WATER RESEARCH COMMISSION

WORKING PAPER

An approach to introduce independent water production (IWP) to South Africa

by

Kevin Foster, Rajiv Paladh & Jay Bhagwan

ABSTRACT

This paper responds to South African President Cyril Ramaphosa's 2020 call for independent water producers to play a role in ensuring South Africa's water future. It explores the route to the introduction of independent water producers in South Africa. It looks at the history of private participation in water production globally and in South Africa and establishes the lessons learnt and considers these in the context of South Africa's legislative and regulatory environment for water. It proposes that space should be made for independent water production that produces water through a programmatic approach with IWP programmes supporting implementation at key points in the South African water value chain. It then outlines an emerging way forward for the implementation of independent water production in South Africa.

Background

The South African water crisis is characterised by insufficient water infrastructure maintenance and investment, recurrent droughts driven by climatic variation, inequality in access to water and sanitation, deteriorating water quality and a lack of skilled water engineers (Department of Water and Sanitation, 2018). In recent years, South Africa has been facing serious water supply challenges, especially in the Northern, Eastern and Western Cape provinces and KwaZulu-Natal, through drought and infrastructure failure. These challenges have resulted in several small towns being threatened by total water supply failures and livestock farmers facing financial ruin. The challenges have occurred in bulk supply (primarily due to drought and reliance on surface water) and distribution (primarily due to water loss through infrastructure failure).

President Cyril Ramaphosa raised the possibility of using independent water producers (IWPs) to address challenges in water infrastructure development in South Africa, in his 2020 State of the Nation Address (SONA). Independent water production has been identified as a mechanism to expand private investment in public infrastructure and address challenges facing water production and infrastructure development. There have been examples of the private sector mobilising to address the water supply challenges as municipalities have been forced to raise costs and limit supply. This includes industries that have implemented their own seawater desalination and groundwater extraction solutions. Municipalities, like the City of Cape Town have also explored alternative sources of water such as desalination and wastewater reclamation and have received proposals for more adventurous approaches, such as capturing and melting icebergs.

In the National Water and Sanitation Master Plan for South Africa, the Department of Water and Sanitation (DWS) says that the "growing crisis" in the water sector "is beginning to encourage decision-makers to see private sector participation as a pragmatic and beneficial response" (Department of Water and Sanitation, 2018). However, funders require bankable projects and have "indicated the need for an enabling environment to mobilise larger private sector investment" (Department of Water and Sanitation, 2018). Similarly, National Treasury has indicated that a comprehensive management strategy needs to be developed to attract investment in water resource development, bulk water supply and wastewater management, as well as the application of lessons from the country's renewable energy independent power producers programme (REIPPP) to the water sector (National Treasury, 2019). Thus, support for the private sector to play additional role in the water sector is growing amongst public institutions, and this could include independent water production and IWPs.

However, the possibilities, limitations and role of IWPs need to be defined and understood to make this pragmatic approach to improving water security, as outlined by DWS and National Treasury, possible. This paper outlines the emerging positions that could be adopted by government in defining the role and expanding opportunities for IWPs to contribute to the South African water supply challenges. The emerging positions are based on a literature review and initial interviews of key stakeholders in the South Africa water sector. This forms part of an ongoing study exploring independent water production in South Africa.

Defining independent water production

Globally, an independent water producer is understood to be an entity, which is not a publicly owned water utility, but which owns and operates facilities to produce water for sale to customers. Customers can include utilities, central government, municipalities and end users, like industry or agricultural users.

This definition is very broad, which potentially limits its usefulness when being applied for programmatic infrastructure delivery purposes, as implied by the President's speech and envisioned by National Treasury. This is because water production is a very complex and technology specific process and can occur at vastly different scales from a solution within a small village to an intervention

that can service a large city or region. To increase the usefulness of this broad definition for the South African case this position paper outlines possible categorisations of independent water production in South Africa around which support programmes for IWPS could be adopted to improve infrastructure, service delivery and water security.

The Context for IWP

International experience

The international experience of private involvement in water production has typically involved private participation in the public service provision through development and management of supply and network schemes and operating contracts. Recent droughts in Australia, California (USA) and Spain, as well as increasing development in Dubai, Abu Dhabi and Israel has seen a rise in seawater desalination plants, many of which are owned and independently operated for supply to cities and industries. These operations typically have long term offtake agreements with the independent operator and customer. The international experience of these desalination projects has been varied, with viability depending heavily on contextual factors including scale, quality of feedwater, location of plant, extent of environmental regulation, cost and availability of energy, and the extent of drought. The current global average cost of desalination is $1.21 per kl, with costs in mature markets dropping to around $0.50 per kl and below (Bosman, 2021)[1].

There are also other international examples of independent water production. Imported water, shipped by barges, is crucial to survival of some island nations in and around the Caribbean. There are examples groundwater extraction and treatment and distribution at varying scales, wastewater treatment for potable and non-potable re-use at the city scale and the campus scale. There are also examples of smaller scale technologies, such as water from air technologies, to produce water at a small scale. This growing use of the private sector to produce water has indicates the emergence of a new model for independent water production outside of its traditional roles of public service provision.

South African experience

Private sector involvement in the South African water sector has largely been through private sector participation in the public water distribution system. This has predominately been in the form of contracts that have been initiated by the public sector and require compliance with the National Water Act, either short terms management contracts for the operation and maintenance of existing infrastructure, or long-term concessions for the development, renewal and operation of supply schemes. The Dolphin Coast and Mbombela concessions have been local cases that are considered qualified successes.

Private sector involvement in the production of water, rather than distribution has been used extensively at small scale in South Africa by private industry. The use of this model increases during times of drought, with high levels of uncertainty of supply and high municipal tariffs due to demand management effort. The technologies used are typically groundwater extraction and treatment, seawater desalination at the coast and wastewater treatment. These are relatively small-scale projects, however, when compared to bulk supply schemes, and the costs tend to be relatively high and variable, depending on quality of feedwater, the cost of energy, and the quality of water required. Some of these plants operate continuously, while other have been built, used and decommissioned when the drought has passed, and municipal water tariffs decrease to an acceptable level.

There are also cases in South Africa of independent producers playing a role in production for public water services authorities, such as the development of 10 Ml/Day desalination plant by MEB to supply

[1] The bulk tariff at Rand Water was R11.67 in 2019/20. This is the equivalent of US$ 0.81 at an exchange rate of US$1 = R14.43.

the King Cetshwayo District Municipality in Kwa-Zulu Natal. This plant was commissioned in 2017 through a design and supply contract (MEB, 2016).

Cooperative schemes such as Water User Associations (WUA) operate independently to supply raw water to farmers, industry and Water Service Authorities (WSA). These schemes operated through a mandate from the National Water Act and demonstrate a possible model for IWPs in South Africa. However, the context within which the WUA exists must demonstrates a viable business case.

Despite this experience, the established institutional and regulatory frameworks, and the weak financial standing of many WSA's in South Africa make this a challenging space for independent water producers to enter, as transaction costs are high and customers' ability to pay is uncertain. Without programmatic support, which will allow both IWPs and their customers to learn through the implementation of projects, reduce transaction costs and institutional barriers, and secure reliable revenue streams for producers, independent water production in South Africa is likely to remain focussed on securing small scale water supply for specific commercial contexts. This could be a missed opportunity for large scale supply for the public and contributing to national water security.

IWP in South Africa

The opportunity: A Programmatic Approach to IWP in South Africa

Adopting differentiated programmatic approaches to IWP in South Africa creates the opportunity to address some of the regulatory, financial and technical challenges within the sector at the specific points in the water value chain. This approach allows the relevant water institutions to address their specific needs in a structured and supported manner and appropriate scale that could ensure accelerated delivery of infrastructure and services.

The programmatic categories of independent water production that could be explored are:

- Resource development and bulk production
- Wastewater treatment
- Emerging innovations
- Community management

Resource development and bulk production

The opportunity for independent water production in South Africa could include the development and management of conventional surface water resources (dams or run-of-river) or ground water boreholes for raw water supply, treatment of raw water, or desalination plants. These types of projects are likely to take the form of a public private partnership, where the IWP will own and develop the required infrastructure and supply water at a given price to a water board or WSA. The PPP contracts could specify that the infrastructure could remain owned by the IWP indefinitely or could be transferred to the water board or water service authority at some point in the future.

Conventional Resource Development

The potential for conventional water resource development is very site specific and depends on catchment characteristics and climatic conditions, as well as the suitability of the site itself. Most of the economically feasible sites in and around the major towns and development nodes in South Africa have already been exploited to some extent and any new development will come at a much higher cost than existing infrastructure and it's unlikely that an IWP would be prepared to invest this level of capex unless there are specific methods of guaranteeing off-take agreements and appropriate pricing above current levels.

There is however opportunity for IWP water resource development where the primary purpose of water supply is not domestic supply. Current examples of these opportunities are the development of

surface water resources for irrigation, mining and industrial purposes, where a small proportion of the yield can be allocated for other more general purposes, such as domestic supply for surrounding communities. In most cases the primary developer (farmer organization, mine or industry) will want to maintain control of the water source, particularly if its key to its production and the potential for an outside IWP organization to take on the development and operations is seen to be limited. There is however potential for the primary developer to become an IWP in itself.

Water licensing in term of the National Water Act would be required, but the regulatory burden of introducing IWPs at this point in the water value chain is unlikely to be unduly onerous, as legislation and regulation the use of PPPs is already well developed in South Africa and National Treasury provides institutional support for their development. The Municipal Systems Act also allows municipalities to appoint private service providers to assist them to deliver their services. Some work may need to be done in terms of increasing the efficiency of signing long term (20 year plus) contracts and easing the conditions for municipalities using private service providers. Environmental legislation and Water Use Licences are likely to be the most onerous that projects will need to overcome, but this will be site specific, and sites can be selected strategically to encounter reduced environmental regulation.

Desalination

Currently, the greatest impact opportunity and lowest hanging fruit for IWP is seawater desalination. Projects have already been explored to supply the City of Cape Town, eThekwini and Umgeni Water and private plants already having been built and operated for own use by industry in Mossel Bay, Saldanha Bay and Richards Bay. Independent water producers could supply desalinated to water boards and water services authorities as an additional source of water to their existing sources.

Large-scale desalination could be particularly effective in coastal areas that are prone to drought or are expected to experience reduced annual rainfall or increased surface water evaporation as a result of climate change. Climate change will particularly reduce rainfall at the coast in the Northern Cape, Western Cape and Eastern Cape, as well as parts of KwaZulu-Natal (Water Research Commission; South African Weather Service, 2017). IWP using desalination could be used to top up dams and reservoirs or to support water service authorities with decentralised desalination facilities to supply specific communities who are otherwise difficult to connect to a water network. Similarly, with the permission of the relevant water service authority, the independent water producer could supply water directly to industrial and commercial customers at an appropriate scale.

It is likely that IWPs will be the most efficient means of producing desalinated seawater, at least in the short to medium terms, owing to advantages in technical skills and management knowledge around desalination not yet developed in South African water boards and water service authorities. The energy intensive nature of desalination, particularly reverse osmosis, also presents cogeneration opportunities with electricity provision, enabling desalination alongside independent power production projects, particularly solar, wind and natural gas projects.

Desalination provides an opportunity with the fewest potential regulatory barriers and the greatest immediate opportunities is water resource development and bulk water production for water boards and WSAs. Projects at this point in the value chain would benefit from a centrally supported programme, as they will be of a similar scale and nature, meaning efficiencies can be drawn from a programme focussed towards these. It is possible that the new National Water Resource Infrastructure Agency would be the good place to locate a programme toward the development of IWP this scale, or alternatively the Development Bank of Southern Africa. Lessons can be learnt for this program from the Renewable Energy Independent Power Producers Procurement Programme.

Wastewater treatment

Wastewater treatment for reuse offers another potential role for IWPs in South Africa. This could potentially supply either potable reclaimed water or greywater for industrial or agricultural use. The arrangement to develop IWPs at this point in the values chain is also likely to be a PPP arrangement with a long-term offtake agreement. The IWP will build, own and operate the wastewater treatment works, with the possibility of transferring ownership to the water service authority at some point in the future. Key to the success of the IWP, however, will be ensuring a sufficient supply of wastewater from the WSA, to treat for reuse and an agreed sales price for water that supports the business case.

The Municipal Systems Act currently allows municipalities to use private entities to provide services, so appointing an IWP to treat wastewater is permissible in terms of the Section 78 of the Municipal Systems Act. However, it is likely that the entity would have to operate under the terms water service authority's water license, or under its own license. Where WSA's abstract water from rivers these license licenses require that treatment wastewater is returned to the river to maintain flow rates for downstream users. This will limit opportunities for wastewater treatment for reuse (Key stakeholder interview, June 2021). There may be particular opportunities at the coast where effluent or greywater would otherwise have been disposed of in the ocean as this has lower compliance requirements in terms of the National Water Act and would not impact river flows through reduced disposal, although the required estuarine reserves will still need to be maintained. The City of Cape Town is currently developing a project of this nature called the Faure New Water Scheme to produce 100 Ml/day, supported by private sector companies and international experts.

It is again likely that the private sector will be the most efficient way to produce potable water from wastewater, creating an opportunity for IWPs, as skills and experience in these technologies currently resides in the private sector rather than the public sector. It would be possible, however, to transfer these skills to the public sector through the correct structuring of the PPP arrangement (such as a BOOTT – build, own, operate, train and transfer partnership).

Projects of this nature would also benefit from shared learning about their development, implementation, finance and contracting to reduces transaction costs and ensure the provision of high-quality water at a competitive exit price. This again suggests a programmatic approach would help increase efficiency, and the NWRIA could be a reasonable location for the programme, however the increased role of local government means that alternative institutional locations could also be appropriate, such as MISA.

Emerging innovations

Other emerging innovations and technologies also offer alternatives for water production from sources that lie outside of the ambit of the National Water Act. This allows for complete independence and ensures the full control of the resource by the independent producer. These possibilities include innovative approaches to produce water such as water from air technologies, water from icebergs that have been captured and towed towards the coastline and melted into the water system, and imported water, as well as other water 'production' opportunity such as alien vegetation clearing and buying back of commercial forestry to reduce water consumption.

The drawback with these non-conventional water approaches is that they are either relatively untested, implemented at a small scale, or seen to be relatively expensive. Some also require large scale off-takers signing guaranteed contracts to make them viable. For these producers contracting with public utilities is ideal but would be subject to the confines of the Municipal Financial Management Act (MFMA) or Public Financial Management Act (PFMA).

Each non-conventional source has its own quality concerns depending on the source and the processes that are employed to produce the required volumes of water. There are also environmental

implications for using non-conventional approaches to water production. As an example, atmospheric water generation is very energy intense and will have a high carbon footprint. Similarly importing water is likely to have a high carbon footprint, either through the construction of pipelines, or using fossil fuels used for the transportation of the water. Other environmental impacts, such as the arrival of alien invasive species, may also occur when the independently produced water enters the local water system, as is likely to happen, either through introduction into reservoirs, public or private, or into the wastewater system through disposal. This has the potential to be problematic for indigenous water systems, as has been observed in the Lesotho Highland Water Project, and so would need to be carefully monitored. If the water is used for industrial purposes disposal is regulated by the Water Services Act and would need to comply with the standards for industrial effluent. Those standards may also need to be reviewed if imported water is introduced into the system.

There are also potential complex environmental implications for the use of icebergs, in terms of the impact on local ocean water, and local weather systems, which are unknown, and would requiring monitoring and may need authorisations in terms of the NEMA: Integrated Coastal Management Act if it is likely to have an impact on coastal waters.

The use of non-conventional sources of water allows for independent water producers to secure their water source without concern about regulation of their water sources. However, these production techniques are often expensive and complex and are likely to encounter regulation later on in the water value chain.

Opportunities for non-conventional production of water could also be explored in a programmatic approach for IWPs, with the focus on developing appropriate pilots, scaling and setting appropriate quality standards. If the cost of non-conventionally sourced water decline or conventionally sourced water rises, the need to monitor and regulate non-conventional water source will rise. A programme of this nature could be situated within the Department of Water and Sanitation, the Department of Science and Technology, or the Water Research Commission.

Community interventions

Failing municipal infrastructure has led to several communities taking measures to secure their own water supply and wastewater treatment, such as the community of Koster, taking over management of a new wastewater treatment works that the municipality had stopped operating (Muller, 2021). Section 51 of the Water Services Act, allows communities to establish local water committees to take responsibility for their own water supply and sanitation service, with the approval of the water services authority. This creates the opportunity for IWPs to use their expertise to provide water to these committees, through technologies appropriate to the context, scale and available funding. The mechanism for payment would be determined by the committee.

The requirement of approval by the local authority for a water committee to provide its own water is a significant regulatory barrier to the application of IWP in this context and is likely to require regulatory change to overcome.

Water committees are likely to require support in identifying and appointing IWPs to provide their water and sanitation services. A support programmes oriented, first towards facilitating regulatory change to enable the effective use of Section 51 of the Water Services Act, and second toward supporting water committees to do so. A collaborative programme, between the Department of Water and Sanitation, SALGA, and community organisations likely the appropriate approach to developing such a programme.

Emerging position

1. IWP means the production of water by a private company, for own use or sale to a customer. It is not useful to narrow this definition, except for programmatic purposes, and in the programming process to introduce IWP at different point in the South African water value chain.
2. In most instances, the model for IWPs providing water to government agencies, is likely to be a type of PPP arrangement, and programmes should be established in the appropriate branches of government to enable these arrangements at the various points in the water value chain.
3. Pursuing IWP would require different programmatic approaches depending on scale and the point in the water value chain. This includes programmes orientated toward:
    a. the procurement IWPs for resource development and bulk production for appropriate water boards and WSAs.
    b. enabling WSA to appoint IWPs to treat wastewater for reuse.
    c. allowing IWPs to pilot and scale emerging technologies and strategies.
    d. enabling community self-provision through water committees and IWPs, using section 51 of the Water Services Act.
4. An economic regulator would be ideal, and assist IWPs and build confidence for IWP investment, however it needs to be highly capacitated, and be backed by a long track record of good data, which may not yet exist. The development of the track data should be a sector priority towards the establishment of a regulator.
5. Emerging Innovations should be further explored for IWP with proof of concept required before being scaled.
6. The appropriate form of regulation of the of independent water production for each of the programmatic approaches should be explored. This includes determining if IWP's would fall under the National Water Act and the Department of Water and Sanitation, or the Department of Trade and Industry, or the Department of Environmental Affairs. This should also consider whither this regulation should be determined by the technology or resource used.

Implementing IWP in South Africa

Based on this emerging position, the table below outlines the emerging framework for the way forward to enable the introduction of IWP in South Africa. It outlines the initial steps that would need to be taken and the key principles that need to be considered within each of the identified steps.

Table 1: Emerging framework for implementation

Steps	Key principles
Investigate regulatory implications for preferred programmes	The principle of this step is to establish which is the correct regulatory domain for IWP the Department of Water Affair and the National Water Act, the Department of Environmental Affair and the National Environmental Management Act of the Department of Trade and Industry.
Establish a regulator	The establishment of the regulator should be done in a way that ensures alignment with current processes to establish a water regulator beyond just IWP and the wider institutional framework. The principles of the regulator are to: - Ensure credible quality control of water being used and entering the South African Water System. - Ensure low negative impact on municipal business models to ensure that the introduction of IWP does harm democratic local government. - Ensure IWP has limited environmental impacts that might threaten South African water ecosystems.
Establish IWP Procurement Programmes	**Process** The process principles of the establishment of an IWP Procurement Programmes are: - To ensure a proven market for independent water production so that efforts to establish IWP opportunities is not wasted. - To establish a credible, reliable and fair framework for public procurement from independent water producers to give appropriate confidence in the projects. **Commercial** The commercial principles of the programme are: - To ensure credible off-takers of water produced by IWP to provide security for the investment - To establish bankability of IWP projects to attract the required investment - To support producers and off-takers to prepare transactions in a complex governance framework.
Investigate emerging innovations for water production	The principle of this process is to ensure technologies used are proven before use to maintain reliable water production and water quality, while preventing investment losses.
Investigate the further use of Section 51 of the Water Services Act to enable independent community water provision in a sustainable way	This process should enable communities to provide their own water and sanitation, through water committee, where municipal service provision fails, and allow them to choose the manner in which they do so but ensuring that it is done in a sustainable way.

Conclusion and way forward

The table below summarise the emerging position established in the review report and identifies key question relating to the position that will be addressed in the next phase of the project.

Table 2: Emerging positions and key questions

Emerging position	Key questions to be addressed
Position 1: IWP means the production of water by a private company, for own use or sale to and offtaker. It is not useful to narrow this definition, except for programmatic purposes, and in the programming process to introduce IWP at different points in the South African water value chain.	Is this an appropriate definition? Is narrowing the definition per program a useful way to apply IWP in South Africa?
Position 2: In most instances, the model for IWPs providing water to government agencies, is likely to be a PPP arrangements, and programmes should be establish in the appropriate branches of government to enable these arrangements at the various points in the water value chain.	Are PPPs the most viable approach to IWP in South Africa? Where should programmes to enable IWPs be located organisationally?
Position 3: Pursuing IWP would require different programmatic approaches depending on scale and the point in the water value chain. This includes a programme toward: - the procurement IWPs for resource development and bulk production for appropriate water boards and WSAs. - enabling WSA to appoint IWPs to treat wastewater for reuse. - allowing IWPs to pilot and scale emerging technologies and strategies. - enabling community self provision through water committees and IWPs, using section 51 of the Water Services Act	Should we apply a differentiated programmatic approach? Are these the appropriate programmatic approaches to take?
Position 4: An economic regulator would be ideal, and assist IWPs and build confidence for IWP investment, however it needs to be highly capacitated, and be backed by a long track record of good data, which may not yet exist. The development of the track data should be a sector priority towards the establishment of a regulator.	Is there a need for a regulator? What should be considered for the introduction of a regulator? This can include the need for independence, contractual obligations and risks.
Position 5: Emerging Innovations should be further explored for IWP with proof of concept required before being scaled	Can these innovations provide opportunity for IWP in future? How can this opportunity be unlocked?
Position 6: The appropriate form of regulation of the of independent water production should be explored, whether this should fall under the National Water Act and the Department of Water and Sanitation, or the Department of Trade and Industry, or the Department of Environmental Affairs. This should also consider whither this regulation should be determined technology or resource used.	Who should regulate IWPs? Should regulation of IWPs be contingent on the technology used? Should regulation of IWPs be contingent on the water source used?

References

Advisian Working Group. (2021, March 12). *The Cost of Desalination*. Retrieved from https://www.advisian.com/en/global-perspectives/the-cost-of-desalination#:~:text=As%20desalination%20technologies%20have%20developed,build%20desalination%20plants%20has%20declined.&text=Currently%20in%202017%2C%20in%20some,development%20and%20lower%20ener

Bosman, D. (2021). Re-thinking desalination: The value proposition of water as an infinitely scalable, renewable economic commodity. *The Water Wheel*, 37-39.

Department of Water and Sanitation. (2018). *National Water and Sanitation Master Plan.* Pretoria: Government of South Africa.

Department of Water and Sanitation. (2018). *National Water and Sanitation Masterplan.*

Lepono, T., Du Preez, H. H., & Thokoa, M. (2003). Monitoring of water transfer from Katse Dam into the Upper Vaal river system: water utility's perspective. *Water Science Technology*, 97-102.

Muller, M. (2021, June 23). Failing Municipalities Give Way to Local Inititiatives. *Business Live*, pp. https://www.businesslive.co.za/bd/opinion/2021-06-23-failing-municipalities-should-give-way-to-local-initiatives/.

National Treasury. (2019). *Economic transformation, inclusive growth and competitiveness: Towards an Economic Strategy for South Africa.*

Water Research Commission; South African Weather Service. (2017). *A Climate Change Reference Atlas.* Pretoria: WRC.