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Series on Trade and Energy Security – Policy Report 4

# South Africa's Energy Security in the Context of Climate Change Mitigation

Sheila Kiratu

2010

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# Abstract

The energy sector and the provision of electricity for South Africa's population and industries already comprise a complex issue without including the influence of climate change to the equation. Whereas responses to climate change have been informed by the country's commitments to the United Nations Framework Convention on Climate Change, the situation on the ground indicates that the demand for electricity supply will not abate in the near future, which poses challenges for South Africa's energy security and development, both of which are mainly tied to coal. This paper therefore presents the tensions between the country's energy and climate policies and their implications for the region.



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The Trade Knowledge Network is a global collaboration of research institutions across Africa, Asia, Europe and the Americas working on issues of trade and sustainable development. Coordinated by the International Institute for Sustainable Development (IISD), the TKN links network members, strengthens capacity and generates new research to assess and address the impact of trade and investment policies on sustainable development.

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This study is part of a larger, multi-region TKN project that seeks to understand better the impacts of trade policy on energy security. It includes case studies and regional analyses from Latin America and Southern Africa. It was made possible through the generous support of the Norwegian Agency for Development Cooperation (NORAD). The project outputs are available on the TKN website.

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## About the author

Sheila Kiratu is the assistant coordinator for TKN Southern Africa and a researcher for the Development Through Trade program of the South African Institute for International Affairs. In this capacity, she has worked on a variety of themes on trade and investment law and policy for clients from government, intergovernmental organizations, donor intermediaries, business and civil society. Her areas of expertise are investment agreements in Southern Africa, regional integration, trade policy and negotiation in Southern Africa, climate change, and sustainable development. Prior to this, she practised law as an advocate of the High Court of Kenya and at Gadhia and Mucheru Advocates.

## Abbreviations and acronyms

| | |
|---|---|
| DoE | Department of Energy |
| DRC | Democratic Republic of the Congo |
| DSM | demand side management |
| GHG | greenhouse gas |
| Gw | gigawatt(s) |
| IEP | Integrated Energy Plan |
| IPP | independent power producers |
| LTMS | Long Term Mitigation Scenarios |
| MW | megawatt(s) |
| NERSA | National Energy Regulator of South Africa |
| NIRP | National Integrated Resource Plan |
| PPA | power purchase agreements |
| REFIT | renewable energy feed-in tariff |
| SADC | Southern African Development Community |
| SANEDI | South African National Energy Development Institute |
| SANERI | South African National Energy Research Institute |
| SAPP | Southern African Power Pool |
| STEM | Short Term Energy Market |
| TREC | tradable renewable energy certificate |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UK | United Kingdom |
| U.S. | United States of America |
| USD | U.S. dollar |
| ZAR | South African rand |

# Executive summary

In Southern Africa, energy security—particularly that of electricity supply—is central to empowering economic development in the region. Despite being endowed with significant reserves of coal, oil and natural gas, only 39 million of the region's 170 million people[1] have access to electricity, which is generated mainly from thermal and hydroelectric resources. This reflects the imbalance of supply and demand and therefore curtails the potential for economic development.

South Africa's national electricity utility, Eskom, is the largest supplier, providing 80 percent of the region's needs, primarily sourced from coal. This over-reliance on Eskom compromises the region's supply security because the company has reached the end of its surplus generation capacity at a time when the South African government has capped its financial support to the company. Furthermore, climate change science indicates that the country has the 'wrong' primary energy source—coal, which produces a lot of carbon emissions—and that the current trajectory of global greenhouse gas (GHG) emissions is on course to trigger tipping elements that would unlock runaway climate change if not alleviated, potentially making South Africa's reliance on coal generated power a liability rather than an asset.

Having ratified the United Nations Framework Convention on Climate Change in August 1997, the South African government has aligned itself with the global objective of stabilizing the concentrations of GHGs in the atmosphere at a level that would prevent dangerous human interference with the global climate system. This environmental concern demands that the country, as one of the highest carbon emitters in the world, take on climate mitigation imperatives that include reducing its high carbon emissions, which can largely be attributed to the country's heavy reliance on coal for electricity production that mainly services it manufacturing and industrial base, and address the very high carbon intensity of the economy as a whole if it is to remain competitive in the future.

The implication is that South Africa urgently needs to initiate a transition to sustainable energy if it is to meet the imperatives of reducing its emissions. Other reasons are to increase access to electricity, realize the enormous job creation potential of a low carbon economic future, and address the constraints of diminishing water availability and quality in the country.

However, as a major exporter of electricity to the region, it is clear that mitigation targets taken on by South Africa will inevitable affect supply in the region. But at the same time, if national geographic distribution of energy resources can be overcome, immense opportunities exist in neighbouring countries for improving the region's energy profile by contributing to the electricity supply mix and adopting energy mixes that include renewable energy and coordinating energy planning and service provision.

The report therefore aims to look at the roots of electricity supply security in South Africa. Some emerging conclusions are as follows:

- In order for South Africa to effectively reduce its carbon emissions, the country's 'development plan', which currently follows a conventional, fossil fuel energy path, must be abandoned.

1 <http://www.sapp.co.zw/documents/Facilitating%20access%20to%20power.pdf>.

- South Africa will need to redefine its competitive advantage from attracting energy intensive sectors on the basis of cheap but dirty electricity to building a new advantage around climate friendly technologies and systems.

- A transformed institutional and regulatory environment that allows for the participation of clean electricity suppliers in a market currently dominated by Eskom and coal is overdue.

- A global shift to a low carbon economy would create lucrative new opportunities for South Africa in providing market solutions for such a shift, as is evidenced from the fact that countries that have provided sustained, effective support for low carbon alternatives are benefitting most from the early opportunities of low carbon transition. Furthermore, as pressure for transition mounts, investment in low carbon goods and services will continue to accelerate. So economies that are efficiently run and free from the volatility of the fossil fuel market are at a competitive advantage, and consequently companies and governments that are moving fastest on low carbon transition will reap the rewards.

- Even though policy measures are in place to address energy and climate concerns in South Africa, they are undermined by policies in other areas of government. This lack of a coherent vision that includes all government departments results in fractured policies on energy and climate change. South Africa's energy policies need to be tackled in a coordinated way, as they lie at the heart of major national and international foreign policy discussions on matters that affect the country's and the wider region's energy security.

- South Africa further lacks policies that would accelerate the demonstration, development and deployment of low emission energy technologies.

- To develop an integrated vision for energy security, the government must address institutional issues, diversification, and the merits and demerits of centralized powers as opposed to distributed networks, and also take into account the opportunities available in neighbouring countries.

# 1. South Africa's energy security and its drivers

## 1.1 Introduction

The energy security that we are concerned with here is that of the delivery of electricity services and not the supply of imported oil, gas and other forms of energy. With huge energy demand a certainty in South Africa in the long run, the country faces the challenge of establishing sustainable energy systems in the face of climate change and the consequent mitigating actions that are expected of countries with high greenhouse gas (GHG) emissions. This is a challenge, because South Africa's carbon dioxide intensity is particularly high, as it derives so much of its energy consumption from highly carbon intensive coal and its emissions statistics are equivalent to Germany's (UNDP, 2008; Carbon Dioxide Information Analysis Centre, n.d.). In fact, 90 percent of the country's electricity is generated from coal, which is among the cheapest in the world (hence its attraction as a source of energy), while 40 percent of the country's petrol and diesel is manufactured from coal and gas (Unmüßig & Cramer, 2008). South Africa differs from its neighbours in several respects. Basically, however, it is the largest emitter of GHGs in Africa, primarily because of the size of its economy, its large manufacturing and industrial base, and the coal dependency of its energy economy. South Africa is responsible for 39 percent of emissions on the continent (UNECA, 2002: 33), and on a per capita basis[2] is one of the greatest sources of GHG pollution in the developing world.

But coal has lately become the most controversial fuel of all, as it is cheap and readily available almost everywhere, but the most disruptive to the climate. The high levels of GHG emissions that are attributable to fossil fuel based electricity production raise questions about the major issue on the environmental horizon—climate change. This essentially makes electricity—a subsector of energy—an important sector to consider as part of South Africa's energy security. This report therefore aims to provide an overview of the sources and dynamics of electricity demand and supply in South Africa and the Southern Africa region, the country's perspectives on climate change and the consequences of its high emissions, the impacts and vulnerability experienced by South Africa as a result of potential mitigation measures to be taken by the country, and an assessment of the opportunities to provide low carbon energy solutions nationally and regionally.

## 1.2 Demand and supply factors

The exploitation of its main energy-producing natural resource, coal, has been instrumental in meeting South Africa's electricity needs.[3] The main supplier of electricity is the state owned utility Eskom. Eskom generates around 96 percent of South Africa's electricity and is the sole transmitter and distributor to corporations, municipalities, households and villages (Eberhard, 2006). Historically, Eskom had built up a massive surplus capacity on foreign funds, and this capacity was used to supply areas of white habitation during the apartheid regime; this is one of the reasons why, despite having surplus capacity, distribution was concentrated only in a few areas (Fine & Rustomjee, 1996). This created an artificially low price, and even today Eskom is one of four suppliers of the cheapest industrial electricity in the world.[4]

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2 According to UNDP (2008), carbon dioxide emissions per capita in South Africa in 2004 were 9.8 tons, equivalent to Germany's.

3 According to the IEA (2006), in 2006, 67.2 percent of energy generation came from coal, 21.9 percent from crude oil, and 7.7 percent from renewable energy sources and waste. The contributions of natural gas (2.9 percent), nuclear energy (1.8 percent) and hydropower (0.2 percent) are small.

4 See further, <http://www.dme.gov.za/energy/electricity.stm>, accessed 24 June 2010.

However, as part of its post-apartheid development path, the South African government embarked on a policy to provide electricity to the country's entire population. By 2004 approximately 77 percent of urban households were electrified. According to the Department of Energy (DoE), raising South Africa's total electrification rate from 70 to 100 percent (one of the government's major social objectives) can be expected to increase overall consumption in the household sector from 19.32 to 23 percent of total energy consumption in the country by 2025. But the highest demand for electricity in the economy comes from industry (including mining and mineral beneficiation), which consumes more than 51 percent of the country's total energy and twice that of the household sector. The transport and services sectors consume approximately 27 percent and 8 percent, respectively. The agricultural sector's consumption is lowest at 2.6 percent.

Eskom has been very successful in increasing the distribution of electricity across South Africa and is also responsible for a sizeable portion of the electricity used in a number of surrounding states of Southern Africa, including Botswana, Mozambique, Namibia, Swaziland, Lesotho, Zambia and Zimbabwe (Eskom, 2008).

It should be noted, however, that 2008 was a devastating year for Eskom: it had a considerable shortage of capacity that resulted in power outages and electricity prices hikes; both were new to South Africa, which has prided itself on its low electricity prices as a major competitive advantage. While the price hikes may be explained in terms of the economically unsustainable price starting to give way, the outages were interpreted to mean that additional baseload capacity was required and that coal fired power stations would be resorted to again (*Electricity Journal*, 2008).

Eskom has embarked on a strategy that includes building two more coal fired stations, Medupi and Kusile, which will have capacities of 4,788 MW and 4,800 MW, respectively. This is part of the company's strategy to increase its total generating capacity to 80,000 MW over the next 20 years (*The Engineer Online*, 2008).

Demand side factors are precarious, with a reserve margin well below the comfortable band between 15 percent and 19 percent, and there is concern about sustaining economic growth in the light of electricity supply constraints. This is compounded by statements by the South African Reserve Bank to the effect that the country is expected to come out of recession by the end of 2010.[5] In a perverse way, this represents additional strain for the electricity sector, because economic growth correlates with electricity demand growth. This means that the electricity system will be more strained, perhaps even attaining the levels that it did in 2008, when the country experienced power blackouts.

Since no major investments have been made to increase supply in the last 20 years, it is estimated that USD 1.86 billion is required to build the necessary power stations. For a long time the major source of funding for Eskom was its single shareholder, the government. For example, in the past three years (2007–10) the government has extended more than ZAR 60 billion as equity to Eskom, but as far as the new Medupi and Kusile power projects are concerned, it seems that the current recession constrains the government from injecting additional capital into Eskom from the fiscus. This has necessitated a search for private loans[6]—borrowed expensively in overseas markets—and capital increases through

5 Dipuo Peters, South African minister of energy, speech at Business Unity South Africa, 6 April 2010.

6 Eskom recently sought and was successful in obtaining loans from the African Development Bank and the World Bank to finance the Medupi Power Station, despite the raging controversy surrounding the loans. See further, Calland *et al.* (2010).

tariff hikes,[7] in addition to the over ZAR 170 billion in guarantees extended to the company by Treasury to enable it raise the necessary loans it requires in the capital markets.

## 1.3 South Africa's core energy policy

Energy policy in South Africa has undergone a substantial revision and now focuses on energy for development. A multistakeholder consultation process to redefine the priorities and objectives ended with the publishing of the White Paper on the Energy Policy of the Republic of South Africa in December 1998 (South Africa, 1998). It describes South Africa's general policy for the supply and consumption of energy and outlines the path for the growth and development of renewables and the improvement of energy efficiency in an effort to achieve a more sustainable energy mix that promotes the country's economic growth (Imbewu Sustainability Specialists, 2009). South Africa's new energy policy priorities are spelt out, with particular emphasis on improved access to energy for communities previously disadvantaged by apartheid. Another priority that is of relevance is the dismantling of large scale monopolistic structures, notably Eskom and the synthetic fuels sector. This has so far not been achieved and is thus an ongoing process: Eskom still generates more than 90 percent of South Africa's electricity and is the sole transmitter (Eberhard, 2005).

The identified medium term policy priorities for the White Paper include aspects of renewable energy or energy efficiency. Government is supposed to stimulate the development of new and renewable sources of energy; facilitate energy research and development; promote energy efficiency in all sectors of the economy; introduce a voluntary energy appliance labelling system; facilitate the monitoring, evaluation and demonstration of clean energy technologies; follow and participate in international negotiations on climate change; and investigate an environmental levy on energy sales to fund the development of renewable energy, energy efficiency and sustainable energy activities. From the White Paper have flowed scattered legislation and regulations on electricity regulation, which are discussed below.

However, the current and most applicable one is the Integrated Energy Plan (IEP) (South Africa, 2003). This is a framework within which government intends to base its energy policies and decisions. The IEP considers the country's energy needs in a holistic manner, looking at macroeconomic, social and environmental issues affecting energy needs. It was developed by channelling economic data through two basic scenarios: a 'baseline' or business as usual scenario, and a '*siyaphambili*' ('we are going forward') scenario that promotes the diversification of supply and environmental improvement. The conclusions of such data analysis reiterate the dominance of coal in the energy sector and that it will probably dominate for the next two decades. Nonetheless, the IEP emphasizes the long term benefits of promoting a renewable energy industry and looking into the potential of nuclear, gas and synthetic liquid fuels as sources of energy, although the cost factor (renewable energy technologies are expensive) is also emphasized. An undertaking is made in the IEP to prepare integrated energy plans on an ongoing basis as the country's circumstances change.

7 In 2010 the National Energy Regulator of South Africa allowed Eskom to increase electricity tariffs by 24.8 percent for 2010, 25.8 percent for 2011 and 25.9 percent for 2012; see further, *Mail & Guardian* (2010).

**Box 1: IEP scenarios**

* The 'baseline simulated' scenario is a 'business as usual' scenario and works in terms of continuing present trends based on coal as the main energy source.
* The 'baseline optimized scenario' optimizes the 'baseline simulated' scenario based on least cost, taking into account energy efficiency and fuel switching.
* The '*siyaphambili* simulated' scenario promotes fuel diversification away from coal, prescribing other energy technologies at set times.
* The '*siyaphambili* optimized' scenario optimizes the '*siyaphambili* simulated' scenario based on least cost, using energy efficiency and fuel switching.

Source: South Africa (2003: 11)

Commentators have, however, called this an energy plan rather than an *integrated* energy plan, as it makes forecasts about the 'business as usual' scenario (Earthlife, 2009a). As an integrated energy plan, it fails to consider the impact of legislation on the expansion of renewable energy and energy efficiency. Critics such as Earthlife point out that the IEP fails to consider the environmental externalities affecting energy supply in South Africa, i.e. the fact that generation costs and externalized environmental costs such as the impact of GHG emissions and air pollution are not included in the cost of electricity makes coal generated electricity seem cheap and, as a result, renewable energy sources become more expensive in comparison. The trade-off between least cost energy production and factors such as job creation and social development are also not considered. The IEP tries to model intervention around the situation on the ground and fails to consider future possibilities or create potential scenarios, which is the whole point of a genuine integrated energy plan (Earthlife, 2009a). Perhaps it is for this reason that the plan is also too cautious and fails to encourage any investment in renewable energy and energy efficiency.

No other integrated energy plan has since been developed, despite the obligation placed on the minister in the National Energy Act No. 34 of 2008 (South SAfrica, 2008c) for an annual integrated energy plan. Interestingly, and oblivious to the conflict of interests that may arise, the DoE, under the Electricity Regulation Act of 2006, appointed Eskom as the national energy planner to develop the country's National Integrated Resource Plan (NIRP) (Fakir, 2009). It is no surprise that Eskom has proposed a 20 year integrated resource plan for the electricity sector that includes the expansion of coal fired power stations. Since there is no updated integrated energy plan, there is nothing fresh informing the NIRP (Calland *et al*., 2010), thus creating room for the further prioritization of coal as a source of energy and causing more damage to the climate—a program of action that is potentially disastrous, as the reduction of GHG emissions is considered a necessary precautionary measure to avert what the Stern review report warned would be catastrophic to the future well being of the planet's ecosystem (Stern, 2007).

## 1.4 The climate change question

South Africa is a signatory to the 1992 United Nations Framework for the Convention on Climate Change (UNFCCC) and its Kyoto Protocol. Under Kyoto, the biggest emitters of GHGs are encouraged to implement mitigation measures that catalyze energy efficiency and motivate energy sustainability policies. South Africa is classified as a Non-Annex developing country and is therefore exempt from mandatory GHG emissions reduction targets. Nonetheless, the country is committed to the fight against climate change and has instituted several policies and strategies at the national level to reduce GHG emissions.

The reasons for this are simple: the economic, social and environmental costs of failing to act on a deteriorating climate are extremely high. South Africa's agricultural sector would be affected by increased temperatures and faces constraints of increasing droughts and diminishing water availability and quality. If the debate on trade competitiveness is factored in, the country will have to address the very high carbon intensity of its economy as a whole if its goods and services are to remain competitive well into the future of a more climate conscious world. Indeed, there has been significant market response through carbon labeling standards imposed on imported goods. For instance, the UK supermarket chain Tesco is testing labels on 20 products and developed governments are contemplating imposing regulatory interventions ranging from carbon tax measures to border carbon adjustments on importers of carbon intensive products (*EU Observer*, 2010).

The most coherent and ambitious framework for dealing with climate change in the country is the Long Term Mitigation Scenarios (LTMS) plan, which describes a pathway of GHG emissions that keep the levels of emissions at more or less what they are today. This plan is the result of cabinet commissioned research to determine South Africa's potential for mitigating GHG emissions. Commissioned in 2006, the LTMS document was presented in 2008 and it states that 'the actions required in South Africa to mitigate emissions will be driven by policy, both domestic and international, and by investment in new technologies, building a new definition of competitive advantage' while looking at 'attendant costs of each option [for mitigation]' (South Africa, 2008a).

The resultant mitigation trajectories for the country focus on two scenarios; the 'growth without constraints' scenario and the 'required by science' scenario. The 'growth without constraints' scenario assumes a South Africa proceeding on the same economic growth trajectory, supported by its energy intensive sectors such that by 2050 the GHG emissions would have quadrupled. The 'required by science' scenario assumes an emissions mitigation strategy that is supported by the availability of all necessary technology and resources, resulting in GHG emissions reductions of 30–40 percent from 2003 by 2050. The 'required by science' scenario is identified as the best strategy to follow and the LTMS envisages a four step process for climate change mitigation as follows:

1. *Start now:* This involves 'certain quantifiable strategic mitigation options' that are immediately implementable, given a certain amount of effort. Initial high costs are involved in implementing this option, particularly with regard to efficiency in industry and transport, as well as in the use of renewable and nuclear energy in the generation of electricity. This option could reduce emissions by 43 percent by 2050.

2. *Scale up:* This adds more cost to the 'start now' option, but still focuses on energy efficiency, as well as the development of renewable energy, nuclear energy and synthetic fuels. It is forecast to reduce emissions by 64 percent by 2050.

3. *Use the market:* This option focusses primarily on the involvement of the private sector in emissions mitigation through regulatory intervention, primarily through the implementation of a carbon tax. The strategy also involves a moratorium on the building of new coal power plants to create a decline in coal generated power supply such that only 4 Gw of coal generated capacity is left by 2040, while 25 Gw of nuclear power and 118 Gw from renewable sources are added by 2040. The option also looks at 'revenue recycling', where the proceeds from carbon taxes will be used to incentivize renewable energy generation, although this will create a 2 percent negative impact on the country's gross domestic product by 2015 and there will be a need to work on economic growth.

4. *Reaching for the goal:* All costs are levelled out and emissions reduction targets will be reached by 2050. This will be done through the introduction of new technology, resource identification for such new technology, people oriented measures and the introduction of structural adjustments to South Africa's carbon intensive economy.

In July 2008, in response to the LTMS, government launched its vision, strategic direction and framework for climate change (Van Schalkwyk, 2008), which reiterates that government policy will be informed by the 'required by science' scenario with six policy direction themes as follows (South Africa, 2008b):

1. *GHG emissions reductions:* GHG emissions are expected to peak, plateau in 2020–25 and decline in 2030–35.

2. *Build on, strengthen and/or scale up current initiatives:* Energy efficiency and demand side management initiatives are made mandatory and will be constantly reviewed to reflect more ambitious targets, while Treasury will look into the possibility of a carbon tax.

3. *Implementing the 'business unusual' call for action:* The renewable energy sector is key to this theme and policies and measures are put in place to encourage and develop its growth. The transport sector is targeted for GHG emissions reduction and government commits itself to promoting a low carbon economy.

4. *Preparing for the future:* Research and development targets are set for the renewable energy and transport sector, and communication is improved to raise awareness on climate change and the need for mitigation.

5. *Vulnerability and adaptation:* South Africa identifies, describes and prioritizes adaptation interventions and their implementation.

6. *Alignment, coordination and cooperation:* The roles and responsibilities of all stakeholders, particularly organs of state, are clearly defined, aligned and coordinated, while climate change policies and measures are mainstreamed into the alignment structures.

While all of the above is laudable and, in some instances, government has made a concerted effort to stick to its vision and strategic direction, there is a gross lack of coordination among government departments and agencies and lack of a unified approach to climate change mitigation. The development of a renewable energy industry is being hampered by Eskom's plans to expand its coal fired power stations, as well as its mandate to develop the country's NIRP. This is at odds with the intention in the LTMS to institute a moratorium on new coal fired plants and reduce dependence on coal as an energy source. Many policies and frameworks have been created around renewable energy, energy efficiency and climate change mitigation, but all of them remain policy directives to guide decision making and implementation and are not legally enforceable.

This is also further illustrated by the emissions targets for South Africa that President Zuma pledged at the UNFCCC Conference in Copenhagen. Zuma gave an emissions target, dependent on financial and technological support from the developed countries, of 34 percent below 'business as usual' levels by 2020 and of 42 percent by 2025 (Zuma, 2009). These figures seem to have been plucked from the air, as they invoked general surprise from local commentators and industry players (Williams, 2010). This target is totally at variance with what is taking place in South Africa on the ground as regards energy and it disregards the country's lack of ability to implement the curbs without damaging the economy, especially given its reliance on coal fired power (Mundy, 2009).

# 2. The 'business unusual' approach: Opportunities for low carbon generation

By being in the league of high GHG emitting countries, options for the diversification of electricity supply in South Africa become a priority. The following is a discussion of the country's efforts to achieve a balance between economic growth—driven by and requiring electricity supply in the short to medium time from fossil fuels—and climate responsibility by building a low carbon economy.

## 2.1 Substitution vs new technology

Most of the quick measures touted to deal with energy crises and to secure energy are rooted in enhancing commodity supplies such as producing clean coal; switching from gas to coal for electricity generation; promoting coal-to-liquids conversion for transport; cultivating grain crops for the production of biofuels to deal with the uncertainty of oil price fluctuations, etc. South Africa's energy policy follows this trend with the most recently published version of Eskom's new infrastructure construction plans providing for at best 2 percent of electricity coming from renewable sources by 2025, with diversity objectives being met primarily by a new nuclear plant.

This 'substitute for oil or coal' mentality has unfortunately led to energy policy focussing on commodity quantities and flows of electricity, while taking technology and physical assets for granted. Meanwhile, the entire 'carbon market'—and the emissions trading framework by which it functions—adds an additional commodity to the policy mix, but does not address directly the need to improve the performance of energy technologies and infrastructure (Patterson, 2008).

The push for a fundamental shift in approach has been backed by meticulous research that, for example, for the UK has identified and characterized not only the individual fuels and electricity used in the country, but also the end use technologies, and found that managing energy security means managing technology, physical assets and infrastructure and not just commodities (Leach *et al.*, 1980). From this it can be deduced that one of the solutions to the unstable electricity supply lies not in providing more electricity, but in appropriately managing energy infrastructure and finding appropriate technology for various applications, e.g. energy efficient energy carriers, and conserving electricity during non-peak hours, among other things.

But technology pathways in South Africa are extremely difficult to change. Eskom's domination of electricity generation and its preference for fossil fuel is considered to be the most compelling obstacle to developing a renewable energy market in the country.[8] This is illustrated by Eskom's new expansion plan to be completed by 2016, estimated to cost USD 1.86 billion, that in real terms pays only lip service to encouraging renewable energy production, as it includes the establishment of two open cycle gas turbines, two new coal fired power stations, two pumped storage schemes and only one wind farm. Out of a proposed generation of 16,304 MW, the wind farm would contribute 100 MW. Schaffer (2008) has observed that 'we can have wind and solar energy in place of coal fired power stations for the same amount of money', concluding that 'the main constraints (to clean technology and renewable

8 The country's overdependence on coal continues to lock out other options. Because Eskom produces and sells electricity within traditional technological frameworks, clean coal technologies such as flue gas denitrification and other denetrification systems have not yet been installed at current power stations, nor has there been any implementation of carbon capture and storage.

energy) are neither resource availability nor techno-economics but a limiting mindset focused on the supply side and short term thinking favouring low initial costs'.

Renewable energy production can also be sabotaged by Eskom because it is the biggest buyer of (independent) electricity generation in the country. This option for sabotage requires a legislative fix. It is alleged that many investors are queuing up to introduce clean technologies and produce renewable energy, but encounter difficulties with Eskom, which has a 'bullying approach to energy production' and, as one commentator puts it, needs a 'radical shift in view of the power of coal over other forms of energy production' (Dada, 2009: 8).

Renewable energy is also often dismissed because of the grid challenges of storing and distributing it and its inability to cater for bulk supply. But this could be symptomatic of a grid that is not sophisticated and intelligent enough to enable renewable energy, because there are examples in the U.S. of solar and wind energy being generated during off-peak hours and then stored using storage technologies. Many excellent and cheap technology options are already available. Some, like carbon storage technology, need more research and development, but a lot of what is necessary for reducing emissions and scaling up the uptake of renewable energy by Eskom is already available.

The technology pathway problem can also be traced to government departments' governance structures and the lack of a clear division of labour/responsibilities among them. There is a massive disjuncture in the powers allocated to DoE and Eskom (and incidentally, the latter falls under the Department of Public Enterprises and is a case of the tail wagging the dog) (Dada, 2009: 8). For instance, there are no targets for renewable energy, but this responsibility lies with DoE, not Eskom. This highlights the confusion around energy planning, and Eskom is using the gap caused by this confusion to decide the country's energy future (Greyling, 2009: 5). This means that important questions around long term strategies and electricity governance issues need to be resolved. Nonetheless, a few measures have been put in place to catalyze the development of a low carbon economy and incentivize the uptake of clean technology.

## 2.2 Removal of structural barriers to clean energy investment

Fakir and Nicol (2008) have summarized the framework conditions that affect the viability of the renewable energy industry in South Africa as follows: (1) the renewable financial markets are nascent and private investors are risk averse in this regard; (2) for smaller independent power producers (IPPs) trying to make a breakthrough in the renewable energy market, the biggest hurdle is finding the initial pre-feasibility and feasibility finance; and (3) most renewable energy projects fail because developers neither budget adequately nor realistically determine the return on investment for an initiative, and in so doing do not take profit margins and cash flow scenarios into account for the duration of the project. In an underdeveloped market, private investor hesitancy is expected, which has lead the UN Industrial Development Organization to observe that public funds and government measures are needed to capitalize private funding (UNIDO, 2008).

Some of the obstacles discussed are dealt with by the incentives discussed in the following section.

## 2.3 Incentives for clean energy investment: A cost benefit analysis

### 2.3.1 Renewable energy feed-in tariff (REFIT)

The National Energy Regulator of South Africa (NERSA) introduced REFIT in March 2009 (NERSA, 2009).[9] It is aimed at encouraging investment in renewable energy by offering guaranteed tariffs that are supposed to cover generation costs and ensure profits, while at the same time creating 'a critical mass of renewable energy investment and supporting the establishment of a self sustaining market' (Eberhard, 2002: 11).[10] Investors are given access to the national grid and Eskom is designated as the renewable energy purchasing agency and is obligated to buy power from the IPPs through power purchase agreements (PPAs).

REFIT is currently applicable to four technologies: landfill gas; and small scale hydro, wind and concentrated solar power, but it is expected that the technology base will widen. A second REFIT phase is contemplated that is expected to look into such issues as a broader purchaser base and tariffs based on geographical variation, which would be an improvement on the scheme as it currently stands.

However, some analysts allege that the tariffs offered are too low, thus providing no incentive for IPPs to enter the energy market (Goldstein, cited in *Business Report*, 2010). Furthermore, with Eskom being a designated buyer, there is a clear conflict of interest, since the power utility has to negotiate and sign PPAs with what are essentially its competitors.

This situation is further complicated by the fact that while NERSA was finalizing its REFIT in early 2009, DoE introduced the Independent Power Purchaser Regulations under the Electricity Regulation Act.

These regulations apply to renewable and cogeneration technologies other than nuclear power generation and as such have a direct impact on REFIT. They effectively introduce a competitive tendering process for IPPs in order to obtain generation licences and are at cross purposes with REFIT (Fakir, 2009). Renewable energy is put at the same level as conventional energy and, given the current low cost of conventional energy, the odds are thus against renewable energy. There has since been no attempt to reconcile REFIT with the IPP Regulations.

A positive development, however, is the plan to establish an independent system operator that will be separate from Eskom to ensure that it does not abuse its power and will be responsible for PPAs with IPPs. Whether this will materialize, however, is yet to be seen, especially considering that the White Paper on Energy Policy, published in 1998, calls for the breaking of Eskom's monopolistic hold on the energy sector and the fact that, to date, nothing has changed.

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9 NERSA may as yet play a pivotal role in the development of a low carbon economy in South Africa. Already it has pronounced on REFIT. Created by the National Energy Regulator Act of 1999, its powers have been elaborated in the Electricity Regulation Act of 2006. NERSA, as custodian and enforcer of the regulatory provisions in the Electricity Regulation Act, may make an electricity supplier licence subject to such conditions as the types of energy sources from which electricity must or may be generated; and compliance with health, safety, and environmental standards and requirements. NERSA can, therefore, if it so wishes, stipulate the use of renewable energy for the generation of electricity.

10 Eberhard (2002) has identified the absence of a competition inducing framework (in terms of both supply and demand) as the primary obstacle to investing in renewable energy.

### 2.3.2 Tradable renewable energy certificates (TRECs)

A TREC[11] is an electronic record in a database that verifies the origin of renewable energy from a registered renewable energy source (DME, 2007: 11). It represents all the benefits of renewable energy and can be traded anywhere in the world, separately from the electricity grid infrastructure. TRECs represent an extra income stream for renewable energy producers. The benefits of TRECs include the monitoring and evaluation of renewable energy production mechanisms such as REFIT; the purchase of green attributes separate from physical trade, which would bypass the problems associated with the physical trade of electricity in a monopoly environment such as is the case with Eskom; and the administration and verification of the greening of events and products (DME, 2007: 12).

TRECs can also be used as method of accreditation, verification and monitoring of Clean Development Mechanism projects. The South African National Tradable Renewable Energy Certificates Team was formed to facilitate and coordinate the establishment of the issuing body as a non-profit organization, and this was expected to be completed by the end of 2009. One of the problems with TRECs is the lack of harmonization with REFIT, with the problem being primarily REFIT's failure to recognize other sources of renewable energy except the four identified ones (see above), but this is expected to ease as the renewable energy industry takes root.

### 2.3.3 Demand side management (DSM)

In the short term, energy efficiency and DSM are the cheapest ways to meet electricity demand and there are many opportunities to generate 'negawatts' (Marquard, 2009). Through DSM, the White Paper proposes overall energy savings of 4,255 MW over a 20 year period. The current annual DSM target set by DoE is 152 MW, with the intention to increase these levels over time as DSM becomes entrenched in the market. This target is divided into energy efficiency and load management targets for the residential, industrial and commercial sectors with pressure to deal with tough issues: behavioural and institutional change. These interventions include revised building codes (which will specify the energy efficiency standards for new buildings), the replacement of incandescent lights with energy efficient lighting, the much wider use of solar water heating, etc. (25 Degrees in Africa, 2008).

### 2.3.4 Energy Efficient Motors Replacement Program

Launched in 2007, this program promotes the replacement of old, inefficient motors with energy efficient ones (Eskom, 2009). Electric motor users in industry get a once off rebate when they buy selected premium efficiency motors to replace the old ones, while old motors have to be returned to the supplier, where they are scrapped in an environmentally friendly manner and a disposal certificate submitted to Eskom. These rebates are only given if the motor supplier is registered with Eskom to participate in the program.[12]

### 2.3.5 Energy Efficiency Accord

Another government initiative is the Energy Efficiency Accord, an undertaking between business and government signed in 2006 that calls for the participation of business in voluntary energy efficiency initiatives and, more specifically, the development of a specific energy efficiency strategy by each

11 Also known as green certificates, green tags or environmental attributes.

12 See also, <http://www.eskomdsm.co.za/sites/default/files/u1/of_the_ee_motors_programme_FINAL_16_Feb_2010.pdf>.

signatory within a year of signing the accord, among various other undertakings, which have been criticized as being no more than common sense and good business practices, and which may be construed as diluting government's powers to regulate business practices (Earthlife, 2009b). Government reciprocates the business undertakings by encouraging and facilitating voluntary business measures (Earthlife, 2009b). Nonetheless, these commitments by business should go a long way towards securing more energy efficient business practices, work to conscientize business on the importance of energy efficiency and put the country on the path to a low carbon economy.

### 2.3.6 Emissions reporting requirements

While there is no mandatory GHG emissions reporting requirement for companies, the minister of Water and Environmental Affairs has reported that GHG emission reporting will soon be mandatory and that there will be tighter regulations on energy efficiency, vehicle emissions, waste regulations and GHG emissions reporting (Stein *et al.*, 2009). In the past, industry, specifically the top 100 companies listed on the Johannesburg Stock Exchange, voluntarily took part in the South African Carbon Disclosure Project run by the National Business Initiative.

The government can go even further in sweetening the deal with energy intensive industries exposed to international competition by imposing a lower tax if they implement energy efficiency. This approach has been used in developed countries and it requires that the concerned companies (1) change the way they run plants; (2) adopt techno fixes with short payback times; and (3) commit large amounts of capital to rebuild all or parts of their plants (Genesis Analytics, 2007).

### 2.3.7 Tax incentives offered in the 2010–11 budget speech

Noteworthy proposals in Minister of Finance Pravin Gordhan's maiden (2010) budget speech were the proposed introduction of a 'favourable tax treatment' of income generated from the sale of carbon emissions reduction certificates; a depreciation tax allowance for companies investing in energy efficient technologies; a tax on the use of incandescent light bulbs; the allocation of ZAR 1 billion for DSM initiatives; and tax incentives to encourage investment in energy efficient technologies. The budget speech announced the delay of the implementation of a carbon tax on vehicle emissions until September 2010, and no other carbon tax was mentioned.

### 2.3.8 National Energy Act No. 34 of 2008

This Act is the first piece of legislation that addresses the issue of investments in clean energy (South Africa, 2008c). The Act obliges the minister of energy to develop, review and publish on an annual basis an integrated energy plan that must serve as a guide for energy infrastructure investments, take into account all viable energy options and guide the selection of the appropriate energy technology to meet energy demand. The minister is empowered to direct state owned entities to provide for adequate investment in energy infrastructure or invest in critical energy infrastructure (South Africa, 2008c: sec. 18). Section 19 empowers the minister to issue regulations regarding the minimum contributions to national energy supply from renewable energy sources; the nature of the sources that may be used for renewable energy; and measures and incentives to promote renewable energy in all contexts; as well as prescribe on energy efficiency in all sectors of the economy. The Energy Act therefore provides an enabling framework for the formulation of regulations and policies on renewable energy.

To cure the general lack of accurate verifiable information around the energy sector in South Africa, the Energy Act also promulgates the establishment of the South African National Energy Development

Institute (SANEDI), with the consolidation of energy data as one of its primary focal areas. SANEDI, when operational, will basically have assimilated the current South African National Energy Research Institute (SANERI). SANERI's objectives are to fund, encourage and support policy oriented research and its renewable energy research areas include solar and biomass energy, wave/ocean energy, energy storage and second generation technologies for biofuel. Although it is entirely at the minister's discretion, the Energy Act allows for more regulatory emphasis on renewable energy and renewable energy investments. Investors can also draw from the research being done by SANEDI on renewable energy.

Nevertheless, it remains to be seen how SANEDI will relate to Eskom, which has been tasked with formulating the country's NIRP, while SANEDI will have the responsibility of developing the next IEP for South Africa. These mandates to develop the above energy plans flow from two different pieces of legislation, thus emphasizing the point that there does not seem to be an effort to coordinate and harmonize the work of government agencies around the issues of energy.

## 3. The regional equation

It is estimated that the new coal powered power stations expected to come on stream in South Africa will emit as much carbon dioxide as all of New Zealand or the 30 lowest emitting African countries combined, thus overtaking Poland as the producer of the world's most carbon intensive electricity and hence incurring the risk of ever looming and increasing carbon taxes that would make South African goods less competitive in international markets. Thus, regardless of the current dominance of coal in South Africa as the energy source of choice, as well as the country's huge coal reserves, future sustainable electricity supply requires the diversification of energy resources to cleaner forms of energy such as renewable energy.

Tapping into the underutilized potential of the country's renewable energy generation resources could generate 300 MW from wind power, 50 MW from hydropower, 100 MW from biomass and up to 4,000 MW from cogeneration projects. These figures reveal that renewable energy produced domestically will not make much of a dent in the almost 40,000 MW capacity required.[13] However, exploiting regional resources as opposed to purely domestic resources, especially within the Southern African Development Community (SADC)—which has considerable hydropower and natural gas potential—can bridge the gap.

At the regional level, the biggest opportunity lies in the Southern Africa Power Pool (SAPP), particularly hydroelectricity generated in the Democratic Republic of the Congo (DRC). In fact, Eskom has identified more than 900 MW of potential regional imports even without considering the massive potential of the proposed Grand Inga Dam in the DRC, which has the potential to produce over 40,000 MW in the longer term and is on its own equivalent to the current size of the South African grid at approximately 40 Gw. The Mepanda Uncua hydro power project in Mozambique also has the potential to add a further 1,300 MW to the SAPP.

In addition to improving and diversifying South Africa's energy mix, the implementation of an outward policy on energy supply would potentially promote a coordinated strategy for expansion and operation, thus reducing the cost of building expensive power plants and ensuring that electricity can be transferred

13 Remarks made at the South African Renewable Energy City Summit 2008; see <http://www.sacities.net/members/city_summit.stm>.

from areas with low costs to areas with higher costs, which bodes well for economic development in SADC as a whole. But the NIRP illustrates that the government may not be a great proponent of regional electricity trade, because it is difficult to understand why it would not ease the burden of cost of building power stations in South Africa by using significantly less money to erect power stations that have been waiting to be built in Botswana, Zimbabwe and Mozambique and which could supply at least 15,000 MW probably before Medupi and Kusile come on stream.

In spite of the above, South Africa is a member of the SAPP together with 11 other Southern African countries[14] who have undertaken to increase interconnectivity among SADC countries and facilitate cross border electricity trading and power pooling. Several transmission grids in the region have been interconnected since the establishment of SAPP, but many regional electricity markets are still monopolized by government power utilities and exclude IPPs from participating in the power trading market. This situation is not sustainable in light of insufficient capacity to supply electricity demand in the region.

Electricity trade has also been hampered by bilateral agreements, or what is referred to as a more cooperative pool, as opposed to a competitive pool that would allow electricity to be traded as it would be on any conventional commodity exchange. The latter system allows for sellers and buyers to input their requirements for trade in the power pool a day ahead and trade or bid for excess capacity on a real time basis. In essence, Eskom could buy power from one of the other SAPP member countries on the open market without needing prior bilateral agreement, thus improving market efficiency, increasing the volumes of trade and promoting electricity generation from a diversity of sources.

The switch from a cooperative pool to a competitive power market is already under way, and the Short Term Energy Market (STEM) for electricity trade in the region was recently established as a prelude to the eventual establishment of a spot market. STEM provides for trading in surplus electricity on a daily, weekly and monthly basis. Trade is, however, still constrained by long term bilateral transactions that have priority rights to use the transmission grid and the limited participation of IPPs (as some countries do not allow these to engage in trading without going through government utilities). This situation is further exacerbated by national utilities such as Eskom having to fulfill increasing domestic demand and therefore finding difficult to export to the pool as contractually required by SAPP. To address this, SAPP has advocated the harmonization of member states' electricity policy frameworks and the creation of a conducive business environment for private sector involvement (both small and large power producers) that would relieve the burden on national power utilities.

# 4. Conclusion

The transition to a low carbon economy in South Africa should be pursued concurrently with its other fossil fuel based initiatives and not sequentially if the country is to secure its electricity supply and achieve the bold and exemplary commitment it made under the Copenhagen Accord. This requires, firstly, integrated energy planning. Currently, responsibilities within government are divided up so that it is nearly impossible to make decisions that simultaneously have a bird's eye view of the domestic governance of energy and climate change. Even the intellectual mass of technocrats recently convened

14 Angola, Botswana, the DRC, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

under the banner of the Inter-Ministerial Committee on Energy[15] does not come close to marrying the two. Therefore, at the domestic level, institutions need to be rethought to bring the right political levers and players together to conduct whole-system thinking rather than the present fragmented approach. For example, strategies and frameworks have not been amended or reviewed to bring them in line with the LTMS. Perhaps this is something that the newly formed Department of Planning should take up.

Secondly, a transformed institutional and regulatory environment that allows for the participation of clean electricity suppliers in a market currently dominated by Eskom and coal is overdue. To develop an integrated vision for energy security, the government must address institutional issues, diversification, and the merits and demerits of centralized as opposed to distributed networks, and also take into account the opportunities available in neighbouring countries.

Lastly, it has become clear that a push toward decarbonization will be one of the major drivers of global and national economic growth over the next decade and that the economies that embrace this revolution earliest will reap the greatest economic rewards (Brown, 2009). Government and business need to stop viewing the transition to a low carbon economy as a threat and not an opportunity. If anything, as the most industrialized country in the region, the transition to a low carbon society will provide a platform for the development of a clean tech power generation industry and the creation of green jobs in South Africa.

15 The work being undertaken by the working groups under the committee include dealing with the country plan for electricity and a funding model, a nuclear power plan and strategy, distribution network availability, protecting the poor from high tariffs, coal logistics, DSM and energy efficiency, and private sector participation in the electricity industry.

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