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Water Sustainability and Power Generation in SOUTH AFRICA

9.1 Water challenges

9.1.1 Water availability

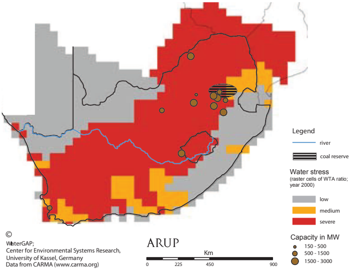
South Africa is a water-scarce country in which the demand in several river basins is in excess of the natural availability of water. The effects of variable rainfall patterns and different climatic regimes are compounded by high evaporation rates across the country. For example, the Cape Town region experiences a "Mediterranean" type climate with rainfall throughout the year and maximum precipitation during the winter. In contrast, the inland climate of Johannesburg has a rainy season in the summer months (October - April) but is dry throughout rest of the year.

Surface water is the most significant resource as groundwater availability is limited by the predominant geology of less permeable formations. In areas where groundwater is available the reserves are frequently over-exploited, for example, the Dendron, Springbok Flats and Coetzersdam.[82] Social and demographic factors also contribute to relative water scarcity; for example, the distribution of significant settlements and industry adjacent to notable mineral deposits rather than water resources.

Water availability in South Africa has been assessed using WaterGAP and the following map (**Figure 10)** shows that many areas of South Africa are experiencing severe water stress.

Figure 10:

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across South Africa. The location of selected power stations (>150 MW) is also indicated.



9.1.2 Climate change impacts

Climate change will have two key effects: (i) increasing temperature and, (ii) reduced and more erratic rainfall. A recent estimate[83] of the effects on water resources suggests that a likely gross reduction of 10% in average rainfall would reduce surface runoff in South Africa by 50-75%. An outlook on how water availability (shown in **Figure 3**) is expected to change on a global level due to climate change is provided by the University of Kassel.[84] **As in other water-scarce countries and regions financial institutions need to take into account that changing weather patterns due to climate change may have severe impacts on power utilities.**

See PI-TP 6

9.1.3 Water quality

Water pollution is a growing problem and can be attributed to a range of sources including: municipal pollution, industrial effluent, returns from irrigation and acid mine drainage. Water quality can further be impacted by high levels of water re-use from returns of treated effluent to rivers despite strict regulations imposed to combat pollution.

In the power sector, water quality concerns often influence the construction of proposed power plants. For example, the feasibility of proposed power stations on the Waterberg coalfields required an investigation of the impact on water supplies of the effluents emanating from urban and industrial areas in Gauteng. A similar problem has been encountered for the proposed extension of Sasol's operations with regards to the development of additional coal-to-liquid plants. Feasibility studies on the treatment of effluents are being undertaken.[85]

See PI-TP 5

9.1.4 Institutional/regulatory context

South Africa's progressive water policy is underpinned by the *National Water Act of 1998*. This legislation has a strong emphasis on social equity, environmental sustainability – using the concept of the "Ecological Reserve" - and on South Africa's responsibility to neighbouring states through the sharing of transboundary river basins. In 2004, the *National Water Resource Strategy* reported that 98% of the available water resources are already allocated, which is why the strategy focused on increasing stakeholder participation. It also provides the framework within which water is managed at the regional or catchment level in defined water management areas. The Department of Water Affairs is responsible for water management decisions in conjunction with River Basin Catchment Organisations and Water Users Associations. The recently announced *Water Growth and Development Framework* is outlined in the box below.

Energy, fuel supplies and water availability

The Department of Water Affairs (DWEA) is negotiating with Eskom to pump water from the Steelpoort River valley to the top of the Nebo Plateau, a height of 700 m, at a reduced energy cost for the benefit of communities in the Nebo area. Given the link between energy, fuel supplies and water availability, the Department has considered factoring in the water needs of the energy sector in its reconciliation strategies and accompanying feasibility studies. In so doing, concepts and principles that underpin this scheme include those of water efficiency, conjunctive uses of water, linkages between water for growth and water for development, and the utilization of alternative sources of energy. There is a close working relationship between the large water users within the energy sector to ensure that current expansion plans for the national energy grid are supported by water resource planning initiatives.

Source: [86]

9.1.5 Transboundary water management and water transfers

South Africa has entered into a number of bi- and tri-lateral transboundary water agreements with neighbouring states regarding shared watercourses such as the Orange and Limpopo River systems.

Nationally, a series of "inter-basin" transfers link the water resources of the country. Large volumes of water are transferred from the relatively water-rich Eastern areas to the water scarce areas in the West by means of man-made infrastructure. As a result of this strategy and despite limited water availability, the South African Government has managed to provide water for agriculture and industry at the required levels.[87]

An example is the Vaal River Eastern Sub-system Augmentation Pipeline (VRESAP). A total of 160 million m^3 of water per annum will be transferred to augment the water supply to the Eskom and Sasol power stations which is currently met from the Vaal River system.

9.2 The electricity power sector in South Africa

South Africa has large coal deposits and is one of the cheapest electricity suppliers in the world. Strong economic growth, rapid industrialization and a mass electrification program led to demand for power outstripping supply in early 2008. In 2006 coal accounted for 93% of the electricity generated followed by nuclear (4.6%) and hydropower (2.2%).[88] Almost all of the electricity produced is generated by the South Africa company Eskom which is one of the largest power producers in the world.[89] Eskom recognises the importance of effective stakeholder engagement for its long-term business success (e.g. expansion; see 7.2.1) and engagement is one of their top ten business priorities.[90]

See PI-TP 11

9.2.1 Expansion

The growth in coal use by Eskom and Sasol is expected to accelerate over the coming years. In April 2008 Eskom began construction of the new Medupi power station in Limpopo, located next to the Waterberg Coalfield that contains vast resources of coal. In the event that coal-fired power stations are built on the Waterberg coalfields, the Department of Water Affairs (DWEA) stated that Eskom would be obliged to intensify its water efficiency practices.[91] **Power providers and the financial institutions financing their activities should have a great interest in the development of water regulation in South Africa.**

See PI-TP 3

See PI-TP 2

Escom is investing in dry-cooled systems. It operates Matimba power station near Lephalale, in Limpopo, which is the largest direct drycooled station in the world.[92] In South Africa there are few installed sulphur removal systems. In 2008, Eskom began construction of a coal-fired power plant, named Kusile Power Station (previously called Project Bravo) which will be completed in 2017. It will be the first power station in South Africa to have flue gas desulphurization (FGD) installed.[93]

See PI-TP 7

The building of the first of a new generation of high-temperature helium gas-cooled nuclear reactors (Pebble Bed Modular Reactor, PBMR) has seen challenges to secure funding arrangements. If successful, the South African project would become the first commercial-scale high-temperature reactor in the world. **Financial institutions can influence decisions on the implementation of new technologies that have a reduced impact on local water availability.**

See PI-TP 1 & 2

9.2.2 Renewable energy

The Department of Minerals and Energy (DME) issued a White Paper on Renewable Energy in 2003. The government set a target to increase the development of renewable energy by 10,000 GWh by 2012. However, South Africa does not have adequate water supplies to meet the needs of large conventional hydropower stations and so far, large scale hydropower is available only in the Mozambique corridor.

See PI-HP 2

Small scale hydropower plants enable CO2 emission reductions and may replace coal fired electricity generated under certain circumstances. These schemes can help to overcome the electricity shortages currently experienced in South Africa. A critical factor is often the option for conjunctive use with irrigation or other storage releases,Small scale hydro schemes have received increasing levels of attention as the following case study illustrates.

There is a further proposal on the De Hoop Dam for the operation of Eskom's proposed hydropower pumped storage scheme in the Limpopo Province.

Case study: Bethlehem mini-hydro power plant, Free State province

Bethlehem Hydro (Pty) Ltd (BH) is an independent power producer. BH commenced construction of a mini-hydro power plant in December 2006 which will contribute towards the government's objective of increasing renewable energy development in addition to its environmental objective of reducing greenhouse gas emissions.

The increase in power production (from 3.9 MW in the feasibility study to the final level of 7 MW), together with the improved greenhouse gas emission reductions and "the recent increase in Eskom's electricity tariffs" [94] has markedly improved the project's financial viability.

Innovative nature of the project

The project is unique in the sense that it is one of the first commercially independent power producers in South Africa to construct a new plant. It is also the first hydro power project to be licensed under the new Water Act (Act 36 of 1998) and one of the first Clean Development Mechanism (carbon credit) projects in South Africa. From an environmental point of view, the provision of green electricity in place of coal-fired power is significant. It also assists South Africa in reaching Kyoto Protocol targets.

Hydropower projects are not common in South Africa due to the seasonal nature of water resources. This project was feasible due to a unique set of circumstances that transformed a seasonal river, the As, in the Free State, into a perennial river as a result of the Lesotho Highlands Water Scheme. Environmental mitigation was also used to offset the Merino wetland which was drained for the project.

See PI-HP 16 & 20

Community involvement

The local community was engaged through the Dihlabeng Local Municipality's Exco, whose members emphasised the use of local labour and local participation during the project. After completion, local contractors will be used for the operation and maintenance, albeit minimal for a hydro power project.

See PI-HP 12 & 13

The project also provided the opportunity for a Free State-Based women's group to obtain an 11% equity stake in a hydro power project. This arrangement was negotiated upfront with the developer to demonstrate their goodwill towards the local community.

Source: [95]

Komati water scheme augmentation project: Options for managing Water Scarcity

Additional demands will be placed on the on the Komati System due to increased power generation, return to service of the Komati Power Station and an upgrade of capacity at the Arnot Power Station.

Eskom investigated a number of options to alleviate the pressure on the Komati System and concluded that the following two alternatives had to be investigated in more detail:

- Install a 35 Ml/d desalination plant at Duvha Power Station, or
- Construct a pipeline and pumping station to transfer water. The two main options were evaluated at a feasibility stage, addressing environmental considerations, capital cost and life cycle cost.

See PI-TP 5

Source:[96, 97]