World Business Council for
Sustainable Development

Case study
2006

Eskom
Reducing water consumption

Situation

Eskom is a large consumer of freshwater in South Africa, accounting for approximately 1.5% of the country's total consumption annually. Eskom power stations run constantly, supplying in excess of 95% of South Africa's electrical energy and more than half of the electricity used on the African continent. Without water, this output would not be possible.

Eskom uses raw water, which is put through extensive purification and treatment before entering the production processes. The salinity of the raw water dictates the volume of effluents that are produced during the treatment process. During 2004, Eskom used 277.6 million cubic meters of water for electricity generation, mainly at its coal-fired power stations.

The water catchment areas in which many of Eskom's power stations were built are relatively water scarce, necessitating the need for inter-basin transfers. Over the years, various water supply schemes have been constructed to supply the necessary water to the power stations. These schemes consist of dams, pipelines, pumping stations and reservoirs and are inter-linked and operated as a system.

Targets

It is expected that Eskom's water consumption will increase over the next 10 years, due to increased demand for electricity. However, decades ago Eskom recognized that the organization would have to find ways of limiting increases in water consumption and contribute to sustainable water use in South Africa. Eskom is thus committed and determined to support the drive to improve the management of South Africa's scarce water resources.

Water use targets in terms of liters of water used per unit of electricity sent out are set for each power station every year. The water targets are linked to the Eskom Sustainability Index contained in performance compacts, which are in turn linked to business unit and individual performance bonuses. The targets are benchmarked against historical as well as theoretical water consumption for each particular type of plant.

Activities

Management strategies are formalized in the company's Environmental Management Policy and more specifically its Water Management Policy. These policies are cascaded down into all levels of the organization. Where relevant, specific business units have their own water policies, standards and guidelines.

Over the last two decades Eskom has introduced a number of innovative technologies to save water. These include dry cooling, desalination of polluted mine water for use at the power stations, and technical improvements on treatment regimes to maximize the beneficial use of water. In so doing, more than two hundred million liters of water are saved every day.

a) Dry Cooling Technology

A conventional wet-cooled power station uses a recirculating system in which cooling takes place via evaporation in an open cooling tower. Approximately 85% of the total quantity of water supplied to a power station evaporates through these open cooling towers. In contrast, dry-cooling technology does not rely on evaporative cooling for the functioning of the main systems. As a result, overall power station water use is approximately 15 times lower than a conventional wet-cooled power station. For this reason, Eskom has implemented dry-cooling technology on power stations wherever feasible, despite the fact that dry-cooled stations comparatively are less efficient than wet-cooled stations and there are higher capital and operating costs associated with the technology. This water conservation effort results in an estimated combined savings of over 200 Ml/day, or in excess of 70 million m^3/annum.

Matimba Power Station near Ellisras in the Northern Province is the largest direct dry-cooled station in the world, producing more than 4,000 Megawatts (MW). It makes use of closed-circuit cooling technology similar to the radiator and fan system used in motor vehicles. Water consumption is in the order of 0.1 liters per kWh of electricity sent out, compared with about 1.9 liters on average for the wet-cooled stations. The choice of dry-cooled technology for Matimba was largely influenced by the scarcity of water in the area.

Figure 1: Matimba Power Station during construction

Kendal Power Station near Witbank in the Mpumalanga Province, is the largest indirect dry-cooled power station in the world, with a water consumption in the order of 0.08 liters per kWh of electricity sent out. Indirect dry-cooling entails the cooling of the water through indirect contact with air in a cooling tower, a process during which virtually no water is lost in the transfer of the waste heat.

b) Desalination

Where power station design permits, Eskom has endorsed a policy of zero liquid effluent discharge (ZLED) at its wet cooled stations. In terms of the ZLED policy, water is cascaded from good to poor quality uses until all pollutants are finally captured in the ash dams. The objective is to dispose of the maximum mass of salts with the smallest possible volume of water without compromising the ability of the ash to encapsulate the salt load imposed.

Figures 2 and 3: Finned tube condensers above forced draught fans

The effective use of this practice has seen the company introduce the use of desalination plants at two of its power stations, namely Lethabo and Tutuka. These treatment processes allow the company to introduce polluted mine-water from the tied collieries for re-use at the power stations. This assists with the prevention of negative environmental impacts on the surface and ground waters of the country.

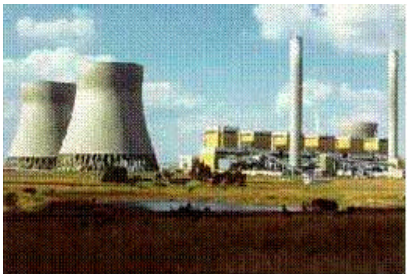

Figure 4: Kendal Power Station

Tutuka Power Station, near Standerton in Mpumalanga, is a wet-cooled station using a dry ashing system, where moistened ash is conveyed to the ash dump on overland conveyors. Blowdown water from the concentrated cooling water (CCW) system is used for ash conditioning. When the power station operates at a low load factor the amount of ash generated is normally insufficient to contain all the blowdown water. Also, the salinity of the Vaal River water used at the station, in combination with the dry ashing system, limits the station's ability to contain water in the ashing system. A desalination plant was therefore required to reduce the volume of water that is disposed of at the ash dumps, to counteract the effect of the poor water quality. For this reason, the power station's desalination plant was built in 1985. The product of the desalination plant is mainly fed into the CCW system, whilst the brine is used for ash conditioning. Initially, the plant was intended to be used only for the treatment of the CCW blowdown. In an effort to explore existing and possible synergies between the power station and its mine, New Denmark Colliery, it was realized that greater benefits will be derived from treating the mine's water in addition to the CCW blowdown.

Figures 5 & 6: Tube bundle heat exchangers within the cooling tower.

c) Water Infrastructure

Eskom has over the past 40 years contributed to the development of an extensive network of pipelines and dams with the South African Department of Water Affairs and Forestry (DWAF), especially on the Mpumalanga Highveld. This has been done through partnering with DWAF in either directly contributing to the infrastructure development financially or by joint involvement in projects. These projects, primarily aimed at providing a secure water supply to the power stations and their associated collieries, has had a significant impact on the viability of supplying water to both industries in the area and water for domestic use. Currently, Eskom is the major contributor to a pipeline linking Vaal Dam to the water supply system on the Mpumalanga Highveld which would provide water security to the area for the next 20 years.

Fig 7: The desalination plant and high -pressure pump

d) Water Metering and Monitoring

The DWAF measures the water they supply to the power stations at the boundary of the power station terrace. Eskom and DWAF has adopted a metering procedure which has seen the implementation of revenue class meters that measure to a level of accuracy of 0.5%. This is an improvement on the previously accepted 5% level of accuracy.

On the power station terraces ongoing meter verification and upgrades takes place. Both on-terrace and third party users' water meter readings are taken at least once per month. Water balances and salt balances are carried out at least once a month using the readings to verify performance and identify potential problems. At the power stations, inspections are carried out during every shift and any leaks are recorded and reported for

repair as part of their formal reporting systems and maintenance procedures. On the raw water supply pipelines, major leaks are rapidly indicated by the remote supervisory control system that senses any reduced water levels in the terminal raw water reservoirs at the power stations. Regular pipeline inspections are carried out to identify minor leaks and all leaks are recorded in mandatory inspection schedules. Water balances are also carried out monthly on the water supply systems.

e) Demand Side Management
Electricity demand side management as practiced in Eskom endeavors to integrate the demand and supply side options to find the lowest cost options for the provision of electricity. Demand side management in electricity may be defined as the practice of a supplier of electricity influencing the manner in which its customers use electricity to increase the beneficial use of the commodity. Although water conservation has not been the primary motive for these initiatives, there have been water savings spin-offs. For every kilowatt-hour of electricity that is saved, approximately 1.26 liters of water is also saved on average.

f) International Co-operation
Eskom is a participant in the Southern African Power Pool, which allows for the trading of electricity between countries in Southern Africa. This means that Eskom can import electricity from neighboring countries to meet increased demands. Since the electricity generated in the countries to the north of South Africa is mainly from hydro power stations, e.g., Cahora Bassa in Mozambique, the importation of this electricity effectively reduces the utilization of South Africa's water resources for electricity generation.

Results

The quantity of energy produced between 1993 and 2004 has increased by 43%, as opposed to an increase in water consumption by 27% (Figure 8). This improved water use efficiency equates to a cumulative saving of 1 400 million m^3 over the period if compared to the quantity of water that would have been used if these power stations were of the wet cooled type. This is approximately five times Eskom's average water use per annum.

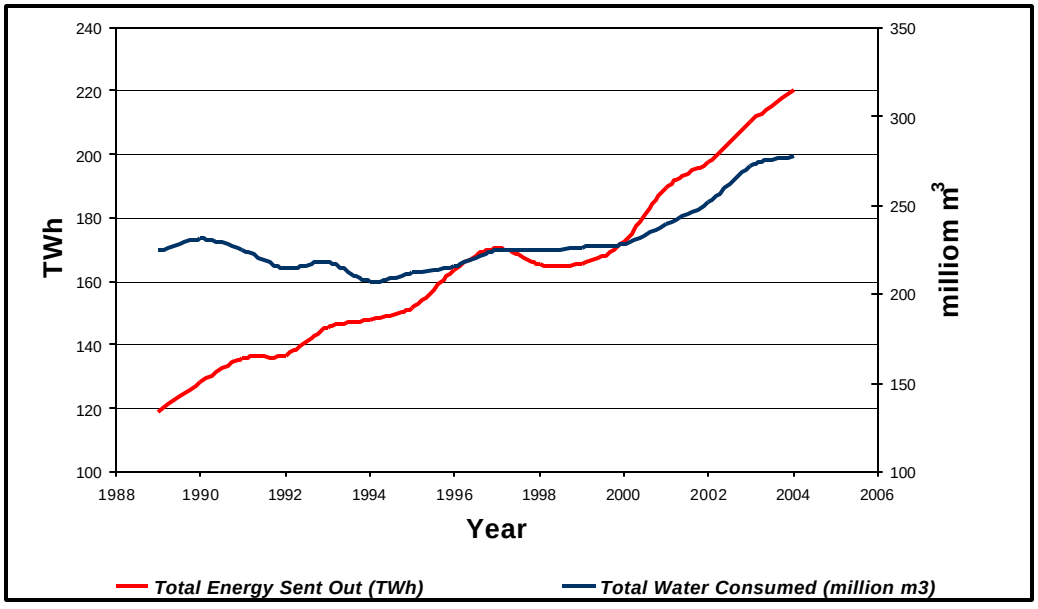

Figure 8: Water use compared to energy produced

Access to water and water availability remains a key factor in ensuring the sustainability of development in southern Africa. The efforts by Eskom to use this precious resource more efficiently are an integral part of the company's commitment to sustainable development.

The Sustainability Index (SI) was introduced in 1996 to ensure long-term sustainability of Eskom's business in the technical, financial, social and environmental arenas. The specific water use indicator (l/kWh) forms part of the SI, and is included in the performance contracts of all those who have an impact on the organizations water use.

The implementation of Eskom's water conservation initiatives, i.e., dry cooling, ZLED and the focus on the judicial use of water at all facilities, has resulted in a significant reduction in the overall specific water consumption over the years, from approximately 2.85 l/kWh in 1980 to 1.26 l/USO in 2004 (Figure 9).

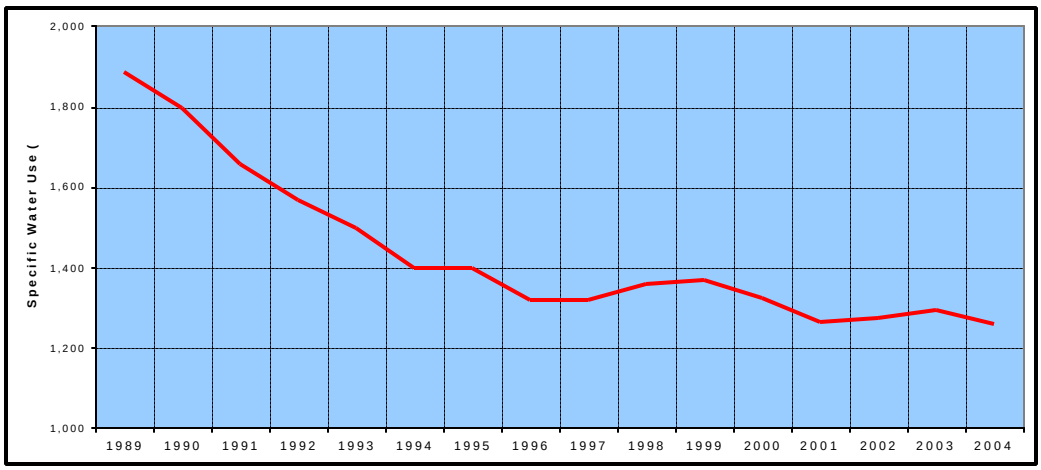

Figure 9. Specific Water Use for Eskom

About the WBCSD

The World Business Council for Sustainable Development (WBCSD) is a coalition of leading international companies that share a commitment to the principles of sustainable development via the three pillars of economic growth, ecological balance and social progress. All regions of the w orld and most major industry sectors are represented in our membership. The WBCSD also benefits from a global network of national and regional business councils and partner organizations representing a large and diversified group of business leaders.

Our mission is to:

- Provide business leadership as a catalyst for change towards sustainable development;
- Support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

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