Chapter 2

Economic growth in South Africa: Getting to the right shade of green

Despite having become increasingly active in the area of green growth policies, and despite having put in place a generally sound environmental policy framework, South Africa needs to improve implementation to meet key environmental challenges. Effective green growth policies should be combined with other structural and macroeconomic policies to reconcile rapid economic growth with environmental sustainability. A key element of such a policy mix is improving price-setting in the key areas of greenhouse gas emissions and water. The South African economy is very carbon-intensive, in part because of implicit subsidies to coal and electricity, while there is as yet no economy-wide carbon price to internalise environmental externalities. More generally, not all instruments to achieve the government's commitments on emissions abatement are in place, and progress on implementation of the instruments that have been identified has been slow. The monitoring of progress and the verification of coherence between different initiatives should be improved. South Africa is already a water-scarce country, and water stress will worsen with population growth and climate change. The existing policy framework is broadly consistent with best international practice, but implementation has lagged. In general, charges for water need to rise to be increase cost recovery and price scarcity, while the allocation of licenses should be speeded up, municipal management strengthened and illegal water use curtailed.

South Africa has become increasingly active as regards policies to deliver green growth

Why care about the greenness of growth?

Given the scale of unemployment and the negative consequences that flow from it, raising employment is undoubtedly the highest immediate priority for economic policy in South Africa. Increasing employment by enough to bring unemployment down decisively will require rapid economic growth over a number of years. In designing policies to achieve that key objective, however, policy-makers need to gauge the risk that the pattern of current growth undermines social welfare in the future. One aspect of this risk relates to a loss of social cohesiveness – too great a widening in the distribution of income and wealth may ultimately disrupt the stability of the economy and curtail growth. Another, the subject of this chapter, is that environmental degradation becomes a constraint on the growth of income and well-being. Coping with this environmental risk while achieving strong growth rates is central to green growth.

As noted in the National Development Plan, for more than a century South Africa exploited its natural resources with little regard for the environmental consequences. The legacy of that approach was an energy-intensive economy highly dependent on cheap coal and polluted air and water from mining and industry. South Africa faces many environmental challenges, including waste management, local air and water pollution, pressures on biodiversity and marine resource management. The forthcoming OECD *Environmental Performance Review of South Africa* will address the full panoply of environmental issues. Two policy questions – climate change and the scarcity of clean water – are of particular importance for the wellbeing of South Africa's population and future economic development, however, and are thus picked out as the focus of this chapter.

These two challenges are interrelated. Notably, climate change is expected to increase the degree of water stress via a higher frequency of extreme weather events including droughts and floods. Action to mitigate climate change could also help more directly to ease water stress: a lower-carbon mix of electricity generation technologies would reduce water use at the margin, as coal-burning plants both emit more carbon dioxide per unit of energy produced than other plants and use more water – coal-fired power stations account for about 7% of non-agricultural water consumption. In addition, a substantially higher relative price of electricity, in part driven by climate change considerations, will reduce overuse of water by weakening the incentive for farmers to use electricity to pump groundwater. Likewise, success in managing water demand could reduce the future need for energy-intensive water supply options like desalination of sea water.[1] In both cases, climate change and water management, the authorities are working towards the expanded use of pricing of externalities to encourage a more economically efficient use of resources, but face important challenges of implementation.

The South African authorities are fully aware of these environmental challenges, and have increasingly embraced green growth policies. To date, given that employment creation is a critical priority, there has been an understandable emphasis on the scope for job creation in the green economy. The New Growth Path (NGP), for example, targets the creation of 300 000 green jobs by 2020, and the Industrial Policy Action Plan (IPAP) identifies the green economy as one of three priority areas for scaling up.

Although this sort of line may be effective as a strategy to sell green growth to sceptical stakeholders, it is not without risks. To begin with, it is likely to exaggerate the scope for "win-win" opportunities which boost growth, even in the short run, while curbing environmental harm. It may thus court disappointment and ultimately even discredit green-oriented policies in the eyes of the public if the growth and employment gains are not forthcoming on the promised scale. Such an approach may also tend to lead to a muddling of objectives, with green growth initiatives being judged mainly on their perceived employment potential rather than their contribution (and the cost effectiveness of that contribution) to sustainability. Meanwhile, it may distract attention from the many other policy measures needed to deliver satisfactory growth rates in South Africa: notably, promoting competition, improving the functioning of labour markets, maintaining the right macroeconomic policy mix and creating favourable framework conditions for investment and innovation. In addition, there is a danger of counting only direct job gains from a given measure (*e.g.* subsidised production of renewable energy) and not any associated job losses elsewhere or indirect effects (Bowen, 2012).

Rather than focussing on the (in any case hard-to-define) "green economy" and "green jobs", it may be preferable to stress the more direct welfare case for engaging in policy interventions to promote greener growth. This is above all that since various environmental harms are not reflected in market prices, in the absence of policy interventions such harms will be oversupplied and the well-being of the population will be lower. This is in line with the OECD's Green Growth Strategy (OECD, 2011a), which notes that at the core of green growth are constraints or distortions in the economy which inhibit returns to "green" investment and innovation, *i.e.* activities which can foster economic growth and development while ensuring that natural assets continue to provide the resources and ecosystem services on which our well-being relies.

The key policy issues are to develop a transition toward a greener economy and a set of policies that will deliver this path. In this context, two policy questions to be answered are how much greener growth should be (*i.e.* at what point would the expected marginal benefits of increasing the greenness of growth be equal to the expected marginal costs) and how to minimise the cost of achieving the targeted shade of green. Given the high degree of uncertainty in this area, governments should be concerned with not only maximising the expected value of social welfare, but also avoiding very bad outcomes. The Stern Review (Stern *et al.*, 2006) drew attention to the risk of catastrophic climate change and argued that the cost of greatly reducing that risk was low. This sort of argument may be of particular importance for a middle-income country like South Africa, which has environmental and social vulnerabilities that make it less resilient than most advanced countries.

It will be necessary to improve the measurement of environmental costs and benefits

Especially given the extent of uncertainty about the long-term costs of a "Business as Usual" approach and the size and timing of the benefits of greening growth, it is also

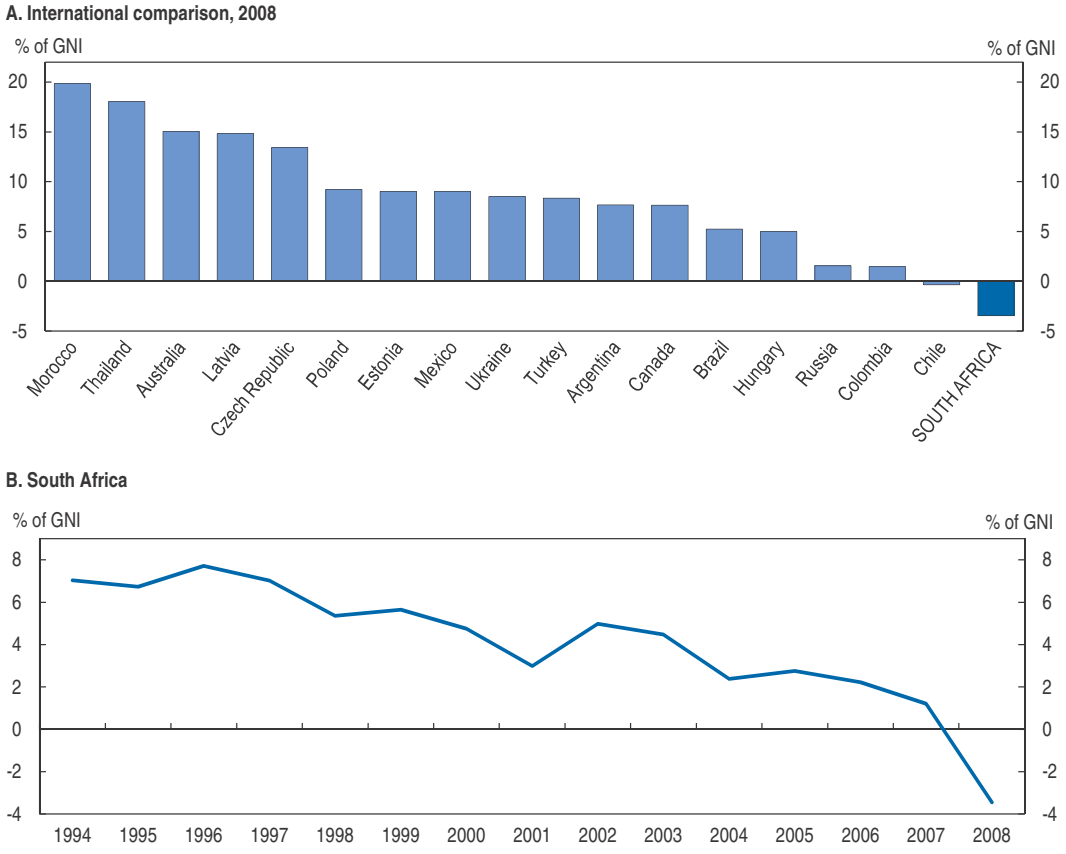
important to fill the knowledge gaps to the extent possible. One avenue to this end is to improve alternative measures of well-being. While it is clear that GDP is an incomplete and imperfect gauge of social welfare, in the absence of a better alternative it continues to be the single most used indicator of living standards. Moving beyond GDP is an area where an increasing amount of theoretical and empirical work has been done (*e.g.* Stiglitz *et al.*, 2010). The OECD has been in the forefront of such efforts (OECD, 2011b), and has created the Better Life Index to illustrate how we might get a better picture of social welfare by combining different indicators, with user-determined weights. Better Life Index data are not yet available for South Africa – only OECD member countries and two non-members, Russia and Brazil, are covered to date.

A worthwhile long-term objective would be to develop and publish national accounts measures that factor in natural resource depletion and the costs of environmental degradation, although this is likely to take time, as such efforts are in their infancy even in more developed countries. South Africa has already made some preliminary efforts to measure resource use, however, via a number of Environmental Economic Accounts. Statistics South Africa has issued discussion documents for energy, minerals and water, providing energy accounts for the period 2002-09, mineral accounts for 1980-2009, and water accounts for the year 2000.[2] These efforts have not yet made it possible to integrate the environmental accounts with the national accounts, so as, for example, to adjust GDP growth for all resource use. In addition, they rely on the irregular provision of data from other government ministries, are not always in line with national accounts classifications (*e.g.* as regards the Standard Industrial Classification of economic activities) and in some cases are limited to physical volumes. Nonetheless, these discussion documents have added to the understanding of natural resource use and sustainability, and progress towards the issuance of regular and complete Environmental Economic Accounts should continue.

South Africa has also made some progress on the creation of sustainability indicators, including at the provincial level. Both the national government and the provinces are obliged to provide periodic State of the Environment reports – the last national State of the Environment report was in 2006. It could be useful for the authorities, and for international comparisons, if South Africa were to monitor the limited set of Headline Indicators and the broader range of measures proposed in the OECD's Green Growth Indicators (OECD, 2011c, 2012b).

If official adjustments to the national accounts to take account of resource depletion and environmental harm are still some way off, estimates from elsewhere are already available. The World Bank's Adjusted Net Saving indicator seeks to show the extent to which a country adds to its wealth, *i.e.* its capacity to generate income, in a given period by adjusting nominal saving by additions to human capital and degradation of the stock of natural resources. A negative number for Adjusted Net Saving indicates a decline in the economy's capacity to generate income, implying an unsustainable path. Compared to other middle-income countries, as well as other resource-rich countries like Australia and Canada, South Africa's adjusted net saving in 2008 was strikingly low (Figure 2.1A). It has also been on a downtrend since the early 1990s (Figure 2.1B), owing mainly to rising energy (coal) and mineral depletion. While the adjusted net saving measure is neither comprehensive nor universally accepted (Neumayer, 2000), South Africa's low relative position and negative trend on this metric are a *prima facie* cause for concern.

Figure 2.1. **Adjusted net saving**



Note: Adjusted Net Saving including PM10 damage.
Source: World Bank, *WDI Database*.

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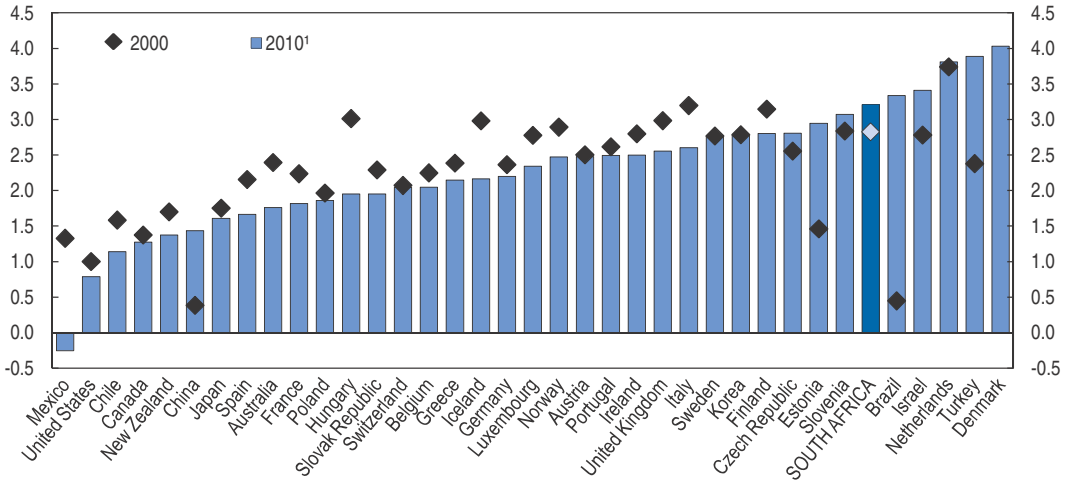
The high environmental cost of growth in the past in South Africa and the tentative evidence that national wealth, the basis for future income, is currently being run down highlight the need to increase the degree of decoupling of growth from natural resource use. Only in that way can the sorts of growth rates targeted in the National Development Plan and the New Growth Path be consistent with sustained increases in well-being of the population.

Getting green policies right involves balancing several instruments at different levels

Governments can advance green growth in various ways, including "green taxes", which South Africa already uses fairly extensively (Figure 2.2), tradable permits, regulation, and support for eco-innovation. Instruments that rely on price signals often have a cost-effectiveness advantage, as this tends to have more decentralised information requirements and equalises the marginal cost of abating a given harm. Sometimes, however, it may be infeasible or too costly to create prices that are not established by the market, making it necessary to resort to other instruments such as regulatory standards.

Apart from technical difficulties, policy-makers face the political economy challenge of taking policy actions that are strong enough to change behaviour and trigger entrepreneurial responses, but not so strong as to create insuperable political resistance. A number of OECD economies, including Australia, the European Union and Norway, have

Figure 2.2. **Environmentally related tax revenues, per cent of GDP**



Explanatory note: Tax revenues are shown net of subsidies, which is why Mexico is shown as having negative environmental related tax revenues. In the case of South Africa no subsidies are deducted from gross tax revenues, as the below-market pricing of coal and electricity are not reflected in budgetary allocations.

1. 2009 for Canada, Greece and the Slovak Republic.

Note: Environmentally related taxes include taxes on energy products (for transport and stationary purposes including electricity, petrol, diesel and fossil fuels), motor vehicles and transport (one-off import or sales taxes, recurrent taxes on registration or road use, other transport taxes), waste management.

Source: OECD Green Growth Indicators Database.

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been relatively successful in meeting that challenge. And within the EU countries like Germany have achieved a high degree of buy-in to environmental goals. In South Africa, the political economy challenge has two important dimensions: providing adequate protection to the large number of poor people and overcoming the resistance of large and powerful enterprises.

In addition, many environmental policy instruments may be applied at different levels of government, and co-ordinating policy across those levels raises a number of difficulties (Box 2.1).

Box 2.1. **Multi-level environmental governance in South Africa**

South Africa's Constitution designates the environment as an area of concurrent national and provincial responsibility, *i.e.* both the national and provincial governments have the power to make and implement environmental legislation. In case of conflict, national environmental legislation prevails over provincial norms and standards. Along with more recent provincial environmental laws (*e.g.* Limpopo Environmental Management Act, 7/2003), the provincial authorities administer historical conservation and land-use planning ordinances (often fragmented substantively as well as territorially) that were applied to apartheid-era homelands, as well as environmental functions delegated to them by the national executive bodies. The management of surface water, groundwater and marine resources as well as national parks are the exclusive competence of the national government.

Box 2.1. **Multi-level environmental governance in South Africa** *(cont.)*

While the stringency of environmental requirements does not vary dramatically across the provinces, significant discrepancies exist between the provinces with respect to the implementation of the national laws. The operational guidelines and actual practices often show the different levels of stringency, *e.g.* with respect to Environmental Impact Assessment procedures and environmental authorisations. At the same time, provinces sometimes undertake initiatives in policy areas where they do not have legal competencies without waiting for national-level programmes (*e.g.* in water resources management).

South Africa has undertaken an ambitious decentralisation programme in order to empower local authorities. The functional expansion of local government authority (including the provision of such environmental services as water supply, sanitation and waste management) has been one of the most significant institutional changes in South Africa since the end of apartheid. Local governments now have the competence for such environmental issues as air pollution, noise pollution, water supply and sanitation, storm-water management, and non-toxic solid waste management. Local authorities also play an important role in regulating land use and development through monitoring and enforcing compliance with relevant zoning regulations.

While the legislation does not provide for the differentiation of environmental responsibilities among the 278 municipalities, the functions they actually exercise depend on their size and capacity. The eight large metropolitan municipalities (Category A) are usually well equipped to execute their environmental mandate and generally have fairly stringent by-laws on air pollution and waste management. The 45 district municipalities (Category B) often assume the functions of smaller local (rural) municipalities (Category C) located in their districts. The exercise of local government powers is subject to national and provincial oversight in order to address capacity gaps and prevent potential mismanagement. For example, the provinces may assume certain regulatory responsibilities if the municipalities lack capacity to execute them: three provinces currently deal with air quality issues which are normally part of the municipalities' remit.

Following the constitutional principle of "co-operative governance" and the provisions of the 2005 Intergovernmental Relations Act, South Africa has established mechanisms and procedures to promote the co-operation between the national, provincial and local governments and to facilitate the settlement of intergovernmental disputes. They include the MINMECs – standing intergovernmental bodies that consist of sectoral Ministers and Members of provincial Executive Councils responsible for functional areas similar to those of Ministers, MINTEC – Directors-General and the heads of the provincial departments and issue-specific working groups. Those seem to be particularly effective in the collaboration between different levels of government on environmental compliance and enforcement. However, an effective implementation of environmental policies is hampered by an important lack of institutional capacity at the provincial and local levels, among others, in terms of environmental management. Most provinces have declining environmental budgets, environmental staff are over-committed and are rarely engaged in horizontal or vertical interagency co-operation. In addition significant discrepancies exist between the provinces, and even greater ones across municipalities, with respect to the implementation of the national legal environmental requirements. The funding gap between the available resources and the needs to meet programme objectives is more acute in smaller, rural, less economically developed jurisdictions, contributing to inequities of policy implementation.

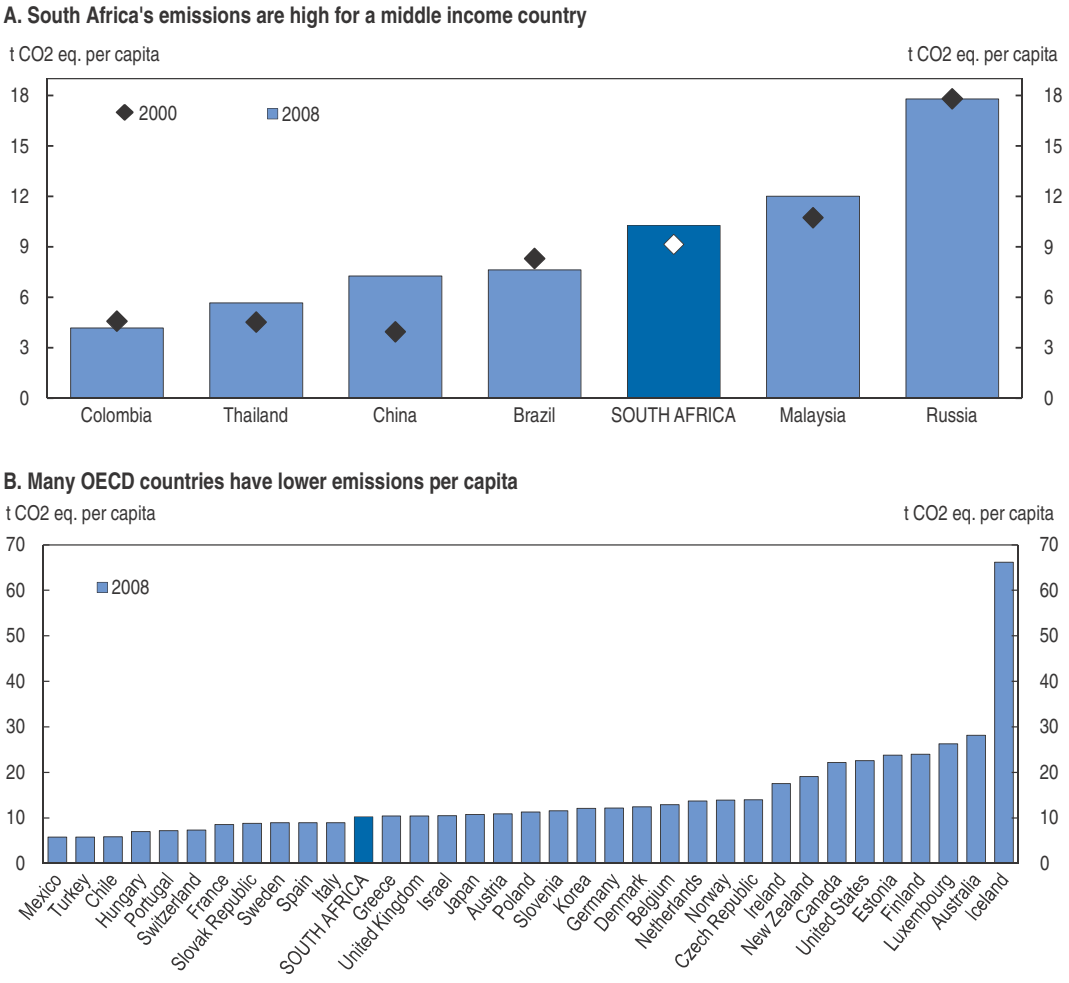
Meeting the challenge of climate change

The economy is carbon-intensive, in part because of implicit subsidies to coal and electricity

South Africa is towards the upper end of the international range in terms of greenhouse gas (GHG) emissions per capita, and among the most emission-intensive middle-income countries (Figure 2.3). Of the 134 countries for which IEA data are available, South Africa ranked 47th in 2008 in per capita greenhouse gas emissions, with 10.3 tonnes of CO_2 equivalent, 43% above the global mean. Even compared to upper-income countries, South Africa is close to the average: 11 of 34 OECD countries have lower greenhouse gas emissions per capita.

Unlike most developing countries, South Africa has a long history of relatively high GHG emissions – per capita emissions were already in the middle of the range for OECD countries in the early 1970s. Also, the growth of emissions picked up to 2.5% a year in the 2000s compared to 1.3% in the 1990s. This reflected an acceleration in the rate of increase of GDP, but South Africa experienced less decoupling than most other countries in the 2000s (Figure 2.4).

Figure 2.3. **Greenhouse gas emissions per capita**



Source: IEA (2011) and World Bank, *WDI Database on line*.

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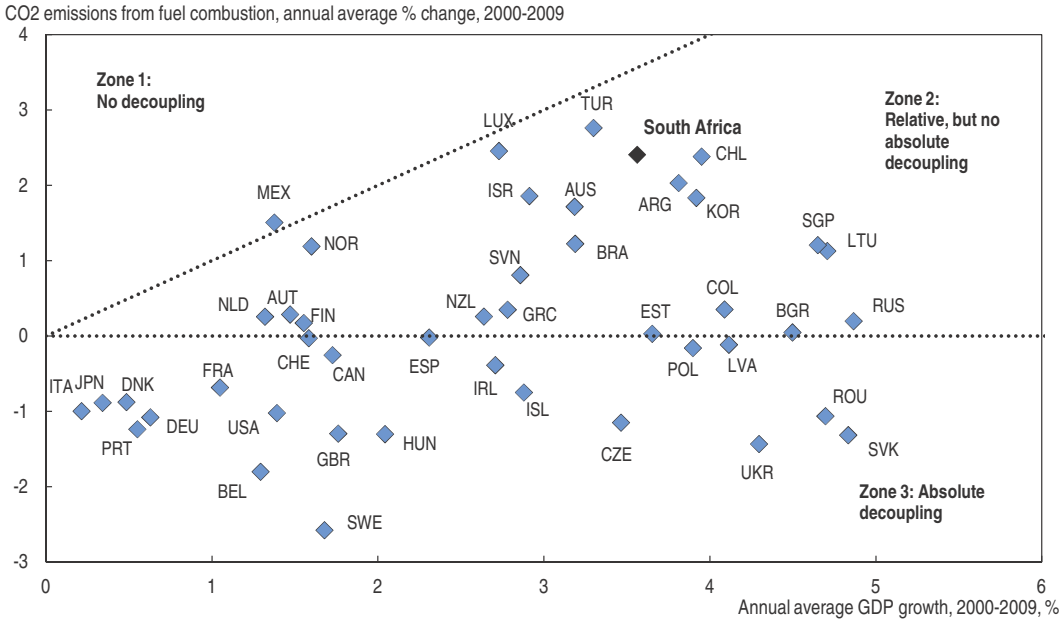
Figure 2.4. **Degree of decoupling of emissions and real GDP**



Source: OECD National Accounts Database; World Bank, *WDI online Database;* and IEA(2011), *CO_2 Emissions from fuel combustion.*

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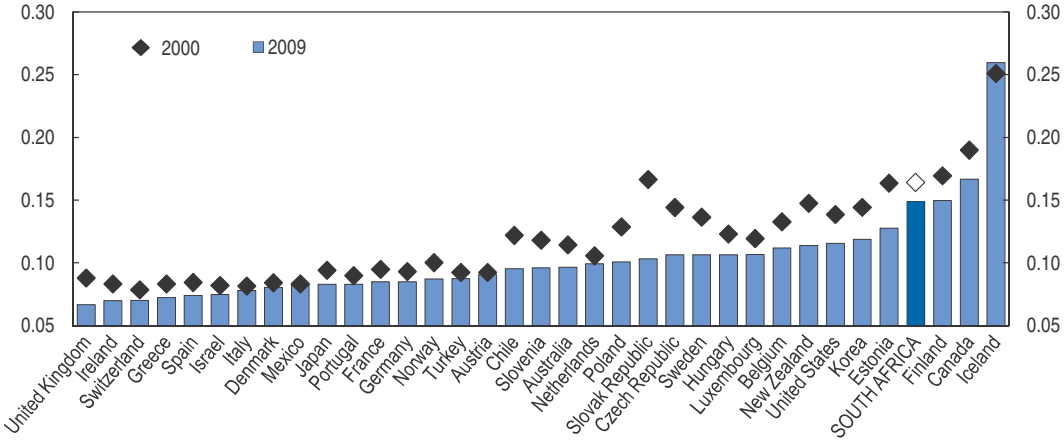
South Africa's relatively high emissions partly reflect the energy intensiveness of the economy. Primary energy use per unit of GDP is among the highest in the world (Figure 2.5), and has fallen less rapidly than both advanced and developing countries: from 2000 to 2009, energy intensity of GDP fell by 9% in South Africa compared to 14% for OECD countries on average and 24% for an average of Brazil, China, India, Indonesia and Russia (Figure 2.6).

Figure 2.5. **Total energy consumption per unit of GDP**

Tonnes of oil equivalent (toe) per thousand 2005 US dollars of GDP calculated using PPPs



Source: IEA, *World Energy Balances Database* and OECD, *National accounts Database*.

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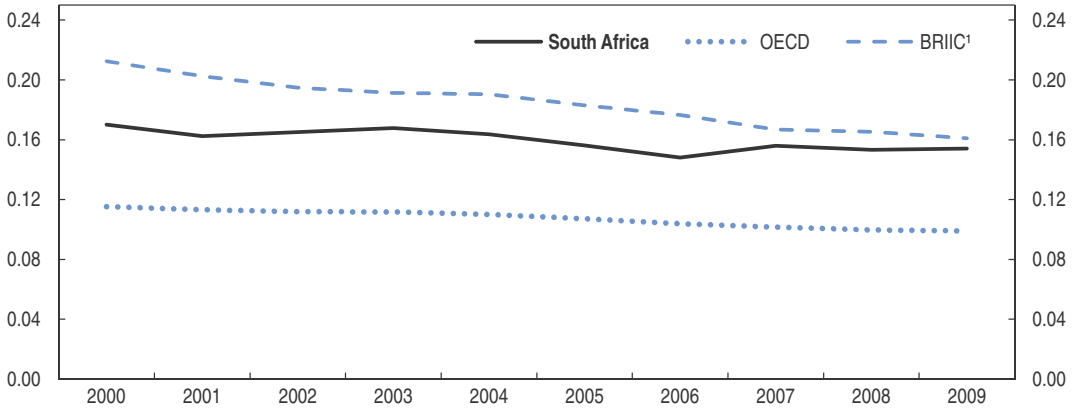
Figure 2.6. **Total energy consumption per unit of GDP, 2000-09**

Tonnes of oil equivalent (toe) per thousand 2005 US dollars of GDP calculated using PPPs



1. Brazil, Russian Federation, India, Indonesia and China.

Source: IEA, *World Energy Balances Database*; OECD, *National accounts Database*; and World Bank, *WDI Database*.

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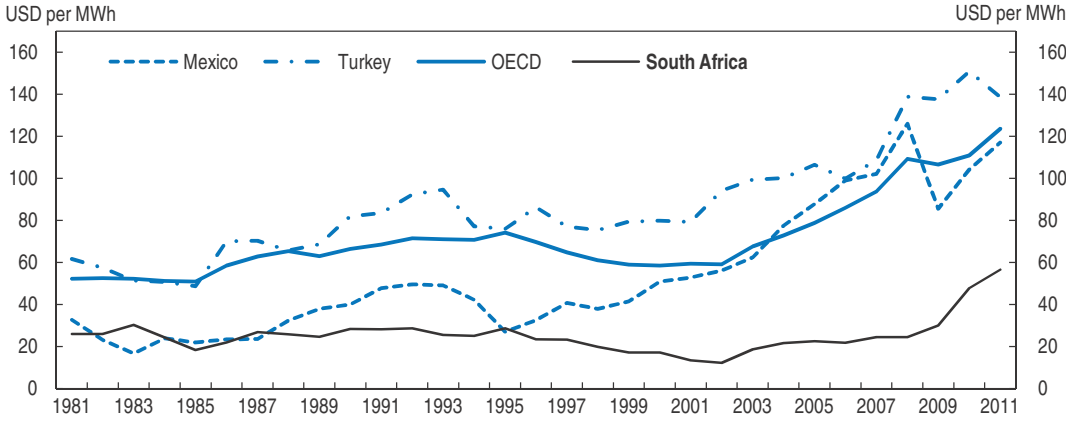
The most important reason for the high emissions intensity of the South African economy, however, is the extremely high share of coal in electricity generation. About 92% of electricity generation is fuelled by coal, with nuclear power accounting for approximately 6% and hydro power 2%. As a result, average CO_2 emissions for power generation are around 1 kg/kWh, some 60% higher than the world average. Electricity generation produces over half of total greenhouse gas emissions in South Africa.

The high energy intensity of the economy and the dominance of coal in the power generation mix largely reflect South Africa's resource endowments: the local abundance of coal and other mineral resources, which result in a relatively large role for energy-intensive mining and processing. It is also, however, a function of domestic prices of electricity having been excessively low for a long period. After a build-up of excess generation capacity in the 1980s, investment was dormant until the last few years, and long-term contracts with very low electricity prices were used to attract foreign investment in smelting operations (using imported ore) in the 1980s and 1990s. Current costs were relatively low, depreciation became a minor factor as plants aged, and domestic prices were not reflective of the capital costs necessary to expand capacity in the future.

From already low levels the price of electricity fell in real terms by almost half between the early 1980s and the low point in 2003, much more than the OECD average and in contrast to other middle-income countries like Mexico and Turkey (Figure 2.7). For many years South Africa therefore enjoyed some of the lowest electricity prices in the world. Indeed, although prices started rising sharply in 2008 (Figure 2.8), after a series of outages sparked an emergency response, as of 2011 South Africa still had extremely low electricity tariffs compared to other middle-income countries as well as advanced economies (Figure 2.9). Eskom, the state-owned power utility that produces almost all of South Africa's electricity, estimates that current electricity prices are still only about two thirds of the level needed to cover total costs, including capital costs, even though average prices have more than doubled in real terms since 2007.

A key reason why current costs have long been very low in South Africa is that Eskom has been able to buy domestic coal at average prices well below its alternative use. Much of Eskom's coal is supplied by captive collieries or under medium-term contracts which have

Figure 2.7. **Evolution of electricity prices for industry, selected countries**



Source: IEA, *Energy prices & Taxes Database* and Eskom.

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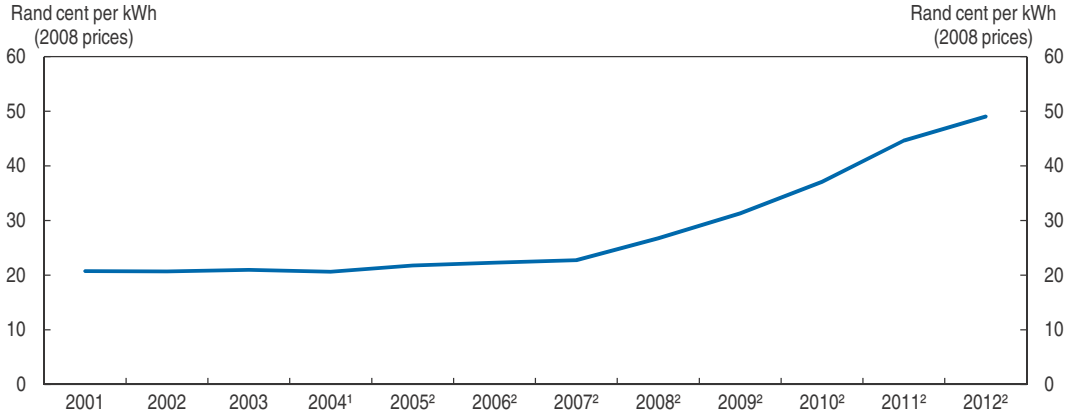
Figure 2.8. **Real average electricity price**



1. Period covered = 1 Jan 2004 to 31 March 2005.
2. Financial year = 1 April to 31 March.

Note: The real price is calculated by deflating the nominal price by the consumer price index.
Source: OECD estimates based on *Eskom 2012, 2010, 2006 and 2003 Annual Reports*.

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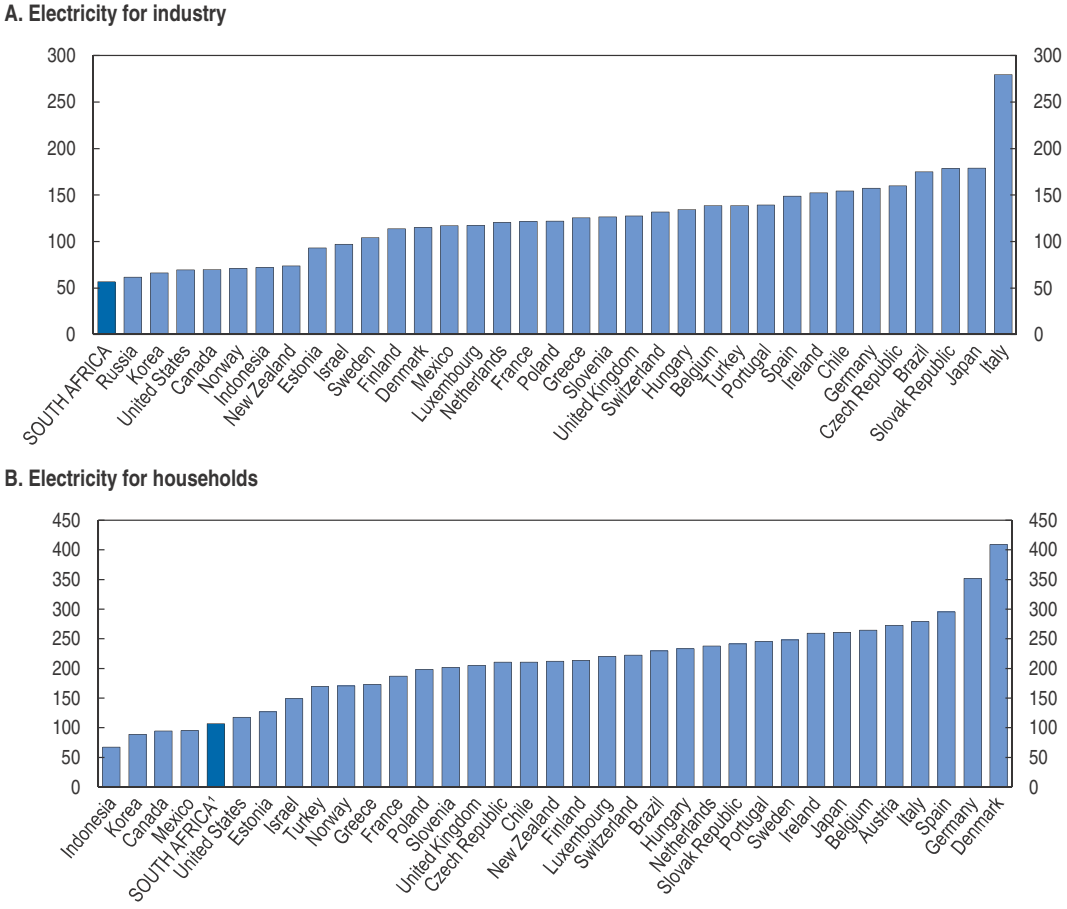
on average been much lower than the export price of coal. One factor facilitating this situation is the limited capacity in rail transport and ports, which are both dominated by another state-owned enterprise, Transnet. This constraint has prevented coal being diverted to exports and forcing Eskom's buying prices to rise to international levels (adjusted for transport costs). Eskom's average coal purchase price is around ZAR 200 per tonne (USD 23), which is only about one fifth of the export price, depending on quality. Although quality differences may make the comparison somewhat misleading, an upper bound on the implied subsidy to Eskom is some two thirds of its total revenue, which is equivalent to more than 2½ per cent of GDP. Regardless of the exact magnitude of the implicit subsidy, it is clear that not only do current electricity prices still fail to cover operational and capital costs, but operational costs are artificially depressed to a considerable degree by Eskom's access to below-market-price coal.

The underpricing of coal and electricity has amounted to a large negative carbon tax, which is to say a subsidy to CO_2 emissions. Also, apart from giving rise to a relatively large

Figure 2.9. **Electricity price, international comparison**

2011 or latest year available, USD per MWh



1. Eskom prices for households. Prices set by municipalities are generally higher.

Note: Fiscal year (April 2011-March 2012) for South Africa, 2010 for Korea (industry only), Indonesia, Canada, Estonia and Brazil.

Source: IEA (2012), *Energy Prices and Taxes*; OECD estimates; and Eskom.

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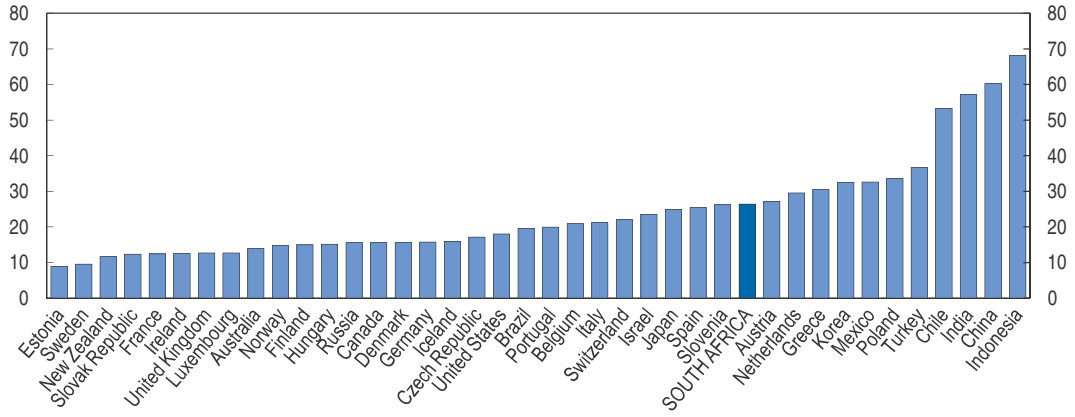
share of greenhouse gas emissions (both current and cumulative), South Africa's energy intensiveness and heavy reliance on coal impose other costs. Emissions of SO_2 are high by international comparison; in the 2012 *Environmental Protection Index* (EPI, 2012) results South Africa scores even worse on per capita SO_2 emissions than on CO_2 per unit of GDP, ranking 122nd of 132 countries (109th for the CO_2 intensity of GDP). South Africa is also above average for airborne particulate matter (Figure 2.10). Since mining, electricity generation and industry are concentrated in certain regions, the burden of local air pollution is particularly heavy in those areas. Reducing CO_2 emissions would help with reducing the health burden associated with these other air pollutants – about 30 000 life-years are lost each year from premature deaths arising from outdoor air pollution.

The policy response to climate change has gathered momentum

The authorities have shown a growing recognition of the threat of climate change to South Africa and the need for a domestic policy response, as part of a global effort. As early as 1994 a National Committee on Climate Change was established, and a Climate Change

Figure 2.10. **Concentration of particulate matter (PM10)**

Micrograms per m^3, 2009



Source: World Bank, *WDI Database*.

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Response Strategy was developed in 2004, while in 2003 there were White Papers on renewable energy and energy efficiency. In 2005 a major domestic climate change conference was held and a process created to come up with Long-Term Mitigation Scenarios. The ANC National Conference in 2007 was another important milestone. The ruling party adopted a resolution committing South Africa to playing a leadership role internationally on the environment and to setting a greenhouse gas mitigation target and placing an emphasis on low-carbon technologies for energy production. These commitments were followed up with preparatory work for the COP 15 meeting in Copenhagen.

At the Copenhagen meeting South Africa promised (conditionally) to restrain the growth of greenhouse gas emissions by 34% in 2020 relative to a Business as Usual (BAU) scenario, and by 42% in 2025. The BAU scenario being defined by a range, the commitment amounts to a reduction relative to the upper end of that range. This would allow for an absolute increase in emissions of nearly 30% in 2020 and over 36% in 2025 relative to actual 2010 levels. Per capita emissions would also continue to rise through 2025, though more slowly. As with other developing countries, South Africa made its commitment conditional on the transfer of technology and financial resources from the advanced countries.

The increasing prioritisation of climate change as a policy issue is reflected in further government strategies and policy documents since the COP 16 meeting. These include the 2010 New Growth Path (pursuant to which there was a Green Economy Accord), the Integrated Resource Plan for energy, the National Strategy for Sustainable Development and the White Paper on National Climate Change Response (all approved in 2011, Department of Environmental Affairs and Tourism, 2011), as well as the National Development Plan endorsed by Cabinet in July 2012. South Africa also hosted the COP 17 round of international talks on climate change, which took place in Durban in November 2011.

The White Paper on National Climate Change Response Policy has longer-term projections, going beyond the horizon of the Copenhagen commitment, according to which absolute emissions would be flat from 2025 through 2035 before beginning to decline.

Given continued population growth, per capita emissions would fall by about 1% a year between 2025 and 2035 and somewhat more rapidly thereafter.

Other official targets include the contribution to final energy consumption of 10 000 GWh of renewable energy by 2013 according to the 2003 White Paper on Renewable Energy Policy. This was to be produced mainly from biomass, wind, solar and small-scale hydro energy systems. The Integrated Resource Plan (IRP) builds on this renewables target through 2030, providing for 30% of final energy consumption to be from renewables by the end of that period. The IRP also incorporates a static assumption about energy efficiency gains amounting to about 1% a year through 2020.

The plausibility of the identified targets is under strain given policies in place to date

Taking the degree of ambition on emissions as given, it is not clear that all of the instruments to achieve the objectives have been identified. Given that the bulk of electricity generation will continue to be from burning coal, with several major new coal plants coming on line over the next decade, the emissions intensity of electricity is projected to decline only gradually. This implies a very rapid decrease in emissions-intensity in other sectors, such as transport, if the emissions targets are to be met.

South Africa does not yet have any economy-wide instrument to price carbon, although the electricity levy goes in that direction, since electricity consumption is the most important source of emissions, and the levy exempts electricity production from renewables (though not nuclear). The electricity levy rate is ZAR 0.035 per kWh, which is equivalent to a relatively low carbon price of about ZAR 35 (approximately EUR 3) per tonne of CO_2 (Rennkamp *et al.*, 2012).

The rate of decoupling of emissions from growth, which has been low, would have to accelerate markedly in the period to 2020 for the Copenhagen targets to be met. From 2000 to 2009 emissions from fuel combustion grew by about two thirds the rate of real GDP growth. That ratio would have to fall to about 0.3 in the period 2009-20 in order to stay within the upper bound of the range announced in Copenhagen, and there is a growing recognition that this is unlikely. The National Development Plan notes that the Copenhagen commitment will be missed "without substantial international assistance".

In addition, the set of instruments that has been identified looks to be skewed towards the use of industrial policy to encourage particular sectors as against quickly establishing uniform economy-wide carbon prices that would have a greater potential to influence the behaviour of all producers and consumers (Box 2.2). It is important to recognise administrative capacity constraints, which militate in favour of measures that achieve large effects with relatively few administrative resources. This probably means focussing on electricity (both supply and demand), which accounts for most greenhouse gas emissions, and also argues in favour of concentrating on putting in place a simple carbon tax covering the whole economy. If that is done, it is not clear that there would be significant additional gains from also putting in place a system of carbon budgets, as envisaged in the 2011 White Paper. And there would be less of a case for a range of industrial policy initiatives involving sector-specific assistance.

The multiplicity of plans and initiatives in the area of climate change mitigation suggests a need for a single body to measure and monitor progress *vis-à-vis* the various targets and to try to ensure coherence between the different initiatives, of only by flagging inconsistencies or disconnects. One model for such a body is the independent Committee

Box 2.2. **Industrial policy interventions to develop the green economy**

In line with objectives articulated in the Industrial Policy Action Plan and the New Growth Path, the government has introduced a range of measures to encourage the development of "green" activities domestically. Prominent examples include the following:

- Renewable Energy Procurement. Local content requirements have been included in the Renewable Energy Independent Power Producer Procurement Programme bidding criteria to encourage the development of local renewable energy equipment manufacturing. Requirements have been incrementally increased in each bid phase. The Green Economy Accord specifies a 35% local procurement target by 2016.
- The Industrial Development Corporation (IDC) Gr-E fund. Renewable energy production and energy efficiency projects are among the qualifying projects for the IDC's Gro-E fund which allocates debt or equity financing of between ZAR 1 million and ZAR 1 billion to businesses at favourable rates.
- The Manufacturing Competitiveness Enhancement Programme. This programme provides grant funding of between 30% and 50% of the total investment cost (with a ceiling of ZAR 50 million) to support "manufacturing and localisation of renewable energy (RE) products and services development". Similar funding is available for a variety of measures that improve the energy efficiency of production (including building retrofitting), make better use of waste products, or promote water efficiency.
- The IDC's Green Energy Efficiency Fund, which provides loans of between ZAR 1 million and ZAR 50 million and preferential rates to firms to fund investments that improve the energy efficiency of their businesses (this includes building retrofitting).

on Climate Change created under the 2008 Climate Change Act in the United Kingdom, but whether South Africa were to follow this approach or use an existing institution such as the Department of Performance Monitoring and Evaluation in the Presidency, it would be best if such a body were accountable to parliament rather than government, in order to ensure that its findings can be publicly debated.

The implementation of the policy instruments that have been identified to meet official targets on emissions has been slow. For example, progress to date on decarbonisation of electricity generation as set out in the Integrated Resource Plan is behind schedule. An important aspect of that process is the contracting with independent power producers for renewables capacity. Following an earlier unsuccessful attempt to set feed-in tariffs to create solar and wind capacity, the process was changed to an innovative series of auctions, with separate allocations for photovoltaic solar (PV), concentrated solar power (CSP), wind, hydro and biomass. The early evidence is that this process does a good job of tracking fast-moving developments in technologies: the price per kilowatt hour for solar PV in the second bid window was about 40% lower than in the first, just a year earlier. But the process has not been entirely smooth. Amid questions about financing for successful bidders, delays in signing contracts following the first two bid windows - the first contracts were signed in November 2012 - have pushed back the timing of the third bid window.

The 2003 White Paper on Renewable Energy Policy set a target of 10 000 GWh of additional renewable energy to contribute to final energy consumption by 2012, to be produced mainly from biomass, wind, solar and small-scale hydro energy systems. So far, only a small fraction of the targeted capacity is in place, and according to U.S. Energy

Information Administration data, total renewables energy production in 2010 was 2.5 terawatt hours (about 1% of total electricity production), which was actually down slightly from 2.7 terawatt hours in 2002. This decline reflects the year-to-year variability of hydroelectric power, which represents the bulk of renewables production to date, but the increase in production from other sources has been negligible so far.

Another source of low-carbon generation in the Integrated Resource Plan is nuclear power, and the plan, finalised just before the Fukushima incident in Japan in March 2011, foresaw an ambitious expansion of nuclear capacity beginning in 2023. With costs and risks perceived to have risen and with timelines strained in the absence of firm commitments, those plans are beginning to look unrealistic and/or excessively costly.

The uncertainty over the nuclear programme also highlights another challenge for the shift to low-carbon generation. The expansion of renewables, while necessary to reduce the carbon-intensity of energy production, also poses major technical challenges to combine base and variable loads. While these challenges can to some degree be met via improvements in grid management, South Africa is likely to need access to additional low-carbon baseload capacity in order to combine achieving the targeted decarbonisation of electricity production and protecting the stability of supply.

The main options for low-carbon baseload capacity are natural gas, probably imported, and hydroelectric power produced elsewhere in southern Africa. Renewable sources combined with energy storage (*e.g.* solar CSP with molten salt heat storage) may also become cost-competitive in time. Options using more regional hydro power and gas were rejected in favour of the "balanced" scenario for the Integrated Resource Plan, in part because of concerns about relying on imported energy. South Africa has a history of prioritising self-sufficiency, from the time of apartheid-era sanctions, and it appears that a relatively high value is still placed on self-reliance.

Security of supply is a valid consideration, given the importance of electricity to the economy, but most OECD countries are heavily reliant on imported fuels, and in some cases significantly dependent on imported electricity. The cost-benefit analysis of price, carbon-intensity and reliability should be regularly reviewed, given the speed of shifts in the global energy picture. For example, the United States is now expected to become a significant exporter of LNG, which could become a cost-effective and lower-carbon competitor for coal. Also, the potential for domestic gas output from hydraulic fracturing ("fracking") is as yet unknown, and its disadvantages in terms of water use and water pollution may turn out to be decisive. If not, however, fracking could go some way to reconciling the preference for low reliance on foreign fuel sources with the objective of reducing the share of coal in electricity generation. In any case, the scheduled regular updates of the IRP should be used to revise it, if necessary substantially, to take into account changes in technology and costs relating to nuclear power, renewables, carbon capture and storage and energy efficiency.

Another area of faltering progress concerns the proposed carbon tax. The National Treasury first circulated a proposal in 2010, but release of a revised proposal, following consultations within and outside the government, has been delayed. Also, when the carbon tax is put in place, it is expected that the initial rate will be set at a very low level, so that it is likely to be several years before the effect on behaviour is significant. There is also a danger of the tax featuring too many exemptions to provide a true economy-wide carbon price.

As against the general impression of a gap between goals and national measures (and particularly implementation of measures), one hope for closing this gap is complementary initiatives at the sub-national level, which could in some cases deliver greater reductions in emissions than counted on in national plans. For example, there appears to be significant scope for small hydro projects in KwaZulu-Natal, while the Western Cape has its own ambitious plans to develop renewables, and has considered imposing its own energy levy.

The relative price of electricity and domestic coal need to rise substantially further

One of the simplest and most important measures is to quickly unwind existing implicit subsidies of coal and electricity. A continued rapid rise in electricity prices is anyway needed to ensure full cost recovery, even excluding environmental externalities. Moreover, the calculations on generation costs reflect assumptions that Eskom will continue to benefit from coal that is much cheaper than the international price. Indeed, the fear that coal will be exported given higher international prices, leaving Eskom unable to get enough coal to maintain electricity production, has led to calls to designate it as a strategic resource, limiting exports. Similarly, the report on state involvement in the mining sector (SIMS) prepared for the ruling ANC recommended that coal be delivered to Eskom on a cost-plus basis, with a limitation on exports (ANC Policy Institute, 2012).

This concern is, however, misplaced and the suggested policy response misguided. National income will be higher if the domestic price of coal is equalised with the export price (adjusting for transport costs). Eskom should pay the market price for coal and the electricity regulator should allow that to be reflected in electricity prices. Only in that way will both Eskom and domestic consumers of electricity have the right incentives to use resources efficiently. As to fears that substantially more expensive electricity will make the tradables sector uncompetitive, it is wrong-headed to seek to protect domestic industry with below-market electricity prices. If domestic tradable goods producers face higher costs as electricity prices rise, creating an incipient disequilibrium in the balance of payments, that should produce a depreciation of the rand, which would maintain balance by switching expenditure from foreign to domestic tradables.

A key aspect of unwinding these implicit subsidies is to ease transport bottlenecks – in rail and ports – which hinder the export of coal. In current circumstances this means more investment by Transnet, but this looks like an example of a lack of competition in network industries leading to worse product market outcomes, underlining the case for reducing entry barriers and splitting up Transnet, as argued in the 2008 OECD *Economic Assessment of South Africa* (OECD, 2008).

Another issue in ending subsidised electricity prices relates to Eskom's below-cost long-term contracts with BHP Billiton for two aluminium smelters in KwaZulu-Natal. The BHP Billiton contracts are not public, but press reports indicate that they deliver electricity at the equivalent of about USD 0.01 per kWh, around one sixth of the average Eskom price and less than half of operating costs (excluding capital costs). Given that the smelters are large consumers of electricity, the implied subsidy is very large. The government has been seeking to renegotiate these contracts, and they were recently referred to the electricity regulator NERSA. It is clearly most unlikely that BHP Billiton would be willing to change the contracts without compensation, but this should be considered, since the most important thing from the perspective of economic efficiency is ensuring that the marginal price

facing electricity users reflects both full operating costs (including capital costs) and environmental externalities.

Another aspect of subsidised electricity is the provision of free electricity to poor areas. This is not a major issue for reducing consumption, since in principle only minimal needs of poor households are covered, but in the longer term it would probably be more efficient to achieve the same equity goals via social transfers. The modalities vary by municipality, but overall free electricity is inefficiently targeted – some better-off households receive it while some of the very poor (including, notably, those without electricity connections) do not. It may also aggravate a culture of non-payment for electricity which is already prevalent – Eskom reports that in Soweto (the worst case) only 20% of billed electricity is paid for,[3] and illegal connections are a significant problem in many municipalities.

A faster increase in energy efficiency should be possible

So far, one means that appears to have been underemphasised in South Africa to reduce CO_2 emissions is boosting energy efficiency. The International Energy Agency has estimated that energy efficiency gains, achieved via regulation and carbon pricing, could achieve most of the global emissions reductions necessary to stabilise CO_2 concentrations at moderate levels (IEA, 2009). In South Africa, however, during the period when electricity prices were low and stable the trend increase in energy efficiency was relatively slow by international standards. The energy intensity of GDP declined by 0.9% a year from 2000-09, whereas the average for the other BRIICS countries was 2.6%, and for the OECD 1.5%. For the future, the Integrated Resource Plan is based on the assumption that the trend in energy efficiency gains would be little changed through 2020 before accelerating thereafter as structural changes in the economy increasingly take place.

The main trigger for faster improvements in energy efficiency is likely to be higher energy prices, a factor that was largely absent until relatively recently, and which appears to have been underemphasised in the IRP. The IRP forecast for power output did not factor in any price elasticity of demand – electricity demand was held constant across the different scenarios (which involved different price profiles). The IRP demand forecast is now widely regarded as too high (Rennkamp *et al*., 2012).

Since 2007, electricity prices have been rising rapidly, providing a test of the responsiveness of demand to the relative price of energy. The real price of electricity (deflated by the CPI) more than doubled between June 2007 and July 2012. Real GDP in the first half of 2012 (seasonally adjusted) was 10.4% higher than in 2007, while electricity output declined by 2.6%. Some of this adjustment is likely to be due to sectoral shifts that are not related to the rising relative price of electricity, but the degree of decoupling in this recent period is nonetheless striking. It is generally considered that short-run demand elasticities are low because structures and equipment are given, whereas long-run elasticities are larger as these factors become variable and as behaviour adjusts. If electricity prices continue to rise rapidly, as they should, there is therefore reason for optimism on meeting official targets on emissions. Whereas emissions rise rapidly throughout the BAU scenario, actual emissions fell in 2009, and electricity consumption, which accounts for most emissions, was still some 2½ per cent lower in 2012 than 2007.

Official scepticism is not always shown towards the effectiveness of price signals in influencing demand. The current proposal for a "standard offer" whereby the state "buys

back" unused energy at a premium from firms shows a recognition of the potential for price-based measures. The premium applied is not publicly disclosed, but it may be that the Eskom is, somewhat ironically, the only customer paying fully cost-reflective electricity prices.

Beyond raising energy prices to fully cover operating and capital costs and to properly value externalities, the case for other policy interventions to encourage energy efficiency rests on other forms of market failure. The fact that economic agents are often found not to exploit energy efficiency savings that are privately cost-effective suggests that such market failures are present. The most frequently mentioned examples of such market failures are imperfect information (*e.g.* lack of knowledge about potential energy savings, leading to under-investment in energy efficiency), split incentive problems (*e.g.* building owners having little incentive to provide energy efficiency to tenants, who pay heating/electricity bills – this can be compounded by asymmetric information, whereby buyers or renters have less information about energy efficiency than owners) and positive externalities (*e.g.* demonstration effects of adopting energy efficient technologies or benefits for other firms from research and development).

It is generally accepted that market failures preventing an optimal amount of energy efficiency provide an economic rationale for policy action beyond energy pricing to encourage energy efficiency. Measures commonly used by OECD countries include energy efficiency labels and minimum energy performance standards for appliances, energy performance standards for buildings, energy efficiency reporting requirements for large energy users, mandatory fuel efficiency and CO_2 emissions information for new vehicles, vehicle fuel efficiency standards, and vehicle charges related to fuel efficiency.

Improved spatial planning is another instrument with potential to reduce energy use and carbon emissions, and one which appears to be undervalued in South Africa's 2011 White Paper on Climate Change. OECD research has found that the urban form is a critical factor influencing energy demand and GHG emissions. The *Cities and Climate Change* report (OECD, 2010a) and the 2011 *Regional Outlook* (OECD, 2011d) note that as urban areas become denser and rely on more public transport, walking and cycling, per capita GHG emissions tend to be reduced. Building energy efficiency retrofits are expected to generate significant green employment opportunities in the construction industry (OECD, 2010b). Finally, integrated strategies for transportation and land use planning can generate policy complementarities, including more efficient public service delivery (OECD, 2010c).

At the same time, it is recognised that in general improvements in energy efficiency, particularly when they come from measures that are privately profitable, give rise to "rebound" effects: the increase in income resulting from energy savings generates higher economic activity, which undoes part of the reduction in energy consumption (Jenkins *et al.*, 2011). In the limit, such rebound effects can even result in "backfire", when energy use is higher than before the improvement in energy efficiency. It should be recognised, therefore, that for measures that reduce the price of energy, there may be a limited net impact on energy consumption and CO_2 emissions. This reservation does not, however, apply to energy efficiency driven by higher prices, which is another reason for focussing on that measure.

A number of policy initiatives are already in place in South Africa to encourage energy efficiency. An *Energy Efficiency Strategy* (Department of Energy, 2003) approved by Cabinet in 2005 recognised the considerable scope for energy savings among both firms and

households and set out a number of Sector Programmes to encourage energy efficiency. A first review of the *Strategy* in 2008 concluded, however, that progress had been limited, owing to a variety of factors including the lack of a monitoring system to track performance versus targets, the lack of sufficiently strong incentives to ensure improvement of energy efficiency across sectors, the absence of standards for energy management plans and insufficient action to raise awareness of energy efficiency and change behaviour. A second review has been underway since 2011. Recently, the government has also introduced building standards for energy efficiency and approved tax allowances for industrial energy savings, and there are also mandatory standards for electrical appliances similar to those used in the EU. In the aggregate, however, the pace of improvement in energy efficiency seems to have increased significantly only after the beginning of sharp rises in electricity prices.

Cost-benefit analysis is needed to assess other means of reducing emissions

The largest renewables energy initiative to date is the drive to install 1 million solar water heaters by 2014, which is a prominent component of the 2010 New Growth Path and the Green Economy Accord that followed on from it. Installation of solar water heaters is subsidised by around 40%, depending on the model. This initiative has benefits in both environmental and social dimensions, and simple and robust solar water heaters constitute a plausible export industry, especially for export to other African countries. Compared to solar photovoltaic and concentrated solar power, both of which also have potential in South Africa, solar water heating is currently much cheaper. On average, installation of solar water heaters appears to have a payback period of only around 6 years, even without the subsidy, and the cost (private and public combined) per tonne of CO_2 avoided is approximately USD 30 on average, which is much lower than many other renewable energy projects worldwide, although it is higher than the prospective carbon tax would be for many years.

From a static economic efficiency perspective, it would seem better to support renewable energy production in a non-technology-specific manner, with an equal cost per kilogram of emissions avoided. The state of technology in different renewable energy sectors would then determine which are cost-effective. There may be a dynamic case for providing differential support for different technologies, with more support for those at early stages of development in order to allow them to gain critical mass and become cost-competitive. It is not obvious from this point of view, however, that solar water heaters should be singled out for special favour, as the technology used is not notably immature compared to other renewables options.

The other point to make about the solar water heaters programme is that although the economics appear relatively favourable, there is no immediate prospect of this initiative making a large dent in South Africa's greenhouse gas emissions. The target of 1 million installations by 2014 appears likely to be missed by a large margin, and even when it is met, the displacement of demand for electricity would imply a mitigation of only about 2% of South Africa's CO_2 emissions. This highlights the limitations of even large industrial policy interventions in addressing the need for emissions mitigation.

Another technology that is considerably less mature but which may have great long-term potential for reducing emissions is carbon capture and storage (CCS). The economics of CCS remain uncertain, even in advanced economies, and there is no near-term prospect of CCS playing a major role in South Africa's efforts to reduce its greenhouse gas emissions.

On the other hand, South Africa's coal-dependence and geology mean that CCS could make a significant contribution to emissions reductions in South Africa in the long run. In the long-term climate change mitigation scenarios of the IEA CCS becomes a significant factor after 2020 and eventually accounts for over a fifth of the reduction of global emissions where warming is limited to 2 degree Celsius, while for South Africa the contribution of CCS to emissions reduction through 2050 is even greater, at one third (IEA, 2012). One obvious advantage of CCS for South Africa, should it eventually be determined to be cost-effective and safe, is that it would allow the country's endowment of coal to be fully exploited.

The current approach, whereby Eskom is monitoring research in OECD countries and undertaking preliminary geological studies to assess the potential for CCS in South Africa, appears to strike the right balance for now. The move to a carbon tax with significant rates and covering all sectors would be expected to give further impetus to CCS research and development in South Africa. In time, the renewables capacity auctions could include an allocation for CCS.

The introduction of a carbon tax raises design challenges, but simplicity is best at the outset

The National Treasury has proposed introducing a carbon tax, possibly as soon as 2013. The initial discussion document (National Treasury, 2010), argued for a simple tax on the carbon content of fuels, imposed "upstream" to severely limit the number of taxpayers (coal mines, natural gas processing plants, refineries), and covering all sectors. It noted that special relief measures present several difficulties, leading to inefficiency in abatement, as sectors with the highest level of emissions, and hence the greatest scope for abatement, devote socially unproductive resources to lobbying for relief. And it underlined the practical difficulties of using border tax adjustments, including the unresolved question of WTO-compatibility.

By the time of the 2012 Budget, however, the Treasury's proposal had become significantly more complicated than the initial vision. The tax would now be applied on variable percentage thresholds of different sectors' emissions, with the possibility of offsets, and the application of border tax adjustments to exempt exports. The basic tax, before taking into account any special conditions, would apply on the top 40% of an energy user's emissions, at a rate of ZAR 120 per tonne (giving an average tax rate on total emissions, before any exemptions, special relief or border tax adjustments, of about USD 5 per tonne, rising to about USD 10 per tonne by 2020). The later proposal, which appears to reflect the lobbying pressures that the initial discussion document predicted would afflict a more complex tax, would require substantially more information to administer.

A full revised proposal was due to be published during 2012 after further consultation within government and with stakeholders, but remains under discussion. A return to the simpler initial vision of the carbon tax would be advisable. A uniform tax on the carbon content of fuels, applied to all sectors, without border tax adjustments, is likely to be the most efficient instrument to achieve the government's targeted emissions abatement. At the same time, it is true that other countries have also succumbed to pressure to exempt or provide temporary relief to high-emission sectors, thereby diluting the effects of the tax in changing behaviour and putting a greater share of the burden of adjustment on low-emission sectors.

While there may be a case for introducing border tax adjustments to the carbon tax at some stage, in order to ensure a level playing field both in domestic markets and abroad, the advantages of simplicity argue in favour of not including such adjustments initially. With low rates in the first few years, carbon leakage will be a minor issue, and as more jurisdictions move to pricing carbon, the need for border adjustments should decline over time. In any event, as noted in the 2010 discussion paper, differences in technologies within an industry may mean that there is no single adjustment that will correctly compensate all firms in the industry. The informational demands and costs of implementing border tax adjustments efficiently appear formidable, if not insuperable.

Simplicity and sound fiscal principles should also determine what is done as regards the "recycling" of revenues raised from the carbon tax. Earmarking of revenues should be avoided – rather, the extra tax burden should be compensated by a reduction in other taxes. One obvious measure would be to eliminate the electricity levy, which largely acts as a carbon tax for electricity generation. Other tax cuts should be governed by general considerations about efficiency and equity. Given a starting position in which medium-term fiscal consolidation is warranted, tax-shifting need not be revenue neutral; part of carbon tax revenues could be retained to improve the structural balance.

Following through on water policy reforms

South Africa's need for effective water use policies is greater than for most other countries

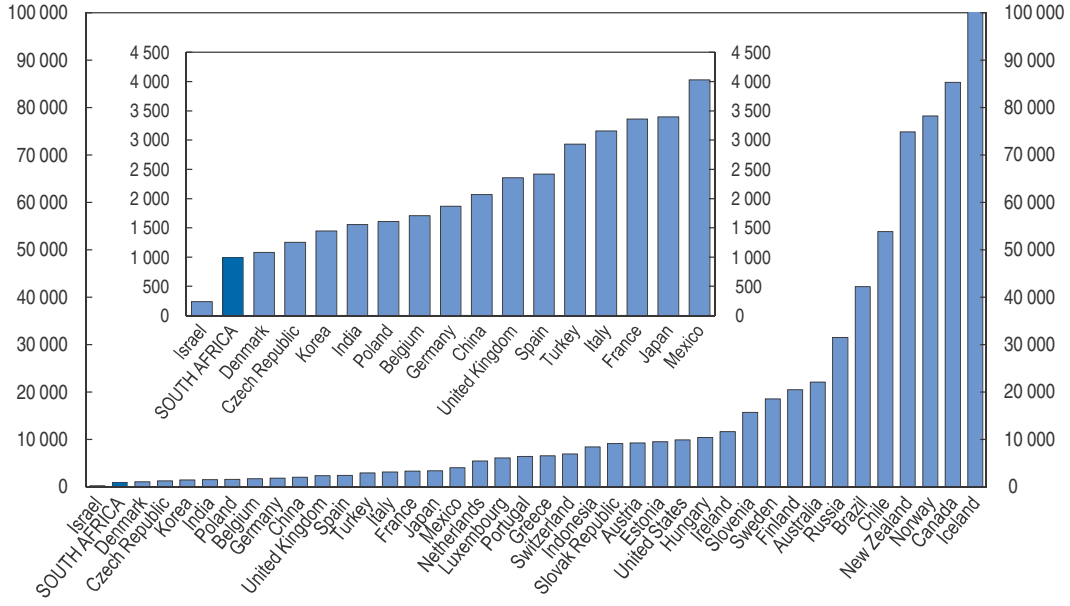
Increasing access to clean water has been one of the successes of the governments of the democratic era. The 1994 Constitution enshrined access to clean water as a right, and the recent Census indicates that the coverage of basic water supply has expanded greatly, from 59% of the population at the end of Apartheid to 95% in 2011. Sanitation has also improved significantly: according to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, the coverage of improved sanitation facilities has increased from 71% in 1990 to 79% in 2010. Unlike much of the rest of sub-Saharan Africa, South Africa will meet the Millennium Development Goal on the provision of clean water.

Notwithstanding the success in improving access to clean water and sanitation to date, there is an acute problem of high and increasing water scarcity, which puts those gains at risk in the future.[4] Among OECD countries only Israel has less available water per capita than South Africa (Figure 2.10). The use of available water resources has risen to over 30% (Figure 2.11), and major water stress is projected to emerge within 15 years, particularly in some inland catchment areas where a large proportion of economic activity takes place. The continued growth of the population and rising incomes will put increasing pressure on scarce water resources, creating policy challenges relating both to ensuring adequate supply and restraining demand. Given that water resources are unevenly distributed, there is likely to be a growing need for intra-catchment transfers, which would imply infrastructure.

The problem of water scarcity globally will be aggravated by climate change, but the impact on semi-arid countries at low latitudes like South Africa is projected to be particularly severe (Intergovernmental Panel on Climate Change, 2007), albeit with considerable variation among regions within the country. Overall, declining surface water availability is likely to be accompanied by a decrease in groundwater recharge. Higher water temperatures, increased variability in precipitation intensity, and longer periods of

Figure 2.11. **Water availability, international comparison**

Total renewable water resources per capita (m^3/inhab/yr), 2010

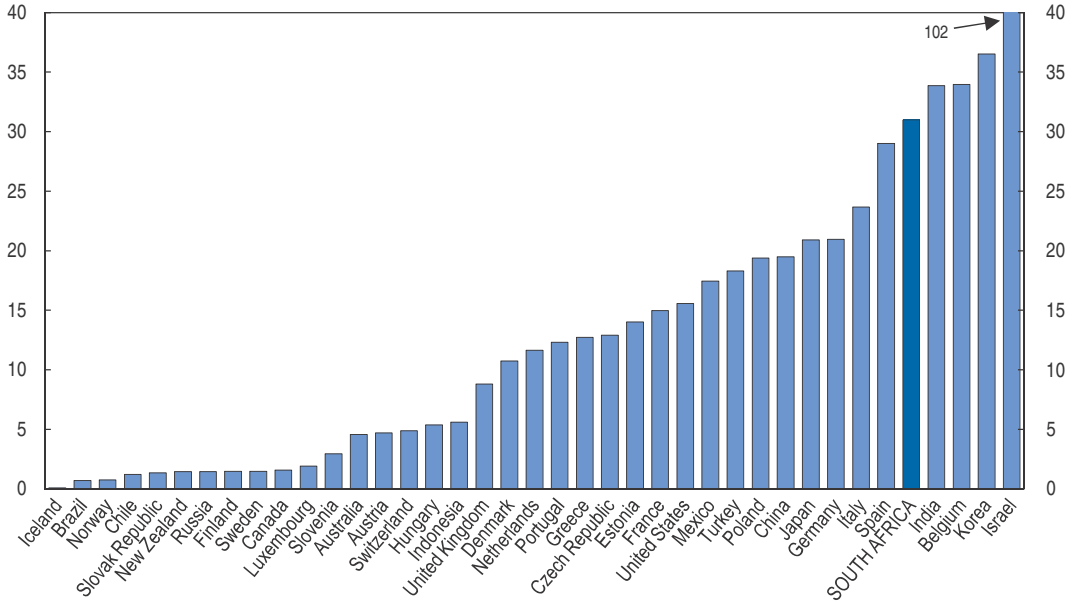


Source: FAO, *AQUASTAT Database on line*.

StatLink http://dx.doi.org/10.1787/888932783610

Figure 2.12. **Pressure on the renewable water resources**

Freshwater withdrawal as % of total actual renewable water resources, latest year available[1]



1. 1999 for Luxembourg; 2000 for Chile, Canada, Australia, Austria, Switzerland, Indonesia and Italy; 2001 for Russia and Japan; 2002 for New Zealand, Portugal and Korea; 2003 for Turkey; 2004 for Israel; 2005 for Iceland, Finland, United States and China; 2006 for Brazil, Norway and United Kingdom; 2007 for Slovak Republic, Sweden, Hungary, Greece, Czech Republic, Estonia, France, Germany and Belgium; 2008 for Netherlands, Mexico and Spain; 2009 for Slovenia, Denmark and Poland; 2010 for India and South Africa.

Source: FAO, *AQUASTAT Database on line* and South African authorities.

StatLink http://dx.doi.org/10.1787/888932783629

low flows are expected to exacerbate water pollution. Climate change is also projected to increase the frequency of extreme weather events such as droughts and floods and raise the rate of evaporation (Bates *et al.*, 2008).

Moreover, water stress is aggravated by the high water consumption of coal-fired power stations, which will supply the bulk of South Africa's electricity for a long time to come (although the more recent existing plants use less water-intensive cooling technologies, as will the new plants under construction).[5] The OECD *Environmental Outlook to 2050* (OECD, 2012c) presents different climate change scenarios depending on the degree of ambition on emissions reduction. In the "450 Core" scenario for climate change, consistent with limiting the temperature increase from pre-industrial times to 2 degrees, the global reliance on coal-fired power stations is much reduced, which would reduce global water use for electricity generation by 37% relative to the baseline projection. In South Africa, given a much higher initial reliance on coal than the world average, the scope for reductions in water demand from this source is even larger.

One basic challenge for policy is therefore to make water use sustainable. This challenge is heightened by the need to pay due attention to equity. Policy will need to be geared both to restraining overall demand and ensuring that basic needs are met and that the poor are not disadvantaged. Moreover, water management has to be conducted within the context of limited administrative capacity and challenges in governance. Human resources are limited and management structures often fragmented and multi-level governance problematic (Box 1.1), with a mismatch between hydrological boundaries and functional units.

The existing policy framework is based on sound principles, but implementation has lagged

National laws and policies are in line with best practice

Even in advanced countries the use of economic instruments to encourage an efficient use of water and ensure sustainability is relatively recent and evolving. South Africa's basic approach to water management is notably modern and sophisticated, especially for a developing country. It is based on the concept of Integrated Water Resource Management, which aims to take due account of equity, efficiency and ecology. The 1998 National Water Act reversed the previous situation, in which landholders were deemed to own the water resources on their land, and made the Minister of Water Affairs and Forestry the trustee, on behalf of the national government, of the nation's water resources.

A part of water resources is designated as the Reserve, which has two components, ecological and social. The ecological component is the amount of unused water necessary to ensure that water use is sustainable, while the social component is to meet the basic needs of the population. In principle, only when the Reserve is met can other water use be authorised. Such additional water use is divided into Schedule One, corresponding to small quantities of water used for domestic purposes with no probability of negative impacts, General Authorisation, Existing Lawful Use (largely relating to the water use of white farmers in the period before the new law came into effect) and Licenses. It was hoped that the trading of allocations under the licenses would put a price on the marginal use of water and help to ensure an efficient use of this limited resource, once basic needs were met via the Reserve and Schedule One.

In line with best international practice, the government's water strategy enshrines the user pays and polluter pays principles. For urban water, users pay according to increasing block tariffs. An initial block of 6 000 litres per person per month, designed to cover basic needs, is provided free, and thereafter prices rise in steps at successive usage thresholds. This is the same approach used for electricity, and in both cases the price structure rightly charges more for additional use at the margin.

Local government integrated development plans now include a water component; provincial growth and development strategies take into account sectoral development, notably agriculture and conservation; there is a 5-year national water resources strategy; and pathways for sustainability to 2030 have been mapped. Many OECD countries lack a similarly integrated strategy.

The first National Water Resource Strategy (NWRS), produced in 2004, projected that there would be sufficient water to meet all needs in the near future, given careful management. Already at that time, however, allowances for the ecological component of the reserve were not being met in many areas, and the effects of climate change on water availability were not factored into these calculations (Department of Environmental Affairs and Tourism, 2006). Moreover, implementation of the NWRS has lagged, and the system as envisaged is far from fully formed. As the draft second National Water Resource Strategy, circulated for consultation in 2012, admitted, there has so far been limited implementation of Water Conservation and Demand Management; limited implementation of Water Allocation Reform to redress past racial and gender imbalances in access to water for productive uses; inadequate regulation of water resources and compliance monitoring enforcement; a shortage of technical and management skills to implement the National Water Act; poor integration of monitoring and information management; and inadequate establishment of water management institutions and decentralisation of water management.

On the latter front, the authorities have been slow to create Catchment Management Areas (CMAs), which has meant that the planned decentralisation of water management has not happened. The national Department of Water Affairs and Forestry has instead retained direct control in most of the country. Of the 19 catchment areas defined originally, by 2011 CMAs had been created for only 3, and none had been given full licensing powers (Movik and de Jong, 2011). In part to speed up the process of achieving full coverage and to overcome administrative capacity constraints, the number of catchment areas is currently being reduced to 9. The establishment of the CMAs would facilitate the building of local partnerships with water users; co-operation between industrial users and municipalities has already produced demonstrable results, improving wastewater management and reducing municipal water losses.

More monitoring and independent regulation could be useful for urban water supply

The structure of water pricing for urban households is conducive to reconciling efficiency and equity considerations, although in general it appears that average and marginal prices are too low to deliver efficiency. The price per cubic meter is initially zero, rising in bands to a maximum of around ZAR 20 (approximately USD 2.25) per cubic meter, depending on the municipality. The average price for a household consuming 15 cubic meters per month in Cape Town is estimated by the International Benchmarking Network for Water and Sanitation Utilities to be equivalent to USD 0.95 per cubic meter of water, and USD 1.53 per cubic meter for water and wastewater combined. This is much lower than

in many OECD countries - Denmark's per unit price is nearly 10 times as high, Australia more than 6 and France more than 5 - but close to the global average and higher than in a few OECD economies.

Although municipalities are formally required to account separately for water services, limitations on administrative capacity mean that this requirement is generally ignored and not enforced. Thus, the information necessary to allow reliable estimates of cost recovery to be made is generally lacking, and improving the data on costs and revenues for the water sector should be a priority. Moreover, there is neither a framework to ensure that pricing is cost-reflective and internalises scarcity, nor clear incentives for municipalities to maximise efficiency and deliver sufficient investment and maintenance. Transfers from the national government are intended to cover the provision of free basic water, while there is also cross-subsidisation among households and between industrial users and households. Municipalities may also use other revenue sources, such as electricity tariffs, to cross-subsidise water supply.

There is little evidence of a generalised financing crisis for urban water supply, although efforts have been made to limit the cost of free basic water provision, which to a significant degree benefits non-poor households. The use of increasing block tariffs appropriately puts a higher price on higher levels of consumption, giving incentives to reduce consumption at the margin, while guaranteeing water supply for basic needs. This is especially so for metropolitan areas, where most water infrastructure (including projects such as the Lesotho Highlands Water Project) is funded by users. Nonetheless, it appears that water is underpriced in at least some areas, leading to underinvestment, poor maintenance and high wastage rates. Other significant problems in cost recovery in urban water supply are non-payment and water losses in transmission.

One reason for the tendency of water to be underpriced in relation to cost recovery needs is political economy pressures to limit tariff increases. While the Water Services Act specifies general principles for the setting of retail tariffs – they are to be cost-based and take into account equity and sustainability considerations, with transparent disclosure of subsidies – little guidance is provided on how to apply these principles in practice, and the water service authorities (municipalities) are self-regulating. Charges are often kept in line with overall inflation in order to maintain affordability and avoid an unfavourable impact on the poor, at least in the short term – however, low water prices (resulting in insufficient cost recovery) often turn out not to be pro-poor, as they tend to result in an undersupply of water services, forcing poor households to buy water from private vendors (OECD, 2012b). In South Africa the free provision of water for basic needs should suffice to protect the poor from higher tariffs in the upper consumption bands.

Given the problems seen in practice to date, and in order to ensure better and more consistent economic regulation of retail water tariffs across the country, there may be a case for creating an independent regulator. An important step towards effective regulation would be to require municipalities (perhaps at first only the largest, metropolitan, municipalities) to properly separate the accounting of costs and revenues for water and sanitation to improve reporting.

The problems of unregulated use and undercharging are greatest in agriculture

As in many countries, most water use in South Africa is for agriculture, and this is where the challenge of ensuring efficient water allocation and limiting water pollution is greatest.

As recognised in the OECD report *Sustainable Management of Water Resources in Agriculture* (OECD, 2010c), there is no one-size-fits all policy for water management for agriculture, but a number of policy directions are generally applicable. In particular, policy-makers should strengthen institutions and property rights for water management in agriculture; ensure charges for water supplied to agriculture at least reflect full supply costs; improve policy integration between agriculture, water, energy and environment policies; enhance agriculture's resilience to climate change and climate variability impacts; and address knowledge and information deficiencies to better guide water resource management.

South Africa still has some distance to go to apply these principles. As regards institutions and property rights, despite the fundamental *de jure* change made in the 1998 Water Management Act, *de facto* little has changed. In part related to the slow progress in establishing Catchment Management Areas, a great deal of agricultural water usage remains unmeasured and uncharged. Very little has yet been done to license agricultural water users, in part because of legal challenges from relatively well-off landowners. Meanwhile, there have been mistakes and inequities. While large-scale farmers were often able to continue using water without restriction, others have sometimes found themselves having to pay for licenses without even having the infrastructure to extract and distribute the water. Companies that run stand-pipes to service poor households that don't have their own water connections have sometimes had to acquire licenses, raising the price paid for basic needs by unconnected households.

Another key issue is the monitoring of water use. There is a National Register of Water Use which contains details of water use registrations, water diversions and waste water discharges, but as recognised in the second National Water Resource Strategy, this register is incomplete and in many cases actual water use is not recorded. A related problem is illegal abstraction of water by farmers from the infrastructure built and paid for by domestic and industrial water users in some areas.

In addition, water charges in agriculture are too low. Agricultural water users, in general, do not pay a return on assets and the depreciation charge is capped. The 2007 Pricing Strategy provides for a 4% return on the depreciated replacement cost of assets, but actual revenue falls far short of this, in large part because most irrigation users are exempted. In practice, therefore, there is still a heavy reliance on the state funding for the operation, maintenance and refurbishment of water resource infrastructure, and this tends to result in underinvestment.

Agricultural water pollution is another significant problem. While the polluter-pays principle is enshrined in law, and while a system for charging for waste discharge was developed nearly a decade ago as an instrument to encourage major polluters to find ways to reduce their impact on the resource, this system has yet to be implemented.

Apart from the crucial issues of measuring and charging for water use at economically efficient rates, including pricing scarcity and pollution, there are other measures to be taken to better manage water in agriculture. In particular, the adoption of drip irrigation and the reuse of effluent and brackish water for irrigation should be encouraged. The National Development Plan proposes a significant expansion in irrigation, with a focus on small farmers and high-value cropping systems, in part via increased efficiencies in existing irrigation, as well as by focusing on areas of the country where there is still surplus water. There may also be a case for taxing fertiliser in order to limit diffuse water pollution, which is hard to measure and charge directly.

Water pollution from mining is a health threat

The problem of acid mine drainage from old disused mines highlights other failures in the tracking and control of groundwater pollution. Acid mine drainage occurs when old mine shafts and tunnels fill up, leading to underground water oxidising. Acid mine water is thought to have been overflowing from the western basin, located below the Krugersdorp-Randfontein area north-west of Johannesburg, for some 10 years. The acid water is believed to be still below the surface of Johannesburg and surrounding areas, but is rising.

The government has taken emergency action to pump out underground water in the West Rand mining basin and to remove heavy metals from the pumped underground mine water prior to it being released to surface water resources. It has also established a Hydrological Monitoring Committee to monitor the quality of mine water in the West, Central and East Rand mining basins, and commissioned a feasibility study for a long-term solution to address the problem of acid mine drainage in the East, Central and West Rand underground mining basins near Johannesburg. Consideration has also been given to an environmental levy, to be paid by operating mines to cover the costs of the legacies of past mining, but no action has yet been taken in that direction, in part because the operators of the old disused mines are not necessarily also current mine operators. While current legislation requires financial provisions to be made for mine closure and rehabilitation, in practice such provisions have been inadequate or poorly implemented, and even the ownership of many closed mines is unknown.

Box 2.3. **Recommendations on climate change and water policies**

Climate change mitigation

- Reduce implicit and explicit subsidies for energy and coal consumption, and use other instruments, such as cash transfers or supply vouchers, for protecting the poor.
- In designing climate change mitigation policies bear in mind that administrative capacity constraints militate in favour of relatively simple instruments such as a carbon tax.
- Apply the carbon tax as broadly as possible, including the electricity sector.
- Regularly revisit and revise the Integrated Resource Plan to take account of new information about technologies, costs and demand.
- Within the approach to emissions mitigation, increase the emphasis on energy efficiency.
- Give responsibility for monitoring progress on the various objectives relating to climate change to a single institution, and make that institution accountable to parliament via a regular reporting process.

Water

- Accelerate the allocation of water-use licenses and ensure that charges for water reflect supply costs and scarcity.
- Give responsibility for ensuring that water pricing is consistent with national laws and policies to an independent regulator.
- Speedily implement charges for waste discharge.

Notes

1. Actions to mitigate climate change and better manage water resources will not always be complementary, of course. In some cases there are likely to be tradeoffs. For example, the policy of encouraging biofuel production to reduce carbon emissions runs against the imperative to economise on water, since biofuels are relatively water-intensive. And production of natural gas by hydraulic fracturing, which may facilitate a reduction in South Africa's dependence on coal, is also a water-hungry process, apart from possible risks of groundwater pollution.
2. As regards water, it is unfortunate that the draft 2012 National Water Resource Strategy did not include any update on the figures provided in the 2004 Strategy, suggesting that progress in monitoring the use of water resources is lagging.
3. See *IOL Business Report* article of 22 November 2012: "Eskom: Soweto debt stands at R 3.3 bn", *www.iol.co.za/business*.
4. Probably the greatest risk to access to clean water and sanitation, particularly to meet basic needs, is not overall water scarcity but failures of service delivery at municipal level. Nonetheless, increased overall scarcity will sharpen tensions between domestic use on the one hand and agricultural and industrial use on the other, and will tend to make it more expensive to meet the basic water needs of households.
5. Apart from its high water usage, Eskom is cited in the 2011-12 National Environmental Compliance and Enforcement Report as the organ of state with the highest rate of non-compliance with environmental legislation, with several instances of non-compliance with the terms of water use licenses.

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