GreenCape

Community focus group session held in TR Section by CORC, as part of this project.
Source: CORC 2021

Opportunities for container-based sanitation in Cape Town

1 Main Insights

a. The number of people living in informal settlements in Cape Town is expected to increase, with estimations that 53% of all new households over the next 20 years will be informal[1].

b. The demand for improved sanitation will continue to grow in the city, providing opportunities for container-based sanitation (CBS) solution providers, to help meet this demand.

c. The City of Cape Town's (CCT) Water and Sanitation (W&S) Directorate prioritises the installation of full-flush toilets. Where this is not possible, they provide a range of non-sewered sanitation options including chemical toilets, as well as two CBS options: portable flush toilets (PFTs) and container toilets.

d. The CCT appoints service providers to supply, deliver and service these toilets, via contracts valued at an estimated R120 million per year (for PFT and container toilets) and ~R115 million per year (for chemical toilets).

e. As CBS is a relatively new approach to sanitation, GreenCape undertook community focus group sessions to better understand the experience of using the PFTs and container toilets, and how it can be improved. In general, the communities appreciate and accept both options, when full-flush toilets are not available. The PFTs, which are provided to individual households, are considered to be safe alternatives to using shared toilets, especially at night, and are transportable and easy to use, including for disabled people.

f. There are, however, a number of opportunities to improve on the design and servicing of these CBS solutions, that were raised in the focus group sessions.

g. At present the excreta from the PFTs and container toilets is taken to a centralised wastewater treatment works, however in future there may be opportunities for solution providers to beneficiate the excreta into valuable products.

The lower tank (container) of the portable flush toilet provided by the City of Cape Town
Source: GreenCape

What is container-based sanitation?

Container-based sanitation (CBS) is a sanitation system that consists of an end-to-end service in which toilets collect excreta in sealable, removable containers (also called cartridges). The containers are regularly collected and transported to treatment facilities when full.

Internationally, there are examples where CBS has been used to provide safe, reliable, widely accepted, rapidly deployed, circular economy sanitation solutions for dense urban informal settlements.

CBS is a relatively new approach to sanitation (~10 years old), and in 2019 was formally recognised as "improved sanitation" — and household-level CBS models as "safely managed" — by the Joint Monitoring Programme (JMP) for Water Supply and Sanitation, the official UN body for monitoring progress toward the sanitation Sustainable Development Goal.

For more information, consult the World Bank's report on **Evaluating the Potential of Container-Based Sanitation** or visit the Container Based Sanitation Alliance **website**.

[1] *City of Cape Town's Water Services Development Plan 2022/23- 2026/27, 2040 Planning Scenario*

2 Purpose

This industry brief is written for sanitation solution providers that are interested in the container-based sanitation market in Cape Town. The brief highlights relevant information on the market, including:

- An overview of the current CBS market in Cape Town
- Community feedback on the current CBS options
- Opportunities for CBS in Cape Town
- Contracting with the City of Cape Town
- Next Steps

Container toilet
Source: GreenCape

3 Overview of the current CBS market in Cape Town

The City of Cape Town is estimated to have around 276 000 households[2] living in ~600 informal settlement pockets (see **Figure 1**). This number is set to grow, with estimates projecting that 53% of all new households over the next 20 years are likely to be informal[3]. The number of households living in informal settlements could therefore reach almost 900 000 by 2040[4].

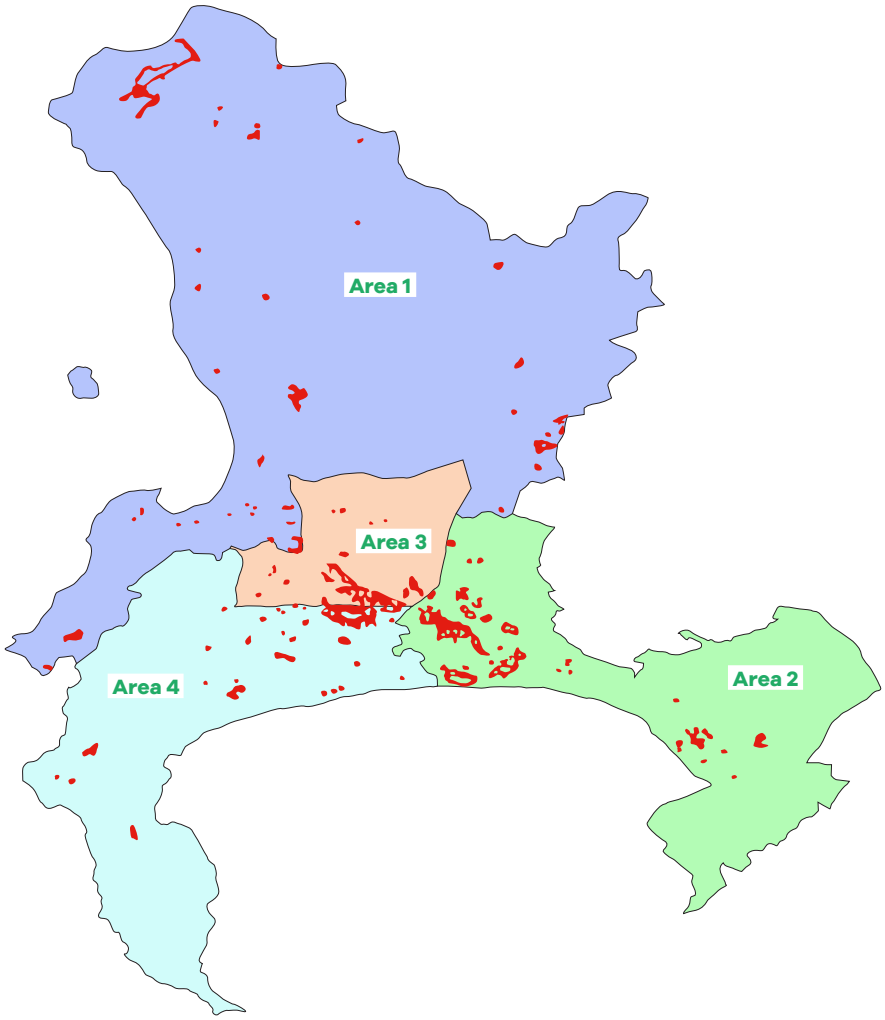

Figure1: Location of informal settlements in the City of Cape Town (shown in red)

[2] *2021/22 Medium Term Revenue Expenditure Framework*
[3] *City of Cape Town's Water Services Development Plan 2022/23- 2026/27, 2040 Planning Scenario*
[4] *Assuming an average annual growth rate of 3.2% of total households in Cape Town (based on growth rate between the 2001 and 2011 national census)*

Community focus group session held in BM Section by CORC, as part of this project.
Source: CORC 2021

Community focus group session held in BM Section by CORC, as part of this project.
Source: CORC 2021

The CCT's W&S Directorate currently provides a range of sanitation solutions to these informal settlements, including full flush, chemical, container and portable flush toilets, as shown in **Figure 2**.

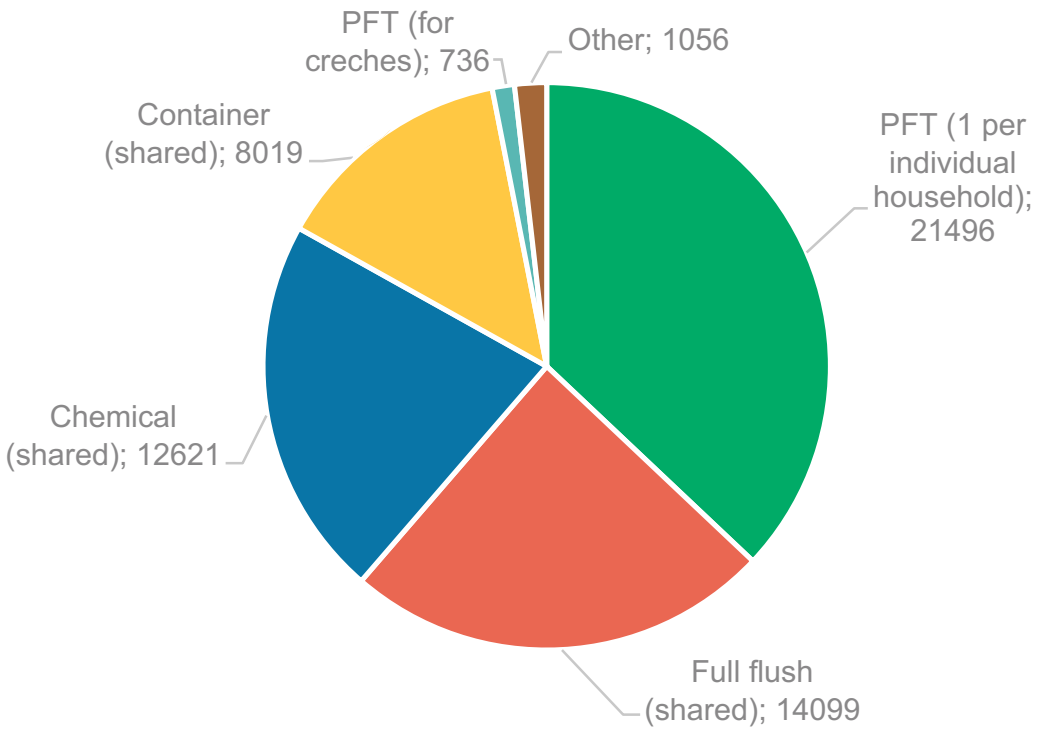

Figure 2: No. of sanitation service points provided by the City of Cape Town to informal settlements in Cape Town, based on the June 2021 Asset Register[5]

The installation of full flush toilets is generally prioritised. However, dense urban informal settlements pose a number of challenges to the roll out of full-flush sewered sanitation solutions, including difficult access, lack of land tenure or space to build sanitation solutions, challenging physical and topographical conditions (such as rocky soil, closeness to water bodies, and high-water tables) or a lack of water supply and/or regular exposure to flooding.

Where it is not possible to provide full flush toilets, the CCT offers non-sewered sanitation solutions, including chemical toilets, as well as two CBS options: portable flush toilets and container toilets. Further information on these two types of CBS toilets is provided in sections 4 & 5.

4 Portable flush toilets (PFTs)

The PFTs currently offered by the CCT are lightweight, plastic toilets that can be hand-carried by one person and can be used inside homes. They are issued to individual households for their private use (i.e. these toilets are not shared between multiple households). The toilets are imported and consist of two sections (see **Figure 3**):

- the upper tank, which includes the toilet seat and cover, upper tank (which can be filled with up to 15 litres of fresh water for flushing), and a hand pump (for flushing the water from the upper tank into the lower tank, to move the excreta into the lower tank).
- The lower tank is where the excreta (a mixture of urine and faeces) is stored, and includes a valve that can be opened to allow the excreta to be flushed into the lower tank during use, and can be closed when not in use, to reduce odours and spills. The lower tank also has an opening (that can be sealed with a cap), that is used to empty and clean the tank.

The total dimensions of the PFT are approximately 430mm (length) x 360mm (width) x 390mm (height) with an (empty) weight of 4.6 kg.

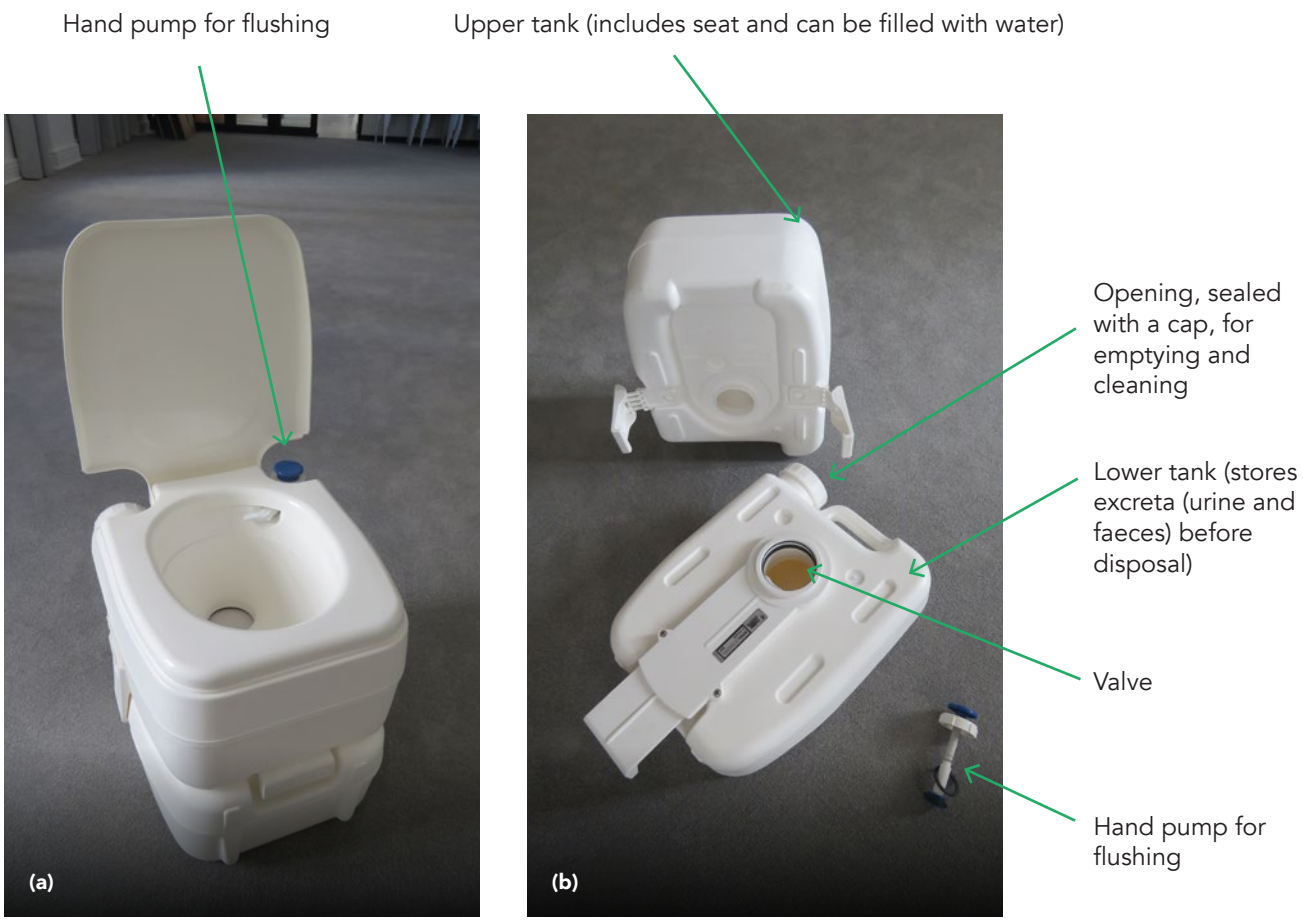

Figure 3: A portable flush toilet showing (a) full assembly and (b) components.
Source: GreenCape

[4]*These figures exclude sanitation service points provided to non-settlements, which totalled ~1,250*

There are approximately 22 000 PFTs in use in ~70 informal settlements across the city. The CCT has a 36-month contract with a service provider for the supply and delivery of these PFT units, which comes to an end on 30 June 2023 and is valued at ~R10 million per year[6].

There is also a separate 36-month contract with two service providers for the servicing of the PFTs (i.e. the collection, emptying, cleaning and returning of the lower tanks). The 36-month contract, valued at ~R55 million per year[7], comes to an end on 30 June 2022.

The service providers are contracted to service the lower tanks a minimum of three times per week. The tanks are collected from the individual homes at scheduled times and are taken to a designated collection point within the community. From there they are taken to Borcherds Quarry Wastewater Treatment Works (WWTW), where there is an automated Faecal Sludge Management Facility to empty, clean and disinfect the tanks (the facility is not yet fully operational but, at the time of writing, the CCT was in the process of appointing an O&M service provider to optimise, commission and operate the facility). The excreta is then treated in the WWTW, together with the sewered wastewater that enters the plant. The cleaned tanks are then recharged with 2 litres of a chemical that is capable of disinfecting, controlling odours and cleaning the tanks. The recharged tanks are then returned to the collection point, from where they are then returned to the households. Each household is issued with 2 lower tanks, so that while one tank is being emptied and cleaned, the other can be used by the households, connected to the upper tank.

Container toilet in situ
Source: City of Cape Town

Container toilet showing the upper toilet seat and cover and the lower polyethylene container
Source: GreenCape

5 Container toilets

The container toilets currently offered by the CCT are plastic toilets that are housed within precast concrete structures and are shared between multiple households. The CCT aims to provide at least one container toilet per five households. As shown on the left, the plastic toilets include a toilet seat and cover, as well as a 100 litre polyethylene container (tank), where the excreta (a mixture of urine and faeces) is stored.

The total dimensions of the plastic toilet are approximately 560mm (length, at its longest) x 675mm (width, excluding handles) x 425mm (height, including seat).

There are approximately 8 000 container toilets installed in ~48 informal settlements across the city. The CCT has a 36-month contract with a service provider for the supply, delivery and placement of the precast concrete toilet structures and the plastic container toilets units, which comes to an end on 30 June 2024.

There is also a separate 36-month contract with two service providers for the servicing and management of the container toilets (i.e. the collection, emptying, cleaning and returning of the excreta tanks). The 36-month contract, valued at ~R50 million per year, comes to an end on 30 June 2024.

The service providers are contracted to service the tanks a minimum of three times per week. During servicing, the dirty tanks are collected and replaced with clean tanks. The dirty tanks are transported to Borcherds Quarry WWTW where there is an automated Faecal Sludge Management Facility to empty, clean and disinfect the tanks (not yet fully operational, as explained above). The excreta is then treated in the WWTW, together with the sewered wastewater that enters the plant. The cleaned tanks are recharged with 20 litres of a chemical that is capable of disinfecting, controlling odours and cleaning the tanks. At the next service, the clean tanks are returned, replacing the dirty tanks. The service providers are also responsible for the daily cleaning of the top structures, including cleaning the interior, toilet seats etc. The CCT requires that the service providers source all unskilled labour from the local community.

Within informal settlements in Cape Town, container toilets are often referred to as 'bucket toilets', even though container-based sanitation is a safe and hygienic upgrade of the historical bucket toilet system.

[6] *Based on the published contract value of R30 million over 3 years.*
[7] *Based on the published contract value of R166 million over 3 years*

Community focus group session held in TR Section by CORC, as part of this project.
Source: CORC 2021

6 Community feedback on current CBS options

As part of a project funded by the CCT, GreenCape appointed a service provider (Community Organisation Resource Centre - CORC) to undertake four focus group sessions with community members from informal settlements. The objective of these sessions was to gain a better understanding of their experience of using the PFTs and container toilets, and how it can be improved. The sessions took place in November 2021 in the following informal settlement pockets in Cape Town: Kosovo (Philippi), BM Section (Khayelitsha), TR Section (Khayelitsha) and Marikana (Philippi).

The focus group sessions highlighted the following key insights:

Acceptance

- In general, there was an appreciation for, and an acceptance of, CBS when full-flush toilets are not available. The PFTs, which are provided to individual households, are considered to be safe alternatives to using shared toilets, especially at night, and are transportable and are easy to use, including for disabled people. There were, however, a number of servicing and design concerns raised by the participants.

Servicing

- The PFTs, which have an excreta storage capacity of 20-22 litres, need to be emptied at least three times per week to ensure they do not leak or exceed capacity. The container toilets, which are shared between households and have a capacity of 100 litres, also need to be emptied at least three times per week.
- The toilets also need to be cleaned regularly, and the cleaning products need to be safe and not pose any health risks to the toilet users.
- The collection and emptying of the full PFT containers needs to be managed such that the containers are not stored at local collection points for too long, as this increases the risk of damage due to exposure to sunlight (which causes leaks), or results in unpleasant odours or health hazards to the neighbouring community.
- It is important that containers are returned clean after emptying and that adequate chemical disinfectant is added to reduce the risk of unpleasant odours and flies. If insufficient chemical is added, the households have to use their own limited funds to buy products to add to the toilet to reduce odours (e.g. bleach, washing liquid).
- It is also important that service providers keep to a reliable schedule for the cleaning and emptying of the toilets each week. This enables the communities to ensure that the toilets are unlocked or available at the right times, and also reduces the risk of full containers being left at collection points for too long.
- The community should have access to easy and affordable reporting channels that allow individuals to lodge complaints when they are dissatisfied with the service, or report faulty toilets, with prompt response times.

Design

- Both the PFTs and the container toilets need to be more robust and durable to accommodate heavier people and to reduce the risks of cracking, breakages and leakages. This includes components such as the lids, seats, containers and moving parts (e.g. the PFT's release lever or flush button). It was also mentioned that the PFTs stain, discolour or get dirty easily, and are not desirable to use after 3-6 months.
- When full, the PFTs tend to leak or smell, therefore either the container needs to be larger or the PFTs need to be more robust.
- Child safety is important to take into consideration in the design of any container-based sanitation solutions.
- It was suggested that the toilet seats could be made wider to accommodate larger people, but it was acknowledged this needed to be weighed up against child safety risks.
- Some participants indicated a preference for the PFT to have a wider opening in the bowl to make it easier for the excreta to enter the bottom container and limit mess.
- Some participants also expressed a preference for the container toilet to include a flap or mechanism that prevents the user from seeing the contents of the container (excreta) before and after use.
- The full PFT containers are taken to Borcherds Quarry WWTW, where they are emptied and cleaned via a small opening (that can be sealed with a lid). It was suggested that this opening is widened to facilitate the cleaning and emptying processes.

Other

- Shared container toilets need to be located close enough to the households, to minimise safety risks, especially at night. Street lighting should also be provided close to the toilets.
- One of the focus group sessions took place in a community that did not have PFTs, as they had previously rejected them. They were not aware that the PFT design had changed, and the participants expressed an eagerness to find out more about how they can be issued with the newer PFT model. As the CCT offers the PFTs on a request basis (communities request PFTs via their councillors), it is likely that a number of communities in informal settlements are not fully unaware of what PFTs are, and that they are available to them, if requested.

Container-based sanitation provides an opportunity to address much needed sanitation needs in informal settlements.
Source: City of Cape Town

7 Opportunities for CBS in Cape Town

The growing number of households living within informal settlements is driving the demand for sanitation solutions in Cape Town. The current market size for non-sewered sanitation for the CCT's informal settlements is estimated to be **~R120 million per year** (for PFTs and container toilets) and **~R115 million per year** (for chemical toilets), based on the CCT's current contracts with service providers for the supply, delivery and servicing of these toilets. The current PFT and container toilet contracts offer the following opportunities for CBS solutions providers:

- Supplying and delivering PFT and container toilet hardware, including the toilets and top structures
- Servicing and managing the PFTs and container toilets (e.g. collecting, transporting, empting, cleaning and returning the tanks)
- Plumbing installations and related maintenance and repairs of communal toilets

Beneficiation opportunities

At present, the excreta from the PFTs and container toilets is taken to Borcherds Quarry WWTW for treatment. However, in future there may be opportunities to beneficiate it into valuable products, particularly if urine diversion toilets are used in the future (the City's current CBS toilets do not incorporate urine diversion - faeces and urine are captured together). This would create opportunities for investment in local beneficiation and manufacturing facilities.

Internationally, there are several examples of successful CBS solutions providers that are able to lower the overall cost of their service by generating additional revenue from the sale of beneficiated products. These organisations include Loowatt (Madagascar and Philippines), Sanergy (Kenya), Sanima (Peru), Sanivation (Kenya) and SOIL (Haiti), which convert the collected faeces into fertilizers, compost, animal feed or solid fuel briquettes.

At the time of publication, the primary sludge from Borcherds Quarry WWTW is being dewatered and, according to the CCT's service level agreement, is sent to landfill. The waste activated sludge is applied to land. However, there are some **established** facilities that are able to beneficiate sludge in and around the CCT, as well as some **emerging** options. Despite the CBS waste currently being treated with the CCT's wastewater, internationally more opportunities for beneficiation of the CBS waste arises if it is diverted prior to the WWTW. This is because the CBS waste is only domestic waste with a lower risk of contamination, while the WWTW also receives industrial wastewater that can be high in heavy metals and reduce the number of available sludge beneficiation opportunities[8]. CBS waste is also well-suited to being co-beneficiated with other organic wastes (such as garden greens etc.).

The established facilities in Cape Town that are able to beneficiate sludge, are all associated with agricultural products such as soil enhancers, fertilizers, ground remediation products, backfill for construction, and liquid fertilizer and compost for farming.

The established facilities include:

- Composters: there are many composters in and around the CCT and varying in scale and process type. However, at the date of publication, there is only one site with a Waste License that allows for the handling of hazardous wastes, including the CBS' un-stabilised sanitation waste.
- Urea liquid fertilizer manufacturers: this type of fertilizer is popular internationally, and a local start-up is looking for additional sources of urine from urine separation toilets to convert into this sterilised fertilizer.

There are also a number of emerging options for the beneficiation of CBS waste in Cape Town, which typically are either in the direction of energy production (e.g. biogas, syngas, briquettes, biomass for fuel or electricity) or nutrient recovery (compost, fertilizer, soil enhancers, nutrient extraction and purification) and include:

- **Black soldier fly (BSF) larvae farming:** Defined as the valorisation of organic waste through the act of larval feeding of the black soldier fly, Hermetia illucens. It provides waste reduction and stabilisation while producing a product in the last larval stage, the so-called pre-pupae. The high protein and fat content of the product allows for multiple uses, including animal feeds and fuel production. A study conducted by the University of Stellenbosch[9] found that BSF grown on human waste can successfully be used as a protein source in broiler and egg layer diets. A nutrient rich waste slurry, also known as frass, is also produced and is readily used in organic fertilizers internationally. While no commercial scale black soldier fly waste processing facilities have been established in or around Cape Town yet, there is a growing interest, with trials and pilot facilities in progress, an established business for the export of fly larvae to seed plants, and the recent establishment of an industry association, namely the Southern African Mass Insect Rearing Organisation (SAMIRO).
- **Briquettes:** The manufacture of fuel briquettes through the partial combustion of organic wastes is a well-established process internationally, however, there are no known facilities in South Africa. For example, in Kenya, CBS companies convert the faecal waste or frass into fuel briquettes that can be used in wood-fired industrial boilers. In the Western Cape, all large industrial boilers are coal-fired. There may be an opportunity for industries to switch from coal to sanitation briquettes, but this is dependent on various factors including fuel costs, scale of production, briquette size and quality. Testing and analysis is needed to determine if this is a viable circular economy solution in Cape Town.
- **Pyrolysis:** A thermochemical decomposition of organic material at elevated temperatures (>450°C) in the absence of oxygen into carbon monoxide, hydrogen and carbon dioxide (synthesis gas or syngas). The syngas can be burned to produce electricity or further processed to manufacture chemicals, fertilizers, liquid fuels, substitute natural gas (SNG), or hydrogen. The remaining solids include bio-char, which is a carbon-rich form of charcoal used in composts, fertilizers and soil enhancers; to produce coatings, bioplastics, paints and thermal conductive fillers; remove contaminants from water as activated carbon; as a fuel; or as a catalyst for the production of hydrogen from biogas.

Biotechnology companies in Cape Town involved in BSF farming include **Inseco** and **Maltento**.

Black soldier fly larvae
© Agriprotein

These emerging beneficiation solutions are largely being driven by a number of regulatory changes, most notably:

- **Liquid waste landfill ban (2019):** As of August 2019, the nationwide ban of liquid[10] waste disposal to landfill came into effect as required by the Norms and standards for disposal of waste to landfill (Notice R 636 of Government Gazette No. 36784, 23 August 2013).
- **Organic waste landfill restrictions (2027):** Objective 3 of Goal 3 of the Western Cape Integrated Waste Management Plan (DEADP, 2018), sets waste landfill diversion targets for organic waste. All Western Cape based municipalities, including the CCT, are required to reduce the landfilling of organics by 50% by 2022, and 100% by 2027.

Other existing regulations, however, are delaying the uptake of beneficiating sanitation wastes. Most notably, the Environmental Impact Assessment process required to obtain a Waste License for processing sanitation wastes (considered hazardous if not stabilised). This process takes at least 1.5 years and requires numerous specialist studies that can accrue to millions of Rands. Fortunately, the DFFE have recently promulgated Norms and Standards for the Organic Waste Treatment (GN1984 of 2022)[11]. These Norms and Standards set minimum requirements for a wide range of organic waste treatment activities processing more than 10 tonnes per day[12]. This red tape reduction regulation subsequently replaces the need for undertaking a highly onerous, time consuming and costly Waste Management License process, which includes undertaking an associated Environmental Impact Assessment. One of these requirements is that applicable activities must register activities with the relevant provincial waste authorities (in the case of the Western Cape this is the DEADP). These Norms and Standards should be seen a progressive and reduce regulatory barriers for organic waste beneficiation.

GreenCape has also published an industry brief on **'Circular economy solutions for primary, waste activated and digested wastewater sludge'** in Cape Town, for solutions providers interested in this market.

8 Contracting with the City of Cape Town

The CCT is mandated to provide water and sanitation services to its constituents and, as a public sector body, is required to follow strict procurement protocols, including those outlined in the Municipal Finance Management Act (MFMA). Projects (including pilot projects) exceeding R200 000 in value typically need to follow a competitive bidding (tender) process, and are advertised on the City's Tender Portal. For more information on how to enter the public water sector market, please consult GreenCape's **industry brief** on the topic.

9 Next Steps

CBS is an emerging approach to sanitation that can help address the growing demand for improved sanitation in Cape Town. There are opportunities for local manufacturers, suppliers and service providers to further improve on the solutions already offered within the CCT. Internationally, there are examples where the beneficiation of the excreta has unlocked revenue opportunities, lowering costs and diverting waste from landfill. In Cape Town, these opportunities may emerge in the future.

For further information and support on any of the content provided here, please contact GreenCape's water sector desk: **water@greencape.co.za**

[8] *If a chemical is added to the containers after cleaning (as is currently done in Cape Town) tests should be conducted to ensure it does not interfere with the beneficiation processes.*

[9] *A van Schoor (2017), The assessment of black soldier fly (Hermetia illucens) pre-pupae,grown on human faecal waste, as a protein source in broiler and layer diets, MSc (Agriculture) Thesis*

[10] *As defined by Section 5.1.q of Notice R 636 of Government Gazette No. 36784, 23 August 2013*

[11] *This range is applicable to most types of organic waste treatment, but for the processing of animal matter, these Norms and Standards apply to facilities processing over 1 tonne per day, and for thermal treatments, it is applicable to facilities processing over 10 kg per day. These are the Draft Norms and Standards, awaiting finalisation and promulgation at the time of publication.*

[11] *https://www.dffe.gov.za/sites/default/files/gazetted_notices/nemwa_organicwastetreatmentnormsstandards_g46169gon1984.pdf*

[12] *These norms and standards do not apply to any organic waste treatment facility treating: any infectious animal waste, raw sewage, or sewage sludge that does not meeting minimum quality standards as regulated under the national norms and standards for domestic water and sanitation services (GN982 of 2017)*

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This brief was made possible thanks to the generous support of the City of Cape Town.