SOUTH AFRICAN AGRI-PROCESSING RESOURCE EFFICIENCY

Opportunities, challenges and outlook

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Acronyms

AB Inbev	Anheuser-Busch Inbev
APRE	Agribusiness Resource Efficiency Project in South Africa
CHP	Combined Heat and Power
CIP	Clean In Place
CMA	Catchment Management Agency
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
DED&T	Department of Economic Development and Tourism
DWS	Department of Water and Sanitation
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GWI	Global Water Intelligence
IFC	International Finance Corporation
IDP	Integrated Development Plans
IPAP	Industrial Policy Action Plan
kl	Kilolitres
KPI	Key Performance Indicator
MAS	Manufacturing, Agribusiness and Services
MW	Megawatt
NDP	National Development Plan
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NRW	Non-Revenue Water
NWA	National Water Act
NWP	National Water Policy
NWRS	National Water Resources Strategy
O&M	Operations and Maintenance
PPP	Public-Private Partenrship
PV	Photo Voltaic
RCL	Rainbow Chickens Limited
RMAA	Red Meat Abattoir Association
SAB	South African Breweries
SABIA	South African Biogas Industry
SALGA	South African Local Government Association
SECO	Swiss State Secretariat for Economic Affairs
SSEG	Small-Scale Embedded Generation
SWAN	Safe Water and Nutrition Program
SWPN	Strategic Water Partners Network
WCDM	Water Conservation and Demand Management
WCG	Western Cape Government
WDM	Water Demand Management
WEF	World Economic Forum
WRC	Water Research Commission
WSA	Water Services Authority
WUA	Water User Association
WWF	World Wildlife Fund

Acknowledgments

This report was produced as part of a broader Agri-processing resource efficiency Project in South Africa (APRE), aimed to help transition to better water and resource efficiency practices for companies engaged in agricultural processing. The Project is expected to help mitigate water supply risks in the sector, resulting from the water scarcity challenge in South Africa and throughout the region. The Project is funded by the Swiss State Secretariat of Economic Affairs (SECO), and the team would like to thank Franziska Sporri (Head, Economic Cooperation and Development), Gerhard Pienaar (Deputy Head, Economic Cooperation and Development), Nonhlanhla Halimana (Programme Manager, Economic Cooperation and Development) and the entire SECO team for the ongoing support and guidance.

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Executive Summary

South Africa's agri-processing sector is a key driver of economic growth, as it contributes to value addition, job creation and exports. Increasing water scarcity, combined with rising costs of energy and fuel, is threatening the competitiveness and sustainability of the sector. IFC's Manufacturing, Agribusiness and Services (MAS) Advisory team, in partnership with the Swiss State Secretariat for Economic Affairs (SECO), launched a four-year program – the Agribusiness Resource Efficiency Project in South Africa (APRE) – to address market challenges and help the industry transition to better water and resource efficiency practices. The program aims to improve water use efficiency, reduce overall water consumption, and mitigate water supply risks in the sector.

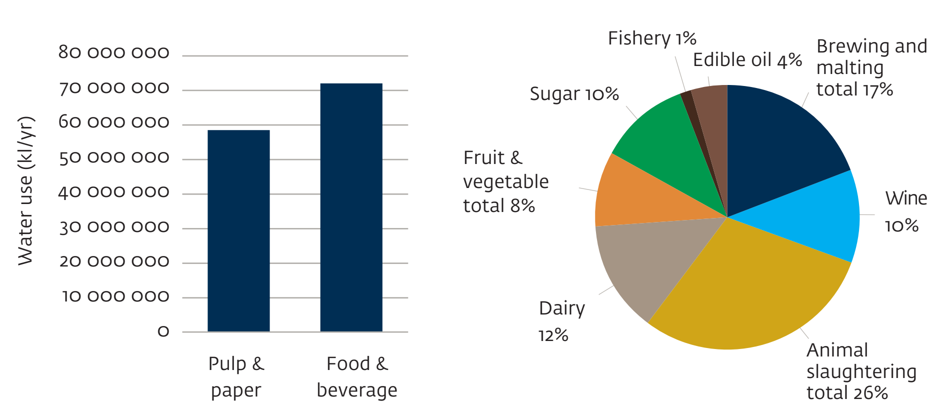
In January through May 2019, the IFC project team, with support from GreenCape, one of the leading agencies in the resource efficiency space in South Africa, and with inputs from the Agricultural Business Chamber (Agbiz), one of the largest industry associations, has conducted a study of opportunities for reduction of water use in agri-processing, analyzed persisting barriers for better efficiency and highlighted possible areas for improvement at the level of the firms, within the sector as a whole as well as in the policy and regulatory framework.

To perform the assessment, the team has conducted an extensive review of available research on the topic and interviewed more than 50 private firms, government agencies and sector associations.

The key findings of the assessment are presented below.

1. The sector's water consumption of approximately 130 million m^3/year is divided between pulp and paper and food and beverage sub-sectors. Food and beverage sub-sectors, in turn, are represented by 9 key sub-sectors, six of which together with pulp and paper sub-sector account for approximately 90% of total water consumption by the agri-processing sector:

Figure 1. Water consumption in the agri-processing sector.



The cold drink sub-sector is dominated by companies that are diversified into other sub-sectors and Coca-Cola, a single major international producer, and is less associated with the agri-processing operations. Therefore, the cold drink sector was excluded from the detailed analysis of the food and beverage sector.

2. As demonstrated by high-level international comparisons, while the South African agri-processing industry is performing well compared to international companies, there are still opportunities for improved efficiency. However, the economic potential is limited by the relatively low cost of water and wastewater discharge fees, which weakens the business case.

3. The **total potential for primary water savings** across the key agri-processing sub-sectors can be estimated at just under **30 million m³/year, equivalent to 20% of the total sector consumption** (this varies between 10% and 65% across sub-sectors and in best-practice technologies already implemented by some players). The potential would be realized through these key types of intervention:

    a. Low-cost savings measures, including retrofits of water supply and distribution infrastructure at the company facilities;
    b. Process improvements and equipment upgrades that result in a reduction of water use per unit of output; and
    c. Water reuse, recycling and effluent treatment projects, which could include biogas-to-energy components.

    Realization of this potential would result in **savings of over US$20 million annually** (excluding corresponding energy savings and indirect savings from avoided loss) and require **investment of over US$400 million**. Approximately 80% of the savings potential can be achieved with US$200 million of investment.

4. Poultry, red meat, dairy, fruit and vegetable subsectors represent the most unrealized yet feasible potential for water efficiency, followed by malting and brewing as well as wineries. The water-related projects in the pulp and paper sector, as well in the sugar sector, tend to be much larger on average; however, a lot of the potential has already been realized.

5. The drivers for water efficiency are not solely associated with the direct cost of water through tariffs and fees. Business continuity, water scarcity and quality risks are the key drivers in many cases. They could be further quantified through loss of production output and revenue as well as the increased cost of alternatives. The business case can be further enhanced by additional revenue streams, from effluent to biogas projects, sales of energy and other effluent treatment by-products.

Figure 2. Sub-sector potential matrix.

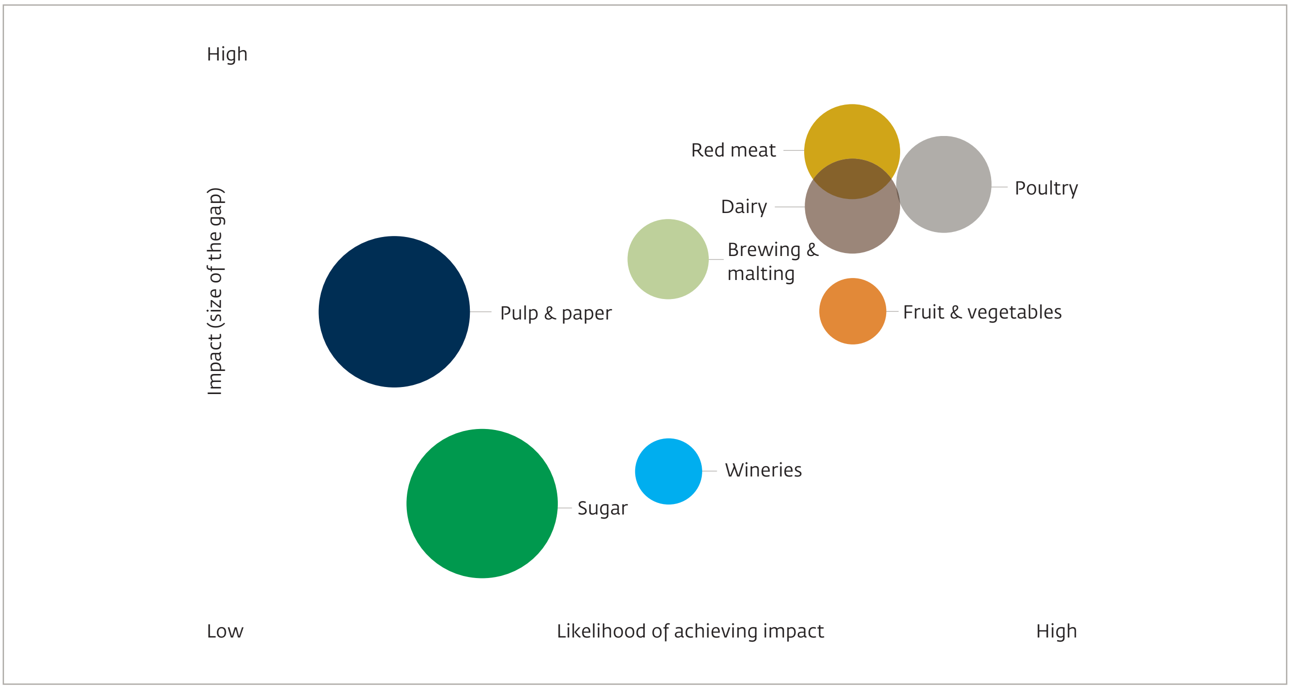
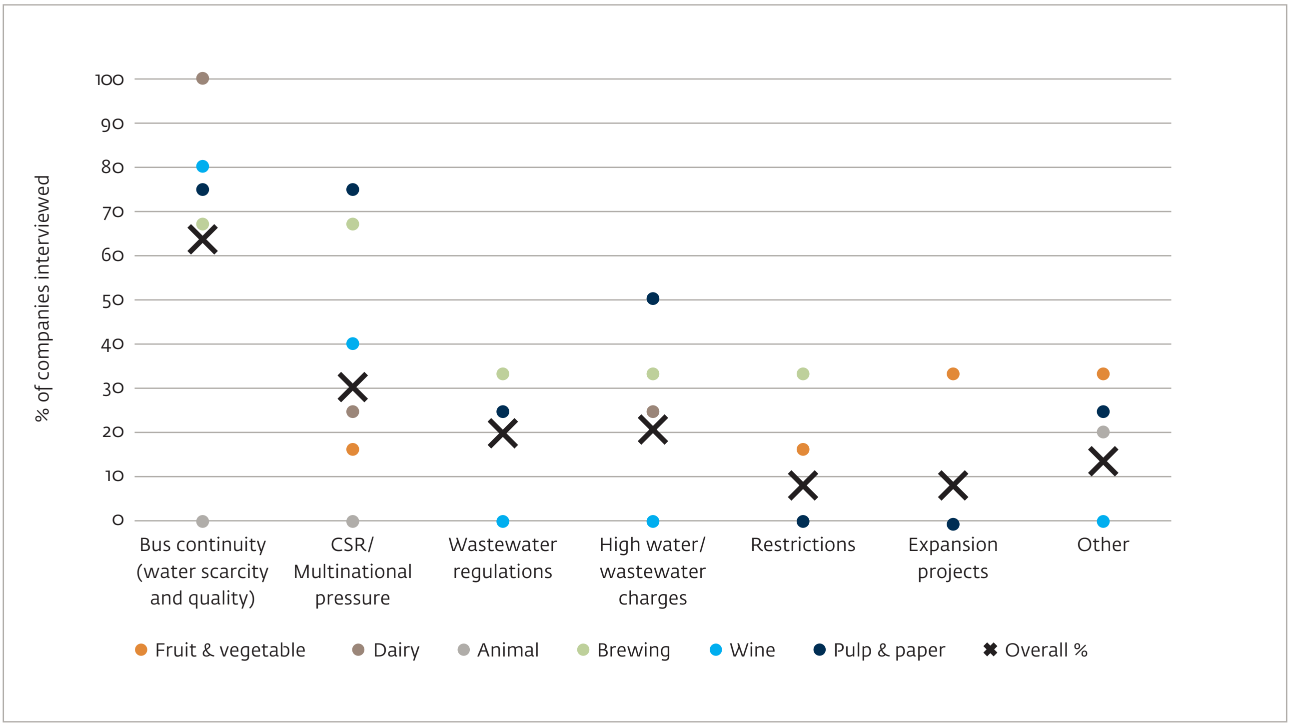
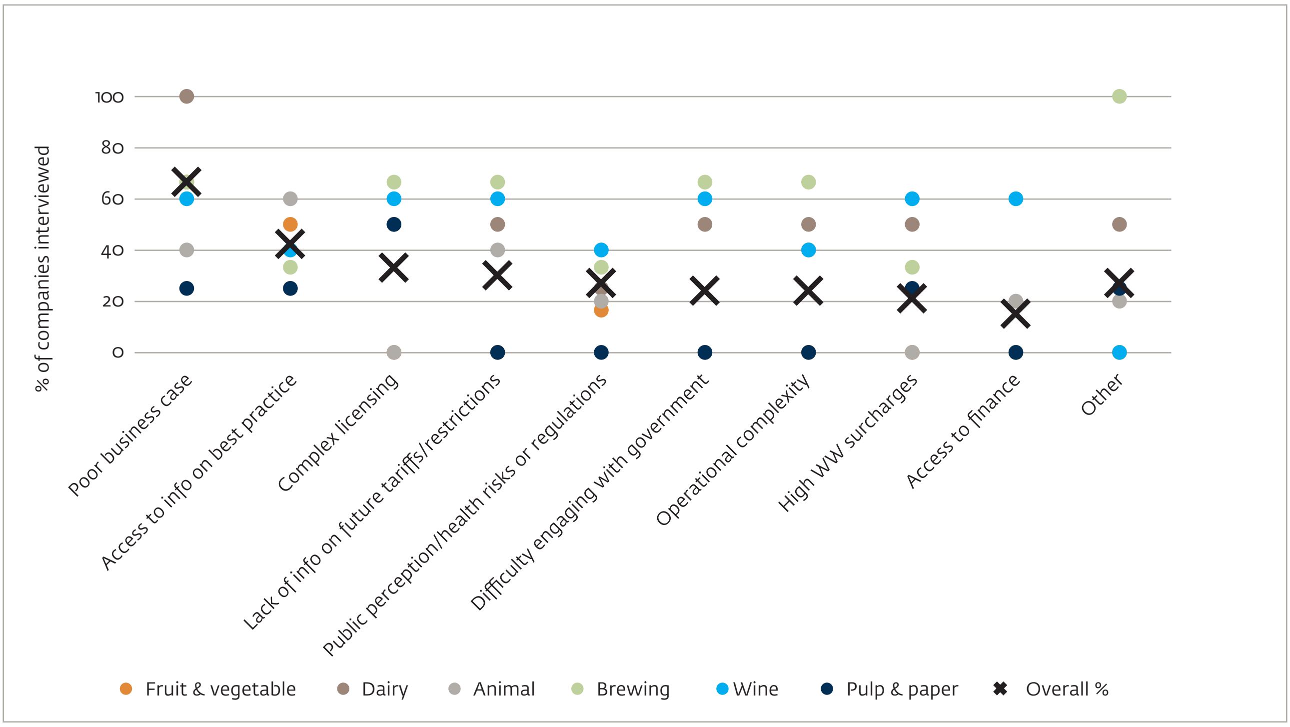


Figure 3. Factors impacting the business case for water efficiency.



6. Among the challenges and barriers, the companies consistently mention the weak business case, as well as lack of knowledge of best practices, indicating a need for support in developing projects. A number of issues raised are associated with the enabling environment for water efficiency and regulatory matters.

Figure 4. Barriers for water efficiency.



7. In the policy space, advancements in the following key areas will create an enabling environment for water efficiency:

- Integrated planning of water use;
- Water use authorization and groundwater use licensing;
- Water reuse and recycling regulations (including sector-specific); and
- Water use tariffs and fees, water discharge and treatment payment review.

While the public-private dialogues still remain an efficient instrument to reaching these goals, and municipal authorities are important stakeholders and potential partners in those engagements, there are other key groups of regional/local stakeholder that might be the lead counterparts:

- Water users' associations;
- Emerging catchment management agencies; and
- Sector associations engaged in advocacy on standards and requirements for a given sub-sector (as relevant for corresponding agri-clusters).

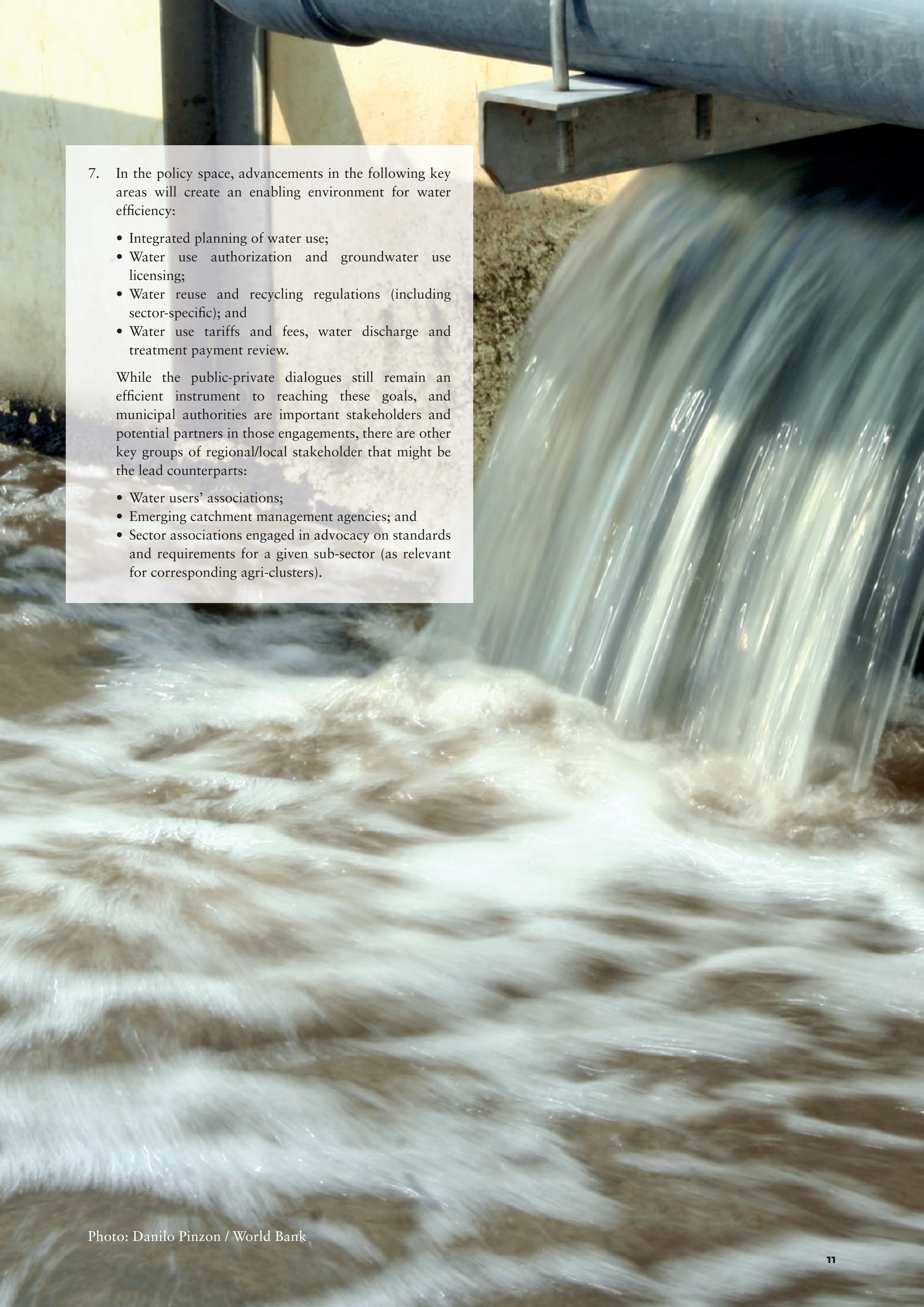


Photo: Danilo Pinzon / World Bank

1. Background and objectives

1.1 Background

Water scarcity, greater water demand and changing water supplies due to climate change are severely affecting large parts of Southern Africa, including South Africa. These issues pose a significant risk to the region, underlined by the identification of water supply as one of the highest ranking long-term global risks by the World Economic Forum.[1] *South Africa faces several challenges regarding water supply – rainfall levels are already lower than other parts of the world, and in recent years, water availability has been further impacted by El Niño, a weather phenomenon that affects ocean water temperatures and associated rainfall patterns, resulting in severe drought. Coupled with increasing demand for water, these limitations mean that the gap between demand and supply of water is set to widen significantly.*

The Government of South Africa recognizes that water security is essential for meeting the policy objectives of inclusive economic growth and reduced poverty, as set out in the National Development Plan. The National Water Resource Strategy 2, the instrument used to operationalize the National Water Act (Act 36 of 1998) (NWA), aims to ensure that water resources are managed in a way that contributes to South Africa's economic and social objectives, identifying conservation and demand management as a critical element of the strategy.[2] The Water Services Act (Act 108 of 1997) governs supply of water and sanitation services at a municipal level, and sets out norms and standards for tariffs, while the Municipal Systems Act (Act 32 of 2000) provides for establishment of by-laws by local government covering tariffs for water and effluent. Other developments in the environmental legislation, such as the 'user pays' and 'polluter pays' principle implementation governed by the National Environmental Management Act (NEMA), will also have the impact on effluent treatment policies.

The new legislation will be supported by a Water Security Framework, National Water and Sanitation Resources Strategy, and a National Water and Sanitation Master Plan; these aim to support reduced future water demand, amongst other key objectives. Despite the focus on improving the enabling environment, responses to water security challenges have proven to be inadequate, as evidenced by various 'Day Zeros' in the Western and Eastern Cape Province.

1.2 Objectives

The agri-processing sector plays an important role in South Africa's economy, making significant contributions to Gross Domestic Product (GDP), exports, employment and food security. However, increasing water scarcity, combined with rising costs of energy and fuel,

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[1] *World Wildlife Fund (2017). Water scarcity overview.*

[2] *Applicable legislation, in addition to the National Water Act and Water Services Act, includes the National Environmental Management Act, National Environmental Management: Waste Act, National Environmental Management: Air Quality Act, and Environmental Conservation Act, which cover waste management, amongst other issues. Other legislation covering industrial processes is also applicable to water and waste management, for example the Occupational Health and Safety Act, as well as sub-sector specific legislation such as the Meat Safety Act.*

is threatening the competitiveness and sustainability of the sector. The key impediments preventing companies from fully addressing water scarcity are a lack of a clear business case as to the benefits of investing in water efficiency measures; inadequate access to information and advice on best practices and benchmarks; and a lack of technical capacity and experience in implementing water use and efficiency measures and technologies. Furthermore, the policy and regulatory environment does not adequately encourage water efficiency measures.

The Agri-Processing Resource Efficiency (APRE) program, implemented by International Finance Corporation (IFC) with support from the SECO, aims to promote the implementation of cost-effective and innovative water and energy efficiency technologies and practices. As in many other sectors, the use of water by the agri-processing sector is tied to energy use.

As part of the project, IFC, with support from GreenCape, one of the leading agencies in the resource efficiency space in South Africa, and with inputs from Agricultural Business Chamber (Agbiz), one of the largest industry associations, has conducted a study of opportunities for reduction of water use in agri-processing, analyzed persisting barriers for better efficiency and highlighted possible areas for improvement at the level of the firms, within the sector as a whole as well as in the policy and regulatory framework.

Photo: Scott Goodwill / Unsplash

2. Rationale for Water Efficiency in South Africa

2.1 Water scarcity in South Africa

South Africa is a water-scarce country and is characterized by a skewed distribution in rainfall and evaporation rates that far exceed precipitation. Due to the El Niño and climate change, parts of South Africa, including the Eastern Cape, Free State, North West, Limpopo and Western Cape Province have suffered from severe droughts.

Consumption of water in South Africa is estimated at over 16 billion m^3/year, with demand expected to increase significantly. Municipal use (including domestic use) makes up 27 percent of consumption. Non-domestic consumption is estimated at 10 billion m^3/year, of which about 9 billion m^3/year is drawn from non-mains sources and 1 billion m^3/year is potable water. Primary sectors (agriculture, mining and afforestation) use about 93 percent of non-domestic consumption, while secondary industrial sectors (including energy production) use about 7 percent, at 640 million m^3/year. The manufacturing sector (including agri-processing) uses about 360 million m^3/year.[3]

Forecasts indicate that the gap between water supply and demand is expected to increase over the next 20 years. A significant contributor to this growth in demand is the industrial sector, of which agri-processing is an important component.

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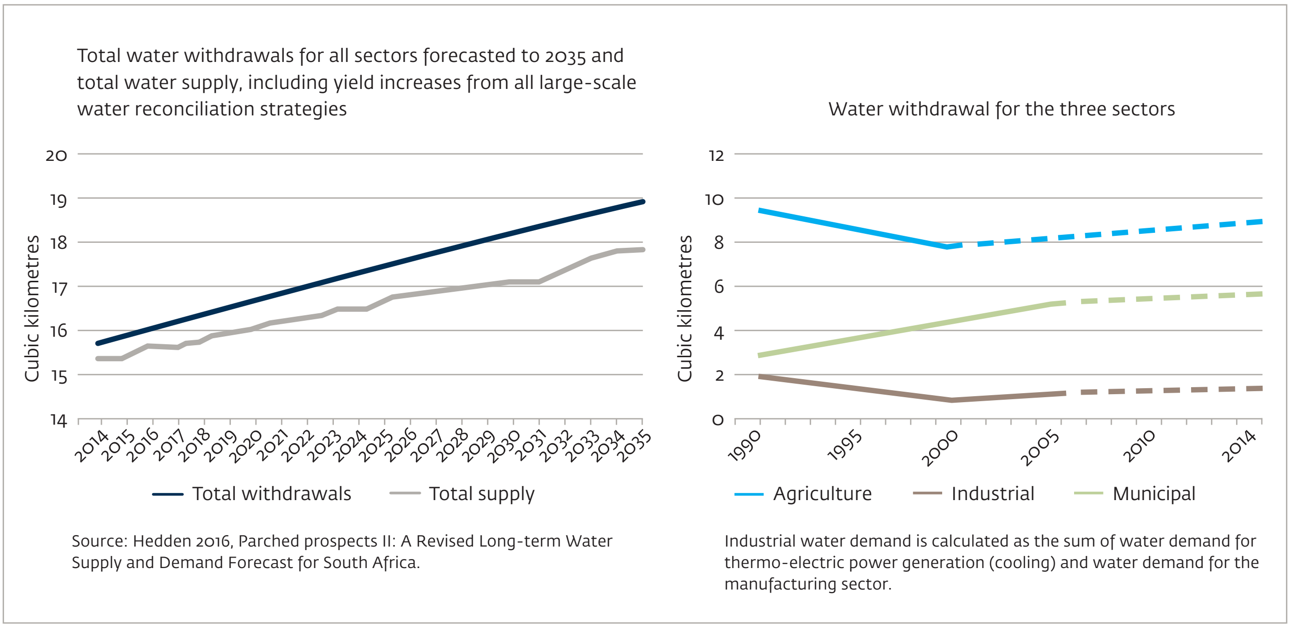
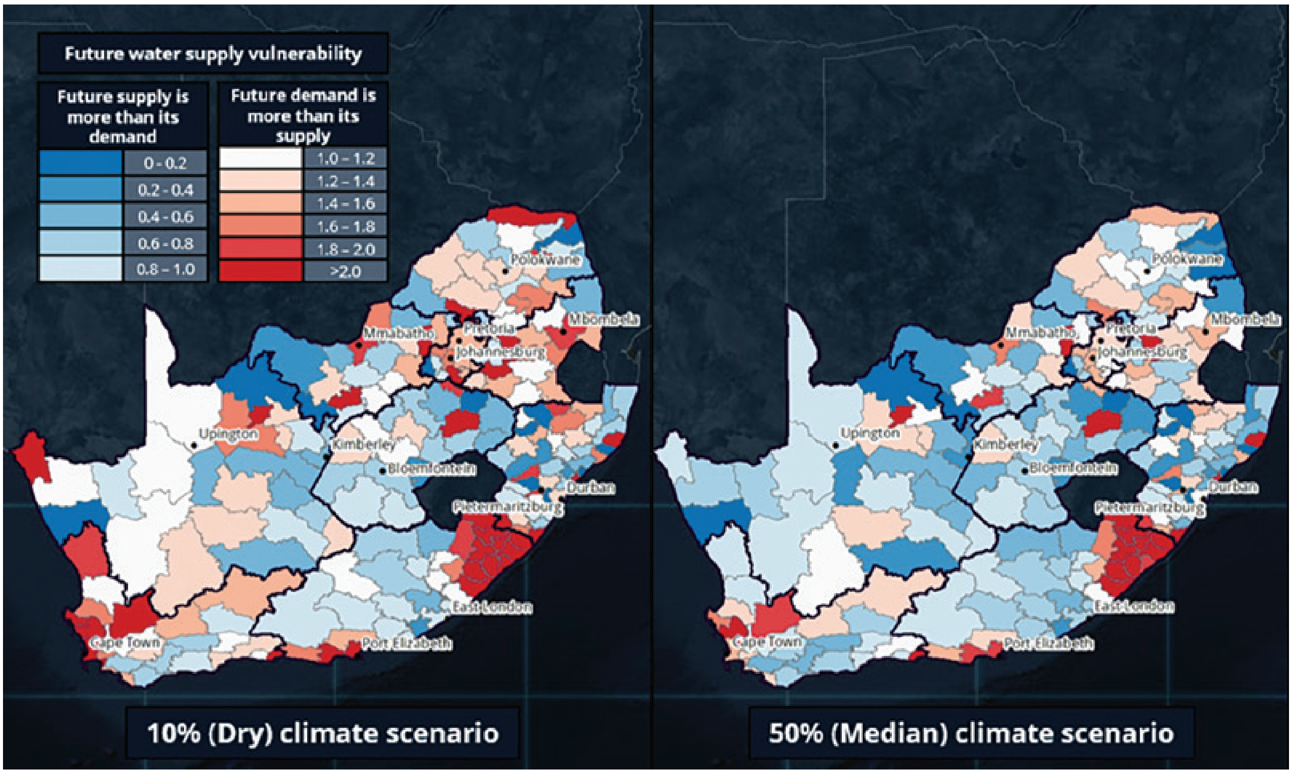
[3] *Sources: GreenCape. 2018. Water 2018 Market Intelligence Report; 2030 Water Resources Group. 2018. NRW and Wastewater Financing in South Africa: Market Size, Barriers and Opportunities for SWPN South Africa.*

Figure 5. Projected water supply and demand in South Africa (Hedden, 2016).



By 2050, many parts of South Africa (including areas with concentrations of industrial activity) are expected to be vulnerable to water supply risks (Figure 6).

Figure 6. 2050 water supply vulnerability with medium population grown and climate change exposure considering local run-off changes (Green Book, 2019).



2.2 The agri-processing sector's economic contribution and water consumption

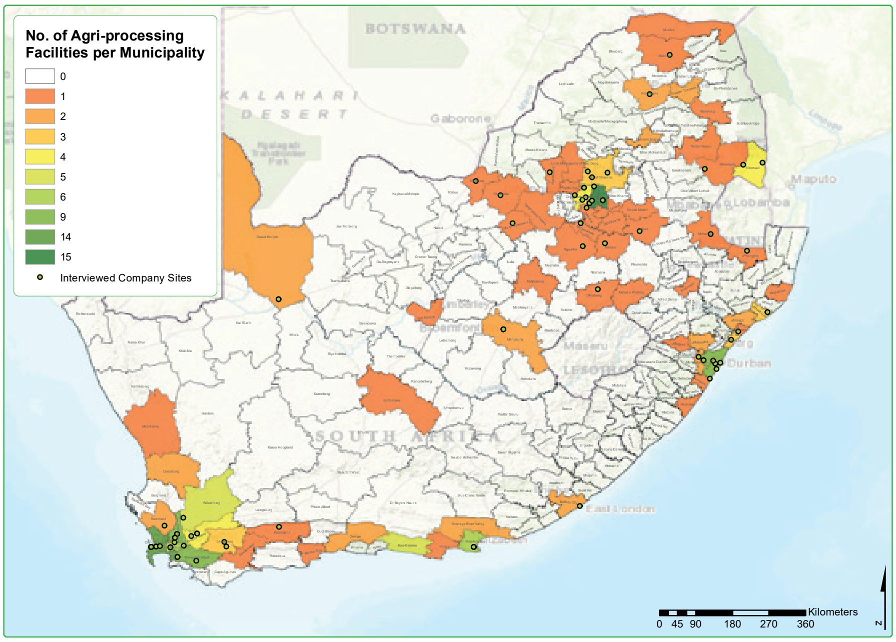
For the purpose of the study, agri-processing is defined as the sector of the economy that comprises primary and secondary processing of primary agricultural produce to transform this into value-added goods. This includes such sub-sectors as diversified food processing and timber processing (pulp and paper); however, excludes food and other agricultural product distribution, logistics and retail.

The agri-processing sector plays an important role in South Africa's economy, contributing ~4.3% of the country's gross domestic product per the data from Department of Agriculture, Fisheries and Forestry,[4, 5] employing more than 200 000 people,[6] contributing about 10% of exports, and supporting food security in the country and regionally. Furthermore, agri-processing companies located in rural areas, where primary production occurs, provide crucial jobs for rural communities.

As such, agri-processing is a key sector earmarked for growth and development in various policies and mandates, including the Industrial Policy Action Plan (IPAP). The food and beverage sector (a sub-sector of agri-processing) is expanding, with product sales increasing from around ZAR110 billion in Q2 2010 to ZAR130 billion in Q2 2018 in constant 2018 ZAR.[7] The gross fixed capital formation (GFCF) for the food, beverages and tobacco sector was just under ZAR4 billion in the 1970s and is projected to reach ~ZAR14 billion in 2021.[8] Investments in the food sector are dominated by a handful of large companies. In 2015, 74% of the total fixed investments in this sector were attributed to Tiger Brands, Pioneer Foods Group, AVI Ltd, Oceana Group, RCL Foods, Tongaat Hulett, Rhodes Food Group, Astral Foods and Clover Industries.[9]

Figure 7 shows the location of the manufacturing facilities of the major companies within some of the key agri-processing sub-sectors, including animal slaughtering, dairy, fruit and vegetable processing, pulp and paper, brewing and malting and wineries. Ekurhuleni, eThekwini, Cape Town, Theewaterskloof and Drakenstein are important local municipalities and municipal districts in the agri-processing sector, as well as Stellenbosch, Witzenberg, Kou-Kamma, Nelson Mandela Bay (Port Elizabeth), Breede Valley, Nkomazi and Johannesburg. The Western Cape, in particular, hosts a number of agri-processing facilities. The food, beverages and tobacco sector is the province's largest manufacturing sector, (28.1% of manufacturing in 2017,) and is a priority economic sector for the Western Cape Government.[10]

Figure 7. The location of the facilities of the major agri-processing companies within each of following sectors: fruit and vegetable, animal slaughtering, dairy, brewing, wine, pulp and paper, and sugar. Source: GreenCape 2019.



[4] *As of June 2019, the name of the Department changed to Agriculture, Rural Development and Land Reform. Legacy acronym used throughout the document.*

[5] *DAFF 2017.*

[6] *DTI 2017.*

[7] *StatsSA 2018.*

[8] *Quantec 2018.*

[9] *Nhundu 2017.*

[10] *Provincial Treasury, 2018.*

Agri-processing is heavily dependent on water for a number of processes, and as an input to end-products. Processes that use water include equipment and general cleaning and sterilization; washing and conveyance of produce; steam generation; cooling; cooking, pasteurizing, tanning, dyeing, etc.[11] As many of the manufacturing sites are located in areas that face water scarcity challenges, the sector is highly vulnerable to water-related risks. The potential impacts of these risks include financial and operational losses, cut-backs, retrenchments and closures.

In addition, industry is often dependent on Water Services Authorities (WSAs, typically municipalities or state-owned entities) to provide water and sanitation. However, many WSAs lack the capacity to deliver these services reliably. Each year WSAs are assessed for their institutional effectiveness,[12] and in 2016/17 only 5% were rated as having a low vulnerability, while 70% were rated as either highly (33%) or extremely (37%) vulnerable. These capacity constraints further increase the risks of water shortages to businesses and can lead to significant impacts. As an example, a major poultry producer, claimed over R85 million profit loss at one of their facilities due local municipality failing to provide reliable water services, because of the deteriorating infrastructure. Their employees can only work half their normal hours due to the restricted water supply.[13]

South African industry is therefore highly vulnerable to water supply risks, and in 2019 the World Economic Forum ranked 'water crises' as the second highest risk for doing business in the country,[14] closely behind unemployment.

2.3 Gaps in support for water efficiency measures

While South Africa has a relatively dynamic water policy framework, the policy and regulatory environment falls short of encouraging water efficiency measures, and in some cases poses barriers to improved water use.

Overall, water tariffs remain relatively low, thus the business case for investing in water efficiency is driven primarily by mitigating the risks associated with decreasing water supplies. The effects of low water tariffs can adversely impact companies, rather than by potential cost savings. Furthermore, there is a complex system of incentives, some of which run contrary to the encouragement of effective water management. For example, industrial and consumer water savings measure can reduce municipal revenues, with some municipalities reporting a steady decline in revenues as a result of conservation measures introduced in response to recent droughts. While such savings would otherwise free up water to supply new developments or under-served consumers, the redirection of surplus water to such groups is often hindered by a lack of new bulk infrastructure investment and the ability of under-served users to pay for their water.

A similar issue relates to effluent treatment, whereby private initiatives can reduce the economic viability of public effluent treatment plants, particularly in the case of large agri-processors that are often the dominant users of local plants. This has implications for the structuring for Public-Private Partnerships (PPPs) that are increasingly pursued by local authorities in South Africa for their effluent treatment solutions.

In some cases, food safety and quality assurance and related regulations pose barriers to adoption of water efficiency measures which are considered good practice in other countries or are inconsistently applied leading to lack of clarity amongst industry players.

There is also limited direct support for water efficiency – while various initiatives, such as water footprint assessments and water and energy efficiency audits and surveys,[15] are underway in South Africa, direct water efficiency engagements with industrial companies are limited and tend to deal with more basic efficiency measures. The lack of engagement is due to an unclear understanding of the business case for water efficiency measures. A rigorous and robust analysis of the cost drivers, related operational procedures and realized efficiencies, including advanced monitoring and management systems, is often needed.

In addition, the country faces challenges in implementation of its policy intentions. This becomes particularly apparent at the local level, where municipalities face institutional and capacity limitations, such that 54% of municipalities that submitted Green Drop information achieved critical and poor scores, with this rising to 70% for the No Drop program. These constraints have translated into ageing infrastructure that is not effectively operated and maintained, such that as much as 41% of municipal water does not generate revenue and 35% of water is lost through leakages.[16]

Due to the complexity that these issues create in shaping effective policy, solutions that focus on institutional and procedural challenges become increasingly relevant. They provide opportunities to address the implementation challenge that local authorities face, and, when coupled with increased participation in and partnership with the private sector in water management, they can open new opportunities to close the gap between stakeholder's expectations of local authorities and the quality of service that the authorities are able to provide.

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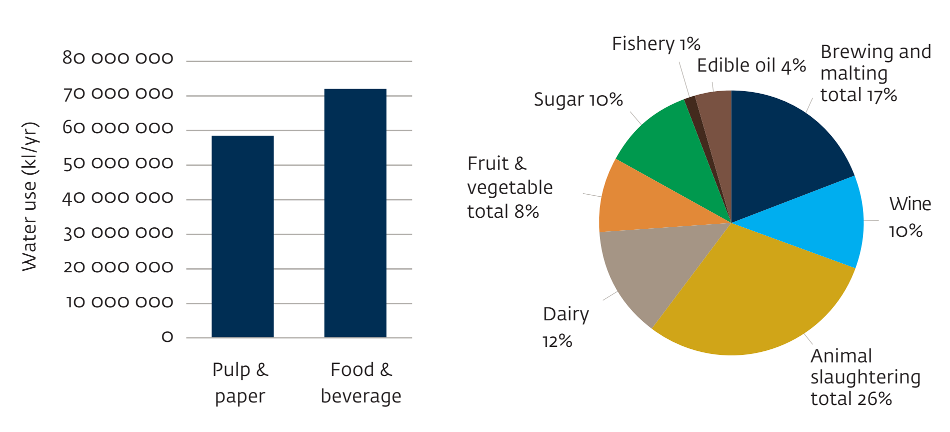
[11] *Cohen, B., Mason-Jones, K. and Rambaran, N. Doing Business in South Africa, Water in Agro Processing.*
[12] *Department of Water Affairs and Forestry 2003.*
[13] *Business Day 2019.*
[14] *WEF 2019.*
[15] *Carbon Dioxide Information Analysis Center, Top 20 Emitting Countries by Total Fossil-Fuel CO_2 Emissions for 2008.*
[16] *Department of Water and Sanitation 2018.*

3. Water use practices in the agri-processing sector

3.1 Water consumption in agri-processing

The agri-processing sector is estimated to use ~130 million m³/year, of which ~55% is for food and beverages, and ~45% for pulp and paper (Figure 8).[17] *Figure 8 also shows the estimated breakdown of water used in the food and beverage sector, with animal slaughtering account for roughly one quarter.*

Figure 8. Estimated water use in the agri-processing sector by sub-sector. Left-hand chart compares pulp and paper with food and beverages total water usage. Right-hand chart gives a breakdown of water usage in the food and beverage sector.[18]



This study focuses on seven key sub-sectors, which account for ~90% of water used in the agri-processing sector, excluding cold beverages, that are not linked to agri-processing, but covers diversified beverage operations under the dairy and fruit and vegetable (juice processing) sectors:

- Fruit and vegetable processing;
- Dairy processing;
- Animal slaughtering and processing (includes red meat and poultry, which are assessed separately, as relevant);
- Brewing and malting;
- Wine production;
- Pulp and paper processing; and
- Sugar production.

[17] *Classification of which sectors belong to agri-processing vary, but for the purposes of this assessment, it includes food and beverages and pulp and paper sectors.*

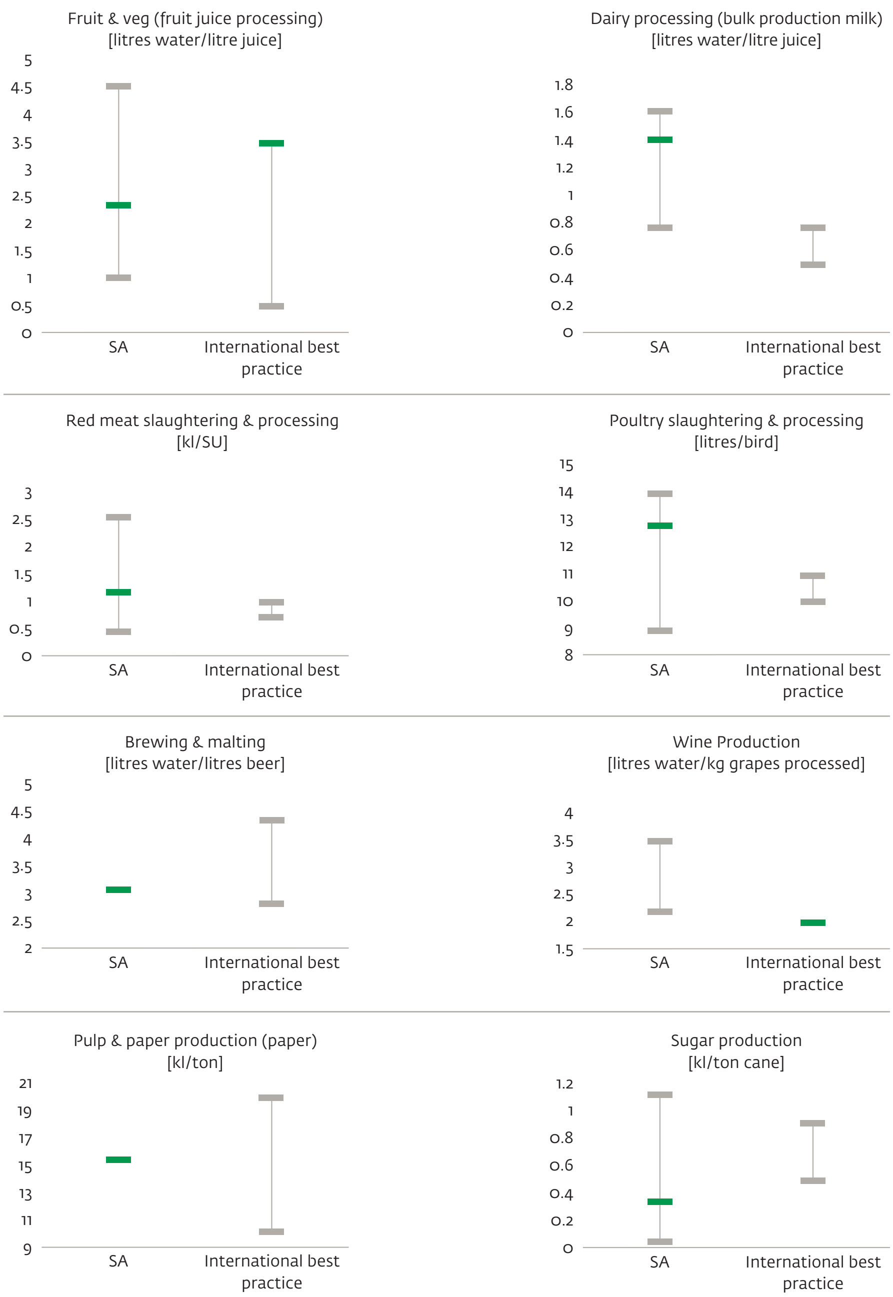
[18] *Water usage data was generally estimated from average water benchmarks linked to production within each sector, multiplied by the production numbers (e.g. sourced from WRC NATSURVs, if available). WRC 2010 was also used to estimate the usage within the pulp and paper, soft drink, edible oils and fisheries sub-sectors.*

These sub-sectors are also associated with high wastewater volumes that represent a potential resource for improved water and energy efficiency.

3.2 Water use practices and efficiency: international comparisons

South African agri-processors compare relatively well to international companies in terms of water efficiency, and it is only when South African companies are compared to international best practice, that notable opportunities for efficiency are revealed (see Figure 9). For instance, average water usage in dairy processing is on par with international averages, but the highly efficient polish dairy sector demonstrates the potential for even higher efficiencies. However, the local conditions may require higher water usage in comparison to cooler countries, and as seen below there is a high degree of variability within the local sector benchmarks. It is for this reason that the most efficient users in South Africa were the basis for the estimations of the potential for efficiency potential in the rest of the sector.

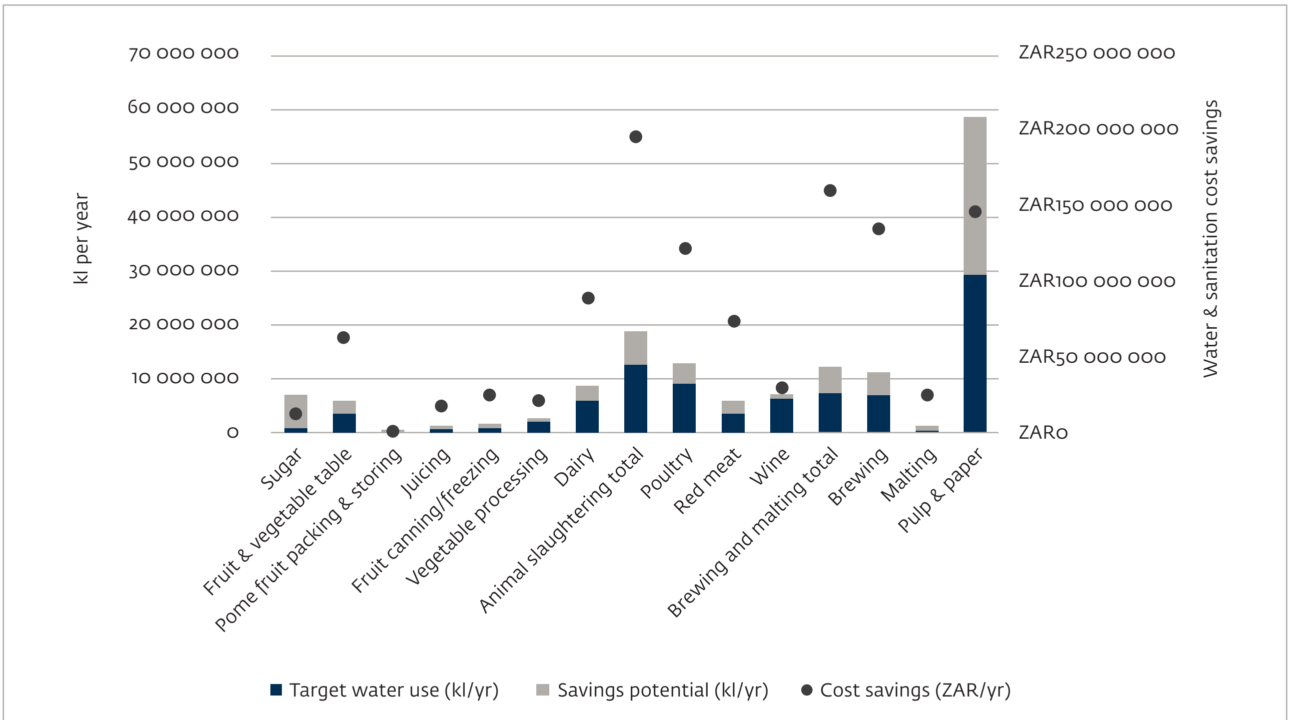
Figure 9. SA agri-processor sub-sector water usage benchmarks in comparison to international best practice. Green bar = average and grey bars = upper and lower thresholds.



While the South African agri-processing industry is performing well compared to international companies, there are still opportunities for improved efficiency. Figure 10 shows the estimated water savings potential per sub-sector (shown in red), with the target water use shown in green. The target water use is based on the local minimum water use benchmarks within the relevant sector, and therefore assumes that each agri-processor could become as efficient as the most efficient agri-processor in their sub-sector in South Africa. These calculations show that there is significant potential for water savings in the pulp and paper industry (~20 million cubic m/yr), with notable potential in the sugar, animal slaughtering, and brewing and malting industries.

However, as some industries typically source their water from cheap raw water sources (e.g. sugar and pulp and paper), the water cost savings (indicated by the black dots) are relatively low, compared to industries that purchase potable municipal water. As a result, the water cost savings in the animal slaughtering sector (which typically sources its water from municipal supplies) are estimated to be higher than those in the pulp and paper industry (~ZAR200m/yr compared to ~ZAR150m/yr), despite the lower water savings potential (shown in grey).

Figure 10. Estimated total potential for water and cost savings, per sub-sector. The estimated current total water use of each sub-sector is indicated by the height of each bar (i.e. target water use plus savings potential).[19]



However, such an assessment based on high-level international comparisons, doesn't account for the specifics of a given sub-sector, including the types of products (grade, species, cultivar), local conditions (available resources, land, logistics, climate) and labour. Further, the economic potential needs will depend on the business case, defined to a significant extent by tariffs that are set at the local level and also vary between sub-sectors.

In the next chapter, the business case for water (and resource) efficiency is discussed, followed by the more detailed analysis of opportunities at the sub-sector level based on available data on similar projects as well as projects implemented by interviewed companies. This will allow the study to arrive at more accurate estimates on water savings opportunities, size of the gap in terms of performance and knowledge and then prioritize interventions in the context of the APRE project.

[19] *Cost savings were estimated assuming that sugar, pulp and paper and packhouses source their water from raw water sources at ZAR2/kl, and the remainder source water from municipalities (assumed to cost ZAR32/kl for water and sanitation). This cost is based on the average Step 1 tariff of the municipalities shown in Figure 12, and assuming the sanitation charge is 50% of the water charge and applies to 95% of the water used. Water savings potential estimates were based on minimum water use benchmarks in South Africa.*

Photo: A'Melody Lee / World Bank

4. The business case for water efficiency in agri-processing

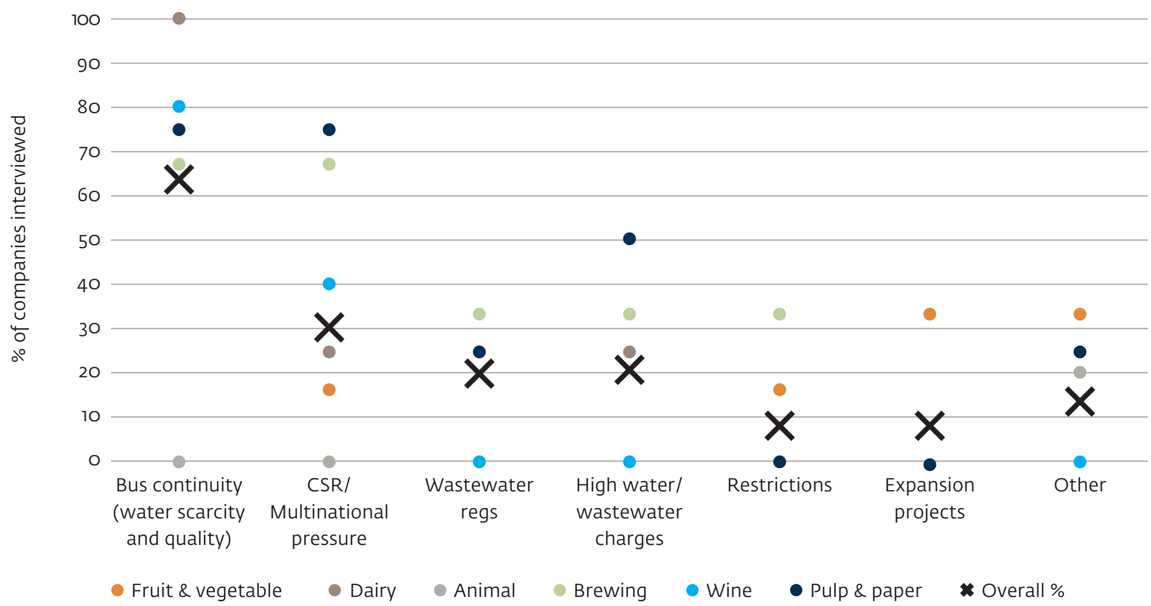
4.1 Drivers for water efficiency

The interviews with key stakeholders in the agri-processing sector revealed that the major drivers for the adoption of water efficiency in the sector are as follows (see Figure 11 for their relative importance):

- Business continuity risk, linked to water shortages or poor water quality, is the dominant driver for investment water efficiency in the sector. Where these risks are serious, companies are willing to invest in water efficiency and reuse projects that provide water security, even when traditional paybacks are unfavourable. For example, at RCL Foods' Rustenburg facility, their planned water efficiency interventions will increase their back-up (reservoir) water supply from 8 to 16 hours, thereby limiting business continuity risks linked to temporary water shortages.
- Corporate social responsibility (CSR) is also a key driver, particularly for multi-national organizations. Sectors dominated by multi-national companies, such as brewing and pulp and paper, are strongly driven to invest in water efficiency through CSR.
- Wastewater discharge regulations and charges are often a driver for effluent reuse projects. Companies that discharge wastewater to the environment (or for irrigation) are required to meet water quality standards and obtain the required licences or authorizations. Similarly, wastewater discharged to the municipal sewer systems may incur surcharges or penalties if the quality does not meet the desired standards. For companies that are under pressure (financially or legally) to invest in systems to pre-treat their wastewater before discharge, the option of further treating to potable standards for reuse becomes more attractive. For example, a dairy invested ZAR12 million in a membrane bioreactor plant in order to meet wastewater discharge limits and plans to invest in a reverse osmosis plant to further treat the effluent to potable standards for reuse. However, in general, enforcement is poor, and many companies prefer to pay the fines or ignore the regulations even if risking being shut down.
- Investment in utilities is often a lower priority for agri-processors than investment in expansion projects. Water efficiency projects that enable the business to expand, are likely to be more attractive.
- Other drivers include water restrictions, the benefits of improved competitiveness through better compliance and water and energy cost savings (especially low-cost interventions).

The observed situation corresponds with that seen in many emerging markets, where the cost of water is perceived by companies directly through the tariffs and cost of energy associated with water supply, distribution and discharge. At the same time, direct costs often do not factor in the water scarcity and supply issues, and the companies find other ways to incorporate these criteria in their decision-making process.

Figure 11. Drivers for water efficiency specifically mentioned during stakeholder interviews.



Motivation associated with regulations, as voiced by respondents' is an important factor and calls for analysis of the policy around water use in general, and specifically agribusiness, which is further explored in Chapter 8.

The next section discusses the tariffs, charges and their role in the business case for water efficiency in South Africa, which is important to arrive at valid assumptions for further potential estimation – and formulate possible interventions for enhancing the business case.

4.2 Water tariffs and their impact on the water efficiency business case. Additional revenue streams and supplementary payback factors

Water tariffs are relatively low as municipalities are often reluctant to raise tariffs to cost-reflective levels. Because tariffs vary significantly across municipalities, see Figure 12 and Table 16,[20] the business case is highly dependent on the location of the plant and the source of the water. As a result, the payback periods for many of the capital-intensive water projects (e.g. effluent reuse or biogas) are typically not less than 7 to 8 years. Paybacks can be even longer, especially if water is drawn directly from cheaper surface or groundwater (raw water) sources. Agri-processors, as shown in the following Chapters, are typically interested in investments with paybacks of less than 3 years and are therefore unlikely to invest in these types of water projects, unless there are other drivers (e.g. business continuity risks, corporate social responsibility, regulatory compliance, expansion). To illustrate the impact of tariffs on the business case, Figure 13 compares the paybacks for effluent reuse and smart metering under the City of Cape Town's Level 1 and Level 6 restrictive tariffs[21] for a food and beverage company generating 1 000 cubic m/day wastewater.[22] Regardless of the tariff, smart metering (a low-cost intervention) makes business sense, whereas the feasibility of effluent reuse is highly dependent on the tariffs.

[20] *The data compares volumetric water tariffs and excludes any fixed costs, surcharges.*
[21] *Tariffs are often linked to water restriction levels, with higher tariffs corresponding with higher water restriction levels.*
[22] *Municipalities set different tariffs for different water restriction levels, and tariffs typically increase as restriction levels increase.*

Figure 12. Industrial water tariff comparison across key municipalities and municipal districts (ZAR/cubic m, ex VAT, no water restrictions in place).[23]

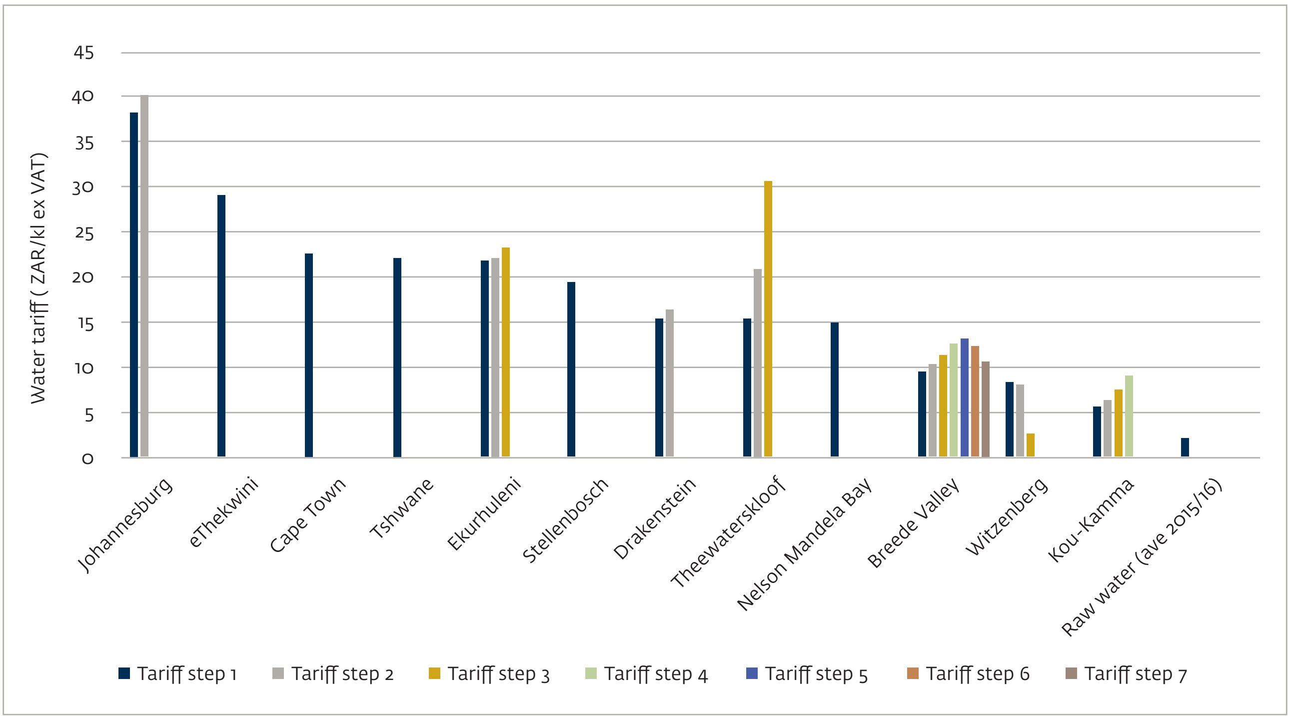
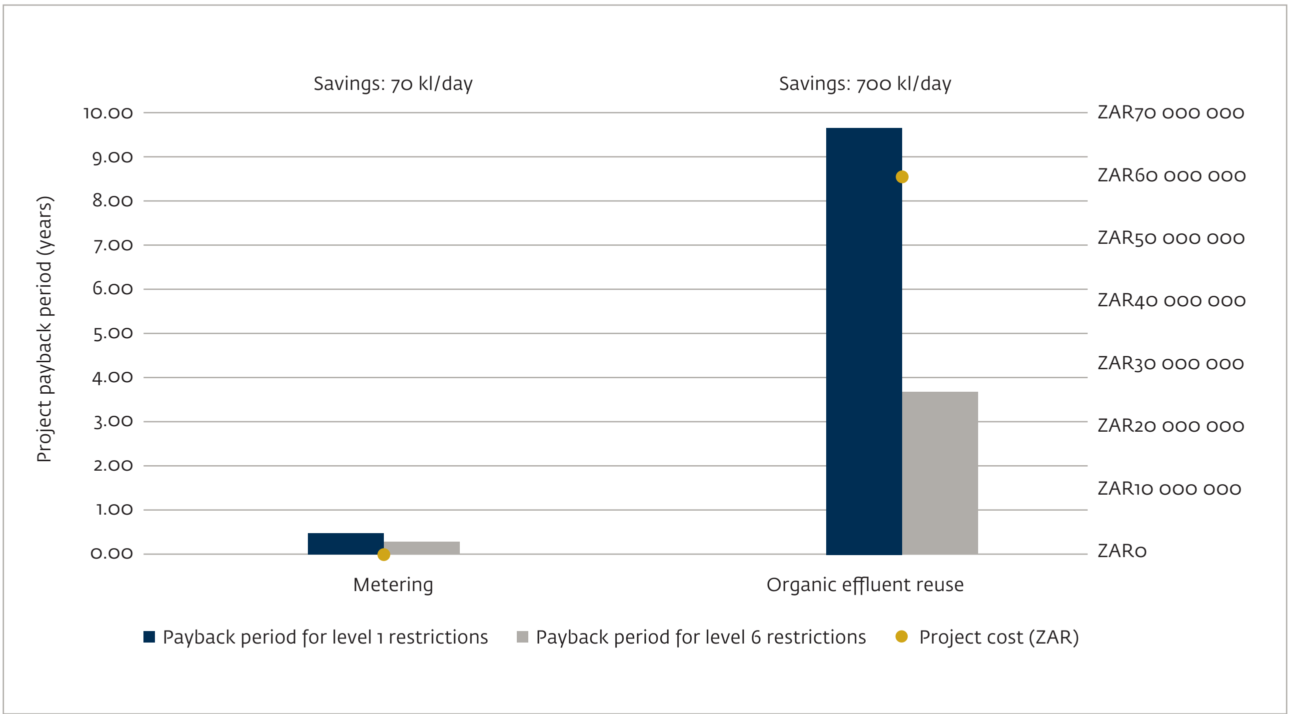


Figure 13. The business case for smart metering and organic effluent reuse in an agri-processor generating 1 000 cubic m/day wastewater for City of Cape Town's Level 1 and Level 6 restriction water and sanitation tariffs (FY 2018/19).[24]



[23] *Tariff steps allow for different volumes of water used to be billed at different rates. Where only one step exists (i.e. it is a flat rate), this indicates a fixed volumetric tariff that is independent of usage.*

[24] *Assuming 70% of wastewater is recovered through reuse and metering reduces the water usage volumes by 7% (however, in practice this has proven to be much higher).*

Saline water or wastewater that is treated to potable standards usually requires treatment by reverse osmosis. This process results in brine (saline wastewater) that can be difficult and costly to dispose of. Often municipalities will not permit brine to be discharged to sewer if the water quality discharge limits are exceeded. Further, liquids and saline wastes can no longer be sent to landfills in South Africa from August 2019 and 2021, respectively. Many water treatment projects cannot proceed due to a lack of a cost-effective brine management solution. In some cases, projects go ahead, but with a much lower water recovery rate (e.g. 40% compared to 70%) to avoid concentrating the brine too much, which weakens the business case.

The business case for energy generation as part of water projects (including biogas from effluent and solar PV) could be improved if additional revenue can be generated from or from wheeling. If the corresponding policies and procedures under the dedicated Small-Scale Embedded Generation initiative are streamlined by the Ministry of Energy, it will help fast-track the approval for projects and open the market for embedded generation for businesses that buy electricity directly from Eskom.[25] However, businesses that buy their electricity from the municipality are still required to register with the municipality, but only 25% of South African municipal electricity distributers allow SSEG installations (most of which are in the Western Cape), with even fewer have official application systems or tariffs in place.[26] In addition, only four municipalities have approved wheeling tariffs.

To illustrate the importance of these revenue streams to the business case, one of the leading juice producers in the country stated in an interview that they will have to shut down their plant if they are not able to export their excess electricity to the grid in the off-season. This would prevent the company from processing the residue, which, beyond dropping an attractive energy generation opportunity, would lead to extra cost for the company and the community to manage the waste.

Digestate, a by-product of anaerobic digestion (biogas plants), is not considered by investors to be a viable revenue stream, because there are no established markets for it, and it cannot be equated to a guaranteed monetary value within a financial model. Its monetary value is currently being researched, with the aim of developing this market. If this revenue stream can be unlocked, it will improve the business case for biogas projects.

[25] *Caboz, J, 2019 It just became much easier for businesses to move off Eskom's grid - here's why , Business Insider.*
[26] *SALGA 2018.*

5. Potential and challenges for water efficiency in agri-processing sub-sectors

5.1 Cross-sectoral opportunities for water and resource efficiency

There are a number of water efficiency opportunities that apply across the agri-processing sector (i.e. cross-sectoral), as summarized. These opportunities, and their associated costs and paybacks, were identified through the stakeholder interviews, as well as the GreenCape experience in supporting Western Cape-based agri-processors during the drought.

Low-cost interventions (including measures to upgrade the water supply and distribution infrastructure at facilities) appear to be widely adopted by the major agri-processing companies, but it is likely that there are still significant opportunities for these interventions in smaller companies, especially those outside of the Western Cape. However, water treatment companies report that many agri-processing companies do not have access to reliable water quality and usage data throughout their site (due to a lack of metering and monitoring), suggesting that are still opportunities for the wider adoption of smart metering and sub-metering.

The National Cleaner Production Center (which undertakes free resource efficiency audits for industrial companies) has also identified improved metering and monitoring (and effluent reuse) as the major water efficiency opportunities remaining in the sector.

Effluent reuse

Wastewater (effluent) can be captured before it is discharged into the municipal system or into the environment, and treated on site to varying levels and reused on site. Treating wastewater to potable (drinking water) quality means that the water can be reused for most processes (except where consumer perception or regulations limits the reuse of wastewater).

Low-cost interventions

A number of low-cost interventions can be implemented to reduce water demand. These include:

- Installing meters and implementing a monitoring regime;
- Staff awareness campaigns, improved water metering and monitoring;
- Development of an action plan;
- Simple water-efficient retrofits (on/off spray nozzles, aerators, low-flush toilets, low-flow showerheads for staff use.

Some examples of low-cost interventions implemented by agri-processors include:

- A dairy company in the Western Cape installed a system to recover and reuse the water used to cool pistons on one of their sites. The system cost ZAR200 000 and they reduced their consumption by ~20% (1 l/kg product).
- A soft drink manufacturer invested ZAR140 000 in a system to recover and reuse rinse water from the bottling plant and initiated a staff awareness campaign. They reduced their water consumption by 27% (36 000 cubic m/yr) and reduced their wastewater production by 61%.

Internal reuse

Wastewater can be captured from an internal process, treated to the required quality and used in a fit-for-purpose application. One such example is reuse of Clean in Place (CIP) rinse water. CIP is a common process where pipes/vessels are cleaned internally between different batches of product, by injecting water and cleaning agent into the pipes/vessels, followed by repeated rinsing, until all of the cleaning agent has been removed. The rinse water can be captured and, with the basic treatment, reused in the wash-cycle in the next CIP cleaning cycle.

Several companies that have implemented these measures in their Western Cape operations as a result of the recent drought, have realized the benefits, and have implemented them across their operations in other parts of the country.

The adoption of effluent reuse (treating the final effluent to potable standards for on-site reuse) with or without energy recovery (biogas) is relatively limited to date, largely due to the poor business case and high capital costs, as outlined in Section 4. However, internationally, food and beverage companies are increasingly seeing the benefits of creating value from wastewater. This is largely driven by a growing pressure to meet or exceed environmental standards, tightening wastewater regulations, increasing water stress and the risk of brand damage if local communities are affected by their wastewater. The demand from global food and beverage companies for water technologies is expected to have doubled by 2020 (compared to 2011) with double-digit growth projected for technologies associated with reuse and biogas (membranes and anaerobic digestion).[27]

Further, companies that are reliant on municipal supply are exploring and investing in alternative water supply (e.g. ground or surface water) to diversify their water supply risks.

Solar PV is also an opportunity for many sites, especially fruit packhouses. This opportunity may grow if a simple process for licensing and registration is adopted for smaller-scale applications (Integrated Resource Plan 2010-2030). The Minister amended the regulations for companies to apply to the National Energy Regulator of South Africa (NERSA) for licensing applications for projects 1-10MW without requiring ministerial sign-off. These changes should help fast-track the approval for projects and have opened up the market for embedded generation (including biogas projects) for businesses that buy electricity directly from Eskom, though the impact from the changes is yet to be seen on the ground.

In conclusion, the key cross-sectoral opportunities for improved water efficiency are smart water metering and monitoring, and effluent reuse (with or without biogas recovery). In the case of smaller agri-processors, there is also the opportunity for the more widespread adoption of low-cost interventions.

Treated municipal effluent

Wastewater (effluent) that is treated by municipalities and made available for non-potable use is termed treated municipal effluent. This treated effluent can either be used as is for low-grade applications, or treated for the end-purpose. Due to health concerns, this is primarily only an option for the pulp and paper industry.

Anaerobic digestion and biogas

Anaerobic digestion is a collection of processes by which micro-organisms break down biodegradable material in the absence of oxygen. In industrial applications the process is used to improve the quality of the organic wastewater (either for reuse on-site or to comply with wastewater discharge limits).

A by-product of anaerobic digestion is the production of biogas. This gas can be released into the atmosphere, captured and bottled for later use or sale, burned off for heat energy, or converted to electricity. The latter requires a Combined Heat and Power (CHP) generator.

The summary of possible efficiency interventions that are or could be implemented by agri-processing companies, based on the experience in South Africa and interviews conducted as part of the study, are presented in the table overleaf.

[27] *GWI 2012.*

Table 1: Summary of water efficiency opportunities in the agri-processing sector.

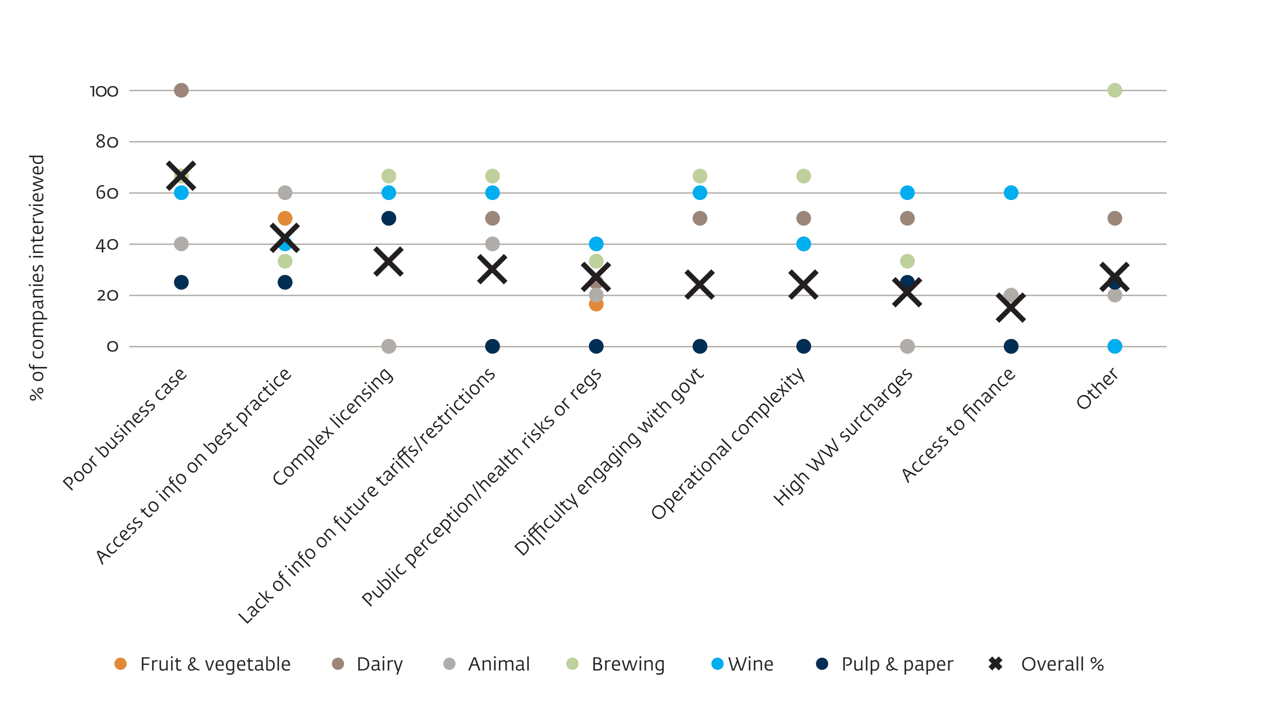
	Project type	Typical costs	Typical water savings	Payback	Potential for further uptake
Low-cost interventions	• Staff awareness and incentive campaigns • Staff awareness and incentive campaigns • Improved metering and monitoring (e.g. smart metering) • Water infrastructure retrofits (e.g. efficient spray nozzles, automatic shut-off values) • Reuse of higher quality waste streams (e.g. pump seal water, CIP rinse water)	<ZAR2 million Smart metering: ~ZAR1 700 - ZAR6 000 per meter for 20-25mm sub-meters ~ZAR30 000 for large (100mm) bulk meters[28]	Up to 30%	Short (<3 years)	Implemented widely by large agri-processing companies, but there are still opportunities for smart metering Opportunities for more widespread adoption in smaller companies
Process equipment	• Upgrade and replacement of less efficient equipment	Sub-sector specific (see Sections 5.4-5.9)			
Reuse and recovery	• Effluent treatment and reuse with/without energy recovery (biogas)	ZAR20-120 million (capex) ZAR12-15/ cubic m (opex)	~45-70% of wastewater recovered	7-8 years +	Limited projects to date, but growing opportunity

5.2 Cross-sectoral challenges and barriers for water efficiency

Agri-processors face a number of challenges or barriers that hinder their ability to implement water efficiency projects. Figure 14 shows the relative importance of the different barriers, based on the stakeholder interviews. The percentage of organizations that specifically mentioned each barrier is shown by sub-sector (colored dots) and overall (black crosses) and provides an indication of the relevant importance of each barrier.

[28] *These costs exclude the communication networks and data management components.*

Figure 14. Barriers to water efficiency specifically mentioned during stakeholder interviews.



As shown, the single most reported barrier to implementing capital-intensive water efficiency and reuse measures is the poor business case for the investment (67% of the organizations reported this as a barrier). This has been discussed in detail already in Chapter 4. This Chapter 5 and prioritization in Chapter 6 largely discussed the possibilities under the existing business case as perceived by the sector players.

It is notable that, apart from the business case, other reported barriers are largely policy related. This reinforces the need to address this as part of the policy analysis which is provided in Chapters 7 and 8.

Other barriers include a lack of internal resources to identify and motivate for projects, space constraints, energy trade-offs, access to capital (particularly when there are higher priority projects) and the cost of capital.

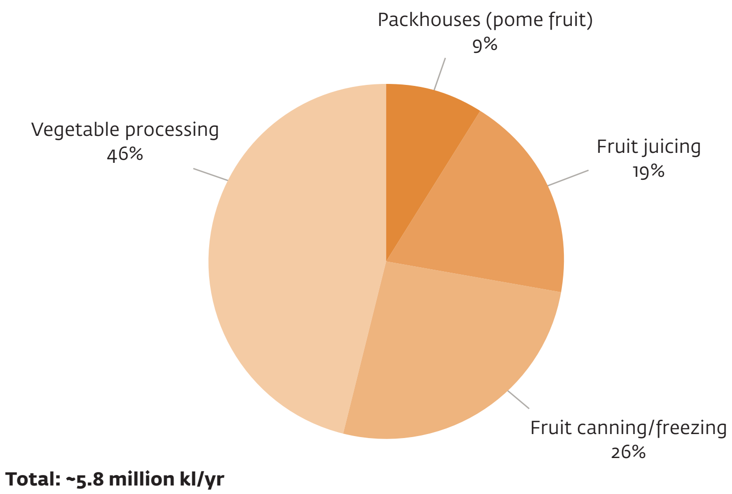
A barrier indicated by prevalent stakeholders is the lack of access to best practices which signals the knowledge gap. We explore this in more detail at the level of further sub-sectors, as well as in Chapter 6.

5.3 Fruit and vegetable packing, storing and processing

Fruit and vegetable processing includes a range of processes, such as juicing, canning, freezing and drying. The sector is estimated to use ~5.8 million cubic m/yr, of which vegetable processing (which is dominated by potato and tomato processing) accounts for around 46% (Figure 15). Fruit canning, which uses ~26% of the sub-sector's water use, is largely concentrated in the Western Cape, where the drought has led to a significant improvement in water efficiency in the sub-sector. Juicing, which is predominantly fruit-based, is spread more widely across South Africa. Only 1% of fruit is dried and is therefore not a major water user within this sub-sector. The packing and storing of fruit for export (undertaken in packhouses) has also been included in this sub-sector, as it represents the highest value product (~$3bn in 2017).[29] Only pome fruit packhouses are considered in this analysis, as they tend to be large and centralized and use considerably more water than citrus or table grapes (the other major exported fruits).

[29] *NEA 2018.*

Figure 15. Estimated water use in the fruit and vegetable sector by processing type.



5.3.1 Water efficiency opportunities in the sector

Water efficiency opportunities in the fruit and vegetable packing, storing and processing sub-sector are set out below and represent examples of best practices for each subsector showcased by some of the leading producers.

Table 2. Efficiency opportunities in fruit and vegetable processing.

Sub-sector	Examples of opportunities in the sector
Canning & freezing	**Process efficiencies** A fruit canning market, reduced its municipal water consumption by ~45%, through various measures, including: • Replacing water conveyance systems with dry conveyance systems; • Installed automatic shut-off valves to production lines; • Replacing the spray nozzles with more efficient nozzles and improving the pressure; • Basic toilet/basin water efficiency measures; • The use of spring water to supplement municipal supply. **Effluent reuse** Effluent reuse helps maintain compliance, as well as maintain water security, while achieving certain savings. A project example from one of the leading industry players demonstrates compliance and security as the key drivers: • Total water use: 500 000 cubic m/yr; • Wastewater generated: 300 000 cubic m/yr (60% of water use); • Wastewater recovery: 50%; • Overall water savings: 30%; • Municipal water cost savings: ZAR1 500 000/yr; • Wastewater pumping savings: ZAR1 million/yr; • Capex: ~ZAR100 million.

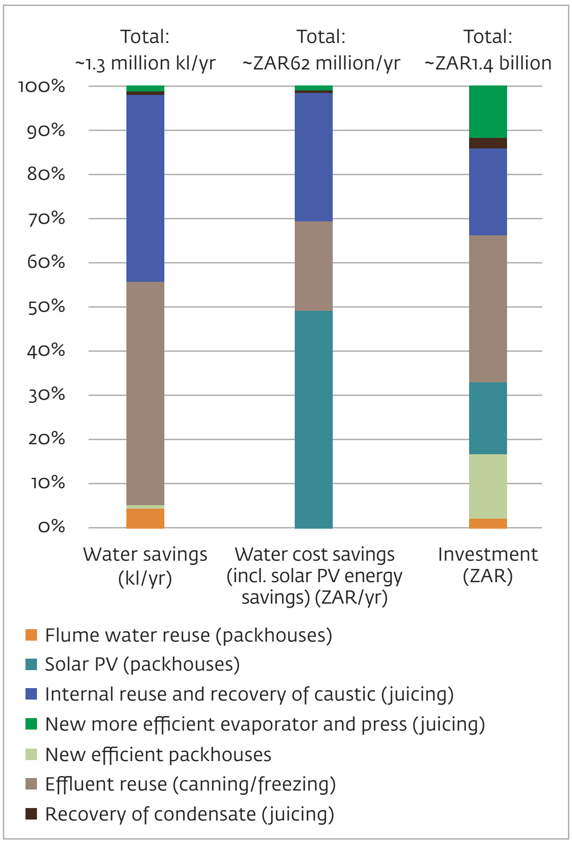
Sub-sector	Examples of opportunities in the sector
Juicing	**Internal reuse and recovery** As proven by various examples, an international benchmark of 0.5 l/kg fruit processed can be achieved and even exceeded through the following measures: • Installation of a solids removal system so that the flume water can be reused and replaced every 12 hours, instead of the typical 3-hour interval; • Advanced cleaning of the evaporators, whereby ultra-filtration and absorber units are cleaned in stages: (a) caustic wash, (b) a rinse followed a sanitizer wash (with conductivity sensors to capture wastewater); • Recovery and reuse of sanitizer wash is for cleaning (e.g. floor cleaning), and reuse of the push water from the evaporator and ultra-filtration unit in the press; • Reuse of cooling water at the pump seals (seal water); • Installation of buffer tanks with extra surplus water to cover gaps between water recovery cycles and high demand cycles, avoiding the use of municipal water in the interim; • Sending of the caustic wash water to the caustic plant, achieving recovery of 90-95% of caustic; • Recovery of the condensate water from evaporators.
Pome fruit packing & storing	**Flume water reuse** A filtration system for the flume water could bring significant benefits. It could be possible to save up to 50% of flume water, which would exceed 15% of the total use. Once again, the main drivers would be business continuity and social sustainability: at the direct cost of water observed in known examples, economic feasibility of such projects is challenging.

5.3.2 Water efficiency potential

Figure 16 shows the estimated realizable water savings for the fruit and vegetable sub-sector over the next 4-6 years and required investment (by intervention type, including solar PV on packhouses). The figure provided is a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.[30] Energy savings from solar PV on packhouses are estimated to account for roughly half of the cost savings potential in this sector.

Effluent reuse, solar PV and internal reuse and recovery measures are the major opportunities in this sector.

Figure 16: Estimated realizable water savings for the fruit and vegetable sub-sector over the next 4-6 years and required investment (by intervention type, including solar PV).

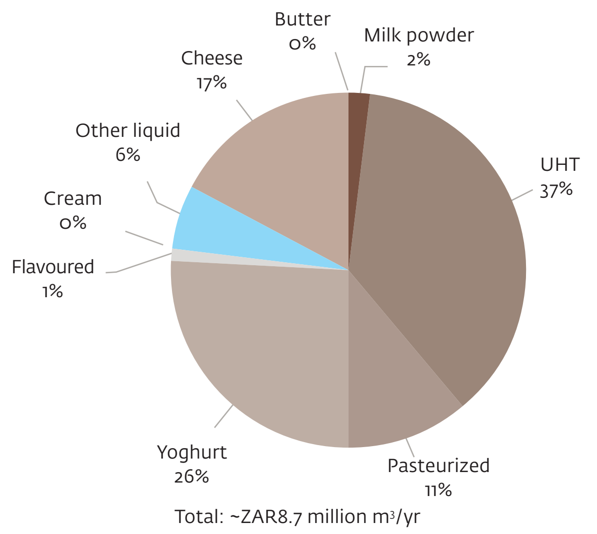


[30] *Assumptions:*
Packhouses: 5 of the 7 major pome fruit packing companies can install flume water reuse (18% saving, 2 known to have already implemented), 2 large packing companies will each need to invest in a new packhouse (5% saving),
Canning/freezing: 2 fruit canning and 3 vegetable canning facilities have the business case for effluent reuse (30% saving).
Juicing: major juice companies have the potential to invest in internal reuse and caustic recovery systems (60% saving), 2 have the business case to replace their press and evaporator equipment (16% saving) with more efficient equipment and 2 have the potential to invest in recovering process condensate (10% saving).
Solar PV: 11 of 13 major packhouse sites invest in 1.5MW.
Tariffs: ZAR2/kl for raw water (packhouses), ZAR10/kl for fruit canning water costs, ZAR32/kl for municipal water and sanitation costs for all other sub-sectors. Cost savings include energy cost savings from solar PV.

5.4 Dairy Processing

South African unprocessed (raw) milk purchases have steadily increased from ~2.6 billion kg (2007) to ~3.3 billion kg (2017), with a few large processors dominating the market. The industry is estimated to use ~8.7 million cubic m of water each year. The production of (ultra-high temperature) UHT milk is estimated to account for ~37% of this water use, with yoghurt and cheese accounting for 26% and 17% respectively (see Figure 17). Typically, 60-70% of water used in all dairies is for cleaning of the factory or equipment.

Figure 17: Estimated breakdown of water use in the dairy processing sector by product.



5.4.1 Water efficiency opportunities in the sector

Most of the dairy companies, including the interviewed stakeholders, had implemented no- and low-cost interventions that include:

- Staff awareness and incentive campaigns;
- Improved water metering and monitoring; and
- The reuse of cooling water (e.g. pump seal water) and final stage CIP rinse water.

Companies have reported water savings of up to 25% from these measures.

Sites that produce milk powder can implement projects to recover and reuse the evaporated water ('cow's water') in the first CIP rinse. Accompanied by effluent monitoring equipment, this represents efficient solution which does not only help save water but allows to reduce material losses and improve wastewater quality.

Based on the interviews, the major companies (which dominate the market) appear to have largely implemented low- and no-cost interventions, suggesting there is limited further scope for savings through these measures.

However, an emerging opportunity in this sector is effluent reuse that is being driven by water security risks, corporate social responsibility and wastewater discharge regulations and charges. Depending on the products manufactured by the facility, between 75-95% of the water ends up as wastewater and is increasingly being viewed as a resource. Nestlé's Mossel Bay dairy plant has implemented several water efficiency measures, including effluent reuse for non-product contact purposes, as outlined in the insert below.

Figure 18. Nestlé Mossel Bay case study.

Case study: Nestlé's Mossel Bay dairy processing plant

Nestlé's Mossel Bay plant is their primary dairy processing facility in SA and produces milk products that include Nespray, Nido, Klim, condensed and culinary milks.

In 2009 (when the Mossel Bay area experienced a severe drought) Nestlé initiated a water-saving program that was phased in over several years and has resulted in water savings of 65% (~14 000 cubic m/month) compared to 2009. The measures include:

- Low-cost interventions, including staff awareness campaigns, improved water metering and monitoring and the development of an action plan.
- The recovery and reuse the water evaporated from the milk ('cow's water'), using reverse osmosis treatment.
- The treatment of their factory effluent (excluding sewage water) to potable standards using anaerobic digestion and membrane filtration for non-product contact reuse (cleaning purposes). The biogas produced is used to power a boiler, reducing energy demand.

These interventions, which cost ~ZAR84 million, were driven by water supply risks and corporate social responsibility, despite the unfavourable traditional paybacks.

The plant was chosen as one of five Nestlé factories internationally to be 'zero water'. They are now looking at further ways to recover and use their water, and ultimately aim to become a zero water intake facility. Due to public perception and health risks, they do not intend to treat and reuse their effluent for product-contact purposes.

5.4.2 Water efficiency potential

As outlined previously, the major opportunity in the dairy sector is effluent reuse, which is estimated to save ~900 000 cubic m/yr through investments of ~ZAR470 million (Table 3). The figure provides a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.[31]

Table 3. Estimated realizable potential for effluent reuse in the dairy industry over the next 4-6 years.

Water savings (cubic m/yr)	Water cost savings (ZAR/yr)	Investment (ZAR)
900 000	ZAR29 000 000	ZAR470 000 000

5.4.3 Challenges or barriers specific to the sub-sector

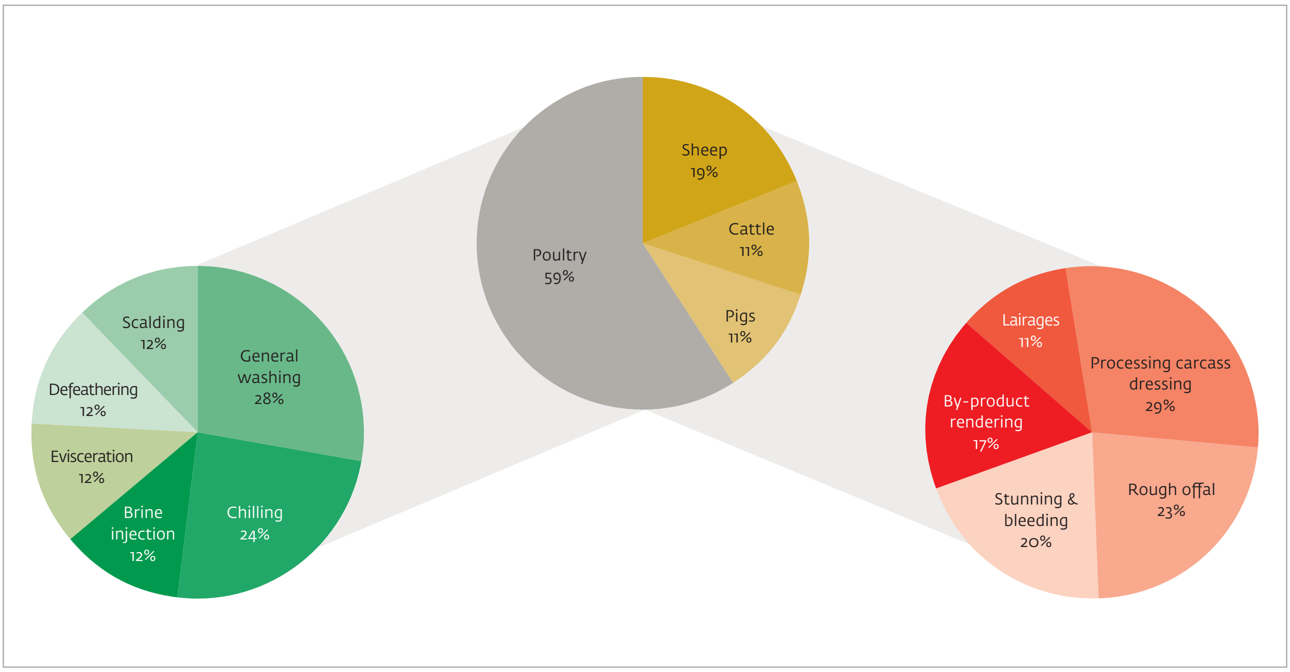
The sector faces a number of challenges with respect to implementing resource efficiency measures, as follows:

- In general, the dairy industry has low profit margins, especially processing 'white milk'. As a result companies are moving towards value-add, fast-moving consumer goods (e.g. sterilized milk, yoghurts etc.) which carry the industry. The industry in general is cash strapped and capital strapped, which limits investments in water efficiency.
- Water usage varies considerably from dairy to dairy, and tends to be higher in factories that have more production lines or more product changeovers. It is therefore difficult to benchmark the performance of dairies, and companies tend to prefer to benchmark internally.
- Solar PV is an opportunity at many sites, with several companies indicating that they will invest in solar PV once wheeling and small-scale embedded generation is permitted in their municipality. However, solar PV may be difficult to implement at facilities that produce milk powder, due to the additional costs associated with the need for regular cleaning of the panels to remove settled dust from the powder stacks.

5.5 Animal slaughtering and processing

The animal slaughtering and processing industry is estimated to use ~19 million cubic m per year, of which poultry uses ~60%. General washing and chilling account for roughly half of the water usage in the poultry industry (Figure 19). The red meat processing industry accounts for ~40% of the sector's use, with cleaning and carcass washing accounting for ~80% of total use.[32]

Figure 19. Estimated breakdown of water use in the animal slaughtering sub-sector (WRC 2017a, b).



[31] *Assumptions: The 4 interviewed dairies use 35% of total water use by the sector (based on known company water usage and the overall sector estimate). Investments and savings are scaled-up from known projects from the interviews. It is assumed there is a business case for 5 of the 20 large dairies (assumed to have 85% of the market and water use) to implement effluent reuse. Municipal water and sanitation tariffs are estimated to be R32/m³ (incl. VAT) on average.*

[32] *WRC 2017a.*

5.5.1 Water efficiency opportunities in the sector

In the animal slaughtering industry there are several opportunities for improved water efficiency through various low-cost measures, including:

- Scheduling of animal delivery to achieve continuous slaughtering operations and minimize cleaning;
- Dry cleaning where possible (e.g. gut and manure cleaning);
- Reuse of high-quality waste stream, e.g. cooling water for primary washing of lairages;
- Collecting lairage manure as a solid waste;
- Water efficient directional spray nozzles for washing and cleaning;
- Automatic shut off valves and sensing devices (e.g. for pig scalding tank levels);
- Smart water metering and sub-metering.

Many of the interviewed companies have implemented one or more of these interventions.

It is estimated that red meat abattoirs can reduce their consumption by 15-30% (and up to 60% in smaller abattoirs) through low- and no-cost interventions.[33] There are also opportunities in the poultry sector. As an example, a small chicken abattoir reduced its water consumption by 20% through low-cost interventions that included water efficient spray nozzles, leak repairs, improved management and water awareness training.

As chilling accounts for 24% of water use in the poultry sector, or 1.5-2 l/bird, the abattoir replaced their chilling system with a hybrid water/air spin chilling technology that has helped them achieve a water usage of 10.5 litres per bird at the facility, which is within the range of international best practices.

Between 70-90% of the water used by the industry ends up as wastewater. This wastewater typically contains a high organic loading (Chemical Oxygen Demand – COD) and the sector is under growing pressure to improve the quality of its wastewater. Abattoirs are increasingly looking to anaerobic digestion (biogas) technologies to treat their wastewater. The treated wastewater can then either be reused onsite for non-potable purposes, or further treated (e.g. using reverse osmosis) to potable standards for reuse. In addition, the biogas produced in the process can be used to generate electricity that can offset the energy demands of the abattoir. As the poultry abattoir industry is relatively concentrated in a few large sites (3 companies collectively have 12 abattoirs and own 55% of the market), there are economies of scale for these projects in this sub-sector.

The red meat industry is less concentrated than the poultry industry, with ~80 large facilities, and ~200 facilities suppling 75% of the meat production. There are also opportunities for biogas plants in this industry, with ~5 projects already implemented. In 2016, the potential for electricity generation at cattle and pig abattoirs was estimated to be 47 737 and 9 035MWh per annum respectively.[34]

An example of a successful biogas project in the abattoir industry is the system installed at RCL Foods' poultry abattoir in Worcester.

Table 4 highlights some key statistics for this plant.[35]

Table 4: Key statistics for the anaerobic digestion plant at RCL Foods' abattoir in Worcester.

	Key Statistics
Plant location	Worcester, Western Cape
Commissioning date	March 2017
Waste source	Abattoir wastewater
Technology	Anaerobic flotation reactor, with combined heat and power unit
Wastewater volumes	3 000 cubic m/day
COD	30 000 mg/L
Electrical and thermal heat capacity	1.55MW and 1.68MW
Estimated wastewater recovery[36]	~33% (limited to low-grade water uses as water is non-potable)
Water saved (used for non-potable uses in abattoir)	~1 000 cubic m/day
Capital cost	ZAR120m
Electricity generated (2018)	8 539MWh (30% of total abattoir requirement)
Payback	Biogas project paybacks are typically 8-15 years
Procurement model	Build-own-operate (BOO) model. RCL foods pays Green Create (the project developer) to treat their water and buys back the treated water for reuse.
Future plans	Plant will be increased from 1.68MW to 4MW eq at a cost of ZAR230m

33 *WRC 2017b.*
34 *SABIA 2016.*
35 *IRCL Foods 2018, Green Create.*
36 *It was assumed that 33% is reused.*

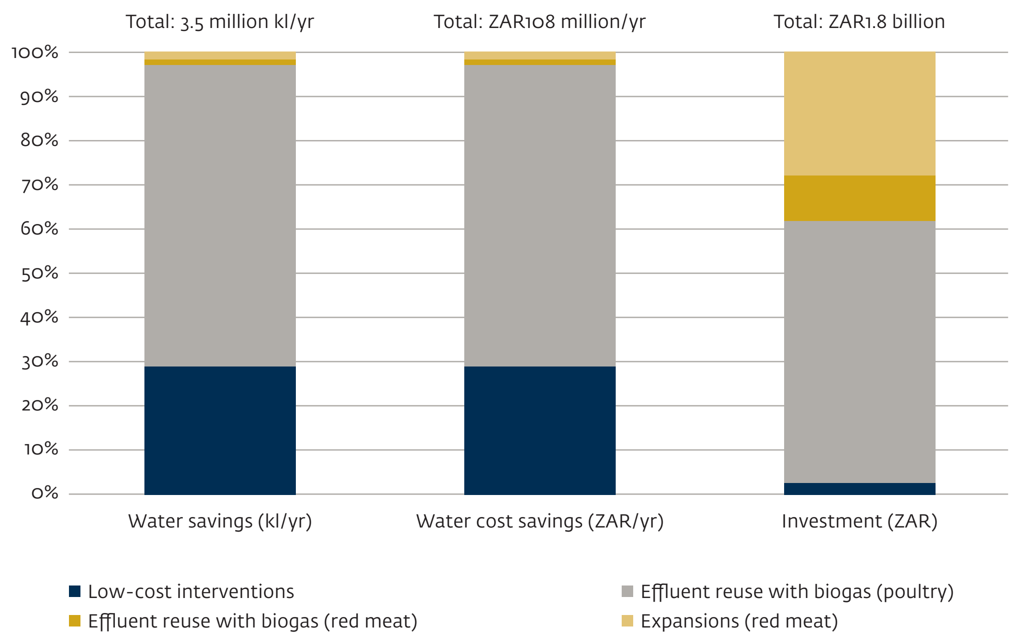
Following the success of this project, RCL Foods are considering replication of the project at another facility. The plant will treat wastewater from their abattoir as well as chicken litter from their farms. Up to 50% of the wastewater is expected to be recovered and reused on site for non-food contact purposes. In addition, ~60% of the abattoir's electricity requirements and 100% of the animal feed mill's steam requirements will be generated by the plant.

5.5.2 Water efficiency potential

Figure 20 shows the estimated realizable water savings for the animal slaughtering and processing sub-sector over the next 4-6 years and required investment (by intervention type). The figure provides a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.[37]

The sub-sector's realizable water savings potential over the next 4-6 years is estimated to be in the order of ~3.5 million cubic m/yr. These savings are linked to low- and no-cost interventions, particularly in the red meat industry, and effluent reuse (with biogas) in the poultry sector.

Figure 20. Estimated realizable water savings for the animal slaughtering and processing sub-sector over the next 4-6 years and required investment (by intervention type).



5.5.3 Challenges or barriers specific to the sub-sector

The sector faces a number of challenges with respect to implementing resource efficiency measures, as follows:

- The poultry industry is under strain from cheap imports, which are affecting product market share and profit margins, and companies are focusing their investments on business continuity.
- There is currently a negative perception about biogas technology in the red meat sector, due to poorly developed business cases (that limit revenue streams), and poor operations and maintenance (O&M) management of projects implemented in sector in SA to date. Biogas plants in the poultry sector have been better managed and have an established track record.
- Due to the high nitrogen concentrations in red meat abattoir wastewater, a carbon-rich feedstock (e.g. manure) is needed to supplement the wastewater in the biodigester, which affects the business case. Abattoirs that are co-located with feed-lots have the opportunity to utilize the manure as a carbon-rich feedstock. However, most sites do not have access to manure as abattoirs seem to be generally independent of the farms.

[37] *There is a business case for effluent reuse (with biogas) at 8 poultry abattoirs (1-4MW biogas, ZAR120-230m, 40% water saving) and 7 red meat abattoirs (500kW biogas, ZAR40m, 30% water saving). Water costs average ZAR31/kl. Low-cost intervention savings potential of 5% in poultry and 15% in red meat. Two red meat sites are known to be expanding (ZAR250m each, 30% savings).*

- O&M skills for biogas projects are typically not available in-house within the sub-sector, and a transfer of skills or an upskilling of existing staff is required in order to operate and maintain the equipment, which adds to costs and complexity.

5.6 Malting and brewing

There has been a recent shift from national to multinational ownership of large breweries.[38] The key companies in the sector are South African Breweries (SAB), a subsidiary of Anheuser-Busch InBev (AB InBev) since 2016, and Heineken South Africa (Heineken SA), which now operates as an independent entity in partnership with Namibian Breweries since the Brandhouse Joint Venture with Diageo was dissolved in 2015.[39] These companies currently employ over 10 000 people in South Africa.

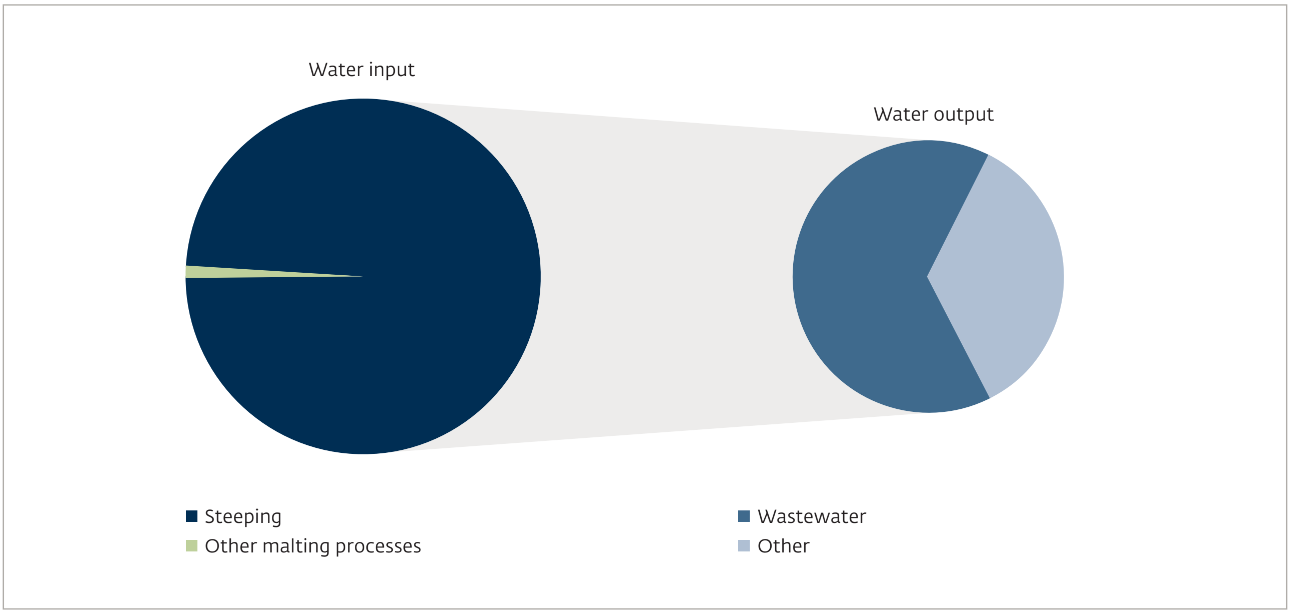
In 2014, the total beer production capacity in SA was over 3 500 kilolitres with more than 99% of the market captured by large companies.[40] SAB had a capacity of 3 100 million litres of beer and an 88.2% share of the beer market in SA, while the Sedibeng Brewery, partly owned by Heineken SA as part of the Brandhouse Joint Venture, had a capacity of 400 million litres of beer and an 11.4% share of the beer market in SA.

Both AB InBev/SAB and Heineken SA have global company commitments to 'green' production and are using benchmarking to assess their progress toward water efficiency targets. This is driven by a recognition that water security is a key risk for business continuity and competitiveness, particularly in water-stressed areas in South Africa. AB InBev have recently done 15 water risk assessments for African sites, three of which were in South Africa: SAB Newlands Brewery in Cape Town and SAB Maltings in Caledon (in the Western Cape) and SAB Ibhayi Brewery in Port Elizabeth (in the Eastern Cape).

5.6.1 Water use in malting

Malting includes three primary processes, namely steeping, germination and kilning. As shown below, steeping is responsible for almost all water consumption and the majority of effluent generation. On average, for every ton of malt produced, 4.5-5.0 cubic m water is required for the steeping process and approximately two-thirds of this (3.0-3.3 cubic m) is generated as wastewater.[41]

Figure 21. Water use for the malting processes.



[38] WRC 2016.
[39] Heineken SA 2019.
[40] WRC 2016.
[41] EUREKA SWAN 2009.

5.6.2 Water use in brewing

Water for brewing is sourced from municipalities, boreholes and/or freshwater springs, with the majority of large breweries using municipal water. Non-product containing water consumption is affected by cleaning of process equipment, pasteurization and general washing, e.g. bottles, floors, etc. The water intensive stages are milling, filtration, pasteurization, packaging and cleaning; and the brewing processes which consume the most water are floor cleaning, milling, mashing, separation, flushing of filters, using the vacuum pump for filtering, keg washing, boiling, cooling, fermentation with yeast, maturation and pasteurization, and cleaning of packaging materials, i.e. washing bottles.[42]

In terms of wastewater, the majority of South African breweries treat water at the source and do not reuse it as part of the brewery process.[43] Breweries have different wastewater concentrations with the typical values and ranges of key components discussed in detail in the NATSURV.[44] If the effluent is not pre-treated to acceptable limits, the brewery is fined by the municipality. In some breweries, effluent flows to an underground tank where the pH of the effluent is balanced before being released into the municipal sewer. Others have a sump, a low space that collects liquids, for wastewater, and this infrastructure allows them to construct wastewater treatment plants if needed.[45]

5.6.3 Water efficiency opportunities in the sector

Many of the breweries in South Africa have implemented water saving measures and the interviewed companies are performing at or below international benchmark levels. According to the NATSURV, global water consumption ranges from 40-80 litres water / litre beer produced and best practice is considered to be 55 litres water / litre beer, although some breweries operate at 40 litres water / litre beer.[46] Based on information from the interviews, Heineken SA is aiming to reach 30 litres water / litre brewed product from their current baseline of 40 litres / litre, and SAB is aiming to reach 20 litres water / litre brewed product from their current baseline of 30 litres / litre.

Many water saving technologies that prevent losses and promote control, minimization and recycling of water to the extent possible without compromising hygienic standards are already implemented by large breweries in South Africa.[47] There is also potential for effluent reuse through the anaerobic digestion of wastewater. This can include a biogas component, which can further supplement heat or electricity on-site, but is only viable for large breweries.[48] Best practices include:

- Water recycling, specifically for cooling water and wash water;
- Cascaded water management, where water is recycled from one process to the next;
- Flash pasteurization instead of tunnel pasteurization; and
- Improved practices and water efficient technologies for cleaning, specifically high-pressure, low-flow hoses, automated bottle washing fixed spray injectors, and clean-in-place (CIP) methods for decontaminating equipment such as fermenters and storage tanks.

In addition, cleaner production methods and water risk assessment tools such as water foot-printing (SAB and WWF, 2009) have been used by local breweries to reduce business risks and improve environmental sustainability.[49]

Water efficiency opportunities specific to malting.

In malting specifically, water efficiency interventions focus on reducing the volume of water used in steeping. Best practices have made single-step water steeping possible and has produced water consumption ratios as low as 3 cubic m/ton of barley malt produced.[50] These include:

- Spray-steeping rather than successive immersions in water; and
- Recirculating, cooling and humidifying water.

SAB Maltings is aiming to reach 30 litres water / litre malt from their current baseline of 35 litres / litre and is specifically interested in the following:

- Innovative methods for steeping, specifically 'sprinkling', where sprinklers are used to spray a fine mist onto the malt rather than immersing it in water;[51] and
- Effluent reuse, which can be particularly complex for malting systems, as described in the case study overleaf.

42-49 *Water Research Commission 2016.*
50 *Guido and Moreira 2013.*
51 *Peake and Cluff, 2007.*

Figure 22. Case study: water reuse in steeping.

Case study: The challenges of effluent reuse in steeping

Effluent reuse is particularly complex in malting as treated steeping water retains an inhibitor of barley germination. This impacts the next stage of malting as it slows down the rate of germination and adversely affects malt quality and throughput tonnage.[52]

Recent research suggests effective water treatment systems would require a combination of a membrane bioreactor coupled to reverse osmosis in order to effectively remove the inhibitory compound and enable its reuse in the steeping process. The major variables impacting the feasibility of this technology are the site-specific costs of water abstraction and wastewater treatment.[53]

Although results have been positive at a pilot and commercial scale, with up to 70% of recycled water available for re-steeping, the current capital and operational costs do not make it a viable option for malting companies with their own boreholes and wastewater treatment plants. However, for sites which are facing rising costs for municipal water supply and effluent treatment, it may be possible to demonstrate a favourable medium-term payback.[54]

5.6.4 Summary of water efficiency opportunities in South Africa

Based on the interviews, key water efficiency opportunities lie in effluent reuse and, specifically for malting, in innovative processes for steeping. These are discussed in the table below and are associated with savings of 200 000-600 000 cubic m water per site per year.

Table 5. Water efficiency opportunities in the brewing and malting sector.

Sub-sector	Examples of opportunities in the sector
Malting	Innovative processes can be considered to improve the efficiency of steeping. This includes a water efficient process that uses 'water sprinkling' instead of immersion. Although the investment size is fairly low (~ZAR5 million) per plant, there is high potential for water savings (up to 30%). Known projects are expected to achieve a 6-month payback.
Malting	Effluent reuse proved to have significant viability in the areas where tariffs have increased, and the production of malted barley reduced drastically due to water restrictions of up to 30%. Feasibility studies commission by some of the players confirm that the water savings potential from this solution can reach 50% and, in municipalities in the Western Cape where the tariff reaches ZAR50/cubic m, the payback could be estimated at 3.5 years.
Brewing	In brewing, effluent reuse also represents the dominant high-potential solution, with water saving opportunities similar to malting, though slightly higher payback period (up to 6 years) for projects assessed in Gauteng and Eastern Cape.

Other opportunities that can be that can be bundled with water efficiency investments include:

- Alternative water supply: major players are investing in alternative water supply, with a particular focus on groundwater abstraction to reduce the water risks for the malting process.
- Alternative energy, specifically solar PV: all major players are at the early stages of investing in solar PV with a minimum investment of ZAR9 million per unit. This is being undertaken through long-term PPAs and further rollout across their offices and facilities may present a small but strong investment opportunity.

5.6.5 Water efficiency potential

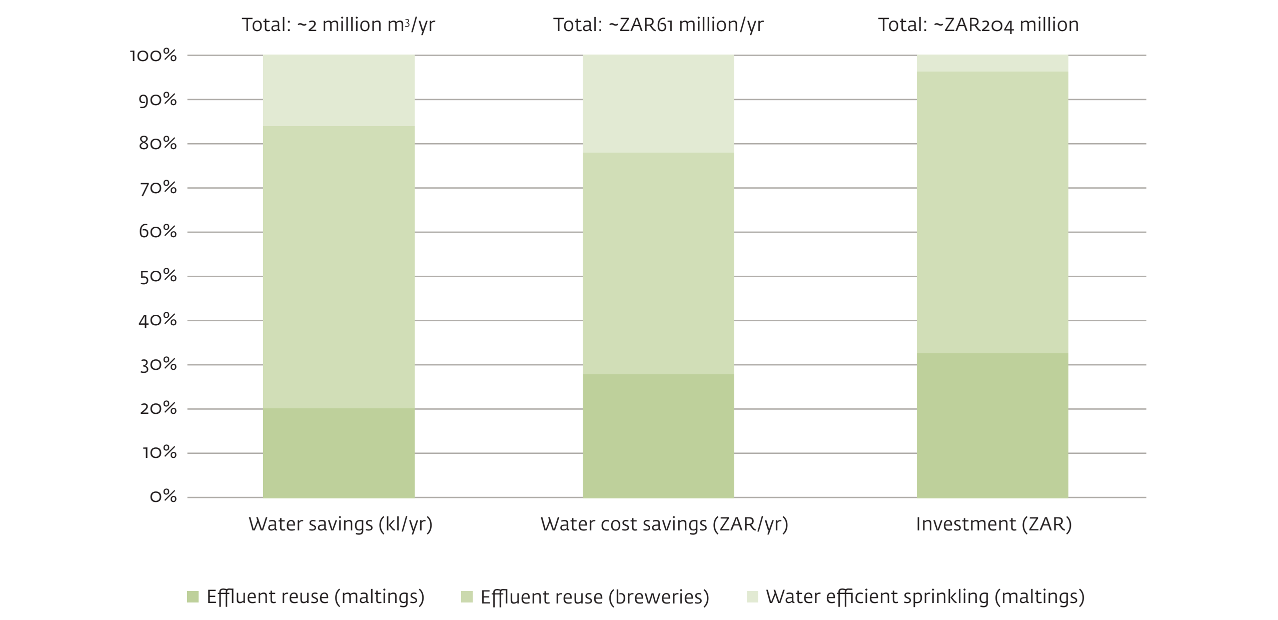
Scaling up water efficiency investments related to effluent reuse and improvements in steeping suggest the sector has a potential to save ~2 million cubic m of water per year and over ZAR60 million in cost savings. This requires an estimated ZAR200 million in investment. The figure provides a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.[55]

52 *Guido and Moreira 2013.*

53-54 *EUREKA SWAN 2009.*

55 *Assumptions: Effluent reuse potential at 3 breweries (ZAR40-50m, 50% water savings), efficient sprinkling at 2 maltings plants (ZAR5m, 30% water savings) and effluent reuse at 2 maltings plants (ZAR26-40m, 50-60% savings). Water tariffs R14-50/kl, depending on site.*

Figure 23. Estimated realizable water savings for the brewing and malting sub-sector over the next 4-6 years and required investment (by intervention type).



5.6.6 Challenges or barriers specific to the sub-sector

Malted barley is a key input to beer production and thus challenges for this sub-sector include risks related to the availability and cost of barley.[56] Water, specifically, is a key constraint to barley production as most areas in South Africa are unsuitable for cultivation or require water for irrigation. Barley production is generally restricted to winter rainfall areas, and the Western Cape is the largest producer of barley in SA (89%) and is the only area where dryland production occurs. Any shortfall requires importing malted barley at higher costs and from volatile international markets.[57] In addition, the malting plants are particularly vulnerable to water restrictions and are limited in terms of water reuse opportunities (see case study on previous page).

Uptake of alternative water and energy sources or improved efficiencies in this sub-sector, driven by increased tariffs, surcharges and water restrictions, can threaten the sustainability of the municipal revenue model, particularly for smaller municipalities which are reliant on large plants for revenue, e.g. SAB Maltings in Caledon. However, the plant's reduced competitiveness in comparison to imports may have larger socio-economic impacts for the region in terms of job losses. Maintaining this balance requires input and communication from both the industry and municipality.

5.7 Wine production

The majority of the wine sector is spread across the Western and Northern Cape, with many wineries in areas of high water risk.[58] The industry is fairly consolidated as 50 of the 500 wineries are responsible for 74% of the total value. Distell is the most significant employer and has the most production sites in South Africa (a total of 16).

The major processes that use water in the cellar include winemaking, cooling and cleaning processes.[59] The major water use areas are the crush pad and press area, the fermentation tanks, barrel washing and soaking, the bottling line, and the cellars and barrel storage areas.[60]

Wineries generate large volumes of poor-quality wastewater, particularly during harvest. Most of the raw water entering wineries ends up as wastewater with high levels of COD. There is considerable variation in wastewater quality parameters between wineries, as well as a strong seasonal variation.[61]

Most wineries reuse their cellar wastewater for irrigation, but are generally required to pre-treat the wastewater. A minimum of 70% of the wineries undertook preliminary or primary treatments in 2009, whilst a small remainder opted for secondary and tertiary treatments.[62] The industry has the potential for wastewater management and reuse, but the seasonality of production often makes the business case challenging for smaller wineries.

56 *DAFF 2017b*
57 *Bizcommunity 2014.*
58-59 *DED&T 2019.*
60 *Galitsky et al. 2005.*
61 *Howell and Myburgh 2017.*
62 *Dillon 2011.*

5.7.1 Water efficiency opportunities in the sector

Distell used approximately 4 litres of water to produce 1 litre of wine in 2014,[63] and the wine industry used approximately 3.9 litres of water to produce 1 litre of wine in 2015.[64] This was since then improved with the 2018 value close to the global best practice benchmark of 2 litres water / kg raw grapes processed and a recent evaluation of three wineries demonstrating range from 2.2-3.5 litres water / kg raw grapes processed.[65]

Most large wineries use benchmarking and have implemented relatively basic and low cost and/or high payback water conservation and demand management interventions, such as reducing the pressure in water systems and encouraging behavioural change. This can have a significant impact on individual wineries. For example, these interventions, which only cost ZAR2 million, reduced a winery's water use by 25% and increased water use efficiency from 10 litres water / litre wine in 2012 to 3-4 litres water / litre wine in 2018. Similarly, another winery invested ZAR0.5 million over 2017-2018 into these interventions and achieved 12% savings.[66] This suggests there may be potential opportunities to 'bundle' these investments for several smaller wineries or look at shared infrastructure for treatment of water.

Although the wine industry water use efficiency has improved by 27.5% during the Western Cape drought and there are further potential opportunities to allow water cascading and reuse of cooling water,[67] effluent reuse was highlighted in the interviews as the key water efficiency opportunity. This is driven by the fact that:

- Most production facilities use municipal water, which is associated with risks relating to supply and cost, particularly in the Western Cape; and
- Relatively few sites have access to quality groundwater or other alternative sources.

Winetech report that effluent treatment and reuse is a key focus area for the majority of cellars in South Africa and several of the interviewed companies are pursuing this, particularly Distell (see case study below).

Figure 24. Case study: Distell.

Case study: Distell's efforts to improve water efficiency and security

Water efficiency is a key component of Distell's sustainability journey and is considered essential for risk reduction and business continuity. Distell has 16 sites where the company manufactures and/or bottles wine, cider and spirits. The majority of these sites are located in the Western Cape and are solely reliant on municipal water.

Distell is a leader in water efficiency. Their benchmark target, based on the 2016 International Beverage Roundtable Report, is 2.5 litres water per litre packaged product and their current average across wineries, distilleries and bottling plants is 3.0 litres water per litre packaged product (as at the end of February 2019).

Their first step to improve efficiencies related to water use and wastewater generation was through water auditing and benchmarking, which has been supported by sub-metering. Their initial 2018 benchmark was reached in 2014 and they have now reached their 2020 target and are setting new targets for 2025. Although water consumption and wastewater production varies significantly, water use was reduced from 1 400 000 cubic m per annum (2015) to 800 000 cubic m per annum (2018) for the Western Cape sites during the drought.

The biggest opportunities to reduce water has been the following:

- Recycling cooling water in tunnel pasteurization systems;
- Reusing bottle rise water for cooling systems;
- Closed loop water cooling systems for distillation;
- Changing the pressure in water systems i.e. use of low flow, high pressure systems; and
- Behavioural change by staff.

Wastewater is typically treated and irrigated on land (for smaller sites) or released to the municipal sewer (for larger sites). In general, all wastewater plants have a biogas component and typically is used for steam in the Western Cape and for electricity in Gauteng.

5.7.2 Summary of water efficiency opportunities in South Africa

Based on the interviews, key water efficiency opportunities lie in effluent reuse. These are discussed in the table overleaf and are associated with water savings of 40 000-120 000 cubic m per year per site.

[63, 65-67] *DED&T 2019.*

[64] *DED&T 2015.*

Table 6: Water efficiency opportunities in the wine sector.

Sub-sector	Examples of opportunities in the sector
Wine	Distell uses water for agricultural expansion, production of raw materials and production processes. Maintaining a high standard on water quality is very important as legislation requires their operations to do so. This means responsibility on treatment and disposal of waste water is imperative. Over the 12 months, the Western Cape experienced the worst recorded drought and, as such, different measures need to be implemented to find other ways of water usage. Distell is currently investigating alternative water supply such as ground water and reclaimed waste water. Distell is constructing a new waste water treatment and water reclamation facility at Springs. This facility will use a number of treatment steps including reverse osmosis to return some treated effluent water to drinking water quality. Distell has similar water reclamation plants approved under South African National Standard (241) for the Adam Tas and Wellington sites. These sites implement anaerobic waste water treatment.

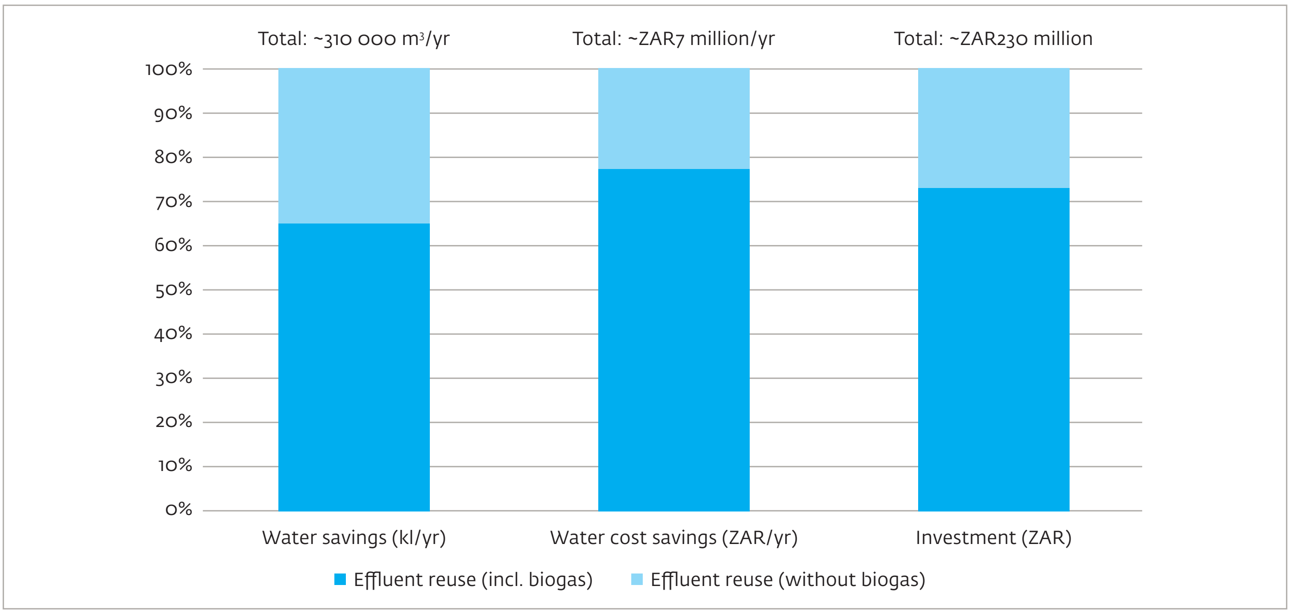
Other opportunities that can be bundled with water efficiency investments include:

- Alternative water supply: Water cost was not a key driver for some sites, particularly in the Northern Cape, but there was a great deal of interest in alternative supply options to reduce their reliance on surface water and on municipal infrastructure. Major players have already invested in boreholes and some are seeking a license to transport surplus water to other sites if needed.
- Alternative energy, specifically solar PV: Energy costs are high in summer during the harvest as facilities require cooling. All interviewed companies rely on grid electricity from their municipality and have back-up diesel generators to mitigate load shedding. Production losses and additional costs for diesel have driven interest in solar PV, in which some players have made investment.

5.7.3 Water efficiency potential

Scaling up water efficiency investments related to effluent reuse, including effluent reuse without biogas, suggest the sector has a potential to save over 300 000 cubic m of water per year and ~ZAR7 million in cost savings. This requires an estimated ZAR230 million in investment. The figure provides a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.[68]

Figure 25. Estimated realizable water savings for wine sub-sector over the next 4-6 years and required investment (by intervention type).



[68] *Assumptions include: Effluent reuse with biogas at 3 sites (ZAR50-70m, 34-70% savings), effluent reuse (without biogas) at 3 sites (28-60% savings, ZAR20m). Water tariffs ZAR8-25/kl.*

5.7.4 Challenges or barriers specific to the sub-sector

The seasonality of wine production is problematic for the smaller sites, which generally have a high water and electricity demand from January to May. However, the larger cellars with bottling plants run throughout the year and thus have a consistent demand for water and electricity, and typically a stronger business case for investments in resource efficiency and alternative supply.

Winetech specifically highlighted a lack of funding to demonstrate the viability of effluent reuse, and support innovative water technology and service providers.

One of the interviewees specifically highlighted issues of non-compliance for their wastewater due to increased effluent concentration – a result of being legally forced to reduce water use (i.e. the municipality has essentially created a lose-lose situation for companies).

5.8 Pulp and paper processing

The paper and pulp processing sub-sector has reduced water consumption systematically over the last few decades. In 1990 the WRC NATSURV survey recorded water usage of between 33 and 136 cubic m/t for paper and pulp mills and between 1 and 49 cubic m/t for paper mills. The WRC NATSURV completed in 2017 for the sub-sector recorded a marked reduction for the companies surveyed, with 11.9-76.1 cubic m/t recorded for paper and pulp mills and 3.5-38.8 cubic m/t for paper only mills. This trend was confirmed by the companies that were interviewed, with most of these indicating that no or low-cost interventions have been implemented and that these have led to significant savings. Recent interventions noted by one of the companies have yielded water efficiency gains of a further 50%.

The three companies interviewed also represent the variability within the sub-sector, with two of the companies extracting raw water directly from river sources, and one company being fully reliant on municipal water and treated municipal effluent (see Table 7 for details of water sources utilized in the sub-sector). Furthermore, one company is doing extensive water efficiency and effluent projects in order to increase water efficiency at existing sites, a second company is expanding its operations significantly and building new plants with a strong emphasis on investing in technologies/plants designs that enhance environmental parameters (energy, water and wastewater), and the third company is maintaining the status quo (or decreasing production) and not investing further in water efficiency (since their source water is treated effluent from the municipality). Both raw water and treated effluent are generally significantly lower cost than municipal water (Table 7) which can impact the business case for new water projects. However, some projects will still go ahead for other reasons (such as improving effluent discharge quality, or if the maximum abstraction rate has been reached the only way to increase production is to become more efficient with existing water allocation).

Table 7: The source of water used in the pulp and paper sector and the relative average cost of this water.

	Raw Water	Treated Effluent	Municipal	Other
Relative water usage in the pulp and paper sector (2004 data)	83%	10%	6%	1%
Average cost of water (excluding sanitation, effluent charges) among surveyed companies (current, ZAR/cubic m)	ZAR1,36	ZAR2,80	ZAR21,14	_

5.8.1 Water efficiency opportunities in the sector

The companies interviewed (which represent ~96% of the production volumes of the largest 17 paper and pulp manufacturing sites in South Africa according to 2004 data) believe that most of the water savings opportunities have been realized, either through recent new plant builds (or re-builds) and specific water projects at existing plants. Expansion or new build projects with associated energy, water and wastewater efficiency interventions represent the largest opportunity in the sub-sector, although these are more challenging to isolate and fund specifically, since process optimization when done at the design stage is more holistic. Furthermore, the expansion projects are at sites which access low-cost raw water from a river source, thus representing a less favorable business case compared to projects that offset municipal potable water.

Opportunities for standalone projects at existing plants relate mainly to treated municipal effluent (see case study overleaf) and biogas projects for wastewater treatment and reuse. The treated effluent represents a significantly lower cost of water compared to potable water supplied by a municipality. The pulp and paper sub-sector is one of the few in the agri-processing sector that can utilize treated effluent, since the rest of the sector has exceptionally high health and safety standard that prevents treated effluent from being used widely (except for non-process related uses). Even if the treated effluent is treated further to potable standards, most agri-processors are not willing to risk the negative consumer perceptions of utilizing wastewater in their final product.

Figure 26. Case study: Mondi Merebank.

Case study: Mondi Merebank, a world-class facility

Mondi Merebank was using 35 000 cubic m/day of potable water in 1997, and initiated plans to reduce the water demand at the 5 mills at this site.

- In 2001, the Merebank site started purchasing 10 000 cubic m/day of treated effluent (blend of 95% reclaimed sewage and 5% treated industrial effluent) from Durban Water Recycling, which operates the plant on behalf of the eThekwini Municipality (the project was partly funded by the World Bank).
- The volume of treated effluent was later increased to 30 0000 cubic m/day (with the remaining 5 000 cubic m/day of potable water used in the demineralization plant which requires high water quality.
- In 2013, KwaZulu-Natal (KZN) experienced a severe drought, and a reverse osmosis plant was installed to treat and reuse the water from the demineralization plant, resulting in a further reduction in potable water use to 300 cubic m/day. Mondi reduced the number of mills from 5 to 1 during the last 10 years, and now use 12 000 cubic m/day of treated effluent and 300 cubic m/day of potable water.

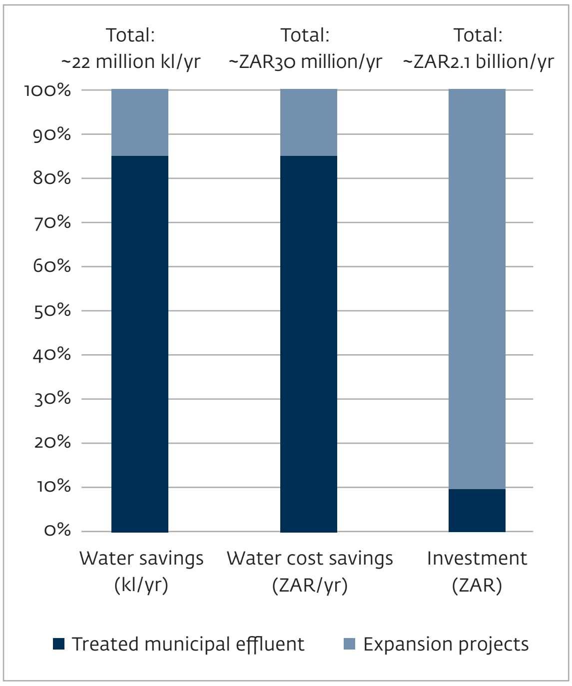
Mondi Richards Bay has already implemented process related water efficiency projects and now uses 55 000-65 000 cubic m/day of potable water supplied by uMhlathuze Municipality. The company is in discussion with the municipality to use treated municipal effluent at this site, and a feasibility study is currently underway for a similar project to the Merebank one (where the treatment plant is operated by a 3rd party on behalf of the municipality, with Mondi purchasing the treated effluent from the 3rd party or municipality).

5.8.2 Water efficiency potential

The water efficiency potential varies greatly depending on the type of project. In 2018 SAPPI set a target of reducing water consumption across the company by 10% by 2020, but have already achieved a 20% reduction in 2019. While most low-cost efficiency interventions have been implemented by the industry, the opportunity to use treated municipal effluent instead of raw water is a significant opportunity (see Figure 27). The figure provides a rough estimation of the realizable savings potential, based on the opportunities identified in the interviewed companies, scaled up to the sector level.

The total water savings potential in the sub-sector is estimated to be approximately 22 million cubic m/year, with the cost equivalent calculated at ZAR30 million/year (relative volumes and costs of the various water sources were used).

Figure 27. Estimated realizable water- and cost-savings and investment sums for the pulp and paper processing sector over the next 4-6 years, by intervention.[69]



[69] *Assumptions include: Treated effluent is an opportunity for one site and it can supply 85% of water requirements and costs ZAR1.6 million per million litres of water treated per day. The expansion projects only include the estimated component for water efficiency (25%), and are assumed to be 10% more efficient than existing facilities. Water costs are ZAR1,40/kl (raw water).*

5.8.3 Challenges or barriers specific to the sub-sector

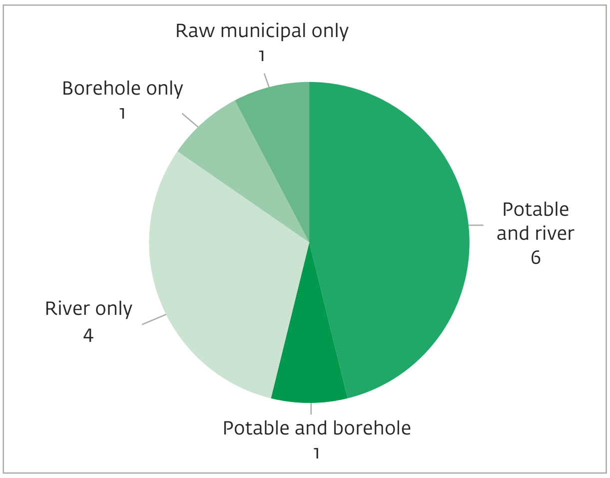
Setting up long-term contracts to purchase large volumes of treated effluent from municipalities is generally a complex process which can take a long time to develop. The one example of this in South Africa in this sub-sector utilizes a hip (PPP) model, and the same company has indicated it would prefer the same model for other such projects. Municipalities that have the capacity to set up PPPs are slowly becoming more open to these types of projects, but the reality is that most municipalities do not have the capacity to successfully procure a PPP project, so this opportunity cannot necessarily be scaled up to the whole market.

5.9 Sugar cane processing

The sugar cane processing sub-sector is a very large water user. However, due to external factors including the drought, sugar tax and cheap imports, this industry is under significant pressure, with steadily declining sugar cane production since at least 2002.[70] There is therefore very little appetite for investment in water projects in a declining industry. The industry is also already water efficient and reuse of wastewater is already common, with fit-for-purpose wastewater being reused for processes requiring varying water quality.

Most sugar mills have access to raw water from rivers (Figure 28; 10 out of 13 respondents in the 2017 WRC NATSURV). Since the cost of water varies greatly by source (raw water costs much less than municipal water), the business case for further water efficiency projects is likely to be poor at most of the mills, unless it is driven by wastewater discharge quality. This is unlikely to be a major driver either, since sugar cane contains ~70% water, and most of the wastewater is generated by the condensate in coolers.

Figure 28. Water sources utilized by sugar mills in South Africa (indicates number of mills).



5.9.1 Water efficiency opportunities in the sector

The South African Sugar Association is in the process of formulating an integrated water resource strategy for the industry. However, much of the water savings emphasis is targeting reducing water during the irrigation of cane crops, as the relative water demand required for processing is a small fraction of the overall water use by the industry,[71] which has also been confirmed by the interviews conducted in the sub-sector.

Within the sugar cane processing mills, approximately 75% of the water consumption is within the condenser (cooling) system and represents the largest opportunity for water savings at under-optimized mills. The literature indicates that often 90% water savings can be achieved through waste-water recycling and fit-for-purpose reuse, but from the interviews the cost-effective opportunities have largely been implemented by the companies in South Africa.

5.9.2 Water efficiency potential

Most mills have access to raw water from river sources, but where this is not the case, mills have a much stronger emphasis on water efficiency (mills using potable water supplied by the municipality have much lower water usage, as low as 0.04 cubic m/ton of sugar cane processed, compared to the industry average of 0.37 cubic m/ton). South African mills also perform well compared to international companies, which typically use 0.5 to 0.9 cubic m/ton (various sources). This indicates there is not much further potential in the South African market due to the poor business case for water efficiency projects where the cost of water is low (which is the case with raw water from river sources).

5.9.3 Challenges or barriers specific to the sub-sector

The sub-sector is under severe pressure from external factors, including the recent drought, sugar tax and cheap imports, and is not currently prioritizing further water efficiency measures or investment.

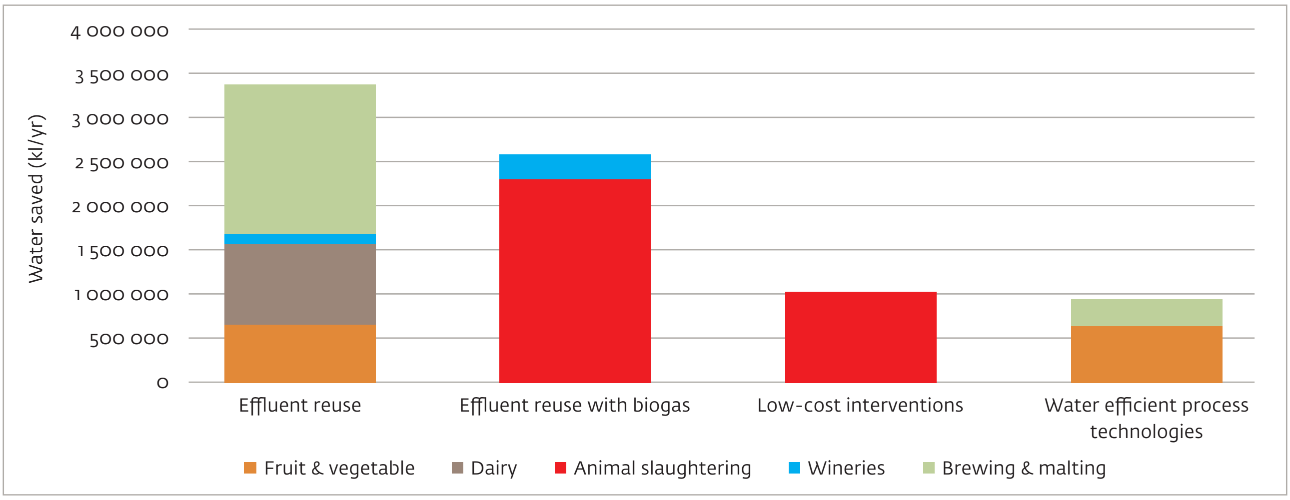
[70-71] *Water Research Commission 2017c.*

5.10 Summary efficiency potential

As discussed in previous chapters, some of the best practice measures have already been implemented by the industry leaders and represent good examples for replication throughout the respective sub-sectors and in the industry as a whole.

A tentative breakdown by sub-sector, based on known projects and responses of the interviewed companies is provided below.

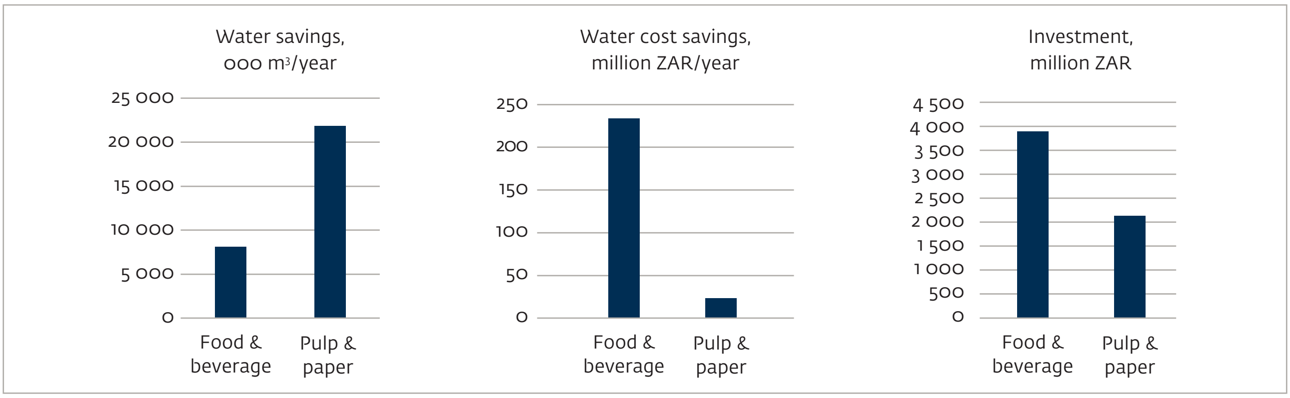
Figure 29. Estimated realizable water savings over the next 4-6 years, by intervention type and sub-sector.[72]



There is further potential for adoption of efficiency measures by major players in the agri-processing sub-sectors, especially in the water recycling and effluent treatment space. Assuming the business case prevalent in South Africa today, based on perceived water cost in key sub-sectors and geographical cluster based on international benchmarks as well as reported data on successfully implemented projects throughout Chapter 5, it can be estimated that, across the agri-processing sector, there is theoretical potential to reduce the primary water use by 29,9 million cubic meters per year (around 20% of the total consumption), saving ZAR265 431 million (US$20 million)[73] per year in direct water costs (excluding additional benefits from parallel energy savings, revenue loss avoidance, environmental losses), etc. Achieving this will require investment of just over ZAR6 billion (US$428 million).

These numbers represent theoretical potential; practical implementation and prioritization of projects in various sub-sectors will depend on numerous other factors, which would in turn drive opportunities for support at the project and sector level. These factors include the sub-sector specific business case and additional qualitative drivers for projects and initiatives. The chart shows, for instance, that the pure water cost-based case is much better for the food and beverage sector as compared to pulp and paper (and yet can be considered relatively weak without additional benefits). However, the latter is also one of the major sectors in the economy that generates and discharges wastewater. These factors are discussed in Chapter 6 in more detail to identify priority sectors and focus areas for further intervention.

Figure 30. Summary water efficiency potential in agri-processing sector in South Africa.



[72] *Animal slaughtering includes poultry and red meat sub-sectors.*
[73] *Hereinafer assuming US$1=ZAR14.*

6. Strategic positioning and gap assessment

6.1 Comparative gap assessment, strategic positioning and approach at the level of sub-sectors

Following the assessment of overarching and sub-sector-specific opportunities and barriers, this chapter discussed comparative positioning of the sectors vis-à-vis best practices and identifies those that could realize relatively more benefit from implementing water and resource efficiency projects.

To develop the subsector positioning matrix, IFC has considered a number of factors to evaluate the possible impact from implementing water efficiency (and supplementary energy measures) in each sub-sector (the size of the gap), as well as the likelihood to achieve this impact in the medium term (4-5 years). IFC has considered both quantitative factors based on the sub-sector analysis, as well as qualitative, based on the interviews with selected companies. While the interview samples cannot be claimed as fully representative, they allow to develop the ranking of the specific sub-sectors. Each criterion was analyzed and assigned a High (H), Medium (M), or Low (L) ranking for each sub-sector. In certain borderline situations, interim rankings have been assigned (L/M, M/H).

To assess the impact, we chose the '**size of the gap**' concept, focusing on still unimplemented economically feasible potential both in terms of **water and monetary savings**. The size of the latter would positively correlate with the overall impact. We have also taken into the account the qualitative gap, assuming that the **pre-existing knowledge, plans and planning** would diminish the remaining gap and therefore negatively correlate with the overall impact. Further, we have taken into account the possibility for **demonstration effect and environmental benefits** that would positively affect the overall impact. Thus, the overall impact ranking reflects the comparative size of the gap.

Overleaf is the breakdown of the impact rankings per sub-sector, with justification derived from the analysis conducted in Chapter 5.

Table 8. Savings potential ranking.

Sub-sector	Estimated water savings potential (m³/year)	Estimated cost savings potential (ZAR/year)	Comments	Savings ranking
Fruit & vegetables	1 330 000	31 407 400	While estimated volumetric water savings are smaller relative to the total water consumption and in total, compared to certain other sectors, the cost savings per unit are significant, positioning the industry close to medium.	M
Dairy	906 500	29 008 800	Similar situation to the fruit & vegetable sector.	M
Poultry	2 622 500	81 585 800	The poultry sector water use is significant and the water savings potential is almost triple that of dairy, and the monetary savings potential is quite significant.	H
Red meat	847 400	26 117 100	Situation is similar to diary and fruit & veg sub-sectors	M
Wineries	309 100	6 970 600	Wineries have relatively small total consumption and limited total savings potential; however, still significant as a share of total.	L/M
Brewing & malting	2 030 500	60 723 900	Brewing and malting sector enjoys savings per unit ratio similar to animal processing sub-sectors; at the same time, it's also a major consumer of water in the beverage industry.	H
Pulp & paper	21 425 400	29 617 100	The industry is one of the major water consumers and has a significant total potential compared to others; however, the savings per unit indicate that much of the evident potential has already been exhausted. At the same time, significant additional savings can be generated through treated effluent.	M/H
Sugar	615 200	1 230 400	The sugar sector is a key water user; however, the level of compliance with best practices is already high, including the implementation of the high-cost measures, limiting the residual potential.	L

While various factors affect the business case for water across sub-sectors as shown in the prior analysis, some of the 'lower cost of water' industries clearly stand out; poultry and red meat processing sub-sectors demonstrate solid savings potential per unit of water saved.

Table 9. Pre-existing knowledge and planning ranking.

Sub-sector	Comments	Ranking
Fruit & vegetables	Knowledge of water efficiency and expertise mostly concentrated on the primary farming side; some efficiency projects implemented in packhouses.	M
Dairy	Similar situation to the fruit & veg sector.	M
Poultry	The poultry sector companies seem to have done some planning efforts and research in the water space; relatively recent studies on potential exist.	M
Red meat	Situation is similar to the poultry sector, existing knowledge and guidance date back to the 1990s.	L/M
Wineries	Wineries, especially located in the Western Cape, demonstrate high level of knowledge and awareness. Some of the sector leaders (Distell) demonstrate world-class planning.	M/H
Brewing & malting	Leading companies in brewing in malting demonstrate world-class approach to water, similarly to wineries.	M/H
Pulp & paper	The industry has a lot of pre-existing knowledge, including from a significant international presence in the market and research done locally.	H
Sugar	The situation is similar to the pulp and paper sector.	H

It can be noted that both sugar and pulp & paper sub-sectors seem to have full awareness and are in principle poised to tackle the higher-cost measures, as the business case is there. The animal processing sub-sectors, at the same time, do seem to have a certain knowledge gap.

Table 10. Other benefits (environmental & demonstration effect) ranking.

Sub-sector	Comments	Ranking
Fruit & vegetables	As, by its nature, the sector's water consumption mostly lies outside the processing facilities, the demonstration potential at packhouses and cold storage could be relatively small, as are the environmental implications. At the same time, canning and juicing factories have and could further demonstrate stronger examples.	M
Dairy	Major players in the sector have and would be capable to produce strong demonstration examples, including beyond the sub-sector.	H
Poultry	Strong demonstration and replication potential possible, though a lot of the developments would be site-specific and will need to be customized.	M/H
Red meat	Situation is similar to the poultry sector.	M/H
Wineries	Some potential for demonstration exists, and would be mainly applicable for one sub-sector and one geographic area.	M
Brewing & malting	Similar to wineries, however, the potential is enhanced by the presence of major international players.	M/H
Pulp & paper	Given the strength of the players and the role they play in total water consumption, and practices developed, any project would be a powerful demo example. Environmental implications are also significant.	H
Sugar	The situation is similar to the pulp and paper sector, with less environmental benefits.	M/H

Pulp & paper and sugar sectors are the strong positive outliers, as their projects would be typically visible and have lasting impact on communities and geographical areas. To a certain extent, the same applies to the dairy sector.

To evaluate the **likelihood of achieving an impact**, we chose **capacity (either at the firm or at the sector level) to absorb and implement recommendations** as the key parameter. It includes both technical capacity (which is not equivalent to specific expertise and knowledge on water use and efficiency technology) and managerial capacity (ability to make informed project decisions). We have also included the **level of commitment** as assessed during the interviews: this allows to adjust the theoretical need for intervention for factors that may be outside the scope of the program and the water space – the sector may be facing other challenges and issues that may prevent prioritizing water and resource efficiency in the short- to medium-term. Some of them may be a result of barriers (policy, technical, governance), some may be due to the challenging market environment for their product. The rankings and comments are provided below.

Table 11. Capacity to implement ranking.

Sub-sector	Comments	Ranking
Fruit & vegetables	As a rule, the firms would possess the capacity required to implement the projects of required complexity.	M/H
Dairy	While some of the small dairy producers might have less project experience and technical capacity, this could be compensated by the strength of international players and the sector association.	H
Poultry	Situation is similar to the dairy sector.	H
Red meat	Situation is similar to the poultry sector; however, at the level of small abattoirs, the managerial and capacity commitment seem to be lower.	L/M
Wineries	The capacity at the firm level is limited, though associations are doing significant work to strengthen it.	M
Brewing & malting	Similar to wineries.	M
Pulp & paper	The sector has generally demonstrated high technical and managerial capacity in absorbing innovative technologies and has a strong support from the association. At the same time, some of the small timber processors are less skilled beyond their daily operations.	M/H
Sugar	The situation is similar to the pulp and paper sector.	M/H

A notable observation is that, with a possible exception of smaller local players in the some of the sub-sectors, technical and managerial capacity seems sufficient to implement water and resource efficiency measures, though, as stated previously, some of the sub-sectors don't possess pre-existing knowledge and experience, specifically on water.

Table 12. Level of commitment ranking.

Sub-sector	Comments	Ranking
Fruit & vegetables	While some players don't consider water in processing as a priority, they do recognize the importance and benefits of improving efficiencies.	M/H
Dairy	The commitment may be limited by concerns related to international competition, though key players, especially in the Western Cape, reported water as high priority.	M/H
Poultry	While the key players are struggling with international competition, there is a high demonstrated commitment from the sector association.	M/H
Red meat	Despite lagging behind implementation of efficiency measures in the smaller abattoirs, resource efficiency is being put on the sector-wide agenda, which used to be dominated by the veterinary and food safety issues.	H
Wineries	The sector associations showed moderate level of interest towards resource and water efficiency, while specific players have highlighted that as a priority.	M
Brewing & malting	Situation is similar to wineries, with the key player (AB InBev) demonstrating high commitment.	M
Pulp & paper	Though generally committed to the water efficiency agenda, the sector representatives prompted that it may not be a short-term priority.	L/M
Sugar	Similar to pulp and paper, due to the challenging market situation.	L

The summary Impact/Likelihood ratings are then as follows:

Table 13. Summary rankings.

Sub-sector	Impact (size of the gap)				Likelihood of achieving impact		
	Savings potential (water and cost)	Pre-existing knowledge, awareness and planning	Other benefits (demo effect, environmental)	TOTAL	Capacity to implement projects, at the firm or association level	Assessed level of commitment	TOTAL
Fruit & vegetables	M	M	M	M	M/H	M/H	M/H
Dairy	M	M	H	M/H	H	M/H	M/H
Poultry	H	M	M/H	M/H	H	M/H	M/H
Red meat	M	L/M	M/H	H	L/M	H	M/H
Wineries	L/M	M/H	M	L/M	M	M	M
Brewing & malting	H	M/H	M/H	M/H	M	M	M
Pulp & paper	M/H	H	H	M	M/H	L	L/M
Sugar	L	H	M/H	L	M/H	L	L/M

To provide additional guidance on the approach to sub-sectors and firms, the team introduced a supplementary metric to assess comparative scope of intervention based on the **sector composition** (**average player size**) and known typical **project sizes**. The ranking is comparative and indicative and should not be treated as a pre-defined size of investment.

Table 14. Sector concentration/player size ranking.

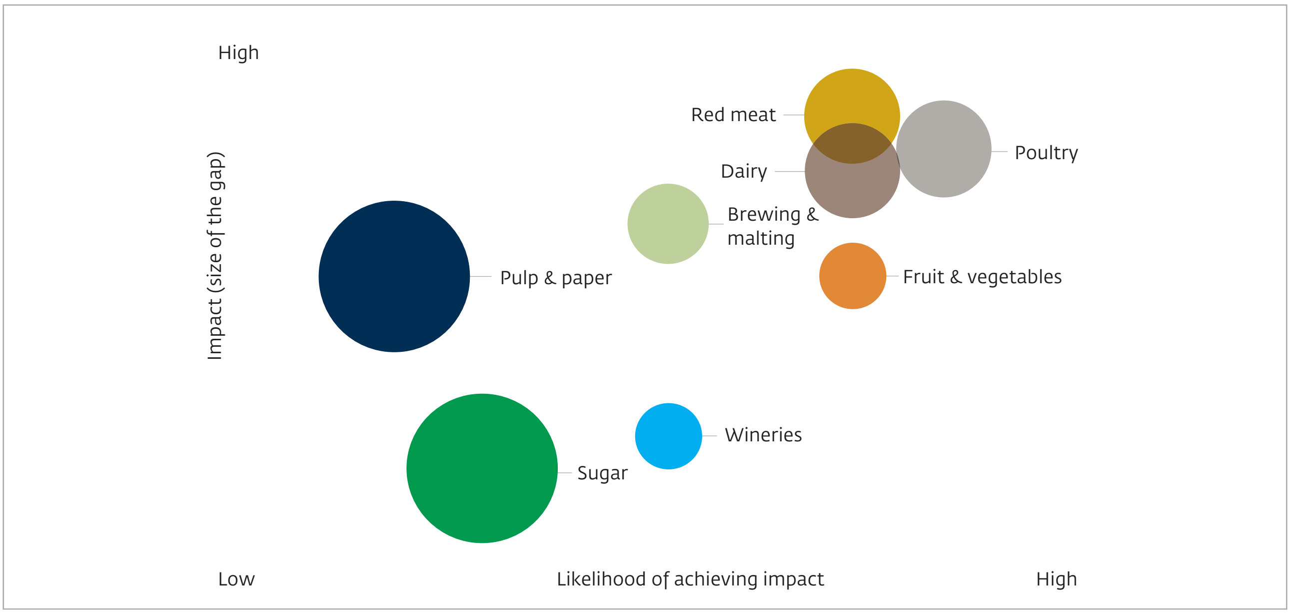
Sub-sector	Comments	Ranking
Fruit & vegetables	Fresh produce dominated by smaller packhouses, with a few major operators in the citrus, tomato, avocado and mango segments. In the canning segment, 2-3 major producers dominate.	M
Dairy	A few major players (Clover, Parmalat, Nestlé) are complemented by medium-sized businesses.	M/H
Poultry	Sector is dominated by large- and medium-scale integrated operators, while the market share of the small abattoirs is far less significant.	M
Red meat	Sector is dominated by large- and medium-scale integrated operators, while the market share of the small abattoirs is far less significant.	L/M
Wineries	Small and medium-sized businesses dominate, larger players (Distell, KWV) have significant distillery operations, preventing direct engagement with IFC.	M
Brewing & malting	A large international player (AB InBev) is complemented by medium-sized and microbreweries.	H
Pulp & paper	The sector is dominated by 5-6 major players.	H
Sugar	The sector is dominated by 5-6 major players, with smaller mills taking up a less significant portion of the market.	H

Table 15. Project size ranking

Sub-sector	Comments	Ranking
Fruit & vegetables	Water & resource efficiency would typically be combined with packhouse/cold chain upgrades, which have more significant cost overall.	M
Dairy	Efficient process equipment upgrades and effluent treatment facilities would contribute to the relatively higher project cost.	M/H
Poultry	Process efficiency measures represent medium-sized opportunities, with larger potential engagements on effluent treatment/biogas.	M/H
Red meat	Process efficiency measures represent medium-sized opportunities, with larger potential engagements on effluent treatment/biogas.	M/H
Wineries	The companies are likely to implement smaller-scale efficiency measures and consider more costly process improvements (similar to Distell in Western Cape).	L/M
Brewing & malting	Process efficiency projects and mid-size wastewater treatment would dominate the mix.	M
Pulp & paper	Effluent treatment projects would be a mainstream investment, taking up a significant share of greenfield or expansion projects.	H
Sugar	Efficiency could be a part of a mainstream project to set up/refurbish a mill or a boiler system, which represents significant cost, should the project materialize.	H

The resulting sector ranking matrix is displayed below, with the size of intervention represented by the size of the bubble:

Figure 31. Sub-sector strategic positioning.

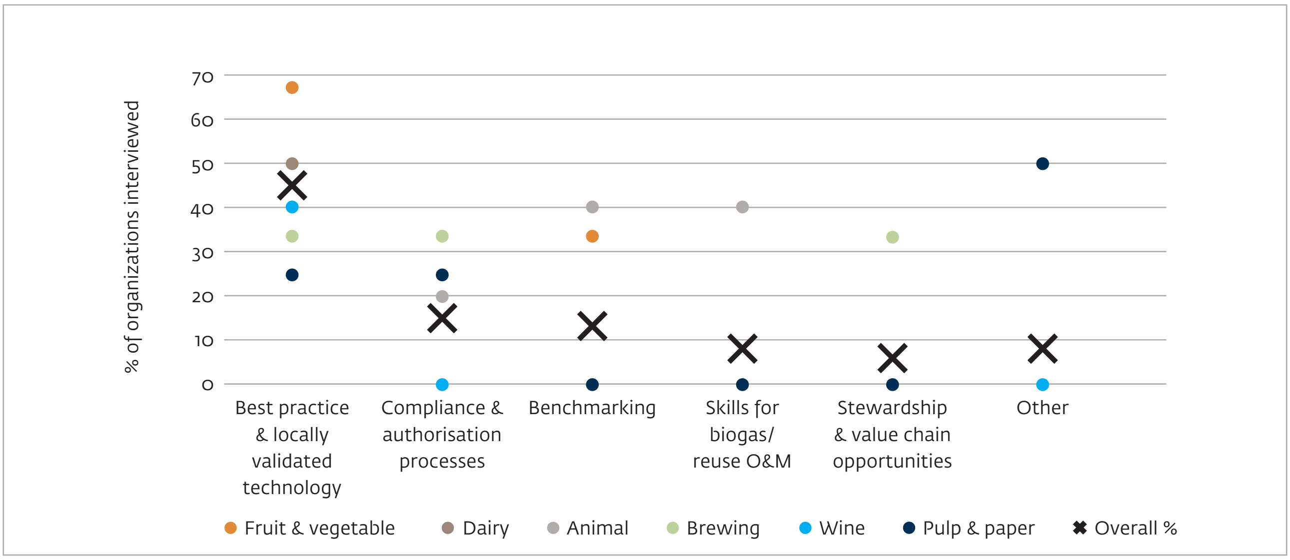


The matrix demonstrates that, at the sector level, as a combination of impact and likelihood, there's a visible high-opportunity cluster comprising animal processing (poultry and red meat) and dairy sectors, followed by brewing and malting, with fruit and vegetable processing lagging behind. Despite the high contribution to the overall water consumption, in terms of the program value-add, pulp and paper, as well as sugar sector, are lagging behind.

6.2 Gap analysis and focusing of effort

As discussed in Section 5.2, one of the key overarching issues around water efficiency mentioned by most of the interviewed companies across various sub-sectors was lack of awareness and knowledge. The team has explored the knowledge gap with stakeholders in more detail, and some of them were able to provide details on specific types of skills and knowledge that could be upgraded. The summary of the responses is provided below. For some of the responses, the breakdown by sub-sector is provided – it is worth noting that some of the higher response rates are contributed by the sectors prioritized for engagement in the previous section.

Figure 32: Knowledge gaps relating to water efficiency, mentioned during interviews.

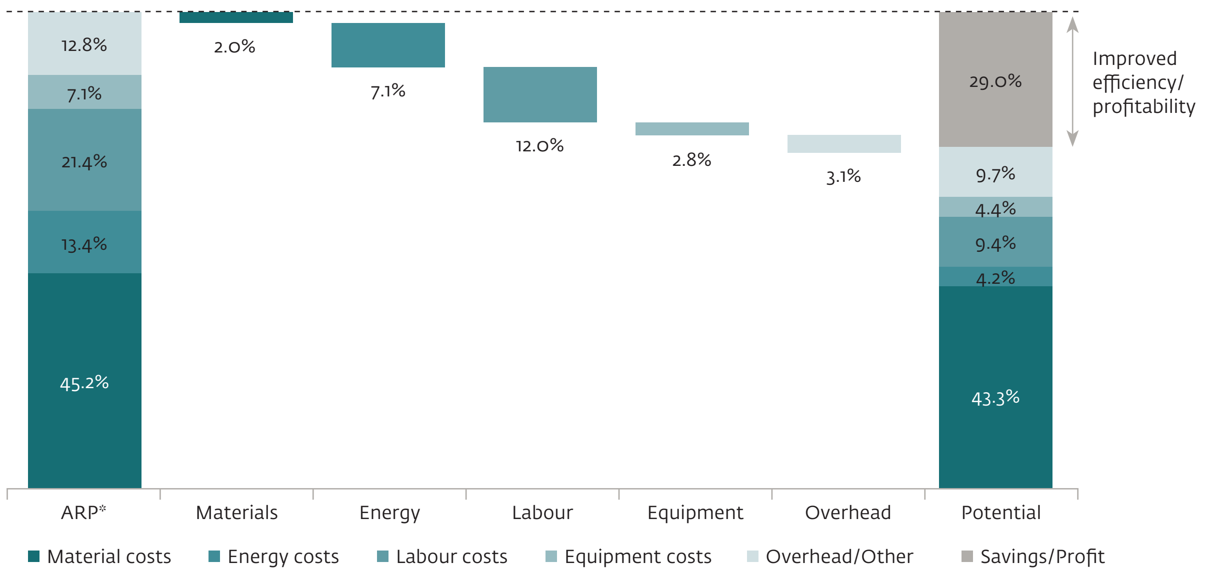


Lack of access to information on best practices and locally validated internationally proven technologies was mentioned by most respondents as one of the key issues, followed by information on compliance and authorization processes for water (and groundwater) use. The latter further signals the importance of intervention in the enabling environment space and will be discussed in greater detail in Chapters 7 and 8.

From WBG experience, development and dissemination of best practice guides can help the uptake of innovative solutions at the sector level. At the same time, the best practices are to be tailored to specific gaps in performance, product/segment and external conditions (location, climate, access to resources), that could differ even within one sub-sector. Therefore, the application of best practices will need to be verified and customized. One of the proven ways to achieve this is in-depth benchmarking focused on a specific market segment, and considering a set of key performance indicators that will help assess specific gaps in performance and offer technologies and equipment to catch up with best practice benchmarks. Benchmarking (international and regional benchmarks) also feature among the aforegoing responses, albeit less prominently. Together, benchmarking and the best practice information represent a valuable product for a sub-sector.

One example of such advisory intervention and a product is the Resource Efficiency Benchmarking in the Foundry Sector in Russia, which assessed the gaps in performance across the robust set of key performance indicators (KPIs) and made the case for the use of tailored best practices across these key aspects of operations.

Figure 33. Russia Resource Efficiency Benchmarking Study: the overall cost benchmark and actual performance.



* ARP - ave. Russian performance
Source: IFC (2010), "Resource efficiency in the Ferrous Foundry Industry in Russia: Benchmarking Study," October.

This (or similar) approach should be most applicable for the high-potential subsectors and resonates well with the challenges and limitations of high-level benchmarks on water and resource use voiced by the stakeholders, especially in the dairy and meat processing sectors. Such benchmarks would not account for difference in products and processes and need a more in-depth analysis.

Photo: Dominic Chavez

7. Policy framework on water use in agri-processing in South Africa

7.1 Key policy instruments and approaches

7.1.1 Policy instruments

Ensuring national water security to support South Africa's ongoing social and economic development will require the consolidated efforts of government, the private sector and civil society. On the one hand this takes the form of ensuring that there is sufficient water supply, of suitable quality, to support the economic growth of the country, whilst on the other hand ensuring that all South Africans have access to potable water as a fundamental development goal. This needs to be achieved without compromising the ecological sustainability of water resources.[74]

This complex balancing act is supported by the National Development Plan 2030 (NDP),[75] that recognized the importance of driving infrastructure development, reducing water demand, ensuring improved efficiency in agricultural water use, and investigating water reuse and desalinization options. These ambitions were set in the context of a recognized need to improve the institutional arrangements and operational functioning of the water sector, as well as to develop a comprehensive investment framework to support water initiatives.

The development of the National Water Policy (NWP) (Department of Water Affairs and Forestry, 1997) and the promulgation of the Water Services Act (Act 108 of 1997) and the NWA (Act 36 of 1998) provided South Africa with a roadmap for the management of water resources and the delivery of water services. These were supported strategically through the development of the National Water Resource Strategy,[76] and the Strategic Framework for Water Services.[77]

Most recently, the development of the first National Water and Sanitation Masterplan[78] has pulled together the core elements of water resource management and water services delivery as an overarching plan to strengthen water management and development, in support of economic growth and social development.

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74 *Department of Water Affairs and Forestry 2009.*
75 *National Planning Commission 2012.*
76 *Department of Water Affairs 2013.*
77 *Department of Water Affairs and Forestry 2003.*
78 *DWS 2018.*

7.1.2 Adaptive approaches

The complexity of managing water will increasingly require adaptive approaches, as pressure on finite resources mount. In response, management arrangements can no longer rely upon the command and control approaches of the past, as the management of water is complex, non-linear and often poorly understood.[79] As a result, and in alignment with the tenets of Integrated Water Resource Management, South Africa's framework for water management was adjusted to incorporate, amongst others, the key concepts of:

- Establishing localized institutions to support water management at catchment and local levels, underpinned by stakeholder engagement;
- Developing appropriate planning instruments that enable improved inter-sectoral integration and sustainable growth and development;
- Strengthening the regulatory environment through increased self-regulation and reporting as well as improved compliance monitoring and enforcement; and
- Increasing awareness and knowledge of the various institutional, planning, operational, and regulatory processes that are required to effectively manage water resources.

In support of this agenda, the DWS[80] is implementing a number of programmatic steps towards supporting this agenda, of which key points are outlined below.

Water for Growth and Development. This framework, developed in 2009, provided the first attempt at shifting the management of water resources away from purely demand-driven planning to one of an integrated management framework that outlines the role of water in supporting the country's growth and development. The framework indicated the need to be responsive to the needs of the different economic sectors, whilst requiring that these economic sectors factor water implications and risk into their development planning. Therefore, this framework called for improved integration in planning instruments across sectors, and between spheres of government. The framework also highlighted a range of instruments to support improved water resource management and sustainable development, including regulatory instruments, market-based instruments, self-regulation, and awareness and knowledge exchange.

Verification and Validation. As part of the transition to the NWA there was a legal translation of existing water use authorizations through a process of registration and the issuance of licenses as 'existing lawful use'. In order to improve the understanding of the true extent of water use in the country, the Department undertook an extensive and complex process to verify and validate water use. These studies have provided a more accurate assessment of current water use levels, but the stakeholders concur that the process cannot be considered as fully completed.

Reconciliation Strategies. Recognizing the importance of key economic development centers across the country, the Department engaged in the development of water supply reconciliation strategies for key supply systems. These were aimed at ensuring ongoing water security for these development nodes, which included the Western Cape Water Supply System, the KZN Coastal Metropolitan Area, the Richards Bay and surrounding towns, the Olifants River Water Supply System, the Vaal River Water Supply System, the Orange River Water Supply System, the Algoa Water Supply System and the Amatole Water Supply System.

All Towns Reconciliation Strategies. Noting that many smaller municipalities were facing significant water supply challenges that were often beyond the capacity and resources to resolve locally, the Department undertook an extensive program of engaging with the many smaller municipalities that were not connected to bigger supply systems. The objectives of these studies included identifying interventions to reconcile the water requirements with the available water for the next 20 years (up to 2035), developing strategies to accommodate future changes in actual water use, integrating augmentation and bulk supply options to achieve optimized overall benefits, and assessing the potential savings through water conservation and water demand management (WDM) measures, as well as the potential for reconciling current and future water requirements.

National Water Resources Strategy (Edition 2). Whilst the first edition of this strategy provided insight into the various aspects of managing South Africa's water resources, the second edition was developed in support of the NDP and recognized the importance of the broader water sector, including the private sector and civil society, in managing water resources. Whilst possibly not as detailed as it needed to be, the fact that this addition included an implementation plan was a useful step forward in terms of recognizing that there were priorities that need tackling.

These priorities included:

- Infrastructure planning;
- Development and operation and maintenance of infrastructure;
- Water conservation and WDM;
- Equitable water allocation;
- Water resource protection;
- Institutional establishment and governance;
- Compliance monitoring and enforcement.

[79] *Holling & Meffe 1996.*
[80] *As of June 2019, name changed to Department of Human Settlements, Water and Sanitation. Legacy acronym used throughout this document.*

National Water and Sanitation Masterplan: The need to address the ongoing degradation of water resources whilst supporting growth and development, required a far more detailed plan of action. Whilst some had described the situation with regard to water resources management and development as a crisis, there were areas of concern that warranted development of a consolidated plan as to how the water sector was going to sustainably support the growth and development of the country. The statistics outlined in the 2018 Masterplan reflect the status of water resource management and development:

- 5.3 million households do not have access to safe and reliable drinking water;
- 14.1 million people do not have access to safe sanitation;
- 44% of wastewater treatment works are dysfunctional;
- 41% of municipal water does not generate revenue, amounting to lost revenue of approximately ZAR10 billion per annum;
- 35% of municipal water is lost to leakages;
- 48% of the country's remaining wetlands are endangered;
- 83% of the national monitoring sites reflect some form of water quality challenge;
- Approximately ZAR33 billion in investment is needed in the water sector over the next 10 years to ensure water security.

A detailed action plan under volume 3 of the National Water and Sanitation Plan provided a more rigorous roadmap to strengthen the water sector and support growth and development. Whilst the levels of integration required across sectors are absent, the complexity that this introduced for a national masterplan are significant.

7.2 Policy challenges

Despite this progress, there are still significant challenges facing the water sector in the short-term that are front and center of South Africa's water agenda. These include:

Legislative review. The DWS has been undertaking a review of its two core pieces of legislation, namely the Water Services Act (Act 108 of 1997) and the NWA (Act 36 of 1998) for the last few years. These have been developed internally with no engagement, and this has created significant uncertainty as to the intent of this revision, and the implications thereof.

Revised water policy positions (2013). Released with limited stakeholder engagement, these policy positions introduced very significant changes that would have impact across the water sector. Amongst others, the policy positions included the concept of 'use it or lose it' with regard to water allocations; removed the concepts of temporary water use transfer and trading as enabled by Section 25 of the NWA; indicated that all irrigation boards and water user associations would be disestablished; and that Regional Water Utilities would be established to provide bulk water supply. Many of these require legislative amendment, which is yet to be realized and, as a result, has served to cause continued uncertainty over the validity of these policy positions. The latter have been adopted by the DWS before the framework laws were amended, causing further concerns.

Inability to stabilize the institutional framework. Despite the clarity of the NWP[81] and the National Water Act, the DWS has both questioned and changed the institutional frameworks for water resource management on a number of occasions. To date, only two of nine planned Catchment Management Agencies (CMAs) have been established, with the model for these institutions having changed on several occasions. The delegated powers and duties to the two existing CMAs have been adjusted and withdrawn repeatedly.

One of the key institutional challenges is the uncertainty as to the status of irrigation boards and water user associations. There are three main key transformation challenges with the Water Boards. Firstly, water resource availability in terms of over-allocation of resources, most canals having reached carrying capacity, efficiencies versus ageing infrastructure, and competing demands for agriculture and domestic food nexus. Secondly, the extent of liability on infrastructure where some irrigation boards and privately financed infrastructure have huge loans and debts. Thirdly, there are fees and levies regarding affordability challenges for emerging farmers (repossession of land). Presently, the water boards and WUAs are not empowered to perform these duties as mandated, as many irrigation boards are still in place and WUAs haven't been created to begin with. Further, the formal delegation of authority from NWA to WUAs hasn't happen. The mandated water usage monitoring and reporting thus becomes a challenge, as only 52% of water users joined the association which are largely still being institutionalized.

This has resulted in a lack of stability within the water sector that has resulted in failure to deliver on aspects of policy and legislation, a lack of effective integration across planning instruments – with the absence of catchment management strategies being particularly significant – continued staff turnover and loss of capacity, and an ongoing degradation of water resources.

81 *Department of Water Affairs and Forestry 1997.*

Financial crisis. These issues have been compounded by DWS's financial crisis, which in the last few years has resulted in the Department being unable to play the role of sector leader to the extent that is required and has delayed the implementation of key policies and plans. In 2018 that the Department owed ZAR1.8 billion for accruals and payables for the 2017/2018 financial year. Of this amount, ZAR904 million had been for infrastructure projects. As a result, the Department had had to adjust its annual performance plan downwards to prioritize the payment of accruals and no new projects were entered into in the 2018/19 financial year.

Water discharge standards. The use of discharge water has become a growing demand in many communities and optimal use and control for recycling of treated wastewater is aligned with public health policy. The function of the Department of Health which applies the South African Guide for Permissible Utilisation and Disposal of Treated Sewage Effluent become important in managing the water discharge standards, but the guidelines under the department has not been updated or reviewed since its inception in 1978. When wastewater reuse guidelines/regulations are formulated, the industries and conditions need to be considered, especially for water that does not meet standards, to understand where they can be utilised in other types of production. Presently, many industry stakeholders see some of the standards as not adequate for their operations and costly to maintain with little positive impact.

Water restrictions apply across the board to all water users. Improved regulation for appropriate framework for water restrictions under NWA needs to be applicable according to suitability of the industry to which the law should apply. Currently, the restrictions do not take into account the prior efforts already taken to reduce the baseline, treating all firms as uniformly 'inefficient', thus creating disincentives and potential risks for business operations.

7.3 Implementation challenges

The complexity of implementation has been a significant challenge to the water sector and, as a result, there is a range of key policy prerogatives that have yet to sufficiently move beyond intent. This lack of implementation progress has in most instances served to weaken the sector, and is generally attributed to being a primary driver of the recent water crisis.[82]

Some contributors to the lack of implementation progress include:

- Legislative complexity: The sector has continued to struggle with the implementation of the NWA (Act 36 of 1998). This in part attributable to ongoing changes to approach, but also due to not translating key aspects of the legislation into practical and pragmatic approaches.
- Cooperative governance challenges: Sectors have been focused on delivering on their key mandates without providing resources to effectively engage in cooperative governance approaches.
- Insufficient integration of planning instruments: The complexity of planning instruments across national, provincial, local and catchment scales, with variations in timelines and process, has resulted in a lack of effective integration between these instruments.
- Poor administrative process: Whilst there have been efforts to improve administrative processes, there are still processes – such as the issuing of water use licenses – that are still lengthy and inefficient, to the extent of the companies not being able to utilize the permits. There are capacity and process issues at play, but equally the failure to establish catchment management agencies with the necessary delegated authority.
- Ineffective regulation: Lack of resources and poorly capacitated staff has resulted in weak compliance monitoring and enforcement. Cooperative approaches between the water and environmental sectors has seen progress towards improved enforcement, but further improvements are required.
- Insufficient financial resources: The lack of financial resources across the water sector has resulted in many institutions not being able to effectively deliver on core functions or to initiate innovative projects.
- Stretched capacity: Most public sector institutions are under-capacitated without the necessary staff complements, skill sets or systems to support delivery on core functions.

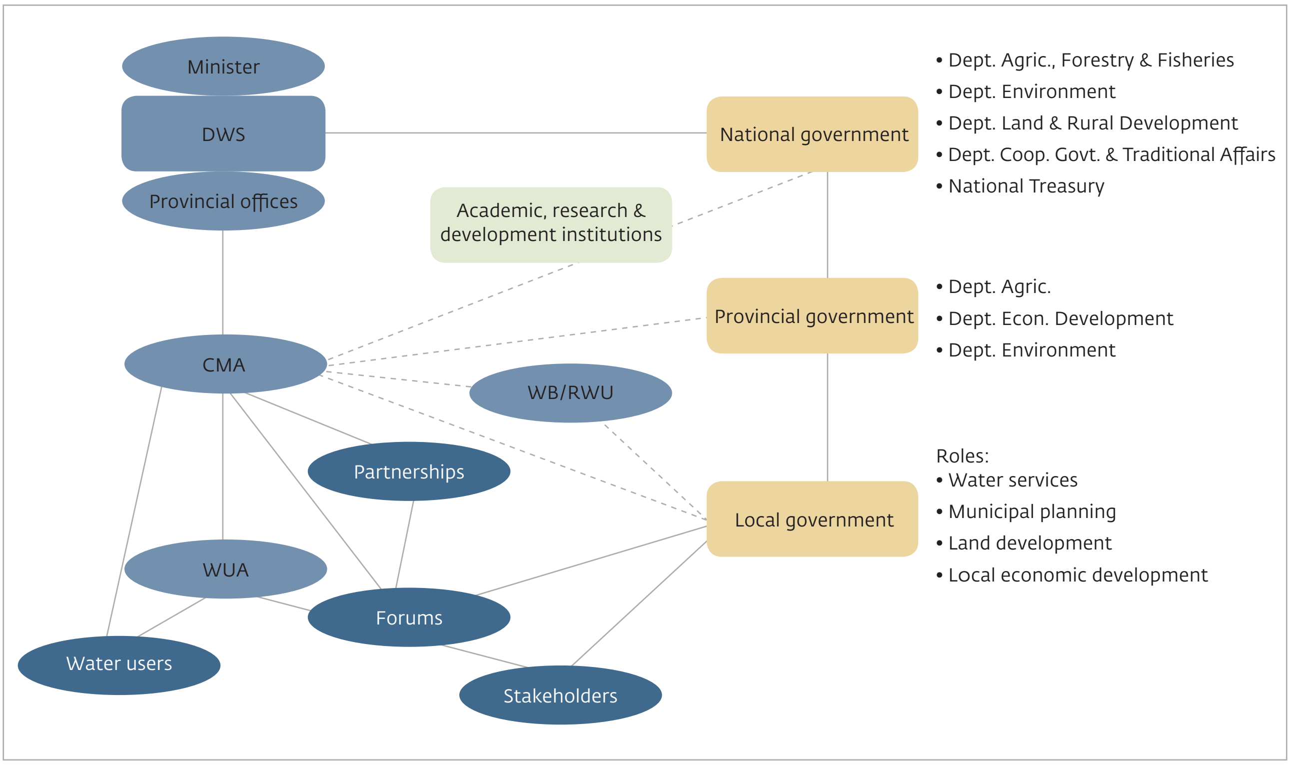
Some of these issues were also raised by the private sector firms in agri-processing, as challenges and/or factors weakening the business case for water efficiency overall, as discussed in Chapters 4 and 5.

7.4 Water governance at the local level

A key dimension of the South African water story has been its inability to stabilize the institutional and governance framework responsible for the management and regulation of water resources. The NWP for South Africa (1997) and the NWA (1998) both provide clear guidance to the establishment of catchment management agencies and water user associations as part of an institutional framework that would enable water resource management to take place at both catchment and local levels (Figure 34).

[82] *Department of Water and Sanitation 2018.*

Figure 34. Water sector institutional framework.



However, there has been ongoing concern about the establishment of catchment management agencies, particularly in terms of their capacity to ensure effective management of and accountability for scarce water resources. As a result, successive Ministers and Directors-General have adjusted policy positions with regard to the establishment of catchment management agencies. Whilst the DWS has Provincial Offices that can perform these water resource management functions, they faced a number of challenges relative to catchment management agencies:

- Inherent functions: There are a number of inherent functions within the legislation that only a catchment management agency can perform, including the development of a catchment management strategy. The lack of catchment management strategy development across large parts of the country has been problematic for catchment and local level development by not having the necessary planning linkages with Integrated Development Plans (IDP) produced by local government.
- Effectiveness: As a public entity that must consider the need to ensure effectiveness with limited financial resources, catchment management agencies are incentivized to develop efficient and effective processes. This is supported by working with stakeholders in the development of their catchment management strategies, developing shared and commonly held priorities. Revenue generated within the catchments is used to undertake these priority actions, with institutional legitimacy thereby becoming tied to effective delivery.
- Accountability: The two catchment management agencies that are currently operational have revealed high levels of staff accountability. This accountability is '360 degree' in nature, with the institution being accountable to the Minister of Water and Sanitation, to DWS and the various technical line functions, to local government, and to the various stakeholders within the catchments, as well as to other sector actors that require water.

To date, two catchment management agencies are operational: Inkomati-Usuthu and Breede Gouritz. DWS is currently undertaking the Advisory Committee processes required to appoint the Governing Boards for four other agencies, including the Vaal, Olifants, Pongola to Mzimkulu and the Limpopo.

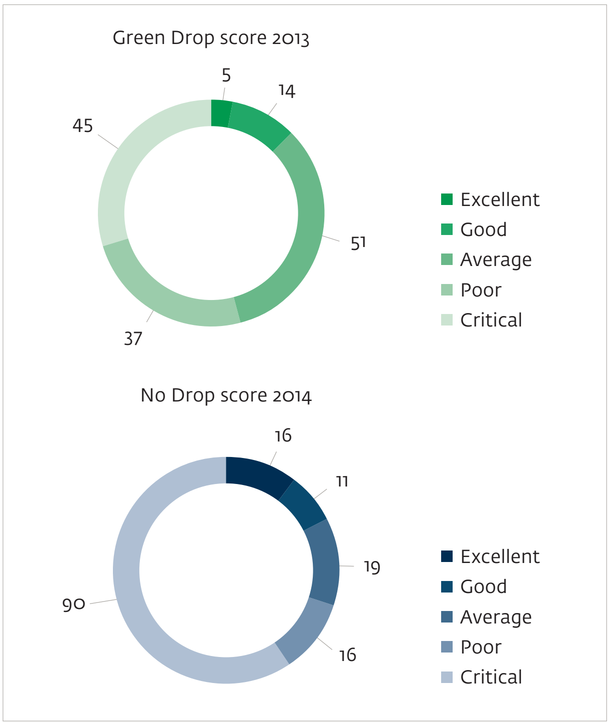
The prevalence of water user associations – local institutions established as new institutions or through the transformation of irrigation boards – bring further local-level institutional ambiguity. The transformation of irrigation boards has been problematic in that many have been slow to transform, while the many new water user associations have faced considerable capacity development challenges. As a result, the 2013 policy review called for the disestablishment of these institutions, noting that catchment management agencies can establish local level institutions only once the agencies themselves are established.

This is problematic for the water sector in that these institutions provide a useful platform for local water users to come together, pool their resources and develop joint initiatives to improve water use efficiency, manage and maintain common infrastructure and to provide localized compliance monitoring. In addition, these institutions can be multi-sectoral in nature, providing the platform for water users from different sectors to engage in matters of shared concern. To date, water user associations have largely been focused on the agricultural and irrigation sectors, with few multi-sectoral associations.

Meanwhile, many municipalities have significant challenges in terms of capacity and resources, noting that in many instances these institutions do not have a sufficiently strong revenue base to support their effective functioning. This results in poor performance with regard to planning for future development, the management and maintenance of infrastructure for water services provision, as well as monitoring compliance with municipal by-laws.

The Blue, Green and No Drop systems developed by DWS to monitor performance of municipalities in terms of meeting water quality standards, water discharge from wastewater treatment works and for water use efficiency standards, provide useful insights into the competencies of local government to manage water infrastructure and provide services (Figure 35).

Figure 35. Green Drop and No Drop scores for 2013 and 2014, respectively.



These reflect that 55% of municipalities that submitted information had critical and poor scores for Green Drop, with this rising to 70% for No Drop. These clearly demonstrate that many municipalities have challenges with regard to the management and maintenance of infrastructure. This is not surprising when many of these municipalities lack the necessary technical and engineering skills to operate and maintain infrastructure. Noting the risk that this places upon business, some industries are providing support to municipalities to help them address these issues. For example, some mines are supporting municipalities in addressing these issues to reduce their operational risk, undertaking capacity support initiatives under the banner of their Social Labour Plans. Notably, the governance framework for this type of support is still considered unclear and there are no clear guidelines for such deals in the PPP legislation, reducing opportunities for efficient dispute resolution and increasing business risk.

8. Opportunities to improve the enabling environment in the water use space

8.1 Emerging and potential opportunity areas

The water sector has faced a significant array of challenges to date, with many of these related to national and strategic level policy matters, but also local level institutional and execution issues. However, bright spots are apparent in the operations of existing catchment management agencies and water user associations, and indicate that improved engagement on water management are indeed possible. Whilst there are opportunities to have impact at the local level there is also opportunity to engage the more strategic issues. Some of these opportunities are reflected below.

- Establishment of CMAs: DWS has started the process to appoint governing boards for four new catchment management agencies. It will be valuable to engage with DWS to assess timelines for the appointment of these boards, the operationalization of the agencies (noting staff transfers from DWS) and the planned timelines for the development the catchment management strategies for each water management area. The development of CMA strategies and their operationalization become important processes for the private sector and civil society to engage in improved planning and for better interaction on issues pertaining to water use licenses and regulatory compliance. In addition, the agencies will likely engage more actively with stakeholders, and therefore the establishment of water user associations and catchment management forums become important platforms for the private sector and civil society.
- Water allocation planning: Despite the ongoing requirement to introduce water allocation reform, through such instruments as compulsory licensing, very little has been achieved to date. There has also been little progress in developing water allocation plans for water management areas. The Inkomati-Usuthu catchment management agency has now embarked upon the development of a water allocation plan for its management area, which will likely be the first of its kind in South Africa. In developing this plan, there will be a need to consider current water use, the need for water use efficiency and how to incentivize that, as well as to engage with key development sectors to understand growth trajectories and business expansion. Such processes provide a meaningful opportunity for business and local government to engage with water managers to find mutually beneficial ways of enabling sustainable growth.
- Water user associations: Whilst there has been some uncertainty about these institutions, the fact is that many DWS staff (particularly within the provincial offices) recognize their importance for localized water management. Until such time that this institutional form is removed from the policy and legislation, there is acknowledgement of the role that these associations can play. There is an opportunity to engage further with already established

water user associations, where appropriate, but equally to support new water user associations centered around local economic development and water use efficiency, with water user associations providing a useful platform to support joint initiatives towards improved water management and knowledge exchange.

- Municipal role in water management: Recent engagements with the South African Local Government Association (SALGA) have reflected concern that local government cannot adequately undertake its water functions without the catchment management agencies being established. This is because of the important connectivity between water resource management and the requirements to support water services delivery, with a catchment management strategy needed to support IDP. As an important complement to this, there is a need for municipalities to incentivize improved demand management, improve water use efficiencies and tackle the high levels of non-revenue water. Similarly, the effective treatment of industrial effluent within municipal systems is of specific concern, as the treatment technologies deployed are often inadequate. Finally, there is a need for municipalities to strengthen by-laws and ensure that there is improved compliance monitoring. Providing incentives for companies to self-monitor their water use and waste discharges, and to submit this data in regular reports would support municipalities towards better compliance.

However, at face value, municipal incentives at times run contrary to water use efficiency, as consumer and industrial efficiency measures often negatively impact municipal revenue streams. In addition to this, water use efficiency on site may result in more concentrated effluent discharges that may attract municipal wastewater discharge surcharges, thus disincentivizing water use efficiency.

- Integrated water quality management: There are significant concerns regarding the ongoing degradation of water resource quality. The recently developed policy, strategy and implementation plan for improved and integrated water quality management call for more effective engagement of the private sector in supporting water quality management. DWS is now preparing to take more active steps to implement a range of activities that support this, including the introduction of the waste discharge charge system. Developed around the 'polluter pays' principle, the system aims to promote the sustainable development and efficient use of water resources, promote the internalization of environmental costs by polluters, create financial incentives for dischargers to reduce waste and improve use of water resources, and recover costs associated with mitigating water quality impacts of waste discharge. This system will not be implemented in all catchments but will be targeted for use where water quality challenges are significant.
- Compliance monitoring: DWS has in recent years strengthened its approach to compliance monitoring and enforcement. This has been undertaken in partnership with the Department of Environment Affairs to pool resources and enable improved monitoring effectiveness. DWS is also planning to introduce administrative penalties that would enable officials to take swifter action against unlawful water use, which may however take significant time to implement. However, there is equally a drive to encourage users to self-regulate and report, thereby reducing the burden on public institutions. This concept of disclosure is at the heart of water stewardship approaches which industry is under increasing pressure to adopt. Working with the appropriate authorities – local government, DWS or the relevant catchment management agency – will be essential to ensure that the data and information provided is appropriately captured and stored.
- Access to information: There has been repeated commentary from various stakeholders that access to information is particularly difficult. DWS has been developing the National Integrated Water Information System to improve access to information, as well as provide information in appropriate formats that are useful to water managers and users. Engagement with the DWS in this regard will be useful in understanding progress, but also in providing guidance to DWS on the types of information required, noting that smaller businesses do not always have easy access to information and guidance on water use efficiency approaches. Lastly, there is a need to inculcate an ethic of data and information exchange at local and catchment levels, which DWS and its water management institutions need to champion, including the sharing of best practices and lessons learned.

In further sections, we shall discuss the role of municipalities and local stakeholders and specific actions that could be taken at that level to improve the business case for firms and maximize impact from water efficiency measures for the community as a whole.

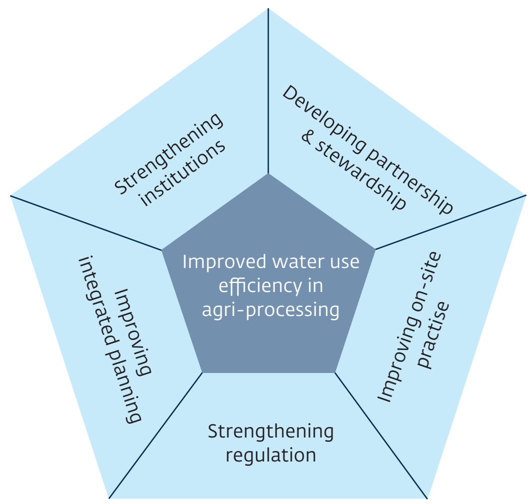
8.2 Tackling the water challenge at the local level

Drawing from this mix of forward-thinking policies combined with institutional challenges, the focus of the project's local water policy improvement measures will be structured around an opportunity cycle that will explore improvements in water management frameworks to support the realization of local improvements in agri-processing water use and efficiency practise, that can further inform ongoing improvements in the water management frameworks.

This is premised on an approach that realizes that to effect systemic changes – in policy, regulatory practise/and institutional process – there is a need to work with national and provincial actors to resolve strategic and procedural challenges (top-down), whilst working at the local level to realize actual practise changes that can support and strengthen national and provincial level policy, regulatory practises and processes (bottom-up).

Five focus areas will serve as key drivers of change for the project, many of which are primarily focused on locality-specific change, but which also require local-national partnership and implementation.

Figure 36. Intervention areas at the local level.



Specifically for improving the enabling environment for agri-processing water efficiency, Improving integrated planning and strengthening regulations seem to be the most promising areas.

Integrated planning and water use planning, in particular, has been found to be one particular area of interest evident from the analysis activities pertaining to the dimensional rankings above, as well as in consultations with municipal authorities. Undertaking a situation assessment within geographies to develop a common understanding of the water resources context starts to build trust between key stakeholders and enables agreement on the key steps that need to be taken to support more effective water resource management within specific catchment areas. This would be required as part of the catchment management strategy process and therefore the key counterpart would be the **catchment management agencies**, but having the DWS Provincial Office host workshops to get this more integrated planning process in place would provide a significant first step. This could be linked to the Integrated Development Planning process for municipalities and involve several of the latter in the exercise.

In the strengthening regulations domain, the following areas would be key:

Water use authorization policies and processes (particularly on groundwater use). While difficult to address, there could be targeted interventions for specific geographies to unlock delays and help agri-business to track progress. The DWS is trying to find ways to improve the existing systems and are open to inputs about how the processes could be practically streamlined. Inputs and data from the emerging catchment management agencies and water users associations could be key in unlocking this policy barrier and an impactful area of applying APRE efforts at the local level. In addition to this, there is a need to improve the awareness materials and guidance that the DWS provides in terms of these procedures.

Improvement of water reuse and recycling regulations offers an ideal opportunity for agri-processing companies to reduce the costs associated with water supply, as well as decreasing the pressure on South Africa's strained water resources. South Africa's National Water Resources Strategy Second Edition (NWRS2) places significant emphasis on water re-use as a possible response to increasing demand and water scarcity. With the introduction of improved purification technology, reuse and recycling measures are becoming viable options for many businesses (Department of Water Affairs, 2013). Even where regulation calls for reuse measures, poor enforcement from DWS and municipalities often leads companies to just pay fines or ignore regulation.[83] The DWS, whilst having promoted water reuse, have not resolved the authorization and regulatory dimensions that relate to reuse and recycling. This creates some uncertainty around how regulatory systems will manage water reuse and recycling. Specific incentives could be created at the level of a municipality and/or catchment to incentivize companies financially. Due to the specifics of wastewater/effluent types coming from various industries, these could be sector-differentiated and therefore partnership with the sector associations might aid the analysis and strengthen impact. An example is the Red Meat Abattoir Association (RMAA, the key aggregator in one of the priority sub-sectors) that is engaging in policy advocacy specifically on the opportunities for water recycling in red meat processing. Beyond engaging with focus local authorities on water discharge and

[83] *GreenCape 2019.*

effluent treatment standards, fees and surcharges, such an intervention will require engagement with DAFF on sector-specific food safety standards involving the quality of water used.

Public perception is also a factor that has significant influence on whether an agri-processing business utilizes recycled water. Although recycled water can be treated to potable standards, the perception of using recycled water for products that are destined for human consumption can negatively impact sales.

Tariffs, surcharge and fees review. As discussed in Chapter 4, one of the major factors for the relatively weak business case for certain water efficiency measures is the lack of direct economic rationale and the fact that many of the risks and challenges (scarcity, quality, environmental impact) are not perceived directly through tariffs and other payments associated with water. While within municipal water authorities' domain, there have been calls for the pricing of water to be quite fundamentally reviewed and National Treasury have undertaken several analyses in this regard. The DWS have not undertaken a recent review of the raw water pricing strategy (through this is legally required to be undertaken every five years). Furthermore, the DWS has been slow to initiate the establishment of an economic regulator that would oversee these tariffing structures. This does mean that institutionally it is difficult for the industry to raise concerns regarding tariffing structures. There is space to strengthen the effort by conducting a tariff review with a focus on sub-national level tariffs and fees.

Public-private dialogue remains the key mechanism of delivery on the areas above, including incorporation of inputs from the private sector players and aggregators, and catchment-level aggregators, as well as delivering the case and good practices developed at the local level to the national water and sanitation authorities for further broader policy framework review.

9. Summary and conclusions

The study has established that, for many agri-processing companies in South Africa, water and resource efficiency is already becoming a priority. While it is at times challenging to formulate the business case for water efficiency improvements solely based on the direct cost of water arising from the tariffs, the companies take into consideration such factors as business continuity and risk of output and revenue loss due to water scarcity. Further, many view it as a social responsibility commitment, given general challenges with water access for the communities where many agri-processors operate.

During research and interviews, IFC has observed a number of projects that have already been implemented or planned, in all major sub-sectors, that demonstrate the above. High-level international comparisons are showing that, on many levels, South African companies are not far behind their international counterparts.

However, international benchmarks and stakeholder interviews suggest that there is room for improvement.

The study has established that the **total potential for primary water savings** across the key agri-processing sub-sectors can be estimated at just under **30 million m^3/year, equivalent to 20% of the total sector consumption** (this varies between 10% and 65% across sub-sectors and in best-practice technologies already implemented by some players). The potential would be realized through these key types of intervention:

a. Low-cost savings measures, including retrofits of water supply and distribution infrastructure at the company facilities;
b. Process improvements and equipment upgrades that result in reduction of water use per unit of output; and
c. Water reuse, recycling and effluent treatment projects, which could include biogas-to-energy components.

Realization of this potential would result in **savings of over US$20 million annually** (excluding corresponding energy savings and indirect savings from avoided loss) and require **investment of over US$400 million**. Approximately 80% of the savings potential can be achieved with US$200 million of investment.

Poultry, red meat, dairy, fruit and vegetable subsectors represent the most unrealized yet feasible potential for water efficiency, followed by malting and brewing as well as wineries. The water-related projects in the pulp and paper sector, as well as in the sugar sector, tend to be much larger on average; however, a lot of the potential has been already realized.

Many of the interviewed firms and other stakeholders indicated the role of enabling environment in incentivizing companies to do more in this space, appreciate the full cost of water and proactively contribute in the public-private dialogue when key decisions on water use are made, especially at the provincial and local level.

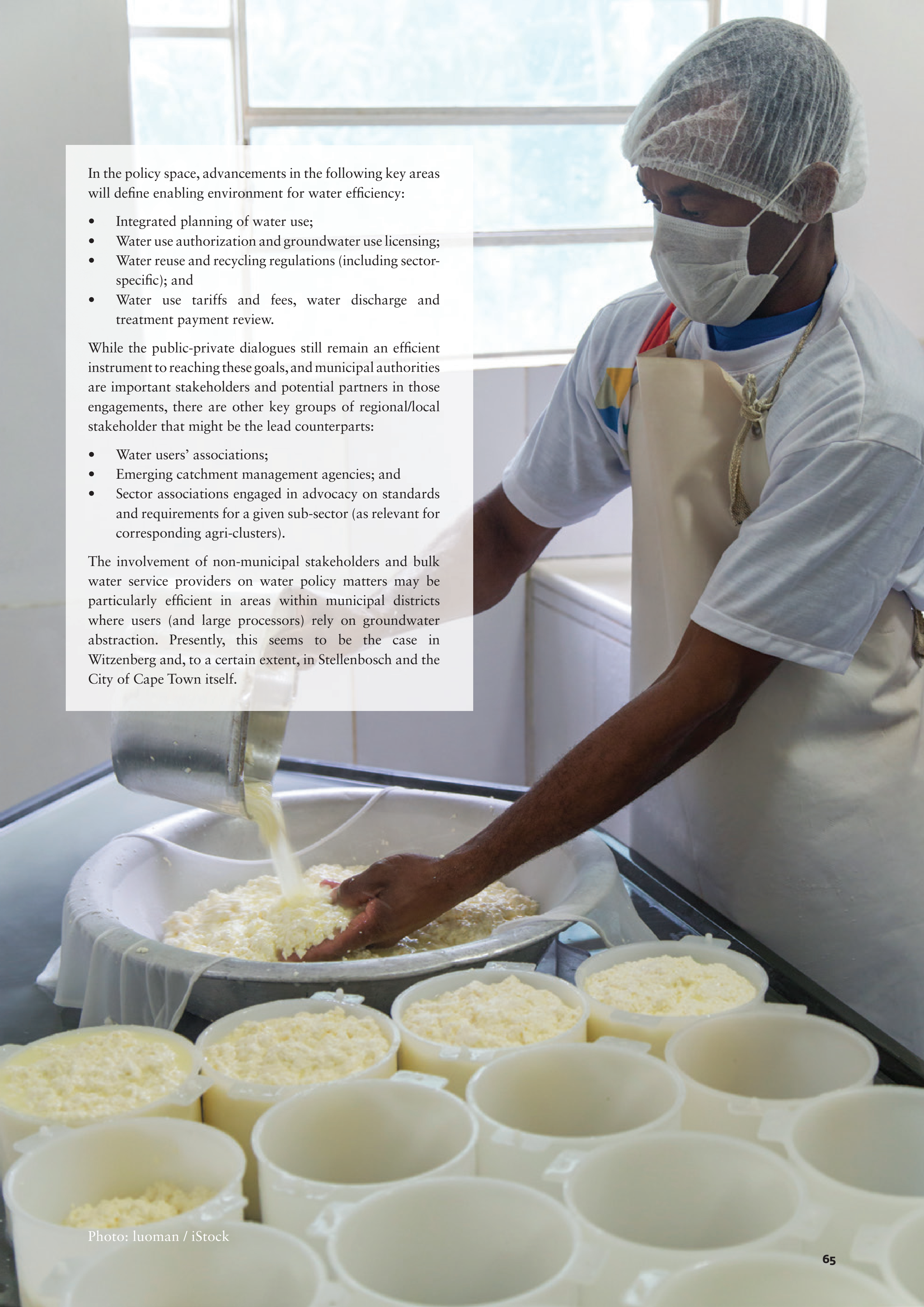
In the policy space, advancements in the following key areas will define enabling environment for water efficiency:

- Integrated planning of water use;
- Water use authorization and groundwater use licensing;
- Water reuse and recycling regulations (including sector-specific); and
- Water use tariffs and fees, water discharge and treatment payment review.

While the public-private dialogues still remain an efficient instrument to reaching these goals, and municipal authorities are important stakeholders and potential partners in those engagements, there are other key groups of regional/local stakeholder that might be the lead counterparts:

- Water users' associations;
- Emerging catchment management agencies; and
- Sector associations engaged in advocacy on standards and requirements for a given sub-sector (as relevant for corresponding agri-clusters).

The involvement of non-municipal stakeholders and bulk water service providers on water policy matters may be particularly efficient in areas within municipal districts where users (and large processors) rely on groundwater abstraction. Presently, this seems to be the case in Witzenberg and, to a certain extent, in Stellenbosch and the City of Cape Town itself.



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Annex A

Case Studies of local-level policy intervention and public-private dialogues with potential for replication under APRE.

uMhlathuze Water Stewardship Partnership
Location: Northern KwaZulu-Natal, City of uMhlathuze

The uMhlathuze Water Stewardship Partnership (UWASP), established in 2016, emerged as an initiative to address water risk in Richards Bay. The partnership was localized and comprises several institutions in the northern KwaZulu-Natal area, such as Department of Water and Sanitation and Catchment Management Agency of Pongola-uMzimkulu; GIZ's International Water Stewardship Program (IWaSP; now shifted to NatuRes); National Business Initiative; WWF SA; Strategic Water Partners Network (SWPN); Tongaat Hulett, Mondi South Africa, Grindrod, Transnet and Richards Bay Minerals.

The primary objective is to ensure water availability for residential and industrial use (sugar, forestry and manufacturing), while at the same time securing sustainable livelihoods and environmental integrity of key ecosystems within the highly-stressed uMhlathuze water catchment. This is achieved through:

- Enhancing the management of the freshwater coastal lakes and surface water dam that provide for uMhlathuze's needs;
- Supporting water use efficiency and reducing water loss amongst downstream users;
- Facilitating agricultural water stewardship and irrigation efficiency;
- Securing ecological infrastructure through invasive species clearing and wetland rehabilitation; and
- Developing community water-related champions, entrepreneurs and micro-enterprises.

To achieve the above, the UWASP assigned specific roles to the stakeholders of the partnership and held these stakeholders accountable for achieving set objectives. Whilst the steering committee is accountable for the overall partnership, clear roles and responsibilities have been established so as to ensure clear accountability for implementation and the achievement of results.

Emfuleni Partnership
Location: Gauteng; Emfuleni Municipality

In response to water shortages, municipalities agreed to reduce water use by 15% by 2014. The water losses experienced by the Emfuleni Municipality was in excess of 40%, posing a threat to surrounding businesses and residents due to the lack of water security. Businesses, in particular, felt the pinch as this hampered economic development in the area. Even though businesses also had to comply with the reduction in water use, the sustained water losses continued to pose a threat.

Recognizing the severe financial and capacity constraints of the local municipality, Sasol, together with GIZ formed a partnership with the Emfuleni municipality. Sasol stepped in with technical and financial assistance to support the municipality to reduce the water losses in their system, thereby increasing the water availability to all in the area. By jointly implementing water conservation/ WDM measures with the municipality, Sasol was able to build the capacity of local municipal managers while also increasing their own water security.

The Emfuleni Partnership demonstrates how private sector resources – skills, human resources and finance – can be leveraged through a public-private sector cooperation model to channel investment to public water infrastructure and for building the capacity of municipal service providers.

eMalahleni Water Reclamation Scheme
Location: Mpumalanga; eMalahleni Local Municipality

A partnership between mining companies and government for addressing water quality and water quantity challenges, the eMalahleni Water Reclamation Scheme is a prime example of private and public-sector partnerships. Mines in the area had several shared risks, including rising mine water levels and watershed contamination, resulting in deteriorating regional water quality. In addition, the eMalahleni municipality faced water supply challenges, whilst mining companies were experiencing social unrest from communities with service delivery concerns. The reclamation scheme was then constructed to address the challenges through treating excess mine water for use within the mines and to supply potable water to the eMalahleni municipality. The eMalahleni case is an example of how wise water management can provide a common solution to shared concerns by addressing the interests of industry, local government and local communities.

Bojanala Water Forum
Location: North-West; Bojanala District Municipality

The Bojanala District Municipality (BDM) has been facing significant water challenges in terms of delivering sufficient water services to communities. This has been exacerbated by an on-going drought. The Department of Water and Sanitation advised that the BDM establish a cooperative partnership with mines, water boards and local municipalities to address the difficulties being experienced. At face value, the concept of getting the mines to fund water developments was attractive, but there was rapid realization through discussion that 'throwing money' at the problem was not sufficient to address the challenges at hand. The real need lay in having the capacity and competencies within local municipalities to deliver such water projects. The mining houses were quick to respond to the needs of the Bojanala Water Forum in providing technical support, with the understanding that this should not only focus on short-term initiatives but also build capacity to meet longer term objectives.

Annex B

Table 16: Industrial water and sanitation charges for selected metros (ex VAT, no water restrictions in place).

		Cape Town	eThekwini	Tshwane		Ekurhuleni		Johannesburg	
		ZAR/kl	ZAR/kl	Monthly use (kl)	ZAR/kl	Monthly use (kl)	ZAR/kl	Monthly use (kl)	ZAR/kl
Water	Step 1	22.78	29.12	0-100 000	22.28	0-5 000	22.06	0-200	38.3
	Step 2			10 001-100 000	21.14	5 001-25 000	22.41	>200	40.4
	Step 3			>100 000	19.70	>25 000	23.38		
Sanitation	Step 1	20.47	8.21	Not stepped	8.31	0-5 000	9.21	Not stepped	28.7
	Step 2					5 001-25 000	4.90		
	Step 3					>25 000	3.19		
	% water assumed to be wastewater	95%	90%	80%		100% (TBC)		100% (TBC)	

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