. On de-recognition, the difference between the carrying amount of the financial asset and proceeds receivable is included in profit or loss.

Financial liabilities (or a portion thereof) are de-recognised when the obligation specified in the contract is discharged, cancelled or expires. On de-recognition, the difference between the carrying amount of the financial liability and the amount paid for it is included in profit or loss.

Fair value methods and assumptions

The fair value of financial instruments traded in an organised financial market is measured at the applicable quoted prices necessary to realise the asset or settle the liability.

The fair value of financial instruments not traded in an organised financial market is determined using a variety of valuation methods and assumptions that are based on market conditions and risk existing at the reporting date, including independent appraisals and discounted cash flow methods.

Related parties

The Group operates in an economic environment currently dominated by entities directly or indirectly owned by the South African government. As a result of the constitutional independence of all three spheres of government in South Africa, only parties within the national sphere of government will be considered to be related parties.

Key management is defined as being individuals with the authority and responsibility for planning, directing and controlling the activities of the entity. All individuals from the level of Group Executive up to the Board of directors are regarded as key management.

Close family members of key management are considered to be those family members who may be expected to influence, or be influenced by key management individuals or other parties related to the entity.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Standards and interpretations issued, not yet effective

At the date of authorisation of the financial statements of the Group for the year ended 31 March 2013, the following standards and interpretations were in issue but not yet effective:

Standard/Interpretation	Description	Effective date
IFRS 9 (2009) (AC 146)	Financial instruments. The impact of this amendment on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2013
IFRS 9 (2010) (AC 146A)	Financial instruments. The impact of this amendment on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2013

The Accounting Practices Board and the Financial Reporting Standards Council has announced that South African Statements of Generally Accepted Accounting Practice (SA GAAP) will be withdrawn and cease to apply in respect of financial years commencing on or after 1 December 2012. The CSIR will therefore adopt a new reporting framework, either International Financial Reporting Standards (IFRS) or Generally Recognised Accounting Practice (GRAP) for the financial year ending 31 March 2014.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP				CSIR			
	2013		2012		**2013**		2012	
	R'000	**%**	R'000	%	**R'000**	**%**	R'000	%
2 REVENUE								
Parliamentary Grant	**594 478**	**29**	556 837	30	**594 478**	**29**	556 837	30
Parliamentary Grant received	**601 838**	**30**	549 111	30	**601 838**	**30**	549 111	30
Less:								
Grant received for projects started before year-end but not completed	**(56 999)**	**(3)**	(49 639)	(3)	**(56 999)**	**(3)**	(49 639)	(3)
Add:								
Grant received in prior year for projects completed in this year	**49 639**	**2**	57 365	3	**49 639**	**2**	57 365	3
Contract R&D income	**1 388 632**	**70**	1 270 045	70	**1 389 016**	**70**	1 273 400	70
Local private sector	**178 519**	**9**	177 835	10	**178 903**	**9**	181 190	10
Local public sector	**1 027 998**	**52**	952 909	52	**1 027 998**	**52**	952 909	52
International sector (including Africa)	**182 115**	**9**	139 301	8	**182 115**	**9**	139 301	8
Royalties	**20 205**	**1**	10 244	–	**14 811**	**1**	10 244	–
	2 003 315	**100**	1 837 126	100	**1 998 305**	**100**	1 840 481	100

Contract R&D income is disclosed after taking into account the effect of the time value of money (the value of discounting) in terms of SAICA's Circular 9 of 2006: Transactions giving rise to adjustments to revenue/purchases.
The value is R14,12 million (2012: R8,33 million) and is included in finance income (note 4).

Included in public sector contract R&D income is R50,29 million (2012: R55,45 million) ring-fenced allocation from the Department of Science and Technology for specific initiatives managed through memorandums of agreement.

Included in contract R&D income is rental income amounting to R29,38 million (2012: R27,99 million).

Estimates on Parliamentary Grant recognition are based on cost to completion, budgets and percentage of completion.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

3 PROFIT BEFORE INCOME TAX

Profit before income tax is arrived at after taking the following items into account:

Audit fees	**3 495**	4 744	**3 495**	4 669
Fees for services	**10 177**	6 214	**9 945**	5 991
Patent costs	**7 688**	5 616	**7 456**	5 393
Legal costs	**2 489**	598	**2 489**	598
Operating leases	**8 819**	11 371	**8 755**	11 340
Buildings	**2 681**	6 245	**2 617**	6 214
Equipment	**4 313**	3 795	**4 313**	3 795
Vehicles	**1 825**	1 331	**1 825**	1 331
Net realised foreign exchange gain	**(21 741)**	(13 644)	**(21 741)**	(13 644)
Net unrealised foreign exchange gain	**(1 930)**	(4 112)	**(1 930)**	(4 112)
Board members' and Executive Management's emoluments (note 17)	**19 720**	15 549	**18 246**	14 954
Impairments/(reversals of impairments)	**8 062**	(3 702)	**10 032**	(3 180)
(Reversal of impairment)/impairment on subsidiaries, joint ventures and associates	**(2 102)**	(1 089)	**107**	(147)
Impairment/(reversal of impairment) on trade receivables	**9 925**	(3 033)	**9 925**	(3 033)
Impairment on intangible assets	**239**	420	**–**	–
Bad debt written off	**512**	1 154	**512**	1 154
Loss/(profit) on disposal and write-off of property, plant and equipment	**785**	(307)	**776**	(307)
Transfer of building to the Department of Public Works	**–**	(21 929)	**–**	(21 929)
Loss on disposal of interests in subsidiaries, joint ventures and associates	**–**	4 727	**–**	5 185
Lost and/or stolen equipment and vehicles*	**958**	308	**958**	308
Losses incurred	**2 464**	308	**2 464**	308
Losses recovered	**(1 506)**	–	**(1 506)**	–

* These are losses incurred in the normal course of the CSIR's business and are covered by the CSIR's insurance policy. The net losses incurred on these are included in the loss/(profit) on disposal and write-off of property, plant and equipment amounts.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
4 FINANCE INCOME/EXPENSE				
Finance income	**51 965**	44 028	**51 052**	42 792
Interest on bank balances and investments	**37 850**	35 699	**36 937**	34 463
Adjustment on initial recognition of contract R&D income*	**14 115**	8 329	**14 115**	8 329
Finance expense	**(4 676)**	(4 419)	**(4 676)**	(4 419)
Adjustment on initial recognition of operating expenses*	**(4 676)**	(4 419)	**(4 676)**	(4 419)
	47 289	39 609	**46 376**	38 373

* These adjustments are due to the effect of the time value of money (the value of discounting) in terms of SAICA's Circular 9 of 2006: Transactions giving rise to adjustments to revenue/purchases.

5 INCOME TAX EXPENSE

The CSIR is exempt from South African income tax in terms of section 10 (1) (t) (i) of the Income Tax Act, Act No 58 of 1962.

	%	%
South African normal rate of taxation	**28%**	28%
Profit attributable to tax-exempt entities	**(26%)**	(29%)
Assessed loss (refer note 12)	**(1%)**	1%
Share of profit of associate	**(1%)**	–
Current and deferred taxation – effective rate	**0%**	0%

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

6 PROPERTY, PLANT AND EQUIPMENT

	2013			2012		
	Cost	**Accumulated depreciation**	**Carrying value**	Cost	Accumulated depreciation	Carrying value
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Group						
Land	**4 821**	**–**	**4 821**	4 821	–	4 821
Buildings	**383 249**	**68 059**	**315 190**	333 053	67 857	265 196
Equipment	**566 269**	**406 553**	**159 716**	542 618	386 352	156 266
Vehicles	**6 848**	**4 568**	**2 280**	7 176	4 499	2 677
	961 187	**479 180**	**482 007**	887 668	458 708	428 960
CSIR						
Land	**4 821**	**–**	**4 821**	4 821	–	4 821
Buildings	**383 249**	**68 059**	**315 190**	333 053	67 857	265 196
Equipment	**566 161**	**406 502**	**159 659**	542 548	386 318	156 230
Vehicles	**6 848**	**4 568**	**2 280**	7 176	4 499	2 677
	961 079	**479 129**	**481 950**	887 598	458 674	428 924

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

6 PROPERTY, PLANT AND EQUIPMENT (continued)

	Land R'000	Buildings R'000	Equipment R'000	Vehicles R'000	Total R'000
Group					
Carrying value 31 March 2011	5 549	206 992	176 784	3 155	**392 480**
Additions	–	61 832	38 749	103	**100 684**
Disposals and write-offs	(728)	(2 047)	(1 262)	–	**(4 037)**
Transfer of the Satellite Applications Centre (SAC)	–	(1 379)	(16 472)	(114)	**(17 965)**
Depreciation	–	(202)	(41 162)	(467)	**(41 831)**
Loss of control	–	–	(371)	–	**(371)**
Carrying value 31 March 2012	4 821	265 196	156 266	2 677	**428 960**
Additions	–	50 196	48 919	88	**99 203**
Disposals and write-offs	–	–	(1 222)	(26)	**(1 248)**
Depreciation	–	(202)	(44 247)	(459)	**(44 908)**
Carrying value 31 March 2013	**4 821**	**315 190**	**159 716**	**2 280**	**482 007**
CSIR					
Carrying value 31 March 2011	5 549	206 992	176 409	3 155	**392 105**
Additions	–	61 832	38 710	103	**100 645**
Disposals and write-offs	(728)	(2 047)	(1 262)	–	**(4 037)**
Transfer of the Satellite Applications Centre (SAC)	–	(1 379)	(16 472)	(114)	**(17 965)**
Depreciation	–	(202)	(41 155)	(467)	**(41 824)**
Carrying value 31 March 2012	4 821	265 196	156 230	2 677	**428 924**
Additions	–	50 196	48 868	88	**99 152**
Disposals and write-offs	–	–	(1 213)	(26)	**(1 239)**
Depreciation	–	(202)	(44 226)	(459)	**(44 887)**
Carrying value 31 March 2013	**4 821**	**315 190**	**159 659**	**2 280**	**481 950**

Land and buildings are unencumbered and full details of the titles are available at the registered office of the CSIR.

A change in the depreciation estimate due to a change in the useful lives of equipment resulted in a R2,1 million (2012: R1,2 million) decrease in the depreciation amount for the current financial year.

Included above are assets with a cost of R218,0 million (2012: R228,4 million) that are fully depreciated as the remaining useful life is incidental.

During the current financial year, assets to the value of R30,9 million (2012: R83,6 million) were purchased with Government grant funds. At year-end the cumulative value of assets purchased with Government grant funds and shown at a nil cost is R346,5 million (2012: R320,3 million).

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

7 INTANGIBLE ASSETS

	2013			2012		
	Cost	**Accumulated amortisation & impairment**	**Carrying value**	Cost	Accumulated amortisation & impairment	Carrying value
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Group						
Investments in technology	**10 739**	**10 739**	**–**	10 468	10 468	–

	GROUP
	R'000
Carrying value 31 March 2011	18
Additions	448
Loss of control	(18)
Impairment*	(420)
Amortisation	(28)
Carrying value 31 March 2012	–
Additions	271
Impairment*	(239)
Amortisation	(32)
Carrying value 31 March 2013	**–**

* There are no guarantees of future cash flows and therefore the intangible assets have been impaired.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
8 INTEREST IN JOINT VENTURES AND ASSOCIATES				
Cost of investments less impairment losses	**1**	1	**1**	1
Loans to joint ventures and associates	**36 937**	37 437	**33 937**	33 937
Share of post-acquisition losses	**(19 283)**	(19 249)	**–**	–
Share of pre-acquisition gains	**151**	151	**–**	–
	17 806	18 340	**33 938**	33 938
Impairment of joint ventures and associates	**(10 866)**	(12 968)	**(32 668)**	(32 637)
	6 940	5 372	**1 270**	1 301

The loans to joint ventures and associates are interest free, unsecured and have no fixed terms of repayment.

Agreements have been entered into between the CSIR and certain joint ventures and associates to subordinate the loans made to those joint ventures and associates. The subordination agreements will remain in force for as long as the liabilities of the relevant joint ventures or associates exceed their assets, fairly valued.

Details of the joint ventures and associates at 31 March 2013 are as follows:

Name of joint venture/associate	Place of incorporation	Portion of ownership interest	Portion of voting power held	Principal activity	Carrying value 2013 R'000	Carrying value 2012 R'000	Financial year-end
Joint ventures							
Sera (Pty) Ltd	South Africa	50%	50%	Commercialisation and licensing of patents	**10 866**	12 968	31 March
Ellipsoid Technology (Pty) Ltd	South Africa	50%	50%	Development of encapsulation technology	**1 280**	1 327	31 March
Associates							
Uvirco Technologies (Pty) Ltd	South Africa	45%	45%	Manufacturing of high technology cameras	**5 660**	4 045	31 March
					17 806	18 340	

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

8 INTEREST IN JOINT VENTURES AND ASSOCIATES (continued)

The following are details of the significant joint ventures' and associates' assets, liabilities, income and expenses:

	JOINT VENTURES GROUP		ASSOCIATES GROUP	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
Current assets	**22 177**	27 489	**17 704**	8 667
Non-current assets	**30 091**	24 471	**3 235**	1 198
Current liabilities	**49 953**	44 958	**12 577**	5 453
Non-current liabilities	**48 232**	48 232	**2 250**	3 000
Income	**1 727**	1 597	**32 964**	16 629
Expenses	**6 714**	3 957	**28 264**	15 753

9 INTEREST IN SUBSIDIARIES

	CSIR	
	2013	2012
	R'000	R'000
Shares at cost less impairment losses	**4 650**	4 650
Indebtedness	**16 007**	16 083
– by subsidiaries	**32 500**	32 500
– impairment of loans	**(16 493)**	(16 417)
	20 657	20 733

Details disclosed in Addendum A.

The loans to subsidiaries are interest free, unsecured and have no fixed terms of repayment.

Agreements have been entered into between the CSIR and certain subsidiaries to subordinate the loans made to those subsidiaries. The subordination agreements will remain in force for as long as the liabilities of the relevant subsidiaries exceed their assets, fairly valued.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

10 TRADE AND OTHER RECEIVABLES

Trade receivables	**282 943**	153 940	**278 518**	154 196
Prepaid expenditure	**19 035**	24 590	**19 035**	24 590
Other receivables	**1 214**	720	**226**	264
	303 192	179 250	**297 779**	179 050

Trade receivables are shown net of impairment losses. Refer to note 20 for more detail on trade receivables.

11 INVENTORY AND CONTRACTS IN PROGRESS

Contracts in progress less provision for losses	**111 351**	66 680	**111 351**	66 680
Raw materials and consumables	**880**	821	**880**	821
	112 231	67 501	**112 231**	67 501

Estimates on contract in progress recognition are based on cost to completion, budgets and percentage of completion.

12 DEFERRED TAX ASSET

Balance at the beginning of the year	**–**	400
Movement for the year:		
Loss of control	**–**	400
	–	–

Two subsidiaries in the Group are in assessed loss positions and no deferred tax assets were raised for these assessed losses due to the uncertainty of the recoverability in future periods in respect of the carry forward of unused tax losses.

Opening balance	**7 604**	6 144
Amendment to 2009 assessment	**–**	177
Assessed tax loss generated for the year	**(2 600)**	1 283
Assessed tax loss carried forward	**5 004**	7 604

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
13 ADVANCES RECEIVED				
Advances on contracts received from clients and stakeholders	**756 887**	618 620	**756 887**	618 620
14 TRADE AND OTHER PAYABLES				
Accounts payable and accruals	**351 547**	298 124	**350 145**	297 444
Salary-related accruals	**154 041**	145 016	**154 041**	145 019
	505 588	443 140	**504 186**	442 463

15 OPERATING LEASE COMMITMENTS

Financial commitments under non-cancellable operating leases will result in the following payments falling due:

Within one year:	**1 176**	2 501	**1 114**	2 442
Land and buildings	**182**	1 544	**120**	1 485
Vehicles	**994**	957	**994**	957
Within two to five years:	**1 316**	1 469	**1 316**	1 411
Land and buildings	**120**	58	**120**	–
Vehicles	**1 196**	1 411	**1 196**	1 411

Agreements relating to operating lease payments for vehicles vary from 12 to 60 months and payments are fixed for the term of the agreements.

The CSIR leases buildings under operating leases. The lease periods vary from 12 to 60 months. Lease payments are increased with a fixed annual escalation percentage to reflect market rentals. None of the leases include contingent rentals.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

16 RETIREMENT BENEFITS OF EMPLOYEES

16.1 CSIR Pension Fund

The fund is registered in terms of the Pension Funds Act, 1956, and is a defined contribution plan. The CSIR's liability to the fund is limited to paying the employer contributions. Life cover and dependants' pensions are fully secured by a continued income and life insurance policy. All the CSIR's permanent employees are members of the fund.

Employer contributions of R74,0 million (2012: R67,3 million) and employee contributions of R43,4 million (2012: R39,4 million) were expensed during the year.

16.2 Mine Officials Pension Fund and Sentinel

At the time of the merger with the Chamber of Mines Research Organisation (COMRO) in 1993, certain COMRO (Sentinel Mining) employees elected to remain members of the Mine Officials Pension Fund and Sentinel (previously Chamber of Mines Pension Fund). In terms of the agreement with the Chamber of Mines, this election holds no liability for the CSIR other than paying the monthly employee contributions. The funds are defined benefit plans.

On 1 March 2001 the members of the Chamber of Mines Pension Fund moved to Sentinel.

In respect of the two employees (2012: two employees) who had formally converted their secondment to a CSIR appointment, employer contributions of R105 611 (2012: R99 133) and employee contributions of R58 342 (2012: R54 771) were expensed during the year. Employer contributions are charged against income when incurred.

16.3 Associated Institutions Pension Fund (AIPF)

The fund is a defined benefit plan. The formula used to determine pensions is based on the pensionable earnings of the final year, and the aggregate period of uninterrupted membership.

The CSIR has one employee (2012: one employee) who is a member of the AIPF as at 31 March 2013. The fund is controlled by the state, which has assumed responsibility for the unfunded portions of these funds.

Employer contributions of R5 587 (2012: R5 280) and employee contributions of R3 492 (2012: R3 300) were expensed during the year.

16.4 Post-retirement medical benefits

The CSIR has a post-retirement medical benefit obligation to certain qualifying retired CSIR employees (pensioners) that joined the CSIR prior to 30 September 1996. An offer was made to qualifying pensioners in December 2005 to accept an annuity, payable from an independent source, equivalent to the value of their medical subsidy. The pensioners who accepted the offer are no longer entitled to a subsidy from the CSIR.

The accumulated benefit obligation and the annual cost of accrual of benefits are assessed by independent, qualified actuaries using the projected unit credit method. The estimated present value of the anticipated expenditure for the remaining 18 continuation members (2012: 18 continuation members) was recalculated by the actuaries as at 31 March 2013 and will be funded through cash and cash equivalents. These cash and cash equivalents have not been set aside specifically for this benefit.

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for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

16 RETIREMENT BENEFITS OF EMPLOYEES (continued)

16.4 Post-retirement medical benefits (continued)

The amount included in the statement of financial position arising from the CSIR's obligation in respect of post-retirement medical benefits is as follows:

Present value of obligations	**10 347**	8 260	**10 347**	8 260
Net liability on statement of financial position	**10 347**	8 260	**10 347**	8 260

Amounts recognised in the statement of comprehensive income in respect of the scheme are as follows:

Interest cost	**702**	905	**702**	905
Actuarial loss/(gain) recognised during the year	**1 385**	(2 629)	**1 385**	(2 629)
	2 087	(1 724)	**2 087**	(1 724)

Movement in the net liability recognised in the statement of financial position is as follows:

Net liability at the beginning of the year	**8 260**	10 142	**8 260**	10 142
Movement for the year	**2 087**	(1 882)	**2 087**	(1 882)
Net expense/(income) recognised in the statement of comprehensive income	**2 087**	(1 724)	**2 087**	(1 724)
Settlements	**–**	(158)	**–**	(158)
Net liability at the end of the year	**10 347**	8 260	**10 347**	8 260

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	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

16 RETIREMENT BENEFITS OF EMPLOYEES (continued)

16.4 Post-retirement medical benefits (continued)

Principal actuarial assumptions at the reporting date:

Discount rate at 31 March	**8.00%**	8.50%	**8.00%**	8.50%
Medical inflation costs	**6.40%**	4.30%	**6.40%**	4.30%

The above results are sensitive to changes in the assumed future rate of medical inflation.

The effect of a one-percent increase in the assumed future rate of medical inflation would have the following effects:

Effect on defined-benefit obligation	**782**	591	**782**	591

The effect of a one-percent decrease in the assumed future rate of medical inflation would have the following effects:

Effect on defined-benefit obligation	**(702)**	(524)	**(702)**	(524)

Historical information	**2013**	2012	2011	2010	2009
Present value of the defined benefit obligation	**10 347**	8 260	10 142	9 875	8 862
Deficit in the plan	**10 347**	8 260	10 142	9 875	8 862

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for the year ended 31 March 2013

17 BOARD MEMBERS, DIRECTORS AND EXECUTIVE MANAGEMENT'S REMUNERATION

2013						
			Managerial Services			
	Entity	Fees for services as director	Basic salary	Bonuses and performance-related payments	Retirement fund and medical aid contributions	Total
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr SP Sibisi	CSIR	–	3 111	1 670	517	**5 298**
Non-executive Board members						
Mr G Badela	CSIR	113	–	–	–	**113**
Mr P Benadè	CSIR	133	–	–	–	**133**
Professor TE Cloete	CSIR	70	–	–	–	**70**
Dr PH Goyns	CSIR	–	–	–	–	**–**
Ms MSM Mabitje-Thompson	CSIR	–	–	–	–	**–**
Professor TA Nyokong	CSIR	52	–	–	–	**52**
Professor FW Petersen	CSIR	102	–	–	–	**102**
Mr M Sibanda	CSIR	99	–	–	–	**99**
Ms BS Tshabalala	CSIR	104	–	–	–	**104**
Professor MJ Wingfield	CSIR	43	–	–	–	**43**
Executive Management						
Dr RK Chikwamba	CSIR	–	1 700	210	119	**2 029**
Dr JH Maree	CSIR	–	1 944	848	258	**3 050**
Dr M Motuku (from June 2012)	CSIR	–	1 604	–	138	**1 742**
Mr CR Sturdy	CSIR	–	1 751	827	327	**2 905**
Mr RM Zondo	CSIR	–	1 735	597	174	**2 506**
Subsidiaries						
Non-executive Board member						
Mr M Sibanda	Technifin (Pty) Ltd	23	–	–	–	**23**
Executive Management						
Mr JG Hattingh	Technifin (Pty) Ltd	–	1 451	–	–	**1 451**
2013		**739**	**13 296**	**4 152**	**1 533**	**19 720**

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17 BOARD MEMBERS, DIRECTORS AND EXECUTIVE MANAGEMENT'S REMUNERATION (continued)

2012

	Entity	Fees for services as director	Managerial Services: Basic salary	Managerial Services: Bonuses and performance-related payments	Managerial Services: Retirement fund and medical aid contributions	Total
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr SP Sibisi	CSIR	–	2 916	1 301	484	**4 701**
Non-executive Board members						
Mr G Badela (from January 2012)	CSIR	8	–	–	–	**8**
Mr N Behrens (until December 2011)	CSIR	41	–	–	–	**41**
Mr P Benadè	CSIR	94	–	–	–	**94**
Professor TE Cloete (from January 2012)	CSIR	8	–	–	–	**8**
Dr PH Goyns (from January 2012)	CSIR	–	–	–	–	**–**
Mr ADC Knott-Craig (until December 2011)	CSIR	55	–	–	–	**55**
Ms MSM Mabitje-Thompson (from January 2012)	CSIR	–	–	–	–	**–**
Professor TA Nyokong (from January 2012)	CSIR	8	–	–	–	**8**
Professor FW Petersen	CSIR	78	–	–	–	**78**
Mr M Sibanda	CSIR	91	–	–	–	**91**
Mr M Silinga (until December 2011)	CSIR	33	–	–	–	**33**
Ms KL Thoka (until December 2011)	CSIR	41	–	–	–	**41**
Ms BS Tshabalala (from January 2012)	CSIR	8	–	–	–	**8**
Professor MJ Wingfield	CSIR	50	–	–	–	**50**
Executive Management						
Dr RK Chikwamba (from March 2012)	CSIR	–	121	–	9	**130**
Dr T Dlamini (until December 2011)	CSIR	–	1 436	551	111	**2 098**
Dr JH Maree	CSIR	–	1 809	661	265	**2 735**
Mr CR Sturdy	CSIR	–	1 656	644	303	**2 603**
Mr RM Zondo	CSIR	–	1 564	451	157	**2 172**
Subsidiaries						
Non-executive Board member						
Mr M Sibanda (from November 2011)	Technifin (Pty) Ltd	9	–	–	–	**9**
Executive Management						
Mr JG Hattingh (from November 2011)	Technifin (Pty) Ltd	–	586	–	–	**586**
2012		**524**	**10 088**	**3 608**	**1 329**	**15 549**

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	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
18 CONTINGENT LIABILITIES AND FACILITIES				
Facilities of subsidiaries guaranteed by the CSIR	**20 000**	20 000	**20 000**	20 000

Legal costs and litigation

In the nature of the CSIR's business, agreements with complex deliverables may be entered into. All necessary steps are taken to manage the risks inherent to these transactions. If and when it is evident that there is a reasonable probability that a dispute on a transaction could lead to costs against the CSIR, such costs will be disclosed.

19 CAPITAL COMMITMENTS				
Property, plant and equipment	**44 666**	31 150	**44 666**	31 150

This capital expenditure is to be financed from internal sources.

20 FINANCIAL INSTRUMENTS

The Group has exposure to the following risks from its use of financial instruments:

- market risk
- credit risk
- liquidity risk.

This note presents information about the Group's exposure to each of the above risks and the Group's objectives, policies and processes for measuring and managing risk. Further quantitative disclosures are included throughout these consolidated financial statements.

The Board has overall responsibility for the establishment and oversight of the Group's risk management framework.

The Group's risk management policies are established to identify and analyse the risks faced by the Group, to set appropriate risk limits and controls, and to monitor risks and adherence to limits. Risk management policies and systems are reviewed regularly to reflect changes in market conditions and the Group's activities. The Group, through its training and management standards and procedures, aims to develop a disciplined and constructive control environment in which all employees understand their roles and obligations.

The Audit and Risk Committee oversees how management monitors compliance with the Group's risk management policies and procedures and reviews the adequacy of the risk management framework in relation to the risks faced by the Group. The Group Audit and Risk Committee is assisted in its oversight role by Internal Audit. Internal Audit undertakes both regular and *ad hoc* reviews of risk management controls and procedures, the results of which are reported to the Audit and Risk Committee.

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20 FINANCIAL INSTRUMENTS (continued)

20.1 Market risk

Market risk is the risk that changes in market prices, such as foreign exchange rates and interest rates will affect the Group's income or the value of its holdings of financial instruments. The objective of market risk management is to manage and control market risk exposures within acceptable parameters, while optimising the return.

Foreign currency risk

The Group is exposed to currency risk on sales and purchases that are denominated in a currency other than the respective functional currency of the Group entities and on investments in foreign operations.

The Group enters into forward exchange contracts to buy specified amounts of foreign currencies in the future at a predetermined exchange rate.

Forward exchange contracts are entered into mainly to cover import orders. The Group has no policy to enter into forward exchange contracts for anticipated foreign receipts. The Group does not use derivative financial instruments for speculative purposes.

The Group's exposure to foreign currency risk was as follows:

	31 MARCH 2013					
	Total R'000	**ZAR R'000**	**EURO R'000**	**USD R'000**	**GBP R'000**	**Other R'000**
Trade receivables	**282 943**	249 767	948	30 481	1 060	687
Bank accounts	**179 925**	133 782	8 661	36 604	757	121
Trade payables	**(505 588)**	(501 442)	(1 648)	(1 439)	(788)	(271)
Gross statement of financial position exposure	**(42 720)**	(117 893)	7 961	65 646	1 029	537
Forward exchange contracts	**–**	–	–	–	–	–
Net exposure	**(42 720)**	**(117 893)**	**7 961**	**65 646**	**1 029**	**537**

	31 MARCH 2012					
	Total R'000	**ZAR R'000**	**EURO R'000**	**USD R'000**	**GBP R'000**	**Other R'000**
Trade receivables	**153 940**	118 820	198	34 119	73	730
Bank accounts	**152 822**	51 884	8 513	91 068	679	678
Trade payables	**(443 140)**	(441 486)	(181)	(780)	(575)	(118)
Gross statement of financial position exposure	**(136 378)**	(270 782)	8 530	124 407	177	1 290
Forward exchange contracts	**–**	–	–	–	–	–
Net exposure	**(136 378)**	**(270 782)**	**8 530**	**124 407**	**177**	**1 290**

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	GROUP	
	2013	2012

20 FINANCIAL INSTRUMENTS (continued)

20.1 Market risk (continued)

Foreign currency risk (continued)

The following significant exchange rates applied during the year:

	R	R
Year-end spot rate		
Euro	**11.8346**	10.2515
USD	**9.2351**	7.6855
GBP	**14.0368**	12.2879

Sensitivity analysis

A 10% strengthening of the rand against the following currencies at 31 March would have decreased profit or loss by the amounts shown below. This analysis assumes that all other variables remain constant. The analysis is performed on the same basis for 2012.

	R'000	R'000
Euro	**(796)**	(853)
USD	**(6 565)**	(12 441)
GBP	**(103)**	(18)
Other	**(54)**	(129)

A 10% weakening of the rand against the above currencies at 31 March would have had the equal but opposite effect on the above currencies to the amounts shown above, on the basis that all other variables remain constant.

Interest rate risk

Interest rate exposure and investment strategies are evaluated by management on a regular basis. Interest-bearing investments are held with several reputable banks in order to minimise exposure.

At the reporting date, the interest rate profile of the Group's interest-bearing financial instruments was as follows:

Fixed rate instruments: carrying amount

	R'000	R'000
Financial assets: Fixed deposits	**772 808**	452 633

The Group does not account for any fixed rate financial assets and liabilities at fair value through profit or loss, and the Group does not designate derivatives as hedging instruments under a fair value hedge accounting model. Therefore, a change in interest rates at the reporting date would not affect profit or loss.

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for the year ended 31 March 2013

	GROUP	
	2013	2012
	R'000	R'000

20 FINANCIAL INSTRUMENTS (continued)

20.1 Market risk (continued)

Interest rate risk (continued)

Variable rate instruments: carrying amount

Financial assets: Call deposits	**49 000**	363 000
Financial assets: Bank balances	**179 925**	152 822
	228 925	515 822

Sensitivity analysis

An increase of 100 basis points in interest rates at the reporting date would have increased equity and profit and loss by the amounts shown below. This analysis assumes that all other variables, in particular foreign currency rates, remain constant. The analysis is performed on the same basis for 2012.

Variable rate instruments	**2 289**	5 158

A decrease of 100 basis points would have had the equal but opposite effect to the amounts shown above.

20.2 Credit risk

Credit risk is the risk of financial loss to the Group if a customer or counterparty to a financial instrument fails to meet its contractual obligations, and arises principally from the Group's bank balances and deposits, trade and other receivables and loans to joint ventures, associates and subsidiaries.

Trade and other receivables and loans to joint ventures, associates and subsidiaries

Trade and other receivables and loans to joint ventures, associates and subsidiaries are presented net of impairment losses. Credit risk with respect to trade receivables is limited due to the large number of customers comprising the Group's customer base and their dispersion across different industries and geographical areas. Accordingly, the Group does not have a significant concentration of credit risk.

The Group does not have any significant exposure to any individual customer or counterparty.

Bank balances and deposits

The Group's bank balances and cash are placed with high credit, quality financial institutions.

Guarantees

Refer to note 18 for details on bank guarantees issued with respect to facilities.

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20 FINANCIAL INSTRUMENTS (continued)
20.2 Credit risk (continued)

	GROUP	
	2013	2012
	R'000	R'000
Exposure to credit risk		
The carrying amount of financial assets represents the maximum credit exposure.		
The maximum exposure to credit risk at the reporting date was:		
Held-to-maturity investments:		
– *Current fixed deposits*	**772 808**	452 633
Other cash and cash equivalents:		
– *Call deposits*	**49 000**	363 000
– *Bank balances*	**179 925**	152 822
– *Cash on hand and cash deposits*	**141**	640
Loans and receivables:		
– *Trade and other receivables*	**303 192**	179 250
– *Contracts in progress less provision for losses*	**111 351**	66 680
	1 416 417	1 215 025
The maximum exposure to credit risk for trade receivables at the reporting date by type of customer was:		
Local public	**197 496**	81 937
Local private	**50 479**	35 989
International	**34 968**	36 014
	282 943	153 940

The Group's most significant customers are government institutions.

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for the year ended 31 March 2013

20 FINANCIAL INSTRUMENTS (continued)

20.2 Credit risk (continued)

Exposure to credit risk (continued)

The aging of the Group's trade receivables at the reporting date was:

	2013		2012	
	Gross R'000	Impairment R'000	Gross R'000	Impairment R'000
Not past due	**244 019**	**1 987**	105 394	138
Past due 0 – 30 days	**28 536**	**323**	25 942	172
Past due 31 – 120 days	**12 547**	**3 888**	11 720	1 085
Past due more than 120 days	**15 000**	**10 961**	18 118	5 839
	300 102	**17 159**	161 174	7 234

The movement in the allowance for impairment in respect of trade receivables during the year was as follows:

	GROUP	
	2013 R'000	2012 R'000
Balance at 1 April	**7 234**	10 267
Impairment/(reversal of impairment)	**9 925**	(3 033)
Balance at 31 March	**17 159**	7 234

The allowance account in respect of trade receivables is used to record impairment losses unless the Group is satisfied that no recovery of the amount owing is possible; at that point the amount considered irrecoverable is written off against the financial asset directly.

The movement in the impairment allowance account is due mainly to the following: recoveries of R2,2 million (2012: R6,3 million), utilisation of R2,1 million (2012: R1,4 million) and new impairment allowances of R14,2 million (2012: R4,7 million).

20.3 Liquidity risk

Liquidity risk is the risk that the Group will not be able to meet its financial obligations as these fall due. The Group's approach to managing liquidity is to ensure, as far as possible, that it will always have sufficient liquidity to meet its liabilities when due, under both normal and stressed conditions, without incurring unacceptable losses or risking damage to the Group's reputation.

The Group monitors its cash flow on a daily basis. Typically, the Group ensures that it has sufficient cash on demand to meet expected operational expenses for a period of 60 days, including the servicing of financial obligations; this excludes the potential impact of extreme circumstances that cannot be predicted reasonably, such as natural disasters.

The CSIR has a short-term general banking facility of R500 000 (2012: R500 000) available.

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20 FINANCIAL INSTRUMENTS (continued)

20.3 Liquidity risk (continued)

The following are the contractual maturities of financial liabilities, including interest payments and excluding the impact of netting agreements for the Group:

	2013			2012		
	Carrying amount	**Contractual cash-flows**		Carrying amount	Contractual cash-flows	
		6 months or less	**6–12 months**		6 months or less	6–12 months
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Non-derivative financial liabilities						
Trade and other payables	**(505 588)**	**(505 588)**	**–**	(443 140)	(443 140)	–
Derivative financial liabilities						
Forward exchange contracts	**–**	**–**	**–**	–	–	–
	(505 588)	**(505 588)**	**–**	(443 140)	(443 140)	–

20.4 Fair values

At 31 March 2013 the carrying amount of bank balances and cash, deposits, trade and other receivables, contracts in progress and trade and other payables approximated their fair values due to the short-term maturities of these assets and liabilities.

Basis for determining fair values

Interest free employee loans

The fair value of interest free employee loans is calculated based on the present value of future cash flows, discounted at the market rate of interest at the reporting date.

Trade and other receivables and trade and other payables

The fair value of trade and other receivables and trade and other payables is calculated based on the present value of future cash flows, discounted at the average return on investment rate at the reporting date.

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21 RECONCILIATION OF OPERATING PROFIT TO CASH GENERATED FROM OPERATING ACTIVITIES

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
Operating profit for the year before taxation	**53 264**	65 584	**48 452**	68 998
Adjusted for:				
Loss on disposal of interests in subsidiaries, joint ventures and associates	**–**	4 727	**–**	5 185
Depreciation and amortisation	**44 940**	41 859	**44 887**	41 824
Net unrealised foreign exchange gain	**(1 930)**	(4 112)	**(1 930)**	(4 112)
Net finance income	**(47 289)**	(39 609)	**(46 376)**	(38 373)
Post-retirement medical benefits	**2 087**	(1 724)	**2 087**	(1 724)
Straight-lining adjustment of operating leases	**(130)**	(307)	**(130)**	(307)
Leave accrual and warranty provision	**7 330**	8 638	**7 330**	8 638
Impairments/(reversals of impairments)	**8 062**	(3 702)	**10 032**	(3 180)
Loss/(profit) on disposal and write-off of property, plant and equipment	**785**	(22 236)	**776**	(22 236)
Share of loss of joint ventures and associates	**34**	786	**–**	–
Bad debt written off	**512**	1 154	**512**	1 154
Operating profit before changes in working capital	**67 665**	51 058	**65 640**	55 867
Increase in trade and other receivables	**(132 514)**	(57 256)	**(127 301)**	(54 321)
(Increase)/decrease in inventory and contracts in progress	**(45 838)**	18 933	**(45 838)**	18 933
Increase in advances received	**138 267**	111 744	**138 267**	111 744
Increase/(decrease) in trade and other payables and provisions	**55 248**	(89 015)	**54 523**	(93 276)
Net working capital changes	**15 163**	(15 594)	**19 651**	(16 920)
Cash generated from operating activities	**82 828**	35 464	**85 291**	38 947

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	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000
22 CASH AND CASH EQUIVALENTS				
Fixed deposits	**772 808**	452 633	**757 502**	436 000
Call deposits	**49 000**	363 000	**47 000**	361 000
Bank balances	**179 925**	152 822	**178 868**	151 721
Cash on hand and cash deposits	**141**	640	**141**	639
	1 001 874	969 095	**983 511**	949 360

23 RELATED PARTY TRANSACTIONS

The CSIR is a schedule 3B National Government Business Enterprise in terms of the Public Finance Management Act, Act 1 of 1999 as amended by Act 29 of 1999, and therefore falls within the national sphere of government.
As a consequence, the CSIR has a significant number of related parties, being entities that fall within the national and provincial sphere of government. Amounts due from/to these entities are subject to the same terms and conditions as normal trade receivables and trade payables. For detail on individually significant transactions refer to notes 2, 3 and 24.

In addition, the CSIR has a related party relationship with its subsidiaries (see Addendum A) and joint ventures and associates (see note 8). Unless specifically disclosed, these transactions are concluded at arm's length and the Group is able to transact with any entity.

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for the year ended 31 March 2013

	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

23 RELATED PARTY TRANSACTIONS (continued)

23.1 Transactions with related parties

The following is a summary of transactions with related parties during the year and balances due at year-end:

Constitutional institutions				
Services rendered	**–**	24	**–**	24
Services received	**38**	1	**38**	1
Amount due to	**(23)**	–	**(23)**	–
Major public entities				
Services rendered	**301 547**	285 293	**301 547**	285 293
Services received	**91 299**	19 038	**91 299**	19 038
Amount due from	**23 148**	23 238	**23 148**	23 238
National public entities				
Services rendered	**83 901**	71 796	**83 901**	71 796
Services received	**10 549**	5 074	**10 549**	5 074
Amount due from	**11 619**	28 433	**11 619**	28 433
National government business enterprises				
Services rendered	**3 075**	4 465	**3 075**	4 465
Services received	**792**	689	**792**	689
Amount due from	**719**	859	**719**	859
Provincial public entities				
Services rendered	**300**	834	**300**	834
Amount due from	**–**	381	**–**	381
Provincial government business enterprises				
Services rendered	**3 038**	4 269	**3 038**	4 269
Amount due from	**6 094**	783	**6 094**	783

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	GROUP		CSIR	
	2013	2012	**2013**	2012
	R'000	R'000	**R'000**	R'000

23 RELATED PARTY TRANSACTIONS (continued)

23.1 Transactions with related parties (continued)

Government departments				
Services rendered	**1 211 034**	1 084 391	**1 211 034**	1 084 391
Services received	**881**	6 724	**881**	6 724
Amount due from	**162 276**	21 170	**162 276**	21 170
Subsidiaries				
Services rendered	**–**	–	**7 155**	3 592
Services received	**–**	–	**–**	77
Amount due from	**–**	–	**7 397**	202
Joint ventures and associates				
Services rendered	**425**	2 555	**155**	2 555
Services received	**300**	84	**211**	84
Amount due (to)/from	**(3)**	1 418	**(32)**	1 418

23.2 Transactions with key management

Total remuneration of key management is included in employees' remuneration (refer to note 17 for Executive Management's remuneration).

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24 SATELLITE APPLICATIONS CENTRE (SAC)

In terms of the South African National Space Agency Act, Act No 36 of 2008, the South African National Space Agency (SANSA) was established as a separate public entity, the Executive Authority of which is the Minister of Science and Technology.

Pursuant to the said Act, all rights, obligations, assets and liabilities acquired or incurred by the Satellite Applications Centre (SAC) were, by agreement, transferred to SANSA as from 1 April 2011 and similarly all employees of the former SAC were transferred to SANSA. This transfer was accounted for as a common control transaction with the Department of Science and Technology being the ultimate holding entity and therefore the assets and liabilities were transferred at their carrying values.

Assets and liabilities attributable to SAC are as follows:

	2012 R'000
ASSETS	
Non-current assets	17 965
Property, plant and equipment	17 965
Current assets	20 344
Trade and other receivables	4 036
Inventory and contracts in progress	192
Bank balances and cash on hand	16 116
TOTAL ASSETS	38 309
EQUITY AND LIABILITIES	
Reserves	25 693
Retained earnings	25 693
Current liabilities	12 616
Advances received	4 930
Trade and other payables	7 686
TOTAL EQUITY AND LIABILITIES	38 309

The net assets of SAC on transfer were as follows:

Net asset value transferred	25 693
Net cash outflow arising on transfer of SAC	
Bank balance and cash disposed	(11 945)

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25 DISPOSAL OF INTERESTS IN SUBSIDIARIES AND ASSOCIATES

25.1 Quotec Limited

The Group held 100% of the issued share capital in Quotec Limited. The shares held were sold effective 1 April 2011.

The net assets of Quotec Limited on 1 April 2011 were as follows:

	GROUP 2012 R'000
Net asset value disposed	4 543
Loss on disposal	(4 543)
Total consideration	–
Net cash outflow arising on disposal of interest in subsidiary	
Bank balance and cash disposed	(4 213)

NOTES TO THE ANNUAL FINANCIAL STATEMENTS

for the year ended 31 March 2013

25 DISPOSAL OF INTERESTS IN SUBSIDIARIES AND ASSOCIATES (continued)

25.2 Uvirco Technologies (Pty) Ltd

The Group held 100% of the issued share capital in Uvirco Technologies (Pty) Ltd. On 1 April 2011 Uvirco Technologies (Pty) Ltd issued additional shares. This resulted in the Group's interest reducing to 45%.

55% of the net assets of Uvirco Technologies (Pty) Ltd on 1 April 2011 were as follows:

	GROUP
	2012
	R'000
Net asset value disposed	184
Loss on disposal	(184)
Total consideration	–
Net cash outflow arising on disposal of interest in subsidiary	
Bank balance and cash disposed	(2 966)

25.3 Eyeborn (Pty) Ltd

The Group held 26% of the issued share capital in Eyeborn (Pty) Ltd. The shares held were sold effective 1 November 2011. The investment in Eyeborn (Pty) Ltd was fully impaired in the Group financial statements. No profit or loss was realised on disposal of these shares.

ADDENDUM A: INTEREST IN SUBSIDIARIES

31 March 2013

Consolidated subsidiaries	Country of incorporation	Issued capital	Effective holding		Financial year-end	Interests of the CSIR: Shares at cost less accumulated impairment losses	
			2013	2012		**2013**	2012
		R'000	**%**	%		**R'000**	R'000
Direct investments							
Technology Finance Corporation (Pty) Ltd (Technifin)	South Africa	**5 200**	**100**	100	31 March	**4 650**	4 650
Technovent (Pty) Ltd	South Africa	**5 000**	**100**	100	31 March	**–**	–
						4 650	4 650

The Group has interests in three dormant companies. Details of these interests are available at the CSIR's registered office.

ADDENDUM A: INTEREST IN SUBSIDIARIES

31 March 2013

Interests of the CSIR				
Net indebtedness less accumulated impairment losses by subsidiaries		Net investment		General nature of business
2013 R'000	2012 R'000	**2013 R'000**	2012 R'000	
12 000	12 000	**16 650**	16 650	The acquisition and transfer of technology to industry by licensing new inventions, providing finance to develop technology and venture capital for the exploitation thereof.
4 007	4 083	**4 007**	4 083	The company sources technologies and entrepreneurs from the CSIR, other S&T institutions, universities or any developer of technology and develops these into viable businesses with the aim of spinning them off for capital gain and/or public good.
16 007	16 083	**20 657**	20 733	

abbreviations

4G	Fourth Generation Technology Network
AFIS	Advanced Fire Information System
Aids	Acquired immunodeficiency syndrome
AIPF	Associated Institutions Pension Fund
AISI	Aerospace Industry Support Initiative
BBBEE	Broad-based Black Economic Empowerment
CEO	Chief Executive Officer
CO_2	Carbon dioxide
COMRO	Chamber of Mines Research Organisation
CSIR	Council for Scientific and Industrial Research
CSP	Concentrating Solar Power
DST	Department of Science and Technology
DNA	Deoxyribonucleic acid
DIFR	Disabling Injury Frequency Rate
FCTR	Foreign currency translation reserve
GAAP	Generally Accepted Accounting Practice
GDP	Gross Domestic Product
GRAP	Generally Recognised Accounting Practice
GWh	Gigawatt hour
HCD	Human Capital Development
HIV	Human Immunodeficiency Virus
HR	Human Resources
HySA	South African national hydrogen strategy
IAS	International Accounting Standard
ICT	Information and Communications Technology
IEE	Industrial Energy Efficiency
IFRS	International Financial Reporting Standards
IK	Indigenous Knowledge
IKS	Indigenous Knowledge System
IP	Intellectual Property
iPDM	Integrated Development Planning and Modelling
ISO	International Organization for Standardization
MultiCAM	Multi-spectral imaging system
NCPC-SA	National Cleaner Production Centre of South Africa
NIKMAS	National Indigenous Knowledge Management System
NSI	National System of Innovation
KRA	Key results area
mHealth	Mobile health
miRNA	Micro Ribonucleic Acid
PAA	Public Audit Act
PFMA	Public Finance Management Act
R&D	Research and Development
RDI	Research, Development and Innovation
RECP	Resource Efficiency and Cleaner Production
RIA	Research Impact Area
SA	South Africa
SAC	Satellite Applications Centre
SADC	Southern African Development Community
SAEOSS	South African Earth Observation System of Systems
SAICA	South African Institute of Chartered Accountants
SANAS	South African National Accreditation System
SANDF	South African National Defence Force
SANSA	South African National Space Agency
SET	Science, engineering and technology
SETI	Science, engineering and technology innovation
SETI	Science, Engineering and Technology Institution
SMME	Small, Medium and Micro-sized Enterprise
SMS	Short Message Service
SOC	State-Owned Company
stepSA	Spatial and Temporal Evidence for Planning in South Africa
TAP	Technology Assistance Package
TB	Tuberculosis
the dti	Department of Trade and Industry
TLIU	Technology Localisation Implementation Unit
TV	Television
TVWS	Television White Spaces
UAV	Unmanned Aerial Vehicle
UP	University of Pretoria
US	United States of America
USSD	Unstructured Supplementary Service Data
UV	Ultraviolet
XDR TB	Extensively Drug-Resistant Tuberculosis

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