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Eco-innovation policies in South Africa

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FOREWORD

The report completes a series of country profiles on eco-innovation policies in non-European OECD members and selected non-members. Similar reports on Australia, Canada, China, Japan, Israel, Korea, Mexico, New Zealand, Turkey and the US were released in 2008, 2009 and 2011. This series complements the eco-innovation roadmaps developed by EU member countries under the Environmental Technology Action Plan. It provides an empirical basis for further investigation on policies to support eco-innovation.

A short introduction presents the background for this series of country profiles, including the methodology, and a brief overview of some of the instruments identified.

Country profiles are based on extensive desk research and on field missions in selected countries (Canada, Japan, Korea, the US). Country experts have commented earlier drafts of their country profile.

This report was developed by Inga Jacobs, Richard Meissner and Cebile Ntombela, Council for Scientific and Industrial Research (CSIR).

The report on Israel was developed by Ernst & Young, Tel Aviv. The report on China was developed by Wanxin Li, City University of Hong Kong and Tsinghua Graduate School at Shenzhen.

Other reports in the series were drafted by Xavier Leflaive, under the supervision of Brendan Gillespie. Carla Bertuzzi has provided data and information on measurement issues and has drafted selected sections. IEEP was commissioned for the initial desk research and preliminary identification of policy issues. Country experts have provided most valuable inputs, in terms of time, information and policy relevance: Warren Hughes (Department of the Environment, Water, Heritage and the Arts, Australia), Javier A. Gracia-Garza (Environment Canada), Graham Campbell (Natural Resources Canada), Tim Karlsson (Industry Canada), Noriko Kishimoto (Ministry of the Environment, Japan), Kyu-Shik Park (Ministry of Environment, Republic of Korea), Carlos Muñoz Villarreal (Ministry of Environment and Natural Resources, Mexico), Vera Power and Alison Stringer (Ministry for the Environment, New Zealand), David Widawsky (USEPA), Sebahattin Dokmeci (Ministry of Environment and Forestry, Turkey).

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LIST OF ABBREVIATIONS

AEW	Anglo Environment Way
AMTS	National Advanced Manufacturing Technology Strategy
ARC	Agricultural Research Council
BASA	Banking Association of South Africa
BERD	business enterprise R&D
BRIC	Biotechnology Regional Innovation Centre
BUSA	Business Unity South Africa
CBT	Cape Biotech Trust
CCS	carbon capture and storage
CDP	Carbon Disclosure Project
CEF	Central Energy Fund
CFL	Compact Fluorescent Lamp
CGS	Council of Geoscience
CSD	Commission for Sustainable Development
CSIR	Council for Scientific and Industrial Research
CSP	Concentrated Solar Power
DAFF	Department of Agriculture, Forestry and Fisheries
DME	Department of Minerals and Energy
DST	Department of Science and Technology
DWA	Department of Water Affairs
EEDSM	Energy Efficiency and Demand Side Management
EPP	Electricity Pricing Policy
EST	environmentally sound technology
EU	European Union
FNB	First National Bank
GBCSA	Green Building Council of South Africa
GERD	gross expenditure of research and development
GHG	greenhouse gas
HEI	Higher Education Institution
HSRC	Human Sciences Research Council
IBSA	India-Brazil-South Africa
IDC	Industrial Development Corporation
IDP	integrated development plan
IDM	Integrated Demand-Side Management
IEF	Industrial Environmental Forum
IF	Innovation Fund
IMEP	integrated metropolitan environmental policies
INEP	Integrated National Electrification Programme
IPP	Independent Power Producer
LTMS	Long-Term Mitigation Scenarios
NACI	National Advisory Council on Innovation
NASA	National Aeronautics and Space Administration

NBAC	National Biotechnology Advisory Committee
NBI	National Business Initiative
NCPC-SA	National Cleaner Production Centre, South Africa
NEEP	National Environmental Education Programme
NEPAD	New Partnership for Africa's Development
NERSA	National Electricity Regulator of South Africa
NQF	National Qualifications Framework
NRDS	National Research and Development Strategy
NRF	National Research Foundation
NSI	National System of Innovation
MRC	Medical Research Council
OECD	Organisation for Economic Cooperation and Development
R&D	research and development
REFSO	Renewable Energy Finance and Subsidy Office
S&T	science and technology
SABS	South African Bureau of Standards
SADC	Southern African Development Community
SAEDES	South Africa Energy and Demand Efficiency Standard
SANERI	South Africa's National Energy Research Institute
TIA	Technology Innovation Agency
the dti	Department of Trade and Industry
THRIP	Technology for Human Resources for Industry Programme
TREC	Tradable Renewable Energy Certificate
UCT	University of Cape Town
UJ	University of Johannesburg
UNEP	United Nations Environmental Programme
UNFCC	United Nations Framework Convention on Climate Change
WRC	Water Research Commission

INTRODUCTION

Background

This report is part of the OECD work programme on eco-innovation policies. It complements a series of similar country profiles for non-European OECD countries (Australia, Canada, Japan, Israel, Korea, Mexico, New Zealand, Turkey and the US) and for selected non-members (China, South Africa). In addition, European countries developed roadmaps for eco-innovation policies in the context of the European Commission Environmental Technology Action Plan (ETAP).

The objective of this work is to complement the knowledge base on eco-innovation policies in OECD countries and to provide empirical material for additional research on policy issues related to eco-innovation. The outline of each country profile is similar to that of ETAP roadmaps, to facilitate comparison.

The work on OECD countries was implemented in coordination with country delegations, which have identified experts in each country who could provide additional information and review initial drafts of the country profile of their country.

This report was developed by Inga Jacobs, Richard Meissner and Cebile Ntombela, Council for Scientific and Industrial Research (CSIR).

The report on China was developed by Wanxin Li, City University of Hong Kong and Tsinghua Graduate School at Shenzhen. The report on Israel was developed by Ernst & Young, Tel Aviv.

For the other country profiles on non-EU OECD members, a consultant (IEEP, Brussels, Belgium) had been commissioned to collect all information publicly available in English on eco-innovation policies in each country. Field missions have been organised by the country experts in four countries (Canada, Japan, Korea, the US). During these missions, the OECD Secretariat met with the agencies identified and selected by the country expert. Draft country profiles have been developed on the basis of desk research and field missions. They have been reviewed by national experts and revised accordingly. All country profiles present information which was up-to-date at the end of 2007. In most cases, more recent information has been taken into account.

Policy instruments to support eco-innovation

The country profiles confirm that eco-innovation policies deploy a variety of instruments. They have to adjust to the features of the domestic economy, in particular the knowledge base, the size of domestic markets, and the *vigueur* of the venture capital industry.

In most non-EU OECD countries, public research and development (R&D) remains a major orientation. The US and Japan typically allocate significant public finance to environment-related R&D. However, three trends have emerged: i) some countries are concerned by the competition and trade issues related to such support; ii) public resources are increasingly channelled via Departments not directly in charge of environment policies (Energy, Agriculture, Transport), making inter-agency cooperation even

more necessary; iii) the role of research organisations is being redefined, to intensify linkages with the private sector and stimulate the development of marketable outputs; incubators in the US, or the National Institute of Advanced Industrial Science and Technology's (AIST) Technology Licensing Office in Japan illustrate innovative arrangements in this area.

Attracting private funds to finance environmental R&D is another major policy orientation. The main issue is to reduce risks for private investors investing in environmental R&D projects, while making sure that public money is used effectively and does not crowd out private initiatives. A variety of funds have been established to reduce risks to private investors (e.g. Sustainable Technology Development Canada-SDTC in Canada), or incubators (e.g. The Clean Energy Alliance in the US, Environmental Technology Business Incubator in Korea). Measures are taken to stimulate the venture capital industry and to provide incentives for environment-related projects; e.g. this is the role of the Environmental Venture Fund in Korea.

Environment-related performance standards are being set with the aim of stimulating innovation in goods and services. Such standards are pursued in particular in the field of energy and resource efficiency. However, standards may provide disincentives and can only have a lasting positive effect on innovation if they are timely revised. Schemes such as the Top Runner programme in Japan aim to address this challenge.

Market-based instruments are burgeoning in non-EU OECD Countries. A number of new projects and initiatives have been identified at national or local level. One interesting case is the all-encompassing Emission Trading Scheme envisioned in New Zealand, where equitable sharing of responsibility across sectors and stakeholders is based on the principle of equity across sectors.

There is some evidence that, besides environmental policy instruments and regulation, soft instruments such as voluntary commitments, eco-audits and eco-labels play a role as determinants of innovative behaviour in firms. Voluntary initiatives can become mandatory over time (cf. Stand-by Korea). Industry initiatives abound and, in particular contexts, can change the relationship between the administration in charge of environment policies and the business sector. This is illustrated by Performance Tracks in the US, where the US Environmental Protection Agency (USEPA) and firms enrolled in the programme construct a collaborative relationship. This typifies what can be seen as a new phase in environmental policies which sets out to promote broader sustainability, rather than address one single environmental issue. In that perspective, governments rely less on regulatory tools and endeavour to work with industries, in sectors which are materials and/or energy intensive.

In line with the OECD Council Recommendation on Improving the Environmental Performance of Public Procurement [C(2002)3], green procurement initiatives are burgeoning at local and national levels. Guidelines are supported by websites, green products databases, and *pro forma* requests for tenders. The Green Purchasing Network is an international network active in this area.

Some initiatives set out to promote technologies and products developed by one country. Others try to alleviate barriers to the deployment of environment-friendly technologies and products; shared definitions, standards and labels contribute to a level playing field for the creation and diffusion of environment-friendly technologies, products and life-styles. Such efforts are still plagued by institutional problems related to intellectual property rights and international monetary transfers. Typically, the capacity of a national agency to (financially) support one country's side of a multinational joint venture depends on how countries will share the intellectual property rights. Few cooperation projects reach developing countries (with the exception of East Asia, and China in particular).

COUNTRY PROFILE OF SOUTH-AFRICA

Country definitions of eco-innovation

In its mission to integrate its first and second economies, South Africa is committed to the dual objective of being a competitive player in global markets, as well as transforming its economy away from its former dependence on primary resource production and associated commodity-based industries (OECD, 2007). In this regard, building innovation, and particularly eco-innovation capabilities, is critical to the sustained improvement of living standards, green economic development, and the preservation of natural resources based on productivity-driven growth.

Box 1. South Africa's Sustainable Development Vision

South Africa aspires to be a sustainable, economically prosperous and self-reliant nation state that safeguards its democracy by meeting the fundamental human needs of its people, by managing its limited ecological resources responsibly for current and future generations, and by advancing efficient and effective integrated planning and governance through national, regional and global collaboration.

Source : the National Framework for Sustainable Development in South Africa, 2008

The terms "environmentally sound technology" (EST), "green technology," "environmentally friendly" products and services, or "cleaner production," "pollution prevention" and "cleaner technology," are more often used in South Africa than "eco-innovation."[1] Eco−innovation, in the context of this report, refers to green technology as well as non-technical innovations (innovative business models and processes) that have a favourable impact on the environment. The South African emphasis on eco-innovation is three tiered: 1). Innovation in the research and development of technologies or techniques for environmental protection; 2). Innovation in regulatory approaches and standards; and 3). Focus on the impact of eco-innovation mechanisms as reflected in the national priority of sustainable development. In the research and development of technologies, attention is placed on building innovative capacity, commercialising local research and development (R&D), and providing the necessary skills and funding. Innovative regulatory systems include the provision of regulatory incentives for environmental improvements, and innovative ways to regulate operations in a particular sector, such as South Africa's Energy Efficiency Strategy, for example. Finally, sustainable development is a national priority for a rapidly developing country like South Africa. This is based on the assumption that South Africa can no longer meet its socio-economic goals if ecosystems and natural resources are depleted and degraded (CSD, 2010). Eco-innovation is therefore implicitly addressed in several national policies, strategies and action plans that promote research and development that meet sustainable development objectives. In essence, it is promoted in so far as its impact can drive sustainable development in the country.

[1] Although these terms are not defined in this report, the context in which they are used matches the OECD's definition eco-innovation - innovation (both technological and non-technological i.e. business models and processes) that results in a reduction of environmental impact, no matter whether or not that effect is intended.

South Africa does not however have a specific national act, policy or strategy for eco-innovation. This is arguably as a result of several simultaneously occurring factors:

- The national policy landscape in South Africa is younger than most OECD countries. As such, South Africa's commitment to eco-innovation has not had the time to be developed into binding law.

- Eco−innovation has not caught South African authorities' attention as much as other innovation domains. This is arguably as a result of 1) regulation and public initiatives not being fully developed or coordinated and 2) some initiatives from the private sector (in particular large national companies) paving the way.

- South Africa has used its environmental policies to promote eco-innovation, without necessarily building coherence or synergy with other policies (although isolated policies have been successful in this regard).

- South Africa does not have a unified, common, and ambitious vision on how it can contribute towards eco-innovation as well as how it can harness technological development in this area to help grow the knowledge-based economy.

- Research programmes remain fragmented and small-scale with limited incentives for collaboration (although this is changing).

- South Africa's decline in GERD as a percentage of GDP over the last three years is also bound to affect eco-innovation drives, particularly as it relates to government incentives and the sustainability of funding agencies and programmes.

This does not imply that there is a lack of commitment or support for eco-innovation at the policy level. The evidence of the amount of white papers, policies and national strategies that indirectly address eco-innovation, or address it as a component of a broader programme, is proof of the bourgeoning policy commitment, but it will take time for South Africa to concretise this commitment into law. Moreover, despite the absence of specific eco-innovation legislation, several government departments, research institutions as well as private sector companies, have developed policies, strategies and programmes that promote the development and use of environmentally sound technology (CSD, 1998).

The South African private sector has contributed major investments in eco-innovation in, for example, waste water treatment technology, some of which hold world-wide patents; cleaner production and especially clean coal production; and energy efficiency. In the energy sector, significant progress has been made regarding electricity, clean coal technology and future energy supply and demand (CSD, 1998).

Several universities also collaborate with national and local authorities and the public sector on efforts to promote cleaner production processes, however, this information is scattered in several repositories.

The policy documents that currently drive research in eco-innovation: the National White Paper on Science and Technology of 1996, the National Advisory Council on Innovation (NACI) Act (Act no 55 of 1997), the Ten-Year Innovation Plan, and the National Research and Development Strategy (NRDS) of 2002, have contributed to the expansion of the environmental mandate in South Africa. Specifically, the policy document on Science and Technology (1996) provides the framework for the development of a national system of innovation (NSI) that promotes eco-innovation (CSD, 1998).

This report highlights policies, programmes, initiatives and other instruments in South Africa that influence and support the development and deployment of environment-related innovations in South Africa. It reflects South African national priorities of sustainable development, water and energy security, water and energy efficiency, and a more environmentally sound model for economic growth and development. Accordingly, this report focuses on technologies and non-technological innovations for renewable energy, for energy efficiency, carbon emissions reductions, water efficiency and air pollution prevention and control. The report is not, however, comprehensive: policies to support climate change adaptation and mitigation, effluent reuse, and intellectual property related to eco-innovation are not systematically covered.

The report has four main sections, including this, the introductory Section. Section 2 identifies institutions playing a major role in eco-innovation policies, programmes and initiatives in South Africa. Section 3 provides a national inventory of key policy documents related to eco-innovation. Section 4 highlights key initiatives and programmes that promote eco-innovation in terms of energy efficiency and clean energy, including air quality and carbon emissions reductions. Initiatives exist both at the governmental level as well as in the private sector. Section 4 also lists market-driven mechanisms that support public investment in environmental research and development (R&D), the mobilisation of financing, public awareness drives and collaborative partnerships. The report concludes with a country synthesis in Section 5, which summarises eco-innovation trends in South Africa and distinctive features of South Africa's eco-innovation landscape.

Institutions playing a major role in eco-innovation

A number of governmental departments, universities, parastatals, and other public entities support eco-innovation, often at different levels and with varying degrees of coordination.

Governmental Departments

Department of Science and Technology (DST)

DST is entrusted with the development, coordination and management of the National System of Innovation (NSI) in South Africa. As such, its commitment to eco-innovation is largely driven by the development of R&D support programmes, with a preference given to supply side policy measures. The Department's Ten-year Innovation Plan is centred on five "grand challenges" which are to be addressed through technology development and innovation (See *DST's Ten-Year Innovation Plan* on page 24 below). These "grand challenges" support eco-innovation in the areas of biotechnology, space science, energy, global change and human and social science. The plan also provides for the establishment of the Technology Innovation Agency (TIA), aimed at addressing funding issues related to the commercialisation of technological innovations (See *Technology Innovation Agency (TIA)* on page 24 below). Additionally, the Department's 2010-2013 Corporate Strategy recognises Research, Development and Innovation as one of its major programmes in line with the broader Ten-Year Innovation Plan.

(See *DST* for more information).

Department of Agriculture, Forestry and Fisheries (DAFF)

DAFF plays an important role in the development and implementation of policies, strategies and plans which encourage eco-innovation in the agricultural sector. In its 2010/11 Strategic Plan, the Department identifies six strategic objectives most of which promote and support eco-innovation.

Through the Research and Technology Development Directorate, the Department provides strategic leadership and support in sustainable agricultural production through research and technology

development. The directorate promotes the development of technologies in support of productivity, profitability and sustainability of the sector.

Through the Department's Forestry Policy and Strategy Directorate, a specific role focusing on science, technology and innovation in the forestry sector has been established by the appointment of a Forestry Science, Technology and Innovation Advisor and a Forest Research Coordinator.

(See *Department of Agriculture, Forestry and Fisheries* for more information).

Department of Energy (DoE)

The DoE regulates the energy sector in the country for the provision of safe, sustainable and affordable energy. The department's 2010/11 – 2012/13 Strategic Plan identifies eight strategic objectives which include the promotion of energy security through reliable, clean and affordable sources. This plan outlines key programmes that will be implemented including energy efficiency, demand side management and renewable energy options. The Department also plans to further invest in wind, solar technologies, carbon capture and clean coal technologies.

(See *Department of Energy* for more information).

Ministry of Water and Environmental Affairs

As the designated custodians of water and environmental resources in the country, the Department of Water Affairs (DWA) and the Department of Environmental Affairs (DEA) implement environmental strategies that support innovation to varying degrees of specificity.

The Department of Environmental Affairs, through the 2008 Cabinet, approved the National Framework for Sustainable Development (NFSD) and its current Environmental Strategic Plan 2010/11-2014/15 and Outcome 10. These priorities support eco- innovation in areas of Science and Technology for Global Change, Climate Change, Biodiversity, Sustainable Development, technology to support environmental management and regulation, Waste Management, Green Economy, Air Quality, Marine, Oceans and Coast. The Department is also currently in a process of finalising the National Strategy for Sustainable Development and the Environment Sector Research, Development and Evidence-based policy framework, both which will support eco–innovation.

The Department of Water Affairs (DWA) is responsible for the regulation and management of the water sector in the country. To carry out its mandate, the Department has adopted the Integrated Water Resources Management approach to ensure efficient, equitable and sustainable management of water resources. Additionally, DWA developed two main strategic frameworks, namely the National Water Research Strategy, 2004 and the Water for Growth and Development Framework, 2008, both of which promote eco-innovation in the water sector, specifically looking at water use efficiency, water pricing and licensing.

(See *Department of Water Affairs* for more information on DWA and *Department of Environmental Affairs* for more information of DEA).

*Department of Trade and Industry (**the dti**)*

The dti's role in driving eco-innovation policy and practice is largely within the fields of 'green industries' and energy efficiency. In January 2007, the National Industrial Policy Framework (NIPF) was adopted, which sets out Government's broad approach to industrialisation. The implementation of South Africa's Industrial Policy is set out in its Industrial Policy Action Plan (IPAP), and particularly the second

2010/11 – 2012/13 IPAP (IPAP II), which represents a progressive move towards the systematic promotion of green and energy-efficient goods and services.

Key actions in eco-innovation as stipulated in this document include:

- Assisting the DoE in its commitment to install one million solar water heaters (SWHs) by 2014 through the rollout of the national solar water heating programme, and building manufacturing and installation capacity. **The dti** have published amended National Building Regulations to make it compulsory for new buildings and upgrades to homes to install SWHs and other energy efficient building requirements, as from March 2011. Secondly, **the dti** aims to ensure that legislation is enacted to make it compulsory to install SWH when existing geysers are replaced. Thirdly, it aims to leverage **dti** incentives and IDC industrial financing to support investment and increase manufacturing and installation capacity in the SWH value chain.

- Demonstrating the viability of Concentrated Solar Thermal (CST) as a major renewable energy generation source through the IDC-led establishment of a CST demonstration plant in South Africa, as well as through rollout and manufacturing opportunities.

- Implementing the UNIDO industrial energy efficiency (IEE) project and including energy efficient motors and the scaling up of the National Cleaner Production Centre (NCPC-SA). Project deliverables include a review of the National Energy Efficiency Strategy.

- Strengthening water efficiency standards through a scoping exercise to identify key economic opportunities associated with improved water efficiency.

- Developing sector strategies for other green industries including: a wind energy generation strategy and action plan; a biomass energy generation strategy and action plan; and a recycling strategy and action plan.

(See *IPAP II* for more information).

Provincial Departments and Local/Metropolitan Municipalities

The provincial governments, through the provincial sector departments, develop and implement policies, strategies, plans and programmes which are aligned with the priorities set out at the national level. These cover a number of cross-cutting issues at provincial level including; energy, agriculture, water, waste and environment.

Additionally, local and metropolitan municipalities support the national and provincial priorities through the development and implementation of integrated metropolitan environmental policies (IMEP), and integrated development plans (IDPs). These plans are compulsory, principal strategic plans which support the use of eco-innovation in service delivery. Although plans have been drafted, budget constrains can hinder implementation.

Research and Advisory Councils, and Parastatals

In addition to departmental-led eco-innovation, South Africa also has nine statutory science councils through which the government commissions research for social, scientific and technological development. Each focuses on its own area of specialisation and offer a wide range of science-, technology- and industry-related information, archives, databases, services, products, funding and other facilities, many of which drive eco-innovation initiatives and programmes.

The National Advisory Council on Innovation

The National Advisory Council on Innovation (NACI) is appointed by the Minister of Science and Technology to advise the Cabinet on the role and contribution of innovation in promoting and achieving national objectives. Specifically, the NACI is responsible for diagnosing and proposing actions to further develop the National System of Innovation (NSI), which is defined as "the arrangement of the relationships among all organisations that are involved in the entire range of innovation activities from enablement through creative processes to the implementation stage" (DST, 1996; Marais, 2000). Additionally, NACI is charged with the:

- Co-ordination and stimulation of the NSI;
- Promotion of co-operation within the NSI;
- Structuring, governance and co-ordination of the science and technology (S&T) system;
- Revision of the innovation policy;
- Strategies for the promotion of all aspects of technological innovation;
- Identification of R&D priorities;
- Funding of the S&T system.

While no specific sub-committee on eco-innovation exists in NACI's organisational structure, eco-innovation is implicitly promoted in its other sub-committees. For example, the National Biotechnology Advisory Committee (NBAC), is mandated to advise the Minister of Science and Technology on an appropriate course for biotechnology in South Africa, including the presence of genetically modified organisms (GMO's) in commodities, sustainable funding for basic research in biotechnology, and providing incentives along the biotechnology pipeline.

(See *NACI* for more information).

National Research Foundation

The National Research Foundation (NRF) manages South Africa's national research facilities, with the aim of promoting and supporting basic and applied research in South Africa. In this regard, the NRF provides services and financial support for research and postgraduate research training, in a wide range of fields, including the humanities, social and natural sciences, engineering, and technology, including indigenous knowledge.

(See *NRF* for more information).

Council for Scientific and Industrial Research (CSIR)

The CSIR is one of the largest scientific and technology, R&D and implementation organisations in Africa. It focuses on producing scientific and technological services in areas where industry, parastatals or government clients require support, as well as innovative leadership in the development of new technologies. This, in turn, can be further developed and exploited by the private sector. Eco-innovation and the development of green technologies are therefore emphasised in several of its seven business units.

In terms of resource efficiency and cleaner production, the CSIR hosts the National Cleaner Production Centre (NCPC-SA), a dti funded programme engaged in sector specific cleaner production activities in eight sectors: textiles/clothing, agro-processing, chemicals, plastic, liquid fuels and pharmaceuticals, automotives, tourism, metals, capital and transport equipment, pulp, paper and furniture, and commercial buildings. These activities are:

- Resource-efficient and Cleaner Production advocacy through the use of quick scans, in-plant assessments, workshops, electronic media and print media avenues like newsletters;

- Sourcing, facilitation and transfer of Resource-efficient and Cleaner Production (RECP) tools and development of best practice guides and benchmarks;

(See *NCPC*-SA for more information).

Mintek

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

In terms of eco-innovation, Mintek technology has been successfully used in the water purification industry (i.e. the Minfurn carbon-regeneration furnace), the petrochemical industry (i.e. testing the susceptibility of alloys to corrosion and hydrogen-induced cracking), the non-ferrous metals industry (i.e. introduction of cleaner technologies in the processing of aluminium, cobalt, copper, lead, magnesium, nickel and zinc), and industrial minerals industry (i.e. a major R&D effort towards the beneficiation of titaniferous raw materials, which constitutes one of the country's most significant mineral resources. Mintek's research into waste management and environmental problems also falls under this programme) to mention only a few. The emphasis is on jigging technology, DC-arc furnace treatment of metallurgical waste, the bioleaching of base metal sulphide ores and residues, and technologies for gold refining for the small-scale mining industry. These and other environmental technologies and services are provided to industry through a co-operative agreement with an established environmental consulting group.

(See *Mintek* for more information).

Agricultural Research Council (ARC)

The ARC is committed to promoting agriculture, and related sectors, through research and technology development and transfer. Farmers are provided with appropriate technologies to improve production, whilst the training of farmers and agricultural extension staff in new technologies is an integral component of the ARC's activities.

The ARC conducts research in eco-innovation through its various institutes by focusing on agricultural development that promotes sustainable natural resource utilisation. This includes research activities that cover soil science, agro-meteorology, water utilisation, agricultural mechanisation, resource conservation, farm structures, irrigation, alternative energy, promotion of economic and environmentally acceptable pest control, as well as the development of holistic and integrated land-use strategies.

(See *ARC* for more information).

South Africa's National Energy Research Institute (SANERI)

SANERI, South Africa's newest research council, is entrusted with the coordination and undertaking of public interest energy research, development and demonstration in South Africa. It was established by the then Minister of Minerals and Energy in October 2004, as a subsidiary of the Central Energy Fund (CEF) (Pty) Ltd, the state energy company in South Africa. SANERI's aim is to undertake original research in the energy field that will advance South Africa's development, increase human capacity and eventually lead to commercialisable intellectual property. These areas of research include: oil, gas, electrical power, solar energy, low-smoke fuels, biomass, wind and renewable energy sources. SANERI's role in driving eco-innovation in the energy sector is yet to be seen, but it is expected that its role and responsibilities will increase rapidly in the short to medium term.

(See *SANERI* for more information).

Policy documents related to eco-innovation

South Africa's eco-innovation policy landscape is much newer than most OECD countries. Many white papers have arguably not had time to be developed into binding law. This, however, should not be read as an indication that there is no commitment to eco-innovation at the policy level. The evidence of the amount of White Papers related to eco-innovation is proof of the bourgeoning policy commitment, but it will take time for South Africa to concretise this commitment into law. As mentioned above, several key policy documents currently drive R&D in eco-innovation: the National White Paper on Science and Technology of 1996, the NACI Act (Act No. 55 of 1997), the Ten-Year Innovation Plan , and the National Research and Development Strategy (NRDS) of 2002. Additionally, a number of other sector policies and strategies promote eco-innovation, particularly those in the agricultural, energy, waste, and water sectors.

Particular emphasis is set on energy and electricity policies. Given that 90% of South Africa's electricity is generated in coal-fired power stations, South Africa still has a far way to go in terms of eco-innovation in diversifying electricity generation. However, there is a strong emphasis on clean coal production in the country as reflected in the White Paper on Energy Policy and the Energy Act. The following electricity legislation also emphasise the diversification of electricity generation, clean energy and energy efficiency:

White Paper on Science & Technology, 1996

The 1996 White Paper established a policy framework, and arguably set in motion the transformation of South Africa's S&T system into a better co-ordinated and inclusive system. The NSI approach was developed as the framework within which the S&T policy would be developed and directed towards achieving national socio-economic targets. The paper outlines the functions of the NSI and initiatives in the areas of policy formulation and resource allocation, regulatory policy, performance-level financing, performance, human resource development and capacity-building; and science and technology infrastructure.

Moreover, it addresses systemic failures requiring concerted national action such as a fragmented and inadequately co-ordinated S&T system; the erosion of innovative capacity, poor knowledge and technology flows from the science base into industry; poor networking both within the region and in the global context; and inefficiencies and poor levels of investment in R&D.

Additionally, it set the foundation for the development of the National Research and Development Strategy (2002) as well as the burgeoning Research Information Management System (RIMS). It is therefore still used as the primary policy document for R&D initiatives and innovation in the country.

Unless amendments are to be made, it is likely that this document will continue to form the basis for eco-innovation policy development in the near future.

(See *White Paper on Science and Technology* for more information).

The National Advisory Council on Innovation (NACI) Act (Act No. 55 of 1997)

The Act provides for the establishment and regulation of the NACI, whose role is to advise the Minister of Science and Technology on the role of innovation in achieving national objectives.

(See the *NACI Act* for more information).

Ten-Year Innovation Plan, 2008 - 2018

Although not considered to be promulgated piece of legislation, South Africa's *Innovation Towards a Knowledge-Based Economy: Ten-Year Plan for South Africa (2008 – 2018),* is a highly influential nation-level strategy that has shaped the eco-innovation policy landscape significantly. It strives to transform the country's economy into a knowledge-based economy and is coordinated by the DST. The production and dissemination of knowledge leading to economic benefits and enriching all fields of human endeavour is the main thrust. Four elements are central to building a knowledge-based economy:

1. Human capital development;
2. Knowledge generation and exploitation;
3. Knowledge infrastructure
4. Enablers to address the 'innovation chasm' between research results and socio-economic outcomes.

The Plan also identifies a number of 'grand challenges':

- South Africa's vision is to become a world leader in biotechnology and pharmaceuticals, which is based on the indigenous resources through the expansion of a knowledge base.
- The setting up of a National Space Agency.
- Innovations focusing on long-term energy security and investments into clean coal technology, nuclear energy, renewable energy and the hydrogen economy.
- The country should play a leading role in climate change research.
- The Plan also envisages a South Africa with a more prominent global role and a leading voice that contributes to a greater global understanding of changing social dynamics as well as the role of science in stimulating growth and development

The Ten-Year Innovation Plan is also well aligned with the recommendations of the NACI, and through this, the strengthening of the NSI. The foundation of any NSI is that innovation is a process of learning and this interaction plays a significant role in the innovation process. Also, innovation is shaped by social, cultural and institutional factors that create and distribute resources. As such, the NSI is a network that distributes resources towards the facilitation of innovation. It is therefore the flow of

technology and knowledge between people. The NSI approach also takes into account that knowledge and technology flows are affected by the policies of various government departments other than the DST.

(See *Ten-year Innovation Plan* for more information).

South Africa's National Research and Development Strategy (NRDS), 2002

The strategy identified several interventions to give effect to the White Paper on Science and Technology. It is particularly notable for promoting the development and management of the NSI that promotes eco-innovation. It is centred on three operational strategic objectives including: innovation to achieve mastery of technological change in the country's economy and society, human capital and transformation to increase investment in the country's science base, and alignment and delivery aimed at creating an effective science and technology system.

(See *South Africa's National Research and Development Strategy* for more information).

White Paper on Energy Policy, 1998

The White Paper on Energy Policy (1998) was written to clarify government policy regarding the supply and consumption of energy for this decade. In terms of eco-innovation, it advocates for greater emphasis on demand-side issues, analysed in terms of the energy requirements of households, industry, commerce, mining, transport and agriculture.

It outlines five policy objectives including: increasing access to affordable energy services; improving energy governance; stimulating economic development; managing energy-related environmental and health impacts; and securing supply through diversity. The policy aims to minimise the environmental impact in a cost-effective manner, and also to jointly manage both supply and demand.

The Paper also indicates the government's intention to support renewable energy technologies and to work towards establishing national targets for reducing emissions.

(See the *White Paper on the Energy Policy of South Africa* for more information).

White Paper on Renewable Energy, 2003

The White Paper on Renewable Energy aims to communicate to the public and the international community, Government's goals and objectives for the optimal use of renewable energy. Because of the need to reduce environmental damage caused by South Africa's reliance on electricity from coal, as well as the need for diversification of energy resources, the paper commits the Government to a number of actions that promote eco-innovation to ensure that renewable energy becomes an integral part of South Africa's energy portfolio over the next ten years.

These actions include: fiscal mechanisms; regulatory instruments; standards to promote R&D and investment in renewables; and educational programs to raise public awareness. The government aims to integrate renewable energy technologies into the mainstream energy economy. To achieve this aim it has set a target of 10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013.

This White Paper is significant for eco-innovation efforts pertaining to renewable energy because it provided the basis for the development of the national renewable energy strategy, as well as the implementation plan, which identified various technologies to be implemented based on the level of commercialisation of the technology and natural resource availability. These technologies include:

- Sugar-cane bagasse (the fibre that comes from crushing the sugar cane) for cogeneration;
- Landfill gas extraction;
- Mini-hydroelectric schemes;
- Commercial and domestic solar water heaters;

(See *White Paper on Renewable Energy, 2003* for more information).

Biofuels Industrial Strategy, 2007

The Biofuels Industrial Strategy outlines Government's approach to policy, regulations and incentives. In terms of its focus on eco-innovation, it sets the target of achieving a 2% penetration level of biofuels in the national liquid fuel supply, or 400 million litres pa, in 5 years, without jeopardising food security. This target represents a serious call to the energy sector to innovate in terms of biofuels production but also seeks to continue incentives to develop biofuels through tax breaks and exemptions, and addresses issues of production, land use, water resources, and funding.

Additionally, this Strategy promotes eco-innovation through subsidisation i.e. fuel levy exemptions and pegging the sales price of biofuels as blending components at a price that covers the costs associated with running biofuels plants, agricultural feedstock and transport. According to the Strategy, the cost of biofuels is ring-fenced, and remunerated separately, because blending will be done at wholesale level. The cost to the motorist will be equivalent to $65/bbl (barrel) of crude oil-based refined products and will therefore present a benefit, although limited to only 2% if the price of crude oil stays above $65/bbl. Also, the strategy recommends that the existing fuel levy exemption for biodiesel should continue. The proposed levy exemption of 50% for biodiesel amounts to an effective support of 53c/litre; for bio-ethanol it is R1.21/litre. Currently biodiesel plants producing under 300,000/litres per year are fuel tax-exempt. This is hoped to drive eco-innovation particularly by small investors and producers.

(See *Biofuels Strategy* for more information).

National Energy Act (Act No. 34 of 2008)

Promulgated in 2008, the Act aims to ensure that diverse energy sources are available at affordable prices, in support of economic growth and poverty alleviation, also taking into consideration environmental management requirements. It also charges the Minister with the creation of a programme to promote renewable energy technologies, an energy efficiency program, and an energy research and technology development program.

(See *National Energy Act* for more information).

Electricity Regulation Act (Act No. 4 of 2006)

The Electricity Regulation Act was promulgated with the purpose of establishing a national regulatory framework for the electricity supply industry; making the National Energy Regulator of South Africa (NERSA) the custodian and enforcer of the national electricity regulatory framework; and providing for licences and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated. In terms of eco-innovation, it promotes the use of diverse energy sources and energy efficiency, and ensures that licenses comply with energy efficiency standards and requirements, including demand-side management.

(See *Electricity Regulation Act* for more information). The Act was subsequently amended in 2007 in the Electricity Regulation Amendment Act (Act No. 28 of 2007).

(See *Electricity Regulation Amendment Act* for more information).

Electricity Pricing Policy (EPP) (1398 of 2008) and the Free Basic Electricity Policy

The EPP was implemented in 2004 and the Free Basic Electricity Policy, in 2003, to liberalise the electricity sector in South Africa and also to be transparent and cost-effective. The EPP provides direction and principles for the formulation of electricity prices in South Africa. In line with the national mission to balance meeting social equity, economic growth and environmental goals, this policy was adopted to obtain a balance between affordable electricity tariffs for low income consumers and cost reflective tariffs for all other consumers.

Eco-innovation is promoted in so far as it promotes an energy efficient and environmentally-friendly electricity industry, for which NERSA will develop incentive-based tariff structures and other instruments. Specifically, the policy outlines a demand management approach based on promoting changes in consumption behaviour and enhancing the efficiency in resource use. South Africa's electricity pricing framework is also meant to be developed in parallel with measures that set aside funding for purposes of technological innovation and increased investment in renewable electricity generation technologies.

(See *Electricity Pricing Policy* or the *Free Basic Electricity Policy* for more information).

Agricultural Policy in South Africa, 1998

This policy sets out the general strategies and principles for the development and implementation of agricultural policies in the country. It is centred on seven agricultural policy areas which have great implications for eco-innovation in the agricultural sector. The policy areas with a strong eco-innovation component include production, sustainable utilisation of natural resources and agricultural technology, research, extension and training.

(See *Agricultural Policy in South Africa* for more information).

Policy on Agriculture in Sustainable Development

This policy is aimed at building the agricultural sector to be ecologically, socially and economically sustainable in South Africa. The policy advocates for the development of a national agricultural research system that promotes technology development required for sustainable agricultural productivity growth.

(See *Policy on Agriculture in Sustainable Development* for more information).

Air Quality Act (Act No. 39 of 2004)

This Act stipulates that norms, standards, mechanisms, systems and procedures be issued to improve air quality. It establishes the national framework within which these standards will be created, giving the Minister, or the members of the Executive Council of a province (MEC), the authority to issue standards, enforce regulations and other measures, implement penalties for noncompliance, and establish "funding arrangements."

(See the *Air Quality Act* for more information).

National Environmental Management Act (NEMA) Legislation

The NEMA legislative suite has developed since 1998, with the original NEMA (Act No. 107 of 1998) undergoing an active review and amendment process. The NEMA (Act No. 62 of 2008) legislation represents the latest amendment to the general Act, however, more specific NEMA legislation relating to biodiversity, air quality, protected areas, integrated coastal management have also been developed and subsequently amended.

All of these Acts address research and innovation in a particular environmental area. This suite of legislation provides a good example of how environmental policies support innovation in various industries in which the legislation applies. Regulatory mechanisms are provided ranging from waste to environmental impact assessment regulations, and from bio prospecting, mining and exploration, to dumping at sea and protection of endangered species.

The Waste Act, 2008 (Act No. 59 of 2008)

The President of the Republic of South Africa signed the National Environmental Management: Waste Bill into an Act of Parliament in March 2009, after which it took effect from 01 July 2009. The Act aims to address the current fragmentation in waste legislation in South Africa and provides a fixed set of rules that waste generators and disposers have to comply with. The Act is significant for eco-innovation because the development of effective waste management practices requires research, technology development, as well as technology deployment. As such, the development and implementation of a research and innovation programme that supports effective waste management is recommended, as are interventions that create a sustainable and growing waste management sector in the country. It also identifies norms and standards for regulating the management of waste by all spheres of government; specific waste management measures; outlines licensing and control of waste management activities; as well as the remediation of contaminated land.

National Climate Change Response Strategy, 2004

The National Climate Change Response Strategy is aimed at addressing issues that have been identified as priorities for dealing with climate change in the country. It sets out strategies and actions by the government which will assist South Africa in achieving its sustainable development objectives while addressing the need to respond to climate change. The strategy recognises research, development and demonstration as important parts of the framework of interventions.

(See *National Climate Change Response Strategy* for more information).

White Paper on Integrated Pollution and Waste Management (IP&WM), 2000

This White Paper promotes the implementation of a range of waste management practices, namely reduction of waste at source (cleaner production/technology), reuse, recycling, and safe disposal as the last resort. The resultant National Waste Management Strategies and Action Plans propose strategies and actions for each component of pollution and waste management that will advocate for the use of environmentally sound technologies, particularly regarding cleaner production/pollution prevention.

The White Paper also recognises the importance of both applied and basic scientific research for policy development and decision-making on pollution and waste management. As stated in this paper, Government has made a commitment to:

- promote sound scientific research and monitor and recognise local knowledge and information;

- ensure a wide dissemination of the results of research and other pollution and waste management data;

- encourage access to information and legislation;

- encourage individuals and the communication media to act on the basis of sound information, and

- pay attention to the environment at all levels of the formalised education system to make sure that all members of society understand the sources, the prevention and the minimisation of pollution and waste.

National Water Act (NWA), 1998 (Act No. 36 of 1998)

South Africa's NWA represents a policy model for eco-innovation in its own right. Through the promulgation of the NWA, riparian water rights were replaced by an administrative allocation system, and all water is considered as part of the hydrological cycle (whereas previously groundwater and surface water were treated differently). Other important innovations in the Act include the introduction of the "Reserve" which set aside water for basic human needs and the environment, and provision for the establishment of Catchment Management Agencies (CMAs[2]). It therefore adopts an integrated approach to water resources management and utilisation in order to promote the protection, use, development, conservation management and control of all water resources in the country. In terms of economic mechanisms to promote eco-innovation, the NWA makes provision for the setting of water tariffs at levels which reflect the real cost of water and its relative scarcity or abundance; as well as the introduction of a system of waste charges, to be imposed for discharges to water resources.

(See *NWA* for more information).

Acts related to Research and Development

Research and development in eco-innovation is also prioritised in several research Acts as they pertain to the research councils particularly. Selected Acts are described below.

Agricultural Research Act (Act No. 86 of 1990)

Through this act, the ARC is established with the objectives to develop and transfer technology, promote agriculture and industry to contribute to the improvement of living standards of South Africa's population. Research must also be conducted with regard to the protection of the environment and the optimal use of the country's agricultural resources, as well as the improvement of such resources.

(See the *Agricultural Research Council* for more information).

Genetically Modified Organisms (Act No. 15 of 1997)

Through the Act, a Council on Genetically Modified Organisms is established. One of the duties of this Council is to "promote co-operation between the Republic and any other country with regard to research, development and technology transfer in the field of the genetic modification of organisms..."

[2] At the time of writing this report, there is one CMA active in South Africa

Scientific Research Council (Act No. 46 of 1988)

This Act provides for the continued existence of the CSIR, which was established by section 2 of the Scientific Council No. 33 of 1945. The objectives of the CSIR are to advance industrial and scientific research either independently or in collaboration with other research institutions from the private and public sectors. This research shall be conducted for the purpose of improving the living standards and quality of life of the South African population.

Programmes, Initiatives and instruments: a national inventory

Research and Development

The OECD provides a useful definition of research and development (R&D). Research is experimental or theoretical work undertaken with the goal of acquiring new knowledge of phenomena and observable facts. The aim of a research activity is therefore "to discover novel, practical and non-obvious information of a scientific or technological nature" (OECD, 2002). Development, on the other hand, is the application of research findings or other scientific knowledge towards the creation of new or improved products, processes or services. "Development activities are aimed at devising, developing or creating an invention, design or computer programme of a scientific and technological nature" (OECD, 2002). These above-mentioned definitions will be applied, in this report, to the following section on R&D as it pertains to eco-innovation in South Africa.

Statistics on R&D in South Africa

Specific government R&D expenditure on eco-innovation does not appear to be available in summary form, though the DST annually produces the National Survey of Research and Experimental Development (2008/09 Fiscal Year). Based on the OECD's Frascati Manual Guidelines, the survey is conducted annually by the HSRC, and has become a regular feature of South Africa's S&T landscape.

As reflected in Table 1, the latest survey results report a recorded gross domestic expenditure on R&D (GERD) of R21.0 billion, a nominal increase of R2.4 billion from the R18.6 billion recorded for 2007/08 (DST, 2009). The GERD, expressed as a percentage of GDP provides an indication of the concentration or intensity of R&D in an economy (DST, 2009). Additionally, the 2008/09 expenditure represents a 12.9% nominal increase, but was insufficient to keep up with the increase in the nominal Gross Domestic Product (GDP) of 13.2% over the corresponding period.

While there has been a steady increase in GERD as a percentage of GDP from 0.60% in 1997/98 to 0.95% in 2006/07, it has in more recent years dropped to 0.93% in 2007/09, and later to 0.92% in 2008/09(See Figure 1; DST, 2009). This means that the increase in national R&D expenditure for 2008/09 was not enough to reach the target of 1% of GDP set for that year. Structural and other constraints in South Africa's NSI may have played a role in limiting the kind of expansion needed prior to 2008. That being said, the mobilisation of financing has seen some major progressive changes, including the tax treatment of R&D and/or changes in direct support for R&D.

Few OECD countries have a GERD equivalent less than 1.0% of GDP. Leading countries in R&D expenditure such as Sweden, Finland, Japan and Korea have R&D expenditures exceeding 3.0% of GDP. In comparison to other countries, South Africa's GERD equivalent of 0.92% is lower than the OECD average (2.28%).

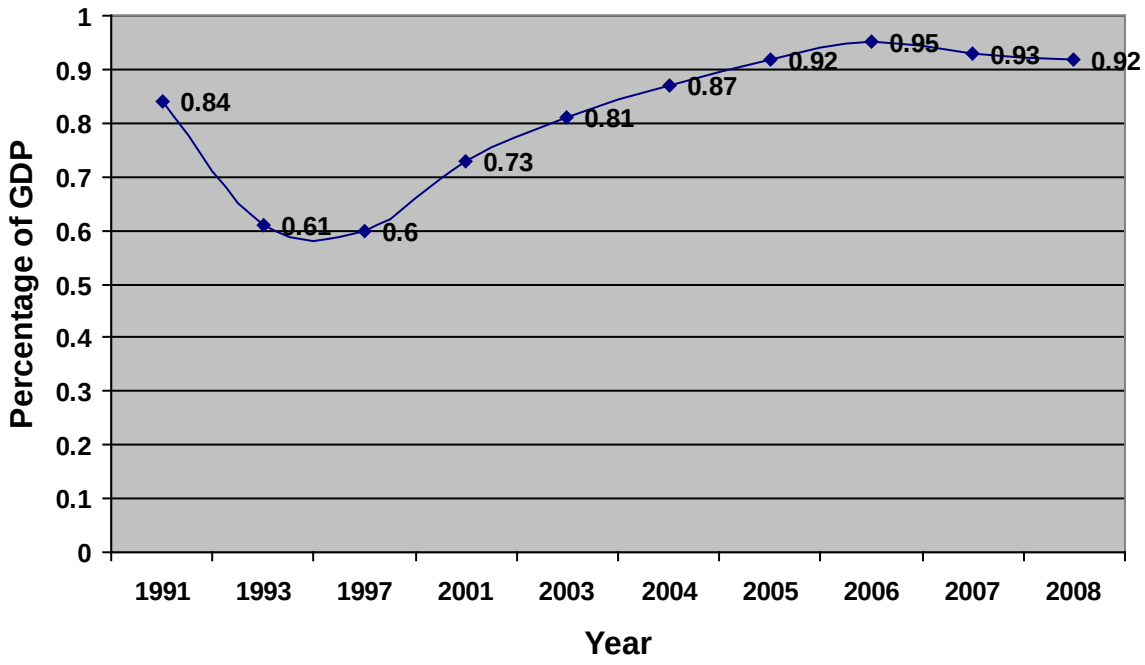
Table 1. Key Figures as reflected in the National Survey of Research and Experimental Development

2008/09 Fiscal Year

Indicator	Value	
	2007/08	2008/09
Gross domestic expenditure on R&D - GERD (Rand Millions)	18 624.0	21 041.0
Gross domestic product (GDP) at market prices (Rand Millions)	1 999 086	2 283 822
GERD as a percentage of GDP	0.93	0.92
Total R&D personnel (FTE)[3]	31 352	30 802
Total researchers (FTE)[4]	19 320	19 384
Total researchers per 1000 total employment (FTE)	1.5	1.4
Total R&D personnel per 1000 total employment (FTE)	2.4	2.2
Civil GERD as a percentage of GDP	0.87	0.87
Total researchers (headcount)	40 084	39 955
Women researchers as a percentage of total researchers	40.3	39.7

Sources: South African National R&D Surveys and Statistics South Africa P0441 Gross Domestic Product, First Quarter 2010

Figure 1. Gross Expenditure on R&D as a percentage of GDP (South Africa, 1991-2008)



Source: South African National R&D Surveys and Statistics South Africa P0441 Gross Domestic Product, Fourth Quarter 2009

[3] FTE = Full Time Equivalent

[4] Following OECD practice, doctoral students are included as researchers

National R&D Programmes and Initiatives

As alluded to previously, several governmental departments and private companies are engaged in the implementation of action plans and strategies that emphasise R&D that will benefit the environment.

DST's Ten-Year Innovation Plan

South Africa's *Innovation Towards a Knowledge-Based Economy: Ten-Year Plan for South Africa (2008 –2018)* is described in more detail in earlier sections. To summarise, it is based on a number of 'grand challenges' but not limited to: the need for long-term energy security and investments into clean coal technology, nuclear energy, renewable energy and the hydrogen economy; the need for South Africa to play a leading role in climate change research; and the affirmation that South Africa play a more prominent global role to achieving a greater global understanding of changing social dynamics as well as the role of science in stimulating growth and development.

(See *Ten-Year Innovation Plan* for more information).

Technology Innovation Agency (TIA)

The TIA was set up as a public entity in terms of the TIA Act, 2008 (Act No. 26 of 2008), with the objective of "stimulating and intensifying technological innovation in order to improve economic growth and the quality of life of all South Africans by developing and exploiting technological innovations." It therefore promotes the commercialisation of local R&D and the development of innovative technology based products and services, particularly in industrial biotechnology, health, information and communication technologies, engineering, and agriculture. Specifically, the role of the TIA agro sector is to act as a catalyst to develop, stimulate and diversify the agricultural economy of South Africa through technological innovation. One way in which it achieves this is through the identification of technologies that can provide viable solutions to commercial, emerging and subsistence farmers.

Moreover, the TIA provides and mobilises financial and non-financial support across several technological areas in various sectors of the economy through:

- appropriately structured financial and non-financial interventions for the commercialisation of R&D;
- the development and maintenance of advanced human capacity for innovation as opposed to just R&D human capital;
- building a culture of innovation in the South African economy; and
- leveraging local and international partnerships in order to facilitate in-bound technology transfer, build local technological competencies, and encourage foreign direct investment for the commercialisation of technologies in South Africa.

The TIA is also the implementing agent for the DST, which means that it is the primary implementer of the NSI. The TIA was formed through the merger of several existing government-led funding agencies some of which focused specifically on building eco-innovation capacity. This migration process of existing funding agencies into TIA is still on-going. The existing entities which have been incorporated into TIA are the:

- Biotechnology Regional Innovation Centres (BRICs) – four regional centres were set up to ensure the advancement of Biotechnology research and development i.e. BioPAD, Cape Biotech Trust (CBT), LIFElab and PlantBio.

- Innovation Fund (IF) - assisted in the conversion of research ideas into commercially useful end-products by funding necessary items such as equipment, R&D expertise, access to managerial skills, the securing of intellectual property rights and the construction of prototypes. By 2008, the IF funded more than R1 billion in projects that ranged from biotechnology to aeronautics. In terms of eco-innovation R&D and the development of technologies, the IF applied the following major criteria when making its selections: technology and novelty, market and commercial case, and team and plan competitiveness, but also quality of life and environmental sustainability.

- National Advanced Manufacturing Technology Strategy (AMTS) implementation unit – served to address technological innovation in the manufacturing sector, focusing on cleaner production and pollution control.

- Tshumisano Trust - served technology-based small and medium enterprises (SMEs) and was hosted by South Africa's universities of technology. While the government provided finance and policy instruments, the universities of technology provided the intellectual capacity to enhance growth and competitiveness of SMEs. Projects related to agri-food processing training, chemical manufacturing and automotive projects were some of the projects highlighted in Tshumisano's 2009-10 Annual Report.

While DST remains active in the policy development area, the TIA will focus on implementation activities and channelling innovation initiatives from a number of different government departments. TIA is still a new entity and its role in promoting eco-innovation remains to be seen. However, structural weaknesses and the lengthy and cumbersome migration process have created stumbling blocks to the smooth implementation of the NSI.

(See *TIA* or *TIA - Innovation Fund* for more information).

Regional, Provincial, Municipal R&D Programmes and Initiatives

R&D initiatives also exist at other levels of scale, ranging from the regional to the provincial and metropolitan, and to the municipal levels. A particularly notable regional initiative, spear-headed by the New Partnership for Africa's Development (NEPAD), is the Water Centres of Excellence.

In terms of the sub-national provincial, metropolitan or municipal levels, the success and effectiveness of implementation of any of the previously mentioned national strategies and programmes is very much dependent on the amount of support and involvement of provincial stakeholders. Key provinces such as Gauteng, KwaZulu-Natal, the Western Cape and the Eastern Cape are often targeted by such national strategies and encouraged to develop applicable guidelines and implementation plans that are coordinated with national-level initiatives. Moreover, at these levels, provincial and metro stakeholders such as government, business, labour and educational institutions are encouraged to participate to ensure that sufficient coordination and support are in place.

Southern Africa NEPAD Water Centres of Excellence

The NEPAD Water Centres of Excellence are academic institutions that meet the requirements for a centre as described in the NEPAD Water initiative guide and include all the higher education institutions and/or science councils that participate in the NEPAD Water Initiative. These include, Stellenbosch

University Water Institute, the University of the Western Cape's Institute for Water Studies, the CSIR's Natural Resources and the Environment business unit, as well as the University of KwaZulu-Natal. The specific goals for these centres are listed as follows:

- To improve conservation and utilisation of the continent's water resources;
- To improve the quality and the quantity of water available to rural and urban households;
- To strengthen national and regional capacities for water resources management and reduce impacts of water related disasters; and
- To enlarge the range of technologies for water supply and improve access to affordable quality water. Several of these centres exist in South Africa, but several also reside in other Southern African countries.

Research undertaken is very much focused on the creation and development of new knowledge and technology related to water quality, water supply and improved access.

(See *NEPAD Water CoE* for more information).

University Initiatives

Research programmes that promote eco-innovation are also housed at different South African universities, each with their own unique focus. For example, the Environmental Policy Research Unit (EPRU), part of the South African Labour Development Research Unit (SALDRU) at UCT, is a research entity with the aim of strengthening policy making through research for sustainable development and poverty reduction. The Unit's goal is the promotion of quality and innovation in research and advice on South Africa's environmental policy. Also, the Centre for Transport Studies coordinates a national initiative to strengthen scientific and technological support to enable the implementation of sustainable transport policies in the country.

In a slightly different vein, the Nanomaterials Science Research Group, at the University of Johannesburg, focuses on the synthesis, characterisation and application of a number of nanomaterials to energy, water, catalysis, medicine and materials.

Research and development in eco-innovation is also conducted at the University of Witwatersrand's Centre of Material and Process Synthesis, where the focus is on the construction and improvement of chemical plants to reduce CO_2 emissions. Here, the entire chemical process is studied in large plants rather than certain sections of the plant or the process.

Performance Targets and Standards

Several types of performance targets exist in various sectors to prescribe, challenge or encourage the government, the private sector as well as the public to regulate their actions through renewable energy standards, energy efficiency targets, and carbon emission reductions by providing demand-side mechanisms that encourage behavioural changes.

The South African Bureau of Standards (SABS)

The South African Bureau of Standards (SABS) is a statutory body that was established in terms of the Standards Act, 1945 (Act No. 24 of 1945) and continues to operate in terms of the latest edition of the Standards Act, 2008 (Act No. 29 of 2008) as the national institution for the promotion and maintenance of standardisation and quality in connection with commodities and the rendering of services in South Africa.

SABS actively supports environmental conservation through the SANS 14001/ISO 14001 certification scheme.

In addition, the SABS, in collaboration with the international Soil Association/Woodmark programme, provides an efficient locally based combined certification service for forest and chain of custody certification. This certification service ensures that timber originates in a forest or woodland that is responsibly managed to high environmental, social and economic standards, and that products from responsibly managed forests are a genuinely renewable resource.

The SABS also sets standards for air quality, illustrated by the publication of two important standards for air quality (SANS 69 and SANS 1929). These standards affect the work of persons concerned with air quality, and are linked to the Air Quality Bill. The SABS involvement with air quality also extends to Conformity of Production (CoP), vehicle exhaust emission and noise tests. Exhaust emission tests are conducted to assess if emissions comply with current and future global requirements.

(See *South African Bureau of Standards (SABS)* for more information).

Energy Efficiency

Standard Offer Policy, 2010

The Policy to support the Energy Efficiency and Demand Side Management: Program for the Electricity Sector through the Standard Offer Incentive Scheme, or the Standard Offer Policy, aims to balance approaches based on regulation, incentives, and market based mechanisms, while simultaneously defining the role of government in accelerating energy efficiency and demand side management (EEDSM).

(See *Standard Offer Policy* for more information).

Integrated Energy Plan

Implemented in 2003 by the Department of Minerals and Energy, the Integrated Energy Plan is a framework that outlines the direction and steps to be taken by South Africa to meet energy needs, given South Africa's current reality of coal dependence for the next two decades at least.

The Plan promotes investigations into nuclear options as a future new energy source; the national priority placed on energy efficient management and technologies; and environmental considerations in energy supply, transformation and end use.

The Plan also uses modelling to forecast which energy sources can be used most effectively, and advocates for the development of different energy sources, including renewables and fuel switching; and energy technologies, to improve energy efficiency.

(See *Integrated Energy Plan* for more information).

National Energy Efficiency Strategy

Implemented in 2005, the National Strategy takes its mandate from the White Paper on Energy Policy, and provides guidelines, goals and means for implementing energy efficient practices nationwide and across all sectors.

The key features of the strategy include energy management activities, energy audits, and energy efficiency standards and labelling for vehicles, appliances and buildings (adopting EU vehicle and appliance standards has been proposed and is under consideration). It also mentions fiscal measures to be taken immediately (no-cost and low-cost interventions as well as higher cost measures with short payback periods), and in later phases, including rebates and incentives.

The Strategy proposes support of R&D for the adaptation of internationally available technology for energy efficiency, but proposes no specific means or budget for this effort.

Additionally, increasing awareness of the costs and harmful effects of inefficient consumption through education and awareness programs is one way in which the government hopes to make a difference in public behaviour. Finally, it designates a national target of 12% improvement in national energy efficiency by 2015.

(See *National Energy Efficiency Strategy* for more information).

Energy Efficiency Accord

The Energy Efficiency Accord is a voluntary regulatory instrument that was implemented in 2005 by an Energy Efficiency Technical Committee comprising of signatory representatives and the Department of Minerals and Energy (DME). The Accord is a long-term process that aims to encourage business-led, voluntary initiatives to improve energy efficiency in the country, and requires signatories to show a determined commitment in this regard. This commitment is also aligned to the national target of reducing energy demand by 15% by 2015.

Recognising the benefits of increased efficiency for economic competitiveness and national security, and financial savings that could be made from energy efficient technologies, the Accord is a pledge by industries and government to engage each other and work cooperatively to realise their commitment. Measures proposed include the use of Demand Side Management contracts, the provision of fiscal and other incentives, the enabling of information sharing and networking, the identification of Best Practices, the promotion of CDM projects, and the development of common reporting requirements, an energy auditing protocol, and training material.

(See *Energy Efficiency Accord* for more information).

The South Africa Energy and Demand Efficiency Standard (SAEDES)

The SABS are tasked to develop a set of South African Energy and Demand Efficiency Standards (SAEDES) guidelines for new and existing commercial and residential buildings (SANS 283). The aim of the SAEDES is retrofit buildings to make them more energy efficient, with the anticipated saving of roughly R600 000 in electricity bills per year. In terms of eco-innovation, it promotes good design, innovation and the use of renewables.

Efficiency standards on household appliances

The National Energy Act (Act No. 34 of 2008) gives the Minister of Minerals and Energy significant authority to make efficiency standards compulsory. Energy efficiency standards as well as the mandatory labelling of household appliances forms an integral part of South Africa's Energy Efficiency Strategy. The latter's purpose is to inform the public on how energy efficient their household appliances are.

According to the Department of Energy, the environmental goal is to reduce greenhouse gases from energy consumption through the introduction of high-efficiency (optimal electricity consumption)

appliances. This is complemented with the social goal of introducing energy-efficient appliances into the market, allowing poorer consumers to have the option of purchasing appliances that are cheaper to run.

Labelling is already applied to refrigerators with the labelling of washing machines, air conditioners, lamps and water heaters being planned. Efficiency standards and the roles and responsibilities of government and parastatal institutions regarding such standards are also outlined in the Department of Energy's Energy Efficiency and Demand Side Management Support Program Policy.

(See *Appliance Labelling Campaign* for more information).

Clean Energy (Air Quality and Carbon Emission Reduction)

Joint implementation strategy for the control of exhaust emissions from road-going vehicles (2003)

The Department of Minerals and Energy and the former Department of Environmental Affairs and Tourism, in collaboration with the South African Petroleum Industry and the National Automobile Association of South Africa drafted this Strategy to achieve improved air quality through the control of vehicle emissions in the oil industry and the vehicle manufacturing industry. The legislation applies a clearly defined timetable based on European standards for vehicle exhaust emissions and appropriate fuel specifications. Initial vehicle emissions limits began in 2005 for newly homologated vehicles and came into full effect in 2006 when all new vehicles were subjected to emissions controls. The fuel specification changed in 2006 when a total ban of the use of lead in petrol came into effect.

(See the *Joint implementation strategy for the control of exhaust emissions from road-going vehicles in South Africa, Final Draft* for more information).

Mobilisation of Financing

In terms of cleaner production, particularly in waste management, the White Paper on Environmental Management Policy recognised that "There are no effective incentives to encourage all waste producers to adopt cleaner production processes and minimise waste generation" (Department of Water and Environmental Affairs, 1997c).

In the water sector, no financial instrument is used at present to encourage eco-innovation, however, there is provision for two types of economic instruments in the National Water Act (NWA) of 1998 (CSD, 1998). Firstly, it stipulates that water tariffs can be set at levels which reflect the real cost of water and its relative scarcity or abundance. This is intended to act as an incentive for the development of water-efficient technologies, improved recycling and reuse. Secondly, the NWA introduces a system of waste charges, to be instituted for discharges to water resources (Republic of South Africa, 1998). These mechanisms promote the development and implementation of improved treatment technologies as well as low-waste technologies.

DST's R&D Tax Incentives Programme

The Research and Development (R&D) Tax Incentives Programme, managed by the DST in conjunction with the South African Revenue Service (SARS) and the National Treasury, encourages the private sector to invest in research and development activities, as an indirect approach to increasing national R&D expenditure. The Tax Incentives Programme is based on the Income Tax Act 1962 (Act 58 as amended), and stipulates that eligible activities can receive a deduction at the rate of 150% of expenditure in respect of scientific or technological R&D.

(See *Tax Incentives Programme Brochure* for more information).

The Central Energy Fund (CEF)

The CEF (Pty) Ltd. is a private company, established in terms of the Companies Act, and governed by the CEF Act, implemented in 1977 and amended in 1994. CEF is involved in eco-innovation practices through its search for appropriate energy solutions to meet the future energy needs of South Africa, but also beyond national borders to the Southern African Development Community (SADC) and the sub-Saharan African region, including oil, gas, electrical power, solar energy, low-smoke fuels, biomass, wind and renewable energy sources.

Energy Development Corporation (EDC), a new division of the CEF is responsible for making commercially viable investments in renewable energy, with the exception of natural oil and other already commercialised and developed energy technologies in Southern Africa.

In the past, monies in the CEF were collected from motorists for energy development purposes, a practice which continued until 1988. Currently, the fund plays a funding role and is managed by the CEF board for that purpose. The use of the money held by the fund is limited to specific purposes which include research and the promotion of renewables.

(See *CEF* for more information).

Technology for Human Resources for Industry Programme (THRIP)

The THRIP is a partially DTI-funded and industry-funded programme managed by the NRF that supports joint industry, research, academic and research initiatives. The basic premise of the THRIP programme is that successful candidates obtain funding that has been jointly sourced from government and industry. The funding criteria require researchers to find solutions to existing challenges facing industry.

Projects supported by THRIP cover a wide range of technology areas, including agriculture, bioprocessing, food, forestry, health care, materials, mining, manufacturing, and power systems. Over 200 THRIP projects have been approved for S&T research grants, that have ranged from R5 000 to R8 million.

(See *THRIP* for more information).

Capital subsidies for renewable energy technologies

The Department of Minerals and Energy, in 2005, announced the establishment of the Renewable Energy Subsidy Scheme. The scheme was set up to only be a once-off capital grant made available for project developers between 2005/06 - 2007/08. However, it has continued beyond this, and is now managed through the Renewable Energy Finance and Subsidy Office (REFSO), whose mandate includes the management of renewable energy subsidies, and the provision of advice to developers and other stakeholders on renewable energy finance and subsidies, (including size of awards, eligibility, procedural requirements, etc). Subsidies cannot exceed 20% of the total capital cost, and the minimum project size is 1 MW (for electricity), implying a subsidy amount of R250 000. Since the establishment of REFSO, six projects with a total installed capacity of 23.9 MW have been subsidised. Three of these projects are small scale hydro, biogas to electricity project, wind energy and landfill gas to electricity.

(See *REFSO* for more information).

Market-based Instruments

Market-based instruments include government or private sector-led initiatives that support eco-innovation through, for example, carbon credit trading, private financing for renewable energy, etc.

A number of market-based instruments in the form of environmentally-related taxes and charges are employed in South Africa. These focus on the transport, non-transport energy, water, waste water and waste management sectors. Some of these charges and taxes are presented below.

- Transport fuels: General Fuel Levy, Road Accident Fund Levy, Equalisation Levy and Customs Levy.
- Vehicle taxation: Ad Valorem Customs and Excise Duty, Road Licensing Fees
- Aviation taxes: Aviation Fuel Levy, Airport Charges
- Product taxes: Plastic Shopping Bags Levy
- Electricity: NER Electricity Levy, Local Government Electricity Surplus
- Water supply: Water Resource Management Charge, Water Resource Development and use of Water Works Charge, Water Research Levy
- Waste water: Waste Water Discharge Charge System (National Treasury 2006).

South African banks(See Financial Services below for more information) are also involved in carbon credit trading through buying and selling of carbon credits.

Tradable Renewable Energy Certificate (TREC)

The Department of Energy's Tradable Renewable Energy Certificate is an electronic record that verifies the origin of energy by registered renewable energy entities, and refers to green certificates or green tags. TREC is based on separating the various attributes of renewable resource-based energy provision from physical energy carriers, electric or otherwise. In addition to being an energy source verifier, it is also a revenue stream for renewable energy Independent Power Producers (IPPs). The major advantage of TREC is that, apart from an extra income stream, the certificates can also be traded worldwide and separately from the electricity grid infrastructure, thus bypassing grid system charges or grid access problems.

(See *Tradable Renewables* for more information).

Eskom's Integrated Demand-Side Management (IDM) Initiative

The South African electricity utility, Eskom, launched an Integrated Demand-Side Management (IDM) initiative to audit energy use in the industrial, commercial and residential sectors. The IDM initiative is dedicated to ensuring short-term security of electricity supply through the coordination and consolidation of various initiatives aimed at optimising energy use and balancing electricity supply and demand. A key aspect of this programme is the promotion and implementation of more energy-efficient technologies, processes and behaviours amongst all consumers by adopting a market-driven approach to meeting consumer requirements. Additionally, the IDM initiative supports Eskom's long-term strategy to reduce South Africa's electricity demand during peak periods.

The series of large-scale Demand Side Management programmes that the IDM initiative encompasses includes:

- Energy Efficiency Demand Side Management (EEDSM) – with the aim of identifying and promoting more efficient electricity use through technology enhancements and behavioural change.

- Energy Management Programme (EMP) – by assisting Corporate Customers to enhance energy efficiency.

- Solar Water Heating Programme – aims to provide financial incentives for consumers to switch to solar water heating.

- Power awareness and communications campaigns.

- Coordinated internal energy efficiency programme.

- Energy conservation scheme (ECS) – that has set out to achieve a 10% energy reduction amongst consumers using more than 25GWh per annum.

- Demand Response (DR), which is a system operator that pays customers to reduce their load to balance demand and supply.

- Internal energy efficiency programme, which aims to achieve a 15% energy reduction for non-essential consumption (Eskom buildings and substations) by 2015 as per the National Energy Efficiency Strategy for South Africa; and also to internally save 1 billion kWh by 2012/2013.

(See the *IDM* for more information).

Solar Water Heating (SWH) Programme

The government-run SWH programme is managed by Eskom, and aims to install one million solar water heaters (SWHs) in households and commercial buildings by 2014.

(See *SWH Rebate Programme* for more information).

Environmentally Sound Products and Services

In the financial services sector, two of South Africa's largest banks i.e. First National bank (FNB) and Nedbank, have introduced products that promote eco-innovation and enable clients to reduce their impact on the environment.

At FNB, various products are currently in the pipeline. One such product is the Green Building Retrofit Loan, called the ecoEnergy Loan, to assist commercial building owners to adopt less carbon-based energy consumption measures and increase energy efficiency. Additionally, the bank's eBucks award programme assists customers in obtaining products that help mitigate the energy shortage, for instance, solar-powered mobile phone chargers. The range of products will be expanded in the future.

Similarly, Nedbank has also produced a range of products that promote eco-innovation including:

- The Nedbank Green Affinity Credit Card's purpose is to raise funds for the protection of South Africa's natural resources. A portion of the annual purchases are donated to the Green Trust.

- Through the Green Affinity Current Account, Nedbank charges a premium on every green cheque book ordered and donates this to the Green Trust on behalf of the customer.

- The Green Affinity Savings Account is also linked to the Green Trust. On this account, Nedbank makes a once-off contribution of $0.37 towards the Trust of the customer's choice. Thereafter, the bank makes another contribution of 0.25% per year of the client's average daily balance in his/her account at no extra charge to the customer.

- Through the Green Affinity Investment, Nedbank also contributes a percentage of the customer's investment into the Green Trust. The higher the investment capital the more the customer donates.

Procurement

Solar Traffic Lights

In 2008, South Africa started a pilot programme for solar power traffic lights. Solar lights were first installed in Cape Town to test their success. Due to the project's success, it has been expanded with solar traffic lights being installed in all major cities, however with less degree of installation success in smaller towns and rural areas.

Free and Subsidised Compact Fluorescent Lamps (CFLs)

In 2006, Eskom distributed more than 7 million CFLs to replace incandescent bulbs. Eskom initially procured 300,000 CFLs for free distribution near Johannesburg to test the feasibility, cost-of-distribution and actual load reductions of the measure, but procured a further 2.7 million for distribution to low-cost housing areas in South Africa upon successful energy saving results.

Awareness raising and training

National Government Initiatives

The National Environmental Education Programme (NEEP)

NEEP is coordinated by the Department of Education in collaboration with other departments as a response to and support for the country's educational policies in line with the context of environmental policy in the country.

Through this programme, environmental learning is integrated throughout the General Education and Training band by means of curriculum design and revision, resource based learning, professional development of provincial and district staff and teachers and the improvement of environmental learning in schools.

(See *National Environmental Education Programme* for more information).

Indalo Yethu: South Africa's National Environmental Awareness Campaign

Developed as a result of the World Summit on Sustainable Development held in 1992, in South Africa, Indalo Yethu is an independent trust of the Department of Water and Environmental Affairs which functions as an endorsement brand promoting greening and eco-friendly practices as a way of life.

This programme aims to reinforce environmental awareness within the context of social and economic development programmes in the country through mass communication campaigns and outreach programmes.

(See *Indalo Yethu* for more information).

Make Mzantsi Beautiful: South Africa's Waste Management Campaign

This is a joint initiative by the Department of Water and Environmental Affairs, Indalo Yethu and Buyisa-e-Bag aimed at encouraging South Africans to stop littering, collect, recycle and dispose of waste appropriately. This campaign was also developed to address issues outlined in the National Waste Management Strategy.

(See *Make Mzantsi Beautiful* for more information).

Private Sector Initiatives

The private sector is also involved in eco-innovation awareness raising.

Industrial Environmental Forum (IEF)

The IEF coordinates the development of environmentally sound technology within the industrial sector. The IEF is completely funded by business, and aims to promote awareness on the transfer of environmentally sound technology through participation and peer incentives. In this regard, it aims to ensure that environmental issues remain part of the South African corporate agenda.

International Responsible Care Initiative

In 1994, the chemical industry in South Africa launched the International Responsible Care Initiative that seeks to achieve cleaner production in the chemical industry. The initiative also focuses on improving performance and encouraging good management practices in the sector; promoting collaborative partnerships between companies and associations; encouraging companies and associations to inform their stakeholders about what they do about their performance including reporting performance data; encouraging companies to engage and work with stakeholders at local, national, and international levels and listening and addressing stakeholder concerns. Current interactions with government include discussions on the introduction of incentives to promote cleaner production processes.

(See Chemical and Allied Industries' Association for more information).

Non-government organisations (NGOs)

A number of national and international NGOs also run environmental education and awareness campaigns in the country. Some of these organisations include the World Wildlife Fund, the Wildlife and Environment Society of South Africa, the Wilderness Foundation, Fauna and Flora International and Birdlife South Africa.

Voluntary Initiatives in the Private Sector

In addition to awareness raising and corporate responsibility efforts, the private sector also plays a more proactive leading role in the promotion of energy and water efficiency, and cleaner processes in

industry. This section deals with selected companies in specific industries such as, Anglo American (mining industry), Sasol and Eskom (energy sector), as well as one of the largest banks in South Africa, namely, Nedbank (financial services sector).

Mining Industry - Anglo American

Anglo American is one of the world's largest mining companies, with extensive operations throughout South Africa, ranging from coal and gold to rare earth elements like platinum and palladium. In terms of its approach to eco-innovation, Anglo's research arm provides the company with solutions and expertise on innovative work that will improve water and energy efficiency through the development of new technologies.

Some of the company's eco-innovation strategies include a focus on energy efficiency through asset optimisation, carbon-reducing projects, low-carbon technologies, adaptation to climate change and the company's Water Wise Programme. This Programme is supported by a water performance standard that forms part of the mining giant's, Anglo Environment Way's (AEW) mandatory set of standards. Anglo American have also implemented a number of water-reporting definitions, and developed models for determining the value of water as well as understanding water balances. In 2010, a Group Water Guideline was published that links to the water performance standards on rehabilitation, land stewardship practices, socio-economic management and mine closure plans. The AEW also informs the company's approach to land stewardship and the minimisation of negative impacts on land. It contains 10 performance standards that contribute to effective land management: rehabilitation, biodiversity, water, mine closure, mineral waste, air quality and hazardous substances.

Energy Sector - Sasol

Sasol is South Africa's major energy and chemical corporation with operations in both South Africa and abroad. The company pioneered coal to liquid petroleum technology in the 1950s, and as such, has a strong eco-innovation culture. Sasol is committed to eco-innovation as reflected in several environmental stewardship drives. In 2008, Sasol established the New Energy division which focuses attention on the development of new business opportunities to reduce Sasol's greenhouse gas (GHG) footprint. In this regard, New Energy oversees the coordination of the energy efficiency drive across the Group to meet its energy targets and optimise future project design.

New Energy is also looking at scaling up and advancing current renewable energy technologies, with attention to solar-photovoltaic (PV) and concentrated solar power (CSP), wind, biofuels and biomass (including the utilisation of algae to sequester CO_2). In line with this, Sasol have already undertaken a 40% stake in a renewable energy start-up company, Thin Film Solar Technology, and have provided a $450 000.00 grant to Stellenbosch University for further CSP research.

Strategically, Sasol's ambition to become a world leader in eco-innovation, and particularly, carbon capture and storage (CCS), is translated into its commitment to only invest in coal to liquid fuel technology or other coal-based plants when clear GHG mitigation solutions are available. In this vein, Sasol have signed a memorandum of understanding with Gassnova SF, a Norwegian state-owned enterprise that manages CCS. Through this memorandum, Sasol hopes to participate in the Technology Centre, Mongstad, currently under construction in Norway. Furthermore, New Energy will in future identify and respond to possible opportunities related to the development of more carbon efficient fuels and technologies for the transportation industry's energy needs.

So far Sasol have invested around $15 million in various energy efficiency-related projects that will collectively reduce about 760 000 tons of GHG per year for the company. The group have also established

an environmental communication task team that will assist with the development and publication of climate change communication.

Energy Sector - Eskom

Eskom is a South African parastatal that generates around 95% of the country's electricity. Eskom's approach to eco-innovation is driven by its commitment to increase its mix of renewable energy sources.

In 2010, negotiations with the World Bank, through government, secured a $3.75 billion loan for the financing of a mixture of energy technologies. Of this, $3.05 billion will be allocated for the completion of the Medupi coal-fired power station. This station will utilise the efficient supercritical technology[5] used in the Organisation for Economic Cooperation and Development (OECD) countries. Additionally, $260 million will be spent on piloting a 100 mega-Watt (MW) wind power project in Sere and a 100 MW solar power project in Upington; and $485 million will be allocated for low carbon efficiency components, which includes a railway to transport coal with fewer GHG emissions. This diversification is part of South Africa's efforts to address climate change through the country's Long-Term Mitigation Scenarios (LTMS) and the United Nations Framework Convention on Climate Change (UNFCC).

Financial Services - Nedbank

Nedbank's proactive eco-innovation approach has earned it the status of the first carbon neutral African bank, and certainly a leader of eco-innovation in South Africa's financial services sector. Carbon footprint reduction measures include carbon footprint measurement, reduction in electricity consumption, limiting business travel, estimating GHG emissions from commuting, reducing paper consumption and reducing water consumption. Reduction targets for energy, water, paper and carbon emission have been set at 12% by 2015 for energy, 5% by 2010 for water, 10% by 2010 for paper and 12% by 2015 for carbon emissions.

Nedbank Capital, the divisional grouping that manages Nedbank's structuring, lending, underwriting and trading businesses, is also involved in a number of eco-innovation projects beyond South Africa's borders, such as forestry protection projects in Uganda, Liberia and Cameroon, and the management of the assets of rehabilitation trusts for two mining clients. The Nedbank Capital Green Mining Awards gives recognition to African mine and mineral beneficiation operations incorporating substantial efforts to promote sustainability. Nedbank also raised awareness at the World Economic Forum Africa and the Prince's Rainforests Project (PRP) in 2009, for the plight of African rainforests. In 2010, the bank continued its commitment to become carbon neutral by purchasing carbon offsets from African forestry projects. Nedbank also has a number of environmentally friendly commercial banking products including the Green Affinity card portfolio as previously noted.

Business Associations

A number of business associations are also committed to promoting eco-innovation in South Africa.

Banking Association of South Africa (BASA)

BASA encourages its members in the banking industry to support eco-innovation by transforming their business models and increasing their social responsibility capabilities. Specifically, it engages with

[5] Supercritical technologies are incorporated into power plants that operate at temperatures higher that the critical point of water. This means that they operate above the temperature and pressure as which the liquid and gas phases of water are in balance. The result is a power plant with a higher energy efficiency rate of above 45%. Such plants use less coal per megawatt-hour, meaning lower emissions, higher efficiency and lower fuel costs.

the South African national government with respect to the National Environmental Management Waste Act No. 62, 2008. Since banks could bear the costs of environmental damage due to inappropriate use of land by the borrower, it is in the interest of BASA, as the representative trade association for the South African banking industry, to have regular consultations with government.

(See *BASA* for more information).

National Business Initiative and the facilitation of Public-Private Partnerships

The National Business Initiative (NBI) is a voluntary business entity comprising of 140 members. The NBI is based on the philosophy that the South African private sector can make a positive contribution to the health of the natural environment. Eco-innovation therefore forms a critical part of the private sector's efforts to bring about increased sustainable development.

The NBI has committed to discover ways and means through business initiatives to improve environmental performance in the country. One example is the improvement of the energy efficiency initiative and the NBI's role in facilitating the development of the Energy Efficiency Accord, signed between the Minister of Minerals and Energy and leading South African businesses, and industry associations in May 2005. The Accord encourages companies to pursue new technologies to reduce energy use while investing in new business activities.

(See Energy Efficiency Accord, on page 28 above, for more information).

In addition, the NBI also developed reporting mechanisms, technical protocols and monitoring and evaluation systems for energy efficiency. This was done in cooperation with government.

(See *NBI* for more information).

Green Building Council of South Africa (GBCSA) and the Green Star

The Green Building Council of South Africa (GBCSA) initiative addresses energy consumption and CO_2 emissions, pollution of air, water and land, the depletion of natural resources, and the disposal of waste. It is estimated that buildings consume 40-50% of the world's energy through their construction and ongoing operation. The GBCSA also addresses many of the pressing service delivery issues facing local authorities today, such as electricity shortages, water shortages, the lack of solid waste disposal sites, transportation issues and many others.

The GBCSA aims to ensure that all buildings are designed, built and operated in an environmentally sustainable way. Through its Green Star SA Project, a multi-unit residential pilot rating tool, the GBCSA assesses the environmental attributes of new multi-unit residential developments as well as major refurbishments of existing multi-unit residential developments or conversions across South Africa. Based on satisfactory assessment, it will then provide developers with the first residential certification using a green building rating tool in South Africa.

(See *GBC* for more information).

Acting Globally

International cooperation in eco-innovation focuses on building international competitiveness through multilateral and bilateral collaborative partnerships, developing regional capacity, and affirming South Africa's role as a regional leader in eco-innovation efforts. With over 60 international agreements in place, DST has a strong focus on fostering relations with key partners and emerging economies. Significant

regional and global participation highlights during 2009/10 included co-chairing the steering group for the OECD's Global Science Forum project on S&T cooperation between developed and developing countries, and serving on the OECD's Committee for Scientific and Technological Policy steering group on science, technology and innovation (STI) cooperation.

Multilateral

In terms of multilateral cooperation, South Africa plays a leading role in the European Union's (EU) sixth and seventh framework programme, and also in the implementation of Africa's Consolidated S&T Plan of Action. In the EU FP7 Framework, recent research programmes have been designed to develop environmental technologies for the observation, simulation, mitigation, adaptation, remediation and restoration of the natural and man-made environment. These research programmes have sought to build South African partners' capacity in improved eco-efficiency, widespread implementation of new system solutions and promoting eco-innovative SME involvement.

South Africa has also signed several international conventions and protocols, some of which are particularly relevant to the sustainable use of energy and the environment. The UNFCCC, ratified by the South African government in 1997, addresses the climate change threat, and urges states to reduce and control their sources of GHG emissions. Linked to this is the Kyoto Protocol. South Africa also ratified the 1990 Montreal Protocol on substances that deplete the ozone layer, which is designed to restrict the use of chlorofluorocarbons and halons.

India-Brazil-South Africa Declaration on Clean Energy

In 2003, the India-Brazil-South Africa (IBSA) trilateral development initiative was established to promote South-South initiatives on development, trade and investment, information exchange and cooperation in areas including agriculture, energy, health, and climate change.

At the second IBSA summit, in October 2007, the three member countries agreed to work together in the promotion of nuclear energy, clean energy technologies and other renewable energies, and the endorsement of climate change mitigation. The declaration also committed countries to pool their resources to ensure a secure supply of safe, sustainable and non-polluting energy to meet global demand, particularly in developing countries. The declaration also stipulated the nature of cooperation, which would include clean coal technologies and renewable energies such as biomass, as well as innovative ways to transfer, develop and commercialise clean energy.

SADC-wide Collaboration

At the regional level, South Africa is a member of the Southern African Power Pool (SAPP), which comprises of different power utilities in Southern Africa, with a secretariat in Harare, Zimbabwe. SAPP started operations in 2002, with the aim of optimising electricity usage in the region. Eskom, undoubtedly the largest electricity producer in the region, generates 45% of the electricity used in the rest of Africa, confirming South Africa's priority on energy integration in the continent.

As an example of regional energy cooperation, South Africa has embarked on diversifying its energy supply base and reducing its reliance on coal, through the substitution of coal for natural gas from Mozambique, as well as tapping natural gas potential in Namibia.

Bilateral

By 2006, 30 bilateral agreements had been signed between South Africa and other countries, resulting in over 400 R&D projects in areas such as information technology, environmental management and

manufacturing management. These bilateral agreements help to foster on-going good relations with other countries as well as in sharing best practice. Through these agreements, funds are also made available to promote R&D in key areas (such as agriculture, manufacturing and biotechnology), thus contributing towards the human-capital development agenda.

One such bilateral initiative is the establishment of a long-term ecological research site in Southern Africa that forms part of an international network of ecosystem observatories, aiming to assist regions to manage their natural resources in a sustainable manner. This research site is the Satellite Laser Ranging System at Hartebeesthoek, and is jointly operated and co-managed with the National Aeronautics and Space Administration (NASA) in the United States.

Country Synthesis

While South Africa does not have a specific national eco-innovation policy, several government departments, research institutions, and particularly large private companies, have developed policies, strategies and programmes to promote R&D in technological and non-technological innovation that have a favourable impact on the environment, whether deliberate or not. Because of the national level importance placed on sustainable development, eco-innovation is also indirectly addressed in several other pieces of legislation, programmes and initiatives. That said, regulation and public initiatives are not fully developed or coordinated inter-departmentally.

Based on this report, several distinctive features of the South African eco-innovation policy landscape can therefore be summarised. In many respects, a duality is evident between an increasing commitment to build eco-innovation and immature institutional structures that do not possess the coordinating and unifying capability to leverage this commitment.

Eco-Innovation as an emerging national priority but cased within sustainable development rhetoric

The emerging global eco-innovation trend is beginning to take off in South Africa. South African attention to eco-innovation has arguably predated this trend, albeit indirectly due to the commitment to achieving sustainable development, expressed at the 2002 the World Summit on Sustainable Development, held in Johannesburg and resultant projects and initiatives. This rhetoric is strong, due in large part, to strategic national objectives of striking a balance between preserving limited natural resources and alleviating poverty. Eco-Innovation as an emerging national priority has therefore arguably been cased within sustainable development rhetoric. In this light, eco-innovation has been pulled along, albeit subliminally, by the sustainable development agenda. While the two are mutually supportive, explicit attention needs to be given to eco-innovation if South Africa is to access markets that can capture the environmental benefits of such innovations.

However, various governmental departments are beginning to articulate their explicit commitment to eco-innovation. The DST is in the process of establishing an eco-innovation directorate, while the DST has created a new Chief Directorate position for Green Industries. It is also clear, in the South African case, that the responsibility of greening the developmental state does not only fall to government. The private sector and a host of public entities are all committed to the development of cleaner and environmentally sound technologies, cleaner production practices, and demand-side incentives to reduce environmental impact.

A new focus, but in general, lack of strategic attention as a whole of government's approach

Notwithstanding the projects, initiatives and burgeoning policy landscape, South Africa does not as yet have a unified, common, and ambitious vision on how it can contribute towards eco-innovation. Unless

this changes, it is unlikely that R&D programmes will become coherent and grow into larger-scale inputs to the knowledge-based economy.

South Africa has used its environmental policies to promote eco-innovation and institute eco-innovation initiatives, however these are scattered through various government departments, agencies, universities and private industry. More recently, environmental concerns have started to be integrated in innovation policies. The emerging trend to make environment and innovation policies operate more synergistically needs to be supported to help achieve ambitious environmental and socio-economic goals simultaneously, as environmental and innovation policies can reinforce each other.

Due to the lack of a long-term ambitious vision, the approach to building the required human, institutional, and infrastructural platforms is ad-hoc and no effective mechanism currently exists that can exploit possible synergies.

Human capital challenges exacerbate the challenge. The national lack of capacity impacts on the ability to both implement eco-innovation R&D programmes (i.e. finding researchers) and to implement the research outputs (in the state departments). Notwithstanding important efforts to building capacity, particularly amongst blacks and women, these efforts are sporadically implemented on a case by case basis, with the existence of considerable barriers for scaling-up. The human capital challenge greatly impedes the development of indigenous eco-innovation capabilities.

Institutionalised approach to eco-innovation through NSI approach but regulation and public initiatives not fully developed and/or coordinated

South Africa has followed a similar path to that of most OECD countries in terms of adopting the NSI approach to S&T and eco-innovation. The NSI is now well entrenched within South Africa's policy discourse, and has significant utility as a conceptual framework for understanding the nature and functioning of the country's totality of S&T efforts (Manzini, 2009). Additionally, the NSI permits a holistic view of how scientific activity relates to economic performance. However, the NSI is still a relatively new construct in the South African context (Manzini, 2009). Complications have arisen that have required restructuring, migration, and amalgamation of existing research or funding entities, and these processes are still on-going. However, these changes also reflect the aim to enhance the efficiency of support, to establish public/private partnerships in R&D or to introduce more competitive programmes for government funding. It will take time for the NSI to develop and transform into a system that can make a substantial contribution to eco-innovation.

More support to commercialise R&D outcomes but decline in GERD as a percentage of GDP

Support to commercialise R&D outcomes has come from several sources, with the national government's re-structured TIA contributing substantially to support efforts. It still remains to be seen how successful the TIA's merger with existing funding agencies will prove in providing support to commercialise R&D outcomes, but currently, progress is evident. Additionally, roughly 10.7% of South Africa's R&D is financed from abroad, and this percentage has steadily grown over the years. As a result of the multi-actor NSI approach, South Africa has also seen an increasing trend of collaborative R&D among businesses, and with government research agencies as well as with the higher education institutions (HEI) sector.

However, arguably the largest driver of support to commercialise R&D outcomes comes from the private sector. In terms of the spread of R&D activities in South Africa, business enterprise R&D (BERD) has formed the largest share of R&D expenditures nationally over the years. The private sector accounted

for 58% of spending on research, with 24.4% of total research spending being conducted in the field of engineering sciences (DST, 2009).

The BERD equivalent contrasts with public sector R&D, which includes government, science councils and public higher education sector, totalling 41% of R&D. The non-profit sector contributed roughly 1.1% percent of total R&D in 2008/09. South Africa's decline in GERD as a percentage of GDP over the last three years is also bound to affect eco-innovation, particularly as it relates to government incentives and the sustainability of funding agencies and programmes.

The role of large national companies

The private sector, and particularly, large national companies therefore drive applied research on eco-innovation. While maximising the leverage of private finance is advantageous to delivering widespread adoption of eco-innovations, it also locks the eco-innovation value chain into a dependency on specific companies and related sectors, resulting in a focussed but overly narrow eco-innovation development trajectory.

Additionally, maximising the potential to attract *sustained* private sector investment in eco-innovation is critically important if long-term term capacity is to be developed. This requires commitment from multiple sectors and a diversity of private sector institutions.

References

Anglo America. 2011a. *Integrated sustainable development*. London: Anglo American. Available (online) at: *http://www.angloamerican.com/aal/development/approach-and-policies/integrated-sustainable-development/*. Accessed on: 6 January 2011.

Anglo America. 2011b. Environment. London: Anglo American. Available (online) at: *http://www.angloamerican.com/aal/development/envs/*. Accessed on: 6 January 2011.

The Banking Association of South Africa (BASA). 2009. Annual review 2009. Johannesburg: The Banking Association of South Africa.

Business Unity South Africa (BUSA). 2010. Media statement by Business Unity South Africa, March 16, 2010. Johannesburg: Business Unity South Africa. Available (online) at: *http://www.treasury.gov.za/comm_media/press/2010/2010040701.pdf*. Accessed on: 6 January 2010.

Business Unity South Africa (BUSA). 2011. *BUSA – One voice for business*. Johannesburg: Business Unity South Africa. Available (online) at: *http://www.busa.org.za/*. Accessed on: 6 January 2011.

Business Leadership South Africa. 2007. *Building the nation: a business contribution*. Johannesburg: Business Leadership South Africa. Available (online) at: *http://www.businessleadership.org.za/documents/BusPart%20for%20Web.pdf*. Accessed on: 6 January 2011.

Chamber of Mines of South Africa. 2011. *What is the Chamber?* Johannesburg: Chamber of Mines of South Africa.

Commission for Sustainable Development (CSD), 1998. "Part V: Guidelines on Technology," South African National Country Profile Report. April 1998. Directorate Environmental Information and Reporting, Department of Environmental Affairs and Tourism. Available (online) at: *http://www.environment.gov.za/soer/ag_21/sar.htm*

Commission for Sustainable Development (CSD), 2010. South African Country Report for the Eighteenth Session of the United Nations Commission on Sustainable Development (CSD-18). Department of Environmental Affairs, January 2010. Available (online) at: *http://www.un.org/esa/dsd/dsd_aofw_ni/ni_pdfs/NationalReports/south_africa/SouthAfricanCSD18CountryReport.pdf*

Council for Scientific and Industrial Research (CSIR). 2011. *CSIR contract research & development partnerships (R&D)*. Pretoria: Council for Scientific and Industrial Research (CSIR). Available (online) at: *http://www.csir.co.za/research_and_development/national_system_innovation.html*. Accessed on: 24 January 2011

Department of Agriculture, Forestry and Fisheries. undated.Policy on Agriculture in Sustainable Development. Pretoria: Department of Agriculture, Forestry and Fisheries.

Department of Agriculture, Forestry and Fisheries. 2010. *Strategic plan for the Department of Agriculture, Forestry and Fisheries 2010/11*. Pretoria: Department of Agriculture, Forestry and Fisheries.

Department of Education. 1995. White Paper on Education and Training. Pretoria: Department of Education.

Department of Energy. 2010a. *Policy to support the Energy Efficiency and Demand Side Management Program for the electricity sector through the standard offer incentive*. Pretoria: Department of Energy.

Department of Energy. 2010b. Strategic Plan 2010/11-2012/13. Pretoria: Department of Energy.

Department of Science and Technology (DST). 1996. *White Paper on Science and Technology: Preparing for the 21st Century*. Pretoria: Department of Science and Technology.

Department of Science and Technology (DST). 2002. South Africa's National Research and Development Strategy. Pretoria: Department of Science and Technology.

Department of Science and Technology (DST). 2007. *Innovation towards a knowledge-based economy: Ten-Year Plan for South Africa (2008 – 2018)*. Pretoria: Department of Science and Technology. Available at: *http://www.esastap.org.za/esastap/pdfs/ten_year_plan.pdf*. Accessed on: 24 January 2011.

Department of Science and Technology (DST), 2008. South African Yearbook 2007/09 – Science and Technology. Department of Science and Technology. Available (online) at: *http://www.gcis.gov.za/resource_centre/sa_info/yearbook/2008/chapter17.pdf*. Accessed on 28 January 2011.

Department of Science and Technology (DST), 2009. National Survey of Research and Experimental Development (2008/09 Fiscal Year). Second Edition, October 2010. Department of Science and Technology: Human Sciences Research Council. Available (online) at: *http://www.dst.gov.za/publications-policies/strategies-reports* and *www.hsrc.ac.za/CCUP-RnD-8.phtml*.

Department of Science and Technology. *2010-2013 Corporate Strategy*. Pretoria: Department of Science and Technology

Department of Trade and Industry. 2010. *National Building Regulations and Building Standards Act 2008 (Act No. 103 of 1977); schedule: amendment to the national building regulations to introduce requirement for the energy usage in buildings*. Pretoria: Department of Trade and Industry.

Department of Transport. 2008. *Draft National Non-Motorised Transport Policy*. Pretoria: Department of Transport. Available at: *http://transport.dot.gov.za/siteimgs/Draft%20National%20Non-Motorised%20Transport%20Policy/DRAFT%20NATIONAL%20NON-MOTORISED%20TRANSPORT%20POLICY.pdf*. Accessed on: 24 January 2011.

Department of Water and Environmental Affairs. 1997a. White Paper on a National Water Policy for South Africa. Pretoria: Department of Water and Environmental Affairs.

Department of Water and Environmental Affairs. 1997b. White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity. Pretoria: Department of Water and Environmental Affairs.

Department of Water and Environmental Affairs. 1997c. White Paper on Environmental Management Policy. Pretoria: Department of Water and Environmental Affairs,

Department of Water and Environmental Affairs. 2004. A National Climate Change Response Strategy for South Africa. Pretoria: Department of Water and Environmental Affairs.

Department of Water and Environmental Affairs. 2010. Strategic Plan 01April 2010 to 31 March 2015. Pretoria: Department of Environmental Affairs.

Department of Water and Environmental Affairs. Department of Water Affairs Strategic Plan 2010/11-2012/13. Pretoria: Department of Water Affairs.

Du Preez, N.D. and Louw, L. 2008. *A framework for managing the innovation process*. Cape Town: PICMET.

Eskom. 2010. *Integrated report 2010: on the path to recovery*. Eskom: Johannesburg. Available (online) at: *http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf*. Accessed on: 5 January 2011.

Hichert, T.N. 2008. Innovations for a sustainable economy: steps for business. *Strategy Insights: Corporate Environment*, 6(2): 1-5.

InnovUS. 2011. *Skeibare permanentemagneet-induksiegenerator*. Stellenbosch: InnovUS.

Marais, H.C. 2000. *Perspectives on Science Policy in South Africa*. Pretoria: Network Publishers.

Masinda, M.T. 1998. *National systems of innovation: implications on science and technology policies in sub-Saharan Africa*. Vancouver: Centre for Policy Research on Science and Technology. CPROST Report # 98-05. Available at: *http://www.sfu.ca/cprost/docs/9805.pdf*. Accessed on: 24 January 2011.

Manzini, S. 2009. Towards a systems and complexity perspective of the national system of innovation. Thesis (M.Sc.Eng.)-University of KwaZulu-Natal, Durban.

National Advisory Council on Innovation (NACI), 2010. South African Science & Technology Indicators 2009. National Advisory Council on Innovation Indicators Reference Group. Available (online) at: *http://www.nacinnovation.biz/wp-content/uploads/South-African-Science-and-Technology-Indicators-2009.pdf*

NFSD, 2008. *National Framework for Sustainable Development*. http://www.environment.gov.za/HotIssues/2008/nfsd/nfsd.html July 2008.

National Treasury. 2006. A Framework for Considering Market-Based Instruments to Support Environmental Fiscal Reform in South Africa. Pretoria: National Treasury.

Nedbank Group. 2010. *Nedbank Group sustainability report 2009*. Johannesburg: The Nedbank Group. Available (online) at: *http://www.nedbankgroup.co.za/financials/2009Sustainability/pdf/nbgSustainability2009.pdf*. Accessed on: 5 January 2011.

Organisation of Economic Co-Operation and Development (OECD), 2002. OECD Frascati Manual, Sixth edition.

Organisation of Economic Co-Operation and Development (OECD), 2007. OECD Reviews of Innovation Policy: South Africa. Science & Information Technology, Vol. 2007, no. 14, pp. 1 – 258.

Republic of South Africa. 1945a. *Standards Act No. 24 of 1945*. Pretoria: Government Printer.

Republic of South Africa. 1945b. *Standards Act No. 8 of 2008*. Pretoria: Government Printer.

Republic of South Africa. 1968. Human Science Research Act (Act 23 of 1968). Cape Town: Government Printer.

Republic of South Africa. 1971. *Water Research Act No. 34 of 1971*. Pretoria: Government Printer.

Republic of South Africa. 1988. *The Scientific Research Council Act No 46 of 1988 (as amended by Act 71/1990)*. Pretoria: Government Printer.

Republic of South Africa. 1990. *Agricultural Research Act 86 of 1990*. Pretoria: Government Printer.

Republic of South Africa. 1997a. National Advisory Council on Innovation Act 55 of 1997. Pretoria: Government Printer.

Republic of South Africa. 1997b. National Land Transport Act 5 *of 2009*. Pretoria: Government Printer.

Republic of South Africa, 1998. National Water Act, Act No. 56 of 1998. Pretoria: Government Printer.

Republic of South Africa. 2000. Integrated Pollution and Waste Management for South Africa: A Policy on Pollution Prevention, Waste Minimisation, Impact Management and Remediation. Pretoria: Government Printer.

Republic of South Africa. 2003a. *Draft Sustainable Utilisation of Agricultural Resources Bill, 2003*. Pretoria: Government Printer.

Republic of South Africa. 2003b. *Natural Scientific Professions Act 106 of 2003*. Pretoria: Government Printers.

Republic of South Africa. 2004. National Cleaner Production Strategy. Pretoria: Government Printer.

Republic of South Africa. 2008. *No. 17 of 2008: Human Sciences Research Council Act, 2008*. Pretoria: Government Act.

Republic of South Africa. 2008. *No. 34 of 2008: National Energy Act, 2008*. Pretoria: Government Printer.

Sasol. 2010. *Sustainable development report 2010: focused and energised*. Sasol: Johannesburg. Available (online) at: *http://www.sasol.com/sasol_internet/downloads/Sasol_SD_2010_1288024256601.pdf*. Accessed on 5 January 2011.

South African Labour and Development Research Unit (SALDRU). 2011. *Environment and Poverty Project: Overview*. Cape Town: South African Labour and Development Research Unit. Available (online) at: *http://www.saldru.uct.ac.za/home/index.php?/Environment-Poverty/environment-and-poverty*. Accessed on: 13 January 2011.

The World Bank. 2010. *World Bank supports South Africa's Energy security plans*. Washington, DC: The World Bank. Press release no: 2010/340/AFR. Available (online) at: *http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/0,,contentMDK:22534959~menuPK:64282138~pagePK:41367~piPK:279616~theSitePK:40941,00.html*. Accessed on: 5 January 2011.