SCALING PATHWAYS FOR SANITATION BUSINESS MODELS

A compilation of insights, milestones, benchmarks and data points along the journey of building impact-oriented sanitation enterprises

SHF
The Sanitation & Hygiene Fund

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Foreword

Sanitation enterprises play a vital role in achieving SDG 6 and improving environmental, health, and social outcomes. A range of promising business models address critical service gaps across the sanitation value chain - including container-based sanitation, safe emptying and transport, on-site wastewater treatment, and various resource reuse solutions.

Yet, despite its urgency and potential, sanitation remains an underdog in the entrepreneurial world: underfunded, undervalued, and often overlooked. Building strong and sustainable sanitation businesses is challenging. Only a few have scaled into large operations, while many micro, small and medium-sized enterprises continue to face significant growth barriers and have yet to identify clear paths to expansion.

To deliver impact at scale, sanitation enterprises require targeted support throughout their development - from early validation to growth and expansion. But what should these businesses aim for at each stage? Which KPIs matter most for different models? What targets for impact and commercial success are realistic? What types of financing are needed, and when?

This document introduces a set of Scaling Pathways for key sanitation business models relevant to the East and West African context. The Pathways outline key factors that influence success, typical milestones, financing needs, and strategic priorities across various stages of maturity. They are grounded in literature reviews, workshops, and interviews with entrepreneurs, sector experts, financiers and support organizations, as well as insights from Cewas' decade-long experience supporting sanitation businesses.

Disclaimer

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Abbreviations

AD - Anaerobic Digestion
BOD - Biochemical Oxygen Demand
BM - Business Model
BSF - Black Soldier Flies
CapEx - Capital expenditure
CBS - Container-Based Sanitation
CHP - Combined Heat and Power
CO2eq - Carbon dioxide equivalent
COD - Chemical Oxygen Demand
CRM - Customer relationship management
CSR - Corporate social responsibility
DEWATS - Decentralized Wastewater Treatment System
ERP - Enterprise resource planning
EBIT - Earnings Before Interest and Taxes
EBITA - Earnings Before Interest, Taxes, and Amortization
FSM - Faecal Sludge Management
FSTP - Faecal Sludge Treatment Plant
GHG - Green house gases
HH - Household
IoT - Internet of Things
KPI - Key performance indicator
MFI - Micro finance institution
OpEx - Operational expenditure
O&M - Operation and maintenance
PPP - Public Private Partnership
RBF - Results-based finance
RoI - Return on investment
RoA - Return on asset(s)
R&D - Research and development
SDG(s) - Sustainable development goal(s)
SOP - Standard Operating Procedure
TSS – Total Suspended Solids

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Scaling Pathways

In 2013, Guy Hutton estimated that every dollar invested in sanitation generates $5.50 in benefits. Additional assessments, including those by the Sanitation and Hygiene Fund (SHF), highlight a sanitation market worth billions in Kenya, Uganda, and beyond. Yet, despite this potential, the sector remains dominated by micro-businesses and small SMEs, with no fully proven, scalable sanitation business models to date.

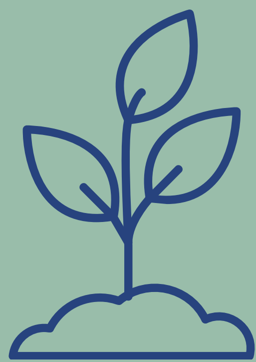
Nevertheless, pioneering sanitation enterprises have made significant strides toward scalable, sustainable solutions. This publication analyzes and compiles insights from leading sanitation SMEs, mapping business models across the sanitation value chain. We examine high-potential models that integrate multiple segments of the value chain, identify key performance indicators (KPIs) and benchmarks, and outline the typical stages of enterprise growth.

The result is four Sanitation Scaling Pathways: practical guides for enterprises seeking to scale, and for pioneering funders and impact investors interested in developing sanitation markets. While these Pathways help simplify the complex process of building sanitation businesses, long-term success depends on adapting models to local contexts. We encourage users to tailor strategies to the specific challenges and opportunities of their markets.

Benefits

The Scaling Pathways compile available experiences, insights and data into fundamental sanitation business models in developing markets. They provide guidance that helps maximising impact through sanitation entrepreneurship by:

- Building a thorough **understanding** of **different** sanitation **business models** and their prospects
- Specifying **KPIs, milestones and strategies** to create impact through viable business models
- Guiding **enterprise mapping and due diligence** with a clear enterprise typology and tailored criteria
- Determining **opportunities and risks** based on success factors, requirements and potential barriers
- Facilitating the **comparison** of investment options, portfolio choices and types of investments
- Identifying **barriers** and options to **improve the enabling environment** for specific business models to thrive



We hope that the pathways outlined in this publication provide both entrepreneurs and impact(-first) investors who seek to solve the sanitation crisis with relevant insights into a very specific niche sector.

The User Journey

The 'Scaling Pathways' can be used by foundations, philanthropic and impact-first investors and donor agencies promoting market-based approaches in WASH and intermediaries, who seek to:

01 Objectives

Establish specific objectives and suitable impact and return options, based on an **overview of impact models** as well as **scaling pathways** and **timelines**.

02 Entry Points

Identify a portfolio of suitable business models by **matching prospects** of the respective models **with investor needs**.

03 Investment Options

Understand success factors and financing characteristics, using **data-based benchmarks** to **analyze** investment **options**.

04 Operationalize

Analyze markets and the investment pipeline, with an overview of **requirements**, **success factors** and **stages of enterprise development** for different business models.

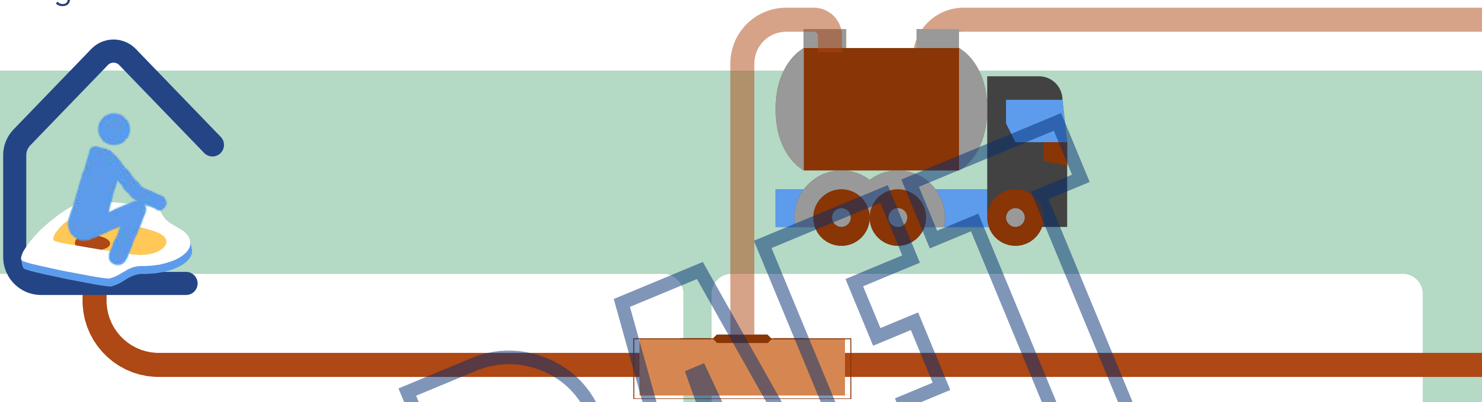
05 Investment Support

Inform due diligence, post-investment monitoring and technical support, based on **business model-specific KPIs**, benchmarks, **milestones** and timelines.

Fundamentals of Sanitation Business Models

Sanitation business models are inherently complex, often spanning multiple stages of the sanitation value chain. This makes them difficult to categorize neatly. However, each stage (from containment, through emptying and conveyance, to treatment and reuse) presents distinct challenges and success factors that influence the viability and scalability of sanitation enterprises.

The following sections outline key fundamentals to consider for business models operating at different stages of the sanitation value chain.



CONTAINMENT

The key distinction in containment-stage business models is whether **toilets are sold as a product or offered as a service**.

Solutions serve households, compounds, or communal facilities, with differing payer-beneficiary dynamics: for example, tenants benefit, but landlords may be the ones paying.

A fundamental **trade-off** exists **between storage** volume and **emptying frequency**, impacting CapEx and OpEx.

Toilets sold as products are typically built by artisans operating as micro-businesses. **Manufacturers** of components such as squatting pans and vent pipes, along with **micro-finance** institutions, play crucial roles in this **value chain**. In many cases, development programs have sought to stimulate demand for toilet construction through targeted subsidies. However, true scalability is generally limited to the product manufacturing segment.

Service-based models, such as container-based sanitation, offer greater potential for scalability. These models **reduce upfront costs** and rely on efficient service logistics to remain competitive.

EMPTYING & CONVEYANCE

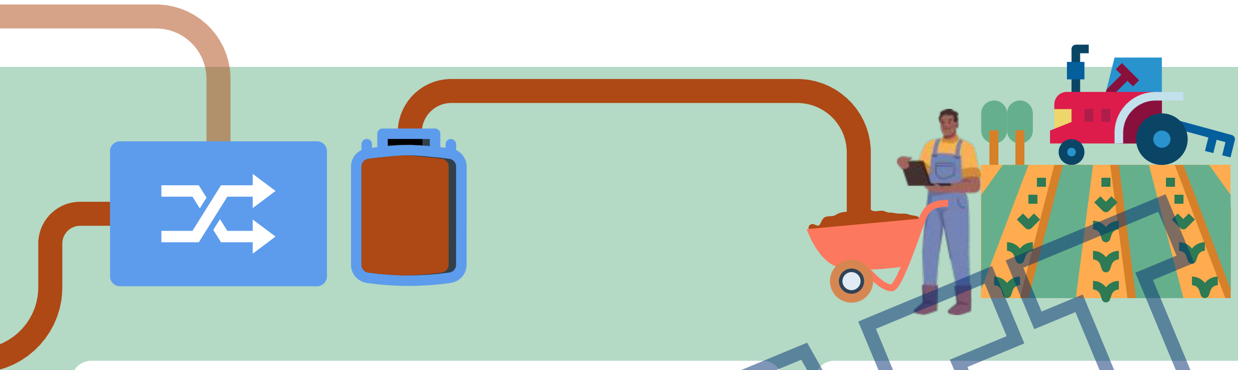
With piped conveyance largely managed by public utilities, business models in this space focus on **emptying, container replacement and road-based transportation**, making **logistics** the core element.

Emptying and transporting wastewater and sludge share similarities with solid waste management, but require far less frequent service. As a result, **containment capacity** becomes a **critical factor** in business model design.

Another challenge is the inefficiency of pit emptying due to **waste disposal practices and poor pit design**, often forcing manual handling by service providers.

Logistics optimization relies on **local aggregation** (e.g., barrels to trucks, trucks to hubs or dumping sites) and route planning to maximize efficiency.

Due to the physically demanding and unhygienic nature of pit emptying, workers tend to prioritize immediate cash income. However, **investing in assets** that enable a shift from manual to mechanical or semi-automated emptying and aggregation, such as vacuum trucks, **can increase service ownership and professionalism**. These same assets, however, also significantly raise **CapEx requirements**.



TREATMENT

Similar to water supply, wastewater treatment is a **volumes business**. Whether revenue is generated through tipping fees, sales of reuse products, or results-based financing, enterprises must treat large volumes of wastewater to be viable.

For this purpose, business models in this space generally follow one of two paths: **large-scale centralized** plants with high CapEx, **or small decentralized units** designed for replication. Decentralized models offer flexibility but require strong local partnerships to secure input flows and ensure consistent operation.

Faecal sludge is low in calorific value, so treatment **often** requires **co-processing** with organic waste. **Time and space** are **critical constraints:** long treatment cycles limit throughput, and substantial land requirement drives up costs.

A core business model consideration is whether **revenue** is derived **from treating waste** (e.g., via contracts or fees) **or** from the **sale of reuse products** or both. Product-based models need strong demand and marketing; service-based models depend on stable waste input and agreements with emptiers or municipalities.

Ultimately, the viability of treatment models rests on **logistics**, consistent **volumes**, and clear **revenue anchors**.

PRODUCTS FOR REUSE

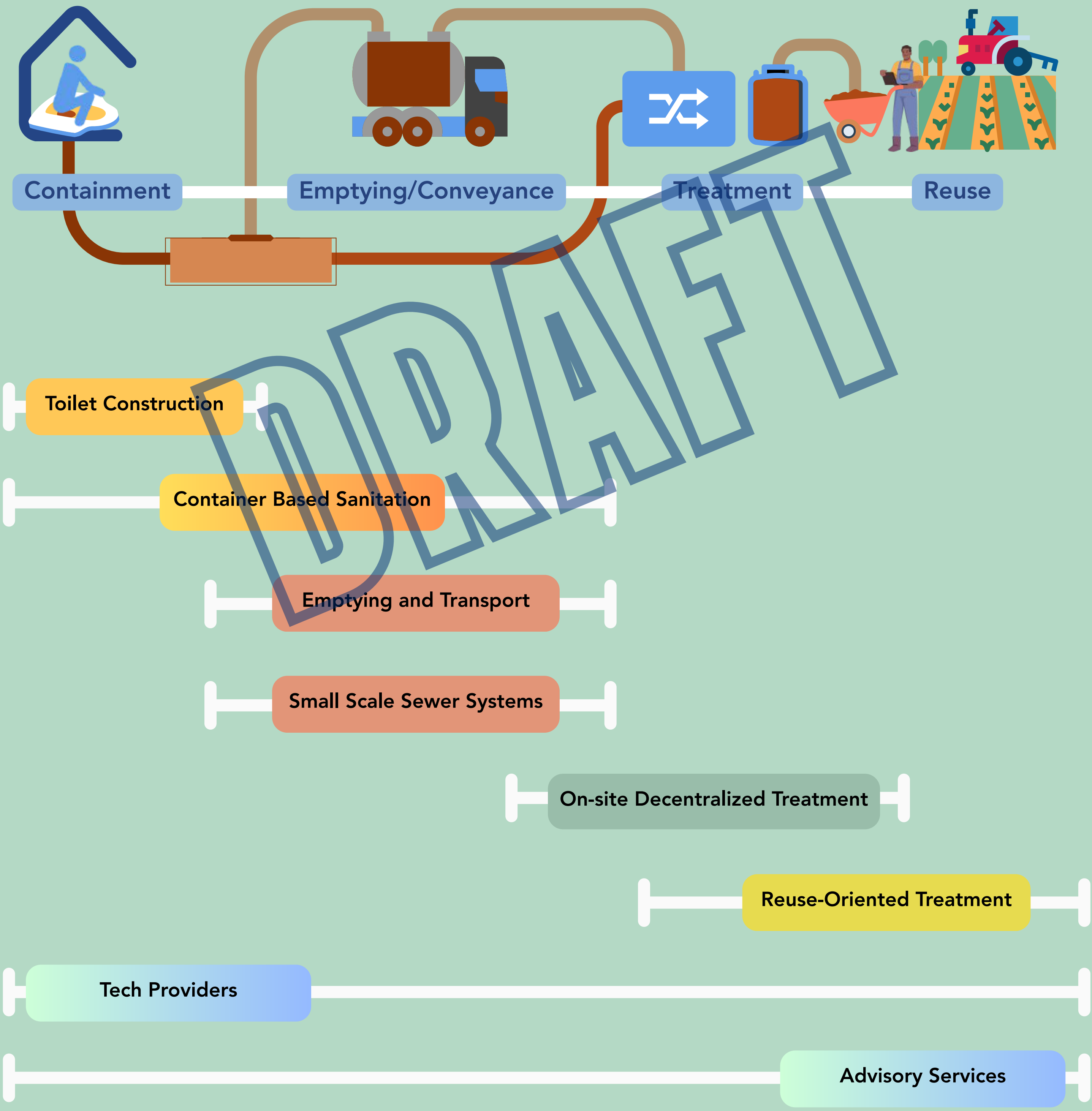
In terms of business models, the focus is on enterprises involved in the production, sale, and distribution of sanitation end products. The **recovery of water, nutrients, or energy** - such as through the production of fertilizers, animal feed, biogas, or treated wastewater - is intrinsically linked to the treatment stage of the sanitation value chain and cannot be viewed in isolation.

For these business models to succeed, it is essential to consider the **demand-side market** for resource reuse, where

- Products must be **cost-competitive** with conventional alternatives.
- Supportive **policies** (subsidies for renewables, inclusion of eco-fertilizers in subsidy programs, official quality certifications) lower effective cost or risk for the end user, thereby stimulating demand.
- **Quality control** and **standards** protect users and the environment, building credibility.
- Efficient **distribution** and last-mile delivery channels can be tapped to make products visible and accessible.
- Physical and institutional **infrastructure** allows accessing customers and ease product uptake.

Business Models along the Sanitation Value Chain

The graph below presents an overview of the predominant sanitation business models along the sanitation value chain in developing markets. As each model plays a crucial role in achieving SDG 6.2, we provide a brief description of all of them. However, detailed scaling pathways have been developed only for selected models with the highest potential to drive impact at scale. This targeted approach ensures a strategic focus on solutions that are both viable and scalable, maximizing their contribution to expanding access to safe and sustainable sanitation.



Toilet construction

Toilet construction businesses are usually micro-enterprises reliant on established supply chains for materials and prefabricated products. Their growth depends on customer affordability, often supported by microfinance or subsidies. Despite their importance to the sanitation value chain, they typically remain micro-scale, which is why no scaling model was developed as part of this publication.

Container Based Sanitation (CBS)

Container-based sanitation provides toilets as a service, reducing upfront costs for customers and addressing a key barrier to scaling at the containment stage. Several social enterprises have demonstrated operations and the model's scalable potential. However, CBS remains a capital- and advocacy-intensive model that requires long-term funding, government engagement, and refinement of both product and service design to achieve viability. A dedicated scaling pathway for CBS is included in this document.

Emptying and Transport

Emptying and transport businesses are critical in non-sewered sanitation systems by safely removing faecal sludge from households, institutions, and commercial premises. Many operate as small, informal service providers. Scaling this model into a professional, multi-truck logistics operation can increase efficiency and profitability, but also demands significant investment in assets, systems, and management. The scaling pathway explores how businesses can transition into larger, professionalized service providers.

Small Scale Sewer Systems

Small-scale sewer systems involve designing and operating decentralized piped networks, usually in dense urban areas or compounds. Due to high CapEx, technical complexity, and reliance on public infrastructure, they are rarely run by private enterprises at scale. Their limited replicability and few documented business cases are why they are not featured in this doucment.

On-site Decentralized Treatment

Decentralized wastewater treatment systems provide on-site solutions for areas without sewer access. They reduce desludging costs, address water scarcity, and provide other reuse options. Examples include biodigesters, constructed wetlands, and modular treatment units. They are included here due to their relevance across rural and urban markets. Enterprises sell systems, offer treatment as a service, or combine both.

Reuse-oriented treatment

Reuse-focused sanitation enterprises convert faecal sludge (often co-processed with organic waste) into products like fertilizer, briquettes, biogas, or protein feed. These businesses operate at both small and large scales, using technologies such as anaerobic digestion, composting, and insect-based processing. They are featured in the scaling pathways due to their potential for circular economy solutions, despite challenges related to scale, regulation, and market acceptance.

Tech providers

Technology providers in the sanitation sector focus on developing and supplying products such as treatment units, digital tools, monitoring systems, or emptying equipment. They are not featured in the pathways because their market success is more difficult to generalize, depending on changing operational and dynamic capabilities along the scaling journey of different technologies.

Advisory services

Advisory-focused sanitation enterprises provide consulting, training, engineering services and technical support to governments, NGOs, and implementers. They don't deliver services to end users directly and rely on project-based income. They are not featured in the scaling pathways due to their distinct consulting business model and limited relevance for service scale-up.

EXPANSION ALONG THE SANITATION VALUE CHAIN

Expanding beyond one section of the sanitation value chain is not just about growth, it's often a necessity. Because sanitation barely pays for itself in just one part of the chain. Unlike other sectors, sanitation enterprises often operate in fragmented markets with weak funding, low margins, and high operational costs. To survive and scale enterprises are often forced to connect business lines: turning waste into value, combining services, or stepping into adjacent business models where customers, cash flow, or infrastructure already exist. This can increase the complexity of a business and also risk distraction from the core offers. Key reasons to expand along the sanitation value chain include:

- Reducing operational costs and/or reliance risk by investing in own infrastructure (e.g., transfer stations) to avoid high dumping or transport fees and improve service margins.
- Controlling the supply chain to secure consistent quality and volume of inputs and infrastructure (e.g. faecal sludge, organic waste, pit design for emptying) critical for stable treatment operations
- Generating additional revenue where treatment fees or public contracts are limited, by monetizing end products like compost, BSF larvae, or biogas.
- Showcasing reuse product quality and benefits by piloting with end users (e.g. farmers), creating branded products, and addressing market barriers like stigma or low awareness
- Capturing data and demonstrating impact by controlling more stages to track user behavior, performance, environmental outcomes, and build evidence for partners and regulators.
- Improving customer trust and compliance by managing more service stages to ensure hygiene standards, environmental compliance, and stronger public and regulatory credibility.

All of these benefits can also be achieved through partnerships with public or private actors. Deciding whether to partner or invest in internal expansion is a strategic choice and one that the Scaling Pathways are designed to help inform.

THE CASE OF CROSS SECTOR EXPANSION

In the real world, sanitation rarely exists in isolation. Communities facing poor sanitation often grapple with overlapping challenges such as inadequate solid waste management, limited access to clean water, low public health outcomes, and gaps in education. For many enterprises, expanding into related value chains or integrating sanitation services into existing water, waste, or health businesses can create greater value for customers, improve operational efficiency, and unlock new revenue streams.

This type of expansion takes different forms depending on the core business model. For example, faecal sludge management (FSM) operators may add solid waste collection or drain cleaning services using the same fleet and personnel. Reuse-focused enterprises often build links to agriculture by selling compost through agri-dealers or providing farmer training. Some of the most practical drivers behind this kind of cross-sector expansion include:

- Sharing resources like staff, vehicles, or infrastructure across services
- Creating new income streams by combining services or reaching the same customers in new ways
- Building on existing customer trust to offer additional services with lower acquisition costs
- Responding to funding or government incentives that support integrated service delivery
- Tapping into circular economy models, such as co-composting organic waste with faecal sludge

Expanding across value chains is not without challenges. It introduces operational, regulatory, and financial complexities. However, for some enterprises, it is a practical response to market realities, and a compelling opportunity for growth.

01 CONTAINER BASED SANITATION

SCALING PATHWAY

01 CONTAINER BASED SANITATION

BUSINESS MODEL

The CBS business model provides a solution for sanitation in areas lacking adequate sewer infrastructure. In this model, sealed, portable containers are placed in homes or shared facilities to collect human waste. These containers are regularly collected by service providers and transported to centralized treatment or recycling centers. CBS services are fundamentally a logistics business, where efficient waste aggregation and transportation are key to optimizing operations and ensuring financial sustainability. Consequently, CBS is particularly effective in densely populated urban areas or informal settlements, offering an accessible alternative to traditional sewage systems. Its revenue typically comes from a mix of customer fees, government subsidies/contract or results based finance, and sales of by-products.

Customer-focused services are key to achieve satisfaction and willingness to pay, though financial sustainability often relies on subsidies and government support. Research highlights CBS benefits for vulnerable populations while identifying gaps in accessibility and infrastructure, driving ongoing improvements. As a climate-smart solution with adaptation and mitigation potential, CBS is gaining recognition, but further research is needed to strengthen evidence in this evolving field.

BUSINESS MODEL *VARIATIONS*

CBS models can be broadly categorized into three types: 1) **household in-home portable units** (e.g., Clean Team, SOIL, Fresh Fit), which prioritize privacy and convenience; 2) **household toilets in superstructures** (e.g. Loowatt), offering fixed installations with full containment; and 3) **private shared toilets** (e.g. Fresh Life), typically used by multiple households, often managed by landlords or local entrepreneurs. While these models use similar container-based technology, they differ in customer segment, marketing, and operational complexity. Household in-home toilets require higher customer acquisition efforts but are simpler to manage; shared toilets enable entrepreneur-led models, often with subsidy support; commercial rental units, though technologically similar, differ in terms of customers, marketing and financials.

REQUIREMENTS

- An environment conducive or at least receptive to the concept of “bucket latrines”.
- Clear licensing/regulatory guidelines for waste handling, transport, treatment, & reuse, supporting CBS.
- Demand and sufficient ability to pay for CBS services, typically due to a lack of sanitation alternatives
- Willingness of government to partner with CBS operators, providing a basis to move towards financial support to bridge the CBS viability gap; e.g. structured as results-based financing or smart subsidies.
- Options for PPPs or formal collaborations with local utilities and governments to share costs and achieve operational integration
- A strong mobile payment culture and accessible treatment or disposal infrastructure, which can enhance service delivery and efficiency

TYPE OF IMPACT

- Improves sanitation access to safely managed, contributing to **SDG 6.2 impact** at highest level, as excreta are transported and treated offsite
- Contributes to eliminating open defecation by making sanitation solutions suitable to densly populated low-income setting
- Contributes to reducing environmental pollution through faecal waste and reduces sanitation related health risks (SDG 4)

Considerations for investing in CBS models

To date, no CBS enterprise has reached EBIT break-even or secured long-term government subsidies and still rely on philanthropic contributions. Both product and service models remain in continuous refinement.

End-games for CBS enterprises vary, ranging from commercializing cost-covering models, securing government contracts to bridge the viability gap, or replicating operations by capacitating local enterprises. Regardless of the pathway, government contracts are seen as essential to achieving scale and long-term viability.

As a result, CBS enterprises must begin investing in lobbying and advocacy early in their scaling journey, as government engagement for a new service model is often a slow and complex process.

Target customer segments differ depending on the business model and end-game. These can include base-of-the-pyramid customers, slightly better-off households, or landlords. CBS enterprises must often balance trade-offs between maximizing impact and achieving cost recovery.

Capital expenditure (CapEx) remains a financing challenge, as it delivers less immediate impact compared to operational spending. CBS toilet designs also vary widely, from improved bucket latrines to aspirational models with full superstructures that can cost over US$ 1,000. Toilet lifespan significantly influences the overall viability and financing model.

CBS enterprises require strong financial backing beyond initial pilots. Funders must be willing to support not only early operations but also long-term systems change, which takes time, sustained effort, and deep engagement.

Investment Model - KPIs, Targets & Key Parameters

The success of CBS models relies on a range of KPIs, including metrics related to the number of active toilets and customers, sales performance, operational efficiency, and logistics. Financial viability largely depends on how effectively enterprises can reduce their cost base (e.g. cost per customer per year) and improve their cost recovery ratio. The strategic end-game also shapes a CBS enterprise's approach. Models aiming for full cost recovery through territorial expansion and densification must closely monitor toilet installations, customer acquisition, churn rates, and operational efficiency, while targeting customers with sufficient ability to pay. In contrast, enterprises relying on a mix of customer revenue, results-based financing, and government contracts must develop robust systems to demonstrate impact, particularly in terms of service expansion and cost-effectiveness compared to alternative solutions.

The following section presents examples of KPI targets, based on insights from CBSA (global), Sanergy's Fresh Life (Kenya), SOIL (Haiti), Sanima (Peru), and Clean Team (Ghana). These figures are **not directly comparable** across contexts or business model variations. Furthermore, both **targets and data points** are subject to change as enterprises continue to refine their operations and strategies.

Cost per customer per year

This indicator reflects the total operational cost of CBS services per user annually. Targets are typically established to achieve full cost recovery or to reach efficient operations with a viability gap that is appropriate for government subsidies or RBF. Fresh Life aims to bring its annual costs down to US$ 13 per customer, from a current cost base of approx. US$ 16 in Kenya with an increased number and density of customers. US$ 10-17 per capita per year is an average range (CACTUS). It has to be noted that costs for shared toilets are generally lower than for individual toilet solutions.

Cost of toilets

Cost of toilets affects the overall viability of a CBS service model, which needs to recover the initial capital cost over the lifespan of the toilet, making durability key. EY and WSUP (2017) set a target **landed cost of US$ 40–50** per Clean Team toilet in Ghana (for current ~US$ 90). Depreciated over five years, this cost supports a 10% net margin at sufficient scale. Other CBS operators have reported actual household toilet costs of as low as US$ 46-130 (CBSA ny) with SOIL's current toilet cost at US$ 70. Shared toilets costs go up to US$ 200 (Fresh Life).

of toilets to achieve EBIT breakeven

The number of toilets needed for positive EBIT in a CBS model depends on factors like efficiency, toilet costs, and potential government contracts. In Ghana, EY and WSUP (2017) estimated a 14% EBIT margin at around 20,000 households under a PPP model.

Density of Customers

CBS services are a logistics model and the density of customers is a key factor influencing the service costs for emptying. A viable CBS business model typically requires a toilet **density of 100 to 200 toilets per km2**.

Leading CBS operators serve 3,000–10,000 toilets; Sanergy reported 8,300 active toilets in 2025 which are run by 7,500 franchise entrepreneurs. Shared toilets serve 34-40 people at a time.

of toilets per waste collector

Targets for this indicator depend on the model used for waste collection. Sanima has reported that waste collectors on average service more than 350 toilets in their model. Other CBS operators report between 100 and 200 toilets per waste collector. (CBSA ny)

Customer churn

Customer churn explains user retention, considering new suspensions, reactivations, and existing suspensions. This works as a proxy indicator for affordability challenges and service dissatisfaction. Clean Team has reported to have reduced customer churn rate to **less than 1% per month**. Other operators reported churn rates between 1% and 2% (CBSA ny).

Fresh Life is closing 100-150 active toilets per months, most of those however only temporary (holidays, default payments, etc.).

KPIs, Targets & Key Parameters (cont.)

Orders and total installations

More advanced CBS models see average customer growth of about 15 to 25 new toilet installations per month, with most providers reaching a peak of around 40 units monthly. SOIL and Sanergy's Fresh Life have reported registrations of up to 220 and 120 new active toilets respectively in a single month (2025).

To scale CBS models, enterprises should target for consistent **orders above 60 per month**. It must be noted that early on, the proportion of orders that result in actual installations may be lower, as customer trust is still being built.

Accounts receivable (AR)

AR reflect cash flow health and the effectiveness of fee collection are essential for financial stability. CBS businesses should strive to keep average AR under 30 days, maintaining less than 10% of accounts overdue, and limiting annual write-offs to under 5% of billed revenue.Total AR should not exceed one month of billing. CBS models typically enforce strict payment policies - often suspending service after 1-2 missed payments - and increasingly use mobile money prepayment, which improves on-time collection and helps keep AR low. For example, Loowatt shifted its operations in South Africa to a pre-payment model bringing AR down to zero.

Collection frequency

Collection efficiency is vital in driving efficiency of CBS models. For example, Clean Team's switch to dry toilets cut chemical use and allowed **weekly instead of thrice-weekly collections**, increasing gross margin from <20% to >50%. Freshlife

Fee collection ratio

To improve cost coverage, CBS enterprises should aim for fee collection rates of at least 85%, using mobile payments and enforcing strict policies to minimize unpaid balances. Providers like X-Runner (now Sanima), Clean Team, SOIL and Fresh Life have reported collection rates ranging from 74% to 90%.

Investing Along Maturity Progression

01 Piloting	02 Initial growth	03 Expansion
6-12 MONTHS	+ 2 YEARS (total 2.5 - 3 years)	+ 2-3 YEARS (total 4.5 - 6 years)

Business Milestones

01 Piloting

Operational: Validate the CBS model by piloting 50–200 toilets, setting up core processes & refining the service.

Commercial: Secure 50+ paying customers, cover up to 20% of operating costs, and conduct unit cost analysis, identifying cost drivers.

02 Initial growth

Operational: Achieve 5–10% market penetration in target areas, serving 1,000+ toilets with consistent growth of 15+ per month

Commercial: Lower overhead & annual CapEx to match operational costs and reach 50% cost coverage & positive gross margin on core CBS services.

03 Expansion

Operational: Reliable servicing of 3K–5K toilets at 15–20% market penetration, growing by 40+ units/month in at least two regions.

Commercial: Reduce costs per customer per year **to <US$ 20** and secure government contracts or RBF to cover cost.

Impact & Return

01 Piloting	02 Initial growth	03 Expansion
250 - 1'000	**2'500 - 7'500**	**15'000 - 50'000**

people with improved access to **safely managed sanitation**

Reducing open defecation in pilot area and early evidences of health and safety improvements

Sanitation-related health risks reduced due to safe disposal/treatment

Up to **100 jobs** created

Required Resources

01 Piloting: **~US$ 100'000** in grant funding, self-financing and/or early stage equity

02 Initial growth: **~US$ 500'000** as a mix of grant and government funding (should be secured at outset)

03 Expansion: **Up to US$ 2M** grant funding with growing government subsidy

CapEx Investments

01 Piloting
- Initial toilet inventory and equipment purchase (incl. barrels, vehicles, storage containers and tools for emptying)

02 Initial growth
- Additional toilet inventory and vehicles (small carts, motorbikes, larger trucks, tractors or trailers)
- Setup transfer hubs & invest into storage space

03 Expansion
- Potentially invest to expand into reuse model to generate additional revenue from by-products

02 Initial growth – 03 Expansion
- Possibly set up localized toilet production facilities (molds and contract with plastic manufacturer

Working Capital

01 Piloting
- Salaries for initial team, incl. operations manager, collector(s), sales and finance
- Co-creation process & user-centered design BEFORE piloting toilets
- Stakeholder consultation and rapid prototyping, territory identification, market research, development of initial CB toilets, logistics model and treatment site and process
- System roll-out to pilot collections of waste and payments with customers

02 Initial growth
- Build & train a customer-focused sales team
- Develop a (software-based) system for route optimization
- Shift to mobile payments or agent banking to collect fees
- Streamline service model and toilet design & optimise production site

03 Expansion
- Establish branding strategy, including above-the-line marketing approach
- Expansion of target market, considering logistical implications
- Invest in team and build internal controls & SOPs to ensure a stable service routine at scale

02 Initial growth – 03 Expansion
- Conduct market research and invest into R&D to optimize toilet design
- Implement or adopt geolocated mobile software to track customers from sale to payment, with offline support
- Build a solid impact management system

Value Chain

01 Piloting
- Build awareness of the CBS concept and train communities on how to use toilets

02 Initial growth
- Negotiate government contributions - e.g. to use treatment sites

03 Expansion
- Secure firm commitment from government partners for new sites

02 Initial growth – 03 Expansion
- Identify or develop affordable transfer, storage and waste-to-resource facilities

All phases
- Lobby for official government recognition of CBS as a legitimate sanitation solution with the aim to have CBS included in national sanitation policies or city plans.

04 Scaling to break even

+ 3-4 YEARS (total 7.5 - 10 years)

05 Consolidation

+ 2-5 YEARS (total 9.5 - 15 years)

Business Milestones

Operational: Serve 8K–100K toilets with 20%+ market penetration in all active areas, expanding service clusters in existing cities and operating in at least five cities.

Commercial: Covering all routine operating expenses with internally generated revenue.

Operational: Secure long-term (5+ years) **government contracts** for CBS services and expand to new target markets, maintaining quality KPIs

Commercial: Enterprise advances toward financial sustainability with public integration, achieving a 10%+ net margin (requiring ~50% gross margin in countries like Ghana) to attract local entrepreneurs to engage in CBS.

Impact & Return

100'000 + / **1M +**

people with improved access to **safely managed sanitation**

300+ formal jobs and 1000+ income opportunities (franchisees, micro-operators, agents, contractors)

10'000 - 100'000 tons of faecal sludge collected and treated per year

Required Resources

US$ 10-15M (+/- 3-6 M/year)

Grant funding and in-kind support from public utilities

Carbon finance

Blended financing (mix of revenues, public subsidy, carbon credits, etc.) to support scale

CapEx Investments

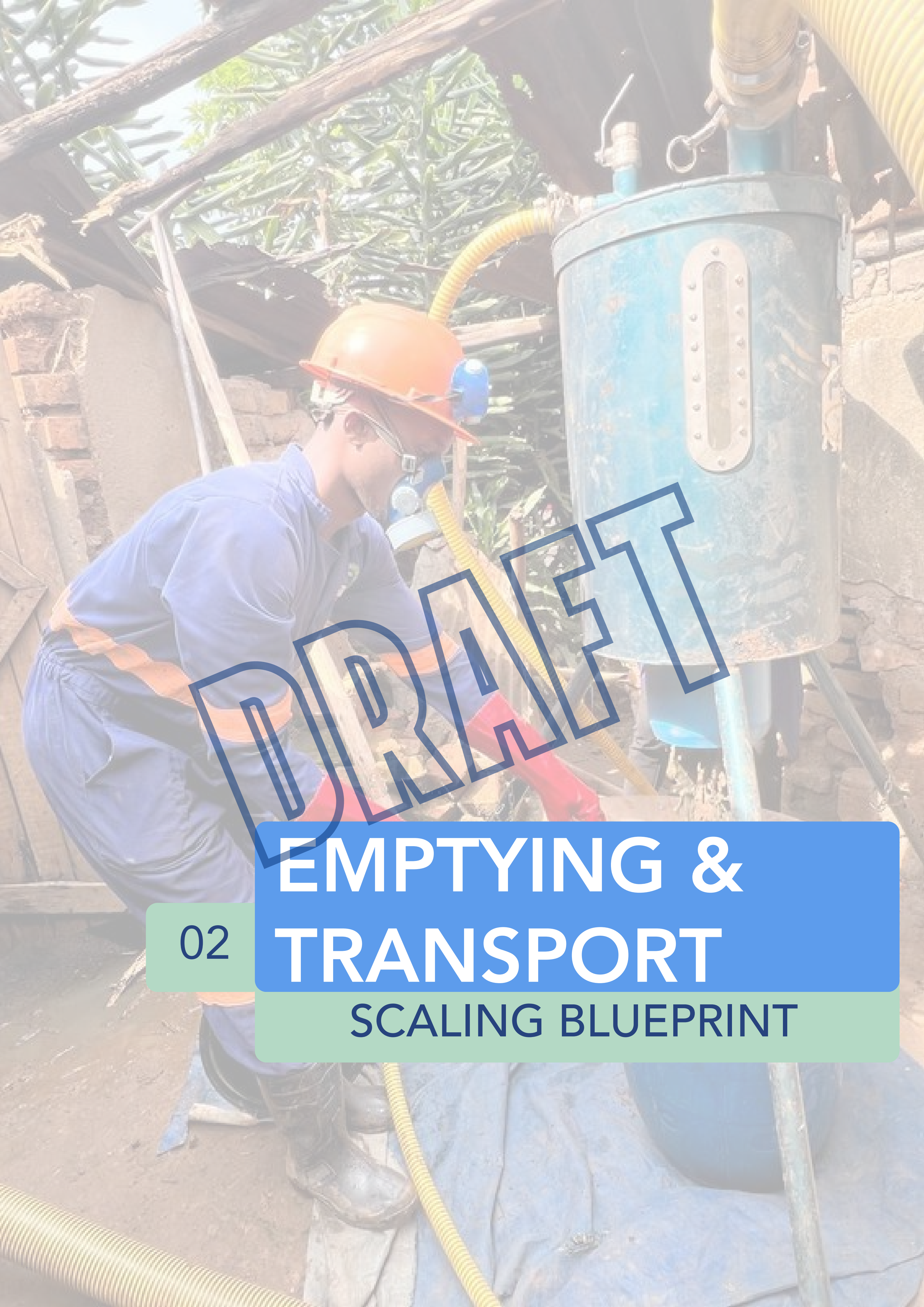
- Continued investment into toilet production/installation or supply chain
- Expansion of transfer station capacity (waste consolidation) and vehicle fleet
- Possibly invest into technology upgrades (IoT sensors, etc.) to manage large networks
- Increasing investments into asset replacements (new vehicles, toilets, etc.)

Working Capital

- Strengthen governance and internal processes to support growth and enhance investment readiness
- Build coordination structures and teams for different target markets
- Establish centralized services such as customer service, impact monitoring, marketing, and government contracting
- Develop a strategy to improve the effectiveness of political engagement for expansion
- Replication of standardized service model
- Invest into internal legal expertise and partnerships to negotiate new PPP agreements
- Potentially diversify offerings, developing more profitable service lines like rental toilets for events
- Expanding to new cities/geographies and/or by deeply integrating with public systems for mass replication. Requires sufficient density of customers in service areas
- Impact measurement and management, including external communication and reporting

Value Chain

- Influence policy and governmental priorities as a precursor to contracting
- Secure contracts per city with a focus on urban non-sewered areas
- Investment in a performance-based structure to drive down the viability gap
- Lobby for government to directly, or through international funders, provide contracts to service a set number of households (and potentially treat a specific quantity of waste)

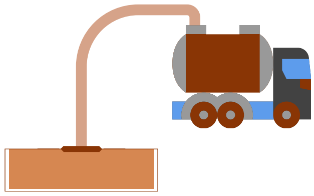


02

EMPTYING & TRANSPORT

SCALING BLUEPRINT

02 EMPTYING AND TRANSPORT



BUSINESS MODEL

Emptying and transport businesses provide sanitation services by removing faecal sludge from pit latrines, septic tanks, and other onsite sanitation systems. In urban and peri-urban areas without centralized sewer networks, these services are essential and are delivered by micro, small, and a few medium-sized businesses to households, enterprises, and public institutions. Emptying and transport is a high-cost, physically demanding, and often inefficient business, particularly for manual and semi-mechanized operators, while efficiency and profitability improve with full mechanization. Given the availability of cheaper alternatives such as pit sealing and competition from informal providers, businesses must balance professionalization (through licensed, high-quality service and strong customer engagement to ensure repeat business) with maintaining affordability. As operations require significant CapEx for trucks and desludging equipment, financial sustainability requires maximal asset utilization. This can be achieved through optimized route planning, waste aggregation, and serving diverse customer segments. Emptying businesses typically charge volumetric tariffs based on trip distance. Those aiming to scale or provide holistic services may adopt cross-subsidy models, charging higher rates to commercial clients to offset costs for low-income households, or rely on external subsidies.

BUSINESS MODEL *VARIATIONS*

Variations of this business model are characterised by the level of mechanization and service offering:

- Emptying methods range from manual scooping to semi-mechanized hand pumps (e.g., Gulper) and specialized pumping equipment (e.g., Pitvaq) that enhance efficiency. Fully mechanized vacuum trucks provide the fastest and most profitable service but are expensive and often inaccessible in dense settlements or for low-income customers. Many businesses combine methods and technologies to balance cost, efficiency, and coverage. Manual emptying is not formally legalized as a business in many countries, including Kenya and Ghana.
- Additional services, such as construction, maintenance and renovation, call centers for service requests, solid waste management, or other contracting work, are often offered by pit emptying businesses to diversify revenue streams, increase profitability, and improve efficiency and sales.

REQUIREMENTS

- Significant sanitation issue (i.e., high water tables) and no sewer connection
- Service provision licenses from the local government to operate and dump
- Access to dedicated treatment or disposal sites compliant with local regulation and accepting thick sludge
- Access to subsidies for pro-poor services or viability gap financing
- Government policies and regulations incentivise formal services, including manual emptying, charging cost reflective tariffs, providing targeted subsidies, regulating waste transportation, etc.
- Safe work environment: Workers are trained and equipped with PPE, particularly for manual services

TYPE OF IMPACT

- A sludge emptying and transport business contributes directly to SDG 6.2 by enabling access to safely managed sanitation services, where excreta are not only collected but also safely transported and treated. Without such services or sewers, the sanitation value chain breaks down, even if toilets are in place.
- Professional sludge transport helps prevent the illegal dumping of faecal waste into water bodies, drains, or open land, which is common in areas without regulated services. By delivering sludge to treatment facilities, emptying and transport enterprises help reduce untreated waste and protect water sources, supporting the achievement of SDG 6.3.

Considerations for investing in empyting and transport

Emptying and transport services operate similarly to other essential utilities such as solid waste collection, water delivery, or fuel distribution. They require strong logistics management and asset-heavy operations. Fleet assets are both the backbone and the largest liability of emptying and transport enterprises. All scaling models depend on fleet investment, with some also requiring additional infrastructure for transfer and treatment facilities.

Few emptying and transport businesses have achieved profitability at scale. Most operate with one to five trucks and struggle to reach the operational threshold where efficiency improves and overhead costs are absorbed. Margins exist but remain fragile due to high operating costs, limited ability and willingness to pay, and competition from informal operators that undercut on price and speed.

Scaling is possible but rarely linear. In East and West Africa, three pathways are common:

1. ***Branches & Inclusion***: Expanding geographically while combining different levels of mechanization and technology, ensuring social inclusion of low-income customers.
2. ***Emptying & Treatment***: Integrating treatment facilities within existing markets, with a focus on safe treatment, environmental impact, and potential reuse.
3. ***Mechanization++***: Targeting dense urban areas with fully mechanized services for middle- and high-income segments to increase profitability.

These models involve trade-offs between social impact, value chain integration, and commercial return, and overlaps between them are frequent. Progression into these models is not limited to micro and small enterprises; companies active in waste management, wastewater treatment, or infrastructure development also diversify into them.

Investment Model - KPIs, Targets & Other Relevant Parameters

Emptying and transport at scale is a demanding logistics business, with few companies operating successfully at large scale. Key factors for growth include securing financing for trucks, choosing the appropriate emptying method (manual or mechanized), and maintaining professional service quality. Operational KPIs, such as jobs completed per day, gross margin per job, and sludge volume removed, are essential for determining profitability and adjusting pricing. Fleet capacity and quality are critical for most businesses, making KPIs like asset utilization rate and return on assets key to investment decisions. A few enterprises have shown that expansion through multiple branches can succeed in broadening service coverage, but this approach requires significant CapEx and strong management to sustain consistent service quality and profitability across locations.

The following overview provides operational and financial KPIs for emptying and transport models and EXAMPLES of targets (ranges) that we compiled based on insights from Brilliant Sanitation (Uganda), Brooms (Kenya), Pit Vidura (Rwanda), ETS Gana Gouro (Côte d'Ivoire).

Mechanization Level

Mechanized services with large exhauster trucks (15–20 m³) offer the highest efficiency, but their capital and infrastructure requirements make them less common than small (2–5 m³) and medium-sized trucks (5–10 m³). In hard-to-reach areas, semi-mechanized methods are often the only option, limiting scalability due to higher labor and time costs. Barrels may be transported on tuktuks or flatbed trucks, while technologies such as PitVaq and Pupu Pump can improve efficiency. The pumpability of sludge from pits depends heavily on the amount of solid waste present. Multistage haulage, where sludge is transferred from small to large trucks, can help reduce fuel costs per cubic meter.

The proportion of **barrel-based semi-mechanical emptying generally decreases** compared to cesspool emptying **as companies scale**. For example, Pit Vidura completes about 30 percent of its services with barrels and 70 percent with different sizes of exhauster trucks. However, there are limits to how much service can be delivered with fully mechanized methods due to infrastructure constraints and latrine accessibility. As a result, a mixed fleet can provide a balance between efficiency and inclusion.

Core KPIs related to Service Delivery

Operational KPIs related to emptying services highly depend on the level of mechanization, type and condition of sanitation facility and should be benchmarked accordingly.

The **turnaround time per job** affects service capacity and workers productivity. For manual emptying time for service delivery can reach up to 5 hours with significant time spent on trash removal and pumping. Semi-mechanized emptying services require 2-5 hours, factoring in volume, thickness, time for preparation and cleaning of equipment. Fully mechanized services with small exhauster trucks require 1-2 hours on average.

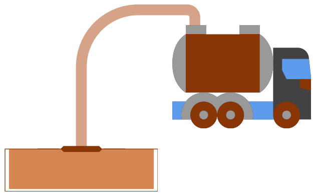
The **volume of sludge emptied per service** is directly linked to pricing, profitability and logistic planning. Manual and semi-mechanized services would empty on average 2-3m³ of sludge per job, while mechanized services would allow for 4-10m³ per job.

The target **# of jobs completed daily** for manual and semi-mechanized emptying is 2 to become profitable. Mechanized service targets can reach 4, also depending on truck capacity and distance to treatment plant.

Service Area

Cities with populations of at least 50,000–100,000 and dense neighborhoods (≥10,000 people/km²) are required for ensuring sufficient demand and operational efficiency. Cities with 100,000 - 500,000 population are better for scale. Transport costs and time are a barrier, and one-way **distances to treatment sites are ideally kept under 10 km**. When transport costs due to distance or road conditions begin to exceed 40% of revenue, or when truck utilization drops below 2 trips or 8m³ per day due to scattered demand, services become less viable. Either higher prices need to be charged or subsidies are required.

In small to mid-sized cities, enterprises can aim for over 50% market share to sustain operations, while in large cities a share of 20% or more is realistic. Availability of treatment or dumping facilities within close reach remains one of the most important criteria for determining whether geographic expansion is viable.



Pricing

Customers for emptying services are typically highly price sensitive, including institutional clients. Pricing is usually based on flat fees or volumetric rates, ranging from USD 10 to 50 per m³ for full vacuum truckloads.

Many businesses set minimum volume thresholds (1.6-2m³) to optimize truck use, often encouraging nearby customers to bundle services and share costs.

Semi-mechanized or manual emptying is often more expensive. In Kampala and Kigali, barrel-based semi-mechanized services charge USD 8-12 per 160L. Prices are strongly influenced by travel distance, site accessibility, and the amount of trash in pits.

Long-term service contracts, typically ranging from three months to three years, are common for commercial and institutional clients.

Gross Margin per Job or Unit of Emptying

In their early years, emptying businesses may achieve gross margins of 30–50% per job, facing high per-unit costs and low operational efficiency. Later-stage businesses can reach 50–60% by improving asset utilization, optimizing routes, and leveraging economies of scale.

Margins are influenced by the level of mechanization, transport distance, disposal fees, and pricing strategies. Semi-mechanized operators require more team members per job, and labor costs are affected by whether employment is formal (including taxes) or informal. For mechanized services, fuel accounts for 30-50% of total costs, with truck age and type having a significant impact on the cost base. In semi-mechanized operations, labor costs are the main expense after fuel.

Revenue and Net Profit per Truck

The average annual revenue per vacuum truck in Africa is US$ 36,000. Considering the monthly cash flow by truck (US$300-1500), single truck micro-businesses usually earn less per truck than a medium size truck business (3-5 trucks).

Revenue per truck and profitibility is higher when businesses serve not only households, but also non-domestic customer segments.

Medium size mechanized emptiers would target 15-20% profit, while a few large companies can achieve >20% profit margin.

Utilization and Maintenance of Equipment

Vacuum trucks, pumps, and barrels should be in active use 80–90% of the time, allowing for downtime due to maintenance, scheduling gaps, and seasonal demand fluctuations. Most trucks are imported second-hand and retrofitted locally, which lowers upfront cost but increases maintenance needs.

Spare parts, if hard to find, can mean significant operational costs spent on repairs. Depreciation should be accounted over 5-10 years depending on asset age and use. Pumps and small devices degrade faster and require more frequent replacement. Realistic return on assets (ROA) is 10–20% for well-run, multi-truck businesses, but is not commonly achieved due to the high purchase price of trucks.

Investing Along Maturity Progression

- **01 Initiating** — 6-12 MONTHS
- **02 Micro-Business** — + 1-2 YEARS (total 1.5 - 3 years)
- **03 Micro to Small Business** — +2-3 YEARS (total 3.5 - 6 years)

Business Milestones

01 Initiating

Operational: 1 vehicle
- Semi-mech.: at least 1 service/day
- Mechanized: 1-2 services/day

Commercial:
- +/- 200 paying clients (households)
- Covering direct expenses

02 Micro-Business

Operational: 2 vehicles
- Semi-mech.: 1-2 services/day (7 drums)
- Mechanized: at least 2 services/day

Commercial:
- 200-300 regular clients
- Mainly household clients

03 Micro to Small Business

Operational: 2-5 vehicles, likely combined semi-mech. and mechanized services
- Semi-mech.: 2 services/day (18 drums)
- Mechanized: 2-3 services/day

Commercial:
- 30-40% gross margin range per job
- Basic brand presence
- Households and institutional clients

Impact & Return

01 Initiating
- Basic services for up to 1'500-3'000 people, focused on households
- 3-5 jobs created for semi-mechanical emptier, 2 jobs for mechanical emptier

02 Micro-Business
- Basic services for up to 5K people, focused on households
- Creation of 1-2 additional jobs
- 1'000-3'000m³ sludge safely emptied

03 Micro to Small Business
- Basic services for up to 30K people,
- Creation of 5-15 additional jobs (emptying teams) depending on level of mechanization
- 3'000-8'000m³ sludge safely emptied

Required Resources

01 Initiating / 02 Micro-Business

USD 1-30K typically self-finance, loans or equity from family or friends. Trucks could also be rented from other companies

03 Micro to Small Business

USD 10-100K using primarily cashflow. Not more than 50% of businesses access any debt, asset finance and/or grants

CapEx Investments

01 Initiating / 02 Micro-Business
- Either semi-mechanized: Tuktuk or Flatbed truck, barrels, emptying tools
- Or mechanized: Small cesspool truck (4-5m³)
- Assets are usually second hand and leased-to-own. With less than USD 1,000 downpayment, operations can start

03 Micro to Small Business
- Semi-mechanized: 1-2 additional vehicles (small-medium size trucks)
- Mechanized: 1-2 additional medium-large size (4m³ and 10m³) vacuum tanker

Working Capital

01 Initiating
- Obtain permits, licenses & agreements
- Initial team development, PPE and internal training on safe and professional services
- Customer surveys and assessments of emptying needs, infrastructure access
- Test operations and service delivery, # of customers and volume of sludge emptied/disposed
- Basic financial management

02 Micro-Business
- Simple sales, marketing and branding
- Optimising routes and schedules for emptying services for increased service area
- Development of technical/operational team; Training and technology equipment
- Establishing basic/manual internal systems and processes to manage a growing team

03 Micro to Small Business
- Training for technical / operational, financial team
- Additional sales & marketing, efforts to drive market penetration, e.g. incentives for operators, etc.
- Data collection on service response time, customer satisfaction, etc.
- Exploration of aggregation of waste in a locality to reduce transport costs
- Improve mechanics capacities to fix and maintain trucks reliably

All stages
- Continued sanitation safety planning, training and vaccinations for operational team members

Value Chain

- Engagement with public authorities to tackle hidden costs of pit emptying services (e.g. demand for bribes, etc.)

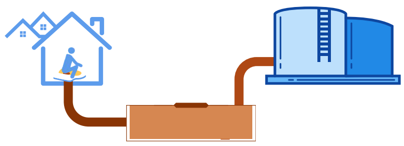
Scaling Pathway Options

	04 Branches & Inclusion + 5-7 YEARS (total ca. 10-12 years)	04 Empyting & Transport + 5-7 YEARS (total ca 10-12 years)	04 Mechanization ++ + 5-7 YEARS (total ca 10-12 years)
Business Milestones	**Operational:** • 4+ branches across several cities • >14,000 services per year **Commercial:** • 50% average market share across branches • Cross subsidy model - i.e. 50% public/ commercial customers (high volume), 30% middle, 20% low income	**Operational:** • Feacal sludge treatment facility (FSTP) integrated with emptying operations • 80-100% of collected sludge is treated for the service area **Commercial:** • Gov. partnerships for emptying services and/or treatment facility • Secure 1-3 years viability gap funding or operational subsidies per FSTP	**Operational:** • 1-2 Metropolis served with 10-15 vacuum trucks each • >10,000 services / year & metropolis **Commercial:** • >50% market share for urban middle/upper income HH and commercial/institutional clients • Securing city-level contracts • Consistent 15–20% net profit margins
Impact & Return	• Basic services for +/- 500K people • 100,000m³ sludge emptied annually • Creation of +60 jobs	• Basic services for +/- 50K people (per treatment site) • 5-10,000m³ sludge treated annually (per treatment site) • Creation of +25 jobs	• Basic services for +/- 300K people (per metropolis) • 15,000-20,000m³ sludge treated annually (per metropolis) • Creation of +25 jobs
Required Resources	**at least US$ 500K** **Sub-commercial debt (<10% interest, tenure >5 years), subsidies for low-income services and pot. catalytic grants**	**US$ 300K-1M** **Sub-commercial debt and grants for fleet, grant funding for treatment station, viability gap financing to start-up treatment operations.**	**US$ 300-600K per metropolis** **Commercial debt or equity for vacuum trucks & pumping equipment, in case of PPP, pot. concessional debt**
CapEx Investments	• Fleet of 20+ trucks of different sizes for mechanized and semi-mech. services. • Upgrade fleet quality & replace old trucks • Equipment and emptying technology, i.e., Pit Vaq or PuPu pump • Set-up of additional branches	• Construction of modular FSTP • Fleet: 5-7 trucks per FSTP depending on service area and 3rd party services • Equipment - tools, barrels, PPE, carts	• 10-15 quality vacuum trucks / metropolis (small, medium, large) and pumping equipment • Central office (and call center) • Technology for trash removal in pits
Working Capital	• Market assessments for geographical expansion through new branches • Training of technical / operational, financial and M&E team across branches • Systematic sales & marketing efforts to drive market penetration • Government partnerships to apply for public tender (i.e. city service contracts), licensing, infrastructure support • Investment into internal systems & processes, increased digitization/software application, data and monitoring • Corporate governance	• Feasibility studies and R&D for new product and service expansion, i.e. treatment of sludge, dewatering technology • PPP agreements with local authorities (i.e. for land provision, licensing of FSTP, capital co-investment) • Targeted marketing in the communities close to treatment plant • Quality control and compliance of treatment site • Possibly contracting - service provider and delegated management	• Route optimization and rapid service to max. operational efficiency • Preventive maintenance and downtime management of fleet • Advanced marketing and customer service and establishment of long term service contracts with clients • Licensing for service and disposal • Contracts (i.e. builk disposal) with dumping / treatment sites
Value Chain	• Engagement in Emptier Associations / Unions on a national and international level • Advocacy work and contributions to national level regulations and policies, and access to finance from large institutions	• Government engagement to enforce sludge disposal	• Lobby and advocacy efforts to open doors for larger PPP contracts for emptying services in larger metropilis

03 DECENTRALIZED TREATMENT

SCALING PATHWAY

03 DECENTRALIZED TREATMENT



BUSINESS MODEL

Decentralized wastewater treatment systems collect, treat, and reuse wastewater through processes such as screening, sedimentation, filtration, and anaerobic or aerobic treatment. They are relevant for both urban and peri-urban customers, as well as rural off-grid areas not connected to a centralized sewer network (over 80 percent in East Africa) and facing challenges such as high desludging costs, overflow and odor, or water scarcity. Treatment solutions can be tailored to different market needs, ranging from high-tech modular systems to nature-based, low-maintenance options. Decentralized systems can serve a wide range of users: small-capacity units (1–10 m³/day) for individual households, medium-scale systems (10–100 m³/day) for institutions, commercial clients, or residential complexes, and large-capacity solutions (over 100 m³/day) for estate developments, commercial zones, or municipalities. They also provide solutions to help water-dependent industries manage production risks from supply interruptions. Business models for decentralized wastewater treatment may be product-based, service-based, or hybrid, depending on the market context, technology, and financing structure.

BUSINESS MODEL *VARIATIONS*

- Product based: One-time sales of systems such as biodigesters or modular plants, with clients covering the upfront capital cost and typically managing operations and maintenance themselves or through third parties. High upfront costs are a barrier for customers in low- and middle-income settings.
- Service-based: The company owns the system and provides treatment as a service through subscription fees, leasing arrangements, or, less commonly, performance contracts. This model is more suited to clients with larger systems, higher maintenance needs, and no upfront capital or technical capacity. It requires the company to finance CapEx, which is challenging for early-stage and smaller enterprises.
- Hybrid models: These involve selling the treatment system while also providing ongoing O&M services for a fee. For large-scale systems, a Build-Operate-Transfer approach may apply, where the company constructs and operates the plant for a defined period before handing it over to the client or government. Revenue is generated from upfront system sales combined with recurring service income.
- Companies may manufacture treatment systems in-house or import prefabricated units. Simpler solutions, such as biodigesters and nature-based systems, are more often locally designed and produced, while complex, high-tech systems are usually imported, then assembled and customized to local needs. Few companies in Africa currently specialize in technology optimization for wastewater treatment.

REQUIREMENTS

- Water and wastewater tariffs, subsidies, and policies that incentivize decentralized treatment and water reuse (still far less common than incentives for water supply), including regulations of effluent quality and penalties for discharge of untreated wastewater
- Active enforcement of wastewater regulations
- Access to finance to meet CapEx requirements, both for clients and for solution providers
- Availability of physical space, particularly in urban areas, for on-site installation
- Sufficient demand in locations where centralized sewerage and treatment are not feasible in the short to medium term

TYPE OF IMPACT

- Decentralized wastewater treatment contributes to SDG 6.2 by expanding access to sanitation services and improving existing systems to ensure they are safely managed.
- It also supports SDG 6.3 by increasing the proportion and total volume of wastewater that is safely treated before discharge or reuse.
- Decentralized treatment further reduces GHG emissions by enabling immediate wastewater treatment, which limits methane release, contributing to SDG 13.
- The approach also decreases reliance on pit-emptying services, reducing both operational dependency and recurring costs.

Considerations for investing in decentralized sanitation models

In the early stages, decentralized wastewater enterprises often combine product sales, services, and technology development. Many evolve into hybrid models, starting with system sales, testing technology, and later adding service contracts. Over time, models may become more distinct, although overlaps remain.

Product-based models grow by selling treatment units and expanding market reach. They require upfront investment in manufacturing, retrofitting, inventory, and distribution but can deliver faster revenues and positive margins if conversion rates are high. For more advanced imported systems, adopting a prefabrication model with local manufacturing or assembly can reduce transport costs and speed up deployment. Strong after-sales support is essential to ensure system functionality and maintain market reputation.

Operator-focused service models are more challenging to launch. Sales cycles are long, stakeholder management can be complex, and working capital needs are higher. If treatment assets are co-financed by public or development partners, CapEx requirements are lower; if the enterprise owns the assets, cash flow management becomes a major challenge. Once established, recurring revenues, fixed customer bases, and potential integration of value chain services (such as collection, treatment, and reuse) can make service models more profitable and scalable than purely product-based approaches. These models scale by increasing service volumes and securing long-term contracts, with operational efficiency and O&M cost control being critical.

Technology-focused models are less common in emerging markets such as East Africa due to the high upfront costs of R&D, prototyping, and certification before revenues begin. These enterprises design and optimize treatment systems for others to deploy, earning revenue from system sales, licensing, or design-build contracts. Success depends on a clear performance advantage or strong intellectual property, as well as the ability to secure finance.

Investment Model - KPIs, Targets & Other Relevant Parameters

Operational efficiency is central to the value proposition for customers, as are potential benefits from resource recovery (treated water, biochar, biogas), which can serve as additional revenue streams. The viability of decentralized wastewater treatment enterprises depends on balancing suitable margins with customers' willingness to pay and affordability within the target market. System sales models must achieve these margins through unit sales, while service-based models can rely on recurring revenue from operating and maintaining systems. In the latter case, negotiating appropriate service fees and reducing O&M costs through system optimization (including remote monitoring with sensors) and clustering customers geographically to lower logistical costs are critical.

Effective management of the cash conversion cycle and customer acquisition costs is essential for maintaining liquidity and ensuring that revenues cover both operating expenditures and capital investments. Demonstrating profitability at the system or customer-segment level strengthens the investment case, enabling scale-up through replication or portfolio expansion.

The data points provide insights that were compiled based on consultations with Omiflo, Kenku Kenya, Kenya Cast (all from Kenya), systema.bio (Kenya, Mexico and India) and Mruna (Middle East).

Space and Time Efficiency

Space and time efficiency are important for urban settings, yet requiring more technical complexity and investment.

Space efficiency is the **land area per unit of treatment capacity** (m^2/m^3/day), with varying requirements:

- <1 m^2 for prefab units,
- 1-3 m^2 for biodigesters
- 5-10 m^2 for wetlands

Time efficiency refers to **hydraulic retention time**. Faster systems enable higher throughput and smaller designs:

- <12 hours for prefab,
- 1–2 days for biodigesters
- 3–5 days for wetlands

Operational Uptime (per system)

High uptime indicates reliable operations and consistent service delivery. Decentralized plants target **uptime in the range of 90-99%**, with >95% ideal for biodigesters or prefab units.

Minimizing downtime is critical to avoid overflows and requires regular maintenance, local spare parts, and tracking of failures, especially in flood- or outage-prone areas. IoT (remote) monitoring optimizes O&M.

Sludge Accumulation Rate

The frequency of **desludging** is often of **great concern to customers**. The volume of sludge produced per m3 of waste treated should be minimal, with a **goal of desludging needs of less than 1 time per year**. If higher, scheduled desludging may need to be offered as part of a maintenance package.

Effluent Quality

Effluent quality is **essential for regulatory compliance, environmental protection and customer satisfaction**. Common parameters include: BOD, COD, TSS reduction, pathogen and nutrient removal. Systems must target **100% compliance** with some countries requiring regular testing to ensure environmental standards are met. High effluent quality is often linked to good operational control and may be embedded into performance-based contracts, particularly in PPP models.

Water Reuse Availability

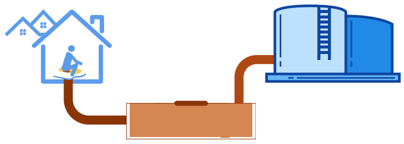
% of treated wastewater reused on-site or nearby, reducing freshwater demand and creating an additional revenue stream or cost savings for clients.

Targets range from **0–40% for basic systems to 60–100% with optimized treatment systems**.

High reuse depends on local regulations, customer acceptance and reuse needs, and infrastructure like storage and distribution. Common reuse include irrigation, flushing, construction or landscaping, which is most valuable in water-scarce urban areas.

Asset durability

The lifespan of a decentralized treatment system impacts CapEx recovery and replacement planning. Durable systems reduce lifecycle costs and service disruptions. Typical lifespans range from 20–30 years, with some like concrete septic tanks potentially lasting 50+ years.



KPIs, Targets & Other Parameters (cont.)

Revenue per system or m3 treated

Revenue can be tracked per system or by volume treated, with models including direct sales, service fees, pay-per-use, or resource recovery (e.g., water reuse, biogas). Revenue depends on business model, pricing, system efficiency, and customer willingness to pay. In Kenya, decentralized providers **target 25–40% gross margins on sales** (higher end for advanced systems). Additional revenue may come from by-products (i.e. water, biochar).

CapEx per system

CapEx varies based on system size, technology, and whether it is a greenfield installation or an upgrade.

Large decentralized systems typically cost US$ 300,000–1 million; small **community systems** range from **US$ 500–800 per household** (Elikham in Kenya reported total costs for systems for estates from US$ 10,000+); and household units range from a few hundred dollars for low-cost, less durable plastic tanks to around US$ 5,000 for robust treatment systems.

Customer Acquisition Costs (CAC)

CAC includes all marketing and sales expenses to secure a new client and is a crucial parameter for scalability. In decentralized wastewater markets, high CAC stems from **technical complexity, low awareness, and long sales cycles**. Conversion rates also **depend on the price of treatment systems**: Kenya Cast sees 80–90% conversion for low-cost septic tanks once they send an offer to a customer, while Sistema.bio converts just 10–15% for more expensive systems.

CapEx Financing

Access to CapEx financing is crucial for project viability, especially in low-income markets where customers typically **pay in installments over 12–36 months**. Affordable **financing**, which often requires concessional loans at **~10% interest**, lowers entry barriers and supports adoption. Enterprises must also manage their cash conversion cycles, which can span days to several months even for direct sales. Elikham (Kenya) charges up to 10% of CapEx for service contracts.

OpEx

OpEx, the costs for covering ongoing operation and maintenance, is a key efficiency metric that affects the cost base of decentralized treatment enterprises. Major cost drivers include energy and consumables like chemicals, filters, or additives, especially in high-tech systems. These impact affordability and long-term viability.

In Kenya, Omiflo reports annual OpEx at **~2% of total CapEx for their plant based** wastewater treatment system, while Elikham's use of **sequencing batch reactors reduces it to under 1%**.

A key factor in evaluating business models is the proportion of overall costs accounted for by OpEx.

Investing Along Maturity Progression

01 Pilot treatment	02 Go to market	03 Initial expansion
6-18 MONTHS	+ 2-3 YEARS (total 2.5 - 4.5 years)	+ 1-2 YEARS (total 3.5 - 6.5 years)

Business Milestones

01 Pilot treatment

Operational: Validate the functionality and regulatory compliance of the decentralized treatment solution with a pilot scale facility

Commercial: Establish approach to market entry. No or minimal revenue

02 Go to market

Operational: Proof value proposition with up to 10 customers, delivering and maintaining wastewater treatment

Commercial: Customers pay for at least 50% of the costs of the first systems deployed to the market.

03 Initial expansion

Operational: Expand geographically to new target markets

Commercial: Sell at least 1 small-medium size system per month with a gross profit of 30% per project, reaching break even with ~US$250K in revenue (case of Omiflo and Mruna)

Impact & Return

01 Pilot treatment

- Few hundred m3 of wastewater are safely treated as a proof of concept
- 100% compliance on parameters like BOD, TSS, etc

02 Go to market

- Up to 1'000 m3 of wastewater treated (and potentially recycled) per year
- Up to 10 jobs

03 Initial expansion

- Up to 100'000 m3 of wastewater treated (and potentially recycled) per year
- Up to 20 jobs

Required Resources

01 Pilot treatment

US$10-20K

ideally 50% grant funding in combination with self funding

02 Go to market

US$20-50K

ideally 50% grant funding in combination with self funding

03 Initial expansion

US$100-250K

(subsidized) loans for pre-financing, grants or equity for working capital

CapEx Investments

01 Pilot treatment

- Pilot scale facility at low capacity to minimize costs
- Testing equipment and materials

02 Go to market

- Pre-financing of systems for initial customers
- Basic laboratory equipment for wastewater and effluent testing
- Further R&D and demo-site installations

03 Initial expansion

- Vehicles for transport
- Adequate storage facilities
- Pre-financing of systems for customers that purchase with PayGo model

Working Capital

01 Pilot treatment

- Testing the treatment of different types of wastewater with the pilot scale solution
- R&D to improve efficiency and design (including for potential modular expansion) of decentralized treatment solutions
- Ensure regulatory compliance (i.e. data collection, tests, permits)

02 Go to market

- Recruit and train a sales team
- Invest into strategic partnerships for initial treatment unit deployments
- Secure demo-site agreements for showcasing installations
- Establishing CRM system
- Secure required licenses & permits
- Start inventory of critical components (tanks, pipes, media)

01 Pilot treatment and 02 Go to market

- Market analysis and customer needs assessment
- Develop agreements with key suppliers (i.e. prefab systems) and contractors

03 Initial expansion

- Tailor the marketing & sales approach to key customer segments
- Develop organizational structures and standardize processes to manage clients and implementation with a growing team
- Depending on the business model develop agreements with implementation, distribution and/or financing partners
- (Preventive) maintenance services to keep O&M costs low and system uptime high

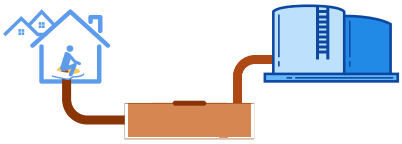
Value Chain

01 Pilot treatment

- Minimum in house capacity, hence partners for inputs, i.e. a facility to host the pilot and local labs or universities for testing

02 Go to market and 03 Initial expansion

- Engage with government and donors to push for results-based payments
- Test and develop partnerships with financing institutions for system financing
- Explore business partnerships for complementary solutions (i.e. biogas or biodigester with constructed wetland)



04 Product Sales to Scale	04 Operator Model	04 Master of Technology

+ 4-6 YEARS (total 7.5 - 12.5 years)

Business Milestones

Product Sales to Scale	Operator Model	Master of Technology
Operational: Hundreds (advanced) to thousands (simple) units installed, active distribution in multiple regions, >90% system functioning rate after 2 years **Commercial**: Various customer segments for small-large products, gross margin 20-45%, net margin of at least 10%	**Operational**: 50–200 systems/plants under service contract, >90% uptime, O&M cost <15% of revenues, possibly integration of collection and reuse **Commercial**: Increase revenue share from O&M from 30% to between 60-80% of total revenue, several multi-year service contracts with public/private clients, net margin 5-10%	**Operational**: >5 successful deployments in different contexts and with scalable customer segments; technical performance meets/exceeds design specs; technology certified **Commercial**: Grow revenue and contracts to support a company valuation of over US$10M.

Impact & Return

Product Sales to Scale	Operator Model	Master of Technology
• >1M m3 of wastewater treated (and pot. recycled) per year • 15-40 jobs	• >1M m3 of wastewater treated (and pot. recycled) per year • Water reuse and sludge reuse outputs • 50-100 jobs **Market-rate interest**	• High-quality effluent enabling reuse • 10-25 jobs **Annual RoI of 5-15%**

Required Resources

Product Sales to Scale	Operator Model	Master of Technology
US$250K-2M **Loans for pre-financing and equity or grants to finance growth**	**US$300K-3M** **(Incl. treatment sites, grant or public co-financed)** **Other CapEx and OpEx through loan/grants/equity**	**US$ 1,5-10M in several investment rounds** **Growth equity, loans for pre-financing and pot. R&D grants**

CapEx Investments

Product Sales to Scale	Operator Model	Master of Technology
• Expand production and assembly capacities, incl. tools, molds, retrofitting equipment • Warehouse / storage capacity • Service vehicles	• Treatment units/infrastructure • Service vehicles, equipment, storage • Invest into retrofitting and upgrading existing and new systems with sensors to facilitate remote monitoring. • Pot. solarize systems to reduce OpEx	• Invest into production capacities and systems that allow to serve increasing (and pot. fluctuating) demand • Continuous pilot sites and testing labs

Working Capital

Product Sales to Scale	Operator Model	Master of Technology
• Increase and continuously train sales and marketing team • Open sales offices or invest into establishing distributor partnerships • Optimize targeted marketing and automate lead generation to continuously improve conversion and reduce customer acquisition costs • Establish strong after sales services • System engineering and inventory	• Build up technical capacities of team • Standardize monitoring, response mechanisms • Build a sales team focused on long-term contracts and account mngt. • Establish performance based subscriptions / lease-to-own models • Expand customer base for operating services beyond own systems • Financing for long lead-time projects	• Ongoing R&D to optimize treatment efficiency and tailor solutions to customer segments / diversify product portfolio • Develop processes and templates to support establishing (ideally exclusive) distribution partnerships • Geographical expansion to showcase suitability of technology for global market • Partnerships with Universities, tech suppliers (i.e. sensors, membranes, etc.)

Product Sales to Scale and Operator Model:

- Strengthening monitoring, data, and service platforms
- Market analysis and customer needs assessment
- Optimize (preventive) maintenance to continuously reduce O&M costs

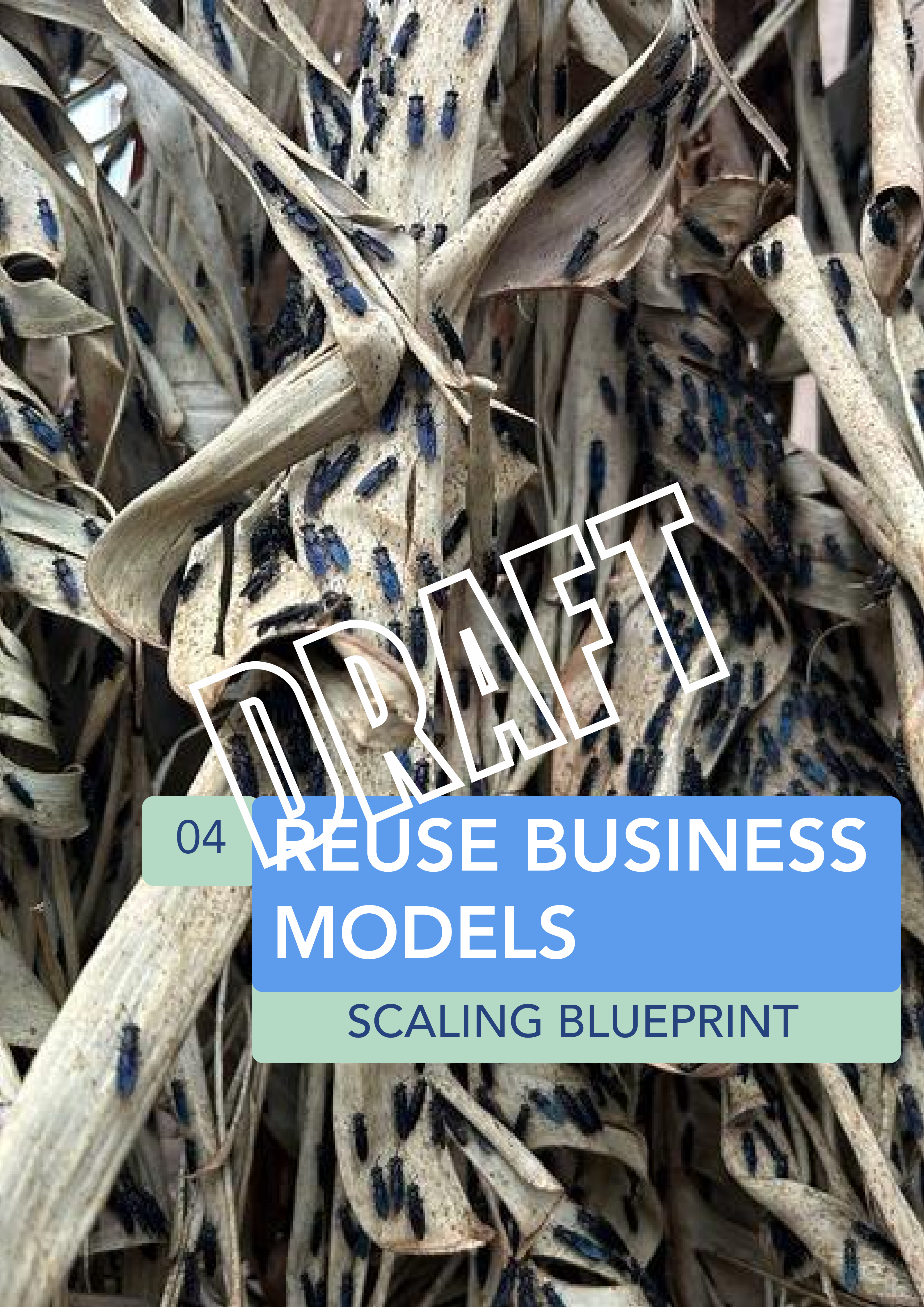
Value Chain

All three models:

- Engage in lobby and advocacy work to ensure enforcement of regulations on wastewater treatment
- Invest in awareness raising partnerships and activities, particularly for new technologies and systems

Operator Model:

- Integration of collection and reuse services or partners



04 REUSE BUSINESS MODELS

SCALING BLUEPRINT

Sanitation Reuse Business Models

Sanitation reuse models turn human waste into marketable products, unlocking value from an underused resource. Their viability depends on achieving sufficient processing volumes to leverage economies of scale, allowing recovered resources to compete with conventional alternatives on cost and quality. A complementary feedstock, such as organic waste, is often necessary to reach these volumes. By addressing public health and environmental challenges while generating revenue and jobs, these models link social impact with commercial opportunity. They typically fall into two categories: energy recovery, where waste is converted into fuel or power, and nutrient recovery, where it is processed into agricultural inputs.

Energy recovery approaches include anaerobic digestion (AD) and briquette production. AD is the most established global solution for converting organic waste, manure, and faecal sludge into biogas, widely used in Europe, North America, and increasingly in developing economies. It breaks down waste without oxygen to produce biogas for cooking, heating, or electricity, along with nutrient-rich digestate for agriculture. Facilities range from municipal plants to decentralised community systems, with financial sustainability linked to reliable waste inputs, economies of scale, and market demand.
Briquette production transforms treated faecal sludge, often blended with biomass, into solid fuel for households and industry, reducing reliance on charcoal and firewood. Carbonised briquettes, produced through pyrolysis, have higher energy content and lower smoke but require more investment, while non-carbonised versions are cheaper and target cost-sensitive markets. Success in both approaches depends on affordable feedstock, efficient drying, proximity to markets, and consumer acceptance.

Nutrient recovery models include black soldier fly (BSF) processing and fertiliser or compost production. BSF systems use insect larvae to convert organic waste and faecal sludge into protein-rich animal feed and nutrient-rich frass for soil improvement. Modular designs allow small-scale starts with expansion as markets grow, generating revenue from waste collection fees, larvae sales, and fertiliser products. Their success depends on reliable, affordable feedstock and market acceptance of insect-based feeds. Fertiliser production from faecal sludge involves treatment to stabilise material, remove pathogens, and recover nutrients. This can be done through pelletising, or composting, often with other organic waste to improve quality and volume. Such products improve soil health and offer sustainable alternatives to synthetic fertilisers, but viability depends on meeting regulations, building distribution networks, and addressing consumer perceptions.

In all cases, sanitation reuse models require context-specific combinations of technology, operations, and market development, but all share the potential to pair public health gains with commercially viable enterprises that deliver environmental and social benefits. Their scalability, however, is often constrained by restrictive regulations on agricultural reuse products. While they share core principles, each model follows a distinct scaling pathway.

04.1 ANAEROBIC DIGESTION

BUSINESS MODEL

Anaerobic digestion (AD) is a biological treatment process that breaks down faecal sludge and organic waste in the absence of oxygen, producing biogas and nutrient-rich fertilizer. Business models built around this process generate revenue through waste management fees and the sale of biogas for energy, as well as solid or liquid fertilizer for agriculture. These models can operate at various scales, from municipal treatment plants to decentralized community or household-level systems. At the municipal level, success depends on securing high waste volumes and establishing off-take agreements with buyers to ensure financial viability.

A steady and adequate supply of waste is crucial for the viability of AD businesses. Because faecal sludge generally has low volatile solids content, successful models typically rely on co-processing with organic waste to enhance biogas yields. In addition to biogas, AD systems often produce a liquid fertilizer by-product, which can provide an additional revenue stream from agricultural markets. Ideally, bulk purchasers of biogas should be located nearby to minimize distribution costs and logistical challenges. Furthermore, operating a treatment facility requires sufficient land for both processing and storage, which can be a limiting factor, particularly in urban areas. To contribute meaningfully to the sanitation crisis, businesses must ensure reliable waste collection systems and partnerships that secure a consistent feedstock supply while navigating land availability constraints.

BUSINESS MODEL *VARIATIONS*

Anaerobic digestion (AD) business models typically follow one of two approaches. Large-scale facilities leverage economies of scale by processing high volumes of waste, generating substantial energy output either for industrial customers or pursuing a long-term goal of feeding municipal gas grids. Excess biogas from large AD facilities can be managed by directing it through a combined heat and power (CHP) system, compressing and bottling it for distribution, or utilizing it locally to meet energy demands. In contrast, smaller AD solutions rely on standardized, modular systems that reduce capital investment and utilize locally sourced feedstock. These smaller units generate multiple revenue streams / benefits - including energy, heat, fertilizer, and tipping fees - and typically require shorter payback periods along with tailored financing options to be economically viable.

REQUIREMENTS FOR AD

- Regulations that limit landfill disposal of organic waste, improving segregation and feedstock quality.
- Policies that enable the safe use and sale of all AD outputs, including digestate.
- Reliable and cost-effective feedstock supply chains to maintain consistent plant operations.

AND ENERGY RECOVERY

- Industrial off-takers ready to replace fossil fuels with biogas or biomethane.
- Stable demand from energy buyers
- Policies and regulations that permit and promote renewable energy
- Supportive infrastructure for storage, upgrading, and distribution of energy products.

TYPE OF IMPACT

- Provides safe treatment pathways for faecal sludge and organic waste, reducing environmental contamination and improving sanitation services (SDG 6.2).
- Reduces GHG emissions, contributing to SDG 13 (Climate Action) by diverting organic and faecal waste from landfills or uncontrolled dumping, and replacing fossil fuels with renewable biogas for energy generation.
- Nutrient-rich organic fertiliser enhances soil health, reduces dependency on synthetic chemical inputs and contributes to SDG 15 (Life on Land) through improved soil management.
- Fertilizer supports local agricultural productivity, directly contributing to SDG 2 (Zero Hunger).

04.2 BRIQUETTES

BUSINESS MODEL

Briquette production from faecal sludge offers a circular economy solution by converting treated sludge into solid fuel for household and industrial use, providing an alternative to firewood and charcoal. Business models built around briquettes generate revenue through the sale of these fuel products, which help address deforestation, energy scarcity, and poor waste management.

The success of briquette enterprises depends on steady access to treated sludge, reliable production facilities, and strong market linkages, especially with communities or industries that rely on biomass fuels. A key challenge is market acceptance, as negative perceptions about the fuel's origin demand sustained investment in awareness-raising and consumer education.
Some businesses, such as Sanivation, center their model on briquettes as the primary fuel product, while others produce them as a by-product alongside different reuse solutions.

Two main types of briquettes determine the investment needs and cost structure of these business models, as outlined below.

BUSINESS MODEL *VARIATIONS*

- Carbonised briquettes are made by pyrolysing dried faecal sludge at high temperatures in low-oxygen conditions, producing biochar that is compressed into a high-energy, low-smoke fuel similar to charcoal. These products target urban households, commercial kitchens, and industries familiar with charcoal use. Businesses must invest in pyrolysis equipment to produce higher-quality briquettes that can compete in urban markets.
- Non-carbonised briquettes, made by compressing dried and stabilised faecal sludge (often with organic additives) without pyrolysis, are cheaper and easier to produce but burn with more smoke and lower energy output. Enterprises producing these types of briquettes often target low-income or rural markets where affordability outweighs performance. While they may face acceptance challenges where cleaner fuels are available, some industries adopt them due to their lower cost and ability to manage ash in industrial burners.

AND ENERGY RECOVERY

- High market prices and demand for renewable energy products.
- Established pit emptying or vacuum tanker services to ensure steady feedstock supply.
- Partnerships with government and private sector actors to secure consistent waste flows.

REQUIREMENTS FOR BRIQUETTES

- High demand for affordable solid fuels, especially in areas facing deforestation, rising charcoal prices, or energy shortages.
- Proximity to key markets to minimise transport costs for bulky, low-margin briquettes.
- Consumer acceptance & willingness to use sludge-derived fuel

TYPE OF IMPACT

- Reduces reliance on firewood and unsustainable charcoal, contributing to SDG 13 (Climate Action) and SDG 15 (Life on Land) by mitigating deforestation and reducing carbon emissions.
- Provides a safe end-use for waste, supporting SDG 6 (Clean Water and Sanitation) by promoting sustainable faecal sludge management and reducing environmental pollution.
- Creating local jobs in waste collection, processing, distribution, and retail, contributing to SDG 8 (Decent Work and Economic Growth), particularly in low-income and informal markets.
- Affordable, locally produced energy source, enhancing energy security and reducing dependence on traditional biomass, contributing to SDG 7 (Affordable and Clean Energy).

04.2 BLACK SOLIDER FLIES

BUSINESS MODEL

Black soldier fly (BSF) larvae production is a biological treatment approach that can co-processes faecal sludge (though, like with AD this is not the norm) and organic waste by utilizing larvae to consume and convert waste materials into protein-rich animal feed and organic fertilizer. Business models built around BSF processing generate revenue primarily through waste management fees, the sale of protein for animal feed, and organic fertilizer for agricultural applications. Compared with other reuse models, BSF requires less initial investments for equipment and technology but needs to cover regulatory and land costs next to operating costs that are driven by payments for organic waste, labour, power as well as administative and marketing costs.

Success relies on establishing consistent supply agreements for both faecal sludge and organic waste, as well as securing stable off-take agreements for larvae-based protein products and fertilizer to ensure profitability. Since insect protein and fertilizer markets are still emerging, developing effective distribution channels is critical. A balanced mix of waste inputs is essential to ensure larval growth and maximize yields. BSF models benefit from proximity to both waste sources and end markets to minimize transportation costs and logistical complexities. Space availability and costs for breeding, larval processing, and product storage can also affect viability.

BUSINESS MODEL *VARIATIONS*

BSF models operate at different scales, from industrial to community and farm-level setups. While distinct from anaerobic digestion (AD), similar factors influence their success across scales:

- Industrial-scale BSF facilities in developed countries leverage economies of scale to process large waste volumes, supplying bulk markets like animal feed and commercial agriculture. These operations rely on off-take agreements, standardized quality, and high capital investment - often out of reach in developing regions.
- Smaller-scale BSF systems are modular and adapted to local conditions. They use local waste inputs and generate revenue from larvae sales, organic fertilizer, and waste services. These models have shorter payback periods, and depend on localized market opportunities.
- Development organizations have promoted micro-scale BSF for smallholder farmers, but these models often prove unsustainable due to the lack of cash-generating outputs.

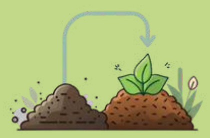
REQUIREMENTS FOR BSF AND NUTRIENT RECOVERY

- Access to land and technical expertise for production
- Demand for protein feed for livestock, fishmeal substitute or in animal feed industry.
- Established animal feed supply chain, incl. competing feed producers, distributers and farmer cooperatives.
- Clear processes to obtain permits to farm insects, certify environmental impact, obtain licenses for feed.
- Regulations supportive of processing faecal and organic waste into agricultural products.
- Affordable transport options for for bulk frass / compost products to agricultural markets.
- Market acceptance of products derived from faecal sludge

TYPE OF IMPACT

- Provides safe treatment pathways for faecal sludge and organic waste, reducing environmental contamination and improving sanitation services (SDG 6.2).
- Reduces GHG emissions, contributing to SDG 13 (Climate Action) by diverting organic and faecal waste from landfills or uncontrolled dumping.
- Nutrient-rich frass improves soil health and increases income of farmers and pastoralists by increasing yields and reducing fertilizer costs

04.3 COMPOSTING



BUSINESS MODEL

Compost and fertiliser production from faecal sludge offers another approach for converting human waste into agricultural inputs. These products improve soil health, support agricultural productivity, and provide a sustainable alternative to synthetic fertilisers. Business models generate revenue through waste management fees (e.g., tipping fees), compost or fertiliser sales, and in some cases, co-products such as soil conditioners or landscaping materials.

Co-composting is common with other organic waste streams (e.g., food waste, agricultural residues). This improves volumes and product quality, but necessitates access to multiple waste inputs and careful process management.

The process involves treating faecal sludge from pit latrines, septic tanks, or the by-product of treatment processes through controlled composting or nutrient recovery technologies to eliminate pathogens and stabilise the material. Market success depends on producing safe, standardised products that meet regulatory requirements for agricultural use and addressing perceptions linked to the origin of the material.

BUSINESS MODEL *VARIATIONS*

- Compost-based models focus on producing organic soil amendments that improve soil structure, water retention, and fertility. These models often target local farmers, landscaping businesses, or urban green spaces. Compost typically has lower nutrient concentrations than synthetic fertilisers but offers broader soil health benefits.
- Fertiliser-based models aim to recover concentrated nutrients, often through drying, pelletising, or chemical processes, producing products with predictable nutrient content suitable for cash crops or commercial agriculture. These models can achieve higher price points but require greater investment in processing technology and quality assurance.

AND NUTRIENT RECOVERY

- Consistent, reliable & affordable supply of treated faecal sludge and organic waste inputs.
- Demand from local farmers, landscapers, or soil restoration projects; or government as part as fertiliser schemes.
- Permits to sell products.

REQUIREMENTS FOR COMPOSTING

- Access to suitable land for composting and storage.
- Access to technical expertise and equipment for composting processes.
- Awareness and recognition of composting as a valuable practice among target customers and local communities.

TYPE OF IMPACT

- Compost and fertiliser production enhances soil quality, reduces land degradation, and supports agricultural productivity, contributing to SDG 2 (Zero Hunger) and SDG 15 (Life on Land).
- Safe conversion of faecal sludge into agricultural inputs reduces environmental pollution and health risks and improves faecal sludge management systems supporting SDG 6.2.
- By reducing reliance on synthetic fertilisers, compost and fertiliser production can lower greenhouse gas emissions and promote circular nutrient management, contributing to SDG 13 (Climate Action).
- Job Creation: These businesses generate employment in waste collection, treatment, processing, and distribution, particularly in urban and peri-urban areas, supporting SDG 8 (Decent Work and Economic Growth).

Investment Model - KPIs, Targets & Key Parameters

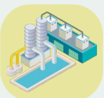
The viability of a reuse business model depends on effective and efficient operations, driven by the volume of faecal sludge and quantity and calorific value of organic waste collected and processed daily, the utilization of the plant's production capacity (usually at least 80% for viable operations), and key parameters reflecting treatment efficiency. Financial performance is shaped by output metrics which influence revenue potential, such as electricity generation or compressed gas production, in the case of anaerobic digestion or larval biomass yield in the case of BSF models. The revenue model relies on income from sales of these products, as well as fees from waste management clients. These revenues must cover operating costs and enable the recovery of capital expenditures over time, with financing costs for CapEx factored in. A profitable business case for an individual treatment plant is essential to building strong investment cases for scaling operations through replication.

The following data points provide targets for KPIs based on insights from some of the most advanced anaerobic digestion, briquetting, BSF and composting business models, including form SafiSana (Ghana), Sistema.bio (global), Chanzi (East Africa), Sanivation, NAWASCOAL, RegenOrganics (all three from Kenya).

Operational Parameters

Processing Throughput

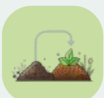
Processing throughput refers to the volume of waste a treatment system can handle over a given period of time, directly influencing the scale of output and potential revenue from waste management fees, energy generation, and resource recovery. Since waste processing is fundamentally a volumes business, achieving meaningful product yields, whether biogas, fertilizer, or feed, requires consistently high input quantities from the outset.



In the case of SafiSana, the goal is to establish treatment plants that process at least **125 tons** of organic and faecal waste **per day** to reach a viable model for municipal treatment plants in Ghana.

Briquetting plants often exist at smaller scales as the input: output ratio is much higher. A briquetting plant **can be viable at 10 tonnes per day**. For commercial success, plants should be much larger to enable bulk sales of outputs to industrial customers with demand for solid fuel.

In Tanzania and Kenya, Chanzi has set up several BSF plants with a processing capacity of **18–24 tons per day** - a mid-scale size between small, subsistence-level systems (which are not economically viable) and large industrial facilities that handle hundreds of tons daily.



Regen Organic's composting facility for fertilizer production in Machakos county, Kenya is designed to process **200 tons/day**. Other ventures report treatment capacities on the order of a few tons/day in pilot phase, scaling to hundreds of tons with investment.

Retention Time

Retention time refers to the duration required to process a batch of waste into a usable product. This varies significantly across different reuse technologies:

- For **AD**, the typical retention times range from **20 to 30 days** per digestion cycle, depending on system design, temperature, and waste composition.
- For **briquettes**, retention time largely depends on drying the waste input. **If sludge is** already **well-dried**, briquettes can be produced within **2 to 3 days**, including processing and cooling. However, natural drying of wet sludge may extend this timeline significantly, especially in humid climates.
- For **BSF** processing, the larvae typically reaching harvest size within **12 to 16 days** after hatching, though this can vary based on feed quality and environmental conditions.
- Retention times for **composting** generally range from **6 to 10 weeks**, covering all phases including active decomposition and maturation. Some accelerated or forced aeration systems can reduce this, but pathogen die-off and stabilisation still require several weeks.

Investment Model - Operational Parameters

Blending ratios

Blending ratios define the proportion of **faecal sludge to other organic waste inputs** required to ensure safe, technically viable, and market-acceptable reuse products. The optimal ratio varies by technology, balancing resource recovery objectives with product quality, operational efficiency, and user acceptance.

For **AD, 10% – 50% faecal sludge** is blended with organic waste (e.g., food waste, agricultural residues, manure). Faecal sludge alone has low energy potential, so co-digestion with richer organic waste significantly improves biogas yields.
Most systems aiming for **high biogas production** maintain faecal sludge content at **10% – 20%**, adjusting based on system design and available feedstocks.

Briquette production has greater flexibility; but **typically uses 10% – 20% faecal sludge**, blended with 80% – 90% organic biomass, such as sawdust, agricultural residues, or market waste.
Faecal sludge adds circular economy benefits but has high moisture and ash content, which limits its proportion. Blending improves fuel quality, reduces smoke emissions, and supports product acceptance.

BSF systems can use **up to 20% faecal sludge**, blended with high-energy organic waste such as food or market waste.
Faecal sludge alone lacks the nutritional content needed for optimal larval growth. Blending with richer organic waste improves yields and product quality, while keeping faecal sludge below 20% helps meet safety standards and maintain market acceptability for protein and fertiliser outputs.

Typically, **10% - 30% faecal sludge** is blended with organic materials such as sawdust or food waste. Bulking agents improve **compost** structure, odour control, and pathogen reduction. Higher faecal sludge content increases nutrient levels but can lower market acceptance of the final product.

Process efficiency

Process efficiency refers to how effectively a reuse technology converts waste inputs into products while minimising resource use, energy consumption, and waste generation. Each reuse model has distinct efficiency indicators that reflect its biological process, technical performance, and product quality. Understanding these metrics is critical for assessing operational viability and maximising economic and environmental returns.

AD prioritises energy recovery and digestate stability, with key efficiency metrics including biogas yield and energy conversion rates. The Combined Heat and Power (CHP) utilisation rate measures how effectively a plant converts biogas into electricity and usable heat. High-performing CHP systems can achieve overall **energy efficiencies of up to 85%** (with 35% electricity & 50% heat).

Briquette production efficiency depends on input quality, drying performance, and calorific value. High-performing systems maintain low moisture and ash content while producing dense, consistent fuel that meets industrial or household standards. Efficient drying not only improves burn quality but also reduces production costs and spoilage. For non-carbonised briquettes, approximately 0.2 tonnes of briquettes can be generated per tonne of faecal sludge input; for carbonised briquettes this can be <0.1 tonne. Other feedstocks have higher conversion ratios.

BSF processing measures efficiency by the protein and fat content of harvested larvae (as % of dry weight) and the reduction in organic waste volume. Higher nutritional value increases the market price of larvae in animal feed. Optimal conditions can recover value from up to 70% of input waste.

In composting, process indicators include temperature profiles for pathogen kill, compost maturity (carbon-to-nitrogen ratio), stabilisation (volatile solids loss), and nutrient content (NPK). Efficient operations can shorten composting cycles to 6–8 weeks with active aeration, compared to 10–12 weeks in passive systems, increasing throughput and revenue potential.

Investment Model - Financial Parameters

Operational cost per ton

The cost base of a reuse model needs to be continuously optimized to achieve and increase profitability over time. Operational costs include among others costs for sourcing of organic and faecal waste, treatment, maintenance, labor, utilities, and compliance measures. In the case of BSF models or, where AD models compress biogas and sell it to end users, marketing, distribution and sales costs can further weigh on the business model.

Operational costs for **AD** are estimated at **US$ 30 -80 per ton** and are driven by waste pre-treatment, maintenance, energy requirements for plant operation, digestate handling, and potential compression, storage, and distribution of biogas to end-users.

Costs are influenced by feedstock quality, need for co-digestion materials, equipment reliability, and whether biogas is used on-site, upgraded to biomethane, or distributed to external markets.

Briquette production cost are highly variable with estimates ranging from **US$ 20-70 per ton**. Costs are driven by drying of faecal sludge (the most critical cost driver), sourcing of complementary waste streams, energy and equipment for processing and compacting, and costs for product storage/distribution.

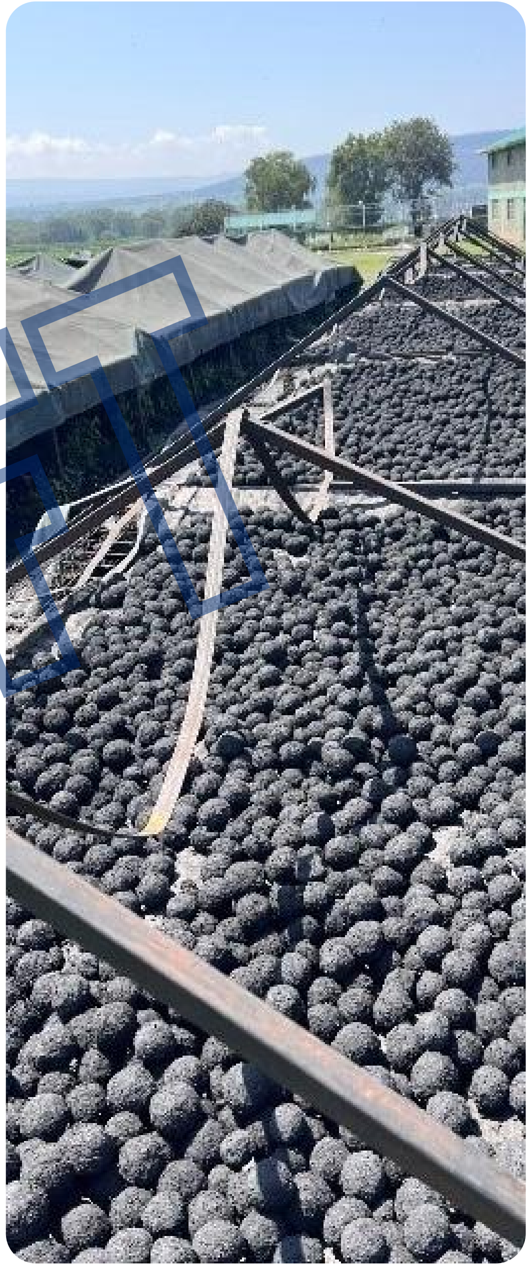
Carbonised briquettes incur higher production costs due to additional pyrolysis step, which requires specialised equipment and higher energy inputs. NAWASCOAL cite that up to **25% of OpEx is in machinery use and maintenance**.

Some reports indicate BSF treatment operational costs on the order of **US$ 30-$100 per ton of waste input** in low-income countries, but this varies widely and e.g. Chanzi has managed to reduce production costs to between **US$20-US$30/ton**, reporting the following cost structure:

Cost of sourcing input: 50%-60%
Cost of production: ~35%
Indirect costs, incl. marketing, sales & distribution: 10%-15%

Operational costs for composting and fertilizer production are estimated at **US$10–40 per ton**, driven by labor for handling, turning, and monitoring; purchase of bulking agents (e.g., sawdust, green waste); pathogen control; land needs; and space for maturation and storage. Additional costs may include water, quality testing, and regulatory compliance.

Regen Organic's estimated cost structure attributes **60-65% for operations, 20% for sales/marketing/distribution and 10% for indirect costs**.



Land use is a key factor, as reuse facilities must be located near inputs, often from urban areas, where space is limited and costly.

Investment Model - Financial Parameters

OpEx cost coverage ratio

The OpEx cost coverage ratio shows if revenues can sustain daily operations, ensuring financial viability.

SafiSana achieved full **OPEX** coverage with a plant that processes **~30 tons** of waste per day and seeks to achieve **full cost coverage** with a **125 tons per day** facility. **sistema.bio** achieved break-even with **US$ 1m revenue**

Breakeven scale varies widely with local conditions such as biomass costs, customer base, and transport. Sanitation used to estimate 1,200 tonnes/month, but new plant designs in different locations have shown profitability at 90–550 tonnes/month, with margins ranging from 9–32%.

Different BFS enterprises use differently sized facilities to reach viable operations: In Chanzi's model cost coverage is reached at **14,2 tons** of waste processed per day per facility.

Regen Organics expects to achieve operation at full capacity of 5'000 tons of input per year at its Kakamega (Kenya) plant within 1-2 years. At this point Regen Organic's projects generate US$ 1.5 million in annual revenue against US$ 1 million in operational and overhead costs. Carbon financing could further strengthen the cost coverage ratio, with 30,000 tonnes of processed waste estimated to generate offsets equivalent to 15,000 ton of CO_2.

Investment and Financing Costs

Refers to the capital expenditures and associated financial costs (e.g., interest, debt repayment) required to establish and operate reuse facilities, crucial for determining financial viability, scalability, and attractiveness to investors across different reuse models. Since financial costs vary significantly across countries and regions, we compiled cost estimates for CapEx investments of different reuse models below.

A greenfield **AD** treatment plant, at the scale of the facility SafiSana is planning - designed to process 100 - 200 tons of mixed waste per day - can be expected to cost approx. **$15K to $20K per ton** of daily treatment capacity.

Sanivation typically works with local governments in Kenya through a Design-Build-Operate-Transfer (DBOT) model. Individual briquetting plants are often structured as 10–15 year contracts with an indicative cost of ~US$2 million for a 40-tonne/day facility (≈US$50,000 per tonne/day of capacity). Currently, Sanitation proposes a portfolio approach. It combines three FSTPs under a single 20-year contract, with a total output of ~3,000 tonnes/month and an estimated CapEx of US$14 million. This translates to roughly US$3.50 per person per year served (over 10 years).

While low tech, micro **BSF** facilities require less investments ($5-50K), commercial BSF facilities require investment around **$15-25K per ton per day** depending on the level of automation. Chanzi's facilities with treatment capacities of 18 - 24 tons per day cost between $350K and $450K.

Regen Organic's **fertilizer** plant in Kakamega, Kenya had a capital cost of about US$ 2 M for a design capacity to process 50-60 tons of waste per day. This suggests roughly **$35K per ton/day** capacity in that scale.

Investment Model - Financial Parameters

Yield of Highest Value Product

The viability of reuse business models that seek SDG 6.2 impact hinges on their ability to generate market value by co-processing organic waste and faecal sludge (not the norm) into commercially viable products. To maximize profitability, processes are optimized to produce the highest possible yield of the product with the greatest market value and margin - e.g. biogas in the case of anaerobic digestion (AD), and larval biomass in the case of black soldier fly (BSF) processing.

Power output refers to the amount of energy generated from biogas, which can be used for electricity, heating, or cooking fuel. Higher outputs improve profitability. In the case of SafiSana's facility in Ghana, the goal is to increase production from currently 1'500 m3 to **6'000 m3 of biogas per day at scale** (30-40 MWh/day). Depending on market price fluctuations in Ghana this translates into ~$3'000 per day or **US$30-50 per ton of input**.

The **briquetting** process yields 40–70% of the input waste, with non-carbonized briquettes achieving higher recovery rates. At market price of $10–15 per 50 kg in a country like Kenya, this equates to **$80–175 per ton of input**. However, producers often receive only a portion of this revenue when distributors or sales agents are involved. Additionally, feedstocks like sawdust, wood shavings, or charcoal dust tend to be more costly than the market or agricultural waste used in other reuse models.

Larvel biomass yield is the fraction of input waste converted into harvestable **BSF** larvae (prepupae) and depends on stock feed (e.g. **5-9% for wet pit latrine sludge** and **10-15% for mixed** organic waste and faecal sludge). Depending on size and process optimization BSF plants can be expected to yield between **2 and 50 tons of larvae per day**. In East Africa, dried BSF larvae can sell for around **US$800-1'000 per ton** (though prices fluctuate) – this can translate to **~US$20 revenue per ton** of waste **input**.

Composting typically yields 25–50% of input, depending on feedstock and process. With retail prices in Kenya around $20 per 50 kg bag, compost generates $200–350 per ton, or approximately **$100–175 per ton of input** after retail margins. However, composting retention times can be up to four times longer than methods such as BSF processing.

Yield of Secondary Reuse Products

In addition to primary reuse products, several models generate secondary outputs that add value to the sanitation value chain. These secondary products might face greater market and regulatory but can diversify revenue streams and enhance overall business viability when integrated effectively.

AD converts up to 90% of the waste input into liquid or semi-solid composted digestate or struvite that contains nutrients.

Instead of just fuel, Sanitation is also selling steam to industries. In this case the enterprise owns and operates the boiler and has a long-term steam purchase agreement with the client. This as a way to improve margins while also having a significant impact on reducing carbon.

BSF larvae convert >75% of organic waste into nutrient-rich frass, an effective soil conditioner, generating around **$10 per ton of input**. Additionally, BSF companies have secured **carbon credits** for landfill avoidance, adding a further $3–$4 in revenue per ton of input. Chanzi is also exploring pyrolysis of organic waste and faecal sludge to produce biochar-based frass, potentially attracting carbon removal credits. Waste off-take fees add further revenues.

follow for BSF

follow for AD

Investing Along Maturity Progression

The following pathways for BSF and AD serve as **examples**, showing **both similarities and differences** in reuse models.

01 Pilot

6-12 MONTHS

02 Initial scaling

+ 2-5 YEARS (total 2.5 - 6 years)

Business Milestones

01 Pilot

Operational: Build a pilot scale facility and confirm ability to sources volumes of waste (both organic & faecal), considering type of waste, seasonality, etc.

Commercial: Confirm viability of the model at a small scale and specific location. Minimal revenue from use of output products.

02 Initial scaling

Operational: Establish 1st commercial facility and build a resilient waste supply from multiple providers, achieving consistent sourcing.

Commercial: Achieve OpEx breakeven. Off-take agreements with clients at the right price and volumes.

Commercial: Achieve EBITDA break even. Establish distribution channels, ensuring sales of larvae and frass.

Impact & Return

01 Pilot

Technological solution to co-process faecal sludge (waste-to-protein and waste-to-energy) developed and tested.

02 Initial scaling

Processing of up to **30 tons** of mixed waste per day, eq. to the faecal sludge and organic waste of **up to 30'000 people**

Creation of 20-30 jobs

Required Resources

01 Pilot

~US$50-150K **~US$10-50K**

in self- or grant funding or early stage equity

02 Initial scaling

US$6-7M **US$500K-2M**

In grant or public funding, potentially in combination with early stage equity and concessional loans

CapEx Investments

01 Pilot

- Build and pilot different types of facilities
- Two small digesters and one public latrine to test operations
- US$ 5-15K for micro-scale BSF infrastructure and up to $50K for larger pilots

02 Initial scaling

- Large biodigester, pot. combined heat & power generators or biogas compressors, drying beds & fertilizer production sites
- Equipment & vehicles
- $350-450K to build a first commercial facility, including breeding tanks, larval rearing trays, processing sheds, and basic equipment (dryers, etc.)

Working Capital

01 Pilot

- Secure a site close to waste supply and output users to assess market acceptance
- Build a small team incl. a local project manager
- Cover costs for transport, equipment and materials
- R&D to fully understand the waste value chain and identify a site for 1st commercial facility
- Proof ability to grow insects

02 Initial scaling

- Obtained necessary permits to handle and process waste
- Expand team with operators, agronomist, sales, laboratory staff
- Feedstock logistics, facility operations, and product distribution
- Up-skill the operations and sales teams
- Refine and roll out sales and product marketing
- Diversify options to sell products e.g. by compressing gas and selling it for cooking
- Establish the size and design of a viable facility
- Digitalize monitoring of key production parameters

Value Chain

01 Pilot

- Develop partnerships for feedstock and waste supply access
- Understanding local conditions affecting operations, economics, politics
- Establish clarity on tipping fees and how to manage them at scale

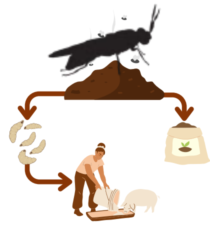
02 Initial scaling

- Build relations and agreements with pit emptyers/vacuum tanker sector
- Advocate for policies that support decentralized treatment, renewable energy production and consumption
- Secure a power purchasing agreement

Both stages

- Securing and sustaining government support with strong license to operate across sanitation, waste, and agriculture sectors

BSF Pathway



03 Operate facilities across multiple locations

+ 2-3 YEARS (total 4.5 - 9 years)

04 International geographical expansion

+ 4-6 YEARS (total 8.5 - 15 years)

Business Milestones

03	04
Operational: Proof ability to operate in multiple locations by setting up around 5 facilities, developing integrated systems and uniformity.	**Operational**: Internationalize and scale operations to 30 - 50 facilities across at least five countries.
Commercial: Reach single digit positive net margins. Optimize operations through efficiency gains and centralized services.	**Commercial**: Reach a net margin of at least 20%. Reaching net margins supporting financing CapEx through commercial loans from 20 facilities onwards.

Impact & Return

03	04
~100 tons/day of waste & faecal sludge processed and 20-40 tons/day of CO2-eq reductions	up to 1'000 tons/day of waste processes and up to 100'000 tons/year of CO2-eq reductions

+ up to 20 jobs per plant & additional income opportunities along waste value chain

Required Resources

03	04
US$ 2-4M Mix of grants and early stage equity, CO2 certificates for emission reductions from landfills	**US$ 15-25M** Concessional & commercial loans and growth equity

CapEx Investments

03

- Development and upgrading of BSF facilities (incl. storage, breeding, packaging, etc.)
- Technology upgrades (e.g. semi-automation of feeding/harvesting and monitoring (sensors, etc.)
- Fleet of collection vehicles (if required)

04

- CapEx for additional facilities
- Upgrading and updating of existing facilities
- Fleet expansion and equipment purchase and replacements

Working Capital

03

- Develop an ERP that integrates monitoring across all facilities and facilitates process optimization through centralized data management
- Expand operational and sales team and on-board CTO
- Pot. invest into CO2 certification (US$ 100-200K)

04

- Finance long cash conversion cycles (accounts receivable and accounts payable)
- Establish integrated, real time data management systems across all facilities
- Data-based R&D to enhance larvae yield and optimize processes
- Invest into third party impact audits

Value Chain

03

- Establish clarity on role of local government and legal framework in different locations
- Improve negotiation position with feed production companies
- Building consumer and industry acceptance for insect-based product

04

- Engage in regional and global policy processes to ensure protein feed and frass are classified as new products instead of recycled waste.

AD Pathway

03 Replicating & selling small AD systems

+ 3-6 YEARS (total 5.5 - 12 years)

03 Operating utility scale AD plants

+ 3-6 YEARS (total 5.5 - 12 years)

Business Milestones

Operational: Successfully expanding with direct operations in at least 3 countries and distributor agreements in at least 10 countries

Commercial: Reach annual revenue exceeding $10M with annual revenue growth above 30%, 10–20% net profit

Investment: Establish partnerships with investors that finance the development of large scale AD facilities.

Operational: Establish facilities that process >100 tons of mixed waste per day, producing >5'000m3 of biogas.

Commercial: Establish off-take agreements w/ industrial clients for 100% of biogas/power and at least 60% of digestate. Achieving a net profit margin of 10% - 20%.

Impact & Return

sistama.bio reportedly sold AD **units treating >40M tons of waste**. This bears potential to co-process **up to 10M tons of faecal sludge** and **reducing > 1M tons of CO2 emissions**

>100t per day of waste processed, including up to 40 tons of faecal sludge (equivalent to 5 - 7 large tankers)

Required Resources

US$10+M

Mix of grants, equity, debt and RBF
+ Carbon finance

US$3-10M per plant
depending on whether plant is upgraded or newly built
~70% concessional loans and ~30% grant/subsidy

CapEx Investments

- Investment in prefab manufacturing
- Equipment for installation

- Expand processing and production capacity, investing into large biodigester, waste acceptance tanks, biogas compressor, drying beds and fertiliser production equipment
- Cover related import tax

Working Capital

- Setup loan programmes or cooperations with banks / MFIs to facilitate purchase of systems
- Invest into robust impact management and certification of CO2 emission reductions
- Adapt sales and go-to market strategies to new countries
- Grow team to increase installation capacity
- Product diversification and potentially expand towards developing large-scale facilities

- Establish a Key Account Manager for industrial clients
- Establish centralized services (incl. marketing & sales support, legal & compliance, etc.) to increase efficiency
- Securing investment and carbon finance (requires setting up state of the are data management system)
- Establish and optimize standard procedures for sourcing, sales and distribution of products

Value Chain

- Develop technical and commercial capacities as well as relationships with distributers and key value chain actors

- Understand and, where necessary, co-develop permitting processes for large AD plant development in different countries

Resources & References

The content of this publication is largely based on insights gathered through engagements and interviews with entrepreneurs, investors, and sector experts. These perspectives were complemented by an extensive literature review, drawing on several noteworthy publications and information sources, including but not limited to the following:

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Thank you for taking part in this informational journey toward empowering WASH entrepreneurs and businesses from early stages to growth and development. To support you further, we work closely with local partners globally to develop programmes that are tailored to the need of each region and provide continuous support to scale up, we also create a variety of tools, best practices and resources that are all available on Cewas' website.

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Authors

Janek Hermann-Friede, Aline Bussmann

Copy Writing

Hannah Wuzel

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