

## Decoupling South Africa's development from *water* demand through a circular economy

### Circular Economy Briefing Note No. 8 in a series of 8

The intention of this short think piece on the circular economy in water, is to initiate discussion on the sector opportunities for South Africa. These opportunities are framed within the context of the current challenges facing the South African water sector.

*“Water is our country’s most critical natural resource. Water security is fundamental to the lives and health of our people, to the stability of our society and to the growth and sustainability of our economy.”*  
H.E. President Cyril Ramaphosa, 5 August 2021<sup>1</sup>.

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### Introduction

Water is essential for life, it drives socio-economic development and supports healthy ecosystems. Without access to reliable sources of water, the economy will stall. This is already evident in South Africa, where recent droughts in the Eastern and Western Cape Provinces, fuelled by changing climates, has negatively impacted local agriculture, manufacturing, tourism, food prices, and exports, resulting in job losses and the diversion of much needed government funds away from national development priorities towards disaster relief<sup>2</sup>.

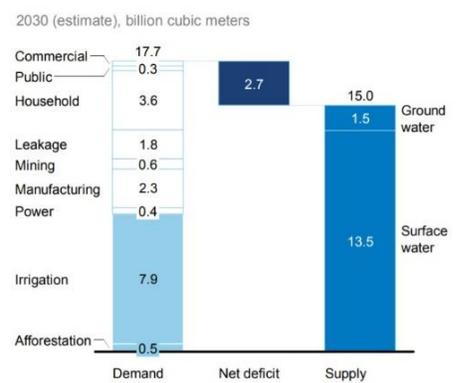
South Africa is a water-scarce country, one of the thirty driest countries in the world with an average annual rainfall of approximately 460 mm, less than half the world average<sup>3</sup>. It is a semi-arid country with a climate characterised by cycles of wet or dry spells, with droughts and floods regarded as natural hazards. Climate variability and projected climate changes are regarded as key risk factors to national water security, particularly to South Africa’s economic development and industrialisation strategies. Currently, South Africa is using 98% of its available water supply<sup>4</sup>. Most of this water comes from surface water (68%) and return flows that support surface water (13%). Based on growth projections and current water use efficiency levels, the demand for water in South Africa is expected to exceed supply by 17% by 2030 (Fig. 1). If left unchecked, this will constrain South Africa’s future growth.

A more sustainable and efficient approach in the use of our very limited water resources is needed. The CSIR recognises the opportunity a circular economy transition provides South Africa in decoupling growth from water consumption, thereby addressing national resource-security in support of socio-economic development, through sustainable water resource use.

When applied to water resources, the circular economy principles of eliminating waste and pollution; closing resource loops; and regenerating natural systems, provide a framework for South Africa to address water security<sup>5, 6</sup> (Fig. 2).

- **Design out waste**, e.g., reducing water use and wastewater generation, improved water use efficiency, better water use practices;
- **Keep materials in use**, e.g., reuse and recycling of wastewater (return flows), reclamation and recovery of resources from water-based waste;
- **Regenerate natural systems**, e.g., improving water flow and quality through the restoration of land by controlling invasive alien plants (IAP) and rehabilitating and protecting wetlands and riparian systems.

These principles are not novel in the South African water sector and have been practiced since the 1980’s, with examples in different sectors that demonstrate these principles. Given our economic growth and development ambitions and associated strategies, as well as many of our prevailing circumstances, it may be opportune to consider how a mainstreamed circular economy paradigm in the water sector can contribute to national water security and socio-economic prosperity.



**Figure 1.** SA water demand versus supply projections for 2030 (WRG<sup>7</sup>)

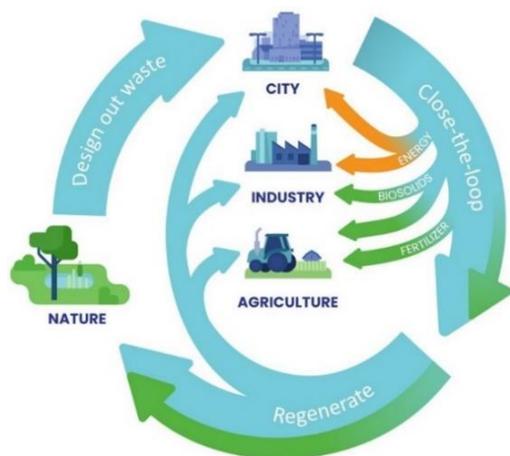


Figure 2. Circular water systems (adapted from Delgado *et al.*<sup>8</sup> and Zvimba<sup>9</sup>)

### The current state of water in South Africa

Water is critical to the South African economy. It is an important input in industrial sectors, particularly agriculture, agro-processing, manufacturing, energy production, mining and forestry<sup>10</sup>. As highlighted by the State President in his Cabinet announcement on 5 August 2021, “... water is a far broader issue, impacting not only on human settlements, but also on agriculture, industry, mining and environmental management. Water is our country’s most critical natural resource. Water security is fundamental to the lives and health of our people, to the stability of our society and to the growth and sustainability of our economy.” This highest level of government commitment is a reminder of the importance of water in our country and reinforces the criticality of water in supporting socio-economic prosperity.

The water sector has a strong influence on all economic sectors. The sectoral allocations (Fig. 3) show the largest demand for water in the agricultural sector (61%) followed by human settlements (27%). However, the financial value of water sales (Fig. 4) highlights the discrepancy between the largest water user sectors and the financial returns on their respective water sales. Given the importance of agriculture to the South African economy<sup>11</sup>, decoupling agricultural production from water demand, must be prioritised.

According to the World Bank, some regions of the world, including Africa, could see a decline in economic growth rates of as much as 6% as a result of water-related losses, with South Africa’s projected economic growth declining by at least 1%<sup>12</sup>. In South Africa, the situation is further complicated by the fact that many of our critical industries are located inland, where access to water, and in particular good quality water, remains a risk. With 98% of water already allocated, any additional economic growth requires re-allocation from existing water supplies or the generation of “new” water through alternate sources. The increase in demand for, and supply of water will result in an increase in wastewater and pollutants, particularly in the inland economic regions. Water supply and water quality are interconnected.

The South African water sector directly contributed approximately R6.4bn or 0.4% to the country’s Gross Domestic Product (GDP) in 2016. The private sector’s involvement in water is largely confined to the provision of supplies and professional services. While there is much to be done in addressing the state of water in South Africa, government also recognises the opportunities that exist in the export of water technology solutions, knowledge and skills diffusion, and the transfer of water-linked products like chemicals, industrial components, and ICT systems<sup>10</sup>.

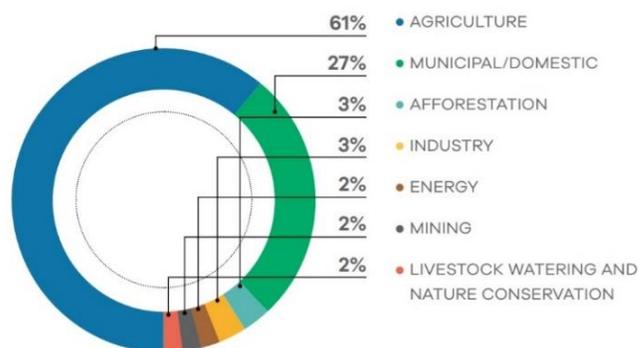


Figure 3. Water allocations in South Africa (GreenCape<sup>4</sup>)

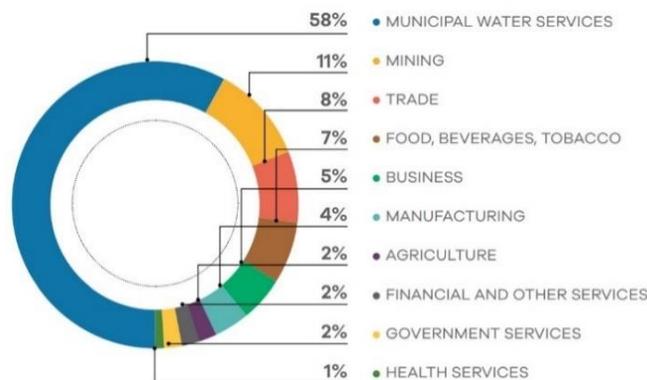


Figure 4. Financial value of water sales per sector in South Africa<sup>4</sup>

A large proportion of South Africa's GDP and jobs are directly dependent on water through its use in the agriculture and forestry, manufacturing, energy, and mining sectors<sup>11</sup>. Growth projections<sup>13</sup> show that water demand leading up to 2030, will increase in the following three key sectors: municipal by 1.3 Mm<sup>3</sup>, agriculture by 0.5 Mm<sup>3</sup>, and industry by 0.5 Mm<sup>3</sup>. The substantial projected increase in municipal water use means that cities of the future must be water-circular, with more sustainable use of water within our urban systems<sup>14</sup>. With increasing pressure on our water supplies, South Africa's water security is at risk. Additional threats are posed by climate change, land-use changes, declining water quality and catchment degradation.

The South African water sector is replete with policies, strategies and plans that embrace different aspects of the circular economy. Although these interventions are differently described, their intention and impact are the same as the circular economy, and are aligned to South Africa's Constitution (1996). Relevant policies include the National Water Act (No.36 of 1998) and the National Water Resources Strategy (2004 and 2013). Other non-statutory policies include an overarching national, and various sectoral, Water Conservation and Demand Management Strategies (developed since 1999), a National Strategy for Water Re-Use (2011), the National Water and Sanitation Sector Masterplan (2018) and Industrial Policy Action Plan (2018) and most recently, the National Water Security Framework for South Africa (2020).

While the circular economy is not specifically recognised in South African water policy, the existing policy framework will serve the sector as it transitions to a more circular model.

### **Circular economy opportunities in the water sector**

Potential circular economy opportunities in the water sector are briefly highlighted, with broad strategic interventions in several priority domains and aligned with the three circular economy principles described below. These priorities include:

- *Decoupling agricultural production from water demand.* This includes primary agriculture and associated downstream agricultural value chains;
- *Decreasing wastage and increasing water use efficiency in the urban and industrial water use sectors.* Reducing water losses, water sensitive design, geographic location of critical and strategic industries;
- *Increasing on-site wastewater treatment and re-use* to minimise pollution impacts on the receiving environment and extending water circularity; and,
- *Strengthening public-private sector partnerships* through greater inclusion of the private sector in innovative circular economy interventions.

### *Design out waste and pollution*

In order to address a looming crisis and close the gap between water supply and demand, a strong focus must be placed on water conservation and demand management. Addressing conservation and demand management at a municipal and

industry level, by reducing leakages, has the potential to realize about 58 Mm<sup>3</sup> of water per year<sup>7</sup>. Results from the National Cleaner Production Centre (NCPC-SA), under the National Industrial Water Efficiency Programme (2015-2019), yielded 862,795m<sup>3</sup> in industrial water savings across 80 businesses<sup>15</sup>.

In the irrigated agricultural sector, South Africa's largest water user, the South African Irrigation Institute supports the sector to optimise irrigation practices and achieve related environmental goals. Its mission is the saving of water through technical interventions and members include designers, engineers, soil scientists, crop experts, entrepreneurs, economists and irrigation farmers. Its initiatives include irrigation enhancement and water knowledge training via its *IrrigationWise Academy*. One of its recently completed programmes was on "Efficient irrigation water use by Water User Associations and Water Users". This was funded by the DWS Fetwater Network and presented on behalf of the Directorate Water Use Efficiency at Jacobsdal, Koffiefontein, Pongola, and Vredendal.

### *Keep products and materials in use*

Transitioning to a circular economy goes beyond waste prevention and minimisation. It is about the sustainable use of water; where maximum value is extracted from water resources while in use. This includes diversifying the water mix to include the reuse of water and wastewater.

Globally, wastewater recycling facilities are finding application in industry, e.g., zero discharge effluent treatment facility (Qatar); water resource exchange between industries (South Korea). These applications result in, amongst others, the reduced discharge of wastewater to sewerage, reduced costs, reduced water consumption, and reduced CO<sub>2</sub> emissions<sup>16,17</sup>. The use of treated wastewater for irrigation in agriculture has been practiced for many years, thereby replacing water use in agriculture and releasing freshwater for alternative use. At the same time, additional resources can be recovered from the wastewater, including biogas, biosolids and nutrients. At a household level, rainwater and domestic greywater have been reused within the home, or for watering green spaces, where water of drinking quality standard is not required<sup>18</sup>.

While the discharge of wastewater has largely been seen as a burden and cost, growing water scarcity in many parts of South Africa has resulted in a recognition of the importance of wastewater collection, treatment and reuse. Currently, South Africa only treats about 54% of municipal wastewater and about 13% of water is directly reused<sup>11, 13</sup>. Mine water is being treated in South Africa for reuse, e.g., Anglo American's eMalahleni water reclamation project, where treated mine water is piped directly to the eMalahleni Local Municipality's reservoirs supplying 12% of the city's daily water needs. Extra water is sent to other Anglo American operations. This reuse prevents polluted mine water from impacting the environment; recovers additional water for municipal use; and reduces the need for freshwater extraction. Industrial wastewater is being reused in the Nestlé Mossel Bay dairy factor, where treated, evaporated water is used for other applications within the facility such as

cooling, garden watering and cleaning<sup>19</sup>. This approach eliminates the need for municipal water intake, and the reduction of wastewater from the factory frees up capacity at the municipality's wastewater treatment plant. A number of new wastewater reuse facilities are planned across South Africa<sup>20</sup>.

### *Regenerate natural systems*

South Africa's water strategy has largely been around the investment in engineered water infrastructure, such as dams and canals. We can no longer manage our water security risks only through this approach. The rehabilitation and regeneration of our natural systems, which supply water, are an integral part of our economy<sup>21</sup>.

Examples of regenerative systems include:

- the Working-for-Water programme, which has been regenerating natural systems since 1995, with the aim of improving the integrity of natural resources and restoring the productive potential of land; improving water security; and promoting sustainable use of natural resources. The programme has resulted in improved water security; enhancing streamflow; improving water quality; supporting secondary industries where biomass from clearing operations is utilized; minimising potential negative impacts such as fire damage; and creating new jobs
- the SANBI Ecological Infrastructure for Water Security (EI4WS) Project, which links with the Water RDI Roadmap Living Catchments intervention to address transformative innovation in catchment governance. These relate to nature-based solutions that address sustainable livelihoods, well-being of people and water resources. It also complements the earlier declaration of the uKhahlamba-Drakensberg Park as a World Heritage site in 2000 which recognised its significance as a critical source of South Africa's water.

The circular economy concept is not new to the South African water sector. The country has a track record dating back to the mid-1990's in addressing water supply-demand concerns. Several of these have endured and matured as scalable solutions in other parts of the country. However, more needs to be done to achieve the scale required for meaningful impact. The public and private sectors will need to invest in the replication of current successful initiatives; the localisation of international examples to local settings; and the identification of new opportunities through ongoing science, technology and innovation.

Key economic sectors for water innovation opportunities, given their water resources demands and impacts, are the agricultural, mining and municipal sectors.

### **Conclusion**

Increasing water demands and deteriorating water quality are severely impacting South Africa's economic development. Constraints in water supply are increasingly compromising water security. Traditional options to supplement our water supply are also becoming unavailable and unaffordable. Together with the

economic growth plans and climate change projections, our water security picture looks bleak.

However, current and long-standing examples in practice of the three circular economy principles provide tangible evidence (financial and water security) of the benefits of the circular economy to water users in our different economic sectors (industries, mines, municipalities and agriculture).

Under these circumstances, the circular economy becomes our "no option solution" and wastewater our "new gold". There are almost boundless intervention opportunities, if sought out. As a forward-focused intervention, the mainstreaming of a water circular economy paradigm in South Africa provides opportunities to support and fortify our current and future economy against the projected changes. Most importantly, the circular economy will provide us with the means to build improved resilience to potential future shocks.

**Acknowledgements:** The authors acknowledge the funding from the Department of Science and Innovation through the CSIR's Parliamentary Grant.

### **References**

1. Daily Maverick. (2021) Dedicated water and sanitation department a good first step-but minister Senzo Mchunu faces a herculean task [\[online\]](#).
2. Godfrey, L. (2020). Developing and achieving a Circular Economy in South Africa – A Strategic Overview. WRC Circular Economy Dialogue.
3. DEA (2011). South Africa's second national communication under the United Nations framework convention on climate change. Republic of South Africa, Pretoria.
4. GreenCape (2021). Water market intelligence report. Cape Town, South Africa [\[online\]](#).
5. EMF (2017). Towards the Circular Economy: Economic & business rationale for transition.
6. ARUP (2019). Water and circular economy: A whitepaper [\[online\]](#).
7. WRG (2012). Background, impact and way forward. Briefing report [\[online\]](#).
8. Delgado, A, et al., (2021). Water in Circular Economy and Resilience (WICER). World Bank, Washington, DC [\[online\]](#).
9. Zimba (2019). Circular economy model for water and wastewater management. UJ Workshop, July 2019. [\[online\]](#)
10. Dtic (2017). Industrial Policy Action Plan 2017/18 – 2019/20 [\[online\]](#).
11. DWS (2018). National water and sanitation master plan. Version 4.2. Volume 2: Plan to action [\[online\]](#)
12. WBG (2016). High and Dry: Climate Change, Water, and the Economy. World Bank, Washington, DC.
13. Donnenfeld Z., et al. (2018). A delicate balance: Water scarcity in South Africa. Institute for security studies, *African Futures*, Paper 13 [\[online\]](#)
14. GoN (2021). Valuing Water Initiative. 4 ways the circular economy can help us manage water [\[online\]](#)
15. NCPC-SA (2020). Impact Report [\[online\]](#)
16. Zhi-heng Y. (2012). Study on the circular utilization of water resource in three industries. IEEE
17. Veolia (2014). Water at the heart of circular economy [\[online\]](#).
18. PWC (2018). Closing the loop-the circular economy, what it means and what it can do for you [\[online\]](#).
19. Nestlé (2018). Nestlé launches zero water technologies site in Mossel Bay [\[online\]](#).
20. DWS (2013). National Water Resource Strategy 2 (NWRS2). Pretoria, South Africa.
21. WWF-SA (2021). Water doesn't come from a tap [\[online\]](#).