Small but electrifying

Much research has been carried out into solutions for efficient and cost-effective off-grid rural electrification. Local hydropower sources are one of these solutions. **by WE Jonker Klunne, CSIR**

LOCAL HYDROPOWER sources can play an important role in electrifying rural areas in South Africa, both as stand-alone applications in remote areas not connected to the national distribution grid, as well as distributed energy sources connected to the grid. In remote locations, hydropower can provide electricity essential for local development, while grid-connected schemes can help in diversifying electricity supply sources for local municipalities.

As the potential for small hydropower (schemes with an installed capacity of less than 10 MW) is typically found away from the larger population areas, it is a suitable energy source for rural electrification purposes. Off-grid applications of small hydropower are either hydro-only systems or hybrid systems that combine hydropower with other energy sources. If properly designed, off-grid mini-grids powered by hydropower can be prepared to be linked to the grid once these have reached their location.

Leading in

There is enormous exploitable hydropower potential on the African continent, but despite this Africa has one of the lowest hydropower utilisation rates. While large-scale hydropower development is becoming a challenge owing to environmental and socio-economic concerns, and more recently its vulnerability to changing climates and water availability in the main water bodies, small hydropower development continues to be an attractive resource, especially in remote parts of Africa. The fact that micro-hydro installations tend to use only part of the available water in rivers makes them less vulnerable to changes in water quantities owing to climate change. Small hydro is a proven technology that can be connected to the main grid, isolated grids or as a stand-alone option, or combined with irrigation systems. Small hydro can adequately contribute to the electricity needs of African countries.

Small-scale hydro in Africa

Small-scale hydropower has a long history in Africa. The first system in South Africa was a 300 kW station on the slopes of Table Mountain, which was inaugurated in 1895 (Barta, 2002). In Tanzania, more than 16 small hydropower systems were installed by church missions in the 60s and 70s of the last century that are still in operation (Mtalo 2005), while in Zimbabwe large-scale commercial farmers in the eastern highlands of the country installed hydro stations as early as the 1930s (Klunne, 1993).

Recently, initiatives have seen the light in a number of countries in Africa to revive the hydropower sector, either through international development agencies or through private sector-led initiatives. Particularly in Central Africa (Rwanda), East Africa (Kenya and Tanzania) as well as Southern Africa (Malawi, Mozambique and Zimbabwe), new initiatives are focusing on implementing small-scale hydropower projects.

Situation in South Africa

Although not very well documented, small-scale hydropower used to play an important role in the provision of energy to urban and rural areas of South Africa. The first provision of electricity to cities like Cape Town and Pretoria was based on small-scale hydro, while smaller towns started local distribution of electricity through isolated grids powered by small hydro stations. However, with the expansion of the national electricity grid and the cheap, coal-generated power supplied through this grid, large numbers of systems were decommissioned.

The South African Renewable Energy Database (Muller, 1999), as developed by the CSIR, investigated the available renewable energy resources in the country, including the potential for hydropower. This was detailed for the Eastern Cape region through a three-year investigative project, entitled 'Renewable energy sources for rural electrification in South Africa'. The primary objective of this project was to identify the commercially viable opportunities for rural electrification in the Eastern Cape using wind-, hydro- and biomass-powered energy systems.

In the 'Baseline study on Hydropower in South Africa', which was developed as part of the Danish support to the South African Department of Minerals and Energy, Barta (2002) investigates the installed capacities of hydropower in South Africa and the potential for new developments. He concludes that twice more the installed capacity of the present installed hydropower capacity below

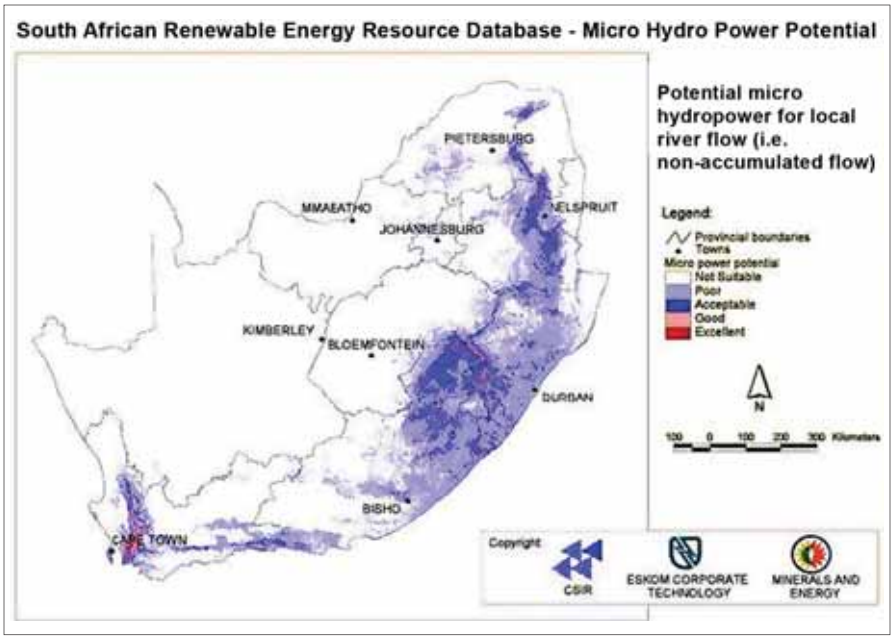


TABLE 1 HYDROPOWER CAPACITY IN SOUTH AFRICA (BARTA, 2002)

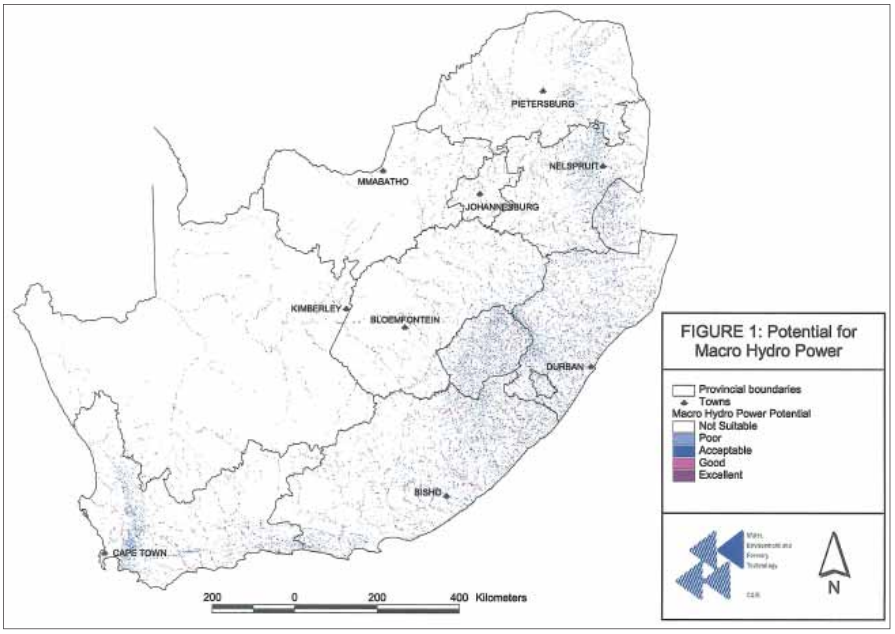
Hydropower category (power output)	Installed capacity (MW)	Potential for development (MW)
Pico (< 20 kW)	0.02	0.1
Micro (20 kW to 100 kW)	0.10	0,4
Mini (100 kW to 1 MW)	8.10	5.5
Small (1 to 10 MW)	25.70	63.0
Total	33.92	69.0

10 MW can be developed in the rural areas of the Eastern Cape, Free State, KwaZulu-Natal and Mpumalanga.

Barriers to and support for the uptake of small hydro

The challenges facing small hydropower exploitation in general are many and most of them are part of the larger picture of general barriers for the uptake of renewable energy and independent power producers. These generic barriers can be summarised into the lack of clear-cut policies on renewable energy and associated requisite budgetary allocations to create an enabling environment for mobilising resources and encouraging private-sector investment, and the absence of lost-cost, long-term financing models to provide renewables to customers at affordable prices while ensuring that the industry remains sustainable. Specifically for small hydro, large-scale implementation is hindered by:

- Lack of access to appropriate technologies in the mini-, micro- and pico-hydro categories, which because of small heads and high volumes or very high heads and low volumes pose special technical challenges.
- Lack of infrastructure for manufacturing, installation and operation. Most of the countries in Africa do not have any facility to manufacture even the most rudimentary turbines or parts that might be critical in maintenance of the schemes.
- Lack of local capacity to design and develop small hydropower schemes for areas sometimes considered too remote. Generally, most of the countries lack specialisation to undertake feasibility studies, detailed studies that would include detailed design and costing of the schemes to make a meaningful impact on use of small hydro sites.



Conclusions

Although South Africa has a substantial potential for small hydropower development – particularly in the rural areas of the Eastern Cape, Free State, KwaZulu-Natal and Mpumalanga – at the moment, only very few stations are in operation. With the current target of 10 000 GWh of electricity generated by renewable energy sources by 2013, as mentioned in the 2003 White Paper on Renewable Energy, The announcement of a feed-in tariff for mini hydropower, the initiation of the Working for Energy Programme, the current government priority on rural development as well as international support offered to the country, the time is ripe for the development of more small hydropower stations to provide currently unserved rural areas with electricity.

Several initiatives on off-grid small hydropower are currently ongoing on the continent from which South Africa can draw valuable lessons with respect to sustainable implementation of such systems. Hydropower development needs to be embedded in a national programme for capacity building and industrial development to foster a new industry to emerge. Particular attention needs to be given to governance issues related to hydrostations as experienced from other countries suggests that linkages with ongoing economic activities will ensure proper management of the system. In addition, the inclusion of entrepreneurs/private-sector developers could benefit the sustainability of the systems. 3S