TRADE & INDUSTRIAL POLICY STRATEGIES

POLICY BRIEF: 4/2018

Forward-looking approach to next generation sanitation and industrial development in South Africa – a briefing

OVERVIEW

A significant proportion of people still require proper sanitation services in South Africa, on the continent, and globally. Given the inadequacies in the current sanitation system, there is a huge potential market for new generation sanitation (NGS) technologies. The size of the market could be much bigger if we consider the proportion of people that do not have sanitation services, those with inadequate services, and those whose services are inappropriate (such as waterborne systems in water scarce areas). NGS has the potential to be a disruptive technology. If properly embraced, it can significantly transform the sanitation landscape and leapfrog the previously unserved and underserved communities. As a new field, there is need for the country to take front-runner advantage. Though South Africa has a strong research, development and innovation background on conventional sanitation, the country needs to be more active to capture the opportunity offered by NGS to industrialise. Efforts by various organisations to promote the development of NGS in the country are providing valuable platforms to leverage.

INTRODUCTION

Sanitation is a multi-step process in which human excreta and wastewater are managed from the point of generation to the point of use or ultimate disposal. Adequate sanitation ensures personal dignity and security, social and psychological well-being, public health, poverty reduction, gender equality, economic development and environmental sustainability (Funamizu, 2017; Stats SA, 2016a; SuSanA, 2008). Sanitation is a big challenge that captures political attention.

In South Africa, the Constitution and other sanitation-related policy documents state that everyone has a right of access to basic water supply and sanitation services. President Cyril Ramaphosa has referred to access to appropriate sanitation services as "an urgent human need" (The Presidency, 2018). At the international level, the adoption of the Sustainable Development Goals (SDGs) is evidence of the renewed effort to tackle water and sanitation related challenges. SDG 6.2 seeks to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation by 2030, paying special attention to the needs of women, girls and those in vulnerable situations.

Conventional sanitation technologies have not solved the challenges in the sanitation sector. Non-sewered, off-grid sanitation systems, commonly referred to as next generation sanitation (NGS), which differ greatly from conventional technologies have been proposed as potentially better. In this paper NGS refers to non-sewered sanitation systems that treat human waste at source.

The key difference between conventional and NGS value chains are depicted in Figure 1 (page 2). NGS emphasises treatment at source, thereby eliminating some components of the conventional sanitation value chain. The key stages of NGS value chain are: capture/containment; treatment; and reuse/disposal. NGS can be defined as an integrated system in which the front-end collects and conveys the specific input to the back-end, which fully treats the waste within the non-sewered sanitation system, to allow for safe reuse or disposal of the generated solid, liquid and gaseous output (ISO, 2017).

This policy brief is based on the report *Forward looking approach to next generation sanitation and industrial development in South Africa*. It can be accessed on the TIPS website at the following link: download main report

Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth

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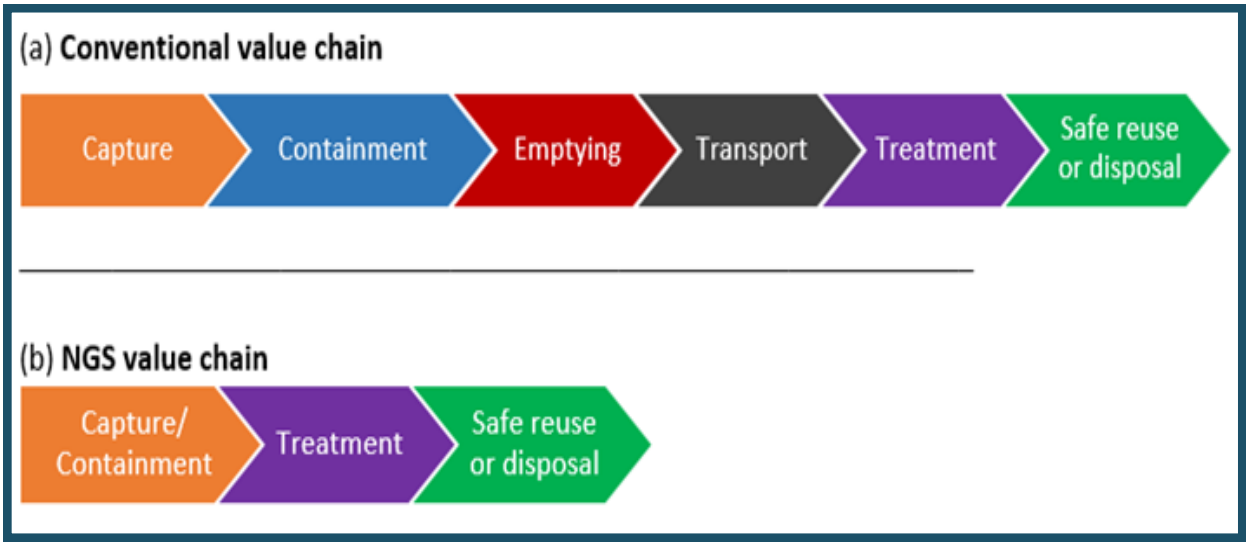
Figure 1: Conventional versus new generation sanitation value chain



Source: Author

NGS sanitation fixtures remove germs from human waste and recover valuable resources (such as energy, clean water and nutrients); can operate off the grid without connections to water, sewer or electrical lines; and promote sustainable and financially profitable sanitation services and businesses (ANSI, 2016; BMGF, 2013).

NGS technologies require no (or minimal) use of water, do not require conveyance, employ on-site treatment of human waste, and seek resource recovery. Some of the common types of waste treatment processing in NGS are: electrochemical, hydrothermal carbonisation, wet oxidation, dry combustion, and biological. NGS is comprised of different technologies which can be applied in different settings (urban and rural) and at varying scales (single-unit or multi-unit).

South Africa is considering positioning itself as a leading manufacturer of NGS technologies. The country's Industrial Policy Action Plan (IPAP 2017/18-19/20) seeks to establish an NGS Cluster Development Programme. From an industrial perspective, this is seen as an opportunity for expanding the manufacturing, services, and supply of sanitation technologies (the dti, 2017).

This policy brief highlights the opportunities and constraints for NGS in the context of industrial development in South Africa. It considers the status of NGS technologies worldwide and the possible opportunity for South Africa. Then, it discusses demand-side dynamics, supply-side dynamics, and business model considerations. It ends by giving policy implications and the conclusion.

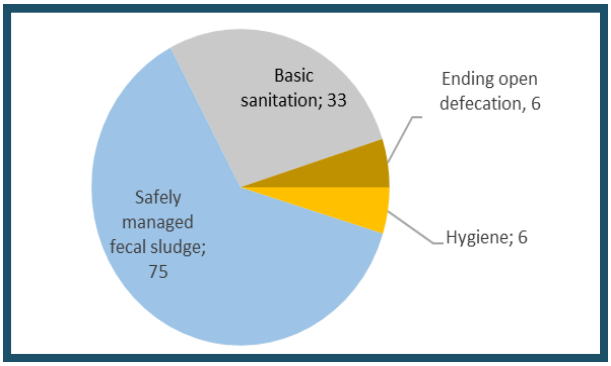
DEMAND-SIDE DYNAMICS: GLOBAL AND LOCAL MARKETS

While some improvements in access to sanitation services have been made across the world, progress has generally been slow.

The sanitation challenge is still huge; a significant number of people still do not have access to proper sanitation services. Globally, from 2015 to the 2030 target of the SDGs, about 1.1 billion people would need services to end open defecation (World Bank, 2016). At the same time, about 3.4 billion people would need access to basic sanitation services, and about 5.3 billion people would require safely managed sanitation services (i.e. safe extraction, conveyance, treatment and disposal of human excreta).

About US$120 billion would be required annually[1] to meet the 2030 SDG sanitation targets in the world (Figure 2). The greatest proportion of this (62%) would be to provide for safely managed faecal sludge, followed by basic sanitation (28%).

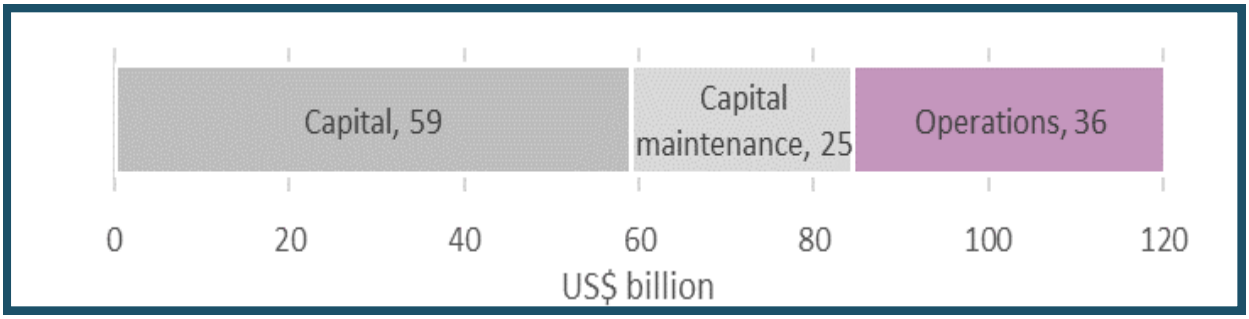
Figure 2: Annual cost (US$ billion) breakdown by sanitation need, from 2015-2030 to address sanitation issues in the world



Source: Author. Based on World Bank, 2016

[1] *These figures are estimates, the actual costs will depend on the technologies used, and the pace of the transition up the sanitation ladder. However, they give an indication of the strong need to invest in sanitation.*

Figure 3: Annual cost (US$ billion) breakdown by expenditure type to address global sanitation issues from 2015-2030



Source: Author. Based on World Bank, 2016

By expenditure type, capital expenditure accounts for half of the quantum (US$59 billion), followed by operations (US$36 billion), and capital maintenance (US$25 billion) (Figure 3).

South Africa has made remarkable progress in sanitation provision since the attainment of democracy. Most people have access to a flush toilet connected to a centralised sewerage system, as shown in Figure 4. However, this scenario of having the flush toilet as the most common type of toilet is not desirable as most parts of the country are water scarce. About 40% of water consumed by households in the country is used to flush toilets (Burger, 2015). Recently, attention towards the wider adoption of systems that use less or no water has increased, for instance through ecological sanitation (ecosan),[2] but this is still marginal and at an early stage (Figure 4).

Though great strides in improving access to sanitation have been made, there are notable backlogs especially in rural municipalities.

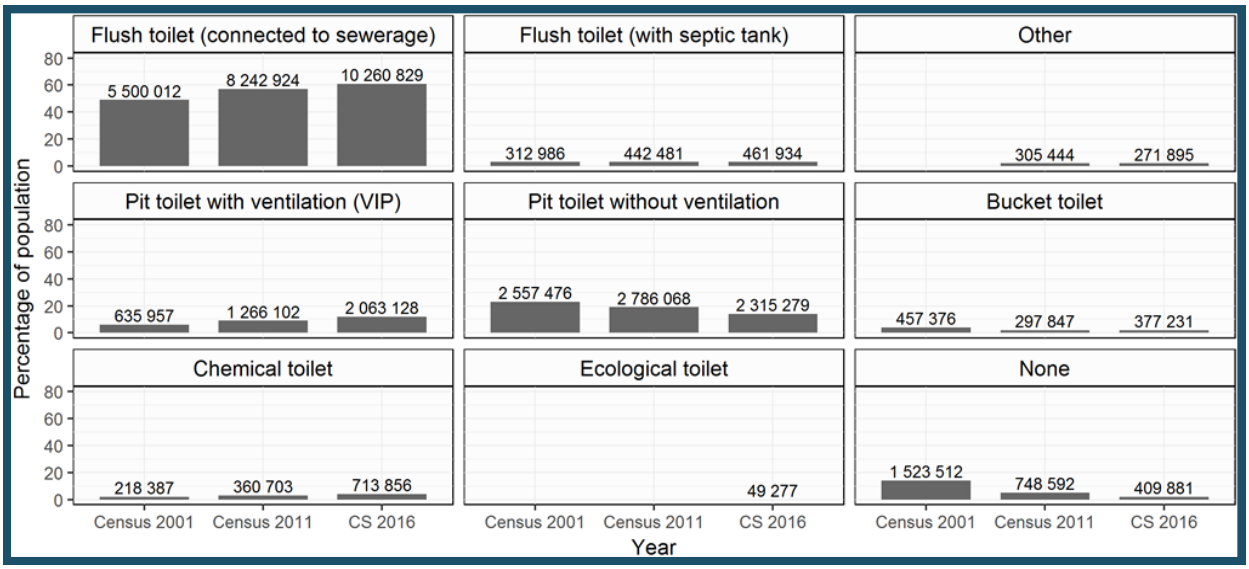
[2]*Ecological sanitation is a sanitation system that turns human excreta into a useful and valuable product, with low risk of environmental pollution and no threat to human health (Dunker and Matsebe, 2005).*

The challenges have historical origins, as black townships and rural areas were previously neglected. To improve access, the government provides free basic sanitation targeted at indigent (poor) households. In 2015, about 3.3 million households received free basic sanitation services while 4.6 million households received free basic water services (Stats SA, 2017).

A key challenge likely to derail progress is the risk of infrastructure failure. Most municipalities in the country lack the capacity to properly operate, maintain and manage assets. Many wastewater treatment plants (WWTPs) are not in good order. In 2014, about 474 out of the 824 WWTPs (58%) were in the high and critical risk categories (DWS, 2017).

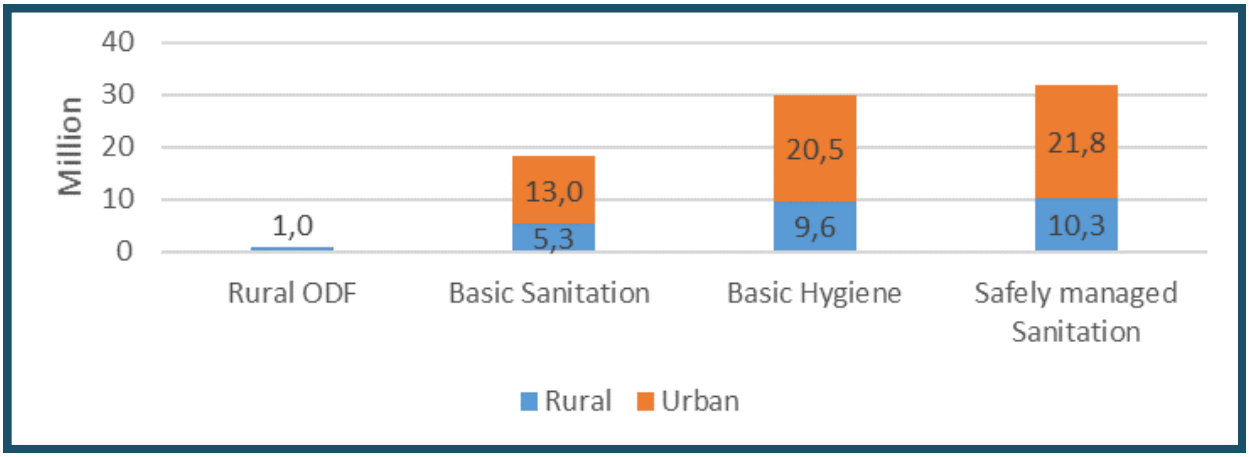
For South Africa to meet SDG targets on sanitation, about 32 million people would require safely managed sanitation services (i.e. safe extraction, conveyance, treatment and disposal of human excreta) from 2015 to 2030 (Figure 5, page 4). At the same time, 18.3 million people would require basic sanitation, while about 30.1 million would need access to basic hygiene services (handwashing station, soap and water at home). Close to one million people would also need services to end open defecation.

Figure 4: Percentage and number of households by toilet type in South Africa in 2001, 2011 and 2016



Source: Author. Based on Stats SA, 2016 p.68

Figure 5: Population to serve with new sanitation services from 2015 to 2030 in South Africa

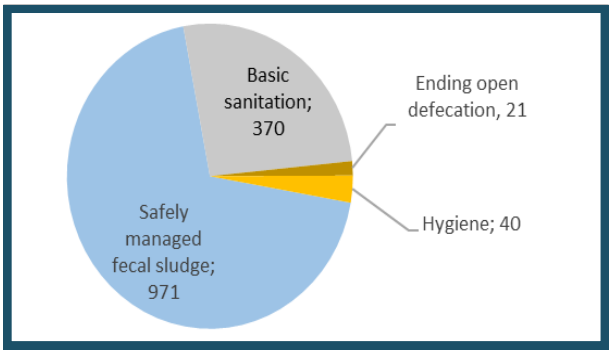


Source: Author. Based on World Bank, 2016

A total of about US$1.4 billion (R17.4 billion) would be required annually in South Africa to meet the 2030 SDG sanitation targets (Figure 6). The greatest proportion of this amount would be required for safely managed faecal sludge (69%), followed by basic sanitation (26%), hygiene services (3%), and eradicating open defecation (2%).

Splitting the US$1.4 billion by expenditure type (Figure 7), capital expenditure accounts for the lion's share (US$690 million), followed by operations (US$409 million), and capital maintenance (US$303 million).

Figure 6: Annual cost (US$ million) breakdown by sanitation need, from 2015-2030 to address sanitation issues in South Africa



Source: Author. Based on World Bank, 2016

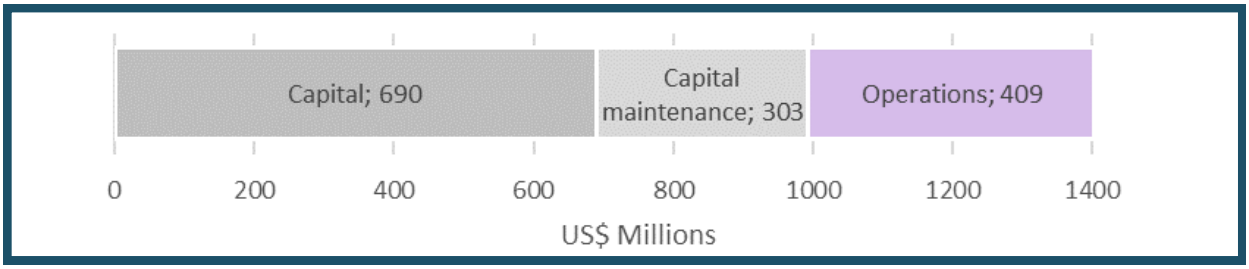
POTENTIAL FOR NEXT GENERATION SANITATION

In other studies, the global market for NGS has been estimated[3] at more than US$8 billion a year (Kone, 2017, citing the BCG analysis). While rural households constitute the largest market, growth in urban demand for sanitation, driven by growing rural-urban migration, is also expected. Africa is expected to gain about 25 million new urban dwellers a year, while Asia should gain about 35 million new urban residents a year through 2050 (BCG, 2014). So the potential market for NGS and the associated industrial development is relatively big. However, a number of factors will influence the demand and uptake of NGS.

The business model for NGS is anchored on two broad market segments (Figure 8, page 5). First, NGS has the potential to leapfrog those who currently do not have access to sanitation services (no or inadequate services). Second, NGS has the potential to be disruptive in the segment that have inappropriate sanitation services (e.g. waterborne sanitation in water scarce areas). About 40% of water used by households in the country is used just to flush toilets, thus the wider adoption of NGS will contribute to massive water savings.

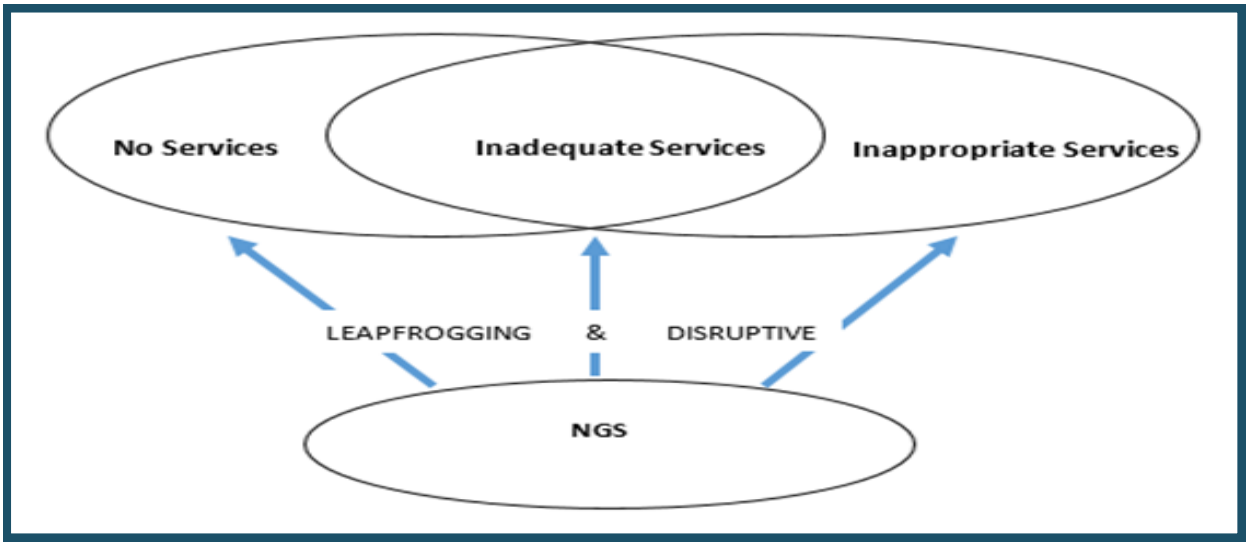
[3] *In this paper, the NGS market size could not be estimated as the author could not access information and data on costs of NGS technologies.*

Figure 7: Annual cost (US$ million breakdown by expenditure type, from 2015-2030 to address sanitation issues in South Africa



Source: Author. Based on World Bank, 2016

Figure 8: Potential for NGS



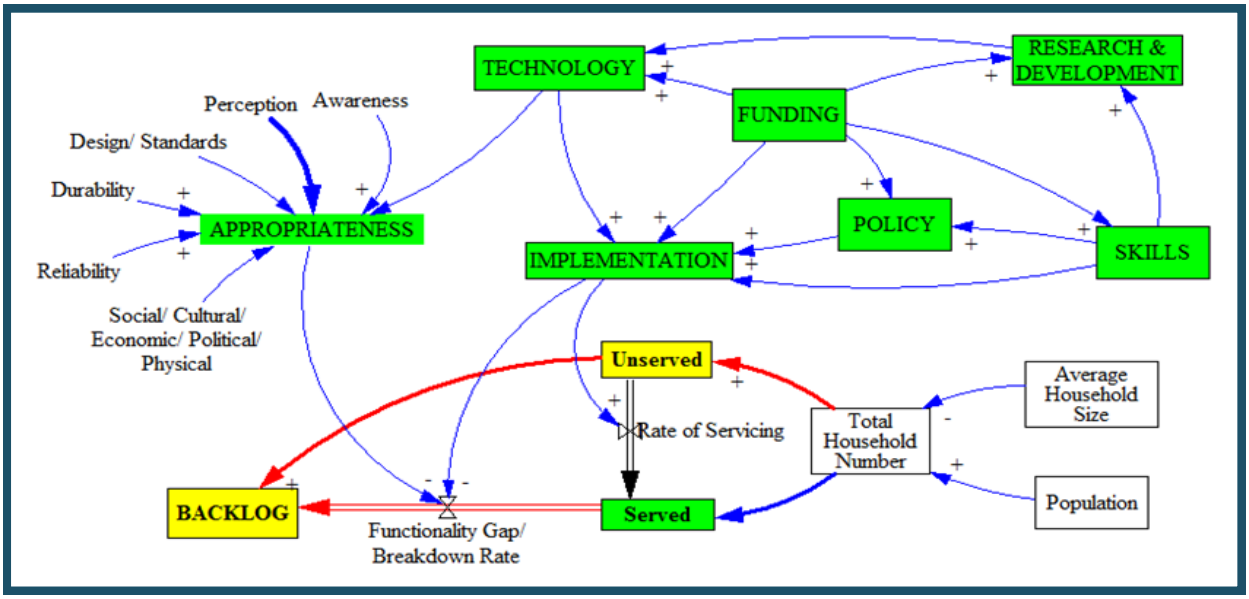
Source: Author

A key aspect of NGS is its potential to contribute towards a circular economy. NGS offers particular solutions compared to conventional technology. Benefits include waste beneficiation, improved water efficiency and supply, revenue generation, cost saving (as there is no need for conveyance), environmental sustainability, socio-economic development, food security, and being fit-for-purpose. Other drivers include enhancing water quality and energy security.

NGS has the potential to leapfrog Africa through provision of off-grid sanitation solutions. Most parts of the continent have the advantage of planning from scratch without the burden of retrofitting. In addition, the potential to develop an industry that integrates urine collection and fertiliser production exists. Considering that the African continent uses low amounts of fertiliser in agriculture (usage below world average), the wider adoption of technologies, such as NGS, that promote resource recovery and fertiliser production makes business sense. However, the knowledge and acceptance gap in embracing human faeces as a valuable resource is a key constraint.

Many factors influence sustainability in the sanitation sector and how NGS technologies would perform (Figure 9). Technology appropriateness is of central importance to wider adoption. Key issues to consider for a sanitation system are: safety, health, acceptability, environmental performance, reliability, sustainability, and reasonable cost (CSIR, 2003; Isidima, 2016; SuSanA, 2008). NGS technologies are mostly at the research and development (R&D) stage (Arbogast, 2017; Isidima, 2016), hence not yet proven. There are still a lot of unknowns about their performance and reliability, as well as their economic and financial viability. In addition, there might be challenges with implementation. Some of the technologies require special technical skills to manufacture, install, operate and maintain.

Figure 9: Conceptual systems view on the sanitation sector



Source: Author

User acceptance is central to the success of NGS. If potential users are not properly informed about the technologies, they might perceive them poorly which ultimately contributes to them rejecting the technology. To mitigate such as risk, enhancing awareness and providing education on the benefits of NGS is needed. It is also necessary to promote stakeholder engagement in the whole process to have buy-in.

Another crucial issue relates to the financing of NGS. Broadly, the South African government plays an important role in the water and sanitation space, especially through providing financial resources. While there has been a steady increase in the expenditure for water and sanitation by the government, from R10.5 billion in 2013/14 to R15.1 billion in 2017/18, and projected to reach about R17.5 billion in 2019/20 (NT, 2017), these funds remain inadequate considering the need to cover backlogs and provide new services.

Some households may not have the ability or not be willing to pay for services. In South Africa, the percentage of households that pay for municipal water services decreased from 62% in 2005 to 44% in 2015 (Stats SA, 2016a). In addition, in 2015, though household expenditure on water was about R15 billion, household expenditure on sanitation was far less, at about R1.5 billion. Against this backdrop, it will be a challenge to rollout NGS technologies, particularly at the household level, as many people might not be willing or able to pay for them.

An important feature in South Africa's household sanitation market is the distinction between indigent and non-indigent households, which also determines who pays for the services. Indigent households are deemed poor, hence they depend on the support from the government or other organisations, while the non-indigent have the capacity to pay for themselves. In this context, the government (including municipalities and state-owned enterprises) has a strong influence on the subsidised market (i.e. for indigent households) as well as in public sector projects, hence it can use public procurement and regulations to stimulate demand.

For instance, government can create a huge market through the construction of public houses and provision of sanitation services in schools. Recently (on 14 August 2018) the Sanitation Appropriate for Education (SAFE) programme was launched by President Cyril Ramaphosa. This seeks to provide innovative, safe ablution facilities at nearly 4 000 mostly rural and township schools that only have pit latrines or other inappropriate facilities (The Presidency, 2018). This is an important entry point for NGS as there was a call to implement appropriate sanitation-water-energy off-grid solutions.

There is a high-end market that can also be leveraged. For instance, large property developments, such as shopping malls, community centres and airports, can be designed or retrofitted to have off-grid sanitation systems. At such centres, it is easier to use less water and employ urine diversion for resource recovery at a large-scale.

It is important to highlight that the sanitation market is highly regulated. Technical barriers can arise as a result of municipal by-laws and building regulations that determine the type of technologies that can be installed. South Africa has national standards that guide the manufacture, construction and testing of some sanitation technologies, but the country does not have specific standards for the evaluation of onsite sanitation technologies (Isidima, 2016).

At the global level, milestones are being reached for sanitation guidelines and standards, which can have implications on NGS. This includes efforts to finalise the formulation of the ISO 30 500 standard for Non-Sewered Sanitation Systems (expected to be published in October 2018). This standard will promote the general safety and performance requirements for prefabricated integrated treatment units, comprising both front-end (toilet facility) and back-end (treatment facility), not attached to a sewer (ISO, 2017).

The South African Bureau of Standards (SABS) is part of the development of the standard (technical committee ISO/PC 305), which should help with the incorporation and localisation of the standard into the South African context. The process to localise the standard in South Africa has already started. SABS and the American National Standards Institute (ANSI) held a workshop on 14 August 2018 in Pretoria, to share information about ISO 30500, and discuss its implementation in the country.

NGS AS AN INDUSTRIAL DEVELOPMENT OPPORTUNITY FOR SOUTH AFRICA

South Africa has a history of sanitation innovation. For instance, the Sanitation Technology Demonstration Centre at the Council for Scientific and Industrial Research (CSIR) in Pretoria, showcases various sanitation technologies that were developed in the country.

There are also sanitation technology demonstration sites around eThekwini Municipality. Other key milestones include the rollout of the Sanitation Innovation Challenge programme as well as the development of the Household Sanitation Technology Assessment and Evaluation Protocol.

Table 1: Potential for NGS

Technology	Company
Unisex Urinal	Liquid Gold
UD with auger and pyrolysis	BAAS Technology & Consulting
Pour Flush	Partners in Development
Solar Toilet	Congretype Pty.Ltd
Toilet bowl coating	Coco Solution
Microflush toilet	Isidima Design and Development
Enhanced Hydrothermal Carbonisation	TruSense

Source: WRC and DST, 2018

Although South Africa has significant expertise in sanitation technologies, there is no notable manufacturing[4] of NGS technologies at present. However, there are various technologies that fit the NGS criteria, which are at various stages of development, testing, and commercialisation (Table 1). Many other technologies are highlighted in the Sanitation Innovation Challenge (SanIC) report (PRG, 2015). Of the 56 technologies reviewed, 16 were rated as promising. Although some of the technologies are not whole NGS systems, there is potential to combine and complement different front-end and back-end components to enhance localisation in the rollout of technologies.

At the global level, most of the technologies are being derived from research funded by the Bill & Melinda Gates Foundation (BMGF) through the Reinvent the Toilet Challenge (RTTC). Some of the leading NGS technologies were showcased at the 2014 Reinvent the Toilet Fair held in India. The majority of the technologies are developed by organisations based in the US, India and the UK.

There is an opportunity for South Africa to access NGS technologies under the global access policy of the BMGF. The BMGF has been seeking partners along the value chain to bring technologies to market (Kone, 2017). This can help establish local assembly, manufacturing, as well as commercialisation targeting distribution, logistics, maintenance and operation. Already, there are partnerships which the country can leverage.

This includes the partnership of BMGF with the Water Research Commission (WRC) and the Department of Science and Technology (DST). Also, the Pollution Research Group (PRG) of the University of KwaZulu-Natal is active in the BMGF's RTTC and has been selected as a testing and evaluation platform for NGS technologies developed in other participating countries.

[4]*Some prominent technologies in the country have generally been described as first-generation sanitation technologies.*

Most importantly, there are some activities being undertaken in the country that seek to enhance NGS. The second phase of the South African Sanitation Demonstration Programme – Accelerated Industrialisation Plan (SASTEP II AIP) led by DST will be launched soon.

This programme is crucial in the rollout of NGS technologies as it focuses on scaling-up the manufacturing and deployment of the technologies (WRC and DST, 2018). It intends to operationalise the IPAP strategy on NGS (the dti, 2017). Key activities under the programme will be scanning and selecting technologies, commercial partner matchmaking, and partnership development.

POLICY IMPLICATIONS

The rollout of NGS technologies remains marginal (globally and in South Africa), the technologies are mostly at R&D stage. This implies many unknowns regarding their performance, reliability, as well as their economic and financial viability. As of now, it is not yet possible to make a proper comparison with conventional sanitation technologies in terms of capital and operating costs, since the necessary information on prices and other variables is not yet available. However, NGS has the potential to leapfrog those who do not have access to sanitation services. At the same time, NGS has the potential to be disruptive in the segment that has inappropriate sanitation services. Thus, the wider adoption of NGS will contribute to massive water savings as well as grow the circular economy.

In general, the adoption and use of sanitation technologies tends to be significantly hampered by the lack of user acceptance and the overwhelming desire to use conventional flush toilets. Therefore, more effort is required to improve user awareness, positive perception, and acceptance of NGS technologies. There is need to transform how people view human excreta and sanitation processes, in particular the view that waterborne sanitation is the best solution, regardless of water availability.

Once appropriate technologies have been developed, tested and accepted, demand will have to be stimulated through local procurement as well as aligning building guidelines, norms and standards, and municipal bylaws. Standards for constructing new buildings (similar to existing regulations in energy efficiency) could be considered to spur the rollout of NGS in the country. There is need to enhance the development of standards, testing, and validation of NGS technologies. In this regard, efforts by SABS to localise the ISO 30 500 standard on Non-Sewered Sanitation Systems should be embraced and enhanced by all stakeholders including sanitation technology developers, building industry, regulators, and municipalities. It is necessary to ensure that such a standard does not limit local capability in innovation. Therefore, the Department of Trade and Industry (the dti) needs to play an important role in the designation (for local content) of the relevant technologies.

To realise significant adoption and enhanced functionality of the technology, the strengthening of skills and training on the installation, operation and maintenance of NGS technologies is needed, as some of the technologies might be more complicated than conventional sanitation technologies. This also relates to companies that will be involved in the manufacture of the technologies. They need to have the necessary skills, labour, and capacity to produce and deploy the technologies. This requires upskilling and reskilling of sanitation practitioners, planners, plumbers, technicians, and engineers.

NGS technologies are mostly at development stage, with few ready for the market. Thus, it is important to enhance local capacity, through increasing funding towards research, development and manufacturing of local NGS technologies, particularly to ensure that such technologies are suitable for the local context. In collaboration with the testing facility at the PRG, the development and localisation of NGS technologies would provide the platform to manufacture for the country and beyond.

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