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Briefing Note: Desalination: panacea or peril for South Africa?

The desalination of water has been identified as a potential source for water in the country. The recent series of droughts has underscored the critical importance of an adequate water supply. In this context, many voices have hailed desalination as South Africa's cure to water security woes. Critics, however, cite its high cost and potential environmental harm as rendering the technology unfit.

Over the past 30 years, desalination technology has evolved as a viable, albeit costly means of producing water, opening up non-traditional sources of water like brackish water[1] and seawater. Desalination of water from any source occurs broadly via two processes: thermal evaporation and membrane separation. *Thermal evaporation* involves the evaporation and condensation of saline water to purify it, and is most prevalent in the Middle East, which has cheap fuel and has historically used facilities that co-generate energy and water. Since heat is a vital input in thermal desalination, the process is typically coupled with power plants and refineries that discharge significant quantities of waste heat. *Desalination via reverse osmosis (RO)* is the prevalent membrane separation process in which pressure is applied to saline water, forcing it through a selectively permeable membrane, which purifies the water and removes the salt.

The key cost drivers of desalination technologies relate to their high energy intensity; membrane maintenance due to their expense and short life; the risk of failure in high-pressure pumping systems; the growth of bacteria on membranes affecting the quality of desalinated water (also known as fouling); and the chemicals required in various parts of the system. Major developments in RO technology have lowered costs. Still, compared to other water technologies, desalination remains costly.

Besides the high capital and operating costs of the plant itself, civil works to accommodate connections to the reticulation system add to an already expensive technology. In addition, the threat to marine life and ecosystems is also a concern. While the environmental damage may be mitigated to some extent, it cannot be fully avoided.

To date, the implementation of seawater desalination in South Africa has been limited to a few small-scale desalination projects. Most South African desalination projects are not currently in operation. They include the following:

[redacted]

- A R20 million, 15 ML/day plant in Mossel Bay operated by Veolia, which is the largest in the country, and has been moth-balled due to adequate water in the region;
- A 2 ML/day seawater desalination plant in Knysna operated by Veolia which incorporates an energy recovery system to save on energy costs;
- A 2 ML/day seawater desalination plant operated by Veolia in Plettenberg Bay;
- A 1.7 ML/day seawater desalination plant for the Cederberg Municipality in the Western Cape, with the option to upgrade to 5 ML/day;
- A desalination plant located in Sedgefield, owned and operated by the Knysna Municipality, and maintained by Grahamtek;
- the Cannon Rocks & Boknes Communities desalination plant which produces 750 m^3 of water per day from groundwater; and
- A mobile desalination plant in Richard's Bay providing 10 000 m^3 of water per day and supplying approximately 150 000 people.

In addition, the eThekwini municipality was considering the construction of a 100 million litre per day plant combining seawater with wastewater.

The high energy costs associated with seawater desalination have largely blocked its implementation thus far.

The largest desalination plant in the country, operated by Veolia, was mothballed due to the high cost of producing water. In that case, the cost of water was approximately double that of water sourced from a dam: R16 per kilolitre for desalinated water as compared R9 per kilolitre.

More recent emergency disaster-relief plants, of the kind installed in the Western Cape, have been estimated to cost up to R40 per kilolitre. Three seawater desalination plants, which cost R250 million each, were expected to be running by March 2018 (the Monwabisi, Strandfontein and V&A Waterfront desalination projects). As of May 2018, none of these three plants were providing water into the reticulation system. The V&A Waterfront plant was dealing with issues around water quality, while the start dates for the Monwabisi and Strandfontein facilities were delayed, without notice for how long.

Experience in other countries, such as Australia, also suggests that the technology can place an excessive financial burden on the fiscus and consumers. In the worst cases, such countries were left with "white elephant" projects that provide no water while draining away limited tax revenues. A similar outcome has already been seen in the Western Cape where plans for desalination have been curtailed in favour of more cost-effective projects, such as tapping into aquifers.

While on the surface desalination may appear appealing, any decision has to take into account its risks and costs. The experience thus far is that funding and the affordability of the fresh water produced will constrain its successful rollout.