Electricity sector overview

In South Africa, coal accounts for about 90 per cent of electricity generation. The Koeberg nuclear power station provides about 5 per cent of generation, gas and diesel provide about 2 per cent, hydropower (including pump-storage) provides 2 per cent and the remaining is provided by wind power (Figure 1). In 2013, South Africa generated 236,760 GWh of electricity.\(^6\)

With the commissioning of the contracted renewable energy (RE) technologies through the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP), the energy landscape in the country is changing rapidly. In particular, wind and solar PV are contributing increasingly to the energy mix of the country. By mid 2015, 1,860 MW of RE capacity supplied electricity to the national grid.\(^6\) As of early 2016, RE IPPs had 2,021 MW connected to the grid.\(^5\)

Generation is dominated by Eskom, the national wholly state-owned utility, which also owns and operates the national electricity grid. In 2015, Eskom provided 214,742 GWh (93 per cent) of the total 230,122 GWh distributed in the country.\(^1\) The company also sells electricity to the countries of the Southern African Development Community (SADC) and in total accounts for approximately 45 per cent of the electricity used in the country.\(^5\)

In 2011, the Department of Energy published the Integrated Resource Plan (IRP) outlining the development of new generation capacities from 2010-2030. The Government’s target is to provide 17,800 GW of new power generation capacity from wind and solar power by 2030. The main source of hydropower, according to IRP, will be the import of 2,609 MW from Mozambique and Zambia, while local, small-scale hydropower and landfill gas based electricity were allocated a share of 125 MW.\(^1\)

By the end of 2015, the REIPPPP had successfully allocated...
5,052 MW of RE generation capacity to 79 preferred bidders, including three small hydropower (SHP) projects totaling 19.1 MW.4

Table 1 provides an overview of the power purchasing agreement (PPA) prices achieved in the REIPPP. The price of ZAR 1.12 per MWh (approximately US$6.92/MWh) as per the fourth bidding window can be used as a reference for the cost of SHP in South Africa. Unfortunately, connecting to the national grid outside the REIPPP process is very difficult and only possible at prices far below the REIPPP PPA prices.7

<table>
<thead>
<tr>
<th>Technology</th>
<th>BW 1</th>
<th>BW 2</th>
<th>BW 3</th>
<th>BW 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore wind</td>
<td>1.36</td>
<td>1.07</td>
<td>0.78</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
<td>(0.066)</td>
<td>(0.048)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>Solar PV</td>
<td>3.29</td>
<td>1.96</td>
<td>1.05</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.121)</td>
<td>(0.065)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Solar CSP</td>
<td>3.20</td>
<td>3.00</td>
<td>1.74</td>
<td>1.62</td>
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<tr>
<td></td>
<td>(0.2)</td>
<td>(0.185)</td>
<td>(0.107)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>—</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.062)</td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>—</td>
<td>—</td>
<td>1.49</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.092)</td>
<td></td>
</tr>
<tr>
<td>Small hydro</td>
<td>—</td>
<td>1.23</td>
<td>—</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.076)</td>
<td></td>
<td>(0.069)</td>
</tr>
</tbody>
</table>

Source: DoE7
Note: Fully indexed to April 2014.

Small hydropower sector overview and potential

The REIPPPP process has initiated substantial activity in hydropower development. During the first three bidding windows, the maximum size of SHP plants was set at 10 MW. However, in the Request for Qualifications and Proposal for the fourth bidding window in June 2014, a new capacity limit of 40 MW for SHP was introduced. Nonetheless, no official definition of SHP exists in the country. Therefore, this report will classify all hydropower plants up to 10 MW as SHP plants.

The installed capacity of SHP in South Africa is 50 MW, while the potential is estimated to be 247 MW. This indicates that only 20 per cent has been developed. However, the longer-term feasible potential could be upwards of 1,100 MW. Between the World Small Hydropower Development Report (WSHPDR) 2013 and WSHPDR 2016, the installed capacity has increased by almost 32 per cent, while the potential has remained unchanged (Figure 2).

Small-scale hydropower used to play an important role in the electrification of both urban and rural areas of South Africa, including Cape Town and Pretoria. Smaller towns used to have their own local electricity distribution networks with isolated grids powered by SHP plants. However, many of those systems were decommissioned as a result of the expansion of the national electricity grid and the cheap, coal-generated power supplied through this grid. For example, the 1.35 MW Sabie Gorge hydropower plant was commissioned in 1928 to serve the town of Sabie, but closed in 1964 when the area was connected to the national Eskom grid.21 After almost 30 years of neglect, SHP development was re-launched with the construction of the first new SHP plant in the Sol Plaatje Municipality in the Free State province.

The South African Renewable Energy Database, developed by the Government, studied the availability of RE resources in the country, including hydropower.19 Subsequently, a three-year project, entitled Renewable Energy Sources for Rural Electrification in South Africa, was undertaken to investigate the resources available in the Eastern Cape region and to identify commercially viable opportunities for rural electrification in the Eastern Cape Province using wind, hydro and biomass power. The outcomes of the two studies with respect to the potential of SHP in South Africa and the Eastern Cape are shown in Maps 1 and 2 respectively.

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, the installed capacities of hydropower in South Africa and
the potential for new developments were investigated.\textsuperscript{23} It was concluded that more than two times the installed capacity of the present installed hydropower capacity below 10 MW can be developed in the rural areas of the Eastern Cape, Free State, KwaZulu Natal and Mpumalanga. A more recent estimate includes the potential of water transfer systems and gravity fed water systems with a total potential of 247 MW.\textsuperscript{9}

In 2015, Eskom operated four large hydropower stations: Gariep (360 MW), Vanderkloof (240 MW), Colley Wobbles (42 MW) and Second Falls (11 MW). It also operated two small stations: First Falls (6 MW) and Ncora (1.6 MW).\textsuperscript{25} The small systems in the country can be divided into the following groups:

- Grid connected systems commissioned prior to the REIPPPP process;
- Systems installed under the REIPPPP process;
- Grid connected systems that fall outside the REIPPPP process;
- Stand-alone systems that do not feed into the national grid.

In the micro range, a substantial number of plants is in operation in the KwaZulu Natal and Eastern Cape region, mainly serving individual farmers.

Another application of hydropower in the country is the installation of in-flow hydropower turbines in water transfer systems. The City of Cape Town operates hydropower turbines at four of its water treatment plants: Blackheath (700 kW), Faure (1.475 MW), Steenbras (340 kW) and Wemmershoek (260 kW). The municipality of Ethekwini and Rand Water utility are developing six and four sites respectively. The City of Johannesburg has released a tender for the installation of 3 MW of hydropower capacity in its bulk water reticulation system. Furthermore, a 15-kW system was installed at the Pierre van Rynveled Reservoir in Pretoria as part of a research project by the University of Pretoria. Bloemwater, the water distribution company of the city of Bloemfontein, has also commissioned a 96 kW system at the inlet of a water reservoir that is now providing power to the company’s headquarters.\textsuperscript{9}

In the second round of REIPPPP, two hydro developers, Kakamas Hydro Electric Power and NuPlanet, were granted the preferred bidder status for the construction of the Neusberg plant (12.57 MW) and the Stortemelk plant (4.47 MW). However, for the Neusberg site, only 10 MW will be developed in accordance with the REIPPPP requirements.\textsuperscript{12,13} In the fourth round, the 4.7 MW Kruisvallei system was selected for implementation. Aside from operational systems, South Africa has a number of existing, inactive small-scale installations that could be refurbished, such as Belvedere (2.1 MW), Ceres (1 MW), Hartbeespoort (potential up to 8 MW), Teebus (up to 7 MW) and others.\textsuperscript{9}

SHP development in South Africa will be focused both on the development of grid-connected projects that will feed into the national electricity system and small-scale systems for private use (not feeding into the grid, irrespective of whether a grid connection is available or not). Additionally, isolated SHP systems can be used for electrification of rural areas. The private use of small-scale systems is expected to grow based on the foreseen rise in electricity prices and low reliability of the grid.

All in all, it is expected that SHP can play a small but important role in the future energy mix of the country.

**Renewable energy policy**

South Africa has a full suite of policies in place to support the energy sector, ranging from a White Paper on Energy Policy to a specific White Paper on Renewable Energy Policy. For the implementation of RE technologies, the REIPPPP is the vehicle. The REIPPPP was launched by the Department of Energy in 2011, switching from the feed-in tariff system that had been created in 2009.

Until very recently, the country’s policy focus has been on large-scale, grid-connected RE. With the National Energy Regulator of South Africa preparing guidelines and policies for small-scale embedded generation, future activities related to SHP development, as well as other small-scale RE projects, will be facilitated.

**Barriers to small hydropower development**

The main barriers to the uptake of SHP in South Africa are the low cost of electricity, the cumbersome process of the REIPPPP, the low appreciation of SHP technology due to perceived low potential and (in some cases) the reluctance of the Department of Water Affairs and Sanitation to provide the required permissions.
References