

The Case for Hydro Power

The importance of the hydraulic energy is, in fact, acknowledged at the international level. Paish states that where a hydropower resource exists, experience has shown that there is no more cost-effective, reliable, and environmentally-sound means of providing power than a hydropower system [5].

Water can close South Africa's electricity gap

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South Africa has failed to take advantage of the full potential of using water without depleting it.

In 2011 Cabinet approved the Integrated Resource Plan (IRP), which sets out a diversification of sources of fuel by 2030. It also stipulates that the future power mix will derive 6% from pumped storage for peak supply and 12% from base-load imported hydropower.

Arthur Melet, senior research analyst for oil and gas at IDC Energy Insights, Middle East and Africa, says that South Africa's current operational capacity is Gariep (maximum capacity 360MW), Vanderkloof (maximum capacity 240MW), Colley Wobbles (nominal capacity 42MW), First Falls (nominal capacity 6MW), Ncora (nominal capacity 2MW) and Second Falls (nominal capacity 11MW).

Melet adds that future capacity includes Ingula, which has a planned capacity of 1 332MW, based on four 333MW turbines. It should be partially operational by January 2014 with four units to be delivered every quarter. In addition, there is the planned Neusberg project that has a maximum capacity of 12.57MW.

The whole idea behind South Africa's IRP is to partly replace coal power plants, while government also needs to find an alternative source of energy to achieve its targets in terms of additional power capacity, adding around 40 000MW by 2030, compared to 2010, says Melet. "Hydro is a part of the plan, but the additional power generation capacity will mainly come from coal-fired power stations." Hydro can be used for base power generation because it is a steady supply and — because it can be stored and released — can be used for peak power, adds Melet.

Wim Jonker Klunne, from the Council for Scientific and Industrial Research, has noted that about 10% of the global hydropower potential is located on the African continent, with the majority of that in sub-Saharan Africa. Yet, only 4% to 7% of this potential has been developed.

"Small hydropower can play a pivotal role in providing energy access to remote areas in Africa either in stand-alone isolated mini grids or as distributed generation in national grids," he wrote in a paper published online.

Challenging solution

Yet, independent power producers (IPPs) that want to use water to generate electricity are disadvantaged because they face strict regulatory and environmental requirements and must pay to use the resource, thanks to Water Affair requirements, says Bo Barta, spokesperson for the Sustainable Energy Society of South Africa.

Under South Africa's Renewable Energy Independent Power Producer Procurement Programme, small-scale hydropower — between 1MW and 10MW — has been allocated capacity of 75MW, with a pricing cap of R1 030 per megawatt hour. Yet, says Barta, South Africa has not placed enough emphasis on the potential of hydropower as a solution to the country's electricity shortage.

The challenge with hydropower is that projects require a long lead-time, says Barta.

He adds that most suitable hydropower schemes are in the range of 300kW and 3MW of feasible capacity, mostly through retrofitting hydroelectricity equipment to the existing water supply infrastructure such as dams, irrigation canals, gravity pipelines and tunnels.

Melet puts lead-time at between three and 10 years, depending on the scope of the project.

However, because South Africa does not have predictable rainfall patterns large storage areas would be required, adding to the cost, Barta adds.

Yet, hydropower has its benefits because it is not as intermittent as wind and sun power, and can be used to

create an energy battery because pumped storage can be used for peak power generation, he notes.

Barta says a 1MW small-scale hydroelectric plant, which can be attached to an existing dam facility, can theoretically use the annual water flow for 95% of the dam's downstream time.

As a result, around 8 322GWh of electricity can be generated in a year and, if a plant has a lifespan of 20 years before major refurbishment is needed, the plant can offset about 148 132 tonnes of CO₂ if the World Bank baseline conversion rate of 890 tonnes CO₂ per GWh is applied, he adds.

Melet says that although environmental issues are not a major concern for small-scale projects, these can be a real issue for large projects that involve the creation of a dam or an artificial lake because there is an impact on fauna and flora and the projects can disrupt river flow, and cause landslides and floods, in addition to potential social impacts if people must be moved.

Potential answer

However, there is a solution that is often overlooked, which is to retrofit irrigation dams that could then be used as a source of water for power without using up the water that is vital for agriculture, says Barta.

He says that there are 4 500 dams in South Africa, of which at least 1 100 can be retrofitted to become mini and small generators.

In 20 years, a 1MW plant can replace about 6 000 tonnes of fossil fuels while supplying some 1 000 sub-urban households with electricity, says Barta.

Small-scale hydroelectric installations are seen as "exemplary" renewable energy converters because they

produce minimal emissions and do not use up the water, he notes.

Adding 75MW to South Africa's power grid through hydro would cost the country around R2-billion, while on average it would cost between R15-million and R25-million a megawatt to retrofit a dam, which is cheaper or equivalent to wind or solar capital spend, says Barta.

Hydropower has the potential to expand Eskom's margin, the difference between electricity demand and supply, by adding a sustainable amount of around 7 200MW in the next ten years from all types of hydropower schemes, especially in high-potential Eastern Cape and KwaZulu-Natal sites, says Barta.

He says that smaller stations could also aid communities that have yet to be plugged into the grid, with the potential to create jobs.

Barta notes that although not currently in favour, small-scale plants were a significant component of the yester-year electricity production in several parts of South Africa, with a plant installed as far back as 1885 at the foothill of the Table Mountain in Cape Town, along with a few small and defunct plants scattered along the feet of the Drakensberg range.

There are a few small-scale plants being upgraded and refurbished, including Belvedere (2MW), Ceres (0.8MW), Clanwilliam (1MW), Kouga (5.3MW), Ncora (2.4MW), Piet Retief (1MW), Pongolapoort (2.7MW) and a few other smaller privately owned installations.

However, the biggest project on the cards is the much-delayed Grand Inga scheme in the Democratic Republic of Congo (DRC). Stage three is set to supply South Africa with about 2 500MW, of a phase output of 4 800MW once complete, says Barta.

The imported power will traverse some 2 800km via several countries, but the project, with a total output of 40 000MW,

is likely to cost more than R25-million a megawatt and will escalate, he adds.

Lead-time to commissioning is around 10 years, estimates Barta, noting that this depends on many political and socioeconomic factors in countries such as the DRC, Angola, Namibia, Botswana and Zimbabwe.

However, the risk with imported hydropower is if there are civil wars, supply will be disrupted. Barta says South Africa should rather focus on local capacity, which gives more long-term advantages such as skills transfer.

In addition, there is a potential to use the ocean for hydropower, which can be done in harbours without any disruption, he says.

"The potential of ocean-generated energy is completely neglected in South Africa, although there is good potential waiting for the coastally-located communities and urban areas."

Barta says, globally, interest is increasing in the technology and South Africa's IRP to balance coal-fired power generation with renewable and alternative sources to increase the output from hydro.

He says several countries are looking into the possibility combining hydropower with other types of renewable energy technologies, mostly wind and solar photovoltaic (PV).

"In South Africa, hydro and solar PV is the future, particularly for small pumped storage schemes."

Hydropower is "undeniably" renewable and robust, says Barta. He notes, however, that South Africa only aims to add another 75MW from hydro, when the country has the capacity to add 10 times as much.

Currently, says Barta, hydropower accounts for about five percent of Eskom's theoretical output capacity of 45 000MW, although this varies depending on whether coal stations are off line for maintenance.

This percentage could grow if the IPP programme capacity is allowed to develop fully to 75MW, but there is a need for a more serious approach in developing both large and small plants, especially in rural areas and within existing urban water supply schemes, says Barta.

* Numerous requests to Eskom and government departments for comment were unanswered by the time of going to print.

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