Social and Institutional Capacity to cope

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Introduction

Environmental sustainability can only be realised if the necessary institutional capacity and underlying social patterns of skills, attitudes and networks that foster effective responses to environmental challenges exist. Our capacity to cope with environmental stresses and associated environmental change is affected by our ability to cope with each situation, as well as the resources available to us.

In a country such as South Africa with a dual economy, the first (or formal) economy and the second (or informal) economy need to be aligned to eliminate stress from unequal institutional frameworks.

Social and Institutional Capacity to Cope

Capacity to cope with change can be categorised into social and institutional capacity, more specifically these can be divided into economic, legislative, management, scientific, technological and infrastructural capacity. Economic capacity would include the ability of a country to make economic resources available to assist with coping, whilst legislative capacity would include both policy and legislative flexibility to deal with environmental change, as well as institutional and legal mechanisms to reduce societies vulnerability to that change (such as social welfare). Governments that are able to quickly and effectively adapt policy and legislation to new situations will enable greater capacity for society to cope with change.

Management capacity includes the availability of both human and financial resources for management, as well as the ability to manage successfully in times of crisis. Scientific, technological and infrastructural capacity includes the 'know how' to adapt to change, the technology to allow adaptation, and the infrastructure to enable adaptation (e.g. electricity, roads, telecommunications).

The history of adaptation in a particular location would also influence the ability to cope with change. Those areas that have to regularly deal with natural environmental change are more likely to be flexible to change, allowing them to cope more easily.

The indicators and variables representing our social and institutional capacity to cope are:

- Eco efficiency
  - Energy efficiency
  - Hydropower and renewable energy production as percentage of total energy consumption
- Environmental governance
  - Percentage of total land area under protected status
  - Percentage variables missing from the "Rio to Joburg Dashboard"

- Private sector responsiveness
  - Environmental management systems
- Science and technology
  - Budget for the environment
  - Digital access index
  - Number of researchers per 1 000 total employment
  - Budget for research and development (R&D)
  - Gross tertiary enrolment rate
  - Education (primary, secondary and Adult basic education and training (ABET))

For further information on the social and institutional capacity please refer to the following:

United Nations Environment Programme 2004. *Global Environment Outlook 3.* http://www.unep.org/geo/

United Nations Environment Programme, Various. *Global Environment Outlook Yearbooks.* http://www.unep.org/geo/

United Nations Environment Programme 2002. *Africa Environment Outlook.* http://www.unep.org/dewa/Africa/

United Nations Environment Programme 2006. *Africa Environment Outlook 2.* Our Environment, Our Wealth. http://www.unep.org/dewa/Africa

Indicator: Eco efficiency

Variable: 31

Description: Energy efficiency

Units: Terrajoule energy consumption.

Source: The Department of Minerals and Energy (DME) 2006. *Digest of South African Energy Statistics 2006.*

The Department of Minerals and Energy (DME) 2006. *Energy Efficiency Strategy of the Republic of South Africa – March 2005.*

South Africa Government Information. www.info.gov.za.

Logic: The more efficient an economy is, the less energy it needs to produce a given set of goods and services.

Discussion: Energy comprises about 15% of South Africa's gross domestic product (GDP), creating employment for about 250 000 people. The total electricity sales by Eskom in 2003 grew to 196 980 gigawatt-hours (GWh). The peak demand on the integrated system totalled 31 928 Mega-watts (MW). Total liquid-fuels sales in 2001 grew by 0.3% to 20 934 million litres (ML). These figures demonstrate the growth of the South African economy and the importance of energy as a key driver of the country's economy.

This energy intensity is above average, with only 10 other countries having higher commercial primary energy intensities. It is largely a result of the economy's structure, with dominating large-scale, energy-intensive primary mineral beneficiation and mining industries. In addition, coal is relied on for the generation of most of the country's electricity and a significant proportion of its liquid fuels (see variable 13). Furthermore, South Africa's industry has not generally used the latest in energy-efficient technologies, mainly as a result of relatively low energy costs. (Above two paragraphs taken from www.info.gov.za).

South Africa's economic growth as measured by the growth in Gross Domestic Product (GDP) was 39.9% for the period 1993 to 2004. The total primary energy supply for these years increased from 3 933 PJ in 1993 to 5 241 PJ in 2004, an increase of 33.6%. This resulted in the energy intensity for the individual years depicted in the following table and graph.

Limitations: Energy intensity is measured by the quantity of energy required per unit output or activity, so that using less energy to produce a product reduces the intensity. Energy efficiency improves when a given level of service is provided with reduced amounts of energy inputs or services are enhanced for a given amount of energy input (from http://intensityindicators.pnl.gov/efficiency intensity.stm). A simple E/GDP ratio measure of energy intensity overstates the extent to which energy efficiency improvements have occurred in the economy, because factors that affect intensity that are unrelated to the efficiency of energy use are included in the ratio. A shift from steel to electronics influences the simple E/GDP ratio, but is not indicative of improvements in energy efficiency.

Table 27: Energy intensity

Year	GDP at market prices (R million)	Primary energy supply (TJ)	Intensity (TJ/R)
1993	755 009	3 924 315	5.20
1994	779 424	4 150 999	5.33
1995	803 710	4 299 195	5.35
1996	838 326	4 269 622	5.09
1997	860 516	4 423 365	5.14
1998	864 968	4 639 614	5.36
1999	885 365	4 636 914	5.24
2000	922 151	4 298 220	4.66
2001	947 373	3 972 681	4.19
2002	982 327	4 637 437	4.72
2003	1 012 763	4 507 518	4.46
2004	1 062 028	5 240 908	4.96
2005	1 115 135	5 078 962	4.55

Source: Digest of South African Energy Statistics 2006. *The DME, Energy balances 2005,* Department of Minerals and Energy; Statistics South Africa (P0441), *Gross Domestic Product 1st quarter 2008*

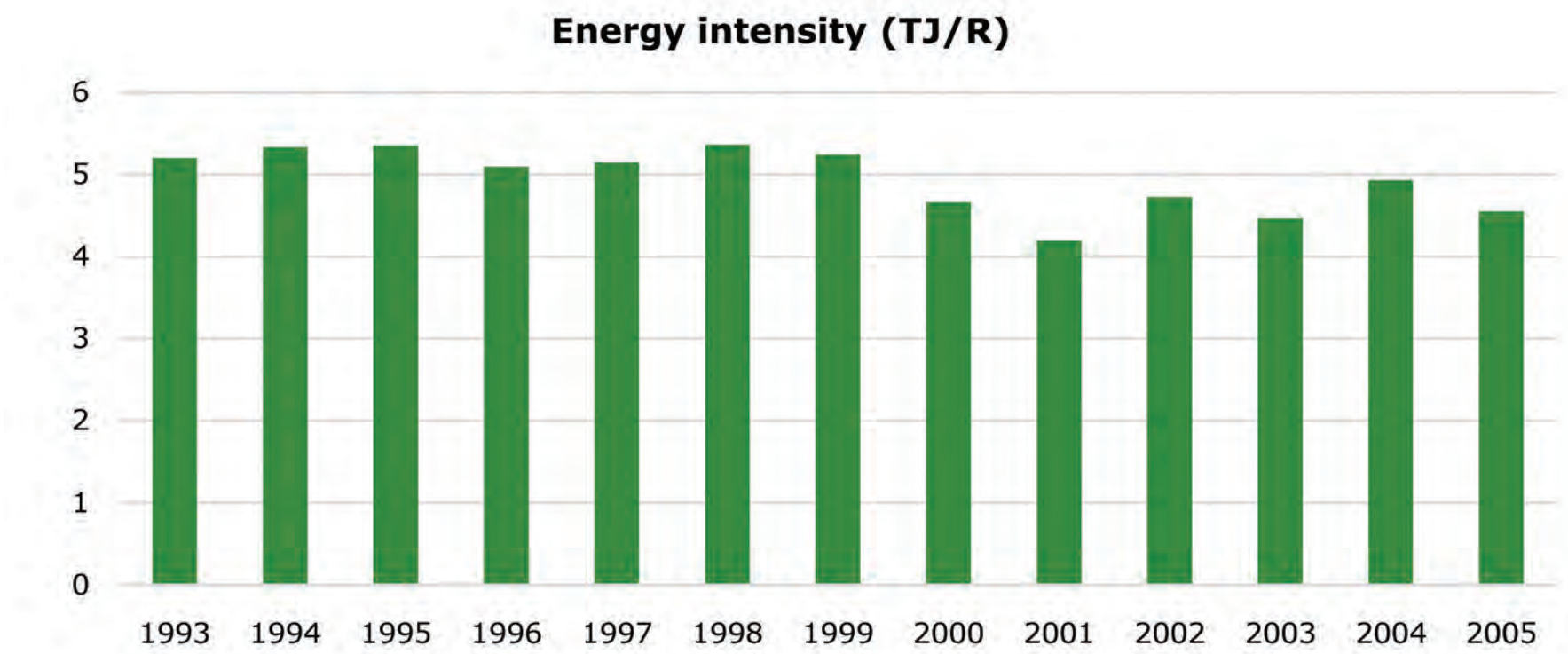

Figure 36: Energy intensity depicted as TJ/R measured from 1993 to 2005

Source: The Department of Minerals and Energy (DME) 2006. *Digest of South African Energy Statistics 2006.*

Indicator: Eco efficiency

Variable: 32

Description: Hydropower and renewable energy production as a percentage of total energy consumption

Units: Terrajoule.

Source: The Department of Minerals and Energy (DME) 2006. *Digest of South African Energy Statistics 2006.*

The Department of Minerals and Energy (DME) 2004. http://www.dme.gov.za

Logic: The higher the proportion of hydroelectric and other renewable energy sources used, the less reliance on more environmentally damaging sources such as fossil fuels.

Discussion: Renewable energy sources, other than biomass, have not yet been exploited optimally in South Africa. A recent study indicates that the country has a high potential for renewable energy with up to 43 TWh of electricity that could be displaced by solar water heating. A study also indicates that the wind energy has a technical potential of 66 TWh to the electricity production.

The government's 2003 White Paper on Renewable Energy sets a target of 10 000 GWh renewable energy contribution to final energy consumption by 2013. Achieving the target will add about 1 667 MW new renewable energy capacity,

Hydroelectric power:
There is 668 MWe of domestic installed hydroelectric power in South Africa. Some hydroelectric power is imported from neighbouring countries.

Biomass:
Biomass is an important source of energy used by both the industry (sugar refining plus the paper and pulp industry) and by households for domestic energy.

The data quality for some of these annual renewable energy consumptions is poor and the data presented below are estimates since the accuracy cannot always be verified. Sugar refineries have installed generating capacities of about 245 MWe and pulp mills have an installed generation capacity of about 170 MWe (Energy Policies for Sustainable Development in South Africa).

Fuel wood obtained mainly from natural woodlands, is the primary source of energy used by just over 2.6 million rural households for heating, and just over 2.1 million for cooking purposes (data from stats in brief, 2006). In some areas, this resource is almost completely depleted and in others it is under heavy pressure. The total annual sustainable supply of wood from natural woodlands in communal rural areas is estimated at about 12 Mt. However, probably no more than half of it is usable as fuel wood with an estimated energy total of 86 PJ/year). In addition to these sources, residues from commercial forestry total about 4,2 Mt per year. Much of this, as well as wood from bush clearing on commercial farmland, is increasingly being used as fuel.

Solar:

The country's solar-equipment industry is developing. Annual photovoltaic (PV) panel-assembly capacity totals 5 MW, and a number of companies in South Africa manufacture solar water-heaters. Solar power is increasingly being used for water-pumping through the rural water-provision and sanitation programme of the Department of Water Affairs and Forestry. In rural areas, it is estimated that about 70 000 households, 250 clinics and 2 100 schools have photovoltaic panels (Energy Policies for Sustainable Development in South Africa). There is also a steady increase in solar water-heating for middle-income households. Current capacity installed includes domestic 330 000 m^2 and swimming pools 327 000 m^2 (middle to high income), commerce and industry 45 000 m^2 and agriculture 4 000 m^2.

Eskom initiated the South African Bulk Renewable Energy Generation (SABRE) programme in 1998 and in 2002 installed a 25 kW solar dish with a sterling engine in Midrand. Eskom is studying the feasibility of building a 300 MWe solar thermal power station near Upington in the Northern Cape.

Wind:

There are about 500 wind turbines on farms that generate direct current electricity, usually 36V. Eskom installed two 660 kWh wind turbines and one 1.7 MWe one at Klipheuwel in the Western Cape as part of its SABRE programme. At Darling, a 5 MWe wind farm has been developed which has been licensed by the National Electricity Regulator (NER).

Municipal waste and wave energy:

There are other sources of energy, which are distributed either directly or indirectly all over the country such as landfill gas with a potential of 7.2 TWh of electricity generation, which is estimated, to grow to 10.8 TWh by 2040. Wave energy potential is estimated at 8 000 MW and 10 000 MW in winter and the potential yield to 70 TWh per year.

Notes: 1. The DME website gives capacity as 2.5 MW. http://www.dme.gov.za/pdfs/energy/cabeere/case friedenheim.pdf

Information taken from: SA information website www.info.gov.za..

Stats in Brief 2006 Digest of South African Energy Statistics 2006. Energy policies for sustainable development in South Africa.

Table 28: Hydroelectric capacity in South Africa

Station	Maximum capacity (MW)	Location
Gariep	360	Orange river
Van der Kloof	240	Orange river
Colly Wobbles	42	Mbashe river
Second Falls	11	Umtata river
First Falls	6	Umtata river
Friedenheim	3[1]	Crocodile river
Lydenburg	2	Ncora river
Ncora	2	Ncora river
Piet Retief	1	
Ceres	1	
TOTAL	**668**	

Source: *Energy policies for sustainable development in South Africa.* Options for the future. Energy Research Centre, University of Cape Town. 2006

Table 29: Total primary energy supply TJ [a]

	1992	1993	1994	1995	1996	1997	1998
Coal	2 990 691	3 028 745	3 117 230	3 243 737	3 299 784	3 370 254	3 268 198
Crude oil	414 946	334 047	428 321	459 980	376 059	450 863	933 682
Gas	11 969	71 814	71 814	71 814	71 814	71 814	53 983
Nuclear	101 324	79 145	105 785	123 284	128 455	137 967	148 375
Hydro	2 707	526	3 866	1 904	4 748	7 531	5 742
Renewables [b]	414 000	419 000	433 432	408 739	408 739	408 739	237 400
Hydro and renewables (%)	10.58	10.66	10.51	9.52	9.52	9.36	5.23
TOTAL	3 935 637	3 933 277	4 160 448	4 309 458	4 309 458	4 447 168	4 647 379

	1999	2000	2001	2002	2003	2004	2005
Coal	3 413 499	3 425 725	3 065 619	2 961 026	3 277 600	3 573 343	3 651 726
Crude oil	764 067	420 746	452 895	1 018 769	615 689	1 016 664	724 774
Gas	70 628	65 024	84 478	83 764	50 218	84 152	153 078
Nuclear	140 040	141 927	116 935	130 811	138 142	145 801	123 193
Hydro	2 614	4 835	7 420	8 485	2 890	2 890	4 199
Renewables [b]	237 400	237 400	237 400	426 467	422 979	418 058	421 992
Hydro and renewables (%)	5.18	5.63	6.17	9.39	9.45	8.03	8.39
TOTAL	4 628 248	4 295 657	3 964 746	4 629 322	4 507 518	5 240 908	5 078 962

a. The energy balances in this table are in accordance with the format developed by the International Energy Agency (IEA), adopted by the Department of Minerals and Energy.

b. Renewables include wind, solar and geothermal energy.

Source: The Department of Minerals and Energy (DME) 2006. *Digest of South African Energy Statistics 2006*

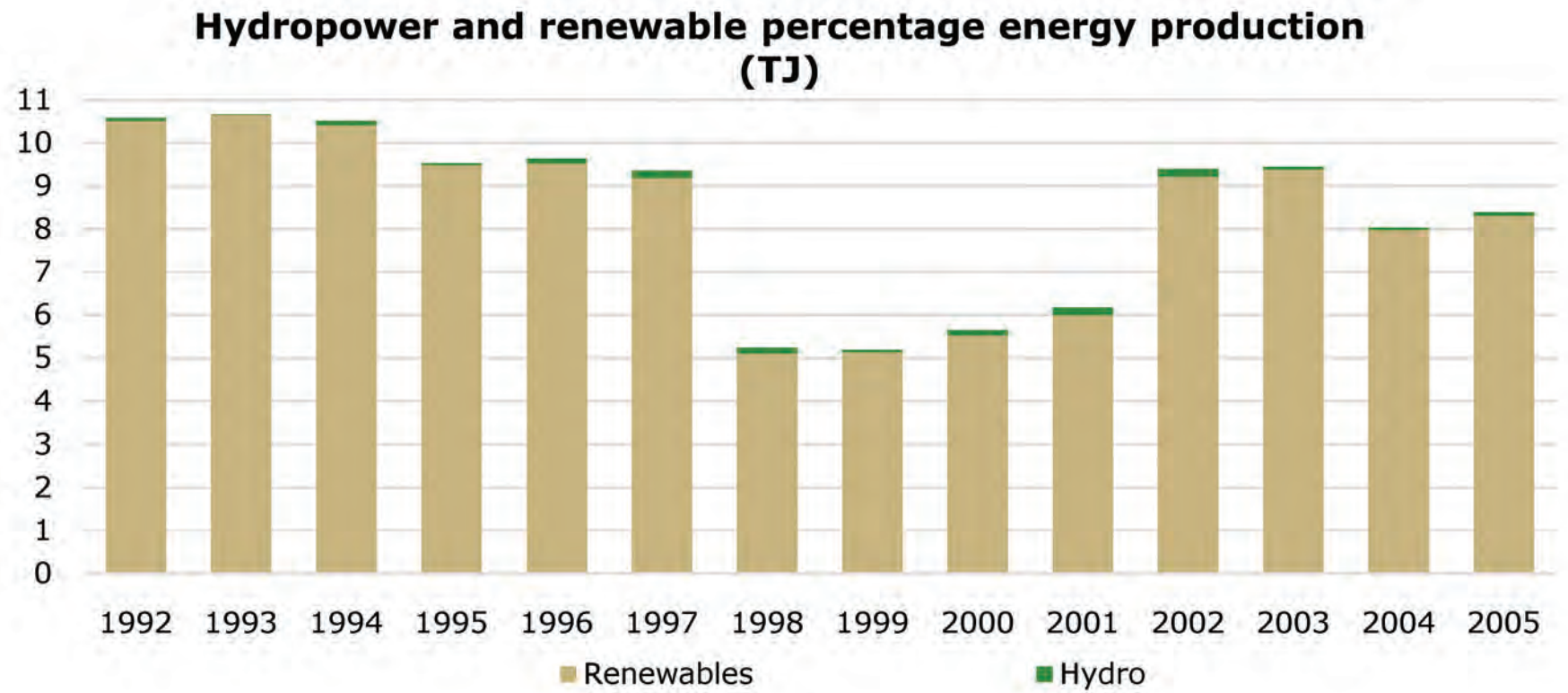

Figure 37: Hydropower and renewable energy production in South Africa measured in Terrajoule (TJ)
Source: The Department of Minerals and Energy (DME) 2006. *Digest of South African Energy Statistics 2006*

Indicator: Environmental governance

Variable: 33

Description: Percentage of total land area under protected status

Units: Percentage of total land area under protected status.

Source: Rougat M. *et al.* 2004. *South African National Spatial Biodiversity Assessment (NSBA) 2004;* Technical Report Volume 1. South African National Biodiversity Institute (SANBI), Pretoria.

Department of Environmental Affairs and Tourism (DEAT) 2005. *South Africa's National Biodiversity Strategy and Action Plan (NBSAP).*

Convention on Biological Diversity. http://www.cbd.int/countries/profile/shtml

Logic: The percentage of land area dedicated to protected areas represents an investment by the country in biodiversity conservation.

Discussion: South Africa is a country rich in biodiversity. Although the country occupies only 2% of the world's surface area it is home to nearly 10% of the world's plant species (24 000 species), about 7% of the world's vertebrate species, and 5.5% of the world's known insect species (only about half of the latter have been described). South Africa is ranked as the 5th richest country in Africa in terms of the number of endemic species and 24th in the world. In addition to its high terrestrial biodiversity the country also has a high marine biodiversity profile. More than 11 000 species are found in South African waters, amounting to about 15% of global species, with in excess of 25% of these marine species (or 3 496 species) being endemic to South Africa. The spatial biodiversity assessment of South Africa's 120 river signatures found that 82% are threatened. More than half, or 44% are critically endangered, while 27% are endangered, 11% are vulnerable and 18% are least threatened.

The country currently has about 528 protected areas, of which 20 are marine, totalling 6.6 million ha or 5.5% of the land area. However, biomes such as grasslands and succulent Karoo are under-conserved, as are rivers.

The 2010 Biodiversity Target 1.1 states that at least 10% of the world's ecological regions should be effectively conserved. Currently South Africa falls well short of this target when taking type 1 protected areas into account.

Limitations: In previous analyses type 3 protected areas were not considered. Currently the Department of Environmental Affairs and Tourism is undertaking a project to re-evaluate the area occupied by all protected areas (including those of type 3).

Notes: 1.Type1 protected areas include National Parks, Provincial Nature Reserves, Local Authority NatureReserves and DWAF Forest Nature Reserves.
Type 2 protected areas include wildlife management areas, private nature reserves, National Heritage Sites, SANDF property, bird sanctuaries, botanical gardens, state land, mountain catchment areas and DWAF Forest Areas.
Type 3 protected areas include game farms, other conservation areas (such as conservancies), and game reserves.

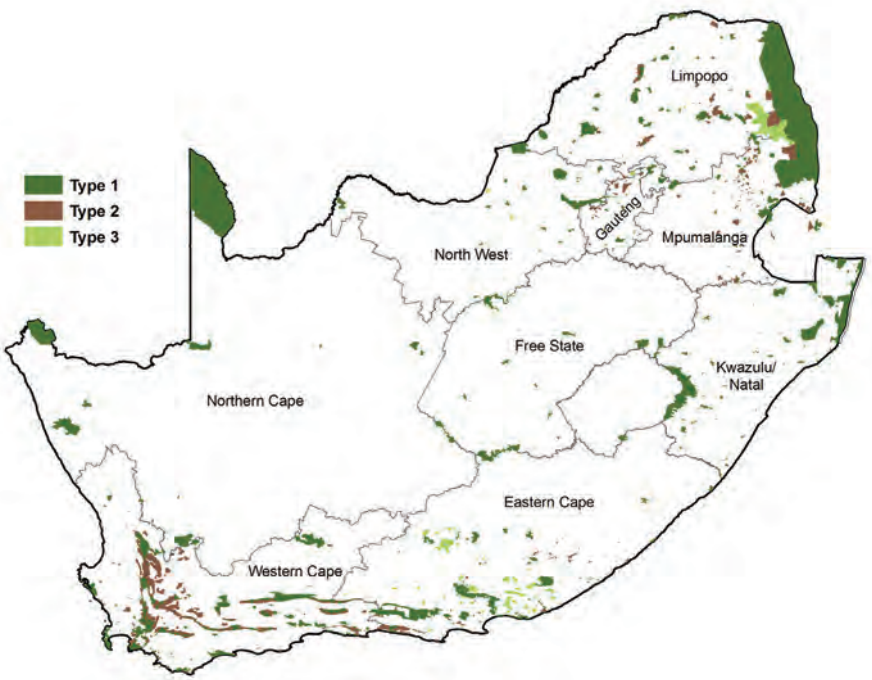

Figure 38: Type 1, 2 and 3 protected areas[1] in South Africa

Source: Rougat M. *et al.* 2004. *South African National Spatial Biodiversity Assessment (NSBA) 2004;* Technical Report Volume 1. South African National Biodiversity Institute (SANBI), Pretoria

Indicator: Environmental governance

Variable: 34

Description: Percentage of variables missing from the "Rio to Joburg dashboard"

Units: Percentage of variables missing.

Source: The Socioeconomic data and applications centre. http://sedac.ciesin.org

Logic: The greater the number of missing variables, the poorer the data availability in that country. Environmental monitoring and data systems are vital for tracking progress towards environmental sustainability.

Discussion: The United Nations Conference on Environment and Development (UNCED) (or earth summit in short) was held in Rio de Janeiro in 1992 where the global programme entitled: Agenda 21 was adopted. Agenda 21 is a comprehensive plan of action taken globally, nationally and locally in all areas where humans impact on the environment. Ten years later in 2002 a second summit with the focus on sustainable development was held in Johannesburg, South Africa.

In order to conduct good environmental governance it is important to know what information is available for a specific country. Environmental monitoring is achieved through the use of different variables/indicators. A decrease in the number of available variables leads to poor data availability. The 35 variables considered for the Rio to Joburg dashboard cover a wide array of factors including environmental, social and economic factors.

Total number of variables measured for SA is 29 out of 35 or 82.6% (or 17.4% missing). These variables are greenhouse gases, female wage gap, homicides, adequate solid waste disposal, hazardous waste generated and waste recycling as a percentage of waste disposal.

A total of 238 countries were considered but 35 countries had no variables in the dashboard. The average percentage of variables missing totalled 51.07%, omitting the 35 countries with no variables showed an average of 42.63%. It is important to note that this average includes a number of countries where only one variable was available for analysis.

According to the Environmental Sustainability Index (ESI) published by Yale in 2005, South Africa can be grouped with other countries though the process of cluster analysis. This exercise aimed at grouping countries with similar environmental statuses together so that comparisons between these countries can be made. Table 30 shows a breakdown of the countries falling in the same group as South Africa and the percentages of variables missing in these groups from

the Rio to Joburg Dashboard. The average percentage of variables missing in this group amounts to 21.31%. South Africa is still well under the average total percentage of variables missing from the Rio to Joburg dashboard with an average of 17.14% compared to the global average of countries in the same group as South Africa being 21.31[1]%.

Notes: 1. O'Connor, John and Jochen Jesinghaus 2002. Data from the: Rio to Johannesburg Dashboard of Sustainability. Software tool distributed at the 2002 World Summit on Sustainable Development in Johannesburg, South Africa.

Table 30: Percentage of variables missing from the Rio to Joburg dashboard for selected countries

Country	Percentage of variables missing
Albania	31.43%
Bangladesh	14.29%
China	17.14%
Cuba	37.14%
Dominican Republic	31.43%
Egypt	14.29%
El Salvador	17.14%
Georgia	40.00%
India	14.29%
Indonisia	17.14%
Iran	22.86%
Jordan	11.43%
Malaysia	22.86%
Mexico	17.14%
Morocco	20.00%
Pakistan	20.00%
Philippines	14.29%
South Africa	17.14%
Sri Lanka	17.14%
Syria	25.71%
Thailand	20.00%
Tunisia	20.00%
Vietnam	31.43%
Zimbabwe	17.14%
AVERAGE	**21.31%**

Source: The Socioeconomic data and applications centre. http://sedac.ciesin.org

Indicator: Private sector responsiveness

Variable: 35

Description: Environmental management systems

Units: Number of businesses that obtained the ISO14001 Environmental Standard.

Source: South African Bureau of Standards (SABS) 2007. Search of system certification with SABS ISO 14001 in South African provinces. http://www.certification.sabs.co.za
Environmental Quality Certification Services (Pty) Ltd. 2007.

i-Cert (Pty) Ltd 2007.

SGS South Africa (Pty) Ltd 2007.
http://gin.confex.com/gin/2003/techprogram/p162html

Department of the Environment, Water, Heritage and the Arts - Australia.
http://www.environment.gov.au/settlements/industry/corporete/ems.html

Logic: This variable reflects corporate institutional support for environmental management. By adopting an environmental management system such as ISO 14001, companies are promoting practices that protect the environment and strive for continuous improvement.

Discussion: “An Environmental Management System (EMS) is a tool for managing the impacts of an organization’s activities on the environment. It provides a structured approach to planning and implementing environment protection measures. An EMS monitors environmental performance and it also integrates environmental management into a company’s daily operations, long term planning and other quality management systems” (Department of the Environment, Water, Heritage and the Arts - Australia).

Environmental concerns are being incorporated in an increasing number of business strategies, in order to meet the environmental demands from the different stakeholders or to create a market demand for greener products. Many companies have integrated the responsibility for pollution prevention in their management system, where actions have to take place, in order to reduce the environmental impacts. The increasing interest among companies for self regulation in relation to their environmental impacts has resulted in a need for methods and tools to support reliability and the process of change towards systematic development of cleaner production processes and products.

In 2006, a total of 290 businesses held ISO 14001 certification through various environmental management systems certification boards. This figure increases yearly as businesses realize the importance of certification which includes a reduction of certain liabilities and insurance premiums and benefits such as loans and funding and increase in supplies and customers. Gauteng and KwaZulu-Natal are the provinces with the most number of businesses certified.

Limitations: Time series data currently lacking for this variable.

Notes: This indicator addresses the Johannesburg Plan of Implementation: Section 18.

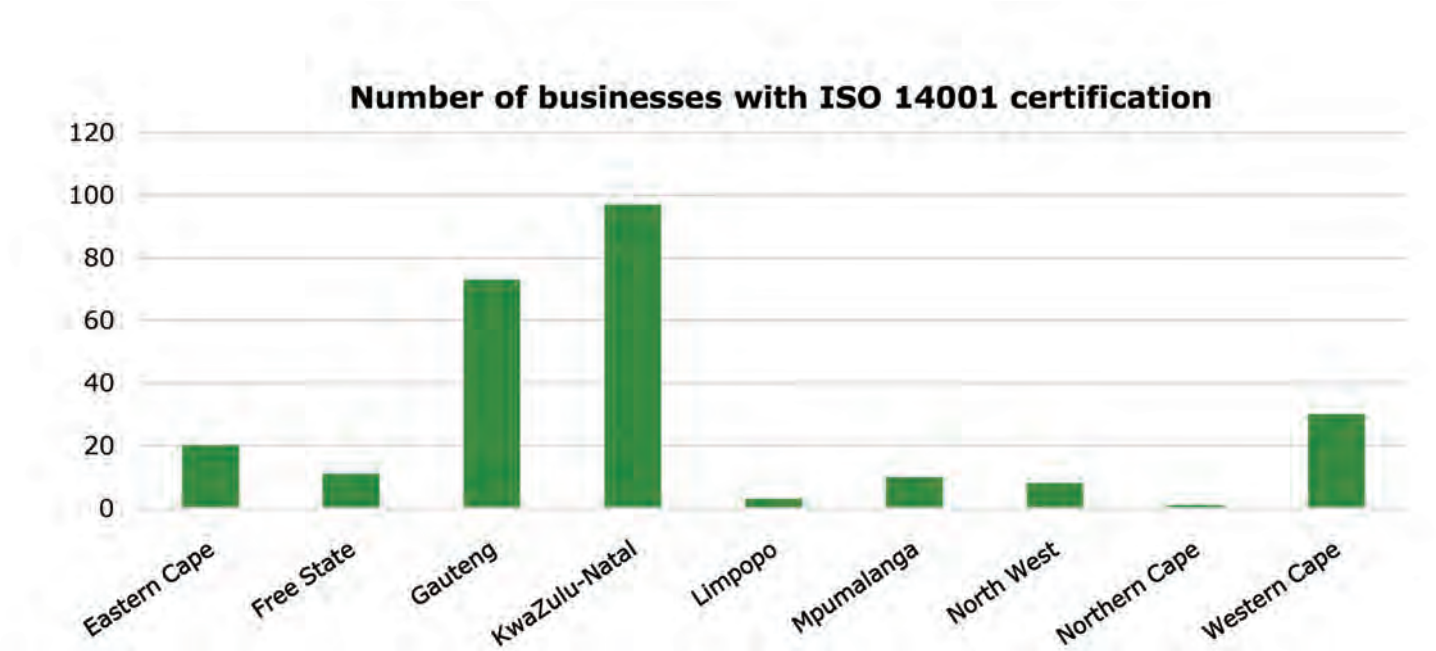

Figure 39: Number of businesses in each province with ISO 14001 accreditation in each province

Source: South African Bureau of Standards (SABS) 2007. Search of system certification with SABS ISO 14001 in South African provinces.
http://www.certification.sabs.co.za;
Environmental Quality Certification Services (Pty) Ltd. 2007;
i-Cert (Pty) Ltd 2007;
SGS South Africa (Pty) Ltd 2007;
http://gin.confex.com/gin/2003/technprogram/p162.html

Indicator: Science and technology

Variable: 36

Description: Budget for the environment

Units: Rands (1 000's) per year.

Source: National Treasury 2006. *National Medium Term Budget Policy Statement and Adjusted Estimates of National Expenditure 2006.* Vote 27: Environmental Affairs and Tourism. Website http://www.treasury.gov.za/documents/budget/2006.

Logic: This variable reflects the political commitment to overall environmental issues by the government. There has been a significant increase in the budget allocated to the environment due to the fact that South Africa is a growing tourist destination, South Africa's international commitments to improved environmental management and environmental social responsibilities to all South Africans.

Discussion: Environmental expenditure increased from R1.4 billion in 2002/2003 to R1.8 billion in 2005/2006. Expenditure further increased to close to R3 billion in 2009/2010. The most rapidly increasing expenditure is seen in the tourism sector due to the fact that South Africa is one of the world's fastest growing tourist destinations. The growth in the environmental quality and protection budget is due to the implementation and enforcement of pollution and waste management policy and legislation, and the expenditure for the biodiversity programme is increasing steadily.

Notes: This indicator addresses the Millennium Development Goal 7.

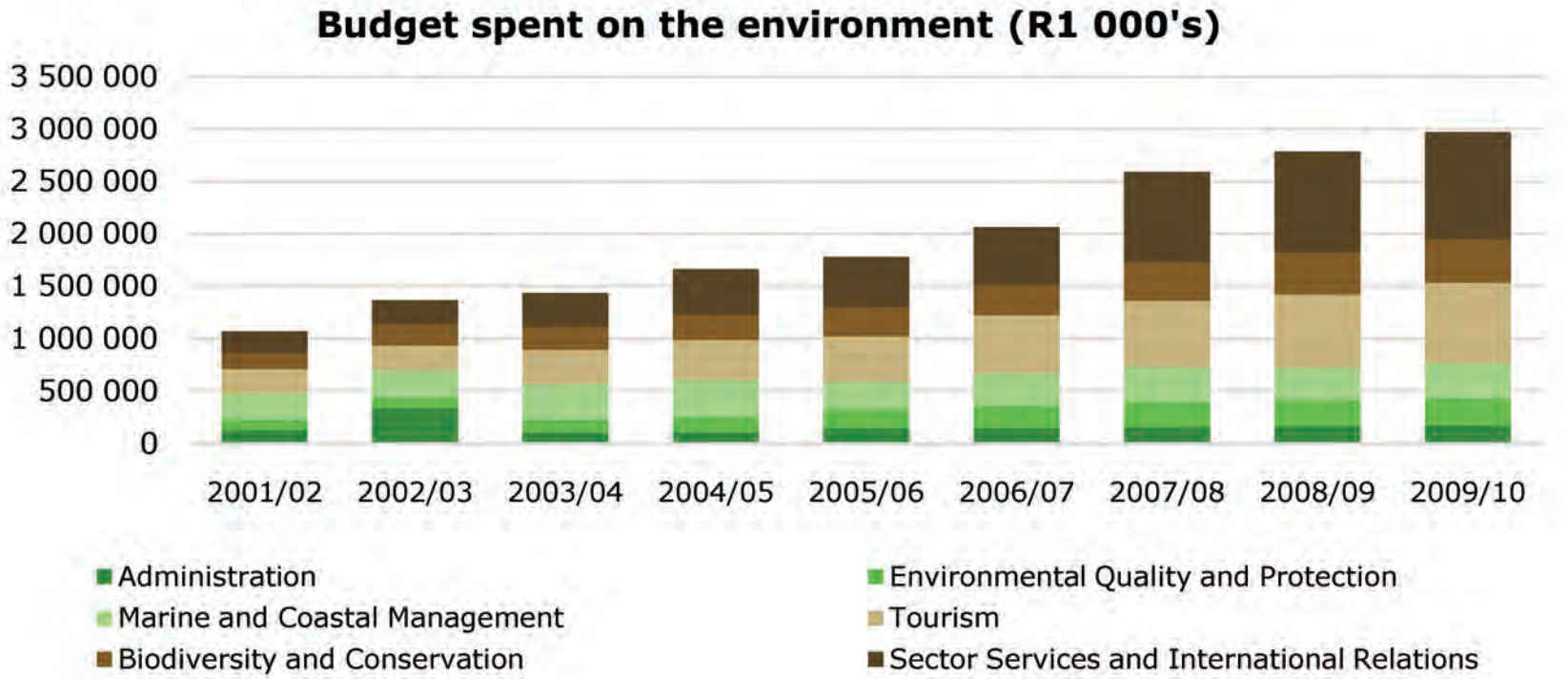

Figure 40: Budget allocated to different sectors in the environmental field in R1 000's from 2001 to 2010

Source: National Treasury 2006. *National Medium Term Budget Policy Statement and Adjusted Estimates of National Expenditure 2006.* Vote 27: Environmental Affairs and Tourism. http://www.treasury.gov.za/documents/budget/2006

Indicator: Science and technology

Variable: 37

Description: Digital access index (DAI)

Units: Index value between 0 and 1.

Source: International Telecommunication Union. http://www.itu.int

Human Sciences Research Council (HSRC) 2007. *Mapping ICT access in South Africa.* Press Cape Town.

Logic: The internet has increased the amount of environmental information that can be accessed and disseminated. Access to the internet is important for access to information, stakeholder participation, decision-making, generating awareness as well as generating innovative solutions to environmental problems.

Discussion: The Digital Access Index measures the overall ability of individuals in a country to access and use new information and communication technologies (ICTs). The index is built around four fundamental vectors that impact a country's ability to access ICTs: infrastructure (fixed and mobile phone subscribers), affordability (internet access price), knowledge (literacy and school enrolment) and quality and actual usage (international internet bandwidth and broadband subscribers) of ICTs. The DAI has been calculated for 181 economies. South Africa was ranked 36th in 2002 with a score of 0.45, but dropped six places in ranking since 1998. Countries are classified into one of four digital access categories: high, upper, medium and low. South Africa's ranking places it in the medium access category.

According to the ITU, 3.1 million South Africans had access to the internet at the end of 2002. Growth in internet access in 2002 was around 7%, the slowest since the internet became available to the South African public in 1993, and the first time it had been below 20%. Similarly the growth equalled only 6% in 2003 and estimates were that 3.28 million people had internet access. This is a mere 1 in every 13 South Africans, marginally up from 1 in 15 at the end of 2001.

The launch of the Asymmetric Digital Subscriber Line (ADSL) and wireless broadband services in 2004 has resulted in modest growth in this market.

With its relatively well developed and diverse infrastructure, South Africa is taking a regional lead role in the convergence of telecommunication and information technologies, promising the long-awaited reduction in telecommunication costs and better availability of information and services.

The HSRC developed two composite indicators of access to ICT which supplements the Digital access index and provides some information on a sub-national (municipal) level. These indicators present two dimensions of ICT access; private access and public provision. With regard to private access, the results from the HSRC study show that in only 13 municipalities are at least one in four households able to access all four ICT items (telephone, cellular phone, personal computer and the internet). Even in areas with maximum ICT access, not more than 42.6% of households have access. When considering public access to community ICT facilities (Multi-Purpose Community Centres, Telecenters and Cyberlabs, libraries and Public Information Terminals), the results show that the overwhelming majority of municipalities have less than two public ICT service centres per 1 000 people. A high concentration of ICT service centres are found in urban municipalities, and low levels in rural municipalities. These differences illustrate the unequal distribution of public ICT service between urban and rural areas.

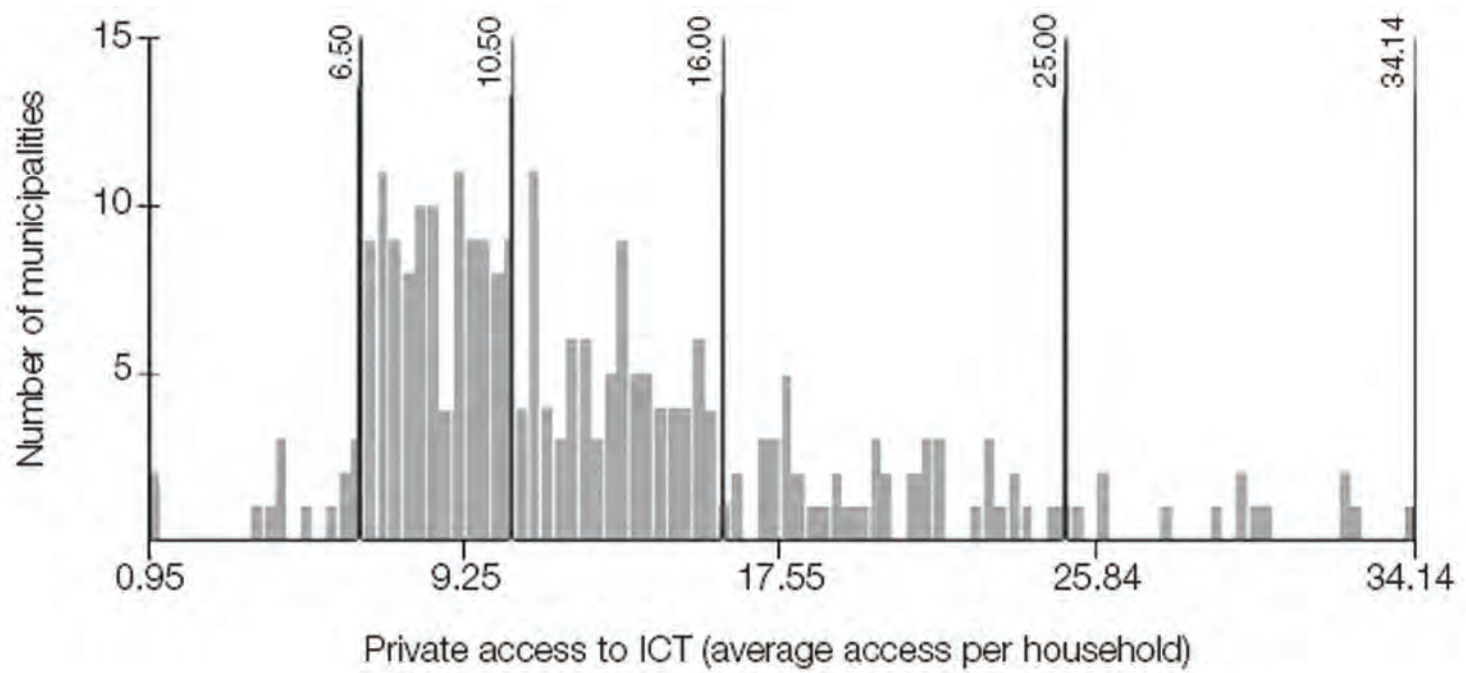

Figure 41: Private access to ICT

Source: Human Sciences Research Council (HSRC) 2007. *Mapping ICT access in South Africa.* Press Cape Town

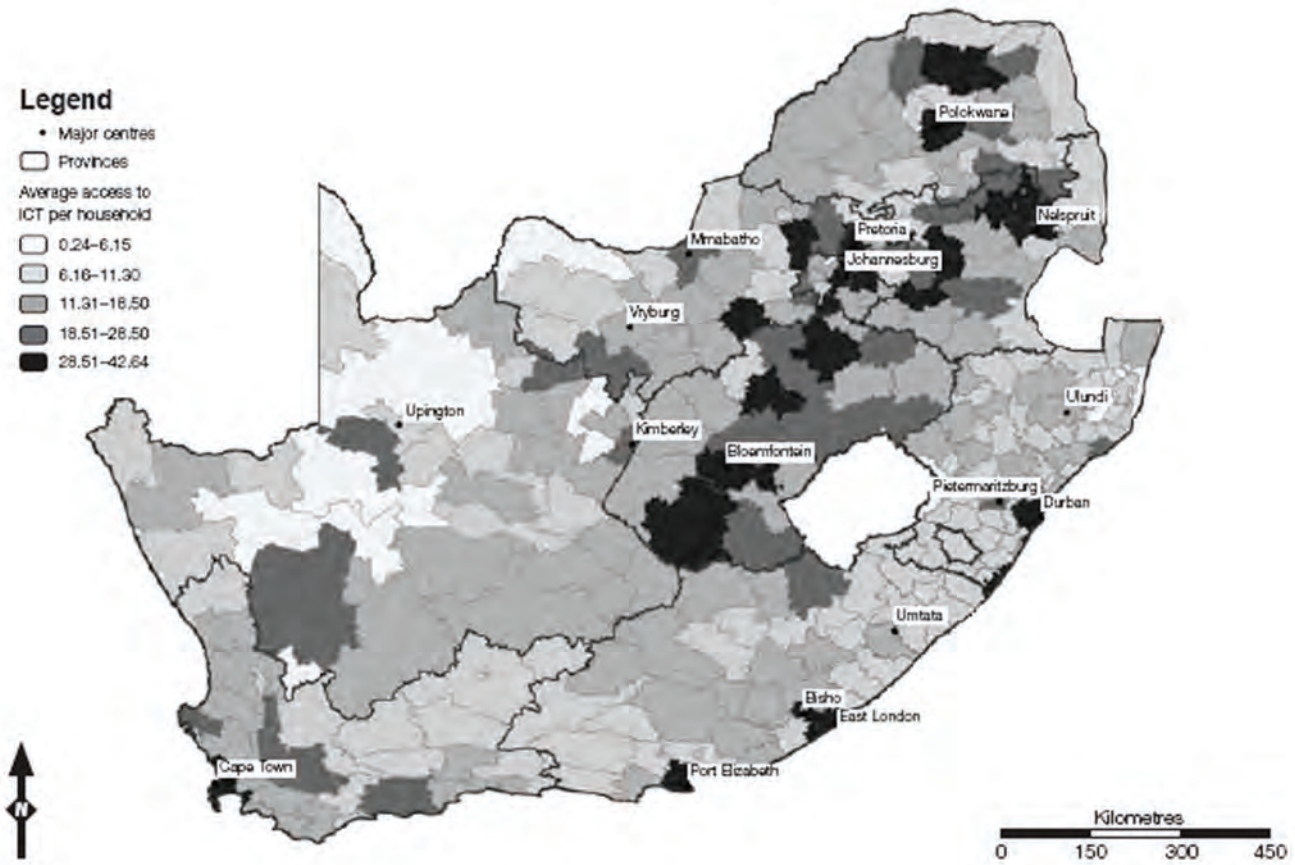

Figure 42: Private access to ICTs per municipality

Source: Human Sciences Research Council (HSRC) 2007. *Mapping ICT access in South Africa.* Press Cape Town

Indicator: Science and technology

Variable: 38

Description: Number of researchers per 1 000 total employment

Units: Number of researchers.

Source: Department of Science and Technology (DST). *South African National R&D Surveys.* http://www.hsrc.ac.za/RnDSurvey
South Africa-The Good News. http://www.sagoodnews.co.za/economy/south africa increases r d spend.htlm

Logic: Scientific capacity is important for the development of new technologies for sustainable environmental management. The Frascati Manual's definition of research and development (R&D) is as follows: "Research and Experimental Development (R&D) is creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock knowledge to devise new applications."

Discussion: At a level of 1.5 full time equivalent (FTE) researchers per 1 000 employment (across all economic sectors), South Africa has a relatively low number of researchers when compared with other countries that provide data to the Organization for Economic Co-operation and Development (OECD). The 2006–2007 survey indicated a total of 18 572 FTE researchers in South Africa.

Between 2001 and 2007 women researchers as a percentage of total researchers in South Africa increased slightly by 3.7%. Of those countries that provide data on women in R&D, Argentina and Russia continue to lead the way, while countries such as South Korea and Japan still lag behind[1]. Comparing the percentage of women researchers across the various sectors in South Africa, disparities become evident. The non-profit sector has the largest percentage of women researchers, followed by the higher education sector, government (including the Scientific Councils) and the business sector.

During the 2006-2007 period the business sector accounted for 55.9% of R&D performance, followed by the government sector at 22.8%. Higher education accounted for 20.0%, while the non-profit sector contribution decreased to 1.3%. The increase from 2003 by business and higher education sectors arose from a combination of better coverage and increased R&D activities within these sectors. About 15% of total funds are provided by foreign sources.

The largest proportion of R&D in 2004 focused on engineering sciences (23.9%), followed by the natural sciences (20.8%), and the medical and health sciences (14.8%). Social sciences and humanities accounted for a further 12.4% of R&D expenditure in South Africa.

South Africa currently has a total of 30 986 full-time equivalent R&D personnel, comprising researchers, technicians and other support staff. Meanwhile, the demographic profile of researchers in South Africa is changing, with women now comprising 39.7% of the total researchers, compared to 12.4% in Japan, and 31.7% in Norway. Among the developing countries, Argentina leads the way with 50.5% women researchers.

Limitations: A gap in the R&D surveys in the 2002–2003 financial period.

Notes: 1. International comparisons – OECD Main Science and Technology Indicators, (2005/2 Edition).

Table 31: Number of researchers and research and development personnel (R&D) expressed as a percentage of gross domestic product (GDP)

	2001-2002[d]	2003-2004[d]	2004-2005[d]	2005-2006	2006-2007
Gross domestic expenditure on R&D (GERD) Rand millions)	7 488	10 083	12 010	14 149	16 520
GERD as a percentage of gross domectic product (GDP)	0.76%	0.81%	0.87%	0.92%	0.95%
Total research and development (R&D) personnel full time equivalent (FTE)	21 195	25 185	29 692	28 798	30 986
Total researchers[b] (FTE)	14 182	14 129	17 910	17 303	18 572
Total women researchers	9 689	11 667	14 163	15 392	15 718
Total researchers (headcount)	26 913	30.703	36 979	39 266	39 591
Women researchers as a percentage of total researchers	36%	38%	38%	39.2%	39.7%
Total researchers per 1 000 total employment[c,e] (FTE)	3.10	1.20	1.60	1.5	1.5
Total researchers per 1 000 total employment[c,e] (FTE)	4.60	2.20	2.60	2.4	2.5
Civil GERD as a percentage of GDP	0.71%	0.72%	0.80%	0.86%	0.89%

a. Following the Organization for Economic Co-operation and Development (OECD) practice, doctoral students are included as researchers.

b. Following OECD practice, total employment is now provided by the International Labour Organization based on the Labour Force.

c. The 0.76% for 2001-2002 is as reported in the 2001-2002 R&D Survey Report and is not based on revised gross domestic product (GDP) figures.

d. Changes in the methodology used by Statistics South Africa in the Survey of Employment and Earnings have resulted in a 39% increase in the total number of employees reported for the formal non-agricultural sectors between March 2002 and March 2004.

Source: Department of Science and Technology (DST). *South African National R&D Surveys.* http://www.hsrc.ac.za/RnDSurvey

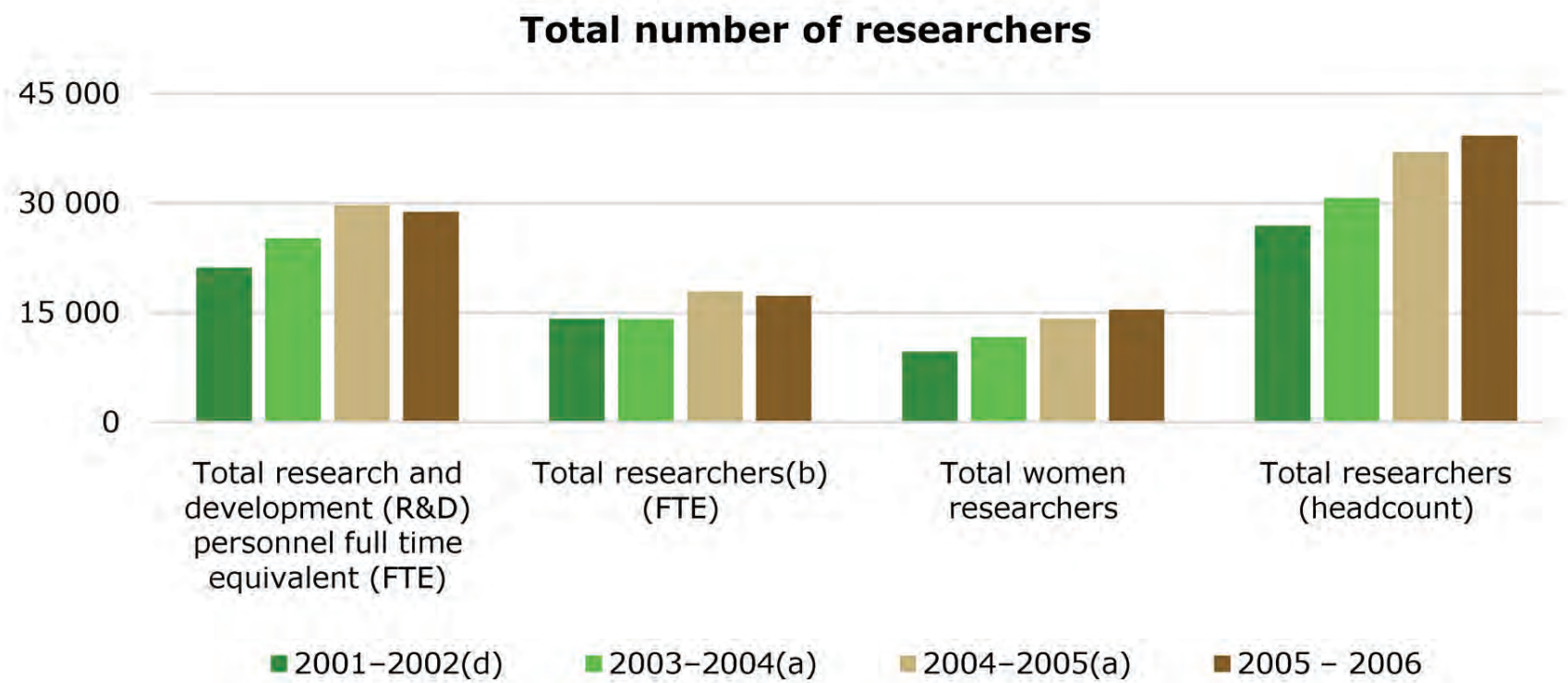

Figure 43: Number of reseachers and research and development personnel in South Africa from 2001 to 2007

Source: Department of Science and Technology (DST). *South African National R&D Surveys.* http://www.hsrc.ac.za/RnDSurvey

Indicator: Science and technology

Variable: 39

Description: Budget for research and development (R&D)

Units: Percentage of GDP per year.

Source: Department for Science and Technology (DST). *National Survey of Research and Experimental Development (R&D)* (2004/05 Fiscal Year). High Level Key Results. http://www.dst.gov.za

South Africa The Good News. http://www.sagoodnews.co.za/economy/south africa increases r d spend.html

Logic: Applied research and experimental development contribute to economic development by providing new R&D based products and processes with potential for introduction to the market. The strengthening of the R&D system through various mechanisms lead to a more competitive international position through R&D based knowledge and innovation.

Discussion: A survey conducted by the Human Sciences Research Council (HSRC) has found that South Africa spent R16.5 billion on research and development (R&D) during the 2006/07 financial year, showing a marked increase when compared to the R14.1 billion spent during the 2005/06 financial year. Applied research and experimental development contribute to economic development by providing new R&D based products and processes with potential for introduction to the market.

The information is critical to South Africa's forward planning, particularly in specifying the targets for the Ten-Year Innovation Plan, which aims to help drive South Africa's transformation towards a knowledge-based economy. Most South African R&D work was performed in the research field of the engineering sciences (20.9% of total R&D), followed by the natural sciences (20.3%) and the medical and health sciences (15.1%).

There was a revise in the South African gross domestic product (GDP) data series and thus the historic high point of R&D expenditure of 1.04% of GDP in 1991 has been reviewed downwards to 0.84%. This means that the 0.92 % recorded for 2005 is the peak in the South African R&D data series. The increase in gross expenditure on R&D (GERD) in real terms between 2001 and 2005 has resulted in a 5% annual growth of GERD expressed as a percentage of GDP. The challenge is to reach the R&D expenditure goal of 1% of GDP by 2008.

Notes: This indicator addresses the Johannesburg Plan of implementation: Section 62.

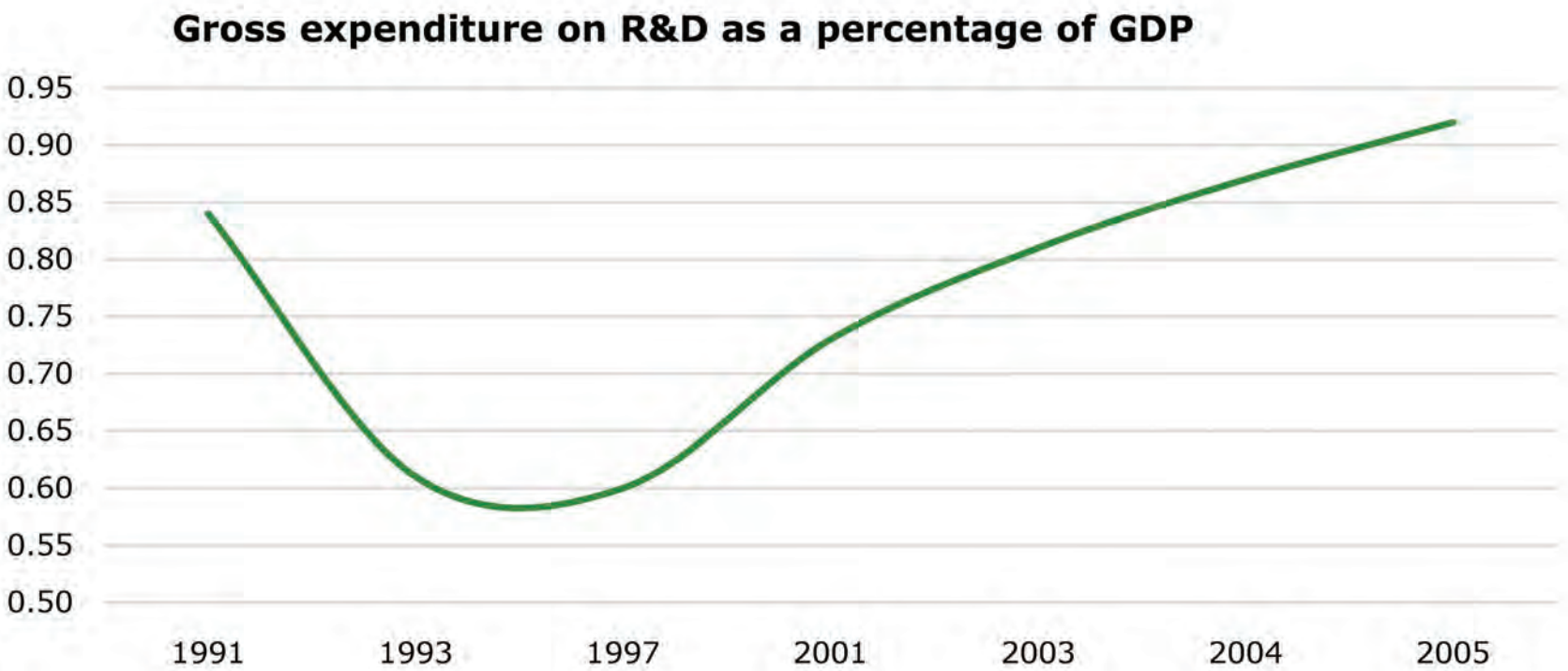

Figure 44: Gross expenditure on research and development as a percentage of gross domestic product
Source: Department for Science and Technology (DST).
National Survey of Research and Experimental Development (R&D) (2004/05 Fiscal Year). High Level Key Results.
http://www.dst.gov.za

Indicator: Science and technology

Variable: 40

Description: Gross tertiary enrolment rate

Units: Percentage of pupils enrolled at tertiary level of schooling.

Source: Department of Education (DOE) http://www.education.gov.za

Logic: The higher the level of education within a population, the higher the capacity for scientific and technological innovation, environmental awareness and ability to address environmental problems.

Discussion: This variable gives a good indication of the literacy level of the country. A higher percentage of pupils enrolled into a tertiary institution leads to a higher capacity for innovation, awareness and the capacity to solve environmental, social and financial problems faced by the country. In the last six years the percentage of students enrolled in tertiary institutions did not fluctuate much, however a significant decrease in the percentage of students is noticeable during 2004. The reasons for this finding are yet to be unravelled.

During this year (2004) there was a decrease in student numbers in both technicon and university enrolments compared to other years. Technicon enrolment numbers decreased by approximately 7% compared to the average for all the years investigated. The number of enrolments in university similarly decreased significantly by approximately 18% compared to the average for all the years investigated. The largest difference in enrolment numbers appears to be in the business and commerce fields where a drastic decrease in enrolment numbers was observed in 2004. During 2006 a total of 741 380 students were enrolled in tertiary institutions in South Africa.

Of this number a total of 211 584 students were enrolled in the science, engineering and technology field equating to 28.54% of the total students enrolled.

Notes: The percentage of students enrolled into tertiary institutions falling into the 5 main areas of study where: Unkn = Unknown; O Hum = Other Humanities; Edu = Education; BC = Business and Commerce and SET = Science, Engineering and Technology.

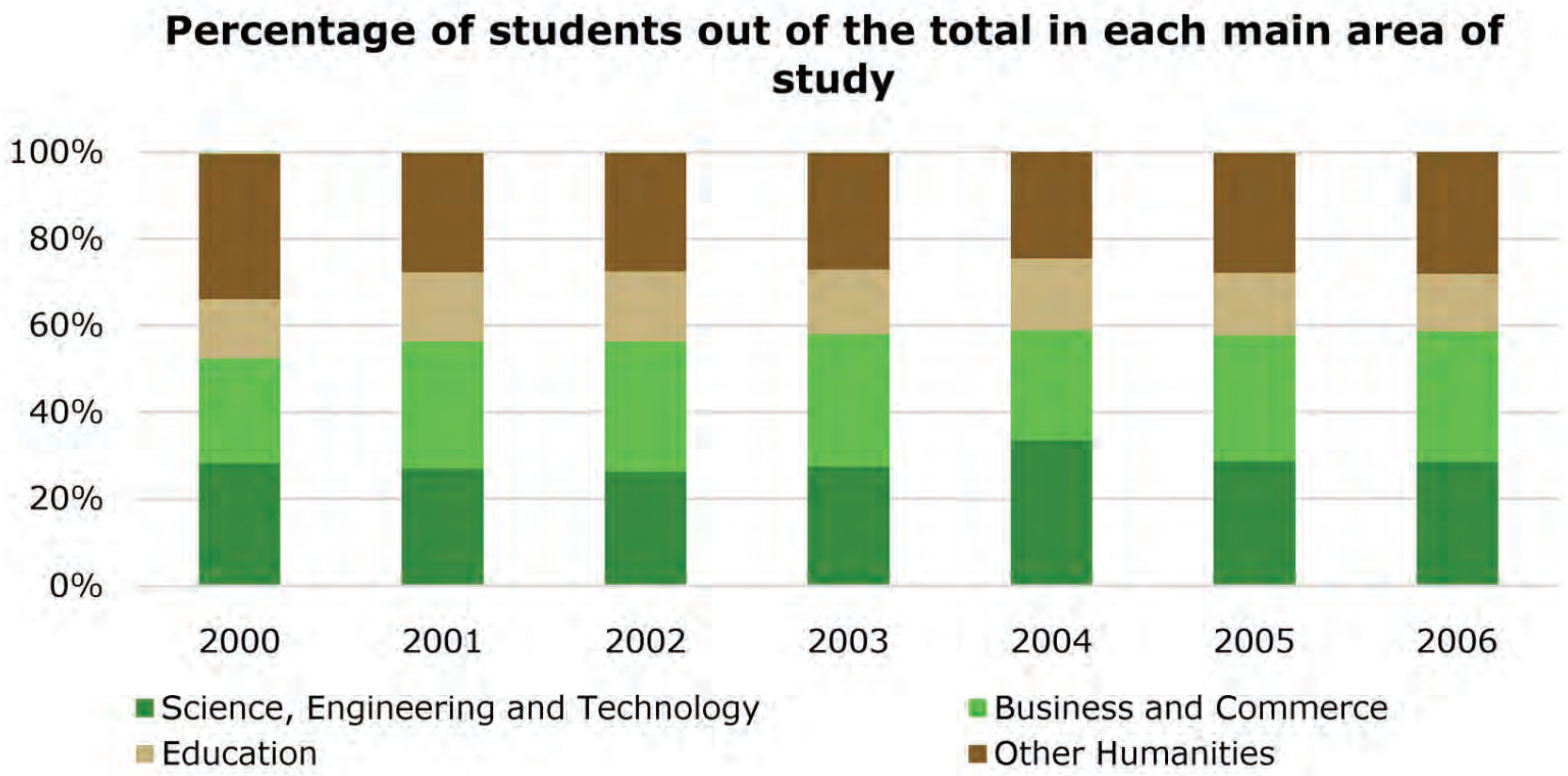

Figure 45: Percentage of students enrolled in each main study area
Source: Department of Education (DOE). http://www.education.gov.za

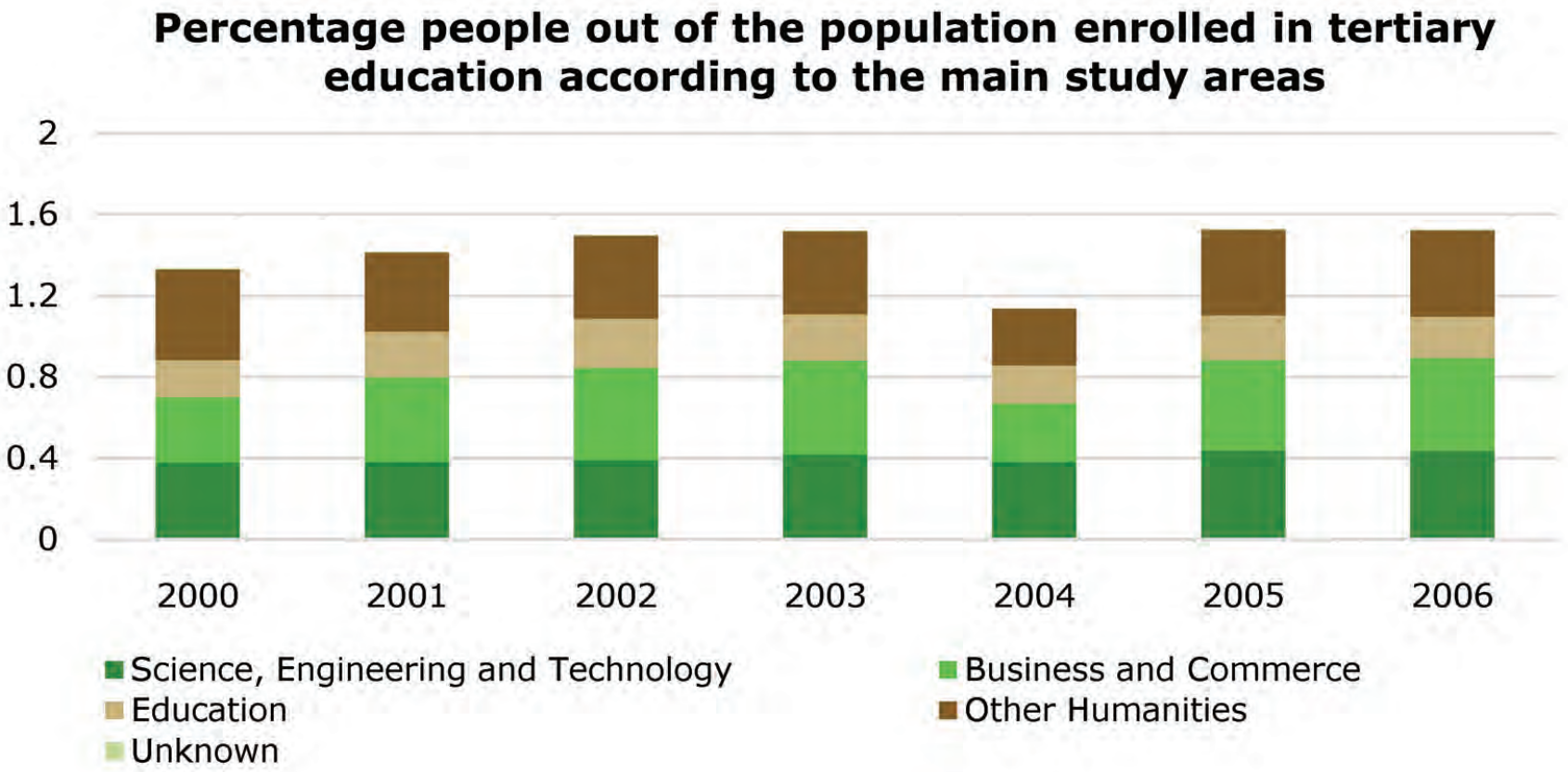

Figure 46: Percentage people enrolled into tertiary education out of the total South African population

Source: Department of Education (DOE). http://www.education.gov.za

Indicator: Science and technology

Variable: 41

Description: Education (primary, secondary and adult basic education and training (ABET))

Units: Number of pupils enrolled at primary, secondary and ABET level of schooling.

Source: Statistics South Africa (Stats SA) 2006: *General Household Survey (Statistical release P0318).* http://www.statssa.gov.za

Department of Education (DOE). http://www.education.gov.za/

South Africa Information. http://www.southafrica.info/about/education/education.htm

Logic: The higher the level of education within a population, the higher the capacity for scientific and technological innovation, environmental awareness and ability to address environmental problems.

Discussion: By mid-2007, the South African public-education system had 12.3 million learners, 387 000 educators, 26 592 schools, 2 278 ABET centers, 50 public FET institutions, 4 800 Early Childhood Development (ECD) centers and 23 Higher Education (HE) institutions. Of the 26 592 schools, 1 000 were independent schools, 400 were special-needs schools and the remainder were ordinary schools. Of all schools, 6 000 were secondary and the rest primary.

This variable gives a good indication of the literacy level of the country. A higher percentage of pupils enrolled into an education institution leads to a higher capacity for innovation, awareness and the capacity to solve environmental, social and financial problems faced by the country. Counts for the number of learners were made on the 10^{th} day of schooling and are represented in Gross Enrolment Rate (GER). GER is the level of participation in education and is defined as the number of learners enrolled into a specific school phase (irrespective of age) as a percentage of the appropriate school-age population. A GER of more than 100% thus indicates that there are over- or under-aged learners enrolled in that specific school phase. There has been a marked increase in the GER of learners enrolled in the secondary schooling phase. The GER of learners in the primary schooling have stayed fairly constant over the time period and have never been less than 100% indicating that learners in this education phase comprise of individuals that are either over or under aged when compared to the school going age for that specific phase. The total numbers of learners in public schools (both tertiary and secondary combined) have showed a slight increase since 2003.

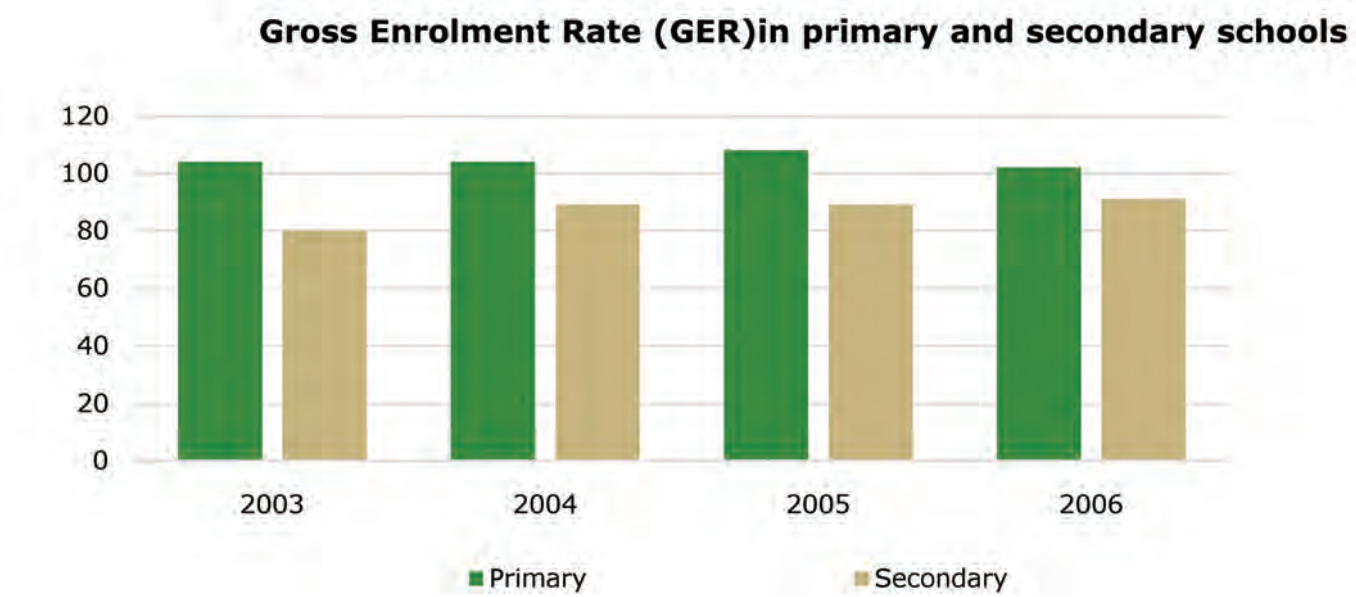

Figure 47: Gross Enrolment Rate (GER) in primary and secondary schools
Source: Department of Education (DOE). http://www.education.gov.za

Table 32: The total number of learners enrolled into public schools (Primary and secondary combined) and into the Adult Basic Education and Training centres

	Number of learners	
	Public	ABET
2003	12 038 922	548 704
2004	12 176 391	548 367
2005	12 217 795	269 140
2006	12 302 236	251 610
2007	12 410 501	No values available

Source: Department of Education (DOE). http://www.education.gov.za