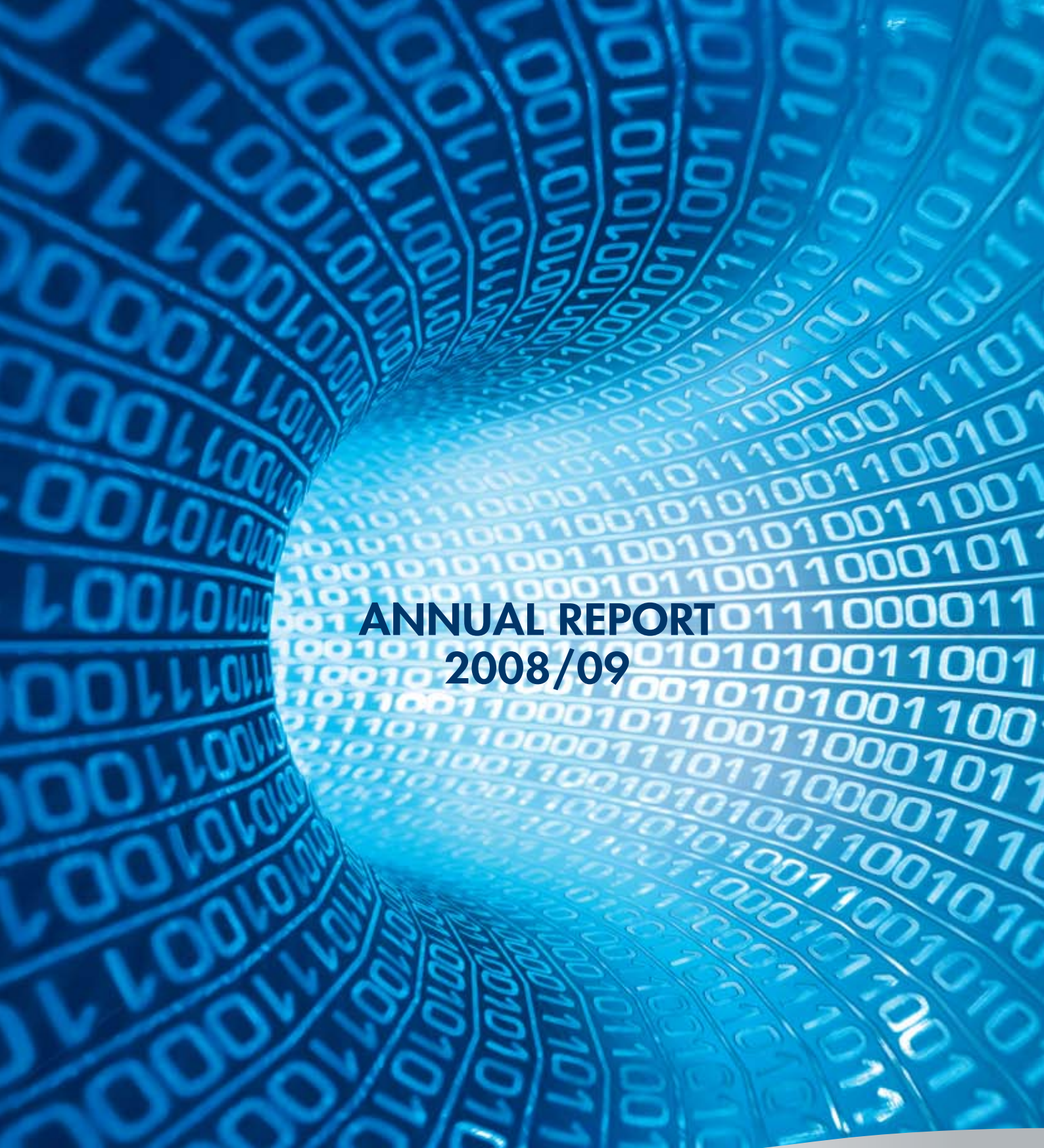
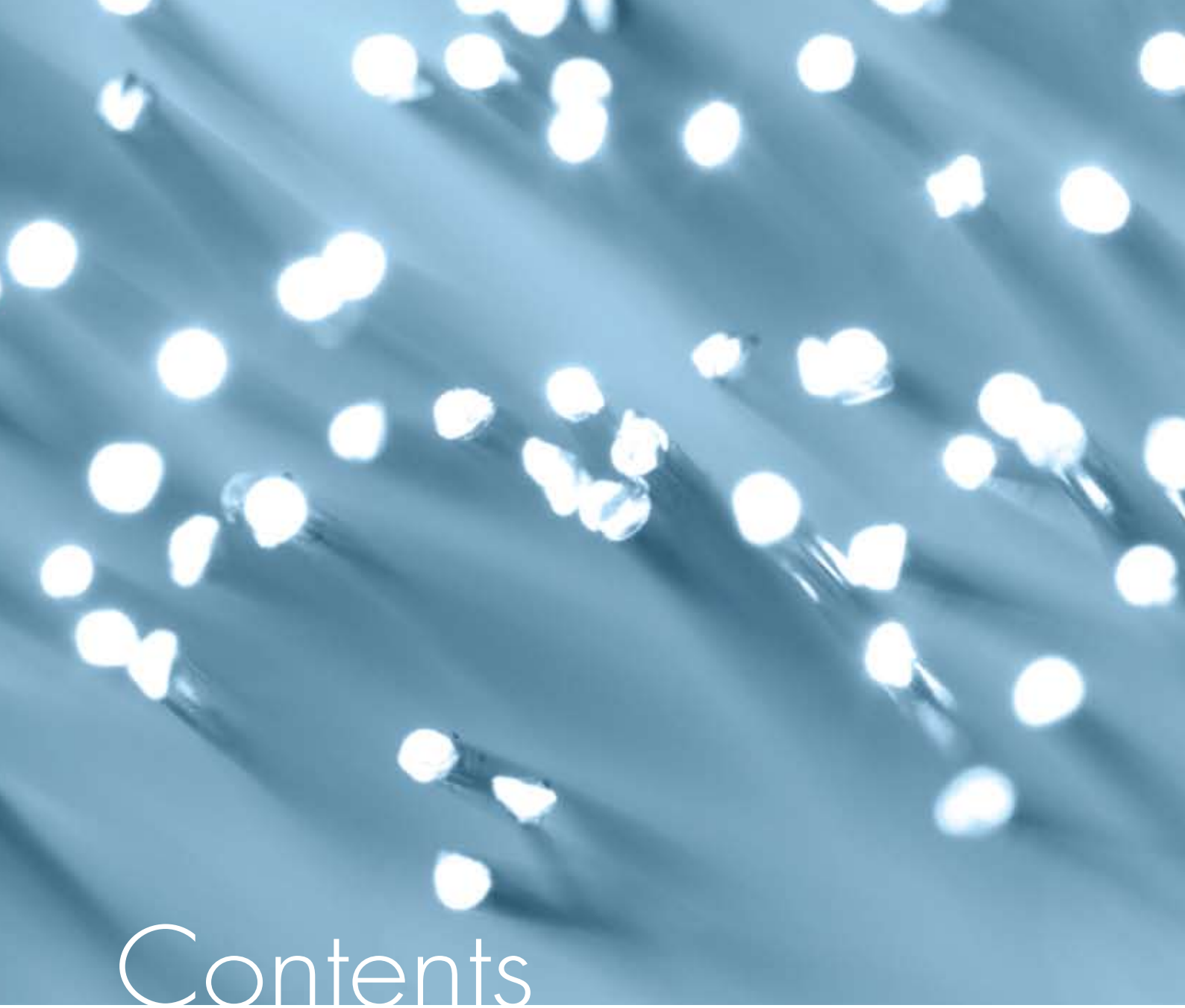


ANNUAL REPORT 2008/09

CSIR

our future through science



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Chairman's overview

The CSIR has a strong culture of discipline and ethics, and a commitment to working on challenges that will benefit South Africa's future development.

2009 brought yet another milestone in the history of South Africa with the instatement of the country's fourth democratically-elected government and changes in structures of state. However, the challenges facing this country have not changed – or diminished. Issues of unemployment, crime, social and economic infrastructure, healthcare and sustainable development are some of the factors negatively impacting on our young democracy in its quest to create a better life for all its citizens.

Chairman's overview

Much has been done by our shareholder, the Department of Science and Technology (DST), in the past year to place science, technology and innovation at the centre of development. In turn, the CSIR has embraced the concept of innovation for development with the intention to deliver on the needs, expectations and objectives of the nation and its people.

Over the years, the CSIR has made a considerable contribution to the fulfilment of many of the government's objectives, particularly those aimed at alleviating the plight of the country's previously marginalised communities. The organisation has partnered with both government and private sector institutions to conduct research in various socio-economic fields including housing, water provision, transport, infrastructure development and industrial competitiveness.

As we move into the new year, the CSIR will develop new linkages and enhance existing partnerships with all spheres of government and across industries in the private sector. I would also like to welcome the new members of the Board and I am looking forward to working with them over the next three years on such objectives and on ensuring that the CSIR remains an internationally-competitive science organisation.

The development of skills in science, engineering and technology (SET) is a priority issue that the CSIR shares with government. The CSIR's Human Capital Development strategy has passed through its second year of implementation and results are evident and recorded in this report. The standing of the CSIR's own intellectual base is impressive in terms of qualification levels. Aside from schemes and assistance to support young SET professionals, the CSIR has put effort into its relationships with tertiary education institutions and a variety of other research organisations to stimulate cooperative projects and skills sharpening or exchanges.

In the new year, the CSIR will focus more strongly on promoting science and technology as enablers for improvement in our society, economy, competitiveness and the quality of life of South Africans. This means greater visibility of the impact and value derived from scientific intervention and intensifying communication and stakeholder engagements to enhance awareness and understanding of the CSIR's work in the public domain at international, national and local level. By narrowing the information and knowledge gaps in society, we will be affording fellow citizens access to useful information.

The CSIR has a strong culture of discipline and ethics, and a commitment to working on challenges that will benefit South Africa's future development. This culture underpins its rigorous scientific undertakings, fit-for-purpose innovations and the exploitation or public dissemination of research and knowledge in the national interest. I would like to encourage the management and staff of the CSIR to remain true this ideal.

By adhering to the highest standards of governance and business principles, the organisation has once again attained an unqualified audit and remained financially sound. In fact, excellent financial results were recorded for the 2008/09 year. This can be attributed to the diligence of management and staff of the CSIR, who have consistently produced quality work, delivered value to their clients and stakeholders, and ensured quality science is balanced by quality business dealings.

Lastly, I would like to thank the CSIR Executive management team for its unwavering commitment and all members of staff who have used their talent and expertise to contribute to the CSIR's success in the past year. I look forward to an even better *'future through science'*.

Dr Sibusiso Sibisi

CEO's introduction

The CSIR's mandate gives sanction to the critical role innovation needs to play in the development of South Africa.

We are required to foster industrial and scientific development and, through that, contribute to the improvement of the quality of life of the people of South Africa by performing directed, multidisciplinary research and technological innovation.

The opportunity for influence is substantial – from employment, infrastructure, education and health to challenges facing our industries and our environment. In our case, scientific exploration is not about science for science's sake. It has to provide answers, bring about improvement and make a real difference.

For the past few years, the CSIR's strategic objectives have remained consistent:

- To build and transform human capital
- To strengthen our core base of science, engineering and technology (SET) skills
- To transfer technology and skills to industry or society.

CEO's introduction

The CSIR's Annual Report for 2008/09 is a record of excellent achievement. Achieving such positive outcomes across all domains is a reflection of a healthy balance that exists between good science and good business at the CSIR. This was an objective we pursued intently since an organisational reconfiguration in 2005. One component of that process was ensuring a core focus on quality R&D, but not ignoring that similar discipline and quality was expected of its operational and financial workings – underpinned by good governance. In fact, since 2005, a steady increase in contract research income is indicative of the interplay between quality, relevant R&D work and sound business practices.

Particular achievements can be highlighted to testify to the past year's performance:

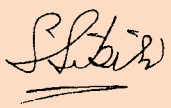
- Over the years, our demographic profile has improved consistently, with our SET base reaching 53% black and 33% female
- The number of permanent staff studying towards Master's or PhD degrees increased from 90 in 2007/08 to 201 in 2008/09 and the number of staff in the SET base with PhDs increased to 273, exceeding the target of 240
- The value of capital investment in scientific equipment and facilities exceeded the target by more than R40 million and totalled R188,3 million
- Publication equivalents increased significantly – 451 were achieved during the past financial year and exceeded the performance target for 2008/09 by more than a hundred
- Exceeding the target by 20, the CSIR was granted 35 new international patents
- Royalty income increased by some R12 million from the previous year (R9,1 million in 2007/08, R21 million in 2008/09)
- The value of contract R&D income supporting national strategies also showed a significant improvement from R373,5 million in 2007/08 to R450 million in 2008/09
- The value of contract R&D increased from R707 million in 2007/08 to R847 million in 2008/09 (excluding ring-fenced grant allocations from the Department of Science and Technology) and we maintained a healthy net profit.

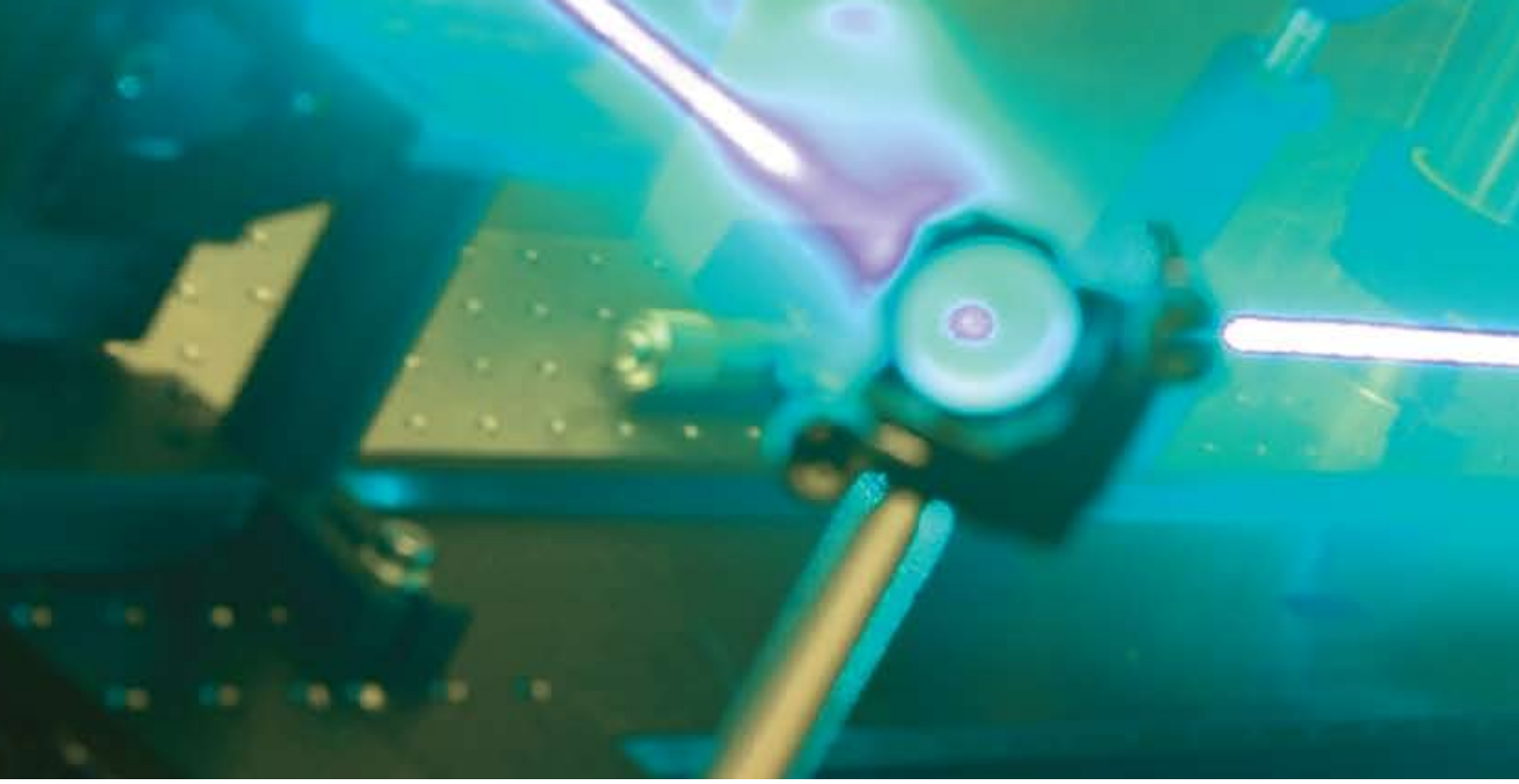
The next pages showcase a few examples of the novel developments and projects undertaken in critical areas such as health, defence and security, energy, industry and both the natural and built environments.

We need to acknowledge the constructive engagement and support from the Department of Science and Technology. We also value the encouragement of and guidance by the CSIR Board.

Above all, we need to record that our success is based on the talents and commitment of the people who work at the CSIR. The organisation sets exacting standards, requires discipline and ethics in all its undertakings and, in turn, supports and acknowledges the individuals who live up to the rigours of a science organisation with the mandate to make a real difference.

Although we are pleased about the strong performance of the past year, it is without any sense of complacency. Our top priority remains the pursuit of innovation to support the country's development.





CSIR Mandate

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 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, and to perform any other functions that may be assigned to the CSIR by or under this Act."

Project highlights

The pages that follow showcase some research and development highlights of work undertaken in the review period.

These have been clustered in chapters based on the areas of impact:

- Health, with a focus on nutrition and affordable, novel treatments
- Natural environment, where the wise use of resources – with a view to establishing a secure future environment – is at the root of our research efforts
- Energy, with the emphasis increasingly on alternative and renewable energy
- Built environment, with its focus on issues of transport and sustainable human settlements
- Defence and security, contributing to the readiness and capability of securing a safe future
- Industry, with a focus on advanced manufacturing and mining.

A chapter has also been included on research infrastructure. High performance computing, faster connectivity or the ability to characterise materials at the nano level, are examples of advances necessary for scientific progress. CSIR research infrastructure is not only available to our researchers, but also to other role players, such as tertiary education institutions and industry. This enables a national contribution to world-class research.

Health

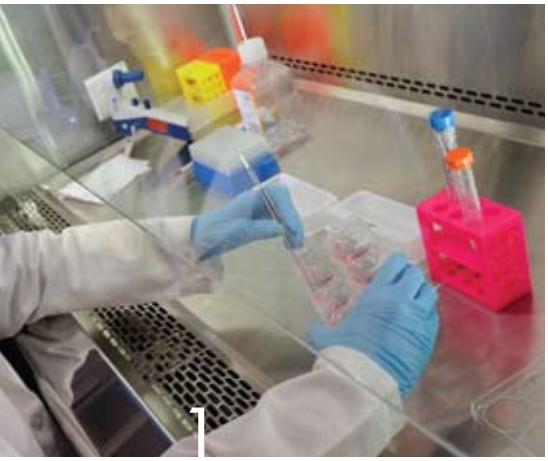
Health issues in South Africa arise from the country's unique situation of an emerging economy that combines the competitive advantages of its resources and manufacturing capabilities with society's deep and pressing socio-economic challenges.

South Africa's burden of disease, particularly diseases of poverty, access to health solutions and socio-economic aspects of food security, require innovation and the development of a bio-economy. As indicated in the Department of Science and Technology 10-Year Plan, South Africa has a range of natural advantages that it can exploit to address the above, i.e. activities such as bioprospecting, bio-informatics and genomics, all supported by a functioning innovation chain.

As shown on the following pages, the CSIR is developing innovative solutions and pharmaceutical products that can help address the impact of diseases such as malaria, HIV/Aids, and tuberculosis on the South African economy. A balanced portfolio of products with long-term development cycles (e.g. drugs, herbal medicines, drug targets) and less regulated, shorter term development products (e.g. cosmeceuticals, nutraceuticals, veterinary products) aim to improve access to and/or local manufacture of affordable drugs and other biotechnology products. Research to develop plant and microbial production systems for the manufacture of affordable bio-therapeutics aims to reduce the impact of manufacturing methods that put pharmaceuticals beyond the means of poorer users.

Biotechnological research to develop a nutritionally-enhanced staple crop supports access to affordable agricultural produce and thus food security. The transfer of the developed technologies is supported by multidisciplinary competences spanning the biotechnology, chemical, food and agro-processing sectors.

Material science is central to the development of biomaterials, which are applied in tissue engineering, the development of diagnostic equipment, and drug delivery systems. In recent years, developments in the fusion of materials and biological systems have spawned tremendous growth in this field.



1 & 2: Two series of potential antimalarials were developed in response to the emergence of resistance to many existing antimalarials.

POLICY SUPPORT: Affordability and accessibility of anti-retrovirals to a larger number of people in support of the Department of Health's strategy to develop affordable treatment for HIV.

Cheaper production of key intermediate in ARVs possible

The CSIR has developed a novel, economically-competitive manufacturing process that is expected to reduce the production costs of thymidine, a valuable intermediate in the preparation of AZT and stavudine. These drugs are used in the first and second-line combination therapy HIV treatment regimens in South Africa.

A patent application has been filed on this technology and the CSIR has granted the commercial rights to a company that will explore various exploitation options, including the granting of licences to existing anti-retroviral (ARV)-active pharmaceutical ingredient producers and the establishment of a new manufacturing facility for South Africa.

Highly active ARV therapy is the preferred method for treating HIV-positive people with a CD4 count of 200 or less. The active pharmaceutical ingredients used in local ARV medication are all currently imported from countries like India. In South Africa, where nearly one million people require ARVs, local manufacturing thereof is an imperative.

The establishment of an industry for local production of ARV-active pharmaceutical ingredients, allowing competitive prices compared to imported products, will be an important development for healthcare and economic growth. It will empower African governments to supply more people with these life-saving drugs.

New antimalarials being developed

CSIR researchers have developed two series of potential antimalarial compounds in response to the emerging parasite resistance to many existing antimalarials and the impact of the disease in the southern African region.

Researchers aimed to develop compounds with activity levels at least equal to the best existing medications; with no toxicity; and which are active against resistant malaria parasites.

As a result of activities in this area, a series each of directed peroxides and folate antagonists have been developed. The best compounds in both series have shown activity at sub-nanomolar levels without apparent toxicity at levels several thousand times higher than the antiparasitic efficacy level.

The folate antagonists under development are showing activity, more than 1 000 times higher than cycloguanil, against resistant strains of *Plasmodium falciparum*, the causative parasite of malaria. Programmes are in place to evaluate both series of compounds *in vivo*, as part of ongoing development programmes geared towards developing new and effective drugs.

3

3 & 4: **The CSIR made a breakthrough in mid-2008 when experiments to produce an antibody against rabies in plants passed several tests in the laboratory.**

4

New venture to produce rabies virus neutralising antibody from plants a winner

A proposed new start-up venture, GreenPharm™, that intends to produce cost-effective antibodies used for rabies prophylaxis in tobacco leaves, was the inaugural winner of the SA Bio Business Plan Competition in 2008.

GreenPharm™ stems from CSIR-led research on a rabies virus neutralising antibody, produced in plants. The business plan proposed a technology platform that will use plants to manufacture proteins used in preventative post-exposure rabies treatment as well as the manufacture of complex therapeutic proteins used in the treatment of diseases such as HIV and cancer.

The prize money of R100 000 and an investment of up to R15 million will be channelled towards the production of clinical batches of an anti-rabies antibody, as an alternative to the existing process of extraction from human or equine blood plasma. Rabies is a viral disease that affects mammals and is often transmitted through the bite of rabid animals, mostly dogs.

The SA Bio Business Plan Competition is an initiative of the Innovation Fund in partnership with Emory University, USA, who jointly organised an executive training programme where participants received world-class training in the development of a biotechnology business.

1 & 2: Fifteen claims for therapeutic concepts for asthma, arthritis, malaria, analgesics and HIV demonstrated positive results and are being developed further. Two herbal remedies, based on the traditional use of plants for the treatment of HIV-infected patients, have shown significant anti-viral activity with limited toxicity in an HIV cytoprotection assay.

POLICY SUPPORT: Development and implementation of the Department of Science and Technology's National Indigenous Knowledge Systems Office (NIKSO): the CSIR assists in the optimisation of traditional medicine, nutraceuticals and food security.

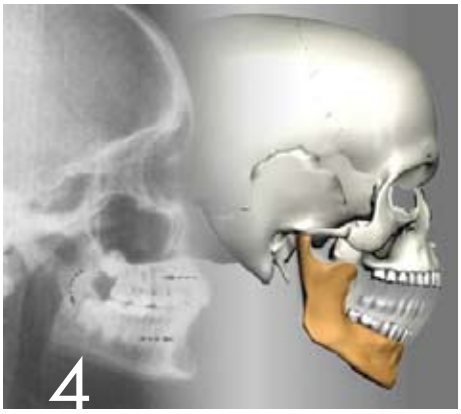
Medicinal plants yield promising results

Through extensive engagement with traditional healers, the CSIR has captured 250 local claims for cures based on medicinal plants. At least 72 claims were identified for therapeutic concepts for asthma, arthritis, malaria, analgesics and HIV. Fifteen of these claims demonstrated positive results and are being developed further as botanical and medicinal products in partnership with the holders of the traditional knowledge. Two herbal remedies, based on the traditional use of plants for the treatment of HIV-infected patients, have shown significant anti-viral activity with limited toxicity in an HIV cytoprotection assay.

Furthering their quest to transform African traditional medicines into scientifically-validated products, and to discover new pharmaceutical active ingredients, CSIR researchers this year expanded their collaboration to Tanzania and Malawi. Two PhD students from these countries have joined the research team. Their studies focus on HIV treatment, using traditional knowledge from their respective countries.

The CSIR's affiliation to the Southern African Network for Biosciences (SANBio) and the Southern African Biochemistry and Informatics Network (SABINA) has been instrumental in establishing collaborative networks.

SANBio is a NEPAD science and technology initiative, while SABINA is a body of six southern African research institutions seeking to exploit biodiversity in the region, and increase capacity in natural products research to impact on food security, public health and value-added exports.



3: **The CSIR applies synthetic and medicinal chemistry for drug-based disease solutions. Current work focuses on HIV/Aids, malaria and TB. Value is added to natural products (traditional medicine and biodiversity) of therapeutic value and a link provided between biological programmes and the study of traditional medicine.**

4: **A conceptual picture of the mandible or lower jaw. A CSIR-developed bioceramic material was used as bone replacement in a mandible reconstruction of a nine-year-old patient.**

Morphogenesis is the development of structural features of an organism or a part thereof.

Bioceramic material for bone replacement

In early 2009, CSIR researchers formulated a synthetic material that was successfully used in a mandible (lower jaw) reconstruction for a nine-year-old patient.

Reconstruction of bone defects remains a challenging procedure. Currently the 'gold standard' in bone reconstruction is autogeneous bone filling, where bone is removed from the patient at a healthy site (such as the iliac crest in the hip), and used to reconstruct the bone at the defect site.

However, this procedure has major shortcomings such as insufficient availability and additional associated pain caused by the bone-harvesting operation. It often results in more complications at the donor site compared to the implant site, especially in children where there is not enough bone to harvest from the iliac crest. A need therefore exists to find a replacement synthetic bone material that will be as effective as a patient's own bone tissue, yet without the complications and shortcomings.

The CSIR and researchers from the University of the Witwatersrand (MRC Bone Research Laboratory) are looking at the development of a bioceramic material, with attached bone morphogenic proteins, for craniofacial applications focusing on larger deficiencies – such as those caused by tumour resections.

Sun power explored as water disinfection technology

In a three-country African project funded by the European Union, the CSIR is measuring the degree to which a zero-cost technology – the sun – can make drinking water safe.

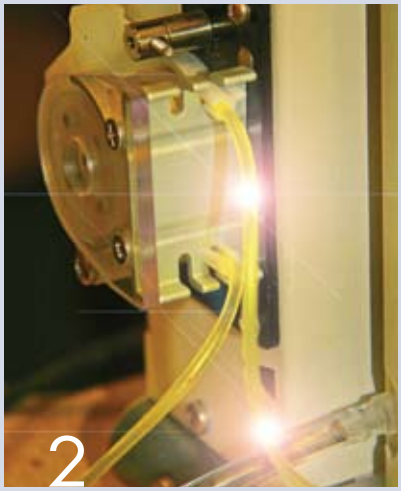
So far, the modern solar disinfection (SODIS) study has shown that the incidence of diarrhoea can be reduced significantly when households complied with the use of SODIS for 75% of the time.

The SODIS protocol for making contaminated drinking water safe requires that clear, transparent containers are filled with contaminated water and placed in direct sunlight for at least six hours. The ability of the sun to make water safe to drink depends on both optical and heat processes that are highly effective at temperatures of 45°C. Ultra violet light has lethal effects on the bacterial DNA, which prevents further growth of the organisms in the water.

In addition, the sunlight is absorbed by natural photosensitisers in the water. This then reacts with oxygen to produce highly reactive oxygen species such as hydrogen peroxide and superoxide dismutase, which have strong disinfecting properties.

This research shows promise for increasing the availability of safe water through inexpensive treatment options.

1: CSIR researchers are sequencing the complete genome of a South African cholera bacterium using cutting-edge 454-sequencing technology, as well as analysing the effect of sunlight and UV-rays on the virulence of *Vibrio cholerae* in southern Africa.



2 & 3: The chemical analysis laboratory is accredited (ISO17025) with the South African National Accreditation System (SANAS). This accreditation ensures that the analytical methods used by the laboratory, and the results achieved from the analyses, are comparable with international standards. Regular internal and third-party audits are conducted by independent quality representatives to measure compliance with the ISO standard.

Analysing food for consumers' health

In contributing to South Africans' health when consuming food, the CSIR provides chemical analytical services that focus on routine chemical analysis of food, fish and beverage products for external customers in the private and public sectors.

It offers a full range of analytical requirements for the South African and southern African food and fishing industries. The laboratory is the only one in southern Africa equipped to test for marine biotoxins in shellfish products in support of the Shellfish Monitoring Programme.

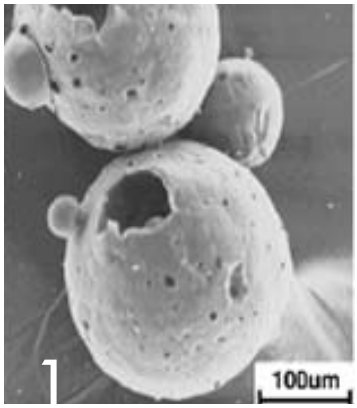
During the past financial year, some 4 000 samples were tested and analysed.

Small molecule drugs bio-manufactured

A CSIR-developed technology has shown successful expression of antigenic peptides (useful for vaccine development), anti-microbial peptides (useful as a topical antibiotic) and anti-viral peptides (useful in anti-retroviral therapy).

Peptides are small molecule drugs currently manufactured by pharmaceutical companies through chemical synthesis. This route can be complex, costly and inefficient; and generates large amounts of toxic waste.

Microbial engineers at the CSIR developed the new technology based on a proprietary micro-organism that has been genetically engineered for the expression of therapeutic peptides. The recombinant microbial fermentation-based technology provides a 'green alternative'. In addition, peptides in the larger size-range, which are problematic for chemical synthesis, can be produced using this system. This research investigates manufacturing options that will reduce the cost of highly effective but unaffordable bio-therapeutics.



1: A microscopic image of a hollow, ported polymer microparticle. These microparticles are the reason why Dermapearl™ lasts longer than other hyaluronic acid-based dermal fillers currently available on the market.

Hyaluronic acid is a natural polysaccharide (a group of complex carbohydrates) that exists in body tissue (e.g. joint synovial fluid) and often binds with proteins.

Dermal filler with longer-lasting effects developed

In many facial reconstruction procedures, dermal fillers are used to 'bulk up' a selected area of human tissue. While there are currently dermal fillers available on the market that are used for this purpose, they generally do not have a very long-lasting effect.

CSIR researchers have developed an injectable, minimally-invasive dermal filler (called Dermapearl™) that has a long-lasting effect as well as possible tissue generation properties. This means that Dermapearl™ might not only act as a filler to 'bulk up' an area of human tissue, but also encourage the surrounding tissue to grow into and eventually replace the bioresorbable implant material.

The technology consists of hollow, ported polymer microparticles fabricated through an emulsion process and used in conjunction with a carrier medium such as hyaluronic acid. It is the specific composition and structure of these microparticles that allows the material to have a longer lasting effect than other hyaluronic acid-based dermal fillers currently available.

Dermapearl™ can be used in both cosmetic and facial reconstruction procedures and has potential applications in fields ranging from drug delivery to tissue engineering. Several applications for the microparticles will be explored in future.

CSIR patents new technology for genetic modification

The CSIR and Pioneer Hi-Bred Inc invented faster and reliable ways to genetically transform plants. This breakthrough came while working on a project to enhance the nutrition and digestibility of grain sorghum through genetic modification. The two organisations have jointly filed two patent applications with significant potential use by plant breeders and genetic engineers. Research is focused on the development of nutritionally-enhanced staple crops that are widely consumed in the developing world.

POLICY SUPPORT:
The CSIR is working with the Agricultural Research Council to implement the Department of Agriculture's policy on the conservation of drought-resistant crops.

2: Using nanotechnology, the CSIR's researchers are developing an anti-TB drug delivery system that will improve the lives of thousands of TB sufferers by enhancing their drug regime.

New controlled-access laboratory for research to beat killer pathogens, viruses

Work has commenced on a new, controlled-access laboratory where research targeted at major public health problems, including HIV/Aids and tuberculosis, will be conducted.

The facility is key to the CSIR's development of new aptamer-based HIV entry inhibitor drugs and rapid and reliable aptamer-based TB diagnostics, which require testing in cell-based functional assays with real, clinically isolated Aids viruses and TB pathogens.

Aptamers are artificial nucleic acid molecules that are engineered in a test tube for specific binding to various targets such as cancer cells, viral and bacterial proteins and whole micro-organisms. It is envisioned that the facility will also be used for conducting collaborative research within the CSIR and with other research institutions in South Africa and abroad.

The controlled-access laboratory, made possible by a grant from the Department of Science and Technology, will be a containment level 3 (or biosafety level 3) facility as required for experiments with high potential risk to personnel and the environment.

This laboratory will assist in progressing research towards new and affordable treatments for diseases that contribute to the national health burden.

3: Major public health problems, including HIV/Aids and tuberculosis, will be researched at the new, controlled-access laboratory.

Natural environment

Human wellbeing is inextricably linked to the natural environment. Maintaining and improving wellbeing in a deteriorating environment is a substantial global challenge, and particularly relevant in South Africa.

The 2007 UNEP Fourth Global Environmental Outlook: Environment for Development (GEO-4) report is the first state of the world report in 20 years. It points out that development strategies often ignore the need to maintain the critical ecosystem services on which development goals depend.

Aside from climate change, the report illustrates serious global environmental deterioration over the past two decades, arising from population growth, increasing consumption associated with economic development, and improper use of chemicals and technologies. Freshwater supplies, agricultural land and biodiversity are key concerns.

More than half of all cities now exceed the World Health Organization's pollution guidelines. In Africa, poverty is extreme (5% of the world income and two-thirds of the world debt), and is seen as a cause and consequence of land degradation.

The recent South Africa Environment Outlook published by the then Department of Environmental Affairs and Tourism, indicates serious problems in South Africa. In 2005, the Environmental Sustainability Index ranked South Africa at 93 among 146 countries, and 20 among the 40 NEPAD countries. All categories of indicators (other than those for agriculture and access to electricity) show a downward trend – or a lack of information to provide an assessment.

The CSIR's natural environment theme focuses on the wise use of resources, with a view to establishing a secure future environment. Central to the theme is research in support of the effective use of the resource base, improving the benefits people derive from natural resources, and avoiding the negative impacts that a deteriorating environment has on people. But global change exacerbates the situation, and research is also undertaken to understand these changes, the likely impacts of change and how best to adapt to change. The projects highlighted in this section reflect some of the CSIR's many research endeavours aimed at improving human wellbeing.

POLICY SUPPORT:
The South African Mercury Assessment Programme has contributed to an assessment of mercury from point sources in the environment. Information contributed to the report on 'Global Mercury Emissions' to be submitted to the United Nations Environmental Programme Governing Council.

Research on mercury in water paints comprehensive picture

South Africa's first comprehensive, national study of mercury in the country's water sources is nearing completion. The investigation has taken CSIR researchers to over 70 sampling sites in all 19 of South Africa's water management areas.

South Africa was labelled the second-worst emitter of mercury in the world in an international report in 2006. Preliminary results of the CSIR study show that the overall mercury emission is lower than the levels reported internationally.

The project is an attempt to understand the condition of South Africa's water and atmosphere in terms of mercury released into the environment; how it builds up (bio-accumulation) in aquatic food chains; and its impact on water resources and human health.

The final report will show the range of mercury concentrations in sediment, invertebrates (such as fish) and water at the various sites. The results will indicate where focused interventions should be aimed and will help with mercury monitoring and management at national and regional levels.

The samples collected were analysed in the newly established mercury reference laboratory at the CSIR's regional office in Stellenbosch.
The study is partially funded by the Water Research Commission.

1: CSIR researchers in sampling mode. The investigation into mercury levels in water has taken them to over 70 sampling sites in all 19 of South Africa's water management areas.

2: From the pristine waters in the Waterberg to some of the most polluted rivers in southern Africa, CSIR researchers are engaged in developing innovative technologies to test and treat fresh water and waste water to make the most of this precious resource.

Protecting South Africa's fresh water ecosystems for a water-safe future

The year under review saw the start of a project to identify a national network of fresh water conservation areas and recommend ways for national and local institutions to create such areas. The project is led by the South African National Biodiversity Institute and managed by the CSIR.

This research will provide South Africa, for the first time, with a national map of priorities for fresh water biodiversity that can be used as input for strategic decisions on the way water resources are managed. Worldwide, fresh water biodiversity is among the most endangered in the world. The sustainable management, conservation and rehabilitation of South Africa's fresh water ecosystems are key to improving the reliability of water supply for future human and industrial use.

In this project, researchers are considering, among others, how many freshwater ecosystems should be allocated to a high level of protection and how to choose these systems to ensure maximum conservation benefit at the lowest possible social and economic cost.

Only about 15% of South Africa's river ecosystems fall within protected areas. Half of these large rivers are degraded by upstream human activities before they enter the protected areas. The biggest gaps in the protection of rivers were found to be in the arid interior and eastern coastline of the country.

Designing one of the world's largest marine-protected areas

South Africa is proclaiming one of the largest marine-protected areas in the world, in the exclusive economic zone of the Prince Edward Islands in the sub-Antarctic. This is South Africa's first off-shore marine-protected area.

CSIR researchers worked with a multidisciplinary team of 14 specialists to design and demarcate the appropriate areas for conserving marine biodiversity, while minimising conflict with the legal toothfish fishery.

The development of an ecologically representative and scientifically planned marine protected area around the islands is consistent with national policy as well as the international treaties that apply in this area.

All available distributional data on species, benthic habitats and ecosystem processes were collated to design a protected area with three management zones.

Zone one is a 22.2 km sanctuary area around the islands, where all activities are strictly controlled and no fishing is allowed. The second zone consists of four restricted areas with limited fishing, designed to scientifically monitor the stocks of Patagonian toothfish and contribute to the recovery of the species. Controlled fishing will be allowed in the rest of the protected area, using certain gear types only and excluding, for example, bottom trawling.

1: A CSIR study found that sand-mining in the estuaries and riverine sections of Durban's rivers will have a dramatic effect on coastal erosion if alternative sources are not found soon. Combined with climate change, the consequences to KwaZulu-Natal's golden beaches could be similar to, and eventually exceed, the erosion suffered in 2007.

CSIR asks for urgent alternatives to sand-mining

Sand-mining in the estuaries and riverine sections of Durban's rivers will have a dramatic effect on coastal erosion if alternative sources are not found soon. Combined with climate change, the consequences to KwaZulu-Natal's golden beaches could be similar to and eventually exceed the erosion suffered in 2007.

A CSIR study found that the impact of dams and mining could result in mean coastal erosion of more than 1 metre per year. Increased sea levels and sea storminess due to climate change will exacerbate the problem.

Furthermore, the study demonstrated that those rivers most affected by sand-mining will take a very long time to recover, even if sand-mining is banned. Increased demand from the construction industry has created a mining rate that already exceeds the natural replenishment rate. This could have a disastrous impact on other industries relying on the sand resource, such as tourism and fisheries.

The study recommended that sand supplies are obtained from alternative sources, such as non-riparian mining and dredging of marine deposits, and that further investigation is needed in terms of the trade-off between tourism and sand-mining.

Innovative solutions developed to meet water challenges

Water has, since the earliest civilisations, been a critical driver of social and economic development. Decisions around water are tougher than ever before: Populations and economies have mushroomed and climate change features strongly on the international agenda. In a regional context, decisions are complex because water does not heed man-made borders and water sources are shared by numerous countries.

Against this background, CSIR water researchers have developed two methodologies to ensure good governance and optimal utilisation of fresh water resources:

- **Improving management of transboundary river basins**
  The Transboundary Waters Opportunity (TWO) analysis considers all the existing and potential water resources within a transboundary basin and a range of possible development interventions and scenarios that would benefit all basin states.

  It has already been applied in the Nile and Jordan River Basins, which are among the most complex river basins in the world. The methodology has been published and is currently being implemented by a CSIR-led consortium in the Orange-Senqu River Basin, involving Lesotho, South Africa and Botswana.

  Sixty river basins on the African continent cross international boundaries. Worldwide, 261 river basins cover 47% of the earth's surface. While billions of dollars have been invested in the effective management of these basins, little progress has been made on basin-scale optimisation. The TWO analysis offers a real opportunity to improve the management of transboundary basins, with enormous benefit for society in water-constrained countries.

- **Trialogue model links science, government and society**
  The potential for a water and food crisis in many parts of the world can, among others, be attributed to a failure of governance. The CSIR has developed a trialogue model for good ecosystem governance, linking science, government and society.

  The conceptual model has been published in a book as a strategy to transfer the knowledge. The handbook, Governance as a Trialogue: Government-Society-Science in Transition, published in 2007, has been widely accepted in academia and by practitioners worldwide. The trialogue model has also been accepted by the Rosenberg International Forum on Water Policy and the Baltic Turntable Initiative, and featured at the 2008 World Water Week and 2009 World Water Forum.

  Governance requires effective science, government and society processes – as well as effective interfaces between these. These interfaces have to be appropriately balanced and available in the right format and at the right time, to deliver on the needs of society through 'good' governance. The model guides efforts towards good governance by balancing the focus on the three processes with the interactions between the processes to guide better decision and policy-making.

GasCAM detects gas leaks remotely

Following the international success of the CSIR-developed CoroCAM and MultiCAM, another new technology – the prototype GasCAM camera – is capable of detecting sulphur hexafluoride (SF6) gas leaks on electrical switch gear and can do so remotely using laser energy.

SF6 is used as a very effective insulating gas. Unfortunately, it is also a major greenhouse gas, far more damaging to the ozone layer than chlorinated fluorocarbons. SF6 produces up to 24 000 times the Global Warming Impact (GWI) of CO_2. There is, therefore, an increasing need (and imminent legislation) to monitor its release into the environment.

Many utilities and governments are recognising the benefits of identifying and repairing SF6 leaks as a starting point to comply with the Kyoto protocol and other treaties. To reduce leakages, one needs to identify them, and the easiest way to identify a leak is to visualise it – exactly what the GasCAM does.

The GasCAM has been demonstrated successfully to potential international clients.

Making more of natural waste products

The CSIR, in collaboration with the Agricultural Research Council (ARC), evaluated soya bean and sunflower oilcakes – the solids that remain after oil extraction – for their potential value-adding applications.

While the ARC focused on using the oilcakes in feed and feed supplements for farm animals, the CSIR focused on developing specialised products such as manufactured fish feeds.

The research resulted in two novel, prototype fish feeds. Feeding studies have been conducted on two fish species – Mozambique Tilapia, a freshwater finfish species, and Dusky Cob, a marine finfish species. The development is significant as no similar plant-based feed exists on the market, except for expensive products for ornamental fish, which are not suitable for fish farming.

The importance of fish food stems from the emergence of food security as a global issue. Fish can provide both high class protein and essential fatty acids for humans. However, there is a global depletion of wild fish resources, necessitating the development of fish culture as an increasingly important sustainable alternative. The economics of commercial fish farming require low cost, good quality feeds.

The project was funded by the Department of Science and Technology.

1: The GasCAM displays leakages of SF6 gas.

2: Research into soya bean and sunflower oilcakes – the solids that remain after oil extraction from soya and sunflower – resulted in two novel, prototype fish feeds. Fish can provide both high class protein and essential fatty acids for humans. However, there is a global depletion of wild fish resources, necessitating the development of fish culture as an increasingly important sustainable alternative.

Early fire detection possible through satellite technology

In a European Union Framework 7 Programme-funded initiative, the Advanced Fire Information System (AFIS) has been rolled out to the Nelspruit Forest Fire Association (FFA) in Mpumalanga. It is envisioned that most regional disaster management centres and fire protection associations in the remote areas of Africa with poor internet connectivity will have an AFIS field terminal installed. Prior to the implementation of the AFIS field terminal, the Nelspruit FFA was reliant on fire-alert phone calls from the public.

The terminal is a near real-time operational satellite fire monitoring system that provides information about the prediction, detection and assessment of fires using remote sensing and GIS technology.

The incident command centre at the Nelspruit air field is responsible for coordinating all vegetation fire fighting in the Mpumalanga, Limpopo and Gauteng provinces. With more than 50 fires at any given time during winter, preference is given to fires with a higher probability of becoming a disastrous fire. Once a serious fire warning is reflected by the AFIS field terminal, a spotter plane is deployed for further investigation and follow-up action. There are also requests from similar disaster management agencies, such as the Western Cape, for this technology.

Availability of quality remote sensing products ensured

As part of the implementation of the DST's South African Earth Observation Strategy (SAEOS) by the CSIR, its earth observation data centre (EODC) has been reengineered. This has been made possible through the use of the Data Information and Management System (DIMS).

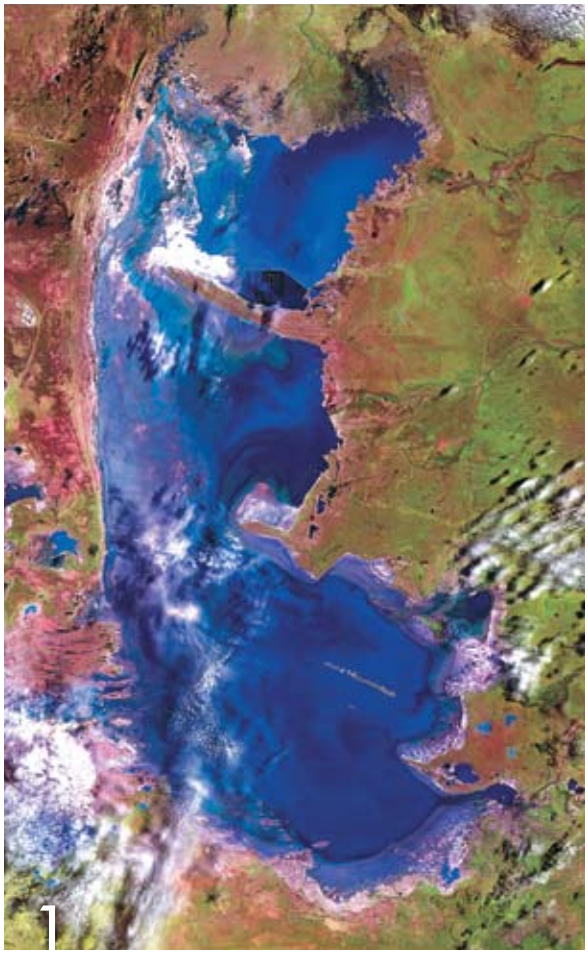
The ultimate goal of SAEOS is to contribute to the nine societal benefit areas identified by the Group on Earth Observation for the long term benefit of all South Africans. These areas are energy, climate, water, weather, ecosystems, agriculture and biodiversity, disasters and health. Through DIMS, it has been possible to ensure that the earth observation portal is fed with the remote sensing archive and new products and imagery.

DIMS ensures operational control, quality and throughput within the CSIR's remote sensing supply chain. The EODC can therefore contribute to various national, regional and international programmes and will play a vital role in the South African National Space Agency.

The successful release of one highly-acclaimed remote sensing product – the 2008 SPOT5, 2.5 m natural colour, seamless national mosaic – has ensured that government and academic end users have access to a fundamental geospatial source layer. The 2008 release is the culmination of the two previous releases (2006 and 2007). The mosaics are the outcome of a three-year contract with Spot Image in France, to provide SPOT telemetry for direct acquisition under a unique multi-user government licence.

The imagery was sourced with funding from a consortium of stakeholders, including the former departments of Water Affairs and Forestry; Agriculture; Science and Technology; and Environmental Affairs and Tourism; STATS SA; Development Bank of South Africa; Eskom; the National Disaster Management Centre; Municipal Demarcation Board and Independent Electoral Commission.

To date, over 200 government and 150 postgraduate users have had free access to this resource under the multi-user licence.



1: Made possible with the CSIR's remote sensing capability, this image shows the Makgadikgadi Pans in Botswana – the largest salt pans in the world covering an area of 37 000 km².

Energy

Our country relies mainly on coal for energy generation – and will continue to do so into the foreseeable future. However, efforts are intensifying to identify alternative energy sources and find ways to use existing energy resources more sustainably.

Measures to explore future energy pathways that may limit emissions and environmental concerns will have profound implications for the energy sector and the country at large. Among others, we are looking at a carbon-free energy solution in the form of concentrated solar thermal power. We are also conducting research on selective solar absorbers to offer low-cost solutions for providing clean energy in rural communities.

The CSIR has been investigating indigenous, lipid-producing algae that could be transformed into biodiesel, sampling approximately 20% of South Africa's aquatic environments. Furthermore, concerns over climate change and energy security have led many countries to consider a 'hydrogen economy'. To this effect, the CSIR and the North-West University have been appointed joint hosts of a Hydrogen Infrastructure Centre of Competence.

We are looking into fuel cells, as these can contribute to energy security, because they can convert potentially renewable fuels such as hydrogen, methanol or ethanol cleanly and efficiently into electrical energy.

Research into biogas and biofuels from municipal waste could lead to carbon neutral solutions and reduced fuel and transport costs. Clean coal technologies are expected to result in lower carbon dioxide emissions than is currently the case. Energy-efficient buildings will contribute to sustainability issues, especially as buildings use more than 25% of the national energy consumption.

Meeting South Africa's energy challenges involves successful collaboration. One such collaboration is with the South African National Energy Research Institute. The CSIR is also a leader in the energy cluster of the Regional Research Alliance and, in terms of NEPAD, very active in the development of an Africa-wide Energy for Sustainable Development programme.

This chapter gives a snapshot of energy-related research done at the CSIR during the past year.

1: The CSIR has been investigating indigenous, lipid-producing algae that could be transformed into biodiesel.

2: The environmental impact of Jatropha's use as a biodiesel source, has been studied.

Indigenous algal strains surveyed for biodiesel potential

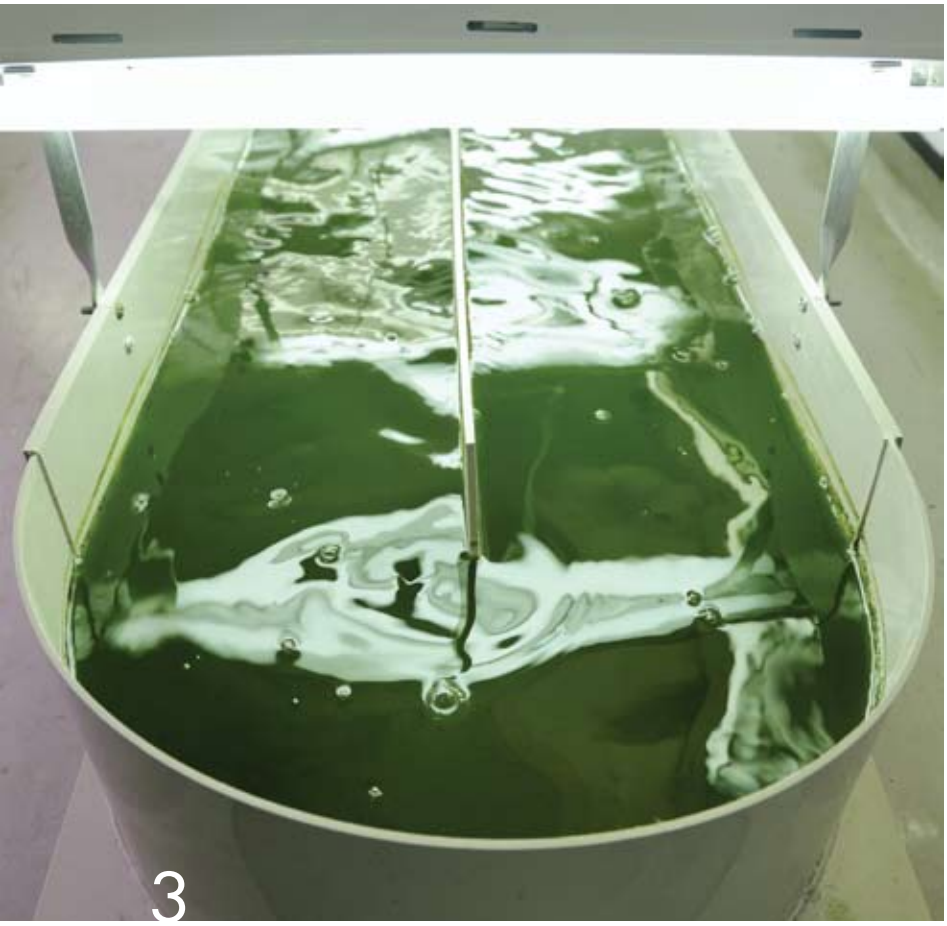
The CSIR has been investigating indigenous, lipid-producing algae that could be transformed into biodiesel. Approximately 20% of South Africa's aquatic environments have been sampled, resulting in some 150 algal isolates, of which 52 produce lipids.

Researchers found six strains that could be of value as a biodiesel feedstock. One of these isolates has demonstrated the production of ecosapentanoic acid, a highly valuable omega 3 fatty acid. Proof of concept studies are underway to demonstrate the market potential of this strain.

The environmental effects of burning fossil fuels and the increased crude oil prices have triggered further interest in biofuels. Biodiesel is traditionally produced from oil seed crops, which have lower yields per land area and threaten food security when compared to algae.

PlantBio has funded a joint project between the CSIR, Durban University of Technology and Mangosuthu University of Technology. This project will result in a national database of all isolated algal strains, including non-lipid producing strains that could be explored later for other valuable products. The current research has attracted significant interest from government and commercial partners.

The CSIR is also investigating the use of industrial waste water and carbon dioxide flue gas to grow algae, thus reducing the negative environmental impact of current industrial practices.



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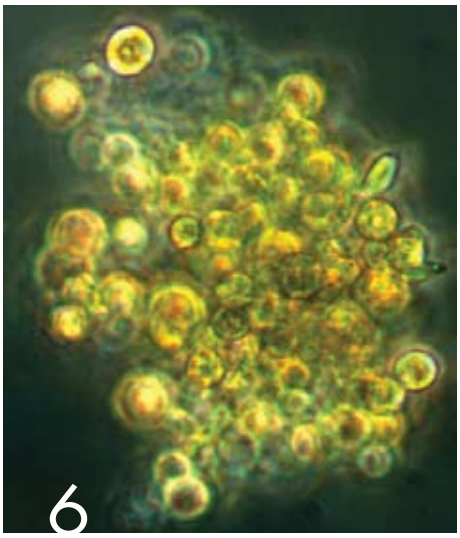

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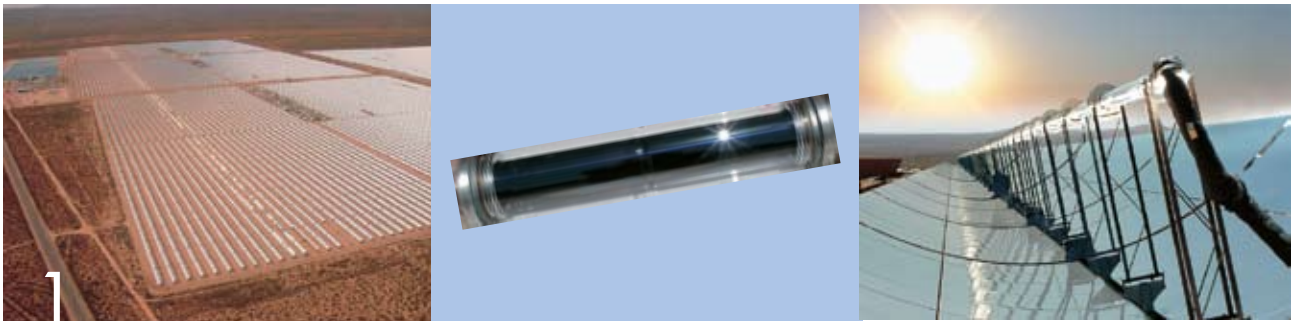
3: The use of industrial waste water and carbon dioxide flue gas to grow algae, thus reducing the negative environmental impact of current industrial practices, is also being explored.

4 & 5: Research on industrial algae strains for biodiesel.

6: A microscopic view of lipids produced by algae.



1: Laboratory results show that CSIR laser researchers have developed a novel selective solar absorber coating that is about 30% more efficient than the best alternative on the market. This coating can be used in the manufacture of efficient solar water heater panels (left) and in the absorber tubes (middle) for concentrating solar power stations using parabolic troughs (right).

Advanced optical materials for clean energy

Selective solar absorbers – materials that harness the energy of the sun – have the potential to offer low-cost solutions for providing clean energy in rural communities. A key factor is the material used to absorb sunlight – it has to absorb as much solar energy as possible. CSIR researchers of advanced photonic materials have succeeded in tailoring the optical and structural properties of materials to achieve a novel selective solar absorber with a composite structure embedded with carbon nanoparticles. Laboratory tests show that it is approximately 30% more efficient than the best alternative on the market.

The sol-gel recipe used to manufacture the composite material has additional advantages of being environmentally-friendly and has a low production cost. Researchers are now working on a roll-out strategy to make this technology available to the South African community, with particular emphasis on low-cost, efficient energy for rural communities.

POLICY SUPPORT:
Joint strategy development for Centres of Competence

Hydrogen infrastructure to enjoy focused research attention

The CSIR and North-West University were appointed as joint hosts of a Hydrogen Infrastructure Centre of Competence (CoC), with the primary goal to develop marketable technologies for the production and storage of hydrogen with a low carbon footprint. A business plan, in the final stages of review, has been developed and the required infrastructure put in place.

This is in response to the Department of Science and Technology's National Hydrogen and Fuel Cell Technology Research Development and Innovation Strategy, where three CoCs are being developed.

Concerns over climate change and energy security have led many countries to consider a 'hydrogen economy', wherein a large portion of the energy currently supplied from fossil fuels would be replaced by hydrogen. South Africa possesses approximately 75% of the world's reserves of platinum, a key material at the heart of converting hydrogen directly to electrical energy. The other CoCs will focus on systems integration and catalysis.

1: Researchers have been developing expertise in microreactor technology, for faster reaction rates and higher productivity.

Building blocks for battery research centre in place

Very few people know that the CSIR made significant contributions to the development of lithium ion batteries – being used in most cellular phones these days. Over the past year, a number of stakeholders have driven forward the plan to establish a Battery Centre of Competence (BatCoC) at the CSIR.

Worldwide, large investments are being made in research that could help find a realistic alternative to the internal combustion engine. To this effect, several hybrid and other electric vehicles have been launched. These vehicles rely on battery power and mostly make use of lithium-ion batteries. However, in some cases the cost of these batteries can account for up to 25% of the cost of the entire vehicle.

Research into low-cost, safe and long-lasting batteries is an almost automatic spin-off from the electric car industry. This presents South Africa with the opportunity to play a meaningful role in the advancement of battery research and innovation. Accordingly, the development of a national strategy has already been endorsed.

BatCoC will initially focus its research on high-capacity materials anode and cathode development, thin film/smart structure batteries, battery characterisation, testing and diagnostics, and battery electronics. It will also seek national and international collaboration while striving to develop human capital in this field.

Energy generation using fuel cells

Fuel cells can contribute to energy security, because they can convert potentially renewable fuels such as hydrogen, methanol or ethanol cleanly and efficiently into electrical energy. They are of particular interest to South Africa, as they incorporate catalytic metals, such as platinum, of which threequarters of known reserves are found here.

A fuel cell is a device that converts the chemical energy of a fuel directly to electrical energy. In this respect, it is similar to a battery. However, the chemical energy for a fuel cell is not necessarily stored inside the cell. Rather, it can be supplied externally, and the fuel cell can continue to operate as long as it is supplied with fuel.

The CSIR is focusing on developing, evaluating and improving the key electrochemical components (catalysts, membranes, gas diffusion layers and electrodes) of hydrogen fuel cells and, lately, alcohol-based fuel cells. Currently, several projects aim to improve different aspects of fuel cells. These are:

- Developing a novel method for making 'designer catalysts' for fuel cell electrodes
- Optimising catalysts in hydrogen fuel cells
- Developing more efficient catalysts for direct alcohol fuel cells
- Investigating different membranes for use in alkaline direct alcohol fuel cells.

Among others, researchers experimented with different types of alcohol fuels (including ethylene glycol and glycerol) instead of the methanol that is commonly used in these cells. They also tested various catalytic inks used in hydrogen fuel cells and developed three ammonium-doped membranes.

1: The CSIR's fuel cell researchers is focusing on developing, evaluating and improving the key electrochemical components of hydrogen fuel cells and, lately, alcohol-based fuel cells.

2: A 5 kW hydrogen fuel cell in the CSIR's fuel cell laboratory. Battery technology has a range of applications, notably for the automotive industry. Researchers aim to find ways of producing batteries that last longer, store more energy, are cheaper to manufacture and environmentally friendly to dispose of.

3: A CSIR researcher with some of the coal samples that are characterised and tested in the CSIR's pilot coal gasification plant.

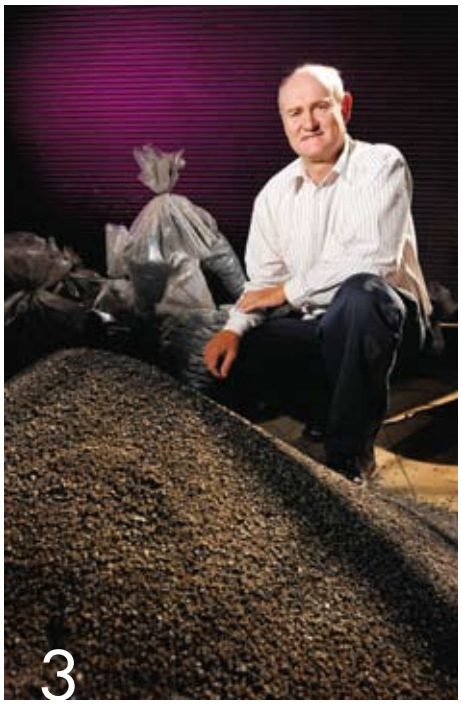
Model developed to predict the performance of South African coals

The CSIR, in collaboration with the South African National Energy Institute (SANERI), has completed a two-year research programme to investigate the performance of a suite of South African coals in a fluidised bed gasifier.

The vast majority of South Africa's primary energy supply is derived from coal. However, the reality of climate change and the financial mechanisms being introduced to combat it, must be faced. South Africa's challenge in the continued use of coal is to enhance efficiency and environmental acceptability by adopting clean coal technologies.

The research included pilot plant experiments and a detailed characterisation of the coals by means of petrographic analysis. A model has been developed to assist in predicting important performance parameters such as carbon utilisation efficiency and the energy content of the gas produced.

This work will be expanded to include modelling of the process parameters within the fluidised bed gasifier and the effect of the inorganic (ash) portion of the coals on promoting or inhibiting the desired conversion.



The CSIR investigates clean coal technologies for more efficient and environmentally acceptable coal.

Built environment

The built environment plays a major role in socio-economic development and a correlation between investment in infrastructure and economic growth has been demonstrated.

Economic growth is, *inter alia*, dependent on quality transport infrastructure (such as roads, airports, railways and harbours), infrastructure for power generation, and information and communications infrastructure. In addition, the effective operation of infrastructure relating to asset management, traffic management and effective logistics is crucial to economic welfare.

Social development cannot take place without the provision of basic amenities such as hospitals, schools, housing, as well as the infrastructure for electricity supply, water provision and sanitation. The AsgiSA strategy targets an investment of at least 25% of GDP in infrastructure (9% by government and 16% by the private sector). The importance of infrastructure to South Africa is also highlighted by the government's special investment of R600 billion over a three-year period.

The CSIR conducts relevant R&D and develops the key solutions that will address the challenges in the built environment. It thus facilitates socio-economic development in South Africa. Specific focus areas include:

- Modelling of city dynamics to support integrated planning in government
- Infrastructure engineering, specifically roads, airports and sea ports
- Materials technology for the built environment
- Building science and technology with emphasis on affordable housing, modern methods of construction and improved performance of public buildings (schools and hospitals)
- Infrastructure operations, with emphasis on logistics, asset management systems, intelligent transport systems
- Infrastructure for municipal services (electricity, water supply and sanitation)
- A multi-year, interdisciplinary research platform (IRIP) at the CSIR to investigate models of sustainable and integrated municipal service delivery. These could be operated as viable business concerns independent of a municipality's ability to recover costs, while not depriving the municipality of a key source of income.

The CSIR has had several successes in the transfer of technology for the built environment, particularly through its heavy vehicle simulator and coastal modelling laboratory that have been used extensively locally and abroad. Specific highlights for the year are detailed on the following pages.

1: **A low income, demonstration house designed and constructed by the CSIR for improved performance and sustainability.**

Quality of low income housing improved

Using innovative technology, the CSIR has demonstrated significant performance and sustainability enhancements for low income housing.

The CSIR designed and constructed a demonstration house on its Pretoria test site, funded by the Department of Science and Technology. The building system used in the house has obtained Agrément certification for new construction products and methods. Various components used in the house will be patented.

In addition, one house is being built in Buffalo City in the Eastern Cape and another at Kleinmond in the Western Cape for demonstration purposes, in anticipation of possible future roll out.

The houses were designed to enable government-funded low income houses of 40 m^2 to be easily extended by their occupants. Using a modular, design-to-fit design approach, zero waste was generated. To eliminate cracked walls resulting from sub-standard foundations, a CSIR-developed technology – ultra-thin continuously-reinforced concrete used for roads – was adapted to form the foundation slab of the house. The design of the bathroom/kitchen area was rationalised, and the waste outlet manifold is pre-manufactured, quality-tested and installed on site. The thermal performance of the roof was improved dramatically through the addition of insulation that doubles as a ceiling.

Housing investment potential atlas assists towards more sustainable human settlements

A housing investment potential atlas is being finalised by CSIR researchers to guide decisions by stakeholders for turning the current dysfunctional, inequitable space economy into more sustainable human settlements. The overall aim is to provide the National Department of Human Settlements with a spatial interpretation of current policy as it relates to human settlements, specifically housing locality.

This is the third edition of the atlas. The CSIR produced the second edition for the Department of Housing in 2005 as input to the multi-year provincial housing plans. The atlas will indicate the most appropriate forms of housing and supportive investment for areas with varying combinations of the potential to support quality of life and place. The analyses in the atlas will also inform the allocation formula for housing funds, according to which shares of the national human settlement budget are allocated to the provinces.

2: Rural communities face unique developmental challenges and constraints. CSIR researchers address rural and second economy challenges through integrated and multidisciplinary research, based on a comprehensive understanding of the distinctive socio-economic conditions characterising rural and second economy areas. The team strives to provide innovative and sustainable technological solutions, looking at rural accessibility and development; water supply and sanitation; rural energy for economic development; and geo-ICT for rural development.

2

POLICY SUPPORT: The Toolkit for Integrated Planning (TIP) is a CSIR demonstrator that shows the simulation of urban growth scenarios, an initiative in support of integrated development planning across sectors and scales.

Toolkit for Integrated Planning aids housing and transport

To strengthen integrated housing and transport development planning across sectors and scales, the CSIR has developed an electronic information platform. It demonstrates the value of providing enhanced information and better evidence as input into spatial analysis and integrated development planning processes, and supports the evaluation of alternative planning policies and decisions.

This Toolkit for Integrated Planning (TIP), a Department of Science and Technology (DST)-funded initiative, consists of two main components:

- A profiler, which is a collation of cross-sectoral spatial and temporal information on current patterns and trends, limited to the period between 1995 and 2007
- A simulator – a set of illustrative urban growth scenarios that demonstrate simulation capability.

The TIP demonstrator can be accessed *via* a web-based user portal and used to demonstrate the content and capabilities of TIP to potential users in government and planning practices by means of a case study area.

Following on the current version that focuses on housing and transport, the CSIR has been contracted by the DST for the second phase of the project, which will include a widening of the spatial scope to include the entire South Africa and more key development sectors.

POLICY SUPPORT: Overloading management system and guidelines to manage the overloading on the road system and prolong the life of roads.

Ultra-thin concrete roads improve lives and create jobs

Following stringent experimentation, technology for the construction of ultra-thin (50 mm thick), continuously-reinforced concrete roads has been developed and tested successfully by the CSIR.

These roads provide an all-weather surface and improve the lives of communities located along the roads by curbing dust, providing access and reducing damage to vehicles. Ultra-thin reinforced concrete roads are labour-intensive and can involve local communities and small contractors, thereby creating employment opportunities. The roads require minimal maintenance – indications are that they have a life span of 30 to 40 years, resulting in reduced life cycle costs and less disruption to road users.

The Gauteng Department of Public Transport, Roads and Works (DPTRW) identified this technology for its roads upgrading programme. Demonstration projects were undertaken in Soshanguve and Mamelodi in the Tshwane Metropolitan Municipality, while construction is also underway in Atteridgeville.

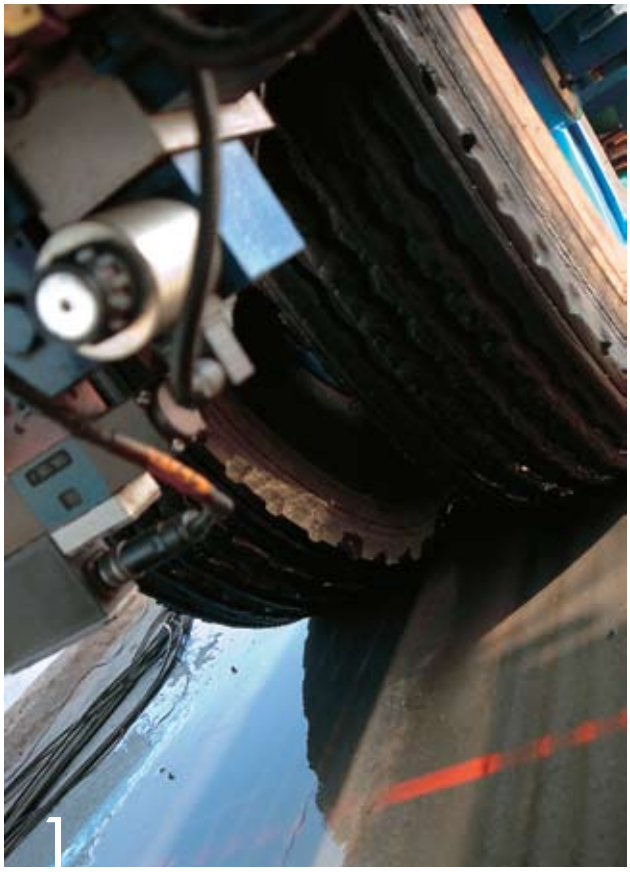
Evaluation programmes of the roads were undertaken by the CSIR, the University of Pretoria and the DPTRW, using the CSIR-developed heavy vehicle simulator, other equipment and tests. Findings indicate that this road construction technology could be suitable for upscaling to provincial roads.

Heavy vehicle simulator delivered to China

The CSIR, in collaboration with its US partner Dynatest Inc, has developed a new model of the heavy vehicle simulator (HVS), of which the first has been sold to Chang'an, a university in Xian, China. The CSIR will also assist with technology transfer by training new users to use the machine, analyse data and road structural design.

The HVS Mk VI has numerous advantages over its predecessor, including reduced weight and complexity, increased wheel speed and test beam length, and improved mobility when towed on public roads. It is also modular and easy to transport. The Mk VI facility simulates the traffic-associated deterioration of a road over its design life (usually 20 years) in as little as three months. It enables the optimisation of road designs through the testing of trial sections well ahead of their implementation in practice. This allows cost-saving and avoids expensive failures.

The international HVS programme has generated foreign income for South Africa of more than R200 million over the past 15 years. The South African National Road Agency Ltd has put out tenders for a full-scale rehabilitation project on major freeways using a specialised, ultra-thin continuously-reinforced concrete technology after the validation using the HVS.



1: The CSIR is recognised as one of the global leaders in road design and evaluation, with 10 HVS facilities currently forming part of research programmes in six countries. HVS work is closely aligned with the need for cost-effective improvements to unpaved roads, as part of a phased upgrading.

2: The CSIR has developed and tested technology for the labour-intensive construction of ultra-thin, continuously-reinforced concrete roads.

1: **Performance-based design has led to safer and more productive heavy vehicles in the forestry industry.**

Timber industry benefits from new heavy vehicle design

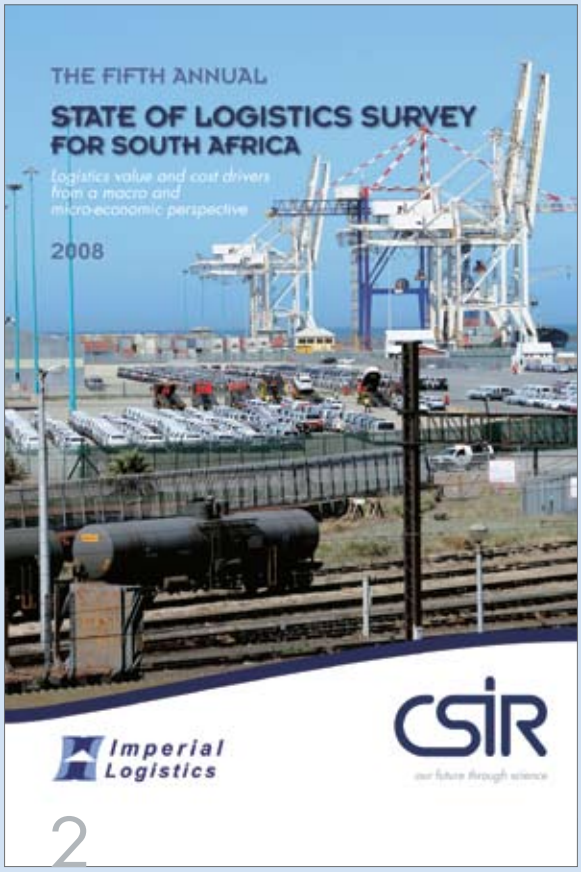
The CSIR, in a collaboration with mainly Australia, is following a new approach for the design of heavy vehicles, resulting in safer, road-friendly and more productive heavy vehicles. The CSIR has introduced two performance based system demonstration vehicles at Sappi and Mondi. The two vehicles will be run and monitored for a period of at least three years.

Initial monitoring results of the two vehicles indicate a saving of approximately 18% in total transport operation costs, which could translate into millions of rand's savings per year for the forestry industry. A larger-scale demonstration project in the forestry industry was approved earlier this year.

The approach focuses on the dynamic behaviour of the vehicle under various critical operating conditions. Through computer simulation, vehicle parameters are optimised to improve safety performance. The demonstration vehicles have been engineered to function optimally for the timber industry, with the ability to carry increased amounts of timber – the vehicles are up to 5 m longer than standard timber trucks.

Premature road deterioration, as a direct result of heavy vehicle overloading, costs South Africa more than R800 million in accelerated road wear and in excess of R10 billion a year in increased heavy vehicle operating costs. The truck fatality rate in South Africa is typically five to six times higher than in many European and North American countries; and the total cost of logistics, as a percentage of GDP, is significantly higher than in many developed and developing countries.

The CSIR aims to facilitate similar projects in other industries.



2: The fifth annual State of Logistics Survey warns that rising internal logistics costs will reduce South Africa's competitiveness.

Survey highlights need to reduce logistics costs

The fourth and fifth annual State of Logistics surveys were published during the past year. The two surveys concentrated on logistics for regional growth and development, and logistics value and cost drivers from a macro and micro-economic perspective.

Logistics costs in South Africa for 2007 increased by 1% to R317 billion – 15.9% of the GDP. One of the biggest logistics problems in South Africa is rising internal logistics costs, which will reduce the country's logistics competitiveness.

Transportation costs make up 53% of total logistics costs in South Africa, which is 14% higher than the world average of 39%. Road and rail are the predominant means of freight transport, with the split for goods transported by road and rail being 87% and 13% respectively. Container traffic holds the biggest opportunity for change – containers need to be transported by train, and then by truck on the last mile.

Since the publication of the first survey in 2004, it has become one of the prime references for logistics in South Africa. The CSIR-initiated research provides valuable support to decision-makers in the development of relevant policies and in making strategic infrastructure investment and maintenance decisions. Time-series data also enable the success of interventions to be monitored over time.

1 & 2: A research engineer with the keofloat system developed by the CSIR to measure very small waves in the laboratory, for studying wave agitation and ship motions in ports.

CSIR develops high-accuracy wave measurement system

A newly developed system enables the CSIR to assure port authorities and advise coastal engineers about the safe and efficient design of ports.

Researchers at the CSIR's hydraulics laboratory in Stellenbosch, together with video image processing specialists, have developed the new 'keofloat' system to measure very small waves in the laboratory. This invention gives the CSIR an edge over other laboratories in the world, especially for wave agitation and ship motion studies for large ports.

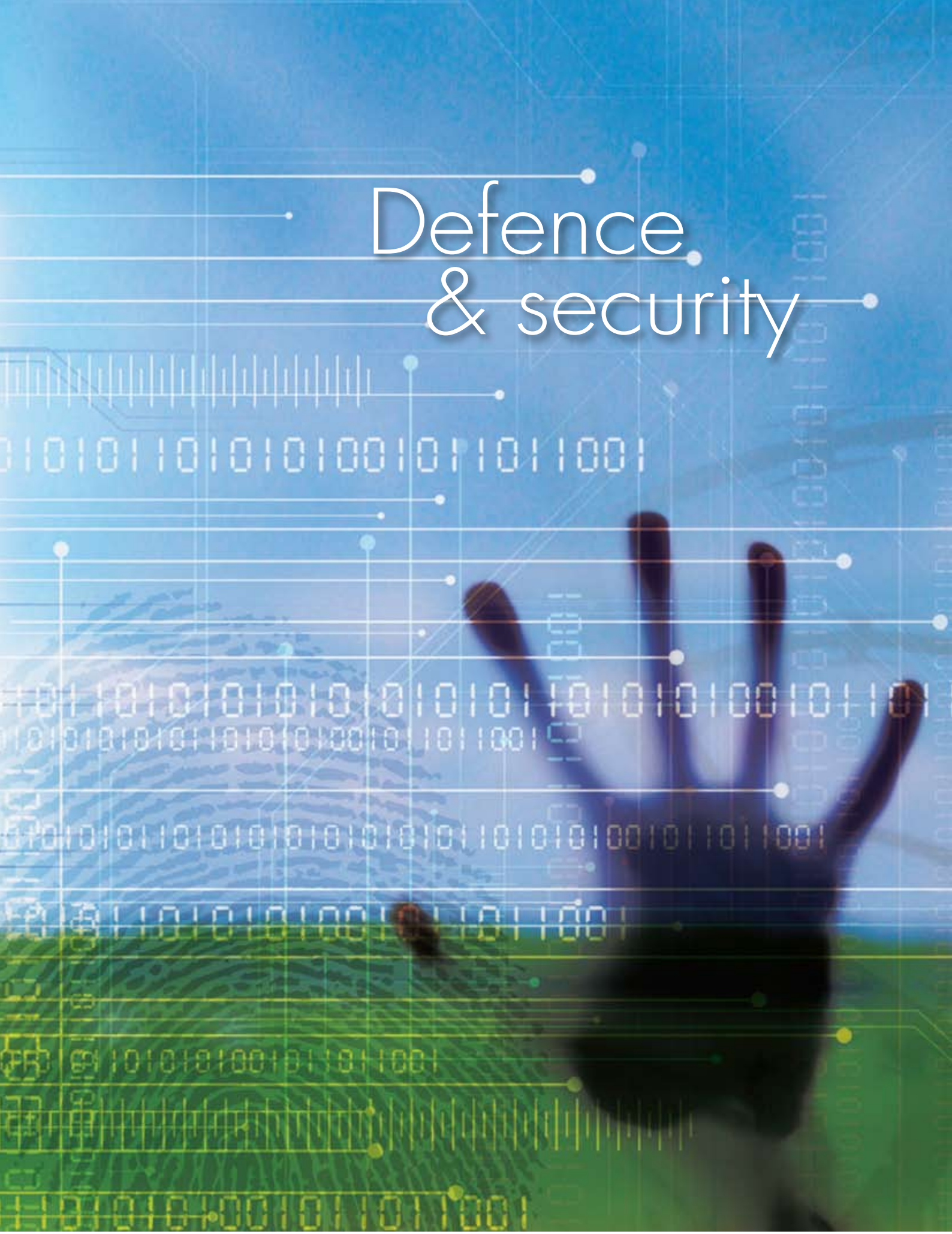
In the final design stage of a new port or port expansion, physical modelling is used to check the weakening of waves in the port. Due to the size of modern ports, these models are constructed at a small scale of 1:100. Tight criteria exist on limited wave heights, especially for loading and unloading container ships. Therefore, the waves in the modelled harbour basin are very small, in the order of a few millimetres.

Keofloats are cylindrical polystyrene blocks that are monitored by a video camera. A sophisticated computer algorithm is used to determine the vertical position of the keofloat at sub-pixel accuracy. The estimated accuracy is 0,3 mm or better for waves smaller than 1 cm, whereas conventional probes guarantee 0,5 mm to 1 mm accuracy.

The CSIR recently deployed keofloats in a project for a marina in the Seychelles and a port in the Persian Gulf.

3: The CSIR-developed bridge management system (STRUMAN BMS) has been adopted by many road authorities. At least 70% of all bridge structures of significant size in South Africa are now monitored through a BMS, and most of these BMSs have been derived from CSIR work. The system is also used by the road authorities in Botswana, Namibia and Swaziland. Bridges and other road structures are key elements in any road network. Maintenance costs may increase substantially as serviceability levels of structures decline. Effective management and proper maintenance of these structures are therefore essential.

4: A variety of armour units (such as dolosse) is used to protect breakwaters, piers and other harbour infrastructure around South Africa. In a CSIR numerical modelling project, researchers used analytical techniques for application to breakwater structural stability and the development of associated simulation and modelling technology. Various approaches are followed and the ultimate goal is to integrate these into an advanced analysis tool. Structures of up to 350 dolosse can now be treated and various characteristics of the packed array of armour units can be calculated, using advanced computing techniques.



Defence & security

The CSIR's work in defence and security is guided by national objectives and the requirements of state departments such as the departments of Defence, Science and Technology, Trade and Industry, the South African Police Service, as well as the defence and aerospace industries. The value and impact of our work are in contributing to the readiness, effectiveness and capabilities of state entities involved in safeguarding the country and conducting operations outside and inside our borders to help establish a peaceful and secure environment for all South Africans.

In addition to defence and national security, we contribute to industrial development through the transfer of technologies and provision of specialised technology services that support industrial competitiveness and growth. By engaging in advanced technology projects, joint programmes with universities and investing in the development of current and potential employees, we help grow the national pool of R&D capable scientists and engineers so critical for achieving economic growth.

The nature of defence and security is changing rapidly, shaped by regional factors. Our role is to be agile in identifying and responding to these changing requirements and to have a deep understanding of the application environment. This, combined with a professional knowledge of technology trends, allows us to identify important science and technology capabilities that will be required or may have an impact in the future and start directing investment towards those.

A range of capabilities in the CSIR contributes towards our work in defence and security. These are sensor systems (radar, optronics and sonar); countermeasures and platform protection; cyber warfare and information systems; command and control; vehicles and platforms; aeronautics; maritime systems; detonics, ballistics and explosives; soldier systems; rapid prototyping; systems engineering; modelling and simulation; field measurement and evaluation; and technology management. Groupings of some of these capabilities lead to new functionalities and innovations of which there have been many examples in the past year, as some of the highlights that follow demonstrate.

POLICY SUPPORT:
Intervention for a safe South Africa: a shift in investment and intervention from enforcement to prevention.

Helping South Africans contribute to a safe society

During the past year, the CSIR used the Action for a Safe South Africa (AFSSA) 'breaking the cycle of violence' model as the basis for facilitating local safety plans in 24 precincts in the Western Cape, commissioned by the South African Police Service (SAPS).

The model advocates interventions in the social arena rather than the criminal justice domain. It focuses on the need for a broad strategy for safety, rather than a security-based strategy. As such, in addition to the SAPS or Department of Justice, stakeholders could also include the departments of Social Development, Sports and Recreation, Arts and Culture, Health, and Education. Each stakeholder is responsible for interventions at different points in the cycle, according to its mandate.

The CSIR worked with local and international experts to find documented evidence and practical examples of interventions that can be implemented at local level with a positive impact on safety.

The AFSSA convention in August 2008 brought together more than 300 key players in community safety and was followed early in 2009 by the publication of a book on the outcomes. The book aims to enable South Africans – from academics, service providers, large and small organisations to individuals – to contribute to a safe society.

Smartcards: Most critical components successfully tested

Following the CSIR's successful testing of the most critical components of a smartcard (the operating system and Java Virtual Machine), the development of SmartIDs will start before the end of 2009.

The project forms part of the CSIR's support for the security of national identity tokens such as SmartIDs, as well as ePassports and eDrivers' Licences. The Department of Home Affairs contracted the CSIR to analyse and improve its tender specification document for national SmartIDs, and to adjudicate the technical solution of tender submissions.

This research will boost local capacity to develop smartcard-based security products and related commercial technologies, such as SIM cards and credit cards.

Countering the threat of roadside bombs

Peacekeeping missions in war torn areas are, at times, hampered by the use of improvised explosive devices along patrolling routes. The CSIR is investigating ways to ensure that deployed personnel and vehicles are protected against such threats.

Engineers are analysing typical threats faced by the defence force and assessing their scientific attributes. The threat itself has to be authentically reproduced to understand the damage mechanisms. These laboratory scale 'threats', called surrogates, can then be used in scientific tests to measure their effects in different scenarios, or against certain material combinations.

Scientists and engineers at the CSIR have developed a number of surrogates that represent generic threats. These surrogates are characterised at the CSIR's detonics, ballistics and explosives laboratory and used in studies that will lead to the development of countermeasures.

Defence systems for better communication

The CSIR has assisted the South African National Defence Force (SANDF) in the development of operational command and control information and communications systems and services (ICS&S). These enable joint, interdepartmental and multinational operations where many systems have to communicate with one another to make South Africa a safer place.

The CSIR participated in national interdepartmental exercises, including Exercise Shield Deployment in Cape Town, Port Elizabeth and Bloemfontein. During 2009, preparation and experimentation focused mainly on the FIFA Confederations Cup, with field support during the event itself.

Activities planned for the next financial year include interoperability technology development support for the FIFA Soccer World Cup in 2010; and ongoing support to the SANDF operational ICS&S requirement definition and acquisition environments.

1: Assessments done at a CSIR test facility of the damage caused by a mine to an armoured carrier.

Fingerprint recognition platform developed

South Africa is currently a net importer of biometric-based products. To improve South Africa's capacity to develop local biometric products and curb the outsourcing of national security safeguards, the CSIR has successfully developed a fingerprint recognition platform that can perform one-to-one verification (where a live fingerprint is matched to a fingerprint stored in some device) and one-to-many verification (where a live fingerprint is verified against multiple fingerprints stored in a database).

Preliminary tests against sample fingerprints showed excellent results. A more rigorous reliability testing regime is being implemented and the system will be packaged into a technology demonstrator. This will be followed by the development of various related biometric-based technologies and applications for technology transfer and commercialisation.

The CSIR's biometrics research capacity was established in 2008.

New radar feed improves measurement capabilities

CSIR engineers have, as part of a radar cross section (RCS) project for an international client, designed and developed a high-powered dual polarised radar antenna feed.

The antenna is used to launch a radar pulse into the air in the direction of the target and receive the signal returned from the target, to measure the RCS of targets (mostly aircraft and ships).

Normally a single polarised feed is used and measurements are done twice, one for each polarisation. Dual polarisation is the ability of an antenna to simultaneously receive vertical and horizontally polarised waves, resulting in only one measurement set. As the flying time of typical targets is very expensive, the dual polarised feed leads to cost savings.

As no suitable feed existed for the antenna, engineers had to design and develop this technology. A further advantage of using a dual polarised feed, is that the cross polarisation return of the target can also be measured. Certain targets have unique cross polarisation features, this can be used for automatic target classification or maybe even target recognition. This feature of the feed will thus also help in conducting further research in target classification and recognition using radar information.

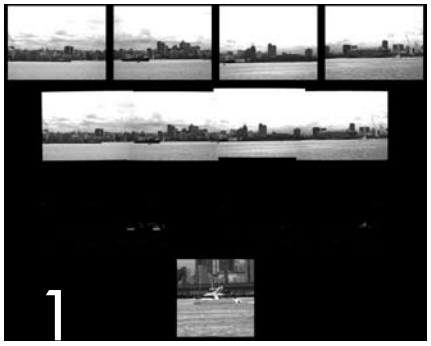
1: The MECORT mobile radar laboratory deployed in False Bay in the Western Cape for maritime target and clutter measurements.

Target recognition with radar gets smarter

The CSIR's AwareNet programme continues to explore new technologies and concepts for persistent and ubiquitous surveillance on which the South African Aerospace industry can base realisable innovations with unique value propositions.

One of the areas researched was radar target classification using inverse synthetic aperture radar (ISAR) techniques. ISAR is a radar processing technique used to generate a target image from which at least the class of target, and in some cases its identity, can be estimated, even at long ranges and in bad visibility. Most published ISAR imaging algorithms are based on the assumptions that the target is rotating around a fixed axis of rotation and at a constant angular rate. However, the motion of small boats in rough seas violates both these assumptions most of the time, leading to significant distortion and/or blurring in the resulting ISAR images.

CSIR research focused on understanding the effects that cause blurring, both through theoretical analyses and practical measurements. This resulted in important insights into the limitations of published ISAR algorithms and how these may be overcome. It is expected that this work will contribute significantly to the target classification function of the AwareNet radar sensor. In the mean time, some of the mathematical models and simulations, as well as the measurement techniques developed, are already finding application in a number of other South African radar R&D projects.



1: The picture depicts the image processing pipeline from raw input video, through image stitching and target detection to target tracking.

SA navy ships acquire new 'eyes' for better surveillance

CSIR researchers have designed and developed a surveillance system for the South African Navy (SAN), using camera sensors as the 'eyes' of a ship.

When the SAN operates in hostile littoral environments, the protection of the ship is of the utmost importance. Potential threats include small arms fire, rockets and improvised explosive devices. Countering these threats requires extensive surveillance of the ship's surroundings. One of the methods currently employed for this task, is using crew members as 'lookouts'.

The wide area surveillance project (WASP) sensor was developed for this application. It consists of four high resolution cameras covering an initial 60° field of view. The images from the cameras are stitched in real-time using a commercial graphics processor card, resulting in an image of 4 000x1 000 pixels. This image is processed in real-time to identify and track objects of interest within the sensor's field of view.

WASP's sensors will be expanded to full 360° coverage in the future, and research directed towards automatic threat classification.

2: Research into unmanned aircraft has received a major boost following the successful maiden flight of the CSIR's modular UA. Subsequent tests of the same unmanned aircraft were also a resounding success.

Unmanned aircraft research infrastructure to expand

CSIR engineers have embarked on a project to develop a national research infrastructure for unmanned aircraft (UA), to test and validate a range of related technologies and experimental sub-systems in a representative environment.

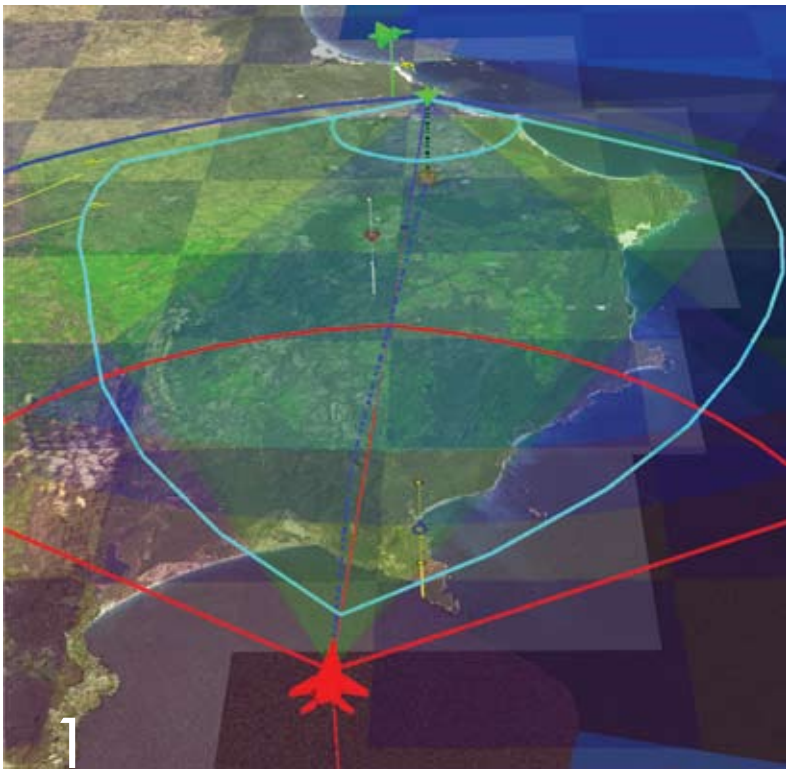
The national UA research infrastructure comprises:

- A UA Systems Integration Laboratory (SIL) that enables the technology components and/or basic sub-system functionalities to be validated by integration and demonstration in a laboratory environment
- A number of modular UAs that provide the above capability in a relevant flight environment
- An advanced air vehicle system that allows advanced technologies and/or sub-systems to be validated by integration in a realistic and relevant environment.

Unmanned aircraft has enormous potential applications such as border control, support during natural disasters or powerline inspections.

2

1: **Missile engagement with an enemy aircraft shows that the red aircraft will be able to launch its missile first.**



Fighter tactics re-evaluated *via* mission simulation

The CSIR developed a tactics simulation framework for the South African Air Force's (SAAF) Gripen, as part of an Armscor contract.

The new generation SAAB Gripen replaced the Atlas Cheetah, necessitating a re-evaluation of fighter tactics. The acquisition of the Gripen has brought fourth generation situational awareness in the form of a tactical data-link and a fully integrated navigation, attack and electronic warfare system.

The CSIR was tasked to assist the SAAF in understanding how best to utilise the new aircraft's capabilities and provide a mission simulation capability that would allow the squadron to evaluate new concepts accurately in terms of tactical posturing, prior to testing these ideas in the air at great cost. This was achieved by drawing on the skills of a multidisciplinary CSIR team, comprising experts from aeronautics working in collaboration with colleagues in command, control and information warfare, optronic sensor systems and radar and electronic warfare.

2 & 3: **The 'Digital Doorway in a suitcase' was developed for humanitarian organisation, Unicef. Dubbing the project 'BEE', it will act as a content server and communication hub within disaster areas. The concept was to develop a DD that could be checked in with an airliner carrying Unicef staff to various disaster areas.**

Providing ICT access in post-disaster situations

The development of a mobile, robust, portable ICT hub for use in post-disaster situations, the BEE, is the outcome of a collaborative project by the United Nations Children's Fund (Unicef) and the CSIR's Digital Doorway (DD) team.

Based on the CSIR-developed DD concept (a freestanding computer terminal that enables access by users of all ages to promote self-learning), the BEE is a 'Digital Doorway in a suitcase'. As a village server, it provides content and a gateway for other services to various devices *via* Global System for Mobile communications, WiFi or other communications backbones. Unicef staff can communicate with the BEE using handheld devices, such as Blackberries or i-pods.

Ease and speed of transportation were key factors in the design and choice of dimensions for the BEE. It can be taken as regular baggage when travelling by air to disaster areas. A mast to support the antennas fits into a 2 m long case.

Further work on this co-created concept demonstrator will focus on housing and simplifying the user interface for basic services.

Industry

Manufacturing contributes over 18.5% to South Africa's GDP; accounts for over half of all exports and is the second largest employer. Yet the sector is in decline. South Africa's future competitiveness will depend on the capacity of the manufacturing sector to master advanced technology domains, to innovate and to meet the special needs of customers and clients.

In line with government's recognition of the importance of advanced manufacturing, with efforts grouped under the National Advanced Manufacturing Technology Strategy, the CSIR focuses on research and development in support of the aerospace industry, light metals beneficiation, cleaner production, foundry technologies, mechatronics and micro manufacturing.

The aim is to increase the competitiveness of local manufacturing industries by developing new and innovative technologies suited to their needs. This will be achieved through specific research and development competencies such as advanced machine design, reconfigurable and flexible manufacturing systems, robotics and mechatronic systems, automation and control, micro manufacturing, microfluidics and microsystems. In terms of the future, we hope to establish a globally competitive micro-manufacturing industry in South Africa.

The CSIR is also engaged in R&D activities that seek to provide South African industries with access to advanced systems such as robotic and laser-based manufacturing. In terms of laser, it has a unique combination of expertise and advanced laser equipment for macro-processing activities for 3D cutting, welding, cladding and hardening, as well as micro-processing activities such as laser-ablation, drilling and shaping. These resources are available for the entire manufacturing value chain, ranging from basic R&D and feasibility studies, to process development, decision support and small batch production. Several South African industry players have benefited from CSIR-developed, advanced laser-based manufacturing processes.

Materials form an integral part of almost every field of science and technology, as it is the basis from where one begins to investigate and develop both existing and new products and technologies. It is a field covering all natural materials, including base and precious metals, natural fibres and biomaterials, to man-made materials such as polymers and composite materials. It has applications in healthcare, energy, the built environment, advanced manufacturing, information and communications technology, sensors and lasers, safety, the natural environment, mining and many more industries. The CSIR's materials research and development activities are conducted on a diverse set of materials, compositions of materials, techniques to process and analyse these materials, and manufacturing processes and technologies for these materials. We work on several metals and alloys, focusing on light metals, and materials used in energy applications such as fuel cells and batteries.

In contributing to the mining industry, the CSIR supports the Centre for Mining Innovation in its objective to generate new knowledge and technology that will enable us to double the South African mineral reserve by the year 2020, while extracting mineral resources without harm to miners

Futhermore, we aim to increase our impact in the social good area and are looking at adopting a sector and cluster development approach to enterprise creation and technology transfer.

The following pages feature the CSIR's work in these fields.

Next-generation modelling for safer, more efficient aircraft

The CSIR was contracted by the Airbus consortium to begin developing the next-generation fluid-structure-interaction (FSI) modelling software that would allow the airframe's dynamic response to be simulated accurately by engineers, thus enabling the design of safer and more efficient next-generation aircraft.

The first phase of the project was evaluated by an Airbus panel of experts and described as "innovative and potentially of great practical application". This was a profound success for South Africa in an exceptionally competitive high-tech field, and the CSIR is now developing the technology further.

The use of mathematical models to describe natural phenomena has been the foundation of science and engineering for centuries, although its impact has been limited due to the absence of equation solution technology.

With the advent of computational mechanics, of which FSI is a recent development, this is set to change. FSI combines the latest in physics, differential calculus, numerical analysis and super computing technology to create an exact mathematical representation of virtually any physical system in cyberspace, be it a building, aircraft or a human heart.

Denel rocket motors successfully laser welded

The CSIR has completed the development of a qualified laser welding process for the manufacture of high pressure vessels used as solid fuel rocket motors in airborne missiles.

The success of the project has led to the CSIR's appointment as Denel's preferred supplier of this technology.

The new process is based on laser-based powder welding technology, which allows a relatively wide operating window, but high accuracy and high strength weldments. The laser welding process complies with all stringent tolerance specifications and can cope with the high mechanical stresses associated with this application. Several motors have been tested successfully.

Novel method for efficient industrial laser paint stripping developed

Micro-optics research at the CSIR has led to the successful design and implementation of a novel optical solution for efficient industrial paint stripping. This was achieved through a partnership with SDI Lasers, an industrial supplier of advanced laser systems.

Generally, chemicals are used to remove paint. This is hazardous and is not environmentally friendly. The use of a laser to strip paint can compromise quality, as the repetitive movement of the laser over parts where the paint has already been stripped can damage the substrate underneath the paint.

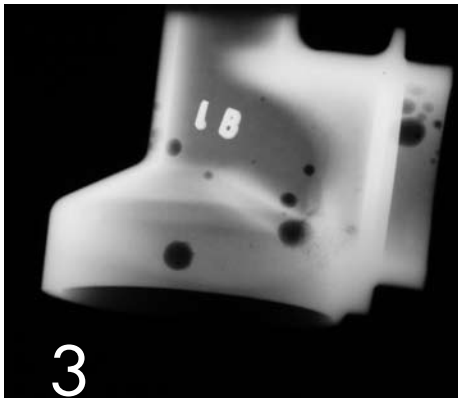
The CSIR mathematical optics research team has developed a method where a uniform intensity beam is used (the energy is constant). The addition of a micro-optical mirror to the laser paint stripping system creates an even distribution of the beam where the laser is focused and ensures even paint removal without damaging the underlying substrate.

1: Laser cladding is a weld surfacing technology recently introduced to the South African industry. The process involves the deposition of any weldable material on the surface of a metal substrate, using a laser beam.

POLICY SUPPORT:
In support of the Department of Science and Technology's Youth into Science Strategy, the Public Understanding of Laser Science and Engineering (PULSE) initiative reached over 300 000 learners, students and educators in 2008.

1: A shell to be used in the casting of titanium is coated in preparation for the casting process. CSIR researchers developed the optimum face coat material and manufacturing methodology for casting titanium into shells *via* ceramic crucible melting of the titanium in a high vacuum furnace.

2 & 3: The X-ray of a titanium casting shows definite flaws in quality that cannot be seen on the surface of the casting. The CSIR-developed titanium castings eliminates these flaws.



Titanium castings of high integrity achieved

CSIR researchers have successfully made high integrity titanium castings by melting the titanium in a high vacuum furnace in a ceramic crucible (a container of metal or refractory material employed for heating substances to high temperatures). Worldwide experience has shown this to be a difficult process that cannot always be duplicated successfully.

The aim is to develop a complete technology chain for titanium investment casting for transfer to industry. Although the current development is intended for the aerospace industry, the technology chain for titanium casting will be suitable for industrial, medical, automotive and even jewellery applications.

The work was done in the CSIR's recently-upgraded Investment Casting R&D facility, with its robotic shell dipping capability and South Africa's only industrial vacuum investment casting furnace.

The processing of light metals such as aluminium, magnesium and titanium holds specific promise in manufacturing lighter, stronger structures and components for the automotive and aerospace industries.

4

5

4 & 5: **Enzymes are natural substances used to speed up chemical reactions. Because the waste from enzyme reactions is biodegradable, responsible industries are increasingly opting for enzymes rather than chemicals.**

Speeding up the use of greener industrial processing

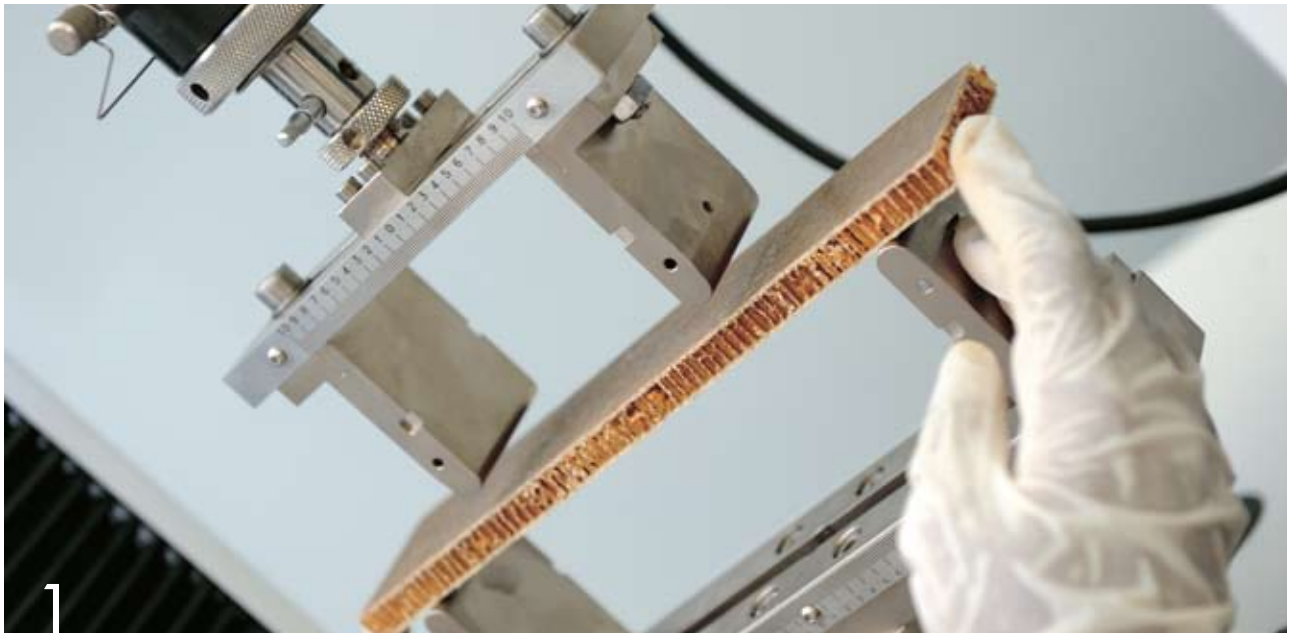
CSIR researchers have developed and patented two technologies to immobilise and stabilise enzymes for use in industrial processes.

Enzymes are natural substances used to speed up chemical reactions and have many applications, from the making of detergents to biodiesel manufacturing. The waste from enzyme reactions is biodegradable and responsible industries are increasingly opting for enzymes rather than chemical catalysts.

The technologies developed through this research make the enzymes robust for industrial use. The development of the Spherezyme™ technology package was funded by BioPAD and licensed for commercial exploitation to local biotechnology company ZA Biotech during the year under review. A second immobilisation technology, comprising a polymer matrix that can be used as a support for enzymes, microbes and proteins, is under development.

EMERGING RESEARCH AREA:

Synthetic biology cuts across the fields of biotechnology, medical innovation, technology for manufacturing and engineering, environmental sciences and information technology. CSIR researchers are leveraging this tool to design 'synthetic' biology systems that mimic those found in nature, for application in diverse areas such as health, energy, the environment and materials.



1 & 2: A sample piece of a natural fibre reinforced sandwich panel, which has been developed for use in the interior of Airbus aircraft, is undergoing a strength test. This is the first natural fibre-based panel for aerospace applications developed using an environmentally benign flame retardant to comply with FST requirements.

Flame retardant natural fibre solution for aircraft found

Through the Natural Fibre Reinforced Biocomposites (NATFIBIO) consortium, CSIR researchers have developed a natural fibre reinforced sandwich panel for the interior of Airbus aircraft.

For the first time, natural fibre-based panels for aerospace applications have been developed using an environmentally benign flame retardant treatment on the natural fibres to comply with flame, smoke and toxicity (FST) requirements. The major advantages of these panels include being lightweight (leading to energy savings), environmentally friendly, fully degradable and sustainable. They are, therefore, truly 'green'. Other advantages include the 'greening' of aircraft components, implementation of REACH (registration, evaluation, authorisation and restriction of chemicals) guidelines and alignment with the European Union's Clean Sky Initiative.

The use of synthetic fibre-reinforced petroleum-based plastics for aerospace and automotive applications is problematic, given the depleting oil reserves and growing ecological damage. One of the challenges in the aviation sector is to address FST requirements when using natural fibres for reinforcing composites. It is critical that panels for aviation applications should comply with the FST standards of the Federal Aviation Authority's airworthiness criteria.

The NATFIBIO consortium project focuses on the development of natural fibre-thermoset composites for use as secondary structures in aircraft.

3: With the CSIR-developed barrier technology, food and beverages previously packaged only in glass or cans, can now be stored in PET or polypropylene.

Barrier technology to extend product shelf life

Food and beverages that spoil when exposed to oxygen, or because of loss of carbon dioxide, are usually packaged in glass containers or cans to ensure maximum shelf life. Storing these foodstuffs in plastic containers would lead to significant advantages, including a smaller carbon footprint when compared with conventional glass and metal packaging as less energy is used for manufacturing.

Researchers at the CSIR have developed a barrier technology that extends the shelf life of products in PET (polyester, the material used e.g. for packaging carbonated soft drinks) by up to 30 times; and those in polypropylene containers by up to 125 times. The coating, when applied to the outside of packaging, significantly reduces the penetration of oxygen and loss of carbon dioxide through the plastic. This means that foodstuffs that are currently packaged in cans or glass because of their sensitivity to oxygen, can now be safely packaged in PET or polypropylene.

The technology successfully passed the food contact notification process of the US Food and Drug Administration for indirect food contact. This is an internationally-recognised requirement for applying a packaging technology in the food and beverage sector. The technology has been licensed to a Canadian manufacturer for a number of territories internationally, while in South Africa trials are underway with a number of local manufacturers.

1 & 2: **Development of the South African essential oils sector (for example *Lippia javanica*, buchu, rose geranium and lemon grass) and medicinal plants (for example African ginger, *Perlagonium sidoides* and milk thistle) involve the establishment of sustainable community-based enterprises across the country. Three sector-level projects involve the development of a management information system using telemetry.**

Enterprise creation for development alleviates poverty

The CSIR pilots projects in different areas of the country to determine the best areas for plant cultivation. The information gained through such pilot studies informs decisions on crop selection when planning enterprise creation projects in specific areas in the country where communities have access to land and water for irrigation.

As part of developing this sector, pilot studies to support and stimulate innovation in the essential oil and medicinal plant sector are also undertaken. In expanding this sector, the development of some 20 essential oil and medicinal plant projects was undertaken in underdeveloped areas across the country. Approximately 300 beneficiaries were employed in these projects, which also involved the transfer of CSIR and externally-sourced technology. Collaborators include researchers at universities and research councils with the aim to transform new product concepts into herbal medicine.

During 2008/09, the CSIR piloted the cultivation of Sutherlandia, German chamomile, Elephantorrhiza elephantine (BP5) and Devil's claw. All pilots showed promising results and will either be continued or moved into full-scale cultivation during the coming financial years.

To further aid farmers in these sectors, the CSIR has developed a system that allows scientists to provide custom-tailored advice to medicinal plant and essential oil farmers on their designated sites without physically visiting the sites. The telemetry system developed in partnership with the University of Pretoria was successfully rolled out to 11 enterprises around the country.

Value of plantation wood base improved

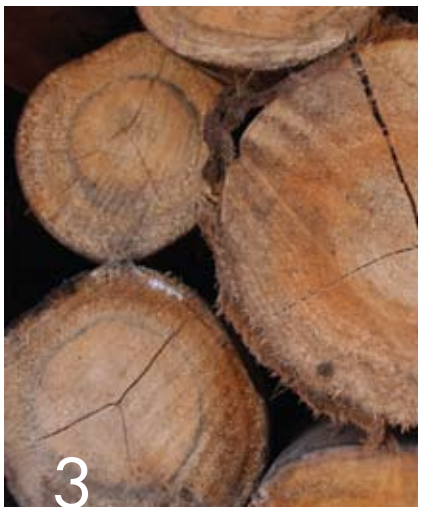
CSIR research is contributing towards transforming the plantation wood base to a higher value at local and international level, through the successful development of genetically improved *Eucalyptus grandis* seed.

The improved seed will produce trees with lower log-end splitting and less brittle wood characteristics, making it ideal for a more competitive hard wood market. The value of high quality veneer wood is approximately four times that of pulp wood. Brittle wood and log-end splitting cause significant losses to the veneer and saw-timber industry.

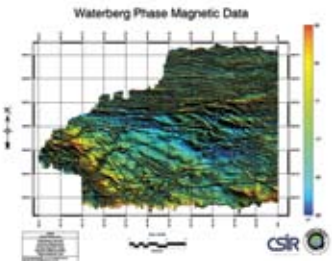
The genetically improved trees are also fast growing, disease tolerant and have a higher wood density than the standard source. This kind of research and technology transfer is essential for an industry faced with climate change, increased fire and pest risk, and limited land availability for forestry.

Established in 2003, the public-private partnership between the CSIR and Northern Timbers developed into a dedicated *Eucalyptus grandis* clonal seed orchard for solid wood products. Seed orchards are a means of mass producing genetically improved seed for industry use by allowing selected trees to cross naturally.

The seed orchard is now in commercial production and approximately 11 million genetically improved trees resulting from this project were planted in the past year, mainly in Swaziland and Uruguay. Genetically improved seed (for research and for commercial production) have also been exported to countries such as Argentina, Australia, Brazil, Hawaii and Paraguay.



3 & 4: **The CSIR's forestry research teams are uniquely placed to improve wood and fibre quality from the genetic level to the final product. Research focuses on genetic improvement and understanding the chemistry, biology and mechanics of trees to contribute to the forestry and forest products sector in South Africa.**



1: This image captures the magnetic fields in the Waterberg coal fields. It was obtained using airborne geophysics and is used to unravel the unknown structure of the Waterberg to help plan mining activities.

Waterberg structure determined for future coal

Through its research, the CSIR has helped map the structure of the Waterberg coalfield. This will enable industry to estimate more accurately the amount of coal that can be mined in the area. The need to mine other areas to sustain the coal industry has become increasingly important as coal mines in South Africa, especially in the Highveld area, are becoming depleted.

The Waterberg coalfield is said to have the capacity to host eight power stations and should have enough reserves to mine for the next 150 years. However, the estimates are based on sparse information, and need to be improved.

Scientists have interpreted airborne magnetic and radiometric data, and acquired additional airborne data, to produce the first detailed structural map of the coalfield.

This structural map is the first step to unravel the unknown structure of the Waterberg area and will help industry to locate, plan and design mines effectively. It also informs strategic decisions about the location of new power stations and other infrastructure, and increases the knowledge about the next important source of energy for South Africa.

AziSA (an isiZulu word meaning 'to inform') – is a set of recommendations for a standardised methodology and protocol to communicate and monitor, allowing improved and safer operations in the mines. It was developed as a tool to help the mining industry facilitate data acquisition and underground control through the introduction of a number of standards.

Safer mines through risk identification

Researchers at the CSIR have developed innovative instruments that can improve working conditions for mine workers and save their lives.

When miners enter a working place after a blast, they first make sure that the place is safe. As part of that inspection, they determine whether there are loose rocks in the roof by tapping, or *sounding*, the rocks. Loose rocks are then pulled down or *barred*.

As part of an AziSA framework, an acoustic sensor was developed to enhance the miners' assessment of the sounding of the roof. The sounding device is 'trained' to respond exactly as an experienced miner would.

The miniature device is attached to the miner's helmet and produces a red light and an audible warning if the sounding of a piece of rock shows it to be loose. A green light results if the sound is recognised as coming from a solid and stable part of the rock mass.

Twenty of these sounding devices have been distributed to mines for testing and evaluation. The CSIR is in discussion with external parties to facilitate the commercialisation of the device.

As another tool in the AziSA suite, the CSIR is currently researching a thermal sensor that can also give an indication of whether rocks are loose. The thermal sensor determines whether a piece of rock is cooler than those surrounding it because it is less well coupled to the host rock, and more susceptible to cooling by passing ventilation air.

Waking up to fatigue management: CSIR-developed guidelines

The risk of fatigue is inherent in any work-time arrangement involving shift work, long, irregular or extended work hours, and work that is physically or mentally demanding, repetitive or requires high vigilance.

The CSIR has conducted studies in the mining industry to develop guidelines on how to manage fatigue. These guidelines are based on international and local best practice and can help the industry to address the issue holistically. The management of fatigue is not simply a matter of correct shift scheduling: a more comprehensive approach is needed.

The guidelines are intended to raise awareness of work-related fatigue and to provide advice that is generally applicable to any workplace in the South African mining industry, where fatigue is an occupational health and safety issue. They are aimed at employers, managers, employees, health and safety representatives, and mine medical practitioners.

Topics covered in the guidelines include general aspects of fatigue, the development of a fatigue management plan, factors to consider when managing fatigue, tools and techniques for estimating risk associated with shift patterns, operator fatigue detection technologies, employee functional assessments and medical evaluations, as well as practical advice to shift workers.

2: In the South African mining industry, fatigue is an occupational health and safety issue. The CSIR is developing guidelines on how to manage fatigue.

Consulting services aid mine safety

The CSIR offers consulting and analytical services as part of its business-orientation towards harnessing the full potential of its research output. This is done by rapidly expanding the impact of research deliverables to a wide footprint of beneficiaries. Mine safety training is one of the consulting services offered. Highlights during the past financial year include:

- Some 160 000 self-contained self-rescuers (SCSR) were deployed in underground mines in South Africa. SCSRs provide the wearer with a supply of breathable oxygen. Together with refuge bays, defined escape routes and mine rescue teams; SCSRs form an integral part of a mine's escape and rescue strategy.

  The CSIR is the only accredited testing authority in South Africa that can monitor their function and performance, and is recognised as an international benchmark.

- 4 799 miners were trained about the risks presented by methane and coal dust underground. These mine explosion and fire awareness seminars were specifically developed by the CSIR for coal and hard rock miners. After participating in the seminars, miners recognise these dangers and are better able to reduce the risk of methane and methane/coal dust explosions underground.

1 & 2: Some 160 000 self-contained self-rescuers (SCSR) were deployed in underground mines in South Africa.

New robotic manufacturing arm constructed

CSIR researchers have constructed a new type of 'robotic manufacturing arm'. It is a lighter, faster and more accurate arm with the potential of increasing productivity.

The aim of the project is to construct a hybrid solution, combining the best aspects of both serial and parallel technologies and demonstrating a novel mechanism for manipulating payloads.

Robotic manipulators are a central part of high-tech industries where they are used for operations such as component assembly, welding, cutting and spray painting. Most robots used for industrial manufacturing have articulated arms equipped with serial technology where, for instance, the motors in the 'wrist' have to be carried and moved by the motors in the 'arm'. This means that the motors furthest removed from the payload have to work very hard to move the entire arm.

In this new innovation all the motors are mounted in the base of a robotic arm and a mechanical construction translates the motor actions into arm movements.

The project is co-sponsored by the Advanced Manufacturing Technology Strategy.

3: Mechatronics is the science of combining principles of software, electronics and mechanical engineering to produce efficient systems. In this picture, a mechatronics research team is seated around an omni-directional robot.

Advances in scientific infrastructure

SA's cyberinfrastructure boosted through supercomputers

South Africa's three primary pillars of cyberinfrastructure in the National System of Innovation consist of the Centre for High Performance Computing (CHPC), the South African National Research Network (SANReN) and the proposed Very Large Data Sets (VLDS) initiative. These will support high performance computing; advanced data acquisition; storage, management and analysis; visualisation and other computing and information processing services over the internet.

The CHPC forms part of the Meraka Institute of the CSIR and is funded by the Department of Science and Technology. The centre hosts and manages supercomputers for the South African research community as well as computational platforms ranging from clustered systems to shared memory processors that help solve different kinds of computational problems. It is currently supporting 10 flagship projects involving a range of universities and research institutes.

One such flagship is the Blue Gene®/P system. Launched in 2008, the Blue Gene for Africa (BG4A) initiative at the CHPC marked a significant milestone in South Africa's expanding cyberinfrastructure. The system is capable of 14 trillion individual calculations per second and is five times more powerful than the fastest research computer currently on the African continent. This donation by IBM has given impetus to the BG4A initiative, which has three interlinking thrusts: infrastructure; promoting collaborative science with a major impact on the African continent; and building of high-end computing capacity in Africa.

Through these advances in cyberinfrastructure, a number of societal benefits are being realised, as evidenced by, for example, the HIV and climate change modelling projects. JOULE, South Africa's first battery electric engineering car, has also utilised the CHPC's supercomputing facilities. The successful bid for the international radio telescope project, Square Kilometre Array, is critically dependent on efficient cyberinfrastructure to respond to demand on high throughput computation and manipulation of telescope images and dissemination to the rest of the world.

Other applications include research on plant genomics to improve the human health-promoting properties of food crops, or to make crops more resistant to drought or disease. In addition, the CHPC, in collaboration with a number of universities, is exploring applications such as modelling in agriculture, energy, information analytics and complex systems.

1: The Blue Gene®/P system is capable of 14 trillion individual calculations per second, and is five times more powerful than the fastest research computer currently on the African continent, the Blue Gene/L in Egypt. Potential projects to benefit from this initiative are environmental simulations, plant genomics and agricultural modelling, energy, information analytics and complex systems modelling.

Milestones in roll-out of high-speed research network achieved through SANReN

SANReN is the South African National Research and education Network that has been designed to provide all universities and research institutions with low cost information and communications technology connectivity. It is funded by the Department of Science and Technology and implemented by the CSIR's Meraka Institute.

Its purpose is to provide South African researchers with access to a high speed and dedicated research network. In line with international best practice, this network will enable researchers to participate fully in global research consortia and enhance multi-media educational capacity.

The goal is to link all research activities and institutions with an affordable network. Beneficiaries include universities and organisations such as the CSIR, Mintek, the Human Sciences Research Council, iThemba Laboratories, the Medical Research Council, and the Agricultural Research Council. In astronomy, the Southern African Large Telescope and Karoo Array Telescope projects, which demonstrate South Africa's ability to deliver the requirements for the Square Kilometre Array bid, will also benefit from SANReN.

The longer-term benefits of SANReN include human capital development, which will lead to increased economic activity in South Africa and the region.

After considerable research into network design and due diligence studies conducted with major metros countrywide and telecommunication companies, a master plan for SANReN was devised. This plan envisages 10 Gbit/s rings in major metros linked to each other by a 10 Gbit/s national backbone. Individual institutions will be linked either to the metro rings or by spurs off the national network.

Early successes for SANReN were the first four research sites to go live in Johannesburg, namely the main campuses of the University of the Witwatersrand, the University of Johannesburg and two of its satellite campuses. Subsequently, a connection between the Hartebeesthoek Radio Astronomy Observatory and the CSIR Satellite Applications Centre has been put in place. The CSIR's Cluster Computing Centre (C4) is also connected to SANReN.

The main focus for 2009 will be to establish the national network and to roll out SANReN in the Cape Town, Tshwane and Ethekwini metros.

New X-band antenna bolsters satellite tracking capabilities

An investment of R22 million in a state-of-the-art X-band antenna has bolstered the capacity of the CSIR Satellite Applications Centre to track more earth observation satellites and increase its archive of earth observation data. This expansion of the existing infrastructure at Hartebeesthoek represents its proactive commitment to support the establishment of space-related infrastructure.

The CSIR is now in a position to acquire additional valuable data to support national, regional and global priorities. This investment will also support the priorities related to the formation of the South African national space agency.

While the X-band antenna was imported from France, the civil engineering and construction was done locally and the antenna was installed by a French team working with CSIR engineers. It is fully automated and capable of carrying most of the earth observation workload, when needed.

In another highlight, the CSIR Satellite Applications Centre supported a total of 22 launches successfully in 2008/09. This is 40% more than previous years. Its KU-band workload was put to the test for the greatest part of these launch supports.

In an historic scientific event in March 2009, NASA's Kepler mission received a helping, albeit remotely located, hand from the CSIR. The Kepler mission is a space telescope designed to discover Earth-like planets orbiting other stars.

Given the timing and trajectory of the launch vehicle, United Launch Alliance contracted the CSIR to provide launch support from Australia. The team contracted a local mobile launch support team from Overberg Toetsbaan. Kepler was launched from Florida on 7 March 2009, and tracked by the CSIR from Tennant Creek in Australia's Northern Territory.

Initial reports from NASA have indicated that all is well onboard the Kepler satellite.

1: The CSIR Satellite Applications Centre supported a total of 22 launches successfully during the past financial year – 40% more than previous years.

Coastal and hydraulics infrastructure upgraded

Continuous investment by the CSIR in its coastal and hydraulics facility in Stellenbosch has reinstated this infrastructure as a world-class facility. Technology R&D is undertaken on innovative methods in coastal engineering, leading to effective monitoring of harbour and coastal structures. All breakwaters and most coastal structures in South Africa are now being monitored by the CSIR. Prototype data are used to calibrate the physical models.

The facility boasts a unique physical model hall, used extensively in port and coastal engineering. Not only is the hall singular in its size and complexity in South Africa, but the modelling system developed by the CSIR has been used successfully for international projects and adopted by peers abroad. Research includes investigating hydraulic stability of coastal structures, moored ship response, ship manoeuvring capabilities, wave penetration, and river and dam modelling.

The hive of activity in the model hall has led to human capital development, attracting civil engineers from Stellenbosch University to choose related topics for their engineering projects and thesis work for BSc and MSc degrees. The purchase of new equipment has allowed the CSIR to provide a platform for new research projects and maintain a leading edge in the field.

1: Dolos models are used for modelling breakwater structures to protect ports and harbours.

Super-resolution microscope helps see single molecules

A new super-resolution microscope is helping the advancement of synthetic biology research. During the year under review, CSIR researchers assisted technical specialists from the international manufacturers with its customised set-up. The new microscope has two state-of-the-art, highly sensitive cameras. It has a confocal spinning disk unit as well as a total internal reflection fluorescence microscope, which help localise biological molecules with super-resolution at the single molecule level. A Nikon inverted confocal microscope has also been acquired.

The ability to see detailed structures at the level of single molecules within cells, will help researchers in the quest to identify and track metabolic processes and pathways. This information aids them in understanding cellular mechanisms that are not fully understood. Also, the information gathered assists researchers in designing new assays and methods in combating diseases such as malaria, HIV and cancer. Further to this, new drugs can be developed to target components and molecules in the cell that affects its ability to fight infection.

This investment is one of several investments by the Department of Science and Technology (DST) in the synthetic biology domain over the past two years. Other investments include a versatile separation system, a first of its kind in Africa, allowing researchers to perform analytical, as well as preparative high performance liquid chromatography (HPLC) in one system.

First-of-its-kind experiment in Africa at femtosecond research facility

Femtosecond science research is a long-term programme at the CSIR aimed at developing world-class expertise and facilities in this new field. This field of research utilises laser systems that delivers extremely short pulses with high peak intensities. One of the advantages of such short pulses is that they are so short that they can be used to measure extremely fast processes, for example very fast biological and chemical processes.

The CSIR's continued investment in its femtosecond research infrastructure, this year made possible a first-of-its-kind experiment in Africa in which laser scientists focused on 'coherent control', which involves the use of coherent excitations, using a femtosecond laser, to control matter. Their ultimate goal is to rearrange a molecule into new compounds by using only light. This experiment formed part of a successful feasibility study conducted for an industrial client interested in obtaining an improved understanding of one of its chemical processes.

1: The Department of Defence contributed to infrastructure improvements to the CSIR wind tunnel complex.

Wind tunnel measurements upgrades, IT systems keep SA at the edge of supersonic tests

The CSIR boasts the largest and best-equipped wind tunnel complex on the continent. To keep the facility at the cutting-edge, the control, measurement and IT systems were upgraded in the year under review.

Winds at supersonic speeds are generated within these facilities to, for example, simulate the conditions in which aircraft fly. World-class instrumentation and measurement capabilities empower researchers to test and evaluate various facets of the aircraft's performance.

The complex comprises seven wind tunnels and a water tunnel, varying from the general purpose, large 7 m low-speed wind tunnel, to the smaller aeronautical high-speed wind tunnel with a test and evaluation capability of 4,5 times the speed of sound.

The facility's track record includes tests on aircraft such as the Mirage F1, Impala, the Cheetah and the recently acquired Gripen.

Super-powered equipment to characterise structures at molecular levels

The CSIR now houses a 600 MHz nuclear magnetic resonance (NMR) instrument that enables researchers to characterise the structures and molecular dynamics of isolated compounds, such as extracted plant material or parts of a protein.

The NMR operates as a very sophisticated radio, by making use of varying radio frequencies, which then interact with the nuclei of atoms in sample material placed inside the magnet housing. This housing contains a superconducting magnet, which generates a force field 300 000 times stronger than the magnetic field of the Earth.

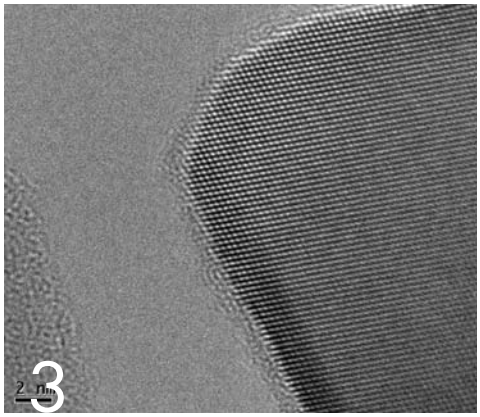
The machine was purchased by the University of South Africa and is located in a custom-built, reinforced facility at the CSIR as part of a memorandum of agreement between the two parties to pursue collaborative research and skills transfer in the field of biotechnology. Access to this equipment improves the ability of South African researchers to compete with leading international counterparts in biotechnology.

Macro investment in nano science

In one of the latest infrastructure developments at the National Centre for Nano-structured Materials (NCNSM), a transmission electron microscope to study nanostructures at atomic level, was taken into use. The 200 kV Transmission Electron Microscope is crucial for researchers' ability to understand materials.

The NCNSM is involved in the discovery of new materials and material properties at the nano-scale level, leading to the development and application of new nano-based products and processes. It focuses specifically on the design, modelling, synthesis, characterisation and fabrication of new and novel nanostructured materials with specific functional properties and various possible applications, including energy.

The centre supports the South African research community with a one stop nanoscience characterisation solution. The facility is open to all research groups, including industry.



2: **The newly acquired Transmission Electron Microscope.**

3: **Shown here are silicon nanoparticles, with the black 'dots' being individual atoms in the crystal.**

4: **The CSIR's National Centre for Nano-structured Materials.**

1: The new robotic arm is able to grasp target objects of different sizes, shapes and orientations beyond human capability.

Intelligent field robotics sees continued investment in infrastructure

The CSIR continued to invest in research infrastructure that will see advances in the use of mobile robots that operate in an unconstrained and dynamic environment. One such example is the use of robots in the mining sector, where conditions are hazardous for humans.

The year under review saw the acquisition of a whole arm manipulator robotic arm; a multifingered programmable grasper with the dexterity to secure target objects of different sizes, shapes and orientations even beyond human capability. This robotic arm outperforms conventional manipulator robots given that it is adaptable to objects scaled for human grasping, such as hand-held tools.

New mechatronics lab stimulates innovation

A new mechatronics laboratory has been set up at the CSIR. The investment provides engineers and researchers with the perfect environment in which to explore mechatronic applications researched within the CSIR.

Mechatronics is a field that brings together four disciplines, namely computers and electronics, mechanical and control systems. It has applications in fields as wide as manufacturing, consumer products, materials processing and defence systems to the automotive, aerospace and medical industries.

The laboratory houses a variety of equipment for electronic and mechanical work. For electronic work, a number of electronics test benches have been equipped with all the standard test instrumentation and light production tools. Through a National Research Foundation grant, the lab will now also have a coordinate measuring machine – a movable arm fitted with a laser probe. This machine will be used for the measurement of mechanical shapes.

A laser cutting machine for the cutting of sheet plastics and wood for quick prototype constructions, and a small milling machine, capable of making quick circuit board prototypes, are also housed in the new lab.

Pronunciation dictionaries in official languages pave the way for access to information

The CSIR's human language technology (HLT) group has developed groundbreaking speech technologies for all 11 official South African languages.

These technologies have been incorporated into the Lwazi telephony platform, a speech-driven information service aimed at providing access to government information in all official languages.

The development includes the release of electronic pronunciation dictionaries, which are critical resources for building text-to-speech (TTS) and automatic speech recognition (ASR) systems. These dictionaries can also be used in numerous other speech technologies, as they provide the required mapping between the written word, and the sounds used to pronounce it.

For the first time ever, the CSIR now has TTS voices for all of the official languages. The TTS system was designed and developed in-house with the explicit goal of easing multilingual speech synthesis. It benefits from research into the efficient rapid development of such systems.

Lwazi, a Department of Arts and Culture-funded project, is built on the open source Asterisk PABX (private automatic branch exchange) and integrates TTS and ASR.

Enhanced ICT portal for disabled persons

The release of the latest version of the National Accessibility Portal (NAP) presented a significant step forward in the drive to integrate persons with disabilities into the mainstream economy and society through the use of ICT.

The NAP R&D initiative addresses the ICT needs of persons across the entire spectrum of disability and their marginalisation from the mainstream economy and society. This initiative was conceptualised and developed by the CSIR's Meraka Institute in partnership with a representative group of disabled persons' organisations and national government through the office on the Status of Disabled Persons in The Presidency.

The latest NAP version contains a number of new features and additional functionality, most notably the inclusion of South African Sign Language (SASL) on the interface, which aids the navigation process for the Deaf. It also provides information through other modalities, specifically an SMS-based query facility *via* the mobile phone, as well as an interactive voice response system *via* the telephone. Substantial research went into the optimisation of the downloading process and the information conveyed in the Sign Language videos. The new version also includes expanded links to employment agencies dealing specifically with job opportunities for persons with disabilities.

In addition, improved communication is facilitated through the addition of messaging between users. Community inclusion and interactivity have been enhanced through added functionality such as 'Share on Facebook', 'Add NAP feed to your Facebook profile', 'Email to a friend', 'NAP messaging to a friend' and 'Discuss this Content'.

CSIR outputs

Contributing to the global knowledge pool

Worldwide, the research paradigm is in the process of expanding into e-research and open scholarship. This implies new ways of collaboration, dissemination and re-use of research results, specifically *via* the web. Online research output repositories – although not yet fully networked in a coordinated way – have become an important vehicle through which South African collections could be made accessible to the rest of Africa and ultimately, the rest of the world.

The CSIR's institutional repository of research publications – Research Space launched in August 2007 – remains the only open access, online repository by a South African research council.

Highlights during the past financial year include an increase in the number of research items accessible from the repository to 2 424, the introduction of a structured quality control system and requests for the CSIR to supply case study information for conferences locally and in New Zealand.

In a quest to disseminate its output as wide as is possible, the CSIR contributes its repository content to a variety of international harvesting services. As a result, the CSIR currently serves on the Board of the WorldWideScience.org initiative – an international science gateway (see http://worldwidescience.org/).

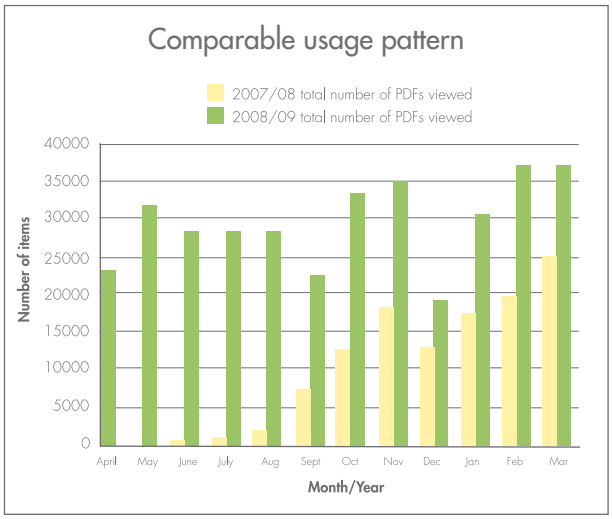
Furthermore, the organisation has contributed to institutional repository training to some 120 South African librarians.

Because of this exposure, the CSIR was invited to co-present a seminar and deliver a conference paper on the challenges of adhering to copyright requirements when managing an institutional repository at an agricultural information conference in Accra, Ghana, in July 2009.

The number of items downloaded from Research Space increased from 113 327 in 2007/08 to 340 616 in 2008/09. A monthly comparable usage pattern for the past two financial years (since June 2007) follows below. On average, 20 000 articles are downloaded from the repository per month.

The CSIR's publication equivalents also increased significantly from the previous financial years, demonstrated by the table below. The following pages list research published in 2008.

View http://researchspace.csir.co.za/dspace



Publication equivalent data

Year	External publications for which publication equivalents are assigned				Other external publications			Total publication equivalents
	Articles in accredited journals	Conference papers (Peer reviewed)	Books	Book chapters	Journal articles (Other)	Conference papers & presentations (Other)	Books	
2006/07	129	115	2	27	43	250	0	220.0
2007/08	180	202	12	50	31	136	0	343.0
2008/09	208	393	9	38	69	228	5	451.5

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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 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 in which 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, Act 46 of 1988, as amended by Act 71 of 1990, the appointment of the CSIR Board is by the Executive Authority, the Minister of Science and Technology. The Board provides strategic direction and leadership, determines goals and objectives of the CSIR, and approves key policies, including investment and risk management and reviews. It also approves financial objectives, plans, goals and strategies. 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), Act 1 of 1999, as amended by Act 29 of 1999.

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

Shareholders Compact

In terms of the 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.

This is annexed in the shareholders performance agreement (Shareholders 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.

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 (GAAP).

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 GAAP and International Standards of Auditing. The Auditor-General's terms of reference do not allow for any non-audit work to be performed.

Risk management

The CSIR Board is accountable for the process of risk management, which is reviewed regularly for effectiveness. Appropriate risk and control policies are established and communicated throughout the organisation. The CSIR Board retains control through the final review of key risk matters affecting the organisation.

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 report and financial statements.

A structured process of risk management has been put in place to ensure that the growth and development of human capital, strengthening of the science, engineering and technology (SET) base, operational excellence and financial sustainability will be achieved and maintained.

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: research; business; fraud; safety, occupational health and environmental management; operating and financial management.

Documented and tested processes are in place, to allow the CSIR to continue its critical business processes in the event of a disastrous incident impacting on its activities.

Research risk management

The Group recognises that research has to be conducted in compliance with the existing legal framework, aligned to CSIR strategies and in accordance with the standards and practices that would ensure outputs that support the CSIR's mandate.

In order to mitigate research-related risks, the CSIR has an established *Good Research Guide* and institutional governance structures such as the research and development (R&D) core management function, the Strategic Research Panel (SRP) and the Research Advisory Panels (RAPs). In addition, projects that require reviews from a research ethics perspective are submitted to the Research Ethics Committee of the University of Pretoria.

The CSIR is in the process of establishing its own Ethics Committee.

Business risk management

The organisation has effective mechanisms in place for identifying and monitoring risks that impact on the CSIR Group. The procedures for implementing the Group's business risk management process include a focus on areas such as human capital assessment and development, technological development and business continuity.

Fraud risk management

The objective is to manage the fraud risk and to raise the level of fraud awareness among the CSIR's internal and external stakeholders. The CSIR's fraud prevention plan intends to reduce the risk of fraud and provide contingency plans that will protect the interests of the organisation. The proactive approach consists of the responsibility for, prevention, detection, reporting, communication and reaction to fraud.

Safety, occupational health and environmental management

The CSIR is committed to the promotion of environmental, health and safety principles and practices to create a safe and healthy environment for all and to meet the requirements of all safety legislation as a minimum standard. This commitment is depicted in two ways: in the manner it serves business as a supplier of environmental management-related products, and in the way it demonstrates sound environmental practices at all CSIR sites.

Operating risk management

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

Financial risk management

Financial risks are managed within predetermined procedures and constraints as identified and detailed in the various policies and the setting of annual goals and objectives. Controls are designed to give assurance that assets are safeguarded and that liabilities and working capital are managed effectively. Organisational policies, procedures, structures and approval framework provide for segregation of duties and contain self-monitoring mechanisms. Compliance is measured through regular reporting against the business goals, internal audit checks and external audit verification.

Going concern

The CSIR Board has reviewed the Group's financial budgets for the period 1 April 2009 to 31 March 2010 and is satisfied that adequate resources exist to continue as a going concern for the foreseeable future. The CSIR Board confirms that there is no reason to believe the business will not be a going concern in the year ahead.

Internal control

The CSIR Board has ultimate responsibility for the system of internal controls. The key controls required to 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 financial 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.

Approval framework

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 and acquisition and disposal of assets. 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.

Each subsidiary company's board of directors has adopted an approval framework, which mirrors that of the CSIR. All subsidiary companies are under the control of the CSIR Board and CSIR Executive Management Committee.

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 quarterly staff sessions, formal induction programmes, technical and strategic focus groups and task teams.

Code of ethics and organisational values

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

Governance structure

CSIR Board

The responsibilities of the Board are governed by the Scientific Research Council Act.

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.

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 13 August 2008, 25 September 2008, 27 November 2008 and 19 February 2009. The Annual Financial Statements for the 2008/09 financial year were approved on 6 August 2009.

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 110 and 111). These committees are selected according to the skills sets required for the committees to fulfil their functions. For the 2008/09 year, the committees complied with their respective terms of reference.

A new CSIR Board was appointed by the Executive Authority with effect from 1 January 2009.

Schedule of attendance at CSIR Board and CSIR Board Committee meetings (1 April 2008 - 31 December 2008)

Board member	Board meetings (3)	Audit and Risk Committee (1)	Human Resources and Remuneration Committee (3)	Strategic Review Committee (1)
Ms N Shikwane (Chairperson)	3	1	3	
Professor C de la Rey	2		3	3
Dr N Dlamini	2		3	
Professor DR Hall	1		1*	1
Mr E Mayet	3	1	1*	
Dr N Msomi	1		1	2
Professor FW Petersen	2	1		3
Dr S Sibisi	3	1	3	3
Professor MJ Wingfield	2			3

* Invitation to the meeting on 26/06/08 was open to all Board members. Both Mr E Mayet and Professor D Hall attended.

Schedule of attendance at CSIR Board and CSIR Board Committee Meetings
(1 January 2009 - 31 March 2009)

Board member	Board meetings (1)	Audit and Risk Committee (1)	Human Resources and Remuneration Committee (0)	Strategic Review Committee (1)
Professor FW Petersen (Chairperson)	1			1
Mr N Behrens	1			
Professor DR Hall	1			
Mr A Knott-Craig	1			
Mr M Sibanda	1	1		
Dr S Sibisi	1	1		
Mr M Silinga	1			
Ms KL Thoka	1			
Professor MJ Wingfield	1			1

Executive Management Committee

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

- Chief Executive Officer: Dr Sibusiso Sibisi
- Group Executive, Operations: Dr Hoffie Maree
- Group Executive, R&D Outcomes and Strategic Human Capital Development: Khungeka Njobe
- Group Executive (Interim), Research and Development: Dr Thulani Dlamini
- Chief Financial Officer: Chris Sturdy
- Group Executive, Services: Raynold Zondo.

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 and centre management.

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

Board of directors of Group companies

The CSIR Executive has control over the boards of the various subsidiary companies.

Board and executive management remuneration

Details of the CSIR Board are set out on pages 108 and 109 of the Corporate Governance Report. The membership and terms of reference of each Board Committee are further described on pages 110 and 111.

Remuneration to Board Members and the Executive Management is set out in Note 19 to the Annual Financial Statements.

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 and the evolution thereof.

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

Public Finance Management Act

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. The Group complies, in all material aspects, with the Act.

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 54(2) 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 Executive

CSIR Executive team from left: Dr Sibusiso Sibisi, CSIR President and CEO; Chris Sturdy, Chief Financial Officer; Khungeka Njobe, Group Executive: R&D Outcomes and Strategic Human Capital Development; Dr Hoffie Maree, Group Executive: Operations; Dr Thulani Dlamini, Interim Group Executive: R&D; and Raynold Zondo, Executive Director: Services

CSIR Board members

(1 April 2008 - 31 December 2008)

Ms Nobusi Shikwane (Chairperson)
Chief Executive Officer
Tshenolitha Business Services

Professor Cheryl de la Rey
Chief Executive Officer
Council on Higher Education

Dr Nomsa Dlamini
Managing Director
Masifundisane Training and
Development Projects

Professor Denis Hall
Professor of Photonics
Director of SMI

Mr Ebie Mayet
Financial Executive
arivia.kom

Dr Nhlanhla Msomi
Chief Executive Officer
Coast Biotechnology Innovation Centre

Professor Francis Petersen
Dean
Faculty of Engineering & the Built
Environment, University of Cape Town

Dr Sibusiso Sibisi
CEO and President, CSIR

Professor Mike Wingfield
Director
Forestry and Agricultural
Biotechnology Institute,
University of Pretoria

CSIR Board members

(1 January 2009 - 31 March 2009)

Back from left:
Mr Norbert Behrens, Group General Manager: Strategy and Planning, Sasol Limited;
Professor Denis Hall, Professor of Photonics, Director of SMI, Heriot-Watt University;
Mr Pepi Silinga, Chief Executive Officer: COEGA Development Corporation;
Dr Sibusiso Sibisi, CSIR CEO and President

Front from left:
Professor Mike Wingfield, Director Forestry and Agricultural Biotechnology Institute: University of Pretoria;
Mr Mclean Sibanda, Head of Innovation Fund IP Management Office;
Ms Khomotso Thoka, Managing Executive: The Talent Hub;
Dr Alan Knott-Craig, Director of Companies; and
Professor Francis Petersen (Chair), Dean: Faculty of Engineering & the Built Environment, University of Cape Town

CSIR Board committees

2008/2009

Audit and Risk Committee

Members (1 April 2008 - 31 December 2008)

Chairperson Mr E Mayet
Professor F Petersen
Ms N Shikwane
Dr S Sibisi

Meeting: 6 August 2008

Members (1 January 2009 - 31 March 2009)

Chairperson Mr P Selinga
Mr M Sibanda
Dr S Sibisi

Meeting: 12 March 2009

Purpose: Deals with all matters prescribed by the regulations issued in terms of the PFMA. Controls the final reviews of the key risk matters affecting the organisation. Agrees on the scope and reviews the annual external audit plan and the work of the CSIR internal auditors. Acts 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

Members (1 April 2008 - 31 December 2008)

Chairperson Ms N Shikwane
Professor C de la Rey
Dr N Dlamini
Dr N Msomi

Meetings: 26 June 2008
13 August 2008
25 September 2008

Members (1 January 2009 - 31 March 2009)

Chairperson Dr A Knott-Craig
Ms K Thoka
Mr M Sibanda

Meeting: None

Purpose: Provides the vehicle for the CSIR Board to influence and control human resources and remuneration in the organisation. Determines human resources policy and strategy. Approves remuneration changes and bonus payments. In addition, it reviews the remuneration and expenses of the Executive Management.

The Human Resources and Remuneration Committee has adopted formal terms of reference in line with King II Code on Corporate Governance.

Strategic Review Committee

Members (1 April 2008 - 31 December 2008)

Chairperson	Professor C de la Rey
	Dr N Msomi
	Professor F Petersen
	Professor M Wingfield
	Professor D Hall
	Dr S Sibisi
Meetings:	08 May 2008
	26 June 2008
	20 November 2008

Members (1 January 2009 - 31 March 2009)

Chairperson	Professor F Petersen
	Professor M Wingfield
	Mr N Behrens
Meeting:	26 March 2009

Purpose: Provides 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. Ensures 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.

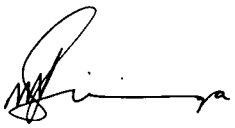
Report of the Audit & Risk Committee

REPORT OF THE AUDIT AND RISK COMMITTEE REQUIRED BY TREASURY REGULATIONS 27.1.7 AND 27.1.10 (B AND C) OF THE PUBLIC FINANCE MANAGEMENT ACT, ACT 1 OF 1999, AS AMENDED BY ACT 29 OF 1999

The Audit and Risk Committee reports that it has adopted the Audit and Risk Committee Charter as its formal terms of reference and that it has discharged all of its responsibilities for the financial year, in compliance with the charter.

The Audit and Risk Committee is satisfied that an adequate system of internal control is in place to reduce significant risks faced by the organisation to an acceptable level, and that these controls have been effective during the period under review. The system is designed to manage, rather than eliminate, the risk of failure and to maximise opportunities to achieve business objectives.

The Audit and Risk Committee has evaluated the Annual Financial Statements of the CSIR Group for the year ended 31 March 2009 and based on the information provided to the Audit and Risk Committee, considers that it complies, in all material respects, with the requirements of the various Acts governing disclosure and reporting in the Annual Financial Statements. The Audit and Risk Committee therefore recommends the adoption of the Annual Financial Statements by the Board of the CSIR.



Pepi Silinga
Chairperson
3 August 2009

Report of the Auditor-General

REPORT OF THE AUDITOR-GENERAL TO PARLIAMENT ON THE GROUP FINANCIAL STATEMENTS AND PERFORMANCE INFORMATION OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE YEAR ENDED 31 MARCH 2009

REPORT ON THE FINANCIAL STATEMENTS

Introduction

1. I have audited the accompanying group financial statements and financial statements of the CSIR, which comprise the consolidated and separate balance sheet as at 31 March 2009, and the consolidated and separate income statement, the consolidated and separate statement of changes in net equity and consolidated and separate cash flow statements for the year then ended, and a summary of significant accounting policies and other explanatory notes, as set out on pages 128 to 173.

The accounting authority's responsibility for the financial statements

2. The accounting authority is responsible for the preparation and fair presentation of these financial statements in accordance with the South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP) and in the manner required by the Public Finance Management Act, 1999 (Act No. 1 of 1999) (PFMA) and the Scientific Research Council Act (Act No. 46 of 1988) and for such internal control as the accounting authority determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

The Auditor-General's responsibility

3. As required by section 188 of the Constitution of the Republic of South Africa, 1996 read with section 4 of the Public Audit Act, 2004 (Act No. 25 of 2004) and section 14(1) of the Scientific Research Council Act (Act 46 of 1988), my responsibility is to express an opinion on these financial statements based on my audit.

4. I conducted my audit in accordance with the International Standards on Auditing and General Notice 616 of 2008, issued in Government Gazette No. 31057 of 15 May 2008. Those standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance whether the financial statements are free from material misstatement.

5. An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the 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 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 financial statements.

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

Opinion

7. In my opinion the financial statements present fairly, in all material respects, the consolidated and separate financial position of the CSIR as at 31 March 2009 and its consolidated and separate financial performance and its consolidated and separate cash flows for the year then ended, in accordance with South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP) and in the manner required by the PFMA.

OTHER MATTERS

Without qualifying my opinion, I draw attention to the following matters that relate to my responsibilities in the audit of the financial statements:

Governance framework

8. The governance principles that impact the auditor's opinion on the financial statements are related to the responsibilities and practices exercised by the accounting authority and executive management and are reflected in the key governance responsibilities addressed below.

Other key governance responsibilities

9. The PFMA tasks the accounting authority with a number of responsibilities concerning financial and risk management and internal control. Fundamental to achieving this is the implementation of key governance responsibilities, which I have assessed as follows:

No.	Matter	Yes	No
Clear trail of supporting documentation that is easily available and provided in a timely manner			
1	No significant difficulties were experienced during the audit concerning delays or the availability of requested information.	✓	
Quality of financial statements and related management information			
2	The financial statements were not subject to any material amendments resulting from the audit.	✓	
3	The annual report was submitted for consideration prior to the tabling of the auditor's report.	✓	
Timeliness of financial statements and management information			
4	The annual financial statements were submitted for auditing as per the legislated deadlines section 55 of the PFMA.	✓	
Availability of key officials during audit			
5	Key officials were available throughout the audit process.	✓	
Development and compliance with risk management, effective internal control and governance practices			
6	Audit committee		
	• The public entity had an audit committee in operation throughout the financial year.	✓	
	• The audit committee operates in accordance with approved, written terms of reference.	✓	
	• The audit committee substantially fulfilled its responsibilities for the year, as set out in section 77 of the PFMA and Treasury Regulation 27.1.8.	✓	
7	Internal audit		
	• The public entity had an internal audit function in operation throughout the financial year.	✓	
	• The internal audit function operates in terms of an approved internal audit plan.	✓	
	• The internal audit function substantially fulfilled its responsibilities for the year, as set out in Treasury Regulation 27.2.	✓	

8	There are no significant deficiencies in the design and implementation of internal control in respect of financial and risk management.	✓	
9	There are no significant deficiencies in the design and implementation of internal control in respect of compliance with applicable laws and regulations.	✓	
10	The information systems were appropriate to facilitate the preparation of the financial statements.	✓	
11	A risk assessment was conducted on a regular basis and a risk management strategy, which includes a fraud prevention plan, is documented and used as set out in Treasury Regulation 27.2.	✓	
12	Delegations of responsibility are in place, as set out in section 56 of the PFMA.	✓	
Follow-up of audit findings			
13	The prior year audit findings have been substantially addressed.	✓	
14	SCOPA/Oversight resolutions have been substantially implemented.	N/A	
Issues relating to the reporting of performance information			
15	The information systems were appropriate to facilitate the preparation of a performance report that is accurate and complete.	✓	
16	Adequate control processes and procedures are designed and implemented to ensure the accuracy and completeness of reported performance information.	✓	
17	A strategic plan was prepared and approved for the financial year under review for purposes of monitoring the performance in relation to the budget and delivery by the CSIR against its mandate, predetermined objectives, outputs, indicators and targets Treasury Regulation 30.1.	✓	
18	There is a functioning performance management system and performance bonuses are only paid after proper assessment and approval by those charged with governance.	✓	

REPORT ON OTHER LEGAL AND REGULATORY REQUIREMENTS

Report on performance information

10. I have reviewed the performance information as set out on pages 119 to 127.

The accounting authority's responsibility for the performance information

11. The accounting authority has additional responsibilities as required by section 55(2)(a) of the PFMA to ensure that the annual report and audited financial statements fairly present the performance against predetermined objectives of the public entity.

The Auditor-General's responsibility

12. I conducted my engagement in accordance with section 13 of the Public Audit Act read with General Notice 616 of 2008, issued in Government Gazette No. 31057 of May 2008.

13. In terms of the foregoing my engagement included performing procedures of an audit nature to obtain sufficient appropriate evidence about the performance information and related systems, processes and procedures. The procedures selected depend on the auditor's judgment.

Finding (Performance Information)

14. I believe that the evidence I have obtained is sufficient and appropriate to report that no significant findings have been identified as a result of my review.

Appreciation

15. The assistance rendered by the staff of the CSIR during the audit is sincerely appreciated.

Auditor-General

Pretoria

27 July 2009

AUDITOR-GENERAL SOUTH AFRICA

Auditing to build public confidence

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 2009.

In the opinion of the CSIR Board, which fulfils the role of directors as envisaged by the Companies Act, Act 61 of 1973, the financial statements fairly reflect the financial position of the CSIR Group as at 31 March 2009 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, Act 46 of 1988, as amended by Act 71 of 1990. The organisation is listed as a Public Business Enterprise in terms of the PFMA, Act 1of 1999, as amended by Act 29 of 1999.

The CSIR mandate

The CSIR's mandate is as stipulated in the Scientific Research Council Act, section 3:

"The objects of the CSIR are, through 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, and to perform any other functions that may be assigned to the CSIR by or under this Act."

Income sources

The CSIR derives income from baseline and ring-fenced grant funding 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 exploits or technology transfer efforts.

Grant funding is spent on research programmes and research infrastructure as well as R&D skills development. Processes, policies and guidelines underpin the effective utilisation of grant funding. A portfolio approach is used to manage the funding and is structured to align with the mandate of the CSIR, priority areas in national strategy and the needs of key stakeholders.

Role in the National System of Innovation (NSI)

The CSIR conducts research across the R&D value chain. This role distinguishes it from tertiary education institutions (TEIs) or public and private sector R&D players (see next page).

The CSIR conducts a degree of fundamental research, but focuses mainly on strategic basic and applied research, technology development or technology transfer and implementation for commercial or social benefit.

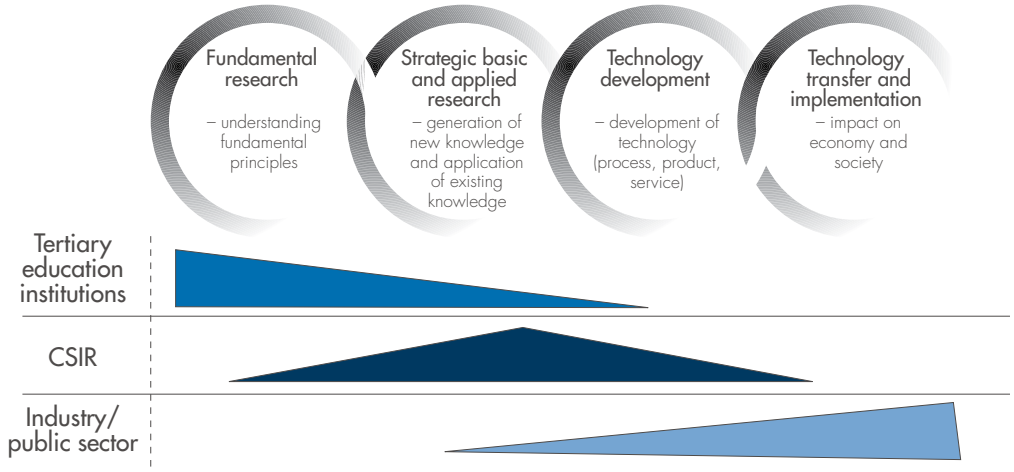
Responding to national imperatives

The CSIR's research agenda is influenced by the National R&D Strategy, the DST's 10 year plan, other key government strategies and the national development agenda. A particular focus is on human capital development (HCD) and national availability of science, engineering and technology (SET) skills.

The CSIR's role at national level ranges from development and implementation of policy at various levels of government to supporting government on matters of service delivery and impact.

The CSIR is directly involved in a number of national imperatives and strategies such as those on employment and sustainable livelihoods, rural development, combating crime and corruption, improving health standards and responsible use of resources.

The CSIR's role within the National System of Innovation (NSI)



As an entity within the NSI, the CSIR annually reflects its contribution to national priorities through a formal Science, Engineering and Technology Institution (SETI) scorecard set by the DST with very specific key performance indicators (KPIs). The CSIR consistently achieves measures of 'outstanding' and 'exceeding stretching targets' in its review ratings. In 2008/09, the CSIR again performed positively against objectives set in its annual Strategic and Operational Plan – evidence of achieving a balance between high standards of science and high standards of corporate governance.

South Africa's national imperatives and global challenges provide the macro-strategic framework within which the CSIR conducts its research. The proportion of CSIR R&D directly supporting national programmes and initiatives has increased by R77 million in 2008/09 to a value of R450 million (or 47% of total contract income) against a target of R375 million. The organisation also supports and actively participates in the New Partnership for Africa's Development (NEPAD).

CSIR R&D themes

The research and development strategy of the CSIR is informed by carefully selected areas of focus referred to as research themes. These themes allow for multidisciplinary and integrative research across the organisation which harnesses the collective capabilities of CSIR research units and centres. Programmes undertaken within these themes allow for research and development across the innovation value chain in a coordinated manner for maximum impact in society, government and industry.

CSIR R&D themes

List of CSIR entities

Category	Entity
Operating units	• Biosciences • Built Environment • Defence, Peace, Safety and Security • Materials Science and Manufacturing • Natural Resources and the Environment • Modelling and Digital Science • Information and Communications Technology (Meraka Institute)
National centres	• National Laser Centre • Satellite Applications Centre
Implementation units	• Consulting and Analytical Services • Enterprise Creation for Development
Emerging research areas	• Mobile Intelligent Autonomous Systems • Nanoscience • Synthetic Biology

Organisational support units form part of a CSIR Shared Services grouping and render transactional or specialist strategic support and administrative services to the rest of the organisation. Portfolio offices such as the Human Capital group and Intellectual Property Management and Technology Transfer Support Unit also exist to coordinate and support strategic priorities.

Organisational priorities

The CSIR's strategy is translated into organisational priorities. Performance is measured both qualitatively and quantitatively, most notably through the KPIs of the DST's scorecard, as mentioned previously.

Organisational priorities have remained consistent over the past few years and have allowed for cumulative performance and entrenchment of strategy. The organisational priorities are as follows:

Priority area:

Building and transforming human capital

To achieve the increased quantity and improve the quality of R&D that is funded and performed in South Africa and called for by the National R&D Strategy, the national shortage of highly qualified scientific and engineering postgraduates is a cause for concern. The CSIR has subsequently put in place a formal Human Capital Development (HCD) strategy and associated programmes to address this concern.

This strategy entered its third year of implementation in 2008/09. The emphasis was on advancing professional development, increasing the numbers of student researchers, black people and women across all SET levels and promoting the upward mobility of SET personnel.

CSIR imperative	Priority area		Main KPIs	2008/09 Target	2008/09 Actual
Building and transforming human capital	Human capital development	Quantity: number of full-time students supported financially	% core PG investment in Master's and PhD studies	16%	14%
			Number of permanent CSIR staff studying towards Master's or PhD degrees	95	201
			Number of studentships supported	150	172
	Human resource management	Quality of CSIR human resource environment	Total size of SET base (number, %)	1 588 (70%)	1 551 (66%)
			% of SET base who are black	53%	53%
			% of SET base who are female	32%	33%
			Number of staff with PhD level qualifications	240	273

SET professional development programmes

- Research and Innovation Core Skills (RICS) Programme for young researchers
- Workshops to assist Master's and PhD students with effective planning and structuring of dissertations
- Training on effective co-supervision of postgraduate students
- Use of Refworks to ease information management in production of research papers
- The number of Chief Researchers, i.e. researchers who have proven themselves nationally and internationally, increased from five to ten
- A new SET leadership programme was introduced
- Career ladders were reviewed and improvements will be implemented in the next financial year.

Pipeline development

- **The Maths & Science Improvement Programme**
  Part of a memorandum of understanding (MoU) with the Denel Centre for Learning and Development, this tuition programme helps 40 learners to improve their science and mathematics results to access university education.

- **The Bursary Programme**
  Of the 37 Honours students supported in 2008/09, 35 qualified for their degrees. In February 2009, bursaries were provided to 67 full-time BSc and BSc Honours students working in fields identified as priority areas by the CSIR.

- **The Internship Programme**
  In 2008/09, 97 BSc and BSc Honours graduates undertook practical experience at the CSIR, including another 17 unemployed science graduates, sponsored by the DST. Eleven were appointed.

- **The Studentship Programme**
  In 2008/09, a total of 172 Master's and PhD students were recruited.

- **Psychosocial support**
  Support is offered to promote the integration of new and young SET staff and to ensure future career growth. The CSIR offers a comprehensive on-boarding process as well as active mentoring and coaching partnerships.

  A CSIR Recruitment Centre was launched in early 2009. The centre allows for streamlined administration, better information management and consistency in procedural compliance. It is set to enhance the CSIR's human resources capability.

The following table shows the staff category over three years:

Staff category	2006/07	2007/08	2008/09
Total staff	2 248	2 260	2 354
SET base	1 490	1 512	1 551
Number of staff with Master's and PhDs	639	678	743
% of staff in SET base	66%	67%	66%
% of black staff in SET base	49%	52%	53%
% of females in SET base	32%	33%	33%

Priority area:

Strengthening the SET base and performing relevant R&D

The CSIR imperative encourages the continual renewal of the SET base and involvement in emerging SET areas. Inculcated in this objective is the need to develop a portfolio that allows the CSIR to generate impact in the first and second economies, improve the quality of life of South Africans, produce SET outputs and demonstrate world-class leadership and innovation.

CSIR imperative	Priority area		Main KPIs	2008/09 Target	2008/09 Actual
Strengthening the SET base and performing relevant R&D	Research and development	S&T resource allocation	Review of Parliamentary Grant, including portfolio analysis	Parliamentary Grant funding deployment conforming fully to objectives of CSIR S&T strategy	All PG projects subject to ex-ante and ex-post evaluation through peer review
			Value of capital investment	R136,4m	R188,3m
		S&T outputs	Publication equivalents	346	451,5
	Strategic research alliances	Activity of research relationships	Number of collaborative R&D activities with a value exceeding R1m	51	79
			Number of collaborative research projects with tertiary education institutes (TEIs)	70	120
	Contract R&D	Quality of contract R&D	Value of contract R&D formally recognised as supporting national strategies	R375,0m	R450,0m
			Customer satisfaction	75%	87%

The CSIR's SET activity is guided by the organisation's R&D strategy as well as SET policies and guidelines. A suite of pertinent policies was approved by the CSIR Board. This includes policies on:

- Research ethics
- Access to data and information resources
- Conduct of research
- Investment of Parliamentary Grant
- CSIR fellowships
- Research alliances.

S&T outputs

The total number of publication equivalents increased by 32% from 343 in 2007/08 to 451,5 in 2008/09. On the basis that the total number of researchers is 722, the publication equivalents per researcher has increased to 0,63, compared to the previous year's 0,43. In 2009/10 the focus is to shift to tracking and improving the quality of publications published in high-impact journals.

Research partnerships

- At the beginning of 2008/09, the CSIR had research collaboration memoranda of agreement in place with five TEIs, namely the universities of Cape Town, Stellenbosch (amended agreements), Johannesburg, Pretoria and the Witwatersrand. An additional four agreements were concluded with previously disadvantaged TEIs, namely the Walter Sisulu University, Tshwane University of Technology, University of Western Cape and University of Fort Hare. A partnership was discussed with the Nelson Mandela Metropolitan University.

- Eighteen projects were implemented through seed funding from the CSIR Cooperation Fund. Twelve of these projects were with previously disadvantaged TEIs.

New research collaborations with international partners

New research activities were initiated with the Global Research Alliance (GRA) and Regional Research Alliance (RRA) partners. The CSIR was a founding member of these alliances. In one example, the RRA launched a project on the impact of mercury on water resources caused by small-scale mining and conducted under the auspices of CSIR Natural Resources and the Environment. The project site was in Botswana and results will be applied in South Africa and Zimbabwe as well. Other domains of collaboration include energy, infrastructure, food security, rural development and infrastructure and mushroom cultivation.

An internal audit of the RRA funds has been completed. There were no audit findings.

With respect to the GRA, the following was achieved:

- Support to DST on a strategy for developing and commercialising innovations on resilience to global environmental change.

- A revised proposal on 'Lifting the Burden of Infectious Diseases' for the Welcome Trust.

- Progress on the Tanga Project investigating the use of medicinal plants to treat symptoms of HIV.

- The low-cost ICT network project was expanded to a second site in Zambia. The CSIR's Meraka Institute and partners in a consortium of African and European research institutions have submitted a proposal for further expansion to the European Union (EU). The Zambian communications authority contributes funding to the project.

- Bilateral relationships with GRA members allow for joint projects and joint project submissions to the EU 7th Framework Programme.

- A CSIR international strategy is being developed with special emphasis on African institutions and guided by the DST's bilateral programme.

Priority area:

Transferring technology and skilled human capital

The CSIR undertakes a range of activities aimed at ensuring that maximum benefit is derived from scientific research conducted for private and public interests.

CSIR imperative	Priority area		Main KPIs	2008/09 Target	2008/09 Actual
Technology transfer and skilled human capital	R&D outcomes	A robust and attractive portfolio of IP and technologies	New international national patents granted	15	35
		An increased rate of technology transfer for both commercial gain and social good	Royalty and licence revenue	R7,9m	R21,0m

Progress in this area includes:

- The Intellectual Property and Technology Transfer Advisory Committee (IPTTAC) held its second and third meetings in the past year, and already contributes significantly to review and evaluation processes.
- A Technology Readiness Level Assessment (TRLA) practice has been introduced to track the progress of technology development and set measurable targets for transfer at specified stages of development.
- The DTI/CSIR Technology Venture Capital programme had a trial run with the intake of the first group of interns.
- The CSIR actively participated in Portfolio Committee hearings on the Technology Innovation Agency and IPR Bill, as well as public hearings on the matter. CSIR recommendations were favourably considered.
- Royalty and licence revenue for the past year amounted to R21,0 million, exceeding a target of R7,9 million.

CSIR IP portfolio performance in 2008/09

CSIR portfolio performance	Achieved
Invention disclosures	49
Number of new technology packages available for transfer	22
Number of new Patent Cooperation Treaty (PCT) applications	11
Number of new agreements signed for commercial/social gain	17

The CSIR has an obligation to ensure the knowledge it generates is disseminated and accessible to society. During 2008/09, CSIR Consulting and Analytical Services provided mine explosion awareness training to 4 799 people from all main mining industries. CSIR Enterprise Creation for Development assisted with ongoing implementation of 20 projects/enterprises, providing employment to more than 435 people in the underdeveloped areas of the country.

A two-day CSIR Research Conference, entitled 'Science Real and Relevant', was held in October 2008 and attracted some 500 interested parties on both days.

Priority area:

Financial sustainability and good corporate governance

Priority area		Main and supporting KPIs	2008/09 Target	2008/09 Actual
Financial sustainability	Operational sustainability	Total income (excluding royalty income)	R1 322,1m	R1 431,7m
		Value of contract R&D	R755,0m	R951,4m
		Net margin before provision for performance bonuses	R52,2m	R140,5m
Corporate governance and responsibility	Corporate governance	Number of significant findings on external audit report	None	None
Corporate citizenship		B-BBEE rating	Level 3 contributor	Level 3 contributor
		Energy consumption	Achieve 1,2% reduction in energy consumption on previous year	Achieved 2,6% reduction in energy consumption on previous year
		Environmental stewardship	Maintain ISO 14001 certification	Maintained ISO 14001 certification
		Disabling injury frequency rate (DIFR)	<0.5 disabling injuries	0.4 disabling injuries

Financial performance overview

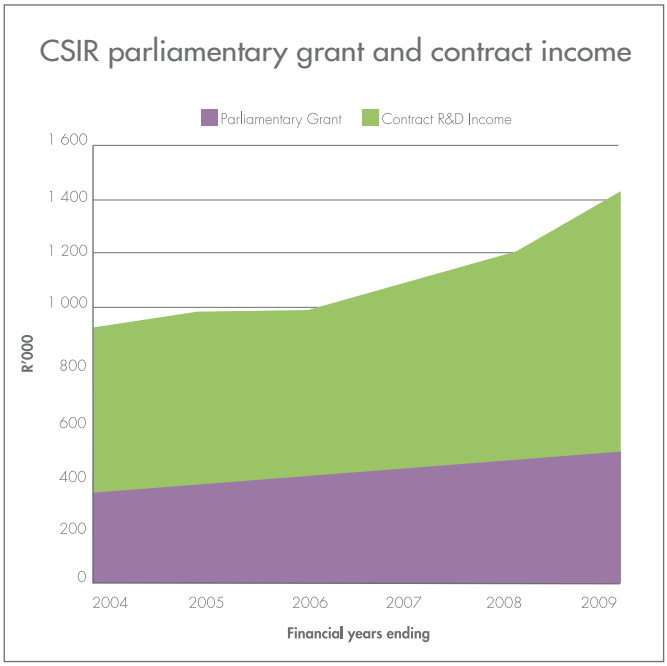
Income

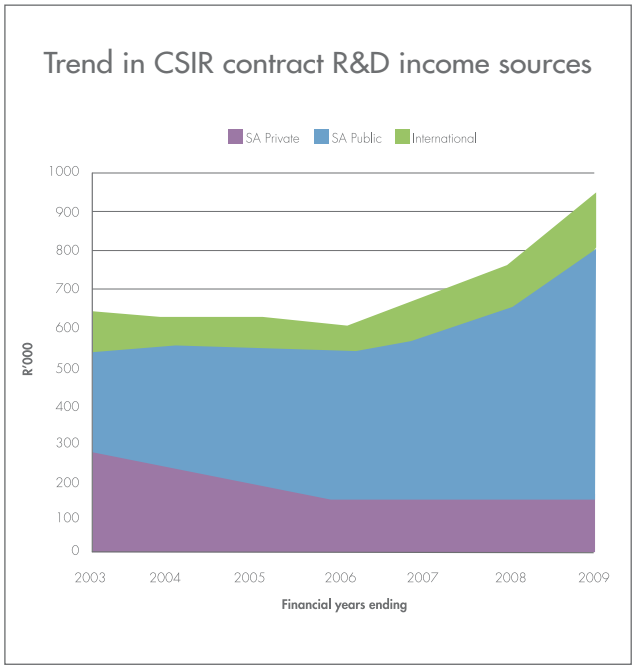
The Parliamentary Grant allocated to the CSIR increased by 7,4% to R477,8 million from the prior year amount of R445 million.

Total contract income increased by 24,2% to R951,4 million (2007/08: R766 million). This includes R104,6 million (2007/08: R59,1 million) ring-fenced funding from the DST.

Income from royalties increased to R21,0 million in 2008/09 from the prior year amount of R9,1 million.

The total operating income of the CSIR increased by 20,8% to an amount of R1 472,3 million (2007/08: R1 218 million).





To recreate an environment within the CSIR that is conducive to scientific research and innovation, without compromising its commercial integrity, the Beyond 60 reconfiguration process came into being as the CSIR approached its 60th anniversary in 2005/06. The CSIR mantra has been one of "sustainable development; sustainable knowledge base; sustainable business". The emphasis has been on securing strategic, larger, multi-year contracts that will also create the potential for human capital development and/or significant impact.

The trend in contract R&D income shows a marked improvement since 2006, especially in terms of income from the public sector, also demonstrating an improved alignment with national strategic priorities. International contract income has also increased. Income from the local private sector gradually declined until 2006 and then stabilised at a low level. To arrest this trend, higher targets for private sector income have now been set.

The CSIR Group operating income for 2008/09 increased by R256,4 million to an amount of R 1 492,7 million (2007/08: R 1 236,3 million), an increase of 20,7%.

Royalty income for the CSIR Group increased by 120,1% to an amount if R36,1 million (2007/08: R16,4 million).

Five-year review of CSIR income and expense indicators

	2009 R'000	2008 R'000	2007 R'000	2006 R'000	2005 R'000
Total income	1 554 910	1 271 062	1 150 467	1 016 104	1 029 932
Parliamentary Grant recognised as income	480 320	429 013	428 055	391 077	356 992
Contract income, royalty income, other income and net finance income	1 074 590	842 049	722 412	625 027	672 940
Local private sector	147 752	137 683	134 647	146 765	187 592
Local public sector	661 682	508 779	435 391	370 892	345 472
International sector (incl. Africa)	142 002	119 584	106 027	82 254	94 291
Royalties and other income	40 516	22 908	17 321	3 412	7 369
Net finance income	82 638	53 095	29 026	21 704	38 216
Operating expenditure	1 495 442	1 219 665	1 125 588	1 047 745	987 348
Employee remuneration	763 867	619 529	579 035	624 202	557 593
Operating expenses	694 435	572 454	496 752	384 157	388 592
Depreciation	37 140	27 682	49 801	39 386	41 163

Net profit and cash flow

The net profit of the CSIR was R59,2 million (2007/08: R51,7 million). The increase in revenue, royalty income and net finance income, due to continued practices of sound cash management and increases in the repo rate, contributed to the net profit. Net profit for the CSIR Group was R58,3 million (2007/08: R54,2 million).

Cash flow generated from operating activities for the CSIR for the year being reported on was R285,5 million (2007/08: R167,3 million). Significant investments of R188,3 million were made in scientific infrastructure and equipment in 2008/09 (2007/08: R85,9 million). This led to the net outflow due to investing activities of R224 million. The cash and cash equivalent holdings increased to R734,8 million (2007/08: R673,3 million).

Five-year ratio analysis

	2009 R'000	2008 R'000	2007 R'000	2006 R'000	2005 R'000
Operating expenses					
Remuneration as a % of total income (excl. finance income)	51,9%	50,9%	51,6%	62,8%	56,2%
Remuneration as a % of total expenditure	51,1%	50,8%	51,2%	59,6%	56,5%
Asset management					
Investment in property, plant and equipment (Rm)	188,3	85,9	79,2	119,2	53,8
Investment in property, plant and equipment as a percentage of revenue	13,0%	7,1%	7,1%	12,0%	5,4%
Net asset turn	3,4	3,2	3,2	2,9	2,7
Current ratio	1,0	1,2	0,9	1,0	1,2
Cash flow					
Net cash from operating activities	285 546	167 307	341 357	146 659	131 909
Cash and cash equivalents end of year (including long-term fixed deposits)	834 830	673 309	557 529	289 070	295 417

Definitions

Net asset turn – Total revenue (incl. 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, AC133: Financial instruments – recognition and measurement have been excluded for the comparison of financial indicators.

The investment in property, plant and equipment in 2007 and 2006 included the DST building costs of R7,8 million and R87 million, respectively.

Energy saving

The CSIR's performance on energy saving for the 2008/09 financial year is acceptable considering an increase in energy demand due to organisational development and business growth. The organisation's energy efficiency performance for 2008/09 showed a 2,6% reduction in energy consumption.

Migration to open source software

The implementation of open source software (OSS) as the basis of CSIR computing has seen 18% of the organisation's staff migrating to OSS during the past financial year. A culture of training in terms of optimal use of OSS has been entrenched and the CSIR has established a research group focused on developing a Linux desktop dedicated to scientific computing to support affordable and flexible scientific infrastructure in Africa and further afield. Internships and studentships were initiated to support the advancement of human capital in advanced software development. The Department of Science and Technology and the State Information and Technology Agency continue to be our main partners in this regard.

Broad-based Black Economic Empowerment audit

In line with the Black Empowerment Act, Act 53 of 2003, and the dti Codes of Good Practice published in February 2007, the CSIR has undergone an audit and verification of its B-BBEE performance and status. The audit involved assessment of the organisation's performance in the following six areas: Management control, employment equity, skills development, preferential procurement, enterprise development and socio-economic development.

Annual Financial Statements

Income Statements

for the year ended 31 March 2009

	Notes	GROUP 2009 R'000	GROUP 2008 R'000	CSIR 2009 R'000	CSIR 2008 R'000
Revenue	2	**1 472 161**	1 222 379	**1 452 774**	1 204 129
Other income		**20 490**	13 943	**19 498**	13 838
Total operating income		**1 492 651**	1 236 322	**1 472 272**	1 217 967
Expenditure					
Employees' remuneration		**771 977**	628 319	**764 134**	619 432
Depreciation and amortisation	6 & 7	**37 409**	28 061	**37 140**	27 682
Operating expenses		**705 645**	580 593	**694 435**	572 454
Total operating expenditure		**1 515 031**	1 236 973	**1 495 709**	1 219 568
Finance income	4	**95 669**	61 271	**92 725**	59 755
Finance expense	4	**(10 023)**	(6 421)	**(10 023)**	(6 414)
Share of loss of joint ventures and associates		**(3 503)**	(58)		
Operating profit for the year before taxation		**59 763**	54 141	**59 265**	51 740
Income tax (expense)/income	5	**(1 485)**	135		
Profit for the year		**58 278**	54 276	**59 265**	51 740
Attributable to:					
Stakeholders		**58 278**	54 276	**59 265**	51 740
Profit for the year		**58 278**	54 276	**59 265**	51 740

Balance Sheets

31 March 2009

	Notes	GROUP 2009 R'000	GROUP 2008 R'000	CSIR 2009 R'000	CSIR 2008 R'000
ASSETS					
Non-current assets		**399 851**	225 429	**426 845**	241 393
Property, plant and equipment	6	**297 975**	225 429	**296 833**	225 118
Intangible assets	7	**10**	–	**–**	–
Interest in joint ventures and associates	8	**1 608**	–	**1 609**	1
Interest in subsidiaries	9			**28 403**	16 274
Other investments	10	**100 000**	–	**100 000**	–
Deferred tax asset	13	**258**	–	**–**	–
Current assets		**1 095 481**	1 115 154	**1 070 658**	1 091 583
Trade and other receivables	11	**138 725**	267 076	**164 720**	261 672
Inventory and contracts in progress	12	**79 338**	61 712	**76 218**	61 712
Cash and cash equivalents	25	**782 528**	691 476	**734 830**	673 309
Non-current asset held for sale	6.1	**94 890**	94 890	**94 890**	94 890
TOTAL ASSETS		**1 495 332**	1 340 583	**1 497 503**	1 332 976
EQUITY AND LIABILITIES					
Reserves		**449 495**	392 732	**446 288**	387 023
Retained earnings		**438 015**	379 737	**435 538**	376 273
Self-insurance reserve	20	**10 750**	10 750	**10 750**	10 750
Non-distributable reserve:					
Foreign currency translation reserve		**730**	2 245		
Non-current liabilities		**8 862**	8 595	**8 862**	8 595
Post-retirement medical benefits	18.4	**8 862**	8 595	**8 862**	8 595
Current liabilities		**1 036 975**	939 256	**1 042 353**	937 358
Advances received	14	**571 734**	448 854	**571 734**	448 854
Trade and other payables	15	**463 814**	490 402	**470 619**	488 504
Provisions	16	**1 427**	–	**–**	–
TOTAL EQUITY AND LIABILITIES		**1 495 332**	1 340 583	**1 497 503**	1 332 976

Statements of Changes in Equity

for the year ended 31 March 2009

	Retained earnings	Self-insurance reserve*	Non-distributable reserve**	Total
	R'000	R'000	R'000	R'000
GROUP				
Balance at 31 March 2007	334 723	10 750	2 243	**347 716**
Transfer of the National Metrology Laboratory (NML) ***	(9 262)	–	–	**(9 262)**
Profit for the year	54 276	–	–	**54 276**
Exchange differences arising from translations of foreign operations	–	–	2	**2**
Balance at 31 March 2008	**379 737**	**10 750**	**2 245**	**392 732**
Profit for the year	58 278	–	–	**58 278**
Exchange differences arising from translations of foreign operations	–	–	(1 515)	**(1 515)**
Balance at 31 March 2009	**438 015**	**10 750**	**730**	**449 495**
CSIR				
Balance at 31 March 2007	333 795	10 750	–	**344 545**
Transfer of the National Metrology Laboratory (NML) ***	(9 262)	–	–	**(9 262)**
Profit for the year	51 740	–	–	**51 740**
Balance at 31 March 2008	**376 273**	**10 750**	–	**387 023**
Profit for the year	59 265	–	–	**59 265**
Balance at 31 March 2009	**435 538**	**10 750**	–	**446 288**

* Refer to note 20

** The non-distributable reserve consists of a foreign currency translation reserve. The foreign currency translation reserve comprises all foreign currency differences arising from the translation of the financial statements of foreign operations as well as from the translation of liabilities that hedge the Group's net investment in a foreign subsidiary, if applicable

*** Refer to note 27

Cash Flow Statements

for the year ended 31 March 2009

	Notes	GROUP 2009 R'000	GROUP 2008 R'000	CSIR 2009 R'000	CSIR 2008 R'000
Cash flow from operating activities					
Cash receipts from external customers		**998 768**	806 554	**976 484**	788 200
Parliamentary Grant received		**477 796**	445 046	**477 796**	445 046
Cash paid to suppliers and employees		**(1 253 492)**	(1 137 127)	**(1 251 372)**	(1 119 034)
Cash generated from operating activities	24	**223 072**	114 473	**202 908**	114 212
Net finance income	4	**85 582**	54 604	**82 638**	53 095
Income taxes (paid)/received		**(1 743)**	122	**–**	–
Net cash from operating activities		**306 911**	169 199	**285 546**	167 307
Cash flow from investing activities					
Acquisition of property, plant and equipment	6	**(114 717)**	(41 175)	**(113 605)**	(41 083)
Proceeds on disposal of property, plant and equipment		**1 129**	55	**1 129**	55
(Increase)/decrease in subsidiary loans				**(11 130)**	4 846
Proceeds on liquidation and deregistration of subsidiaries	28	**–**	154	**–**	–
Transfer of the National Metrology Laboratory (NML)	27	**–**	(9 813)	**–**	(9 813)
Increase in interest in joint ventures and associates		**(419)**	(1 473)	**(419)**	(1 473)
(Increase)/decrease in investments		**(100 000)**	200 000	**(100 000)**	200 000
Acquisition of intangible assets	7	**(375)**	(619)	**–**	–
Net cash (utilised)/generated in investing activities		**(214 382)**	147 129	**(224 025)**	152 532
Cash flow from financing activities					
Decrease in long-term liabilities		**–**	(4 059)	**–**	(4 059)
Net cash utilised in financing activities		**–**	(4 059)	**–**	(4 059)
Net increase in cash and cash equivalents		**92 529**	312 269	**61 521**	315 780
Cash and cash equivalents at beginning of the year		**691 476**	379 243	**673 309**	357 529
Effect of foreign exchange rate changes		**(1 477)**	(36)	**–**	–
Cash and cash equivalents at end of the year	25	**782 528**	691 476	**734 830**	673 309

1 PRINCIPAL ACCOUNTING POLICIES

The CSIR is a parastatal (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 consolidated Annual Financial Statements are prepared on the historical cost basis except for financial instruments held for trading and financial instruments classified as available-for-sale, 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. The interest of minority shareholders is stated at the minority's proportion of the fair values of the assets and liabilities recognised. The operating results of subsidiaries acquired or disposed of during the reporting period are included in the consolidated income statement from the effective date of acquisition or up to the effective date of disposal. All significant intercompany balances between group entities have been eliminated on consolidation.

Where a group enterprise transacts with a subsidiary company, unrealised gains and losses are eliminated in preparing the consolidated financial statements.

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.

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

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Interest in associates (continued)

Where a group enterprise transacts with an associate company, unrealised gains and losses are eliminated 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.

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

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.

Interests in jointly-controlled entities are accounted for by means of the equity method from the date that joint control commences until the date that joint control ceases. 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 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.

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

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 consolidation, at rates of exchange ruling at the reporting entities' financial year-end
- Revenue, expenditure and cash flow items at the average rates of exchange during the relevant financial year (the average rates approximate fair value).

Differences arising on translation are reflected 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.

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 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 stated in South African rand using the rates of exchange ruling on the balance sheet date. The resulting exchange differences are dealt with in the income statement. Non-monetary assets and liabilities stated at fair value are translated at foreign exchange rates ruling at the date the fair value was determined.

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Property, plant and equipment

Owned assets

Land is stated at cost less accumulated impairment losses. Buildings, plant, 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.

Leased assets

Assets acquired by way of finance lease, in terms of which the Group assumes substantially all the risks and rewards of ownership, are stated at an amount equal to the lower of the fair value and the present value of the minimum lease payments at inception of the lease, less accumulated depreciation and impairment losses. Assets held under finance leases are depreciated over the expected useful lives of these on the same basis as owned assets or, where shorter, the term of the relevant lease.

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
- Strategic assets of limited commercial application, which are written down to expected residual value at acquisition, with the remaining carrying value depreciated over the estimated useful lives of the assets.

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

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

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

1 PRINCIPAL ACCOUNTING POLICIES (continued)

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 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 consolidation 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 balance sheet 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 is negative (negative goodwill), it is recognised directly 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
– Development expenditure and intellectual property : 1 to 3 years

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Impairment

Financial assets

A financial asset 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. An impairment loss in respect of an available-for-sale financial asset is calculated by reference to its current fair value.

Individually-significant financial assets 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. Any cumulative loss in respect of an available-for-sale financial asset recognised previously in equity is transferred to 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 and available-for-sale financial assets that are debt securities, the reversal is recognised in profit or loss. For available-for-sale financial assets that are equity securities, the reversal is recognised directly in equity.

Non-financial assets

The carrying amounts of the Group's non-financial assets, other than biological assets, investment property, 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 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 generally 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.

1 PRINCIPAL ACCOUNTING POLICIES (continued)

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 the income statement when due.

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 balance sheet 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 the income statement on a systematic basis over the employees' working lives within the Group.

Actuarial gains and losses are recognised in full in the income statement in the year when actuarially determined. The amount recognised in the balance sheet represents the present value of the post-retirement medical aid contribution reduced by the fair value of the plan assets. 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

Raw materials and finished goods are stated at the lower of cost and net realisable value. Cost of inventory is determined by the weighted average method. 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

Income tax expense comprises current and deferred tax. The charge for taxation 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 balance sheet date. Income tax expense is recognised in profit or loss except to the extent that it relates to items recognised directly in equity, in which case it is recognised in equity.

Deferred tax is accounted for using the balance sheet method 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 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.

The amount of deferred tax provided is based on the expected manner of realisation or settlement of the carrying amount of assets and liabilities using tax rates enacted or substantively enacted at the balance sheet date. Deferred tax is charged to the income statement except to the extent that it relates to a transaction that is recognised directly in equity. The effect on deferred tax of any changes in tax rates is recognised in the income statement except to the extent that it relates to items previously charged or credited directly to equity.

1 PRINCIPAL ACCOUNTING POLICIES (continued)

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.

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 balance sheet 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 balance sheet 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.

The annual Parliamentary Grant is adjusted for the grant received for projects started before year-end, but not completed as detailed above (refer to Government grants).

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 the income statement as it accrues, using the effective interest rate method. Dividend income is recognised in the income statement 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.

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Expenses

Operating lease payments

Payments made under operating leases are recognised in the income statement on a straight-line basis over the term of the lease. Lease incentives received are recognised in the income statement 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 below.

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.

Receivables originated by the Group and not held for trading are measured at amortised cost using the effective interest rate method less any impairment losses if these have a fixed maturity.

Investments and loans

Investments, other than in subsidiaries, associates or joint ventures, are recognised at fair value. Dividends are accounted for on the last day of registration in respect of listed investments and when declared in respect of unlisted investments. On disposal of an investment, the difference between the net disposal proceeds and the carrying amount is charged or credited to the income statement.

Loans are measured at amortised cost using the effective interest rate 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 on hand is stated at face value, which is its fair value. Cash and cash equivalents comprise bank balances, cash on deposit and cash on hand.

Forward exchange contracts

Forward exchange contracts are fair valued and gains and losses are recognised in the income statement. Hedge accounting is not applied.

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.

1 PRINCIPAL ACCOUNTING POLICIES (continued)

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 the income statement.

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 the income statement.

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 balance sheet 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.

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 2009, the following standards and interpretations were in issue but not yet effective:

Standard/ Interpretation	Description	Effective Date
IAS 1 (AC 101)	Presentation of financial statements. The Group will adopt the revised standard on its effective date. The revised standard will affect the disclosures in the annual report.	Annual periods commencing on or after 1 January 2009
IFRS 2 (AC 139) amendment	Share-based payment: vesting conditions and cancellations. The amendment will not affect the Group's results.	Annual periods commencing on or after 1 January 2009
IFRS 3 (AC 140)	Business combinations. The revision is applicable prospectively and will not affect past business combinations.	Annual periods commencing on or after 1 July 2009
IFRS 5 (AC 142) amendment	Improvements to IFRSs - IFRS 5 Non-current assets held for sale and discontinued operations. The amendment is not expected to affect the Group's results.	Annual periods commencing on or after 1 July 2009
Amendments to IFRS 7 (AC 144)	Improving disclosures about financial instruments. The Group will adopt the revised standard on its effective date. The revised standard will affect the disclosures in the annual report.	Annual periods commencing on or after 1 January 2009
IFRS 8 (AC 145)	Operating segments. The revision will not affect the Group's results.	Annual periods commencing on or after 1 January 2009
AC 503 revised	Accounting for Black Economic Empowerment (BEE) transactions. The revision will not affect the Group's results.	Annual periods commencing on or after 1 January 2009
AC 504	IAS 19 (AC 116) – The limit on a defined benefit asset, minimum funding requirements and their interaction in the South African pension fund environment. No effect is anticipated on adoption of the interpretation.	Annual periods commencing on or after 1 April 2009
IFRIC 15 (AC 448)	Agreements for the construction of real estate. IFRIC 15 is not expected to have any impact on the Group.	Annual periods commencing on or after 1 January 2009

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Standards and interpretations issued, not yet effective (continued)

Standard/ Interpretation	Description	Effective Date
IFRIC 16 (AC 449)	Hedges of a net investment in a foreign operation. IFRIC 16 is not expected to have any impact on the Group.	Annual periods commencing on or after 1 October 2008
IFRIC 17 (AC 450)	Distributions of non-cash assets to owners. IFRIC 17 is not expected to have any impact on the Group.	Annual periods commencing on or after 1 July 2009
IAS 23 (AC 114)	Borrowing costs. The revision is not expected to affect the Group's results.	Annual periods commencing on or after 1 January 2009
IAS 27 (AC 132) amendment	Consolidated and separate financial statements. The revision is applicable prospectively and will not affect past business combinations.	Annual periods commencing on or after 1 July 2009
IAS 27 (AC 132) & IFRS 1 (AC 138) amendment	Cost of an investment in a subsidiary, jointly controlled entity or associate. The revision is not expected to affect the Group's results.	Annual periods commencing on or after 1 January 2009
IAS 32 (AC 125) and IAS 1 (AC 101) amendment	IAS 32 (AC 125) Financial instruments: presentation and IAS 1 (AC 101): Presentation of financial statements: puttable financial instruments and obligations arising on liquidation. The amendment will not affect the Group.	Annual periods commencing on or after 1 January 2009
IAS 39 (AC 133) amendment	Eligible hedged items. The revision is not expected to affect the Group's results.	Annual periods commencing on or after 1 July 2009
Various	Improvements to IFRSs (excluding IFRS 5 amendment) The impact on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2009

	GROUP				CSIR			
	2009 R'000	**%**	2008 R'000	%	**2009 R'000**	**%**	2008 R'000	%
2 REVENUE								
Parliamentary Grant	**480 320**	**32**	429 013	34	**480 320**	**33**	429 013	35
Parliamentary Grant received	**477 796**	**32**	445 046	36	**477 796**	**33**	445 046	37
Less:								
Grant received for projects started before year-end but not completed	**(40 588)**	**(3)**	(43 112)	(4)	**(40 588)**	**(3)**	(43 112)	(4)
Add:								
Grant received in prior year for projects completed in this year	**43 112**	**3**	27 079	2	**43 112**	**3**	27 079	2
Contract income	**955 721**	**66**	776 908	65	**951 436**	**67**	766 046	65
Local private sector	**138 368**	**9**	137 858	11	**147 752**	**10**	137 683	11
Local public sector	**661 682**	**46**	508 779	43	**661 682**	**47**	508 779	43
International sector (including Africa)	**155 671**	**11**	130 271	11	**142 002**	**10**	119 584	11
Royalties	**36 120**	**2**	16 458	1	**21 018**	**–**	9 070	–
	1 472 161	**100**	1 222 379	100	**1 452 774**	**100**	1 204 129	100

Contract income is disclosed after taking into account the effect of the time value of money (the value of discounting) in terms of Circular 9 of 2006: Transactions giving rise to adjustments to revenue/purchases. The value is R16,137 million (2008: R11,425 million).

Included in public sector contract income is a R104,58 million (2008: R59,181) ring-fenced allocation from the Department of Science and Technology for specific initiatives managed through memoranda of agreement.

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

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

3 OPERATING PROFIT

The net operating profit is arrived at after taking the following items into account:

Auditors' remuneration	**3 637**	3 080	**3 465**	3 023
Audit fees	**3 637**	3 080	**3 465**	3 023
Fees for services	**6 429**	4 285	**5 687**	3 426
Patent costs	**5 645**	3 621	**4 903**	2 948
Legal costs	**784**	664	**784**	478
Operating leases	**14 400**	15 120	**13 507**	15 089
Buildings	**6 411**	5 327	**5 518**	5 296
Equipment	**5 364**	7 332	**5 364**	7 332
Vehicles	**2 625**	2 461	**2 625**	2 461
Net realised foreign exchange gain	**(13 019)**	(5 022)	**(13 211)**	(4 907)
Net unrealised foreign exchange gain	**(4 568)**	(8 402)	**(4 955)**	(8 402)
Board members' and executive management's emoluments (note 19)	**14 141**	12 894	**11 495**	9 181
Impairment/(reversal of impairment)	**2 422**	(1 849)	**4 113**	(5 497)
Impairment on loans to subsidiaries, joint ventures and associates	**–**	1 415	**–**	1 601
Reversal of impairment on subsidiaries, joint ventures and associates	**(4 692)**	–	**(2 188)**	(3 133)
Impairment/(reversal of impairment) on trade receivables	**6 775**	(4 381)	**6 301**	(4 379)
Impairment on intangible assets	**339**	703	**–**	–
Impairment on property, plant and equipment	**–**	414	**–**	414
Provision for warranty	**1 427**	–	**–**	–
Lost and/or stolen equipment and vehicles	**1 429**	582	**1 429**	582
Bad debt written off	**1 645**	1 332	**1 645**	1 323
Write-down of inventory to net realisable value	**4**	268	**4**	268
Loss on disposal and write-off of property, plant and equipment	**3 621**	6 302	**3 621**	6 298
Loss/(profit) on disposal and deregistration of interest in subsidiary	**330**	(823)	**–**	–

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000
4 FINANCE INCOME/EXPENSE				
Finance income	**95 669**	61 271	**92 725**	59 755
Interest on bank balances and investments	**79 532**	49 846	**76 588**	48 330
Adjustment on initial recognition of contract income*	**16 137**	11 425	**16 137**	11 425
Finance expense	**(10 023)**	(6 421)	**(10 023)**	(6 414)
Interest paid on loans and liabilities	**–**	(7)	**–**	–
Fair value adjustment on trade and other receivables	**64**	246	**64**	246
Adjustment on initial recognition of operating expenses*	**(10 087)**	(6 660)	**(10 087)**	(6 660)
	85 646	54 850	**82 702**	53 341

*These adjustments are due to the effect of the time value of money (the value of discounting) in terms of 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.

South African normal taxation	**1 477**	–
Current taxation	**1 735**	–
Deferred taxation – temporary differences	**(258)**	–
Foreign taxation	**8**	(135)
Current taxation	**8**	(122)
Deferred taxation – temporary differences	**–**	(13)
	1 485	(135)
South African normal rate of taxation	**28%**	29%
Profit attributable to tax exempt entities	**(27%)**	(26%)
Assessed loss	**1%**	(3%)
Current and deferred taxation – effective rate	**2%**	–

The tax rate decreased to 28% in the current financial year.

6 PROPERTY, PLANT AND EQUIPMENT

	2009			2008		
	Cost	Accumulated depreciation	Carrying value	Cost	Accumulated depreciation	Carrying value
	R'000	R'000	R'000	R'000	R'000	R'000
Group						
Land	**5 549**	**–**	**5 549**	5 549	–	5 549
Buildings	**214 457**	**77 260**	**137 197**	189 256	79 717	109 539
Equipment	**557 743**	**405 701**	**152 042**	485 677	377 244	108 433
Vehicles	**6 912**	**3 725**	**3 187**	5 830	3 922	1 908
	784 661	**486 686**	**297 975**	686 312	460 883	225 429
CSIR						
Land	**5 549**	**–**	**5 549**	5 549	–	5 549
Buildings	**214 457**	**77 260**	**137 197**	189 256	79 717	109 539
Equipment	**555 273**	**404 373**	**150 900**	484 074	375 952	108 122
Vehicles	**6 912**	**3 725**	**3 187**	5 830	3 922	1 908
	782 191	**485 358**	**296 833**	684 709	459 591	225 118

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 2007	5 549	110 712	101 059	1 535	**218 855**
Additions	–	4 810	35 789	576	**41 175**
Disposals and write-offs	–	(5 784)	(576)	–	**(6 360)**
Depreciation	–	(199)	(27 463)	(203)	**(27 865)**
Exchange differences on translation of foreign operations	–	–	38	–	**38**
Impairment	–	–	(414)	–	**(414)**
Carrying value 31 March 2008	5 549	109 539	108 433	1 908	**225 429**
Additions	–	31 609	81 524	1 584	**114 717**
Disposals and write-offs	–	(3 749)	(1 000)	(1)	**(4 750)**
Depreciation	–	(202)	(36 877)	(304)	**(37 383)**
Exchange differences on translation of foreign operations	–	–	(38)	–	**(38)**
Carrying value 31 March 2009	**5 549**	**137 197**	**152 042**	**3 187**	**297 975**
CSIR					
Carrying value 31 March 2007	5 549	110 712	100 689	1 535	**218 485**
Additions	–	4 810	35 697	576	**41 083**
Disposals and write-offs	–	(5 784)	(570)	–	**(6 354)**
Depreciation	–	(199)	(27 280)	(203)	**(27 682)**
Impairment	–	–	(414)	–	**(414)**
Carrying value 31 March 2008	5 549	109 539	108 122	1 908	**225 118**
Additions	–	31 609	80 412	1 584	**113 605**
Disposals and write-offs	–	(3 749)	(1 000)	(1)	**(4 750)**
Depreciation	–	(202)	(36 634)	(304)	**(37 140)**
Carrying value 31 March 2009	**5 549**	**137 197**	**150 900**	**3 187**	**296 833**

6 PROPERTY, PLANT AND EQUIPMENT (continued)

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 and vehicles resulted in a R709 746 (2008: R11,55 million) and R2 164 (2008: R264 221) decrease in the respective depreciation amounts for the current financial year.

Included above are assets with a cost of R280,4 million (2008: R245,7 million) that are fully depreciated as the remaining useful life is incidental. During the current financial year assets to the value of R74,7 million (2008: R44,9 million) were purchased with Parliamentary Grant funds. At year-end assets with a cost of R133,0 million (2008: R58,3 million) were purchased with Parliamentary Grant funds and are shown at a nil carrying value.

6.1 Non-current asset held for sale

A building of R94,89 million is in the process of being transferred to the Department of Science and Technology.

The sale of the building is subject to a suspensive condition relating to the rezoning of the property. The expected date for fulfilment is March 2010. Transfer of title will commence thereafter.

7 INTANGIBLE ASSETS

	2009			2008		
	Cost	Accumulated amortisation	Carrying value	Cost	Accumulated amortisation	Carrying value
	R'000	R'000	R'000	R'000	R'000	R'000
Group						
Investments in technology	**9 290**	**9 280**	**10**	8 915	8 915	–

	GROUP
	R'000
Carrying value 31 March 2007	280
Additions	619
Impairment	(703)
Amortisation	(196)
Carrying value 31 March 2008	–
Additions	375
Impairment	(339)
Amortisation	(26)
Carrying value 31 March 2009	**10**

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

8 INTEREST IN JOINT VENTURES AND ASSOCIATES

Cost of investments less impairment losses	**41**	41	**1**	1
Loans to joint ventures and associates	**35 937**	35 518	**35 977**	35 558
Share of post-acquisition losses	**(20 750)**	(17 247)	**–**	–
	15 228	18 312	**35 978**	35 559
Impairment of joint ventures and associates	**(13 620)**	(18 312)	**(34 369)**	(35 558)
	1 608	–	**1 609**	1

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 2009 are as follows:

Name of joint venture/associate	Place of incorporation	Portion of ownership interest	Portion of voting power held	Principal activity	Carrying value 2009 R'000	Carrying value 2008 R'000	Financial year-end
Joint ventures							
ZA Biotech (Pty) Ltd	South Africa	49%	49%	Development and trading in biotechnology and expertise	**215**	196	31 March
Sera (Pty) Ltd	South Africa	50%	50%	Commercialisation and licensing of patents	**13 405**	17 135	31 March
Ellipsoid Technology (Pty) Ltd	South Africa	50%	50%	Development of encapsulation technology	**1 608**	981	31 March
Associates							
AIDC Development Centre Eastern Cape (Pty) Ltd	South Africa	25%	25%	Automotive industry development and support services	**–**	–	31 March
Eyeborn (Pty) Ltd	South Africa	26%	26%	Holding, licensing and exploitation of intellectual property technology	**–**	–	31 March
					15 228	18 312	

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	
	2009 R'000	2008 R'000	**2009 R'000**	2008 R'000
Current assets	**35 208**	33 389	**1 946**	3 584
Long-term assets	**–**	5 259	**1 343**	316
Current liabilities	**3 459**	3 633	**1 693**	3 429
Long-term liabilities	**71 874**	68 134	**4 372**	3 347
Income	**5 819**	9 854	**10 151**	13 399
Expenses	**6 990**	9 739	**10 181**	13 451

9 INTEREST IN SUBSIDIARIES

	CSIR	
	2009 R'000	2008 R'000
Shares at cost less impairment losses	**5 355**	4 650
Indebtedness	**23 048**	11 624
– by subsidiaries	**39 687**	28 557
– impairment of loans	**(16 639)**	(16 933)
	28 403	16 274

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.

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

10 OTHER INVESTMENTS

	% held	Number of shares held **2009**	2008	Class of shares				
Unlisted shares					**–**	–	**–**	–
Breathetex (Pty) Ltd	**20,1**	**12 000**	12 000	Ordinary	**11 025**	11 025	**11 025**	11 025
Breathetex (Pty) Ltd		**11 680**	11 680	Preference	**–**	–	**–**	–
Accumulated impairment losses					**(11 025)**	(11 025)	**(11 025)**	(11 025)
Fixed deposits					**100 000**	–	**100 000**	–
					100 000	–	**100 000**	–

11 TRADE AND OTHER RECEIVABLES

Trade receivables	**103 820**	141 031	**132 736**	135 810
Prepaid expenditure	**30 573**	118 707	**30 573**	118 707
Other receivables	**4 332**	7 338	**1 411**	7 155
	138 725	267 076	**164 720**	261 672

Trade receivables are shown net of impairment losses. Refer to note 23 for more detail on trade receivables.

12 INVENTORY AND CONTRACTS IN PROGRESS

Inventory	**3 052**	3 468	**1 465**	3 468
Contracts in progress less provision for losses	**76 286**	58 244	**74 753**	58 244
	79 338	61 712	**76 218**	61 712

Estimates on contract in progress recognition are based on cost to completion, budgets and percentage of completion. The write-down of inventory to net realisable value amounted to R3 936 (2008: R268 000).

13 DEFERRED TAX ASSET

Balance at the beginning of the year	**–**	13
Movement for the year:		
Accelerated capital allowances	**(34)**	(13)
Provisions	**193**	–
Impairment on trade receivables	**99**	–
	258	–

A subsidiary in the Group is in an assessed loss position and no deferred tax asset was raised for this assessed loss due to the uncertainty of the recoverability in future periods in respect of deductible temporary differences, and the carry forward of unused tax losses.

Prior year assessed tax loss	**5 943**	7 740
Assessed tax loss generated/(utilised) for the year	**3 105**	(1 797)
Assessed tax loss carried forward	**9 048**	5 943

	GROUP		CSIR	
	2009 R'000	2008 R'000	**2009 R'000**	2008 R'000

14 ADVANCES RECEIVED

Advances on contracts received from clients	**571 734**	448 854	**571 734**	448 854

Included in advances received is an amount of R116,8 million excluding VAT (2008: R116,8 million excluding VAT) that relates to the transfer of the building to the Department of Science and Technology (refer note 6.1).

15 TRADE AND OTHER PAYABLES

Accounts payable and accruals	**329 569**	400 179	**336 414**	398 281
Salary related accruals	**134 245**	90 223	**134 205**	90 223
	463 814	490 402	**470 619**	488 504

16 PROVISIONS

	2009			
	Opening balance R'000	Additional provisions R'000	Utilised and reversed R'000	Closing balance R'000
GROUP				
Warranty provision The warranty provision relates to goods sold under a 12 month warranty. The provision amount is determined based on a percentage of the replacement value of all sales made within 12 months of year-end. This percentage is management's estimate of the likely returns of goods under warranty for repairs.	–	1 427	–	**1 427**
	–	**1 427**	**–**	**1 427**

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

17 OPERATING LEASE COMMITMENTS

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

Within one year:	**7 110**	6 835	**6 502**	6 115
Land and buildings	**5 117**	5 199	**4 509**	4 479
Equipment	**–**	32	**–**	32
Vehicles	**1 993**	1 604	**1 993**	1 604
Within two to five years:	**11 744**	15 656	**11 744**	15 656
Land and buildings	**9 219**	13 564	**9 219**	13 564
Vehicles	**2 525**	2 092	**2 525**	2 092

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

The CSIR leases buildings under operating leases. The leases typically run for a period of five years. Lease payments are increased with a fixed annual escalation percentage to reflect market rentals. None of the leases includes contingent rentals.

18 RETIREMENT BENEFITS OF EMPLOYEES

18.1 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 R47,4 million (2008: R41,7 million) and employee contributions of R27,5 million (2008: R23,9 million) were paid over during the year. Employer contributions are charged against income when incurred.

18.2 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 (one member) and Sentinel (three members) (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 employees who had formally converted their secondment to a CSIR appointment, employer contributions of R187 713 (2008: R174 608) and employee contributions of R103 065 (2008: R95 869) were paid over during the year. Employer contributions are charged against income when incurred.

18.3 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 two employees (2008: two employees) who are members of the AIPF. The fund is controlled by the state, which has assumed responsibility for the unfunded portions of these funds.

Employer contributions of R9 178 (2008: R7 543) and employee contributions of R5 736 (2008: R4 715) were paid over during the year to the AIPF.

18.4 Post-retirement medical benefits

The CSIR formed its own Medical Aid Scheme, based on managed health care principles, with a strong emphasis on co-responsibility between the fund and its members. The objective is to provide sustainable health care and simultaneously limit the cost, present and future, to a level that is affordable. The CSIR Board approved a cash payment of R190 million in 1997 to the Medical Aid Scheme, thereby transferring the liability for retirement benefits of members to the scheme. Due to changes in the Medical Schemes Act of 1998, the scheme can no longer accept the liability for retirement benefits of qualifying members of the scheme.

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 26 continuation members was recalculated by the actuaries as at 31 March 2009 and will be funded through cash and cash equivalents.

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

18 RETIREMENT BENEFITS OF EMPLOYEES (continued)

18.4 Post-retirement medical benefits (continued)

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

Present value of obligations	**8 862**	8 595	**8 862**	8 595
Net liability on balance sheet	**8 862**	8 595	**8 862**	8 595

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

Interest cost	**834**	858	**834**	858
Actuarial gain recognised during the year	**(567)**	(955)	**(567)**	(955)
Total	**267**	(97)	**267**	(97)

Movement in the net liability recognised in the balance sheet is as follows:

Net liability at the beginning of the year	**8 595**	12 751	**8 595**	12 751
Movement for the year	**267**	(4 156)	**267**	(4 156)
Net expense/(income) recognised in the income statement	**267**	(97)	**267**	(97)
Settlements	**–**	(4 059)	**–**	(4 059)
Net liability at the end of the year	**8 862**	8 595	**8 862**	8 595
Actual return on investments/plan assets	**11,10%**	9,50%	**11,10%**	9,50%

Principal actuarial assumptions at the balance sheet date

Discount rate at 31 March	**8,00%**	9,70%	**8,00%**	9,70%
Medical inflation costs	**3,85%**	5,48%	**3,85%**	5,48%

Historical information	**2009**	2008	2007	2006	2005
Present value of the defined benefit obligation	**8 862**	8 595	12 751	14 897	380 992
Fair value of plan assets	**–**	–	–	–	(273 685)
Deficit in the plan	**8 862**	8 595	12 751	14 897	107 307

19 BOARD MEMBERS, DIRECTORS AND EXECUTIVE MANAGEMENT'S REMUNERATION

	Entity	Fees for services as director	Managerial Services			Total
			Basic salary	Bonuses and performance-related payments	Retirement fund and medical aid contributions	
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr S Sibisi	CSIR	–	2 275	819	383	**3 477**
Foreign subsidiaries						
Mr AA Davidson	Quotec Limited (UK)	–	1 078	113	4	**1 195**
Dr A Hickman	Quotec Limited (UK)	–	1 325	113	13	**1 451**
Remunerated in British pound						
Non-executive Board members						
Mr N Behrens (since Jan 09)	CSIR	20	–	–	–	**20**
Professor C de la Rey (until Dec 08)	CSIR	12	–	–	–	**12**
Dr N Dlamini (until Dec 08)	CSIR	9	–	–	–	**9**
Professor DR Hall	CSIR	25	–	–	–	**25**
Mr A Knott-Craig (since Jan 09)	CSIR	20	–	–	–	**20**
Mr EH Mayet (until Dec 08)	CSIR	11	–	–	–	**11**
Dr N Msomi (until Dec 08)	CSIR	6	–	–	–	**6**
Professor F Petersen	CSIR	55	–	–	–	**55**
Ms N Shikwane (until Dec 08)	CSIR	21	–	–	–	**21**
Mr M Sibanda (since Jan 09)	CSIR	30	–	–	–	**30**
Mr M Silinga (since Jan 09)	CSIR	20	–	–	–	**20**
Ms KL Thoka (since Jan 09)	CSIR	20	–	–	–	**20**
Professor M Wingfield	CSIR	39	–	–	–	**39**
Executive Management						
Dr T Dlamini (Interim)	CSIR	–	906	112	68	**1 086**
Dr JH Maree	CSIR	–	1 284	330	191	**1 805**
Ms K Njobe	CSIR	–	1 264	305	155	**1 724**
Mr CR Sturdy	CSIR	–	1 234	268	150	**1 652**
Mr RM Zondo	CSIR	–	1 107	243	113	**1 463**
2009		**288**	**10 473**	**2 303**	**1 077**	**14 141**

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

	Entity	Fees for services as director	Managerial Services			Total
			Basic salary	Bonuses and performance-related payments	Retirement fund and medical aid contributions	
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr S Sibisi	CSIR	–	2 056	655	347	3 058
Foreign subsidiaries						
Mr AA Davidson	Quotec Limited (UK)	–	1 010	143	–	1 153
Dr JR Galsworthy (until Dec 07)	Quotec Limited (UK)	–	660	143	5	808
Dr A Hickman	Quotec Limited (UK)	–	1 240	502	10	1 752
Remunerated in British pound						
Non-executive Board members						
Professor C de la Rey	CSIR	16	–	–	–	16
Dr N Dlamini	CSIR	9	–	–	–	9
Professor B Gourley (until July 07)	CSIR	3	–	–	–	3
Professor DR Hall	CSIR	9	–	–	–	9
Mr EH Mayet	CSIR	14	–	–	–	14
Dr N Msomi	CSIR	18	–	–	–	18
Professor F Petersen	CSIR	11	–	–	–	11
Ms N Shikwane	CSIR	27	–	–	–	27
Professor M Wingfield	CSIR	14	–	–	–	14
Executive Management						
Dr T Dlamini (Interim: since Feb 08)	CSIR	–	146	–	11	157
Dr JH Maree	CSIR	–	1 141	487	170	1 798
Ms K Njobe	CSIR	–	1 114	361	137	1 612
Mr CR Sturdy	CSIR	–	1 061	106	95	1 262
Mr RM Zondo	CSIR	–	953	129	91	1 173
2008		121	9 381	2 526	866	12 894

20 INSURANCE AND RISK MANAGEMENT

The insurance and risk management policies adopted by the CSIR are aimed at obtaining sufficient cover at the minimum cost to protect its asset base, earning capacity and legal obligations against unacceptable losses.

All property, plant and equipment are insured at current replacement value. Risks of a possible catastrophic nature are identified and insured while acceptable risks of a non-catastrophic nature are self-insured. Self-insurance has been instituted where the cost-to-benefit relationship exceeds the risk and the incidence of losses is of a minor and infrequent nature. Self-insured risks are reviewed on an annual basis to ensure cover is adequate. An amount of R10,75 million (2008: R10,75 million) is held in a self-insurance fund to cover these risks. This amount is disclosed as part of reserves in the balance sheet. No major losses were experienced during the year under review. Claims of a general nature were adequately covered.

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

21 CONTINGENT LIABILITIES AND FACILITIES

Facilities of subsidiaries guaranteed by the CSIR	**20 000**	17 000	**20 000**	17 000

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.

22 CAPITAL COMMITMENTS

Property, plant and equipment authorised but not contracted	**47 149**	32 069	**47 149**	32 069

This capital expenditure is to be financed from internal sources.

23 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 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 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 Committee.

23 FINANCIAL INSTRUMENTS (continued)

23.1 Market risk

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 currencies of Group entities, primarily the rand, 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, based on notional amounts:

	31 MARCH 2009					
	Total R'000	**ZAR R'000**	**EURO R'000**	**USD R'000**	**GBP R'000**	**Other R'000**
Trade receivables	**103 820**	87 268	3 976	9 168	1 438	1 970
Bank accounts	**91 164**	39 136	10 384	34 159	6 859	626
Trade payables	**(463 814)**	(456 623)	(4 411)	(187)	(2 585)	(8)
Gross balance sheet exposure	**(268 830)**	(330 219)	9 949	43 140	5 712	2 588
Forward exchange contracts	**(5 003)**	–	(5 003)	–	–	–
Net exposure	**(273 833)**	**(330 219)**	**4 946**	**43 140**	**5 712**	**2 588**

	31 MARCH 2008					
	Total R'000	ZAR R'000	EURO R'000	USD R'000	GBP R'000	Other R'000
Trade receivables	141 031	108 033	3 770	22 825	5 952	451
Bank accounts	40 843	25 629	5 851	5 097	3 724	542
Trade payables	(490 402)	(488 955)	–	–	(1 447)	–
Gross balance sheet exposure	(308 528)	(355 293)	9 621	27 922	8 229	993
Forward exchange contracts	(53 975)	–	(40 831)	(12 508)	(636)	–
Net exposure	(362 503)	(355 293)	(31 210)	15 414	7 593	993

	GROUP	
	2009	2008

23 FINANCIAL INSTRUMENTS (continued)

23.1 Market risk (continued)

Foreign currency risk (continued)

The following significant exchange rates applied during the year:

Average rate of forward exchange contracts	**R**	R
Euro	**13.1323**	13.1452
USD	**–**	8.1956
GBP	**–**	16.3646
Year-end spot rate		
Euro	**12.8286**	12.4712
USD	**9.7205**	7.8933
GBP	**13.8163**	15.6815

Sensitivity analysis

A 10% strengthening of the rand against the following currencies at 31 March would have (decreased)/increased 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 2008.

	R'000	R'000
Euro	**(495)**	3 121
USD	**(4 314)**	(1 541)
GBP	**(571)**	(759)
Other	**(259)**	(99)

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	**555 620**	471 255

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 (interest rate swaps) 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.

	GROUP	
	2009	2008
	R'000	R'000

23 FINANCIAL INSTRUMENTS (continued)

23.1 Market risk (continued)

Interest rate risk (continued)

Variable rate instruments: carrying amount

Financial assets: Call deposits	**235 364**	179 000
Financial assets: Bank balances	**91 164**	40 843
	326 528	219 843

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 2008.

Variable rate instruments	**3 265**	2 198

A decrease of 100 basis points would have had the equal but opposite effect to the amounts shown above.

23.2 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 carrying amounts of financial assets included in the balance sheet represent the Group's exposure to credit risk in relation to these assets.

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 21 for details on bank guarantees issued.

23 FINANCIAL INSTRUMENTS (continued)

23.2 Credit risk (continued)

Exposure to credit risk	GROUP 2009 R'000	GROUP 2008 R'000
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:		
– *Non-current fixed deposits*	100 000	–
– *Current fixed deposits*	455 620	471 255
Other cash and cash equivalents:		
– *Call deposits*	235 364	179 000
– *Bank balances*	91 164	40 843
– *Cash on hand and cash deposits*	380	378
Loans and receivables:		
– *Trade and other receivables*	138 725	267 076
– *Contracts in progress less provision for losses*	76 286	58 244
Other forward exchange contracts	–	5 040
	1 097 539	1 021 836

The maximum exposure to credit risk for trade receivables at the reporting date by type of customer was:		
Local public	68 149	57 520
Local private	17 762	49 371
International	17 909	34 140
	103 820	141 031

The Group's most significant customers are government institutions.

23 FINANCIAL INSTRUMENTS (continued)

23.2 Credit risk (continued)

Exposure to credit risk (continued)

The aging of the Group's trade receivables at the reporting date was:

	2009		2008	
	Gross	**Impairment**	Gross	Impairment
	R'000	**R'000**	R'000	R'000
Not past due	**77 664**	**1 300**	100 109	3 640
Past due 0 – 30 days	**15 950**	**1 592**	17 476	146
Past due 31 – 120 days	**17 263**	**5 066**	26 218	2 279
Past due more than 120 days	**11 754**	**10 853**	9 264	5 971
	122 631	**18 811**	153 067	12 036

The movement in the allowance for impairment in respect of trade receivables during the year was as follows:

	GROUP	
	2009	2008
	R'000	R'000
Balance at 1 April	**12 036**	16 415
Impairment loss recognised/(reversed)	**6 775**	(4 379)
Balance at 31 March	**18 811**	12 036

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 R7,8 million (2008: R8,8 million), utilisation of R0,8 million (2008: R5,4 million) and new impairment allowances of R15,3 million (2008: R9,8 million).

23 FINANCIAL INSTRUMENTS (continued)

23.3 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 R5,0 million available.

The following are the contractual maturities of financial liabilities, including interest payments and excluding the impact of netting agreements for the Group:

	2009			2008		
	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	**(463 814)**	**(463 814)**	**–**	(490 402)	(490 402)	–
Derivative financial liabilities						
Forward exchange contracts	**(5 194)**	**(5 194)**	**–**	(48 935)	(40 836)	(8 099)
	(469 008)	**(469 008)**	**–**	(539 337)	(531 238)	(8 099)

Rate of forward exchange contracts:

	GROUP	
	2009	2008
	R	R
Euro	**13.6316**	11.6684
USD	**–**	7.9688
GBP	**–**	13.6110

23.4 Fair values

At 31 March 2009 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.

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

24 RECONCILIATION OF OPERATING PROFIT TO CASH GENERATED FROM OPERATING ACTIVITIES

Operating profit for the year before taxation	**59 763**	54 141	**59 265**	51 740
Adjusted for:				
Loss/(profit) on disposal of interest in subsidiary	**330**	(823)	**–**	–
Depreciation and amortisation	**37 409**	28 061	**37 140**	27 682
Net unrealised foreign exchange gain	**(4 568)**	(8 402)	**(4 955)**	(8 402)
Net finance income	**(85 646)**	(54 850)	**(82 702)**	(53 341)
Post-retirement medical benefits	**267**	(97)	**267**	(97)
Straight-lining adjustment of operating leases	**271**	54	**271**	54
Accrual for bonuses and leave	**93 022**	45 527	**91 555**	45 527
Impairments/(reversals of impairments)	**2 422**	(1 849)	**4 113**	(5 497)
Loss on disposal and write-off of property, plant and equipment	**3 621**	6 302	**3 621**	6 298
Share of loss of joint ventures and associates	**3 503**	58	**–**	–
Bad debt written off	**1 645**	1 332	**1 645**	1 323
Write-down of inventory to net realisable value	**4**	268	**4**	268
Operating profit before changes in working capital	**112 043**	69 722	**110 224**	65 555
Decrease/(increase) in trade and other receivables	**124 233**	(108 125)	**94 025**	(108 685)
Increase in inventory and contracts in progress	**(17 630)**	(20 170)	**(14 510)**	(20 170)
Increase in advances received	**122 880**	94 546	**122 880**	94 546
(Decrease)/increase in trade and other payables and provisions	**(118 454)**	78 500	**(109 711)**	82 966
Net working capital changes	**111 029**	44 751	**92 684**	48 657
Cash generated from operating activities	**223 072**	114 473	**202 908**	114 212

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

25 CASH AND CASH EQUIVALENTS

Fixed deposits	**455 620**	471 255	**416 000**	467 500
Call deposits	**235 364**	179 000	**235 000**	179 000
Bank balances	**91 164**	40 843	**83 460**	26 431
Cash on hand and cash deposits	**380**	378	**370**	378
	782 528	691 476	**734 830**	673 309

26 RELATED PARTY TRANSACTIONS

The CSIR is one of 29 schedule 3B National Government Business Enterprises 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 sphere of government. Amounts due from/(to) these entities are subject to the same terms and conditions as normal trade receivables and trade payables.

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.

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

26 RELATED PARTY TRANSACTIONS (continued)

26.1 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	**–**	517	**–**	517
Services received	**362**	309	**362**	309
Amount due (to)/from	**(101)**	70	**(101)**	70
Major public entities				
Services rendered	**189 430**	140 986	**189 430**	140 986
Services received	**7 835**	16 087	**7 835**	16 087
Amount due from	**21 006**	9 767	**21 006**	9 767
National public entities				
Services rendered	**53 105**	38 055	**53 105**	38 055
Services received	**156 022**	141 321	**156 022**	141 321
Amount due from	**6 934**	5 154	**6 934**	5 154
National government business enterprises				
Services rendered	**2 776**	2 340	**2 776**	2 340
Services received	**2 276**	542	**2 276**	542
Amount due from	**999**	305	**999**	305
Provincial public entities				
Services rendered	**975**	–	**975**	–
Services received	**10**	–	**10**	–
Provincial government business enterprises				
Services rendered	**1 933**	–	**1 933**	–
Services received	**150**	2	**150**	2
Amount due from	**339**	–	**339**	–

	GROUP		CSIR	
	2009	2008	**2009**	2008
	R'000	R'000	**R'000**	R'000

26 RELATED PARTY TRANSACTIONS (continued)

26.1 Transactions with related parties (continued)

Government departments				
Services rendered	**745 355**	573 336	**745 355**	573 336
Services received	**100**	35	**100**	35
Amount due from	**31 105**	5 017	**31 105**	5 017
Subsidiaries				
Services rendered			**16 979**	834
Services received			**–**	1 713
Amount due from			**21 918**	7 128
Assets sold to subsidiaries			**4 290**	–
Associates				
Services rendered	**2 243**	6 234	**2 243**	6 234
Amount due from/(to)	**1 174**	(428)	**1 174**	(428)

26.2 Transactions with key management

Total remuneration of key management is included in employees' remuneration (refer to note 19 for Executive Management's remuneration).

27 NATIONAL METROLOGY LABORATORY (NML)

In terms of the Measurement Units and Measurement Standards Act, Act 18 of 2006, the National Metrology Institute of South Africa (NMISA) was established as a separate public entity, the Executive Authority of which is the Minister of Trade and Industry. The commencement date of the Act, which co-incides with the date of the establishment of NMISA, was 1 May 2007, as per Proclamation R8, published in Government Gazette No 29833 of 26 April 2007.

Pursuant to the said Act, all rights, obligations and liabilities acquired or incurred by the CSIR National Metrology Laboratory (NML) vested in NMISA as from 1 May 2007 and similarly all employees of the former NML were transferred to NMISA.

	2008 R'000
Profit attributable to the NML is as follows:	
Revenue	2 604
Employees remuneration	(3 505)
Operating expenses	(731)
Loss for the year	(1 632)
Assets and liabilities attributable to the NML are as follows:	
Assets	
Current assets	11 529
Trade and other receivables	1 716
Bank balances and cash on hand	9 813
Total assets	11 529
Equity and liabilities	
Reserves	9 262
Retained earnings	9 262
Current liabilities	2 267
Advances received	359
Trade and other payables	1 908
Total equity and liabilities	11 529
The net assets of NML on transfer were as follows:	
Net asset value transferred	9 262
Total consideration	9 262
Net cash outflow arising on transfer of NML	
Bank balance and cash disposed	(9 813)

	GROUP	
	2009	2008
	R'000	R'000

28 DEREGISTRATION AND LIQUIDATION OF SUBSIDIARIES

28.1 CSIR International Limited

The Group held 100% of the issued share capital in CSIR International Limited. The company was deregistered on 1 May 2007.

The net assets of CSIR International Limited on deregistration were as follows:	
Net asset value disposed	(739)
Profit on deregistration	739
Total consideration	–
Net cash outflow arising on deregistration of interest in subsidiary	
Bank balance and cash disposed	–

28.2 Brilliant Security Solutions (Pty) Ltd

The Group held 100% of the issued share capital in Brilliant Security Solutions (Pty) Ltd. The company was liquidated.

The net assets of Brilliant Security Solutions (Pty) Ltd on liquidation were as follows:	
Net asset value disposed	(84)
Profit on liquidation	84
Total consideration	–
Net cash inflow arising on liquidation of subsidiary	
Liquidation dividend received	154

28.3 Implico BV

The Group held 100% of the issued share capital in Implico BV. The company was deregistered on 9 October 2008.

The net assets of Implico BV on deregistration were as follows:	
Net asset value disposed	**327**
Loss on deregistration	**(327)**
Total consideration	**–**
Net cash outflow arising on deregistration of interest in subsidiary	
Bank balance and cash disposed	**–**

	GROUP	
	2009	2008
	R'000	R'000

28 DEREGISTRATION AND LIQUIDATION OF SUBSIDIARIES (continued)

28.4 South African Inventions Development Corporation (SAIDCOR)

The Group held 100% of the issued share capital in the South African Inventions Development Corporation. The Inventions Development Act, 1962 (Act No. 31 of 1962) was repealed upon the promulgation of the Technology Innovation Agency Act, 2008 on 17 November 2008 and SAIDCOR was thereby disestablished.

The net assets of SAIDCOR on disestablishment were as follows:	
Net asset value disposed	3
Loss on deregistration	(3)
Total consideration	–
Net cash outflow arising on deregistration of interest in subsidiary	
Bank balance and cash disposed	–

Addendum A: Interest in subsidiaries

31 March 2009

Consolidated subsidiaries	Country of incorporation	Interests of the CSIR					
		Issued capital	Effective holding		Financial year-end	Shares at cost less accumulated impairment losses	
			2009	2008		2009	2008
		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	**–**	–
Quotec Limited	United Kingdom	**20**	**100**	100	31 March	**705**	–
South African Inventions Development Corporation (SAIDCOR)	South Africa	**27 220**	**–**	100	31 March	**–**	–
						5 355	4 650
Indirect investments							
Included in Technifin carrying value:							
Implico BV (incorporated in the Netherlands)	Netherlands/ South Africa	**71**	**–**	100	31 March	**–**	–

The Group has interests in three dormant companies. Details of these interests are available at the CSIR's registered office.

Interests of the CSIR						
Net indebtedness less accumulated impairment losses to subsidiaries		by subsidiaries		Net investment		General nature of business
2009 R'000	2008 R'000	**2009 R'000**	2008 R'000	**2009 R'000**	2008 R'000	
–	–	**13 216**	7 409	**17 866**	12 059	The acquisition and transfer of technology to industry by licensing new inventions, providing finance to develop technology and venture capital for the exploitation thereof.
–	–	**4 464**	—	**4 464**	–	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.
–	–	**5 368**	4 215	**6 073**	4 215	The principal activity of the company is that of consultants on technology auditing, technology evaluation and technology transfer on behalf of clients in the public and private sectors.
–	–	**–**	–	**–**	–	The Inventions Development Act, 1962 (Act No. 31 of 1962) was repealed upon the promulagtion of the Technology Innovation Agency Act, 2008 and SAIDCOR was thereby disestablished.
–	–	**23 048**	11 624	**28 403**	16 274	
						The company has been deregistered.
–	–	**23 048**	11 624	**28 403**	16 274	

Abbreviations

AFIS	Advanced Fire Information System
AFSSA	Action for a Safe South Africa
AIDC	Automotive Industry Development Centre
AIPF	Associated Institutions Pension Fund
ARC	Agricultural Research Council
ARVs	Anti-retrovirals
AsgiSA	Accelerated and Shared Growth Initiative for South Africa
ASR	Automatic Speech Recognition
B-BBEE	Broad-based Black Economic Empowerment
BatCoC	Battery Centre of Competence
BG4A	Blue Gene for Africa
BMS	Bridge management system
C4	CSIR Cluster Computing Centre
CC	Competency centres
CHPC	Centre for High Performance Computing
COMRO	Chamber of Mines Research Organisation
DD	Digital Doorway
DIFR	Disabling injury frequency rate
DIMS	Data Information and Management System
DPTRW	Department of Public Transport, Roads and Works
DST	Department of Science and Technology
dti	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
EODC	Earth observation data centre
EU	European Union
FCTR	Foreign currency translation reserve
FFA	Forest Fire Association
FSI	Fluid-structure-interaction
FST	Flame, smoke and toxicity
GAAP	Generally Accepted Accounting Practice
GDP	Gross domestic product
Geo ICT	Geospatial information and communications technology
GEO-4	Global Environmental Outlook Environment for Development
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GPS	Global positioning system
GRA	Global Research Alliance
GWI	Global warming impact
HCD	Human capital development
HLT	Human language technologies
HPLC	High performance liquid chromatography
HVS	Heavy Vehicle Simulator
IAS	International accounting standards
ICS&S	Information and communications systems and services
ICT	Information and communications technology
IFRIC	International Financial Reporting Interpretations Committee
IFRS	International financial reporting standards
IP	Intellectual property
IPTTAC	Intellectual Property and Technology Transfer Advisory Committee
ISAR	Inverse synthetic aperture radar
KPI	Key performance indicator
KRA	Key results area
Lidar	Light detection and ranging
MoU	Memorandum of understanding
MRC	Medical Research Council
NAP	National Accessability Portal
NATFIBIO	Natural Fibre Reinforced Biocomposites
NCNSM	National Centre for Nano-structured Materials
NEPAD	New Partnership for Africa's Development

NIKSO	National Indigenous Knowledge Systems Office
NMISA	National Metrology Institute of South Africa
NMR	Nuclear magnetic resonance
NSI	National System of Innovation
OSS	Open source software
PABX	Private automatic branch exchange
PCT	Patent cooperation treaty
PFMA	Public Finance Management Act
PG	Parliamentary Grant
PISA	South Africa Photonics Initiative
PKM	Parallel Kinematic Machine
PULSE	Public understanding of laser science and engineering
R&D	Research and development
RAP	Research Advisory Panel
RCS	Radar cross section
REACH	Registration, evaluation, authorisation and restriction of chemicals
RICS	Research and Innovation Core Skills
RRA	Regional Research Alliance
SAAF	South African Air Force
SABINA	Southern African Biochemistry and Informatics Network
SAEOS	Southern African Earth Observation Strategy
SAIDCOR	South African Inventions Development Corporation
SAN	South African Navy
SANAS	South African National Accreditation System
SANBio	Southern African Network for Biosciences
SANDF	South African National Defence Force
SANERI	South African National Energy Institution
SANReN	South African National Research Network
SAPS	South African Police Service
SASL	South African Sign Language
SCSR	Self-contained self-rescuer
SET	Science, engineering and technology
SETI	Science, Engineering and Technology Institution
SIL	Systems Integration Laboratory
SODIS	Solar disinfection
SRP	Strategic Research Panel
TEI	Tertiary education institute
TIP	Toolkit for Integrated Planning
TRLA	Technology Readiness Level Assessment
TTS	Text-to-speech
TWO	Transboundary waters opportunity
UA	Unmanned aircraft
USD	United States dollars
VLDS	Very large data sets
WASP	Wide area surveillance project

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