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TERNA Wind Energy Programme

Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

23 Country Analyses
Chapter South Africa

Eschborn, September 2007

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PO Box 5180
65726 Eschborn
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Internet: http://www.gtz.de

Edited by:
Angelika Wasielke
Tel. +49 (0)6196 79-1224
Fax +49 (0)6196 7980-1224
E-mail: angelika.wasielke@gtz.de

Authors:
Projekt-Consult GmbH
Dipl.-Ing. Detlef Loy

Design:
Open Ffm.
www.open-agentur.de
Verena Siebert

New Edition of the TERNA Country Survey

Since the first edition of the TERNA country survey appeared in 1999, there has been a distinct heightening of public and political awareness of the consequences of climate change and of energy provision as a key factor in sustainable development. In Germany and other industrialised countries, a political tailwind, effective promotion mechanisms and rising energy prices have created the conditions for a dynamic market in which renewable forms of energy are exhibiting high growth rates within the energy mix. In 2006, global new investment in renewables amounted to US$ 70.9 billion – an increase of 43 % over 2005.

Strong economic development in many emerging countries has triggered rapidly rising demand for energy and competition on the international oil market. Against the background of the rising cost of fossil fuels, supply risks and damage to the environment, the significance of renewable energy as a means of generating electricity is growing – also in developing and emerging countries: according to analyses conducted by the Renewable Energy Policy Network for the 21st Century (REN21), 39 countries have set expansion targets for renewable energy sources and introduced promotion mechanisms, nine of which are developing or emerging countries. Of total new investment in renewable energy around the world, US$ 15 billion was invested in developing and emerging countries. Nevertheless, the majority of countries still have a long road ahead of them before they overcome existing barriers to the successful introduction of renewable forms of energy.

The German and European market acts as the driving force for the wind energy industry and provides an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries. It is the successes in countries such as India, China and Brazil which encourage commitment beyond the borders of industrialised nations. In those three countries there is a growing proportion of local content in the systems and equipment they produce – and not only for supply to their own domestic markets.

A number of other countries though, too, are erecting their first wind farms, thereby establishing the basis for gaining experience to be utilised in future markets.

To help interested players gain access to the new markets, this survey provides detailed descriptions of the framework conditions for electricity markets and renewable energy in 23 developing and emerging countries.

Latin America	Africa/Middle East	Asia
Argentina	Egypt	Bangladesh
Brazil	Ethiopia	China
Caribbean States	Jordan	India
Chile	Morocco	Indonesia
Colombia	Namibia	Pakistan
Costa Rica	South Africa	Philippines
Dominican Republic	Tunisia	Viet Nam
Mexico		
Nicaragua		

This latest country survey and the previous editions are available on our homepage: www.gtz.de/wind. For the first time, the publication is also available on CD-ROM. For information on how to obtain this, again, go to the homepage.

Our grateful thanks go to a large number of GTZ staff members and other experts in the field for their help in putting this information together.

Eschborn, September 2007

Legal Information

1. The data used in this study is based on both publicly accessible sources of information (publications, specialist articles, internet sites, conference papers etc.) and non-public papers (for example internal expert reports from promoting institutions), as well as personal interviews with experts (for example officials at energy ministries in the investigated countries and project staff at promoting institutions). Although all information has been checked as far as possible, errors cannot be ruled out. Neither the GTZ nor the authors can therefore provide any guarantee of the accuracy of the data included in this study; no liability can be accepted for any loss or damage resulting from use of the data included in the study.

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The TERNA Wind Energy Programme

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) wind energy programme, implemented by GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and emerging countries in planning and developing wind power projects. Since 1988 the TERNA programme has pursued the twin goals of laying the foundations for sound investment decisions while at the same time enabling partners to assess wind energy potentials, plan wind energy projects and improve energy-policy frameworks for renewable forms of energy.

The TERNA wind energy programme's partners are institutions in developing and emerging countries that are interested in commercial exploitation of wind power. These include, for example, ministries or government institutions which have the mandate to develop BOT/BOO projects, state-owned or private energy supply companies (utilities) and private enterprises (independent power producers).

TERNA offers its partners expertise and experience. In order to initiate wind power projects, favourable sites must be identified and their wind energy potential ascertained. To do this, wind measurements are normally taken over a period of at least twelve months and wind reports are drawn up. If promising wind speeds are found, the next step is to conduct project studies investigating the technical design and economic feasibility. TERNA also provides advice to partners on matters of finance, thus closing the gap between potential investors and offers of funding from national and international donors.

If required, CDM baseline studies can be prepared and advice can be offered to potential operators on setting up an efficient operator structure. In order to ensure as much transfer of know-how as possible, efforts are made to ensure cooperation between international and local experts, for example when preparing the studies.

In successful cases, TERNA initiates investment-ready wind farm projects by this method. TERNA itself is not involved in financing. In addition to the activities that are tied to specific locations, TERNA advises its partners on how to establish suitable framework conditions for the promotion of renewable energy sources.

Up until 2007, TERNA has been active in over ten countries around the world.

Further information on GTZ's TERNA wind energy programme, the application procedure etc. is available at www.gtz.de/wind or directly from:

Deutsche Gesellschaft für Technische
Zusammenarbeit (GTZ) GmbH
Postfach 5180
65726 Eschborn
Germany

Dr. Rolf Posorski
Tel. +49 (0)6196 79-4205
Fax +49 (0)6196 7980-4205
E-Mail: rolf.posorski@gtz.de

Angelika Wasielke
Tel. +49 (0)6196 79-1224
Fax +49 (0)6196 7980-1224
E-Mail: angelika.wasielke@gtz.de

Tim-Patrick Meyer
Tel. +49 (0)6196 79-1374
Fax +49 (0)6196 7980-1374
E-Mail: tim-patrick.meyer@gtz.de

15 South Africa

15.1 Electricity Market

Installed capacity

In 2006 South Africa's total installed power generation capacity amounted to approximately 43 GW. The South African utility company Eskom is one of the world's largest electricity providers, with an installed net capacity of 39,810 MW (2006).[1] Of this, 90 % is accounted for by coal-fired power stations (35,607 MW), 4 % by nuclear power stations (1,800 MW) and 6 % by hydroelectric power stations (2,000 MW) and gas turbines (342 MW). Additional generating capacities are provided by private electricity producers (approx. 1,390 MW licensed at the end of 2004, chiefly industrial owner-operators) and local government utilities (1,825 MW licensed at the end of 2004). Eskom also has a stake in the Cahora Bassa hydroelectric power scheme in Mozambique, with a capacity of 1,600 MW.

Peak demand in Eskom's integrated network reached 33,461 MW in 2005/2006. Thanks to a new gas pipeline from Mozambique to South Africa, natural gas will also increasingly become established as an important energy source for generating electricity. The first gas-fired combined heat and power station was commissioned in July 2006 in Richards Bay.[2] Another plant in Newcastle was due to begin generating power in the first quarter of 2007.

Power generation

In 2005/2006[3] net electricity generation by Eskom amounted to 221 TWh, of which 205.8 TWh was from coal-fired power stations, 1.1 TWh from run-of-river power plants, 2.9 TWh from pumped storage plants and 11.3 TWh from nuclear generation.

	2000	2001	2002	2003	2004	2005/06
	GWh					
Coal	172,362	175,223	181,651	194,046	202,171	205,837
Hydropower	1,343	2,061	2,357	777	720	1,141
Pumped storage plants	2,591	1,587	1,738	2,732	2,981	2,867
Nuclear power stations	13,010	10,719	11,991	12,663	14,280	11,293
Gas turbines	0	0	0	0	0	78

Tab. 1: Net electricity generation by Eskom; South Africa; 2000–2006, GWh[4]

Eskom produces electricity for the domestic market and for some neighbouring countries. In recent years, however, power imports from neighbouring countries (mainly Mozambique) have grown considerably faster than exports, to the extent that in 2005 there was already an almost exact balance (9,200 GWh was imported and about 12,900 GWh exported). For the future it is planned to make greater use of imports to meet the growing demand for electricity.

In 2004, national (public) gross power generation was 230 TWh, of which 3.2 % was from private generators (7.4 TWh) and a further 0.8 % from local government utilities (1.2 TWh), while the rest came from Eskom power stations. Some 363 GWh was consumed by private self-generators for their own needs.

1 The nominal capacity of all power stations is 42 GW.
2 This industrial combined-cycle power plant with an electrical output of 27.5 MW supplies electricity and heat to a paper mill.
3 1.4.2005–31.3.2006; statistics from before this period always relate to the calendar year.
4 Source: Eskom, Annual Report 2006. The figure for 2005/2006 covers the period 1.4.2005 to 31.3.2006.

Power transmission and distribution

Eskom both owns and operates the transmission grid. The transmission grid encompasses voltage levels between 132 and 785 kV and for the most part is over 60 years old, which means that considerable investment in maintenance will be necessary in the near future. In addition to the domestic grid, the grid infrastructure for interchanging electricity with neighbouring countries is also to be expanded in future. South Africa is an important member of the Southern African Power Pool (SAPP) and thus has access to relatively inexpensive and secure sources of supply beyond its borders.[5] Transmission losses in the reporting period of 2005/2005 were comparatively low at 8.2%.

Degree of electrification

While only one third of households had an electricity supply in 1994, by the end of March 2006 the proportion had already risen to about 72%. At present there are still some 3.4 million South African households without access to electricity. Eight provinces have an electrification rate of over 70%, while only two provinces are below that figure.[6]

Electricity consumption

The consumption of electricity sold by Eskom reached 208.3 TWh in the 2005/2006 accounting year. Between 2000 and 2005/06 the average rate of growth in electricity demand was 3.1%. Almost 40% of the electricity was supplied to distributing companies, with the rest being sold directly to end users. Altogether more than 8 million customers are currently supplied with electricity, roughly half of them directly by Eskom and the other half by municipal or other distribution companies. The largest sectors in terms of power consumption are industry, in particular aluminium producers and mining.

The promising outlook for the economy suggests that as a long-term trend demand for electricity will grow by 4.2% per year, or about 1,500 MW.

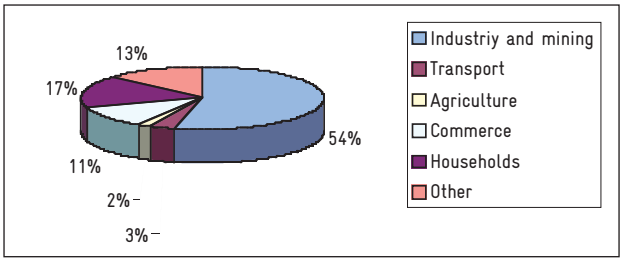

Fig. 1: Electricity consumption by sector; South Africa; 2004; GWh[7]

Electricity prices

Even if electricity generating costs are among the lowest in the world at less than 1.5 euro cents/kWh thanks to the low-cost domestic coal resources available, there are still substantial differences in tariffs between the distribution companies and the various consumer groups.

Eskom and the municipal utilities charged the following average prices to their customers in 2004 and 2005/2006 (Eskom only):

	Power distributors incl. Eskom 2004		Eskom only, 2005/2006	
	ZAR-ct/kWh	€-ct/kWh	ZAR-ct/kWh	€-ct/kWh
Agriculture	31.13	3.42	32.86	3.61
Households	28.82	3.17	40.08	4.41
Commerce	28.45	3.13	22.69	2.50
Transport	22.13	2.43	20.25	2.23
Industry	18.31	2.01	14.75	1.62
Mining	15.37	1.69	16.19	1.78
Others[8]	23.45	2.58		
Other distrib.			16.13	1.77
Average (volume-weighted)	21.82	2.40	17.05	1.88

Tab. 2: Average electricity prices (net); South Africa; 2004 and 2005/06; ZAR cents/kWh, € cents/kwh [9]

5 Eskom and other African electricity suppliers plan to build hydroelectric power stations on the River Congo. This river, which has the largest water volume in Africa, has an estimated energy potential of 100 GW. The project includes a 3,000 km-long power transmission line through to South Africa.

6 These provinces are KwaZulu-Natal, at 64%, and Eastern Cape, at 55%.

7 Source: Digest of South African Energy Statistics, 2005. Department of Minerals and Energy.

8 Among other things this category includes street lighting and exports by the distribution companies.

9 Source: National Electricity Regulator: Electricity Supply Statistics 2004.

Altogether there are more than 2,000 different tariffs in force in South Africa, with prices varying between 2.1 euro cents/kWh (ZAR 0.19/kWh) and 7.8 euro cents/kWh (ZAR 0.71/kWh).

In 2005 the regulator approved a tariff increase for Eskom above the inflation rate. The average electricity price (including levy) for other distributors thus rose from 1.76 to 1.87 euro cents/kWh (16.04 to 17.05 ZAR cents/kWh) on 1 April 2006. This increase is the first step in a three-stage annual price increase, in increments averaging about 5 % per annum. This is the first time that the regulatory authority has approved an annual price adjustment over three years for Eskom. The reason given for this longer-term tariff rise was the need for stable and predictable prices in the light of the investment required for the expansion of power stations.

Eskom has introduced free basic electricity provision for households with very low incomes, with an allowance of 50 kWh per month. This entails entering into a contract with the local authorities, which for their part have to check the neediness of the applicants. In 2004 more than three million households were able to take advantage of this service. That said, at the beginning of 2006 it was estimated that only 27 % of all needy households had been given the free basic tariff.

Expansion planning

Despite growing demand for electricity, Eskom has not brought any new power generating capacity on stream in recent years. In view of anticipated supply shortages from 2007 onwards, Eskom announced in 2004 that three decommissioned coal-fired power stations with a total capacity of 3,800 MW would be put back into service in stages through to 2011. Forecasts indicate that power demand will grow by 4.2 % per year in the long term, giving rise to a need for additional power generating capacity of more than 1,500 MW per year. To date there are definite plans for new coal-fired power stations amounting to 6,000 MW. It is also assumed that about 1,000 MW of capacity could be built in the period 2007-2009 in the form of combined heat and power plants based on renewable energy and waste incineration.

15.2 Market Actors

Eskom

Eskom is the dominant electricity supply company on the African continent. It is responsible for almost all electricity generation in South Africa, for all electricity transmission, and (still) for a considerable proportion of electricity distribution.

Independent power producers

Independent power producers still operate on the sidelines at present. Their share in total electricity generation amounts to only about 3 %. Producers using renewable energy sources in particular have hardly made any headway in the past due to Eskom's low electricity prices and the lack of any government support. However, the South African Government has announced greater support in the coming years, especially for those private producers which generate electricity from renewable energy.

Distribution sector

The distribution sector, which comprises Eskom and municipal utilities, has so far been characterised by a large number of actors. However, many of the 185 municipal and other distribution companies (2004) are unable to operate efficiently and cover costs due to the fact that they have only small numbers of customers[10] and low tariffs.

Restructuring at the distribution level was introduced following a decision taken by the national cabinet in May 2001, with the effect that in future only six urban distributors and one nationwide rural distributor (Regional Electricity Distributors – REDs), each with a standardised tariff structure, will distribute electricity to final customers. To achieve this, the municipal distribution companies will be merged with the distribution network belonging to Eskom. In the wake of the Electricity Distribution Industry Restructuring Act, a state holding company (Electricity Distribution Industry Holdings – EDIH) was formed to implement the reform.

10 Numerous distributors have only between a few hundred and a few thousand customers.

The first distribution company within EDIH, regional electricity distributor RED One, began operation in Cape Town on 1 July 2005. The restructuring process in the distribution sector is supposed to be completed by about 2009.

Other Actors

Department of Minerals and Energy (DME)

The Department of Minerals and Energy (DME) is the ministry responsible for the electricity sector and therefore the most important political institution. It is responsible for energy planning, develops guidelines on energy policy and introduces programmes to develop the energy sector. It also has a significant role to play in the competitive tendering process for electricity generation projects involving independent power producers.

Department of Public Enterprises (DPE)

The Department of Public Enterprises (DPE) has oversight responsibilities for all state-owned enterprises. This includes the largest such entity, the electricity supply company Eskom. In this role the DPE works closely with the DME, which is responsible for energy policy, and the regulatory authority, to ensure optimum conditions for the state-owned enterprises and the economy as a whole.

National Energy Regulator of South Africa (NERSA)

Since July 2006 the former National Electricity Regulator (NER)[11] as set out in the Energy Regulator Act, 2004[12] has been responsible not only for the electricity sector but also for all piped and grid-linked energy sources, i.e. also for oil and gas, and was renamed as the National Energy Regulator of South Africa (NERSA).[13] The managing board is appointed by the DME but it operates independently. The core task of the NERSA is to issue licenses for electricity transmission, distribution and generation and to monitor and authorise tariffs. The authority is financed by a levy that has to be paid by the power producers and which can be passed on to all power consumers as a cost factor.

Since the new Electricity Regulation Act[14] came into force in August 2006, all power generating facilities require a licence. The only exceptions are electricity generation for the producer's own use and non-commercial electricity generation with no connection to the grid.

Up to 2004, NER had granted a total of 15 licences for electricity generation: one for Eskom, nine for municipal authorities and five for private producers (mainly sugar companies using bagasse). All in all these licences covered 51 power plants. Of the 17 coal-fired power stations, 10 belong to Eskom, four to municipal authorities and three to private producers. There are ten hydroelectric power stations, six of which are owned by Eskom and three by municipal authorities, while one plant is privately run. Of seven gas turbines, two belong to Eskom and five to municipal authorities.

11 Until 1 April 1995 its name was the Electricity Control Board.
12 Act No. 40 of 2004, in force since 15 Sept. 2005.
13 Formally the amalgamation took place earlier, on 1 Oct. 2005.
14 Act No. 4 of 2006.

15.3 Legal Framework

White Paper on Energy Policy

The White Paper on Energy Policy presented by the government in December 1998 sets out the most important energy policy goals and is at the same time the fundamental strategy paper for liberalising and privatising the electricity sector. Its core points are the free choice of electricity supplier by customers, the introduction of competition, especially in the generating sector, greater participation of the private sector, and open, non-discriminating access to the transmission system.

Reform of Eskom

The privatisation and unbundling of Eskom is set out in a legal framework plan by the Department of Public Enterprises.[15] Since July 2002 Eskom has been operating as a joint stock company, in which electricity generation, transmission and distribution form separate business divisions. In view of the anticipated electricity shortages, the original plan that Eskom should dispose of 30 % of its generating capacity by 2006 and not add any new capacity itself for the time being has initially been put back.[16] Even without the part-privatisation of Eskom, however, the government is keeping to the plan to surrender 30 % of the electricity market to independent producers in future. In the long term the transmission grid, too, is supposed to be transferred to a separate company in the ownership of the state.

Energy Act

The draft of a framework law for the energy sector (Energy Bill) was presented in 2004. This law, which has not yet been enacted, provides for the establishment of a National Energy Council, the preparation of systematic energy statistics, the introduction of regularly updated integrated energy planning, and programmes on energy efficiency, renewable energy and energy research.

In addition, the national energy efficiency strategy of 2004 targeted a reduction in total final energy demand of 12 % by 2015. There are now signs, however, that such a reduction in consumption will not be achieved.

15.4 Policy Promoting Renewable Energy Sources

White Paper on Renewable Energy

According to the 1998 White Paper on Energy Policy, the South African Government aims to introduce focused promotion for the development, demonstration and implementation of renewable sources of energy for applications on a small and a large scale. A first strategy paper on the use of renewable energy was presented in 2000.[17] The approach was given a concrete form in the White Paper on Renewable Energy, which was adopted in November 2003.

With the adoption of this Paper the Government committed itself to a step-by-step expansion of the use of renewable energy to 10 TWh (or 0.8 Mtoe[18]) by 2013. This encompasses electricity generation from wind, solar, biomass and small-scale hydropower, along with solar thermal water heating and the use of biofuels. In addition to announcing financial incentives to be provided by national and international programmes, the Paper calls for the establishment of a comprehensive regulatory framework including appropriate tariff structures. A strategy paper on implementation was most recently announced for September 2005 but has not as yet been published. Also under discussion is the introduction of an electricity feed law which would lay down arrangements for paying for electricity supplied to the grid from renewable energy sources.

15 'Policy Framework: An Accelerated Agenda towards the Restructuring of State-Owned Enterprises', August 2000.

15 10% of the generating capacity is to go to enterprises owned by black South Africans as part of the Black Economic Empowerment strategy.

17 Department of Minerals and Energy, Implementation Strategy for Renewable Energy in South Africa, Draft 2, February 2000, and Strategy for Renewable Energy in South Africa, Consensus Draft, 19 March 2001.

18 Mtoe: Million tons of oil equivalent

National promotion programmes

Significant promotion of renewable energy sources for electricity generation has been provided since 1994, chiefly within the framework of electrification programmes for rural areas in conjunction with off-grid applications.[19]

At present there are no special rules for supplying and paying for electricity from renewable energy sources. The White Paper on Renewable Energy envisages a tendering model with long-term power purchase agreements. The NERSA has the task of devising the specific framework. In the course of further strategy development, however, it is also planned to consider alternative remuneration models. Given the current electricity prices of 1.6 to 4.4 euro cents/kWh (Eskom), though, at present there is little scope for electricity generation on the basis of renewable energy. In the longer term, however, it is expected that average generating costs will rise because of the building of additional power stations, so the competitive position of renewable electricity generation will improve.

A dedicated programme designed to promote renewable energy was first launched by the Department of Minerals and Energy for the 2005/2006 financial year, and is set to be continued through to 2007/2008 with a total budget of €1.6 million (14.2 million rand). For administrative reasons, however, it proved impossible to distribute the €0.5 million (4.5 million rand) available in the first year, apart from a very small amount. It is a requirement that the projects must have a minimum output of 1 MW (or an equivalent amount in the annual production of liquid fuels). The Renewable Energy Finance and Subsidy Office (REFSO) was set up within the DME to handle the programme.

SABRE-Gen Programme

In 1998 Eskom launched a programme to investigate the potential applications of renewable energy sources for grid-coupled electricity generation on a large scale and to test these in demonstration projects. The South African Bulk Renewable Energy Generation (SABRE-Gen) programme has four components:

- Use of biomass (SABRE-Gen BioEnergy)
- Generation of solar thermal electricity (SABRE-Gen Solar Thermal Electric)
- Use of offshore wave energy (SABRE-Gen Wave)
- Use of wind energy (SABRE-Gen Wind)

Central Energy Fund and other national finance providers

The particular objectives of the Central Energy Fund (CEF), set up in 1997, are to establish universal access to modern forms of energy, to increase the use of renewable energies, and to develop a local gas market.[20] In order to provide assistance and cover risks in the development and demonstration of new energy technologies, the Energy Development Corporation (EDC) was included as part of the CEF in January 2004.

One of the first major projects to receive assistance is the investment stake in the Darling wind farm.[21] The CEF (or EDC) is also the executing institution for an ongoing solar thermal project supported by the GEF. In the hydropower sector the EDC has entered into an agreement with the private investor NuPlanet to establish an independent power producer to exploit hydro energy. The joint subsidiary, Bethlehem Hydro, will build and operate a hydroelectric power plant with a total capacity of 3.9 MW.[22]

19 See section headed Rural Electrification.
20 For further information see www.cef.org.za.
21 See section headed Wind energy.
22 This project has also been registered as a CDM project.

The CEF group also includes the South African National Energy Research Institute (SANERI), which was founded by Ministerial Directive in October 2004. The Institute arranges for research to be conducted (mainly by third parties) in the energy sector – including on renewable energy – and in 2006/07 had a budget equivalent to € 4.2 million.

Further financial assistance is offered by the Development Bank of Southern Africa (DBSA), the Industrial Development Corporation and the Department of Trade and Industry.

Danish-South African programme

The four-year Capacity Building Project in Energy Efficiency and Renewable Energy (CaBEERE) was launched in August 2001 in cooperation between the South African and Danish governments. In addition to developing strategies for disseminating renewable energies and possible implementation measures on a policy level, the programme focused on implementing specific projects, building up a database with service enterprises and preparing fundamental sector studies.[23]

Prospects of a World Bank project

A project entitled Renewable Energy Market Transformation (REMT) is still in the preparation phase; it is supported by the GEF. In addition to institutional empowerment, this focuses on grid-coupled electricity generation and electricity production in the sugar and paper industries for in-plant use. A large proportion of the financial resources is to come from the Prototype Carbon Fund (PCF).[24]

Clean Development Mechanism

South Africa joined the Kyoto Protocol in July 2002. Because electricity generation has until now been based almost entirely on burning coal, South Africa has relatively high CO_2 emissions by international comparison at over 9 t per capita, and thus presents a good starting point for CDM projects.[25] In particular there are considered to be promising potential applications in small-scale projects in the field of power generation from renewable energy.

The Department of Environmental Affairs and Tourism (DEAT) is responsible for climate policy. A Designated National Authority (DNA) was set up within the DME at the end of 2004 to approve CDM projects at the national level.

Up to mid-2006, 20 projects had been submitted to the DNA for provisional assessment and 12 projects for approval. Six of the projects are concerned with the utilisation of methane gas on landfill sites, three with the use of biogas and four with the use of other forms of renewable energy for generating electricity. Three projects have been registered as CDM projects by the Executive Board of the UNFCCC in the meantime.

Project title	Date of UNFCCC registration	Equivalent CO_2 reduction per year
Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town; South Africa)	27.08.2005	Depends on project implementation
PetroSA Biogas to Energy Project	29.09.2006	29,310
Durban Landfill-gas-to-electricity project – Mariannhill and La Mercy Landfills	15.12.2006	68,833

Tab. 3: CDM projects registered with the UNFCCC in South Africa[26]

23 Further information is available from the DME at www.dme.gov.za.

24 The total funding amounts to US$ 165 million. Of this, US$ 103 million is to be provided by private sources, US$ 6 million each by the GEF and the South African Government, and US$ 50 million by the PCF.

25 According to Eskom's 2006 annual report, in the reporting period 920g of CO_2 were emitted per kilowatt-hour of electricity generated.

26 Source: UNFCCC 2006.

15.5 Status of Renewable Energy Sources

Renewable energies currently account for approximately 9% of South Africa's primary energy production. The most significant element within this is the traditional use of biomass (for example firewood) for cooking and heating.

Renewable forms of energy (mainly hydropower) only contribute just under one per cent to the country's electricity generation. In South Africa renewable energy sources are used primarily in off-grid installations. A lack of promotion and the low cost of generating electricity from coal are proving to be the main obstacles to the use of grid-coupled systems.

Hydropower

In 2005 the installed (nominal) capacity of run-of-river power plants amounted to 668 MW, of which Eskom produced 661 MW, mainly in two large hydropower plants. Of the six small hydropower plants (< 10 MW) with a total capacity of 15 MW, two were owned by Eskom and three by municipal utilities. The only private small hydroelectric power plant has a capacity of 3 MW.[27] The total installed capacity of micro hydropower systems is estimated at 0.4 MW.

Hydropower potential

Low precipitation, often only seasonal watercourses and frequent droughts and flooding restrict the potential for hydropower.[28] The realisable potential for hydroelectric power plants with a capacity of less than 50 MW is approximately 9.9 TWh. There are said to be between 3,500 and 5,000 potential locations for micro-hydro-power systems, chiefly located on the Eastern Escarpment.[29]

In isolated cases small plants are promoted within the context of rural electrification. It remains to be seen to what extent the announced strategy to promote renewable energy contains specific hydropower components.

Wind energy

The potential for wind energy is good, especially in the area of the long coastal strip and inland escarpments. The DME published a wind atlas for the first time in 1995. Measurements were conducted in Eastern Cape Province with EU support at the end of the 1990s. An average wind velocity of 6 m/s was measured at a number of different locations. At Cape Point average peak wind speeds of 9 m/s were recorded. A new wind atlas based on detailed data is being drawn up by Eskom within the framework of the SABRE-Gen programme. The annual wind energy potential is estimated at 26 TWh.[30]

Installed and planned wind farms

At present there is only one wind farm feeding electricity into the interconnected grid: a pilot wind farm belonging to Eskom in Klipheuwel, 50 km from Cape Town, consisting of three wind turbines from different manufacturers (rated at 660, 750 and 1,750 kW). The wind conditions at this location, however, are not favourable. Otherwise wind power plants are used to generate electricity in small village grids (totalling approximately 45 kW) and standalone off-grid systems (altogether roughly 500 kW).[31]

27 This private plant is located in Nelspruit in the province of Mpurnalanga and has proved to be a cost-effective, profitable project.

28 Further information on potentials and resources is available in the South African Renewable Energy Resource Database (SARERD): www.csir.co.za/environmentek/sarerd/index.html.

29 Source: DME: Green Power – Business Opportunities in South Africa for Renewable Energy Independent Power Producers. 2003. In the White Paper on Renewable Energy the potential is stated as 11 TWh.

30 Source: SARERD database.

31 Traditionally wind energy is mainly used in windmills for pumping water. Currently over 20,000 such installations are in operation, and with approx. 12 MW account for three-quarters of the installed capacity. See DME – Department of Minerals and Energy: Baseline Study on Wind Energy in South Africa; Final Report; Capacity Building in Energy Efficiency and Renewable Energy Program; February 2003.

A first relatively large, privately implemented wind power project near Darling (on the west coast) with a capacity of 5.2 MW is now set to be brought to fruition in 2007 after a lengthy planning period (the location was chosen as long ago as 1997). With a mean wind speed of 7.5 m/s at an elevation of 50 m and a capacity factor of 30 %, annual electricity production is estimated to be 13.3 GWh.

Under a long-term power purchase agreement (20 years) the city of Cape Town will buy the electricity and pay for it with an added premium on top of the normal purchase costs. In so doing the city intends to meet the commitment that it set itself to increase the share of electricity from renewable sources to 20 % by 2020. The city's own distribution company will transmit the wind-generated electricity to interested consumers as 'green electricity', with the price conditions set accordingly. Because of its status as a demonstration scheme, the Energy Development Corporation (a division of the Central Energy Fund) is also participating in the project, contributing € 2.1 million (19.3 million rand). If operation is successful and there is appropriate demand for 'green' electricity, the wind farm is to be expanded to 13 MW with a further six turbines.

Preliminary investigations are also being conducted at a former military base on Langefontain Farm. It is being considered whether to install 50 turbines of the 2.3-MW class there.[32] In addition to these major projects there are also investigations into the use of small wind power facilities in mini grids, often in hybrid operation with PV or diesel systems.[33]

With regard to the government's objective of supplying 10,000 GWh from renewable energy by 2013, however, wind energy has only a small role to play.

UNDP/GEF wind energy programme

The use of wind power in South Africa is accordingly still at the pilot or demonstration stage. A promotion framework for grid-coupled wind power plants is now supposed to be developed with the aid of international organisations. One such case is the programme launched in August 2001, the UNDP/GEF's South Africa Wind Energy Programme (SAWEP), which is being implemented in cooperation with the Danish organisation DANCED (Danish Cooperation for Environment and Development). The total costs are US $ 10.9 million, with a GEF subsidy of US $ 2.3 million.

The first phase, which ended in December 2006, focused on policy consultancy in respect of a regulatory environment for independent electricity generation, the development of financing mechanisms and support for local project developers. In this connection successful negotiations were held with Eskom on a power wheeling agreement which specifies the conditions for transmitting wind-generated electricity via the Eskom power grid. Contributions were also made to wind measurements, the performance of environmental studies, financing and grid access. The programme is now to be continued in a three-year second phase and then contribute to the construction of wind farms with a total capacity of about 45 MW.

32 See among others: DME, Baseline Study on Wind Energy in South Africa. Final Report. Capacity Building in Energy Efficiency and Renewable Energy Program. February 2003. Or also Winkler, Harald; Renewable energy policy in South Africa: Policy options for renewable electricity; Energy Policy; online version 2003.

33 This includes the Lubisi Dam Community Project, in which two imported 2.2-kW small wind power systems were installed in combination with PV systems. In the Hluleka Nature Reserve two 2.5-kW wind power installations together with PV systems and diesel generators support the electricity and water supplies to a small settlement.

Biomass

Measured against total primary energy production, biomass in the form of fuel wood, wood wastes, dung, bagasse and charcoal ranks very high. These energy sources cover 60 % of the energy consumption of private households.

So far only sugarcane bagasse is of any relevance in power generation. In 2004 it accounted for 414 GWh or about 0.2 % of all the electricity generated. Bagasse is used directly in the sugar factories to fuel combined heat and power stations. At present the electricity produced there is largely used within the plants (221 GWh) and only a smaller proportion is fed into the grid (192 GWh). In 2004 five bagasse-fired plants with a total capacity of 105 MW had licences; all were owned by independent power producers.

Biomass potential

At present (latest figures: 2004) only about a quarter of the electricity generation potential of bagasse is exploited.[34] In addition, wastes from sawmills and paper mills could contribute 7,600 and 4,500 GWh respectively to electricity supplies each year. The annual energy potential of harvest residues is 341 GJ, and residues from livestock breeding could contribute some 5,600 GWh to electricity production.[35]

Biogas

So far there has been hardly any production of biogas from sewage or solid wastes, but this option certainly has potential. The energy content of the domestic and industrial solid wastes generated in 1990 amounted to 40.5 PJ. Methane obtained from sewage could contribute 36 MWh annually to electricity supplies.

The portfolio of the World Bank's Prototype Carbon Fund (PCF) includes a South African landfill gas project. In the city of Durban,[36] CO_2 certificates will be earned following successful implementation of a project converting methane gas from two landfill sites into electricity, and sale of the certificates to the PCF has been contractually agreed. Initially the captured gas is to be converted into electricity in generators rated at 0.5 MW each. If the yield is good, the possibility of a subsequent doubling of capacity is not ruled out.

Solar energy

With average daily solar irradiation of 4.5 to 6.5 kWh/m^2, South Africa has excellent conditions for solar energy applications. The solar radiation values were recorded in a database and published on a map.[37]

Use of solar energy for electricity generation

The total installed PV capacity is approximately 12 MW_p, of which only about 150 kW is attributable to grid-connected systems. In addition to solar home systems (SHS), distributed facilities are used for telecommunications and water pumps as well as for schools and hospitals.

Eskom planned to carry out non-grid-coupled electrification of 16,400 schools and some 2,000 hospitals by 2005. The schools were to be equipped with an average PV rating of 500 W, while larger systems were planned for rural hospitals.[38] Financing was made available through national and international promotion schemes. KfW (KfW development bank) participated in this part of the programme with a contribution of € 9.5 million.

34 Every year some 7 million tonnes of bagasse are produced. Given an output of 200 kWh/t achieved using modern combined-cycle power plants, the calculated potential would be 1,400 GWh.

35 See SARERD database.

36 New name: eThikwini.

37 See SARERD database.

38 The electrification programme for rural hospitals with renewable sources of energy is being headed by the Independent Development Trust (IDT).

Concession programme for 350,000 solar home systems

The provision of small PV systems for isolated supply units in areas that cannot be cost-effectively connected to the national grid is an essential element of the promotion programme for the electrification of rural regions.[39]

At the beginning of 1999 a promotion programme was launched to install a total of 350,000 SHSs, each rated at about 50 W_p. In each of seven regions, 50,000 systems are being installed and looked after by a private concessionaire for each region. The concessions are to be obtained through competitive tendering, and the SHSs are owned by the concessionaires. Between 60 and 80 % of the capital costs are covered by subsidies amounting to ZAR 3,500. Whereas in Eastern Cape Province the remaining costs have to be borne in full by the users (ZAR 58 per month) through fees (fee-for-service model), in other provinces an additional ZAR 40 per user is paid from a government funding pot. Despite this considerable assistance, because of bad experience in some cases in the past SHSs are only installed in households with regular incomes. The monthly fee is usually paid in advance, and this is required in order to activate the power supply.

To date, concessions have been granted in the following regions:

- Solar Vision Ltd. (northern Limpopo)
- Nuon-Raps Utility Ltd.[40] in northern KwaZulu-Natal (8,000 systems 2005-2006)
- KES KwaZulu Energy Services Company (65 % EDF, 35 % Total Fina Elf) in the interior of KwaZulu-Natal: 15,000 households by the end of 2006; about 10,000 households had been equipped by the end of 2005.
- Shell-Eskom in the northern part of Eastern Cape and in southern KwaZulu-Natal
- Renewable Energy Africa (central Eastern Cape)

One of the first concessionaires was the Shell-Eskom joint venture. In its first phase this joint venture tackled the electrification of 6,000 households in Eastern Cape Province during 1999 and 2000. Of the 6,000 systems, only 4,700 were still in operation in 2002. The systems, known as Powerhouse systems, were provided to the households for a one-off payment of € 16.50 (ZAR 150). The users have to buy a magnetic card costing about € 7 to activate the system. The credit on the card is used up after about 30 days and the card has to be recharged. The fees include full maintenance of the system, including battery changing. However, socio-economic and technical factors have prevented the programme from running smoothly.[41]

KfW is contributing € 15.9 million to the investment costs for 27,000 SHSs in two areas, Eastern Cape and North West Province. As yet, though, no contract has been signed with a concession partner.

Use of solar thermal energy

Despite high daily solar irradiation rates averaging between 4.5 and 6 kWh/m^2, the use of solar thermal energy to date has been marginal. The primary cause of this has been the very low and partly subsidised electricity prices, which promote the use of electricity for heating water. On the other hand there is growing interest in reducing the peak loads caused at certain times of day by electric water heaters, among other things by replacing them with solar heaters. Until now almost the only types to have been used are unglazed solar absorbers for heating swimming pools, while the market for glazed collectors for heating water for domestic use is dormant.

39 See section headed Rural Electrification.

40 A joint venture between the Dutch power utility Nuon and the South African company Rural Area Power Solutions Ltd. (RAPS).

41 The many thefts and a lack of willingness to pay have proved problematic. Furthermore, the prepaid card technique proved to be complicated and liable to faults. Shell is considering a new distribution model (Neue Energie, 09/2003, p. 110).

A project with the title Solar Water Heaters (SWHs) for Low-Income Housing in Peri-Urban Areas is currently being implemented, with subsidies from the GEF.[42] This project was preceded by pilot schemes with 100 low-cost solar hot water systems in townships of Durban and Johannesburg. In addition to expanding the solar thermal market, the purpose of the ongoing project, which is being implemented by the Central Energy Fund, is also to raise standards in manufacture and installation and to put appropriate financing mechanisms in place.

A market analysis was performed as the first step. Furthermore, new standards were developed for collector manufacture and for the training of installation engineers, and a test bed was acquired on which to carry out quality assurance and certification of collectors. 500 solar systems are now to be installed in a first project phase, primarily on newly built houses. A second phase is planned in which 9,000 systems are to be installed. The project is being handled in close collaboration with the FINESSE programme (Financing Energy Services for Small Scale Energy Use).

It is also aimed to equip houses with solar thermal systems in low-income townships of Cape Town through a CDM project that has already been registered. This involves both retrofitting to existing buildings and installation in – potentially – several thousand new homes. Some 2,300 systems are supposed to be fitted in the first stage. In mid-2007 it is expected that a directive will come into force in Cape Town which would make it obligatory to fit new buildings with solar hot water heaters.

ESKOM is also investigating the benefits of solar hot water heating in a research project, and is looking to a demand-side management project for the domestic sector to reduce electric peak load.

15.6 Rural Electrification

The proportion of rural households with an electricity supply rose from 21 % in 1995 to 54 % in 2005. Most of the non-electrified households are in the provinces of KwaZulu-Natal and Eastern Cape.

Integrated National Electrification Programme

The Integrated National Electrification Programme (INEP) unites the formerly separate electrification measures that were carried out by NER and Eskom. It has been running since 2001, with the DME taking over responsibility for it in April 2002. The aim is for all households to be provided with an electricity supply by 2012. The electrification programme is being financed by international donors and via the National Electrification Fund, which is fed directly from the national budget and is watched over by the DME.

In the 2004/2005 financial year more than € 110 million (ZAR 1 billion) was available from this programme, which enabled over 217,000 households and around 2,300 schools and health centres to be electrified. Only a very small part of this (ZAR 22.4 million = € 2.5 million) was used for solar home systems in private households (see above). In 2004 some 170,000 new connections were installed by Eskom alone, more than 74 % of them for rural households.

42 Total cost € 5.43 million, GEF subsidy € 0.73 million.

In the 2005/2006 financial year the budget amounted to almost € 130 million (ZAR 1.2 billion). This was enough to connect over 151,300 households, almost 500 schools and 28 health centres to the electricity grid. Nearly € 6.6 million (ZAR 60 million) was used for the provision of non-grid-coupled supply to households in the provinces of KwaZulu-Natal and Limpopo. The budget of almost € 8.8 million (ZAR 80 million) originally intended for these purposes could not be fully utilised, among other things because there were not enough solar modules available on the world market.

Almost € 154 million (ZAR 1.4 billion) was available for electrification for the 2006/07 financial year, including € 43 million (ZAR 391 million) for direct transfers to municipal authorities.

Exchange rate (December 2006):
1 South African rand (ZAR) = 0.11 euro (EUR)

15.7 Information Sources

- Banks, Douglas und Schäffler, Jason:
  The potential contribution of renewable energy in South Africa, Draft Update Report, February 2006
- Bfai:
  Energiewirtschaft Südafrika 2006, July 2006
- City of Cape Town:
  Draft Energy and Climate Change Strategy, 2005
- Department of Minerals and Energy:
  Annual Report 2004/05 und Annual Report 2005/2006
- Department of Minerals and Energy/Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE):
  Landfill Gas Resources for Power Generation in South Africa, November 2004
- Department of Minerals and Energy/Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE):
  Specification of Wind Monitoring Programme for South Africa, October 2004
- DME – Department of Minerals and Energy:
  Baseline Study on Wind Energy in South Africa, Final Report, Capacity Building in Energy Efficiency and Renewable Energy Program, February 2003
- DME – Department of Minerals and Energy:
  Green Power – Business Opportunities in South Africa for Renewable Energy Independent Power Producers, 2003
- DME – Department of Minerals and Energy:
  White Paper on Renewable Energy. November 2003
- DME – Department of Minerals and Energy:
  Digest of South African Energy Statistics 2005

- ESKOM:
  Annual Report 2006

- ESKOM:
  Integrated and prioritized Capacity Expansion Plan, August 2006 (presentation)

- Government Gazette:
  Republic of South Africa, vol. 478 of 6 April 2005, Energy Regulator Act

- Government Gazette:
  Republic of South Africa, vol. 493 of 5 July 2006, Electricity Regulation Act

- Green, William (africapractice):
  Carbon Finance for South Africa – an investor's guide, 2006

- Holm, Dieter:
  Market Survey of Solar Water Heating in South Africa for the Energy Development Corporation (EDC) of the Central Energy Fund (CEF), May 2005

- Minister of Minerals and Energy:
  Draft National Energy Bill, 15 September 2004

- NER – National Electricity Regulator:
  Annual Report 2004/2005 und Annual Report 2005/2006

- NER – National Electricity Regulator:
  Electricity Supply Statistics 2004 for South Africa

- NER – National Electricity Regulator:
  Lighting up South Africa 2002

- Prasad, Gisela and Visagie, Eugene:
  Renewable energy technologies for poverty alleviation – Initial assessment report: South Africa, June 2005 (Energy Research Centre, University of Cape Town)

- Republic of South Africa:
  Draft National Energy Bill, version 3, 15 September 2004

- United Nations Industrial Development Organization (UNIDO):
  CDM Investor Guide South Africa, 2003

- US Department of Energy, Energy Information Administration:
  Country Analysis Briefs: South Africa, February 2006

- Winkler, Harald:
  Renewable energy policy in South Africa: Policy options for renewable electricity, Energy Policy, Online-Version 2003

- Winkler, Harald
  (editor, Energy Research Center/University of Cape Town), Energy policies for sustainable development in South Africa, Options for the Future, April 2006

15.8 Contact Addresses

Department of Minerals and Energy
Private Bag X59
Pretoria 0001
Tel. +27 (12) 317 80 00
Fax +27 (12) 322 34 16
www.dme.gov.za

National Energy Regulator of South Africa (NERSA)
P.O. Box 40343
Arcadia 0007
Tel. +27 (12) 401 46 00
Fax +27 (12) 401 47 00
E-mail: info@nersa.org.za
www.nersa.org.za

GTZ Office Pretoria
P.O. Box 12732
Hatfield 0028
Tel. +27 (12) 342 01 81
Fax +27 (12) 342 01 85
E-mail: gtz-suedafrika@gtz.de
www.gtz.de

African Wind Energy Association (AfriWEA)
P.O. Box 313
Darling 7345
Tel./Fax +27 (22) 492 30 95
E-mail: office@afriwea.org
www.afriwea.org

South African National Energy Association (SANEA)
P.O. Box 868
Ferndale 2160
Tel. +27 (11) 789 13 84
Fax +27 (11) 789 13 85
www.sanea.org.za

Energy Research Centre
University of Cape Town
Private Bag
Rondebusch 7701
Tel. +27 (21) 650 32 30
Fax +27 (21) 650 28 30
E-mail: erc@ebt.uct.ac.za
www.erc.uct.ac.za

ESKOM
Megawatt Park
P.O. Box 1091
Johannesburg 2001
Tel. +27 (11) 800 81 11
Fax +27 (11) 800 43 38
E-mail: paia@eskom.co.za
www.eskom.co.za

Central Energy Fund (CEF)
P.O. Box 786141
Sandton 2146
Tel. +27 (11) 280 03 00
Fax +27 (11) 880 98 03
E-mail: mandlat@cef.org.za
www.cef.org.za

Sustainable Energy Society of Southern Africa (SESSA)
P.O. Box 868
Ferndale 2160
Tel. +27 (12) 789 13 84
Fax +27 (12) 789 13 85
E-mail: info@sessa.org.za
www.sessa.org.za

Southern African – German Chamber of Commerce and Industry
P.O. Box 87078
Houghton 2041
Tel. +27 (11) 486 27 75
Fax +27 (11) 486 36 25
E-mail: info@germanchamber.co.za
www.germanchamber.co.za

Development Bank of Southern Africa
P.O. Box 1234
Halfway House
Midrand 1685
Tel. +27 (11) 313 39 11
Fax +27 (11) 313 30 86
www.dbsa.org

Industrial Development Corporation of
South Africa Ltd.
P.O. Box 784055
Sandton 2146
Tel. +27 (11) 269 30 00
Fax +27 (11) 269 31 16
www.idc.co.za

Embassy of the Republic of South Africa
in Germany
Tiergartenstr. 18
10785 Berlin
Tel. +49 (30) 220 73-0
Fax +49 (30) 220 73-190
E-mail: wirtschaft@suedafrika.org
www.suedafrika.org

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources and to the involvement of foreign investors include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors. This fourth, updated and expanded edition is aimed at overcoming barriers such as these.

The electricity markets and their respective actors are investigated for 23 countries in various regions: Latin America, Africa – Middle East and Asia. The country studies analyse the energy-policy framework conditions and closely examine the status of and promotion policy for electricity generation on the basis of hydropower, wind power, solar power, biomass and geothermal energy. The chapters on each country are rounded off by information about rural electrification.

Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH

Dag-Hammarskjöld-Weg 1-5
Postfach 5180
65726 Eschborn
T +49 (0)61 96 79-1303
F +49 (0)61 96 79-80 1303
I http://www.gtz.de