



## **Sustainable Development: The Case of Energy in South Africa**

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Trade and Industrial Policy Strategies (TIPS)

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<http://www.tradeknowledgenetwork.net>

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TIPS serves as a clearing house by effectively assisting in harnessing all relevant trade and industrial policy research for the South African government's Department of Trade and Industry (DTI) policy considerations, which will strengthen and enhance the capacity for policy analysis in the DTI. TIPS also serves to strengthen the capacity outside of government to construct research on trade and industrial policy in order to enlarge the pool of researchers.

TIPS is currently engaged in research for the DTI in restructuring of the defence industry, in spatial development initiatives and in regional integration.

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# General introduction

## International trade in services and sustainable development: the case of energy and tourism in South Africa

### Introduction to services

As services have become increasingly tradeable on the global market—due in part to technological developments and regulatory reform—they have consequently become more important in international trade negotiations. In addition, the recent review of the General Agreement on Trade in Services (GATS) as part of the World Trade Organisation's (WTO's) built-in agenda has also drawn attention to trade in services. Work already undertaken under the built-in agenda will continue under the Work Programme as set out in the Ministerial Declaration of the WTO Fourth Ministerial Conference held in Doha in November 2001. The Work Programme specifies that participants shall submit initial requests for specific services commitments by June 30, 2002 and initial offers by March 31, 2003.

Developing countries have been grappling with the liberalization of services sectors. Two specific challenges have been encountered: domestic reform of the state monopolies; and, how GATS negotiations are likely to undermine or reinforce domestic reform efforts.

South Africa (SA) is a middle-income economy with one of the highest levels of inequality in the world—close to 30 per cent unemployment and a high incidence of poverty. The problem is compounded by the fact that the economy continues to experience low growth. There is an urgent debate about how best to create long-run growth and reduce inequality and poverty. Policy-makers and economists increasingly recognize that the services sector could become a potential lever to growth and a significant creator of more jobs.

The services sector already makes up 65 per cent of the gross domestic product (GDP), 63 per cent of employment and 74 per cent of capital formation in SA and has been the main source of growth for the economy in the 1990s. The largest sectors are community/social services (18.6 per cent), distribution services (14.5 per cent), business services (11.2 per cent), financial services (6.1 per cent) and transport services (5.3 per cent). The domination of services is more pronounced in the informal sector where petty trade, domestic work and minibus taxi-driving are the most common sources of income, although not subject to liberalization as such. Sectors such as energy and tourism also contribute significantly to the economy. Both these sectors have large, indirect effects on competitiveness, employment and output.

### Sustainable development

The concept of sustainable development was popularized by the International Union for the Conservation of Nature in its “World Conservation Strategy,” and was refined in 1987 in the Brundtland Report of the World Commission on Environment and Development:

Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.

While definitions and interpretations of the elements of sustainable development have varied, the concept is generally viewed as consisting of three primary aspects or “pillars”: economic

(sustainable economic development); social (social development/equity); and environmental (environmental protection/conservation/preservation). Other essential characteristics of sustainable development have been identified by a number of organizations and institutions. For example, the Canadian Commissioner for the Environment and Sustainable Development has suggested that sustainable development must incorporate quality of life, integrated decision-making and equity aspects.<sup>1</sup>

While work in the area of services liberalization is fairly new to SA, work on the synergies between services liberalization and sustainable development does not exist. The major reason for the absence of work in this area relates to the difficulty of assessing the exact nature of the linkages. Although the GATS will be used as a starting point for this analysis, we are interested in the *de facto* liberalization and/or deregulation, irrespective of whether the influences are external or domestic. Looking at two specific sectors—energy and tourism services—this study attempts to investigate the nature of trade liberalization and deregulation within a sustainable development framework. There are several reasons why the energy and tourism sectors were chosen.

## Energy

Energy is central to achieving the interrelated economic, social and environmental aims of sustainable development, and energy services play a crucial role in providing efficient access to energy in support of development. Developing countries are faced with a number of challenges in this regard, such as achieving more reliable and efficient access to energy for domestic consumption and production, growing their share in the trade of energy goods and services, and mitigating adverse environmental impacts from energy activities.

The energy sector includes coal, oil, gas, electricity, nuclear and renewable energy sectors. The main objective of this study is to look at what dominates SA energy supply—coal-based energy—although we also review other forms of energy generation. However, the main emphasis of the energy study is on electricity.

Electricity relates to sustainable development in that it provides a critical service element in:

- running hospitals, schools and businesses;
- heating, cooling and lighting in homes and workplaces;
- preserving food commercially and at home;
- pumping fresh water supplies and sewage;
- maintaining the flow of road, rail and air traffic;
- lighting in public places;
- operating global communications systems;
- providing access to the Internet and the information society; and
- supplying power for a wide range of appliances.<sup>2</sup>

With electrification still a major objective of SA's electricity utility Eskom, which has committed to a further 600,000 connections, an examination of the sustainable development implications of further liberalization and deregulation is merited.

<sup>1</sup> Website of the Commissioner for the Environment and Sustainable Development: [http://www.oag-bvg.gc.ca/domino/cesd\\_cedd.nsf/html/menu6\\_e.html](http://www.oag-bvg.gc.ca/domino/cesd_cedd.nsf/html/menu6_e.html) accessed 30/01/03.

<sup>2</sup> See *Joint Statement by the Electricity Industry on Sustainable Development* for the World Summit on Sustainable Development: [www.basd-action.net/resources/positionpapers/200208\\_electric.pdf](http://www.basd-action.net/resources/positionpapers/200208_electric.pdf)



## Tourism

Tourism is another important services sector that the government has identified as a major contributor to job creation, economic growth and poverty relief objectives. There are various benefits of tourism growth. First, tourism is relatively labour intensive and, therefore, well placed to absorb a large part of the unskilled workforce. Second, the industry uses relatively few imported inputs and gives rise to extensive forward and backward linkages in the hotel, food, entertainment and transport industries. Third, it can be an important source of foreign exchange and contribute to export diversification.

However, certain constraints to tourism growth have been identified, such as: a lack of transparent investment incentives to attract investors; a scarcity of needed infrastructure in regions with the strongest natural resource base for tourism; inadequate tourism education; and inadequate marketing of SA as a long-haul tourism and business centre.

Although considerable work has been done on sustainable tourism, there is a paucity of research and analysis on trade in tourism in southern Africa and in SA specifically, creating an explicit need for further awareness, knowledge and understanding of the sustainable development issues of the sector. The studies that have been conducted on tourism have tended to focus on sustainable tourism and poverty elimination, with only cursory attention given to environmental aspects or specific social dimensions, such as employment.

An important question that faces the SA tourism industry is what impact it will have on both the environment and the poor of SA as the industry grows and its importance to the overall economy expands. This has brought to attention a few important issues, such as how new tourism developments use local suppliers and the distribution of benefits from tourism growth. Tourism is particularly essential in creating employment in remote, poverty-stricken areas of SA.

The research on the tourism sector, which forms part of this study's investigation into the nature of trade liberalization and deregulation within a sustainable development framework, is published as a separate paper.

## Methodology

TIPS' contribution to the TKN Phase II project is a collaborative effort among a number of different researchers from various universities and organizations in SA.

O. A. Akinboade from the Department of Economics at the University of South Africa (Unisa) and E.W. Niedermeier and F. Sibanda from the Competition Commission undertook the environmental discussion of the energy study. Significant modifications and additions to the electricity study were made by Rashad Cassim, the previous Executive Director of TIPS.<sup>3</sup>

The tourism study, contained in a separate publication, was conducted by Paul Robertson and Jolene Skordis, both from the University of Cape Town.

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<sup>3</sup> Much of the information contained within these studies is available in separate papers prepared for TIPS. The following papers can be found on the TIPS website ([www.tips.org.za](http://www.tips.org.za)): *Energy Services, WTO GATS Negotiations and Energy Market Regulation and Liberalization in South Africa* by Anton Eberhard; *The Impact of Electricity Trade on the Environment in South Africa* by O. A. Akinboade *et al.*; and *The Impact of Trade Liberalization on the South African Tourism Industry* by Paul Robertson.

## Structure

After this general introduction, the energy study is presented, with the tourism study published as a separate paper. Both studies start off with a brief description of the linkages between sustainable development and the sector under discussion.

From that context, the economic and regulatory aspects of each sector are discussed in detail. Tourism regulation is described in light of the four modes of services supply, whereas energy is discussed in light of current reform initiatives being undertaken in the industry.

The tourism study investigates the links between sustainable development and tourism services liberalization using three case studies.

The authors selected a property rights approach to analyze the incentive structures under various forms of tourism establishment ownership (private ownership, community ownership and government/public sector ownership), and each establishment is discussed in term of the three pillars of sustainable development.

The energy study comprises a description of the economic and regulatory characteristics of SA's energy services, as well as various elements of energy services reform.

Since electricity generation and provision have significant linkages with sustainable development issues, this aspect of energy services is emphasized, with an extensive discussion on how the electricity sector can advance sustainable development by supporting industrial competitiveness and economic growth; promoting energy efficiency, increased use of renewable energy technologies and reduced emissions; and ensuring widened access to affordable services.

## Abridged findings

### *Energy*

In terms of the environmental aspects of the electricity sector, the authors conclude that:

- an in-depth investigation is needed to establish why the use of solar energy is not as widespread as it would be expected in a developing country such as SA;
- it is important to understand why the current structure of energy production acts as a disincentive to other energy forms;
- subsidization of the major energy industries has negatively affected more efficient sectors by diverting resources away from them;
- there is an urgent need to deal with the problem of coal-based energy in light of various developments, such as growing domestic awareness of the damaging health and environmental effects of coal-based energy and a heightened awareness by SA exporters of energy-intensive products such as steel and aluminum of increasingly stringent regulations in international markets;
- the meeting of social goals and public benefits has been independent of industry structure, which means electrification has been carried out by the old, vertically-integrated, publicly-owned utility Eskom and by local government distributors; and
- it is possible to restructure the electricity supply industry (ESI) and to continue to improve social equity through providing benefits for the poor.

# Energy services

## Executive summary

The energy sector includes coal, oil, gas, electricity, nuclear and renewable energy. This study focuses on coal-based energy as the dominant SA energy supply, although it also reviews other forms of energy generation. The study further looks at the economic and regulatory characteristics of SA's energy services, various elements of energy services reform, and energy services reform in light of sustainable development—specifically economic growth, social elements and environmental impacts. In this regard, the study looks primarily at electricity supply.

Electricity is critical to economic activity, and low prices and reliable supply can advance economic competitiveness considerably. Furthermore, electricity can contribute to social welfare through expanded access to new, clean and affordable energy, but needs to be environmentally-sustainable.

Focusing on the environmental implications of SA's electricity production, this study shows that with the dominance of coal-based energy, there are few incentives to enable the development of renewable energy and clean technologies. It also indicates a need for the inclusion of external costs, a problem with subsidies, and that it is unlikely the industry will change unless there is some impetus for change. Both the GATS negotiations and domestic reform are critical catalysts to change in the industry.

The social and economic objectives of the SA government in terms of electricity provision are greater social equity and welfare, promotion of industrial development, reduction of state debt to free up resources for other purposes, economic development, black economic empowerment, and support for Nepad.<sup>4</sup> SA's electrification program—initially undertaken by the dominant SA electricity supplier Eskom—is now funded through the fiscus. Electrification to provide expanded access has been very successful and in terms of competitiveness, SA has some of the cheapest electricity in the world.

Notwithstanding SA's achievement in electrification, there is a need for reform because of inefficiencies in distribution and investment, and because opportunities exist to unlock economic value. In terms of the SA electricity sector's reform and liberalization agenda so far, electricity distribution has been rationalized; an Independent Regulator established; Eskom corporatized so that it now effectively is a public company; various elements of Eskom such as generation, transmission and distribution unbundled; and partial privatization effected.

The study shows that electricity market liberalization will not necessarily impact negatively on widened access to the poor. As the system is changed (by introducing operations based on commercial principles, etc.), electrification and delivery on social objectives will still take place, since government has ensured that such obligations are institutionalized in the reform process, which includes targets being built into the licensing process.

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<sup>4</sup> New Partnership for Africa's Development

## Introduction

Energy is probably the biggest industry in the world economy, with a turnover of at least US\$1.7-trillion to \$2-trillion per annum.<sup>5</sup> Although much of the energy business is geared to the production and trade of energy goods, there is a growing market in the trade of energy services. Energy services may be considered those services involved in the exploration, development, extraction, transportation, transmission, distribution, marketing, consumption, trade and management of energy, energy products and fuels. While the production and trade in fuels such as coal, uranium and petroleum are clearly regarded as trade in energy goods, there is a growing argument that the production, generation and trade of electricity and gas (which are not easily stored as commodities) should be regarded as an energy service.

A distinction should be made between trade in energy services and trade in energy goods. Some energy products clearly fall in the goods category. This is the case with oil and solid fuels, which are easily stored and traded across borders. So trade in fuels such as oil, coal and uranium constitutes trade in goods. Cross-border trade of electricity or gas is a little more complicated. The purchase of electricity or gas could be regarded as trade in a commodity; however, many of the activities involved in cross-border trade, such as the trading service itself as well as transmission and transport services, would fall under the category of energy services. There is a general understanding within the WTO framework that production of energy goods comes within the scope of the WTO General Agreement on Tariffs and Trade (GATT), while transmission, distribution and related services come within the scope of GATS.

Liberalization of energy services is closely linked to the liberalization of trade in energy goods. In many areas, there is significant potential for cross-border trade. Trade in energy services is usually undertaken in three of the four defined modes. First, there is cross-border supply of services (Mode 1). The energy services most likely to be traded across borders include transportation, design and engineering (for example, using the Internet), and financial services associated with energy trading, marketing, brokerage and risk management. Second, the most significant trade mode in energy services is that of commercial presence (Mode 3). Typical examples would be a foreign-owned energy distributor or the presence of a foreign concessionaire or contract management company. Finally, trade in energy services would often involve the temporary movement of natural persons (Mode 4). The issues involved in the latter mode are common to most service sectors and will not be discussed in detail in this paper.

Market access and national treatment restrictions to trade in energy services are similar to those faced by many service providers and include obstacles to the right of establishment, an inability to provide cross-border services, and discriminatory treatment between foreign and domestic service providers. Furthermore, energy sector regulatory frameworks can often be opaque, discriminatory and arbitrary. Without a regulatory framework that provides a transparent and justiciable basis for fair competition, energy service companies are often at a disadvantage to a favoured competitor. Market access and national treatment commitments, while necessary, are often not sufficient to assure liberalization of energy services. Regulatory reform and certainty are often also necessary.

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<sup>5</sup> *The Economist*, February 10, 2000.

## Economic and regulatory characteristics of SA energy services

### Coal

SA has large coal resources that supply three-quarters of the country's energy and is used to produce among the cheapest electricity in the world. This dominant energy sub-sector is entirely in private ownership and is mainly unregulated in terms of market access and price. Trade issues concern mainly the trade of energy goods—where services are involved they relate mainly to the range of support services for mining, engineering services, rail transport and shipping. Some barriers exist in terms of access to the coal export facilities at Richards Bay. There is a modest coal service industry in the form of local distribution, wholesaling and retailing.

**Table 1: Coal production and consumption in SA, 1990–2000 (in millions of short tons)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production	247.58	256.20	247.28	258.41	272.30	288.39	297.12	324.56	322.00	320.15	326.08
Anthracite	6.05	4.90	6.08	5.72	4.45	3.60	3.92	4.41	2.90	2.72	3.41
Bituminous	241.53	251.29	241.20	252.69	267.85	284.79	293.20	320.14	319.10	317.44	322.67
Lignite	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a
Consumption	193.48	153.13	151.79	156.23	158.09	172.83	165.71	178.13	186.99	174.62	176.30

Source: U.S. Department of Energy (DOE)/Energy Information Administration (EIA). N/a: not applicable

SA is regarded as a comparatively energy- and carbon-intensive country in relation to other African countries, as well as relative to many developed countries. Of the total energy consumption in 1998, 78 per cent was from coal. This shows considerable reliance on a highly carbon-intensive fossil fuel, which has negative impacts on the environment.

Table 1 shows the total amount of coal produced and consumed in SA between 1990 and 2000. More than 40 per cent of the coal produced is used for electricity generation. Coal is also directly used by other sectors, including gold mining, the cement, metallurgical, and brick and tile industries, and for direct household use as a source of energy.

### Petroleum

The petroleum industry in SA is highly regulated in terms of market access and price. On the upstream side, the Minerals and Petroleum Resources Development Act of 2002 provides for the granting of exploration and production rights and the issuing of technical co-operation permits and reconnaissance permits by the Petroleum Agency on behalf of the Minister of Minerals and Energy. The procedures for applying for and issuing of permits and rights are prescribed in Chapter 6 of the Act.

In broad terms, the legislation is comparable to that applied in many other countries and clearly sets out the rights and obligations of various parties. The Act also contains certain provisions to promote the involvement of historically disadvantaged South Africans (HDSAs).

The downstream industry is controlled by the Petroleum Products Act (Act no. 120 of 1977) and a number of industry agreements. The government controls the importation of petroleum products as well as the ex-refinery gate price, the wholesale margin and the retail margin. The price from the refineries is set at import parity. A new Petroleum Products Amendment Bill has been tabled in Parliament in April 2003 and draft regulations have been promulgated that

specify the procedures to be followed in applying for and the issuing of licences. A licence is required from the licensing authority for any party wishing to conduct business as a wholesaler, to own and develop a retail outlet and to conduct business as a retailer of petroleum products. The licensing authority is designated by the Minister and is currently the Director: Hydrocarbons in the Department of Minerals and Energy. Appeals may be made to the Minister. The licences contain certain prohibitions and conditions, which include that sales must be in cash (no credit is permitted) and at the government-determined price, and that self-service is prohibited. The advancement of HDSAs must also be taken into account when licences are issued. In recent years, all new retail sites have been allocated to HDSAs.

There is an industry agreement that all oil companies are required to market Sasol<sup>6</sup> and Mossgas<sup>7</sup> synfuel output. Sasol has given notice that it intends to cancel this agreement and wishes to expand its retail operation.

## **Gas**

A new Gas Act was passed in 2001 that makes provision for the establishment of a gas regulator to issue licences for the construction and/or operation of gas transmission, storage and distribution facilities, and specifies licence application and issuing procedures. Licences contain conditions with regard to ring-fencing of gas transmission, storage and distribution businesses; third-party access to pipelines; exclusive geographic areas for distributors; and the setting of tariffs for consumers and distributors where there is inadequate competition. The Act specifies that for a period of 10 years, the Regulator will be bound to a prior agreement entered into between the Minister of Trade and Industry and Sasol over the development of a gas pipeline from Mozambique's Pande-Temane gas fields to SA's industrial hub. This agreement gives Sasol exclusive transmission rights, exclusive distribution rights in certain geographic areas, limits third-party access and excludes the regulator from setting or reviewing prices.

The government has decided to rationalize energy regulators and it is likely that the functions of the gas regulator will be merged with those of the electricity regulator.

## **Nuclear energy**

The production of uranium, a by-product of gold mining, has declined in recent years and SA now ranks eighth in world production. Uranium is processed into uranium oxide for export by the Nuclear Fuels Corporation of SA (Nufcor), a private company whose board of directors originally comprised representatives from all gold mining groups that were members of the Chamber of Mines. The shareholding has been restructured and the company is now 100 per cent owned by AngloGold Limited. Nufcor and Rand Merchant Bank have set up a new company to help customers deal with the commercial and financial challenges of deregulation. Nufcor International's activities, including marketing of SA uranium production, while the Johannesburg company continues to manage uranium contracts and uranium recovery operations. The Nuclear Energy Corporation of SA (NECSA) is no longer involved in the conversion and enrichment of uranium. Eskom owns and operates Africa's only nuclear power station at Koeberg, outside Cape Town.

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<sup>6</sup> Sasol is engaged in the commercial production and marketing of chemicals and liquid fuels.

<sup>7</sup> Mossgas, SA's state-owned gas-to-fuel producer is part of the national oil company, PetroSA.

## Renewable resources

Traditional use of biomass in the form of fuelwood is being increasingly commercialized as local fuelwood traders respond to reduced stocks for self-collection. There is also a small but active energy management and renewable energy industry, that focuses mainly on solar devices.

The energy industry is supported by a plethora of smaller service industries, including equipment, design, research, consulting and maintenance services and management contracting.

## Energy and sustainable development

The importance of energy to the concept and operationalization of sustainable development was encapsulated during the ninth session of the UN Commission on Sustainable Development (CSD-9), held in April 2001, where one of the final decisions<sup>8</sup> emphasized the centrality of energy in the achievement of sustainable development goals. Accordingly, the decision identifies as key issues the accessibility to energy, energy efficiency, renewable energy, advanced fossil fuel technologies, nuclear energy technologies, rural energy, and energy and transport.

In addition, the UN Development Programme has pointed out the importance of energy to the three pillars of sustainable development (economic, social and environmental):

Since access to modern energy services is an essential pre-requisite for increasing productivity and improving people's livelihoods, new approaches are needed to deliver such energy services to meet the needs of the poor and support sustainable development. Capacity development, technology access, policy innovation, integrated energy and development solutions, and new partnerships with energy investors are all required to overcome energy bottlenecks. Market mechanisms, if properly designed and complemented by regulatory measures, can go a long way to solve the energy crisis in the South, while contributing to protecting the environment.<sup>9</sup>

## SA's energy policy and sustainable development

Although the SA Draft White Paper on Energy Policy does not specifically refer to sustainable development goals or objectives, it does contain a number of provisions that refer to environmental, social and economic aspects of energy. For instance, the White Paper states that:

Fossil fuels such as coal, uranium, liquid fuels, biomass and gas continue to play a central role in the socio-economic development of our country, while simultaneously providing the necessary infrastructural economic base for the country to become an attractive host for foreign investments in the energy sector... [Energy policy] should balance the use of natural energy resources with environmental considerations.<sup>10</sup>

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<sup>8</sup> See UN document E/CN.17/2001/L.2, decision 9/1, "Energy for sustainable development."

<sup>9</sup> See the UNDP SEED website for more information: <http://www.undp.org/seed/eap/>

<sup>10</sup> Department of Minerals and Energy, *South Africa Draft White Paper on the Energy Policy of the Republic of South Africa*, June 1998.

In addition, the government has highlighted as one of its long-term goals the establishment of a sustainable renewable energy industry producing modern energy carriers that will offer a fully non-subsidized alternative to fossil fuels in future years.<sup>11</sup> This policy approach has been concretized through significant financial support for renewable energy research and development.

## Energy services reform

### Key challenges

Most analysts identify four broad drivers for power sector reform internationally. First, there is the desire to improve investment and operational efficiencies that blight the performance of monopoly utilities. Second, technological innovations—particularly in efficient, less capital-intensive generation plants and in new information and communication technologies (ICTs)—make it possible to organize the industry so that new entrants can compete more easily. Third, the need for massive new capacity expansion results in increased demands for finance that is not readily available from public sources and forces greater reliance on private sector involvement. In the fourth place, restructuring and privatization create opportunities to unlock economic value and reduce government debt. Other country-specific drivers—such as ideological commitments to liberalize the economy or simply the need to follow the wave of reform that is sweeping through nearly all power sectors around the world—have also been identified.

It is probably true to say that none of these drivers are experienced strongly in SA. Most stakeholders believe that Eskom operates efficiently. New-generation technologies such as combined-cycle gas turbines have limited application in SA because of the country's limited access to natural gas. Eskom can raise private capital (locally and internationally) at competitive interest rates through its bond issues. Public finances are well managed and the National Treasury does not have a desperate need for privatization receipts. The impacts of international trends in power sector reform are not widely appreciated locally. Eskom proceeds very much like *Electricité de France*, and would prefer to stay as it is and delay reforms as long as it is able to.

Yet, a deeper analysis of the challenges facing the power sector in SA reveals issues that need to be addressed and that will progressively drive the reform process. Chief among these is the need to avoid the mistakes of the past when Eskom over-invested in capacity expansion, and to create an industry structure that allocates risk in a manner that encourages investment efficiency.<sup>12</sup> Further reform imperatives include the need to improve the poor performance of many of the smaller local authority distributors, unlock economic value in the industry and promote black economic empowerment. Finally, whatever reform path is followed, the delivery and expansion of affordable electricity services to all South Africans must be sustained. So far, there have been notable advances in the provision of energy services to poor, unserved households (the proportion of households with access to electricity has increased from 32 per cent in 1996 to 70 per cent in 2001), but the fact remains that almost a third of SA's population still do not have access to such services.

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<sup>11</sup> Department of Minerals and Energy. *Draft White Paper on the Promotion of Renewable Energy and Clean Energy Development*. June 2002.

<sup>12</sup> BusinessMap (2001). *The Electricity Supply Industry: Economic and Social Effects of Restructuring*. Johannesburg.



## Investment in the ESI

At first glance, the SA ESI has performed well. Eskom supplies electricity at among the lowest prices in the world. The average cost of electricity generated is below 10 cent/kilowatt-hour (kWh). In recent years, Eskom has consistently made a positive return on assets. Reliability and quality of supply are good. Average energy availability<sup>13</sup> from its power stations has increased from 76 per cent in 1991 to 92 per cent in 2000. Overall thermal efficiency has remained constant over the past 10 years. Labour productivity has increased and employee numbers have dropped from over 66,000 in 1985 to 46,600 in 1991 and 32,800 in 2000. The national electricity utility is now commercially run with no recourse to the national fiscus. It raises finance through commercial debt—mostly through issuing bonds that are well supported by local and international capital markets.<sup>14</sup>

Eskom's recent low prices and exemplary electrification performance have left the impression that it is highly efficient and that there is no need for reform. Many would simply equate low prices with high efficiency, but this is not necessarily the case. Specific factors account for Eskom's low prices compared to other international utilities.<sup>15</sup>

A close examination of the SA ESI shows that low prices and the ability to fund electrification have emanated from, *inter alia*, very low coal prices and, until recently, exemption from taxation and dividends.<sup>16</sup> Crucially, low prices also stem from the fact that consumers have largely amortized the debt that funded the large investment program of the 1980s, which provided the generation capacity still being used. Eskom has not had to invest significantly in new generation capacity for some years and lower debt and financing costs have been one of the largest contributors to lower overall costs (and prices) (see Figure 1). Eskom's debt to equity ratio has fallen from 2.93 in 1986 to 0.5 in 2001.<sup>17</sup> However, Figure 2 reveals its poor investment record.

Current low prices are economically unsustainable and will need to rise to support new investment.<sup>18</sup> Eskom's Integrated Strategic Electricity Plan suggests that by 2025, total maximum demand could rise to between 40 giga-watt (GW) and 70GW, depending on electricity growth scenarios. A moderate growth scenario would imply a total system maximum demand of 52GW, almost double the current maximum, implying new investment of at least \$6 billion, probably more, depending on technology choices. New capacity might be needed as soon as 2007, although other scenarios define 2011 as being critical. Important investment decisions will have to be made in the next few years. The primary policy challenge is to design an industry structure that provides the incentives to optimize investment efficiencies in future.<sup>19</sup>

<sup>13</sup> Defined as capacity hours available x 100/total capacity hours in the year.

<sup>14</sup> Eskom Annual Reports.

<sup>15</sup> Steyn, G. (2001). *Governance, Finance and Investment: Decision Making and Risk in the Electric Power Sector*. D.Phil, University of Sussex.

<sup>16</sup> Steyn, G. (2000). *A Competitive Electricity Market for South Africa: The Need for Change and a Strategy for Restructuring South Africa's Electricity Supply Industry*. Paper prepared for the Department of Minerals and Energy. Pretoria.

<sup>17</sup> Eskom Annual Reports.

<sup>18</sup> Econ (2002). *Electricity Price Scenarios for South Africa. A Report to the Department of Minerals and Energy*. South Africa.

<sup>19</sup> National Energy Regulator (2002). *National Integrated Resource Plan*. Pretoria.

Figure 1: Cost trends at Eskom (SA cents/kWh)<sup>20</sup>

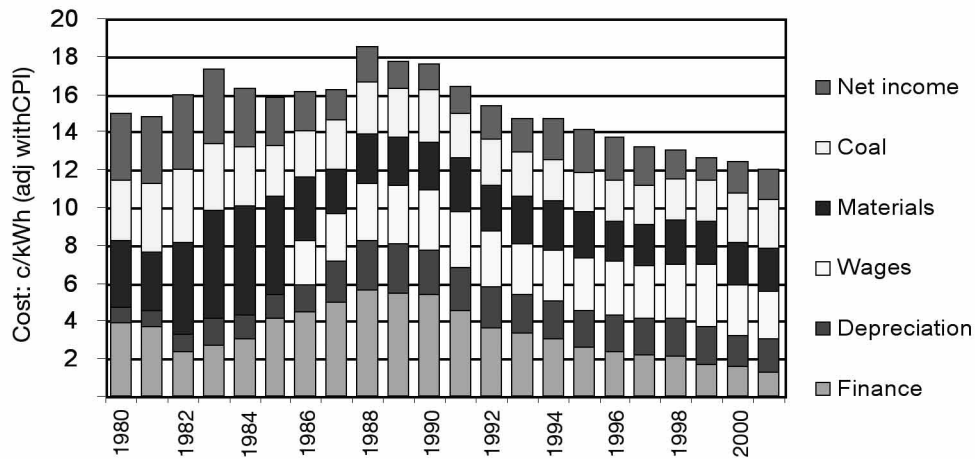
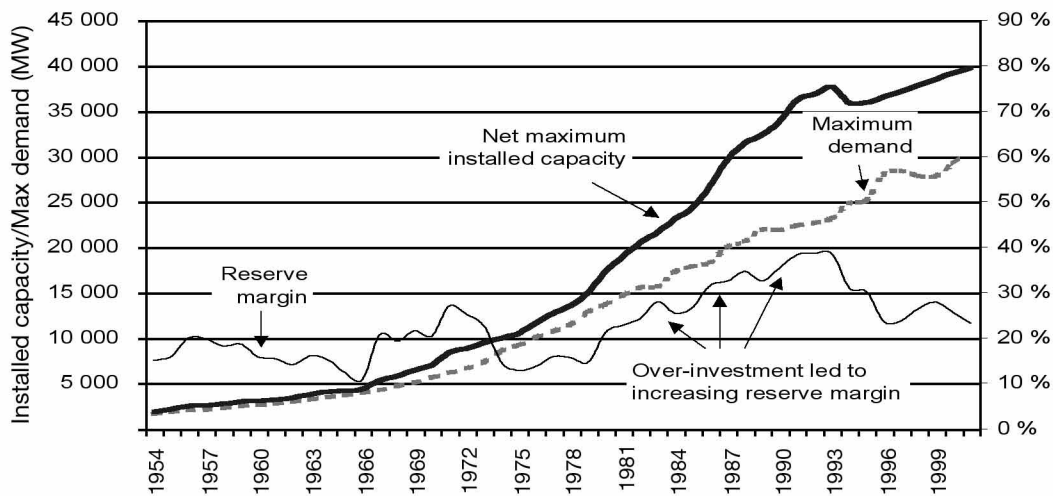


Figure 2: Historical growth in maximum demand and capacity at Eskom<sup>21</sup>



## Inefficiencies in the distribution industry

There has been a growing consensus among stakeholders that problems in the electricity distribution industry need urgent attention. There are simply too many small, non-viable, poorly-run municipal (local government) distributors. Many of the problems stem from the creation of separate black local authorities in the *apartheid* era. Most were not financially viable and their electricity departments struggled with lack of capacity, too few income-generating industrial customers and a huge backlog in new connections for low-income consumers.

<sup>20</sup> Econ (2002). *Benefits and Risks of Power Sector Reform*. Commissioned by the Department of Public Enterprises, South Africa. Memo 29/02.

<sup>21</sup> *Ibid.*

Even after the amalgamation of local authorities in an attempt to increase their financial viability, many still face severe debt problems. These include non-payment from low-income customers, which leads to the authorities experiencing difficulty in paying Eskom. Investment in maintaining networks is inadequate and the security and reliability of supply are being compromised. Individual distributors are further unable to meet the financial demands of the electrification program. Tariffs, for the same customer categories, vary widely between distributors. It is difficult to attract skilled, motivated and adequately paid employees and managers in the industry. It is also difficult for the regulator to regulate more than 240 distribution entities effectively. Rationalization is imperative—also to ensure that electricity is accessible and affordable for the poor. At the beginning of the 1990s, this was the issue of overriding concern.<sup>22</sup>

## **The evolving reform agenda**

Neither in government nor among the stakeholders has there ever been a single, powerful champion for reform. There has also been much institutional upheaval. Key government officials in the Minerals and Energy and Public Enterprises departments have seldom stayed more than a few years in their positions, with the result that institutional memory and capacity were often lost and had to be rebuilt. Consequently, the reform process has been slow, convoluted and frustrating. Perhaps one driver for reform that is clearly articulated in the political domain is the need to accelerate black economic empowerment. Eskom assets are seen as attractive and a portion could be offered to black South Africans on a preferential basis. If new private players are introduced into the industry, it makes sense to put in place a competitive market framework.<sup>23</sup>

Despite the slow progress, some key milestones have been reached. The 1990s saw the launch of a major electrification program with structured subsidies, and a new National Electricity Regulator was established to protect the interests of consumers and to promote efficiencies in the ESI. A new national energy policy was finalized, including broad policy objectives and restructuring principles for the electricity sector. A decision was reached on rationalizing the distribution industry. Eskom has been corporatized and a broad industry restructuring plan agreed to. Finally, detailed work has begun on the design and implementation of a competitive electricity market.

## **Advancing sustainable development**

A key challenge in the reform agenda is to make sure that the public benefits of sustainable development are advanced. The electricity industry can make a difference in the arena of sustainable development through underpinning sustainable economic growth, promoting social equity and adopting more environmentally-friendly technologies. The goal is an electricity industry that delivers secure, low-cost supplies that support industrial competitiveness; provides widened access to affordable services; and encourages energy efficiency, increased use of renewable energy technologies and reduced emissions. The challenge is to ensure that these goals are embedded in the reform process.

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<sup>22</sup> Media briefing by Minister of Minerals and Energy, Phumzile Mlambo-Ngcuka, July 31, 2001, Pretoria.

<sup>23</sup> Department of Minerals and Energy/Department of Public Enterprises (2000). *Options for Reform of the Electricity Supply Industry in South Africa*. Internal Government Paper. Version 3.0. Pretoria.

## Supporting industrial competitiveness and economic growth

The key milestones in the reform of the SA electricity sector are the establishment of an independent regulator, ongoing steps to rationalize the distribution industry into a limited number of financially-viable distribution companies, the corporatization of Eskom, and initial steps towards creating competition and private sector participation in the generation market.

One of the first concrete reforms in the ESI was the clarification of government's role in relation to the ESI through the establishment of an independent regulator. Politicians would no longer approve prices—the regulator would operate within a clear and transparent legal mandate to license all electricity suppliers, approve their tariffs, monitor the quality of supply and settle disputes.

The first national electricity legislation in SA was the Electricity Act of 1922, which set up the Electricity Control Board (ECB). The ECB's powers were constrained by the fact that it did not have direct control over municipal electricity undertakings. The Electricity Act of 1987 also exempted Eskom from having to obtain a licence. This Act was amended in 1994 and 1995 to establish a new National Electricity Regulator (NER) and removed the licence exemptions previously enjoyed by state departments, local authorities and Eskom.

The Electricity Act empowers the NER to:

- issue or revoke licences to generators, transmitters and distributors, and to determine whether licensees are competent to supply;
- regulate tariff levels and structures;
- regulate quality of supply and service standards;
- collect information;
- settle disputes between suppliers and between suppliers and customers;
- approve or reject applications for expropriation of property for facilitation of electricity supply; and
- advise the Minister on any policy matter.

The role of the regulator could change if the ESI is restructured to introduce competition. SA has established a broad competition (anti-trust) policy and legislative framework, which is captured in the Competition Act of 1998. A memorandum of understanding was concluded between the NER and the Competition Commission in 2002, which makes provision for the establishment of a joint working group that will demarcate more clearly their respective jurisdictions and functions. The NER will continue to regulate the natural monopoly components of the industry, such as the transmission and distribution wires. It is also likely to assume responsibility for market surveillance and work with the Competition Commission around any problems or challenges concerning market power and abuse.<sup>24</sup>

While the role of the NER is primarily that of an economic regulator, it can also potentially play a role in ensuring that the government's social objectives are achieved in the industry. The NER could include and monitor electrification provisions in supply licences, while approved tariffs could include cross-subsidies for the poor. These issues are explored later in the paper.

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<sup>24</sup> Eberhard, A. A. (2000). *Competition and Regulation in the Electricity Supply Industry in South Africa*. Competition Commission, Pretoria.

In May 2001, another reform occurred when—after a long and tortuous process of consultation, negotiation and consultancy studies—Cabinet finally agreed that local government and Eskom distributors should be rationalized into six Regional Electricity Distributors (REDs) and that an Electricity Distribution Industry (EDI) holding company would be established to manage the transition.

In 2002, the Minister of Minerals and Energy oversaw the signing of a memorandum of understanding between the NER, Eskom and the SA Local Government Association, in which they agreed to the implementation of the restructuring. However, local governments have remained ambivalent and even hostile to the proposal. Some have argued that the Constitution and the Municipal Systems Act of 2000 entrench their rights to electricity distribution and there have been threats to take the matter to the Constitutional Court. Different elements of the ruling African National Congress (ANC) have expressed diverse interests: while the leadership asserts the importance of a national solution to the problems of electricity distribution, those involved at the local government level fear losing their influence.

Discussion on rationalizing the distribution industry has been taking place for a decade. The process continues and will, no doubt, still face many obstacles as it seeks to cut through competing local government interests, that might frustrate rational proposals to create more efficient business entities that can deliver better services to customers. The sustainable delivery of affordable services to poor households requires a financially-viable distribution industry that can manage an electrification program, effect a degree of transparent cross-subsidization and effectively use government social funds.

A third reform comprised the restructuring of Eskom in the mid-1980s, following the appointment of the De Villiers Commission, which was critical of its governance, management, electricity forecasting methods, investment decisions and accounting. The Commission's recommendations led to new Eskom and Electricity Acts in 1987. Eskom's governance was overhauled and it was required to act on a commercial basis.

However, Eskom's full corporatization was only realized much later. The Ministry of Public Enterprises published *A Policy Framework: An Accelerated Agenda towards the Restructuring of State Owned Enterprises* in August 2000, which stated that:

- Eskom will be corporatized, with transmission, distribution and generation each forming a separate corporate entity; and
- different generating companies will be formed to promote internal competition prior to the introduction of private sector participation in generation, in conjunction with new power requirements.

Transmission will probably remain in the hands of the state and is likely to take the form of a separate independent company.

The Eskom Conversion Act of 2001 replaced the old Eskom Act of 1987 and subsequent amendments. It converted Eskom into a public company (named Eskom Holdings Limited) with its share capital held by the state. Eskom is now liable for the payment of taxes and dividends to the state.

An immediate effect of Eskom paying taxes and dividends was the termination of its own internal funding of electrification. Eskom argued that if it were required to operate as any other

commercial company, government would have to fund the electrification program from the national fiscus.

The publication of an Energy Policy White Paper in 1998<sup>25</sup> established an inexorable momentum for liberalization of the electricity market, while at the same time ensuring that government's social goals are met. The electricity sector's objectives were stated as:

- improving social equity by specifically addressing the energy requirements of the poor;
- enhancing the efficiency and competitiveness of the SA economy by providing low-cost, high-quality electricity inputs to industrial, mining and other sectors; and
- achieving environmental sustainability in both the short- and long-term usage of natural resources.

The White Paper also emphasizes the objectives of improving energy sector governance and achieving energy security through the diversity of supply. It is further stated that to ensure the successes of the ESI as a whole, government will have to consider various developments over time, such as:

- giving customers the right to choose their electricity supplier;
- introducing competition into the industry, especially in the generation sector;
- permitting open, non-discriminatory access to the transmission system; and
- encouraging private sector participation in the industry.

The White Paper further states that government believes Eskom will have to be restructured into separate generation and transmission companies and that it intends separating power stations into a number of companies.

Thus, the model of power sector reform laid out in the White Paper mirrors the standard or ideal model being followed internationally: vertical and horizontal unbundling to separate out the potentially competitive components of the industry (generation and retail supply) from the natural monopoly components (transmission and distribution wires); the introduction of competition through new private players; non-discriminatory, open-access to transmission; and independent regulation.

Since the publication of the Energy Policy White Paper, momentum has been building around defining in more detail how the industry will be restructured to provide competition.

In one of the rare occasions of World Bank involvement in SA, it sponsored a Ministerial Workshop on ESI Reform that was held April 3–5, 2000 in Midrand. At the workshop, the Minerals and Energy Minister said that the government's main objectives of reform were to:

- increase economic efficiency in investment decisions and operation so that costs and prices are as low as possible;
- maximize financial and economic returns to government from the ESI;
- increase the opportunity for black economic empowerment; and
- protect public benefits such as widened access for the poor, energy efficiency, ongoing research and development, and environmental sustainability.

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<sup>25</sup> Department of Minerals and Energy (1998). *White Paper on the Energy Policy of the Republic of South Africa*. Government Printer, Pretoria.

Different government departments seek distinct policy outcomes from electricity sector restructuring. The Minister of Minerals and Energy has consistently advocated that the industry should deliver electricity for all at affordable prices and is a strong supporter of black economic empowerment. The Minister of Public Enterprises has argued the benefits of restructuring state-owned enterprises to make them more efficient and to unlock economic value,<sup>26</sup> while the Department of Trade and Industry wishes to secure low prices to support the growth of a competitive economy. The National Treasury wishes to see growth in foreign direct investment and would welcome additional fiscal receipts to reduce the national debt.

In May 2001, Cabinet approved proposals for the reform of the ESI through a “managed liberalization” process, the elements of which are summarized below:<sup>27</sup>

1. *Structure of the generation industry.* Eskom is expected to retain no less than 70 per cent of the existing electricity generation market, with privatization of the remainder and the initial aim of transferring 10 per cent to black economic ownership by 2004;
2. *Vertical unbundling.* To ensure non-discriminatory and open access to the transmission lines, a separate, state-owned transmission company will be established, independent of generation and retail businesses and with ring-fenced transmission system and market operation functions. Initially this company would be a subsidiary of Eskom Holdings and would be established as a separate, state-owned transmission company before any investments are made in generation capacity;
3. *Market structure.* Over time, an electricity market framework based on a multi-market model, will ensure that transactions between electricity generators, traders and power purchasers take place on a variety of platforms, including bilateral deals, power exchange and a balancing market. The market design should facilitate both physical and financial hedging; and
4. *Regulation.* A regulatory framework will be put in place that ensures the participation of Independent Power Producers (IPPs) and the diversification of primary energy sources.

The Department of Public Enterprises has subsequently established an ESI restructuring office and detailed studies have been undertaken on the clustering of Eskom generation plants and the creation of an electricity market, including a voluntary power exchange with a day-ahead market, a balancing market, a market for ancillary services and a range of other electricity trading platforms, such as bilateral contracts and financial hedging instruments.

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<sup>26</sup> Ministry of Public Enterprises (2000). *An Accelerated Agenda Towards the Restructuring of State-Owned Enterprises: Policy Framework*. Pretoria.

<sup>27</sup> Media briefing by Minister Phumzile Mlambo-Ngcuka, July 3, 2001, Pretoria.

**Figure 3: Likely ESI model in 2004**

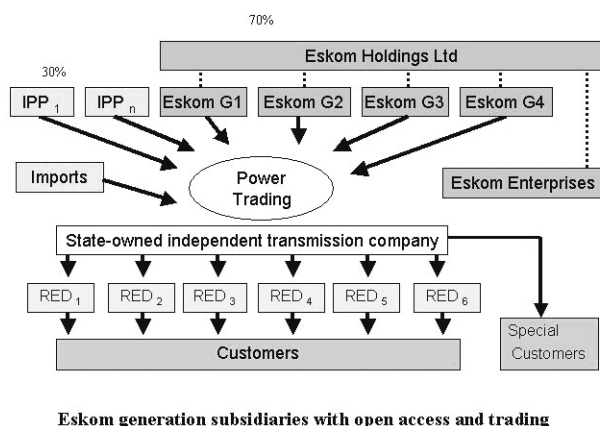


Figure 3 depicts the possible structure of the ESI in SA by 2004 if Cabinet finally approves the agreement reached between the departments of Public Enterprises and Minerals and Energy, the NER and Eskom.

The key question is whether this new industry model will deliver lower prices, which in turn will depend on whether effective competition can be achieved. The generation clusters will have to bid independently and should preferably be separate entities.

### **Widened access to affordable services**

The greatest challenge that faced the electricity industry in SA in the early 1990s was the fact that only one-third of its population had access to electricity. Consequently the majority of the population relied on inferior fuels such fuelwood, coal and paraffin to meet their basic needs for cooking, lighting and heating. These fuels were more costly and involved significant health and safety hazards. With the exception of some studies<sup>28</sup> carried out in the 1980s that highlighted the inequity of electricity provision, little data existed that documented the demand from unserved households. Nearly all white South Africans, including remote farms, had electricity connections, while few black households had access.

In the 1990s, researchers<sup>29</sup> began to map out what a national electrification program might look like and argued that it would be important to restructure the inefficient distribution industry. The changes in the political landscape in SA after 1990 lent some urgency to these calls for action. Energy policy had to be re-directed from the *apartheid* focus on energy security to a new focus on improving social equity through widened access to affordable services.

<sup>28</sup> For example, Eberhard (1984). *Energy and Poverty in Urban and Peri-urban Areas around Cape Town. Second Carnegie Inquiry into Poverty and Development in Southern Africa*. Conference Paper No. 155, University of Cape Town. When Eberhard asked municipal electrical engineers for maps and plans of areas that had access to electricity and those that did not, they were unable to produce any coherent or integrated picture. Planning for those who were unserved was simply non-existent. Hofmaenner, A. (1999). *An Anthology of Research*. Energy and Development Research Centre, University of Cape Town.

<sup>29</sup> For example, Dingley, C. (1990). *Electricity for All*. Monograph. Department of Electrical Engineering, University of Cape Town. Theron, P., Eberhard, A. and Dingley, C. (1992). "Electricity Provision in the Urban Areas of South Africa: Towards a New Framework." *Urban Forum* Vol 2, No 2.



Eskom, anticipating the shift to political democracy and having excess electricity generating capacity, announced in 1991 the target of electrifying 700,000 new households by 1997.<sup>30</sup> There were some high-profile initiatives in Elandsdraal, Orange Farm and Soweto that, in hindsight, can be seen as an attempt at the time to position Eskom favourably in relation to the ANC and a possible new democratic government. However, overall progress was slow. The EDRC called for an accelerated program of electrification that would peak at 500,000 connections per annum and would provide electricity to 85–90 per cent of South Africans by 2010. These proposals were supported by detailed modelling and included recommendations for financing and institutional change.<sup>31</sup>

In February 1992, the EDRC convened a national meeting on electrification on behalf of the unbanned ANC.<sup>32</sup> The seminar brought together industry members, political parties, trade unions and civic organizations, and produced the idea for a national conference on electrification and the creation of a negotiating forum involving all stakeholders.

After two national conferences involving more than 70 organizations, the National Electrification Forum (NELF) was launched in May 1993. NELF's Management Committee consisted of representatives from the Association of Municipal Undertakings, the ANC, the Chamber of Mines, the Department of Mineral and Energy Affairs, the Development Bank of Southern Africa, Eskom, the National Union of Metal Workers, the National Union of Mine Workers, the SA Agricultural Union, the SA National Civic Organization and the United Municipal Executive.<sup>33</sup> NELF established working groups and initiated a number of studies, including the National Electrification Economic Study,<sup>34</sup> which further developed a range of scenarios and assessed their economic impact. All stakeholders supported an accelerated electrification program.<sup>35</sup>

Much of this work was absorbed into the ANC's Reconstruction and Development Programme (RDP), which formalized the goal of electrifying 2.5 million new homes between 1994 and 1999, a goal that was exceeded by the new democratically-elected government.<sup>36</sup> Since the initiation of the electrification program in 1991, more than four million new households have been connected.

At a national level, two-thirds of households now have access to electricity—49 per cent in rural areas and 77 per cent in urban areas.

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<sup>30</sup> Eskom (2001). *Annual Report*. Johannesburg.

<sup>31</sup> Eberhard, A. and Van Horen (1995). *Poverty and Power: Energy and the South African State*. London: Pluto Press.

<sup>32</sup> Theron, P. (ed.) (1992). *Proceedings of the ANC National Meeting on Electrification*. University of Cape Town, February. Elan Press, Cape Town.

<sup>33</sup> National Electricity Regulator (2001). *Lighting Up South Africa: A Century of Electricity Serving Humankind*. Open Hand Press, South Africa, p. 70.

<sup>34</sup> National Electrification Economic Study (1993). *Financing Requirements of National Electrification Scenarios*. Finance and Tariffs Working Group. National Electrification Forum. Johannesburg.

<sup>35</sup> Davis, M., Davidson, L. and Thom, C. (1995). *Background Information for Electrification Planning*. Energy and Development Research Centre, University of Cape Town.

<sup>36</sup> African National Congress (1994). *Reconstruction and Development Programme*. Johannesburg: Umanyano Publications.

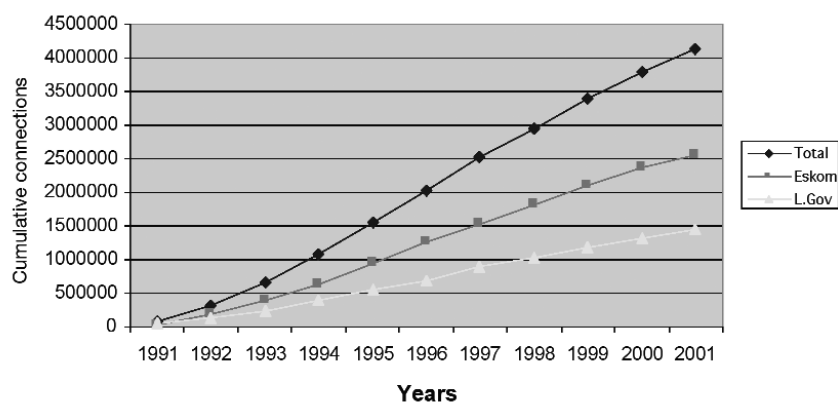
Up until 2000, the electrification program was funded largely by Eskom, either through internal subsidies or through transfers to an electrification fund that the NER allocated to municipalities. More than R8bn was spent on the national program between 1994 and 1999. The average cost per connection has been around R3,200. The electricity industry has been able to fund and cross-subsidize this massive electrification program, largely because there is a substantial industrial customer base that accounts for the bulk of electricity sales. Unit cross-subsidies from these customers have been proportionately small and politically acceptable.<sup>37</sup>

National policy has been that the capital cost of connections should be subsidized. However, there have also been unplanned cross-subsidies in operating costs. At the beginning of the program, it was estimated that the average monthly consumption of newly connected, low-income households would be 350kWh per month (compared with an average of 750kWh per month for a middle-income family in SA). In practice, average monthly consumption has been around 130kWh and can be as low as 50kWh. Few of the new electrification schemes are financially viable, even in the long term. Government has now decided to grant 50kWh per month free to poor consumers who accept load-limited supplies. The grant is made from the National Treasury and is allocated to local governments.<sup>38</sup>

**Table 2: Number of new connections to low-income households since 1991**<sup>39</sup>

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Eskom	31,035	145,522	208,801	254,383	313,179	307,047	274,345	280,977	293,006	250,801	206,103	2,565,199
LA's	51,435	74,335	107,034	164,535	150,454	137,534	213,768	136,074	144,043	139,780	127,255	1,446,247
Farm workers	-	12,698	16,074	16,838	15,134	9,414	11,198	10,375	6,241	6,438	3,560	107,970
Total	82,470	232,555	331,909	435,756	478,767	453,995	499,311	427,426	443,290	397,019	336,918	4,119,416

**Figure 4: Cumulative electricity connections (1991–2001)**



<sup>37</sup> Davis M. (1996). *The Financial Impacts of Electrification on the Electricity Distribution Industry*. Energy and Development Research Centre, University of Cape Town. Department of Minerals and Energy (2001). *National Electrification Programme 1994–1999*. Summary Evaluation Report. Pretoria.

<sup>38</sup> Davis, M. (1995). *Electricity Consumption Growth in Newly Electrified Settlements*. Energy and Development Research Centre, University of Cape Town.

<sup>39</sup> National Electricity Regulator (2001). *Lighting Up South Africa: A Century of Electricity Serving Humankind*. Open Hand Press, South Africa. National Electricity Regulator (2001). *Lighting Up South Africa. Electrification Statistics*. Johannesburg.

Nearly all of these new connections have used pre-payment technology—customers buy tokens or top-up electronic cards to activate their electricity dispenser. The costs of the electricity supply and use were to be recovered through a single energy unit charge. While pre-pay meters have managed to improve revenue collection, they have not always been reliable and have not completely eliminated the problem of electricity theft. Many connections involve informal houses (shacks) and use pre-wired “ready boards”—typically with a few lights and plug points. Eskom has also sought to contain the costs of rural connections though providing load-limited supplies.<sup>40</sup> Increasingly, the emphasis is on maximizing the developmental benefits of electricity through integrating the planning of new connections with the introduction of other services, such as rural clinics, schools and agricultural support.<sup>41</sup>

While it is difficult to quantify the welfare and economic development benefits from electrification, broad benefits are evident. These include improvements in indoor air quality, increased convenience and utility, lower costs, access to new media, education and health facilities, and new entrepreneurial activity.<sup>42</sup>

In addition to the grid electrification program, there has been an active off-grid program using photovoltaic technology. Between 1994 and 2000, 1,350 schools were electrified with off-grid systems. Many rural health clinics have been equipped with solar systems. In addition, government has awarded subsidy concessions to private industry service providers in five geographic areas to supply solar home systems as well as supplementary fuels such as LPG. These are not geographically exclusive concessions, as other companies may also operate in the areas. However, the concessionaire in each geographic area will receive a subsidy of \$320 per installation. The rationale is to assist service providers in building up an adequate service infrastructure and to move towards financial sustainability. Supply targets and service standards have been set and performance will be monitored.

But the concession contractual framework has been less than perfect. For example, there was little entry competition and firms were not required to bid competitively on subsidy requirements. So the opportunity to encourage efficiency and lower costs has not been maximized. Nevertheless, considerable innovation is emerging in the systems and vending technology employed. Most suppliers have adopted a fee-for-service approach rather than the outright sale of solar home systems.<sup>43</sup>

As government begins to reform the power sector, it has moved to secure the national electrification program by establishing a separate National Electrification Fund in the Department of Minerals and Energy. As previously mentioned, Eskom was corporatized in 2001 and now pays taxes and dividends. Although the taxes paid by Eskom in 2001 did not cover the amount allocated to the Electrification Fund by Treasury, it is expected that taxes and dividends will exceed electrification contributions in the future. A National Electrification Programme Management Unit has also been established, as well as a National Electrification Business Planning and Operations Management Unit. Electrification targets will continue to be set for the industry.

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<sup>40</sup> James, B. (1997). *Rolls Royces or Bicycles: Are Current-limited Supplies of Electricity the Bicycles We are Looking For*. Energy and Development Research Centre, University of Cape Town.

<sup>41</sup> Steyn, G. (1996). *Rural Electrification: Delivery or Development?* Energy and Development Research Centre, University of Cape Town. Energy and Development Research Centre (1998). *Rural Electrification in South Africa*.

<sup>42</sup> Eberhard, A. (1999). *Economic Costs and Benefits of Electrification*. Cape Associates.

<sup>43</sup> Banks, D. (1999). *Financial Support for Off-grid Electrification*. Energy and Development Research Centre, University of Cape Town. Banks, D. (1999). *Subsidies for Who? A Rural Electrification Dilemma*. Energy and Development Research Centre, University of Cape Town. Banks, D. (1998). *Criteria to Support Project Identification in the Context of Integrated Grid and Off-grid Electrification Planning*. Energy and Development Research Centre, University of Cape Town.

The electrification program in SA demonstrates that it is possible to make substantial progress in widening access to electricity services for the poor, even as electricity industries are restructured. The electrification program was driven by the advent of democracy and a political commitment to provide services to the poor. It was made possible by an electricity industry that was technically competent and financially strong. In addition, it has been put on a sustainable footing through explicit policy and regulatory instruments that will give expression to government's social goals, even when the electricity industry is unbundled and possibly privatized.

Another element of the social benefits of the electricity industry reform includes change in ownership. For example, there have been a number of black empowerment deals in the petroleum industry. Thebe Investment Corporation purchased a 25 per cent share of Shell's SA downstream retail and marketing business. Shell, with its Sapref refinery (Durban) partner BP, signed an agreement with black empowerment firm Southern Tankers to transport oil from the refinery to other SA locations. Southern Tankers will cover all of the refinery's coastal shipping requirements.

Several other local firms are also involved in SA's downstream energy sector, including black-owned firms Exel Petroleum and Afric Oil. Proposed amendments to SA's Petroleum Products Act would allow synthetic fuel producers Sasol and Mossgas to enter the retail market. Sasol jointly owns the Natref refinery with Total. Sasol has further signed an agreement with Petromoc, Mozambique's state-owned oil marketing and distribution firm, to market petroleum products to Mozambican service stations and commercial customers.

### **Energy efficiency, increased use of renewable energy technologies and reduced emissions**

The production, transformation and use of energy generates substantial environmental impacts in SA, with the coal fuel cycle being the dominant source of air pollution and overall waste generation. Liquid fuels in the transport sector are the second major source of air pollution, whereas in the rural areas the major pollution-related problem among households is indoors, resulting from the inefficient burning of low-quality fuels that adversely affect health.

Much is known about the externalities from coal-based production. For example, coal mining, processing and conversion into power have various adverse effects on the environment, such as direct health hazards, accidents, ecosystem disruptions, and air and water pollution.<sup>44</sup> The burning of coal releases large quantities of sulphur dioxide (SO<sub>2</sub>), nitrogen oxide (N<sub>2</sub>O), particulates and carbon dioxide (CO<sub>2</sub>) into the air, which contribute to greenhouse gas effects. Table 3 illustrates the share of energy generation from each source.

SA was ranked 14th out of 170 countries on a cumulative aggregate tonnage of CO<sub>2</sub> emissions for the period 1950 to 1995, and ranked 22nd out of the same number of countries in terms of energy consumption per unit GDP. One of the reasons for such a high energy intensity is the country's reliance on thermal power.

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<sup>44</sup> TIPS/IISD (1999).

Table 4 indicates major emissions and consumables used in the production of 1kWh of electricity, equivalent to using a 100-watt light bulb for 10 hours. The table shows a slight decrease in the amount of elements used or emitted—except for nitrous oxide (NO<sub>2</sub>)—in the production of 1kWh of electricity from 1999 to 2000.

Table 5 shows an increase in greenhouse gas emissions from 1993 to 2000. This can be attributed to an increase in the amount of coal burned during the electricity production process. The high volume of water used during electricity production is attributed to the wet cooling system. Dry-cooled power stations use relatively less water than wet-cooled ones but emit more particulates and are more expensive.

**Table 3: Electricity generation and consumption in South Africa, 1990–2000 (billion kWh)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Net generation	247.6	256.2	247.3	258.4	272.3	288.4	297.1	324.6	322.0	320.2	326.1
Hydroelectric	1.0	2.0	0.8	0.1	1.1	0.5	1.3	2.1	1.6	0.7	1.3
Nuclear	8.4	9.1	9.3	7.3	9.7	11.3	11.8	12.6	13.6	12.8	13.0
Geo/solar/ wind/biomass	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a
Conventional thermal	146.6	147.8	147.1	155.9	160.0	164.2	173.9	181.1	176.5	173.3	180.0
Net consumption	143.8	146.1	144.6	149.4	156.2	160.9	168.3	175.6	175.8	176.0	181.5
Imports	0.3	0.3	0.3	0.1	0.1	0.1	0.0	0.0	2.6	6.7	5.3
Exports	1.6	1.9	1.8	2.6	2.6	3.0	5.6	6.6	5.1	4.5	4.5

Source: US Department of Energy (DOE) / Energy Information Administration (EIA).  
N/a: not applicable; generation components may not add to total due to rounding.

**Table 4: Environmental implications of using 1kWh of electricity**

Element	1999	2000
Water usage	1.25 litres	1.2 litres
Coal usage	0.5 kg	0.49 kg
Ash produced	1.34 g	130 g
Ash emitted	0.37 g	0.35 g
SO <sub>2</sub> emissions	8.0 g	7.95 g
NO <sub>2</sub> emissions	3.0 g	3.56 g
CO <sub>2</sub> emissions	0.96 kg	0.85 kg

Source: Adapted from Eskom Environmental Reports 1999 and 2000.

**Table 5: Other environmental aspects of Eskom's activities**

Operations	Unit	1993	1994	1995	1996	1997	1998	1999	2000
Electricity produced by stations	Gigawatt-hours net	154,260	160,293	164,834	178,855	187,811	183,093	181,818	189,307
Total electricity sold	Gigawatt-hours	143,800	149,443	153,547	165,370	172,550	171,454	173,422	178,192
Coal burnt in power stations	Million tons	75.9	76.9	79.4	85.4	90.2	87.2	88.5	92.3
Water consumed by power stations	Million litres	223,650	213,220	214,329	215,199	224,754	224,457	226,387	228,759
<b>Emissions from coal fired power stations</b>									
Nitrous oxide NO <sub>2</sub>	Tons	N/a	N/a	1,864	2,004	2,085	2,031	2,010	2,093
Carbon dioxide CO <sub>2</sub>	Million tons	141.0	143.0	147.0	159.0	169.0	163.0	159.4	161.2
Sulphur dioxide SO <sub>2</sub>	Thousand tons	1,134	1,167	1,198	1,295	1,382	1,583	1,506	1,505
Nitrogen oxide NO <sub>2</sub>	Thousand tons	582	582	603	647	688	669	673	674
Particulate emissions	Thousand tons	122.2	122.0	115.3	112.1	83.43	65.21	67.08	66.08
<b>Ash at coal fired power stations</b>									
Ash produced	Million tons	20.9	22.1	23.0	22.2	23.7	24.7	24.3	24.6
Ash sales	Million tons	N/a	0.818	0.943	0.995	1.117	1.175	1.114	1.126
<b>Koeberg Nuclear Power Station</b>									
Radiation release (target less than 0,0025mSv)	Millisieverts	0.0297	0.0005	0.0004	0.0006	0.0006	0.0006	0.0006	0.0005
Low level waste (steel drums)	Cubic metres	100.80	85.47	73.29	109.06	107.54	61.25	70.77	68.81
Intermediate level waste (concrete drums)	Cubic metres	37.65	43.00	28.76	35.69	23.10	22.77	41.21	27.6

Source: Adapted from Eskom Environmental Reports 1998–2000.

In 2000, Eskom's coal-fired power stations consumed a total of 228,759 mega-litres of water from government water schemes to produce 189,307 GW-hours of electricity, compared with 223,650 mega-litres of water that was used to produce 154,260 GW-hours of electricity in 1993. The mining of coal impacts negatively on the environment through the leaching of chemical substances from coal dumps which might contaminate water.<sup>45</sup> Water pollution also comes from oil spills and ash spills. For instance, in 1998 Eskom had eight water-related contraventions of legislation. There were four ash spills, two oil spills from substations and two underground cable oil spills.<sup>46</sup>

Eskom operates an air quality management system with a network of 43 particulate emissions monitors. The ability to keep track of particulate emissions on a continuous basis contributed to a 46 per cent reduction in particulate emissions from 1993 to 2000.

While SA has considerably reduced particulate emissions from power plants over the past decades, the country's SO<sub>2</sub> and N<sub>2</sub>O levels are considerably higher than those of any other African country. SA produces one-third of Africa's total energy-related carbon dioxide emissions though the country produces less than 1.5 per cent of the global total. As a simple function of increased energy use alone, pollution levels may grow rapidly over the next few decades despite improving efficiency and enhanced production techniques.

It can be argued that in the presence of multilateral environmental agreements such as the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (which SA ratified in July 2002), potential barriers to trade and restricted access to markets—such as through the application of environmental standards or consumer resistance to products on environmental grounds—may motivate industries to use cleaner electricity and compel Eskom to adopt technologies for cleaner energy.<sup>47</sup>

Concerns for the environment can, however, collide with goals for expanding economic activities in a developing country like SA. CO<sub>2</sub> emissions have tended to be closely related to economic growth, industrialization and overall energy consumption. Until the last decade, industrialized countries were the largest contributors to CO<sub>2</sub> emissions. In due recognition of this, policies and instruments for reducing such emissions were instituted in several industrialized countries, resulting in their share of CO<sub>2</sub> emissions declining. Since 1991, developing countries have been responsible for more than 50 per cent of the world's CO<sub>2</sub> emissions. This share is expected to increase with greater industrialization and increased energy use per capita that accompanies the process.

The ability of developing countries like SA to respond to concerns about climate change are complicated by the fact that the greater majority of South Africans live in varying degrees of poverty and would want to increase their living standards, which will lead to increased energy use per capita and increased reliance on fossil and other solid fuels that have high CO<sub>2</sub> emissions.

To implement policies that can benefit both development and the environment, it is important to understand the various subcomponents of processes causing the increase in CO<sub>2</sub> emissions as well as trends in the fuel mix.

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<sup>45</sup> Eskom (1998).

<sup>46</sup> *Ibid.*

<sup>47</sup> Although SA has ratified both agreements, because it is designated as a non-Annex I (developing) country, its commitments are minimal. However, there is pressure for SA to participate and act because of its high absolute and per capita greenhouse gas emissions.

## Alternative energy sources

If energy production in SA in its current form is not sustainable in the long term, what should be done? Should we switch to alternative sources of energy, what are these sources, what are the costs and incentives involved in such a move and who would bear these costs? These are difficult questions; however, this study attempts to provide ways in which we can pursue more detailed research to answer them.

There are many forms of renewable energy sources—hydropower, biomass, solar, wind, wave, tidal and geothermal energy. In addition, there is coal-based energy that, through the use of clean technology, produces little or zero emissions. A brief summary of these forms of energy in SA follows.

### *Nuclear*

SA is presently the only country in Africa that has a commercial nuclear power plant. Operated by Eskom, the Koeberg Nuclear Power Plant is located near Cape Town and was established in 1984. Koeberg accounts for approximately seven per cent of SA's electricity generation. The plant uses pressurized water reactor (PWR) technology and has a licensed generating capacity of 1,840MW.

Eskom is in the process of developing and testing a nuclear reactor for distributed applications. The pebble-bed modular reactor (PBMR) is a relatively small (110 MW) nuclear power station, using helium coolant, a graphite moderator and ceramic fuel pellets, which allow the reactor to operate at higher temperatures, thereby increasing its efficiency. The PBMR theoretically also creates less spent fuel than PWRs like Koeberg. It has been estimated that the technology could result in the development of a \$3bn industry. A half-scale model of Eskom's PBMR is operating at the Kurchatov Institute in Moscow.

The PBMR has a fundamentally different configuration to conventional nuclear reactors and power stations. Although a commercial-scale PBMR has never been built anywhere in the world before, the technology is not new. Both Germany and the U.S. discontinued research and development programs. The reason, Eskom argues, is that the electricity demand profile in Europe and the U.S.—with dense populations and well-developed national grids—favours large central power stations, whereas the small, modular PBMRs would come into their own in a large country such as SA where population centres are far apart, power transmission distances and, therefore, costs are great. The design is also said to be inherently safe.

In addition to the PBMR itself, NECSA plans to build a PBMR-dedicated fuel fabrication plant at Pelindaba. If the projected schedule is followed, five modules will be exported in 2007. After that, an additional five would be exported every year until a total of 30 units per year is exported by 2011.

In 2001, Law & McDaid investigated the impact of the proposed PBMR on sustainable development in SA, and contended that since there is not enough demand for PBMRs in SA, the key variable in the equation is the export market. Eskom's long-term demand projections are banking on a switch to nuclear power as a way of moving away from fossil fuel-dependent energy.



However, there seems to be some consensus that the development of the nuclear power station has been costly, and environmental lobbies in SA are strongly opposed to the development of another nuclear plant.

Some have argued that substituting nuclear for thermal is as good as substituting one environmental problem with another.<sup>48</sup> Critics are also questioning both the practicality and overall expense of the PBMR project (since SA currently has excess generating capacity), and suggest that there is no market for the reactors given SA's rich reserves of coal, abundant wind and solar resources, and recent discoveries of offshore natural gas deposits.

### *Hydroelectric power*

With 10 per cent of its current primary energy supply considered to be renewable, SA exhibits great potential in this regard. The Orange River, which flows westward into the Atlantic Ocean, and the Limpopo River, which flows eastward into the Indian Ocean, form the two major river systems in SA. There are many other small rivers and tributaries that allow the construction of dams for water conservation. This facilitates the application of micro-hydro systems. There are an estimated 6,000 to 8,000 potential sites for small hydro projects with a capacity of about 100MW, most of them located in KwaZulu-Natal and the Eastern Cape.

The largest hydroelectric power plant in SA is the 1,000 MW Drakensberg Pumped Storage Facility, which is part of a larger scheme of water management bringing water into the Vaal watershed from the Tugela River. The second-largest pumped storage hydroelectric power plant is located on the Palmiet River, not far from Cape Town.

### *Solar energy*

Solar dish engine systems are said to convert sunlight into electricity at higher efficiencies than any other solar technology. Solar energy is considered ideal because it is cheap and environmentally-friendly. Most areas in SA receive an average of more than 2,500 hours of sunshine per year. Solar radiation levels range between 4.5kWh and 6.5kWh per square meter, on average, every day. A solar equipment industry has already started to take off in SA, with a number of companies involved in manufacturing solar water-heaters. The solar part of the SABRE-Gen program (SABRE-Gen Solar Thermal Project) is evaluating the potential to use solar for electricity generation, for both grid-connected and off-grid applications.

SA has the potential to produce the lowest-cost solar electricity in the world. In November 1998, Shell Solar SA and Eskom embarked on a multi-million dollar project to supply solar energy to 50,000 low-cost housing units. These two companies provided the infrastructure, while the communities established various ventures for supply and maintenance. As of the end of 2000, the joint venture had installed 6,000 solar home systems, bringing electricity to an estimated 30,000 people in the area. To make the systems affordable for residents, the joint venture is charging customers \$10 a month rather than billing customers for the cost and installation of the units.

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<sup>48</sup> See Law, S. and McDauid, L. (2001). *Briefing Doc 5: Trading in Nuclear Power and Pebble-Beds*. Environmental Monitoring Group, July 2001.

## *Wind energy*

Wind is the fastest-growing power source in the world today. SA's installed capacity has grown from 2,000 MW in 1990 to 13,500 MW at the end of 2000. While the costs of power from coal, large hydro and uranium are increasing—mainly as a result of environmental factors—wind power shows decreasing generation costs. At present, costs on a reasonably good wind site are around R0.35/kWh (\$0.045/kWh), expected to come down to R0.27/kWh (\$0.035/kWh) over the next 10 years and to R0.23 /kWh (\$0.03/kWh) by 2020.<sup>49</sup>

SA's wind resource indicates that the upper limit of the contribution of wind power to the grid is determined by quality of supply considerations. International indications are that this could readily be 20 per cent on a technically proficient network—approximately six GW in SA if implemented today. The potential exists for the development of a local industry and for increased use of local components and manufacturing.

Wind energy is already an important source of energy in SA, mainly in the agricultural sector. More than 300,000 predominantly locally-manufactured wind-driven water pumps are installed as a reliable and low-cost option for the supply of water, mostly to livestock. The wind pumps are highly reliable, with very low annual maintenance costs.

Large-scale, grid-based electricity generation and localized mini-grids and stand-alone systems have the recognized benefits of providing pollution-free electricity, reducing transmission costs, diversifying the energy mix and creating an opportunity for independent generation of power by new players in the market, such as municipalities, private businesses and communities. Wind energy can also help SA to respond to the increasing international pressure to reduce greenhouse gas emissions and, at the same time, access the international financial resources that are allocated for these reductions.

Whereas the traditional, multi-bladed, wind-powered pumps operate at the moderate wind speeds experienced over most of the country, sufficient wind resources for economical generation of electricity are only found along the coastline and the Drakensberg escarpment.

## *Biomass*

The main non-hydro renewable energy source in SA is biomass. More than one-third of the population depend on firewood for their household heating and cooking needs. Firewood collected from forests as well as waste from sugar and lumber processing are the main supplies. There are five relatively small power stations in SA using process waste (bagasse) mixed with coal as fuel. These are all co-generation facilities located at the sugar mills and produce steam and electricity for captive use by these sugar mills. They produce about 0.2 per cent of the electricity consumed in SA.

## *Gas*

One of the most under-utilized clean energy sources in southern Africa is gas. Compared to the international average of 20 per cent of the total energy usage, SA uses less than two per cent. Globally, natural gas usage has grown tremendously over the past 10 to 15 years—both because of the clean fuel image of gas and to alleviate dependence on coal.

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<sup>49</sup> See <http://www.awea.org/pubs/factsheets/Cost2001.PDF>

The Department of Minerals and Energy has expressed a keen interest in promoting gas as an alternative energy source. In October 2001, a number of agreements were signed between Mozambique and SA to pave the way for introducing natural gas to SA. A Gas Bill will provide the national regulatory framework to legalize and streamline the gas activities between the two countries, such as issuing licences, promoting competition and approving tariffs. Exploration of the Pande and Temane gas fields in Mozambique is in progress. A start has been made with the construction of a pipeline to bring this gas to SA at an estimated cost of R10bn. It is anticipated that by 2004 some 80 million gigajoules of gas will be imported by Sasol from the Pande-Temane gas fields.

The Kudu Gas Cape Power Project is also being considered. If sufficient gas reserves are found, gas will be transported from the Kudu gas fields in Namibia via a pipeline to the Western Cape Province of SA, where the gas will be converted to energy in a combined-cycle gas turbine power station. Exploration of the Kudu gas fields is still in progress.

### *Clean technology in coal-based energy generation*

Many energy specialists argue that the most promising, environmentally-friendly, form of energy generation for SA is zero emissions coal-based energy. It has been estimated that the share of energy sector investment going into clean technology is about 1.3 per cent.<sup>50</sup>

## Conclusions

There is, to date, very little analysis and information about why renewable resources still comprise such a small fraction of the total energy generated in SA. Casual evidence suggests, however, that the dominance of coal-based energy has created very few incentives in the market to enable the development of, for example, a competitive solar panel producing industry at affordable prices. It is important to understand why and how the current structure of energy production acts as a disincentive to other forms of energy.

SA, like many other countries, has had a history of not calculating all costs, including external costs, into the price of production inputs and the determination of national accounts. Such an omission has had distortionary effects in the past and in future could have far-reaching implications with regard to achieving the goals and objectives of sustainable and equitable growth. It has often been argued that the negative economic effects of subsidizing energy production have often been far greater than the environmental effects.

Moreover, the effect of subsidizing these industries has had the negative effect of diverting resources away from more efficient sectors. The problem is compounded by the fact that subsidies to energy encourage wasteful use,<sup>51</sup> particularly if energy prices fail to reflect the impact of pollution and other externalities. This undermines investment decisions that could favour less polluting technologies.

The case of SA is somewhat different from the standard scenario in the sense that Eskom is not a drain on the SA fiscus and in fact generates profits. Its implicit subsidy of tax exemption has also come to end. In other words, there are no obvious incentives to restructure the sector.

Notwithstanding SA's cheap energy production and the over-investment in generation capacity, there is an urgent need to deal with the problem of coal-based energy in light of various developments. First, SA is responsible for 1.5 per cent of global greenhouse emissions and is also a significant contributor on a per capita basis. Second, there is a growing domestic awareness of the damaging health and environmental effects of coal-based energy. A third concern is the heightened awareness by SA exporters of energy-intensive products such as steel and aluminum of increasingly stringent regulations in international markets. In the fourth place, greater competition exists in SA's energy markets.

In terms of the social and economic aspects of the electricity sector, it was inevitable that energy policy would be transformed from a defensive *apartheid*-era obsession with security to a new focus on promoting social equity and improving economic competitiveness as SA re-integrated with the global economy. The Energy Policy White paper gave expression to this policy shift, but it was already evident in the launch of an impressive electrification program that sought to tackle the huge demand for affordable access to electricity. This first significant change in the ESI after the political transformation of the country was not linked in any obvious way to the restructuring of the electricity industry. The state-owned utility Eskom, in partnership with local government distributors, was able to mount an accelerated electrification program without restructuring. Surplus and cheap electricity was available as a result of over-investment in the previous decade, and a strong industrial consumer base enabled the ESI to cross-subsidize the electrification program without the necessity of imposing unaffordable price hikes.

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<sup>50</sup> <http://helio.interserver.net/Helio/Reports/2001/South-africa/index.html>

<sup>51</sup> See Pearce, D. W. and Warford, J. J. (1993). *World without end: economics, environment, and sustainable development*. Oxford University Press.

This emphasis on corporatization reflects a general commitment to reassess government's role in the economy, particularly the state-owned enterprises in the infrastructure sector.

Thus Eskom, along with other state-owned enterprises, has been corporatised, now pays taxes and dividends and is subject to a shareholder performance contract. At the same time, the relationship of the state to the sector has been clarified through the creation of an independent electricity regulator that approves prices without political interference.

Although the liberalization and restructuring of the ESI in SA is far behind that in many other countries, the reform process continues, informed, in general, by government's commitment to increase the competitiveness of the economy and to broaden economic participation and ownership for black South Africans. Such reform has been set in motion by the broad direction of economic policy and through the work of analysts who brought international experience of power sector reform to bear in the Energy Policy White Paper. Arguments are now being made that a vertically-integrated, state-owned, monopoly industry, even if it is corporatized, is unlikely to make efficient investment decisions. The currently low electricity prices are primarily a result of investment contraction after a period of wasteful over-investment. The key challenge for the ESI is to create a competitive structure where investors bear a more equitable share of the risk, thus creating an environment for better allocative and operational efficiency. The government has made a broad commitment to manage the liberalization of the ESI and to the introduction of competition.

At the same time, the government has maintained its commitment to improve social equity through creating a national electrification fund that subsidizes the cost of extending the grid to a greater proportion of the population. Funds have been allocated from the fiscus and the national electrification program continues. These capital subsidies have been supplemented by an allocation of 50kWh/month of free electricity, as well as cross-subsidies on tariff levels for low-income residential customers.

This experience is important as it demonstrates that the meeting of social goals and public benefits is independent of industry structure. Electrification was carried out by the vertically-integrated, publicly-owned Eskom and by local government distributors. The electrification program will continue despite the pending liberalization of the electricity market in SA.

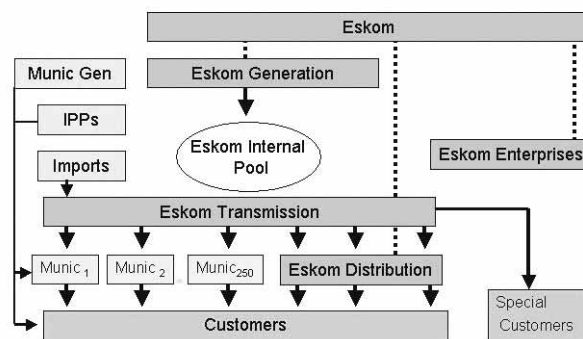
Irrespective of the degree of restructuring and liberalization of the electricity market, explicit policy and regulatory instruments have been put in place to ensure the continued commitment to provide universal access to electricity services in SA. These include a national policy framework, the setting of electrification targets, the allocation of capital subsidies, the establishment of institutions to allocate and disperse the allocations, project and program planning and monitoring, regulatory oversight and enforcement through licence conditions, and the approval of tariff structures that allow transparent subsidies for the neediest. Ultimately, the program has to be designed and implemented in a way that maximizes developmental benefits through integration with the planning and delivery of other infrastructural support services.

Sustainable development and power sector reform are not mutually exclusive. The case of SA shows that it is possible to restructure the ESI and to continue to improve social equity through providing benefits for the poor.

## Appendix A: Key features of the ESI in SA

The SA ESI remains dominated by the state-owned and vertically-integrated utility, Eskom, which ranks seventh in the world in terms of size and electricity sales. It supplies about 96 per cent of SA's electricity requirements, equalling more than half of the electricity generated on the African continent. Eskom owns and controls the high voltage transmission grid and it supplies about 60 per cent of electricity directly to customers. About 240 local authorities undertake the remainder of electricity distribution. They buy bulk supplies of electricity from Eskom, with some also generating small amounts for sale in their areas of jurisdiction. A few industries have private generation facilities for their own use.

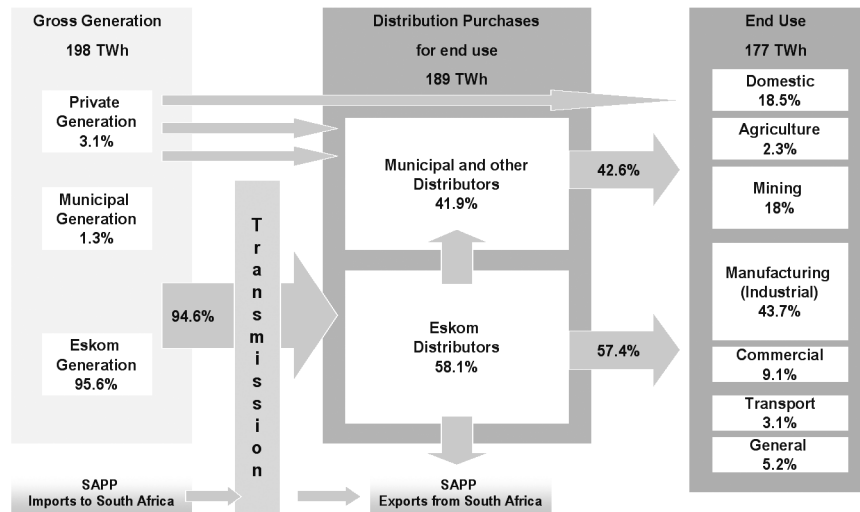
**Figure 5: Structure of the ESI in SA**



**Existing industry structure**

Among Eskom's domestic customers are commercial farmers, a large number of residential consumers, local municipal authorities (who distribute to consumers within their boundaries), manufacturing and mining industries. Manufacturing is the largest consumer of electricity in SA, accounting for 44 per cent of consumption. Mining and residential customers each account for 18 per cent of demand, with another nine per cent going to commercial customers. Residential consumption presently accounts for the fastest growth, owing to SA's success with rural electrification. With more residential consumers being connected to the national grid, there has been in turn a heightened demand during peak periods, and this has had a significant impact on the shape of the country's load profile.

**Figure 6: Energy flows in the ESI in SA, 2000**



Source: NER (2000)

Ninety-one per cent of SA's electricity is generated from coal; nuclear energy accounts for 6.5 per cent, bagasse, hydro and emergency gas turbines make up the remaining 2.5 per cent. Total licensed operational generating capacity in 2000 was 43.1 GW of which Eskom owns 39.9 GW. Some capacity is mothballed and total net operating capacity amounted to 35.3 MW in year 2000. Peak demand on the system was 29.2 MW. Eskom has 24 power stations: 10 large coal fired stations dominate—most of them situated on coal mines in the north-east of the country. Nine of these stations have long-term coal contracts.

Africa's only nuclear station is at Koeberg, 30 kilometres north of Cape Town, and is also owned and operated by Eskom. There is modest hydro capacity on the Orange River, located on two dams—and there are two pumped storage schemes which play a critical role in meeting peak demand, as well as in system balancing and control. Municipalities own 22 small power stations and back-up gas turbines, but these total only five per cent of national generation capacity and generally run at low-load factors. Private generators comprise the remaining two per cent of capacity.<sup>52</sup>

SA sells electricity to neighbouring countries (Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe), representing about three per cent of total net energy produced. Contractually it is bound to take electricity from Mozambique's Cahora Bassa hydro-electric station on the Zambezi. Eskom also imports some power from the Democratic Republic of Congo and from Zambia—mainly for peak load management. In 2000, Eskom imported just slightly more electricity than it exported.

<sup>52</sup> Eskom (2001). Annual Report. National Electricity Regulator (2001). *Electricity Supply Statistics for South Africa*. Pretoria.

Eskom operates an internal pool which generates an optimal dispatch schedule. The system operator and the procurement of auxiliary services is part of Eskom. Eskom owns the national, integrated transmission grid (with the exception of the Motraco line which is jointly owned with the utilities in Swaziland and Mozambique). The national grid comprises 27,000 km of high voltage lines, the bulk of it at 400kV and 275kV. Transmission energy losses are less than four per cent. There are an additional 330,000 km of low-voltage lines owned by Eskom and local authorities. Domestic consumers account for 18 per cent of electricity consumed; manufacturing 44 per cent; mining 18 per cent; and commercial, transport and agricultural users the rest. Eskom supplies 3.1 million customers and municipalities supply an additional 3.4 million.

Eskom makes most of its profits from the sale of electricity to its large mining and industrial customers and in bulk sales to municipalities. These three customer categories account for 82 per cent of its revenue and 89 per cent of its electricity sales. The average selling price to industrial customers is around 12c/kWh. In 2000, the average price to rural and residential customers was 28c/kWh, which does not cover the full cost of supply. The total annual internal cross-subsidy to these customer categories exceeds R1bn. The large municipalities, in turn, make a profit from reselling Eskom electricity, which enables them to subsidize property rates and to finance other municipal services. However, many of the smaller municipalities face debt, non-payment by a substantial proportion of their low-income consumers, inefficient operations and lack of technical and managerial capacity.

In broad terms, the ESI has supported economic development through the provision of low-cost, reliable supply of electricity. In recent years, it has also contributed to improving social equity through increasing access and subsidizing supplies to the poor. However, a number of problems and challenges are driving changes. These include the need to improve the performance of the distribution industry; the need to create a competitive environment for new investment in generation capacity; and the need to unlock the economic value in the industry. These issues are explored further below.



## **Appendix B:**

# **Historical overview of changes in the SA ESI**

The dominant trend in the evolution of the ESI in SA over much of the last century was the growth and consolidation of a large and powerful state-owned, vertically-integrated monopoly. Most of the early private power producers were gradually taken over by Eskom, which became responsible for new supply. The main drivers for the increased concentration and public ownership of the industry were potential economies of scale in power plants, the requirement for large amounts of capital that could be facilitated by government guarantees, and the fact that electricity was seen to be an essential ingredient of government's industrialization strategy. At the same time, the state was also assuming a dominant role in other key infrastructure industries, including rail, air and sea transport, telecom-munications, water, coal-based synthetic fuels, nuclear energy, and also the iron and steel industry. Competition and private ownership in these sectors were thought to be non-optimal; instead the state viewed these industries as key instruments for industrialization, employment creation and economic development.

However, by the 1980s, poor economic performance of state-owned enterprises, combined with broader economic and political pressures on the apartheid state, caused government to look at reforming these institutions. The management of Eskom was not fully accountable and could plan and finance excessive generation capacity. Poor investment decisions were made. The result was massive costs to the economy and, initially, to the consumer. At the same time, the vast majority of disenfranchised South Africans remained without electricity.

Consequently, Eskom's governance was overhauled and new commercial principles were embedded in the operation of the utility. Productivity was improved and financial guarantees by the government were removed. Following the democratic revolution of 1994, emphasis was given to electrification, improvements in the distribution industry, the creation of an independent regulator and the corporatization of Eskom (in parallel with reforms in other state-owned enterprises).

The reform process has been slow and modest; Eskom remains in state ownership and has not been fully unbundled. Many still fear that competition and privatization will lead to higher prices and the elimination of subsidies for the poor. Eskom has played an important developmental role in bringing electricity to more people. Prices are currently low, because there has been no need for investments in new capacity for many years, and the cost of the older plants has mostly been amortized. However, SA is living on borrowed time. Prices will have to rise to fund the next wave of new capacity, expected in 2007 and beyond.

Analysts have pointed out that there is now a reform window during which the ESI can be restructured to create a more competitive and efficient environment for new investment decisions. These arguments are still not widely accepted or understood by most stakeholders. Nevertheless, the momentum for reform rolls on. An Energy Policy White Paper and subsequent Cabinet decisions have laid out a path of managed liberalization, and government has stated that it wishes to see more privatization and greater black empowerment. Competition is being encouraged in other sectors and is, therefore, coming to the electricity sector. At the same time, government is determined that the ESI will deliver expanded and affordable services to more and more South Africans.