



# The world can't wait for sewers

Advancing container-based sanitation businesses as a viable answer to the global sanitation crisis

**WSUP**

Water & Sanitation  
for the Urban Poor

**EY**

Building a better  
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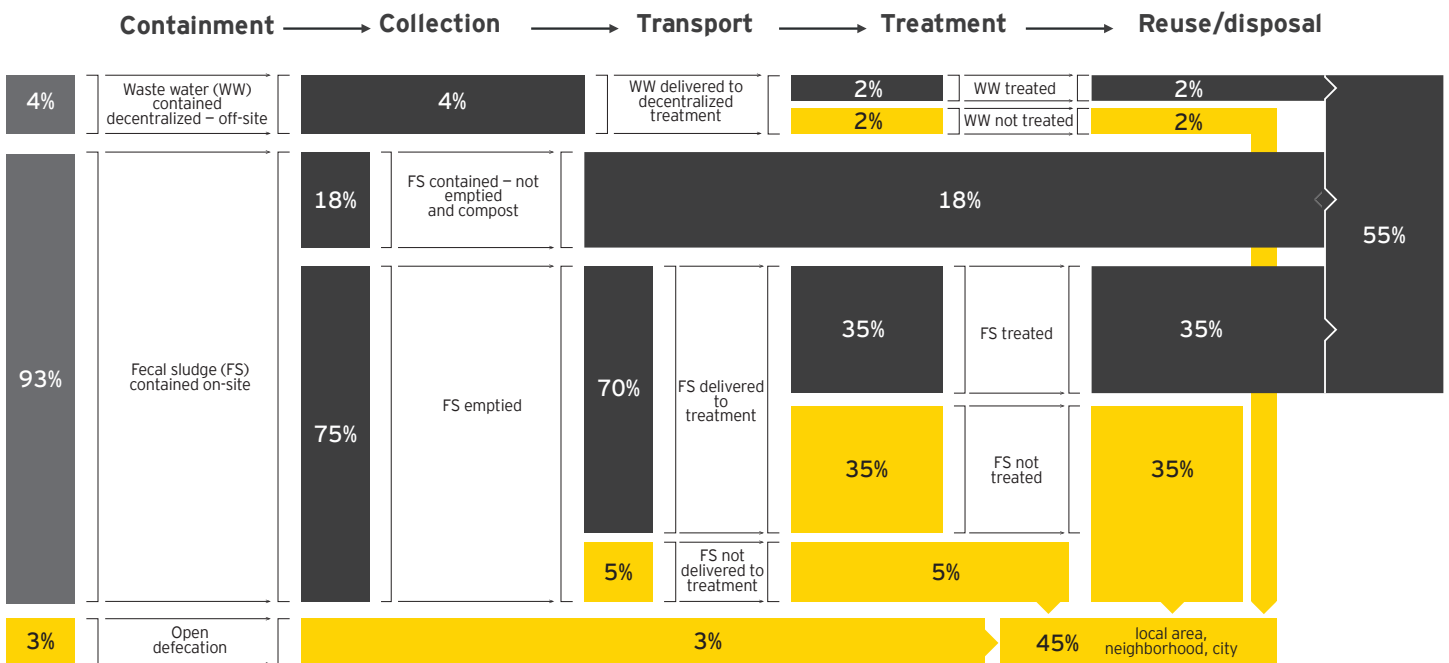


# Introduction

One in three people on earth – around 2.5 billion – lack decent sanitation. As the world's population continues to urbanize at rapid pace, outstripping infrastructure and municipal capabilities, it's a crisis that looms especially large over cities. With populations in informal settlements (“slums”) expected to double to two billion by 2030<sup>1</sup>, these dense urban communities pose one of the biggest challenge to meeting the United Nations (UN) Sustainable Development Goal (SDG) of achieving access to adequate and equitable sanitation and hygiene for all.

The problem is that toilets alone are not an answer. Without effective management of the wider sanitation service chain – containment, emptying, transport, treatment and waste conversion or disposal – a sizeable percentage of waste still ends up contaminating the environment, causing a major public health hazard. For example, in Kumasi, Ghana's second city, 45% of waste remains unsafely managed. In many similar cities, that figure reaches levels higher than 90%.

**Figure 1:** Illustrating waste flows in Kumasi, Ghana<sup>2</sup>



This is why container-based sanitation (CBS) – a service-based business model built around stand-alone toilets that store waste in sealable, removable cartridges – looks like one of the most promising alternatives to the poor sanitation options facing so many lower income urban customers. However, the CBS model is still in the early stages of gaining official recognition as a safe alternative to sewers and other on-site sanitation systems such as septic tanks.

Gaining that recognition requires demonstrating the CBS model's capacity for sustainable growth and replication – to prove its public health, financial and economic benefits at scale. Our analysis suggests that a purely private enterprise model of CBS provision is viable on paper, given the right circumstances, but that those

circumstances may rarely converge in reality. Making CBS work at scale – and in a sufficient range of conditions to make a dent in the global sanitation crisis – needs investment and support from donors, financing institutions and governments at national and metropolitan levels.

This is not a question of public subsidy propping up an otherwise unsustainable business model. It's about a partnership approach to creating the kind of conditions in which CBS has an opportunity to achieve its potential. For their part, CBS providers can and must show their ability to run operationally excellent businesses that deliver quality service at an affordable cost.

<sup>1</sup>The Challenge of Slums – Global Report on Human Settlements 2003, UN-HABITAT, 2003

<sup>2</sup>SFD Promotion Initiative - Kumasi, Ghana, SFD Report created through field-based research by WEDC as part of the SFD Promotion Initiative, November 2015.



Governments can and should recognize that CBS offers a means to provide low-income urban populations with safe collection, transport and treatment of waste, at a fraction of the cost of installing and maintaining sewers or managing fecal sludge from on-site sanitation systems. By creating the right frameworks to incentivize participation of high-quality social entrepreneurs in building CBS businesses, and to encourage public-private partnerships between them and municipal authorities, governments can make it easier to bring improved sanitation to even their hardest-to-reach populations.

In our view, this is the way forward and there are positive signs of momentum. For example, the recently launched Kenya Environmental Sanitation and Hygiene Policy (2016-2030) incorporates sealable containers or cartridges as part of the mix of acceptable technology options for improving urban sanitation. Based on detailed financial analysis and modeling conducted for

Clean Team in Ghana – and conversations with leading authorities on urban sanitation, including David Auerbach of Sanergy, Sasha Kramer of Sustainable Organic Integrated Livelihoods (SOIL) and Peter Hawkins of the World Bank – the insights shared in this paper are intended to help accelerate that progress.

We hope it provides water, sanitation and hygiene (WASH) stakeholders with a blueprint for taking CBS to the next level, gaining the recognition that it deserves as an improved sanitation option and scaling it as an important contributor to the achievement of SDG targets.



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# Background

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While there are several forms of improved sanitation officially recognized by the WHO/UNICEF Joint Monitoring Programme (JMP) for water supply and sanitation, these are often poorly suited to the needs and desires of people living at the base of the pyramid (BoP).

For many, flush toilets and connections to a piped sewer or septic system are simply not an option. Frequently the infrastructure just doesn't exist (and may take years to come), systems are too expensive or technically difficult to construct (particularly in densely populated, flood prone, hilly or rocky areas) or service fees are too high.

Public toilets aren't ideal either. They are not considered to be an improved form of sanitation by the JMP, and there are also issues of safety, security and accessibility at night – problems for women and girls especially.

The world needs a viable, high-quality alternative to piped sanitation. That's why a small number of groups around the world – including Clean Team in Ghana, which was set up and is managed by WSUP – are pioneering the concept of CBS. Uniquely suited to the challenges of dense urban populations, it offers the privacy, security and convenience of having a safely managed toilet in your own home at a price that's affordable.

Typically paid for as a managed service, the CBS model is built around provision of stand-alone toilets, which store waste in sealable, removable cartridges. Those cartridges may then be safely removed, without exposing residents or workers to the waste, and taken to a treatment or resource recovery center for processing and cleaning.

But while CBS has proven capable of satisfying people's need for safe, convenient sanitation on a small scale, it's not without its challenges. Negative associations with old-style, poorly managed bucket latrines can be hard to overcome and question marks remain over whether it can be reliably scaled as a business, with all that that entails – delivering service at an economically viable price that's affordable to low-income customers; establishing sufficient market share and reliable revenue streams; maintaining consistent frequency and quality of waste collection in a difficult operational environment; and adequately disposing of, or processing, the waste.

With Clean Team having grappled with these challenges in Kumasi for several years, and recognizing EY member firms' long-standing commitment to working with impact entrepreneurs, WSUP engaged EY to help. Working on a not-for-profit basis, a project team helped identify ways for Clean Team to achieve profitability and better position itself to scale, including assessing the viability of its CBS model in other markets.

The outcomes of that analysis are what we share here, in the form of insights aimed at improving prospects for success. We believe they are widely applicable, offering the potential for Clean Team and other enterprises to achieve the scale and impact necessary for CBS to gain official recognition as an improved sanitation option.

# Understand the economics

CBS won't gain recognition as an improved sanitation facility unless the model can be shown to achieve public health benefits at scale. In turn, CBS enterprises won't be able to achieve that scale unless they have a financially viable business model, capable of sustaining itself for a realistic number of customers. For this reason, it's essential to start with a clear understanding of the drivers of sustainable performance.

## Insight 1: Gross margin is king

When it comes to understanding basic financial viability, there's really only one indicator that matters – gross margin.<sup>3</sup> Our analysis of the Clean Team model suggests that you can't build a self-sustaining CBS business without achieving a gross margin of at least 50%. Anywhere below 50%, CBS is unsustainable without subsidy, since breakeven at earnings before interest and taxes (EBIT) margin level<sup>4</sup> becomes unachievable below an impractical number of customers, if at all (see Table 1).

**Table 1:** The impact of gross margin on breakeven point

Gross margin	Customers needed for ...		
	0% EBITDA	0% EBIT	10% net margin
50%	5,500	16,000	49,000
45%	8,000	38,000	unviable
40%	10,000	1,000,000	unviable
30%	18,000	unviable	unviable

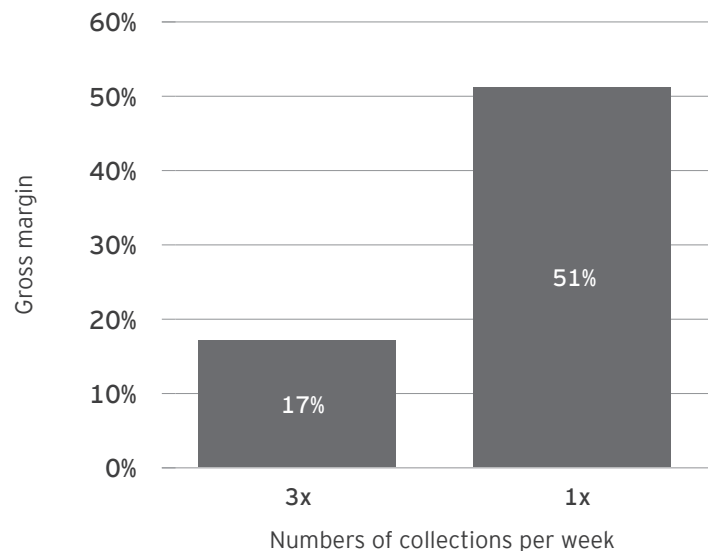
If gross margin is too low (less than 45%), the business will struggle to reach breakeven at 0% EBIT, let alone make the ~10% net margin needed to attract local entrepreneurs to run CBS enterprises as "normal" businesses. Below 40%, capital costs outweigh revenue and even economies of scale aren't sufficient to get the business over the line, hence the "unviable" label. The significance of capital costs are shown by the improved position at earnings before interest, taxes, depreciation and amortization (EBITDA) margin level,<sup>5</sup> before depreciation of capital has been taken into account.

With the high price elasticity of demand (see Insight 2), significant improvements in gross margin are unlikely to come from raising prices, so that means focusing on the business' biggest cost drivers – above all, frequency and cost of waste collection, and the time and cost associated with collecting customer payments. Reducing the former can make a significant impact on profitability (see Figure 2), which is why Clean Team is looking to complete the move to an exclusively "dry" model.<sup>6</sup>

By eliminating the need for chemicals and chemical input costs, a dry toilet gives Clean Team the ability to cut waste collections from thrice weekly to weekly, with a modeled increase in gross margin of 34%. Add in a mobile payment platform, reducing the need to go door-to-door collecting and chasing cash payments, and that figure jumps to 60%.

Assuming all other steps needed to reach a 50% gross margin have been implemented, Figure 2 isolates the impact of frequency of waste collection on gross margin and illustrates the value of being able to reduce collections to once a week.

**Figure 2:** Gross margin is highly sensitive to frequency of waste collection



## Insight 2: Target the 'working poor'

While costs will vary between countries, our work with Clean Team in Ghana suggests an indicative price range of US\$8 to US\$9 per household per month for a CBS business to function effectively. If prices drop significantly below that, then gross margin similarly heads south and the model breaks down. For example, a US\$5 price for Clean Team would entail a gross margin of just 18% – well below the ~50% needed to achieve economic sustainability at any practical scale.

This raises the question of affordability, perceptions of which depend on which frame of reference you use. On the one hand, at costs that have risen to roughly 15 cents per use, a family of four in Kumasi could easily expect to pay US\$20 a month for use of frequently unsanitary public toilets. On the other, US\$8 to US\$9 is equivalent to around two-thirds of the monthly rent for a two-room house in a typical informal settlement – a considerable sum for low-income households. In any event, in practice, it appears that customers' willingness to pay for CBS tails off rapidly above US\$5 and the implications of this are two-fold.

First, it means CBS won't reach the very base of the pyramid – those households living on US\$1 to US\$2 a day – without some form of subsidy. In order to build self-sustaining private enterprises, CBS providers should therefore target the "working poor" – customers who have a steady income, somewhere in the range of US\$50 to US\$150 a month, but who are nonetheless not wealthy enough to install their own septic tank or sewer-connected toilet, or who live in circumstances where these are impractical.

Second, it means CBS providers need to be prepared to respond to low penetration in very large markets – a natural consequence of needing to find these working poor households in sufficient quantity and density (more on this under Insight 7).

## Insight 3: Collaborate to crack scalability

By itself, a healthy gross margin is not sufficient to make CBS enterprises viable and scalable. The business model is also highly dependent on other factors, including:

- ▶ Sourcing sufficient talent to operate what is a relatively complex business – at a standard high enough to retain customers and support expansion, at a cost low enough to maintain adequate profitability
- ▶ Finding appropriate and affordable transfer, storage and waste-to-resource facilities (see Insight 4)
- ▶ Controlling overhead increases
- ▶ Achieving a landed cost<sup>7</sup> of US\$40 to US\$50 per toilet, depreciated over 5 years

While all present their challenges, the latter deserves closest scrutiny – not only because of the impact it can make, but also because we’re not yet aware of any design that has met the twin demands of a US\$40 to US\$50 cost and a 5-year life span.

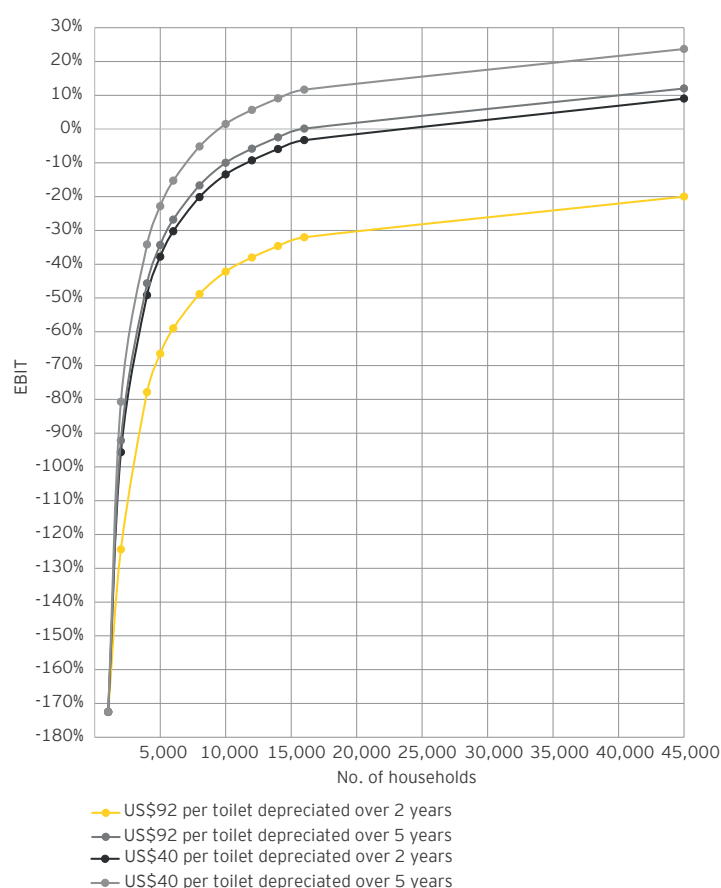
Scale-up projections conducted for Clean Team (see Figure 3) clearly show the value of simultaneously reducing the initial capital cost of a CBS toilet and increasing durability. Should their relatively high-cost units (US\$92) only have a short life span (2 years), the business never reaches operating breakeven.<sup>8</sup> If their useful life extends to 5 years, while the business may reach breakeven at around 16,000 customers, it would take a customer base of around 45,000 to achieve a healthy 12% EBIT margin.

By contrast, the ability to produce units at landed cost of US\$40, depreciated over 5 years, would shrink the customer base needed to achieve that healthy margin to 16,000 – a much more attainable figure for a business that may struggle to achieve substantial market share.

However, as far as we know, no one has yet managed to crack the cost vs. quality conundrum. Either low cost comes at the expense of quality and durability, or quality and durability comes at the expense of cost (e.g., costs of most imported plastic units range between US\$120 and US\$200).

Achieving both simultaneously will almost certainly require extensive collaboration – probably one or both of concerted effort to design and develop new CBS concepts that meet both

Figure 3: Clean Team scale-up projections



cost and quality demands, and active involvement of municipal authorities as partners in CBS delivery (see Insight 8). In the latter case, this could help obviate the problem by providing access to a much larger customer base, by facilitating economies of scale in sourcing and purchasing toilets, and/or by subsidizing services to make higher cost, higher quality toilets available to customers at a price they can afford.

<sup>3</sup> Gross margin is gross profit divided by net sales, expressed as a percentage. It represents the percentage of total sales revenue that a business retains, after incurring direct costs. The higher the percentage, the more the business retains and the more capable it is of servicing its other costs and debt obligations.

<sup>4</sup> EBIT is a popular indicator used to understand a company's operating performance without regard to interest expenses or tax rates.

<sup>5</sup> EBITDA is another popular indicator of a company's operating performance, particularly useful as it eliminates the effects of financing and accounting decisions.

<sup>6</sup> A "dry" toilet is one that diverts urine from the cartridge, leaving only solid waste that users cover with organic solids (e.g., sawdust) after each use to suppress odor. The combination of dry waste and additive can typically sit in the cartridge for up to a week before odor becomes intolerable and collection is needed. By contrast, a "wet" toilet doesn't separate liquid and solid waste and requires use of a liquid chemical odor suppressant, which is typically effective for up to 3 days.

<sup>7</sup> Landed cost is the total cost of goods to the end supplier, including not only cost of manufacture, but also costs associated with transporting goods to their eventual destination (e.g., shipping fees, taxes and custom duties).

<sup>8</sup> The operating breakeven point for a business is the point at which sales revenues cover all costs, both fixed (e.g., rent, loan payments and management salaries) and variable (e.g., labor and materials).

## Insight 4: Link to city-wide waste management

Another critical economic consideration is what ultimately happens to the waste – i.e., whether it's stored and safely decomposed, or somehow processed and reused. In the case of storage, the CBS model is highly dependent on the availability of viable facilities – inevitably requiring high capital outlay to construct – at low or no cost to the business – and of sufficient space to expand those facilities to absorb waste from future business growth. In the case of reuse, it depends on the economic viability of parallel systems for “closing the loop” – for example, converting human waste into fertilizer or combining it with other waste to generate solid biofuel.

Closing the loop requires consideration of city-scale solutions that incorporate other existing waste streams (e.g., wastewater, septage, solid waste, etc.) and a number of CBS organizations are already vigorously pursuing the idea of waste-to-resource processing. Standalone businesses are also emerging, purpose-built to turn human and agricultural waste into commercially valuable products. Some, such as BioCycle in South Africa – which uses human waste as a partial feedstock for black soldier fly larvae that can be turned into a high-protein animal feed – are beginning to test these approaches at scale.

At the time of writing, it has not been determined whether waste processing can generate better than cost-recovery revenues. In circumstances where there is a sufficiently large and accessible market for a given processed product, the answer is probably that it can. It is certainly worth exploring possibilities for strategic partnerships between CBS and waste-to-resource businesses. However, given the challenges already facing CBS businesses to demonstrate financial viability and growth potential, attempting to incorporate waste-to-resource processing into an existing CBS business arguably adds unnecessary further complexity at this stage.

In any event, a strong understanding of each market's affinity for different potential treatment by-products is crucial. It is therefore important that CBS businesses engage with sanitation authorities, waste-to-resource businesses and investors to help create partnerships that allow for and incorporate CBS waste streams.







## Understand the market

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Economic sustainability and scalability are necessary but not sufficient to demonstrate that CBS has broad potential. We also need replicability – proof that the model can be established and scaled in enough low-income markets around the world to justify significant investment. Of course, that means understanding which factors combine to create the most favorable market conditions for CBS. But, just as importantly, it means being able to communicate and fulfill the promise of a distinctive value proposition.

### Insight 5: Use human-centered sales to break through complexity

Many factors combine to make CBS a complex buying decision. Potential customers must balance a variety of considerations ranging from the relatively obvious – space to accommodate a toilet, availability and desirability of substitutes, and ability and willingness to pay for sanitation, for example – to issues surrounding the finer points of product design and cultural factors such as reluctance to share a toilet across mother-in-law/son-in-law relationships.

Finding a way through that complexity requires a human-centered sales approach that teaches salespeople to focus on solving the customer's problem, rather than on product features and price. Typically centered around issues of basic human dignity and the health and safety of family members, personalized conversation helps customers to articulate the biggest problems they face as a result of not having their own toilet, and to come to their own conclusion that CBS offers a better answer to those problems than other sanitation options.

Such conversations should also be used to surface specific design features that might help to overcome any residual concerns acting as barriers to purchase. For instance, that might mean a square design that fits neatly in the corner of small, crowded dwellings, or the ability to disguise the toilet as a piece of furniture to avoid embarrassment in front of guests in a one- or two-bedroom house. WSUP has had some success with these approaches during trials in Kenya.

## Insight 6: Collect reliably to keep customers happy

The provision of waste collection and transfer as a managed service – regularly replacing full cartridges with clean, empty ones and safely transporting waste for treatment and disposal – is key. Done well, it's what separates the CBS model from old-style bucket toilets. Done badly, it's one of the biggest causes of customer attrition.

Clean Team's experience shows that customers will complain when waste smells and will leave if collections are missed. That's why it's imperative to provide an efficient and reliable service – frequent enough that odor doesn't become intolerable, but not so frequent that it breaks the model economically. The challenges of maintaining that level of service consistently and at scale should not be underestimated.

This is another reason why Clean Team is looking to complete the move to exclusively dry toilets that only require weekly waste collections. The ability to reduce the frequency of collection to once a week not only offers the opportunity to reduce costs, but also makes it much easier to maintain a quality service and keep customers happy.

## Insight 7: Size matters

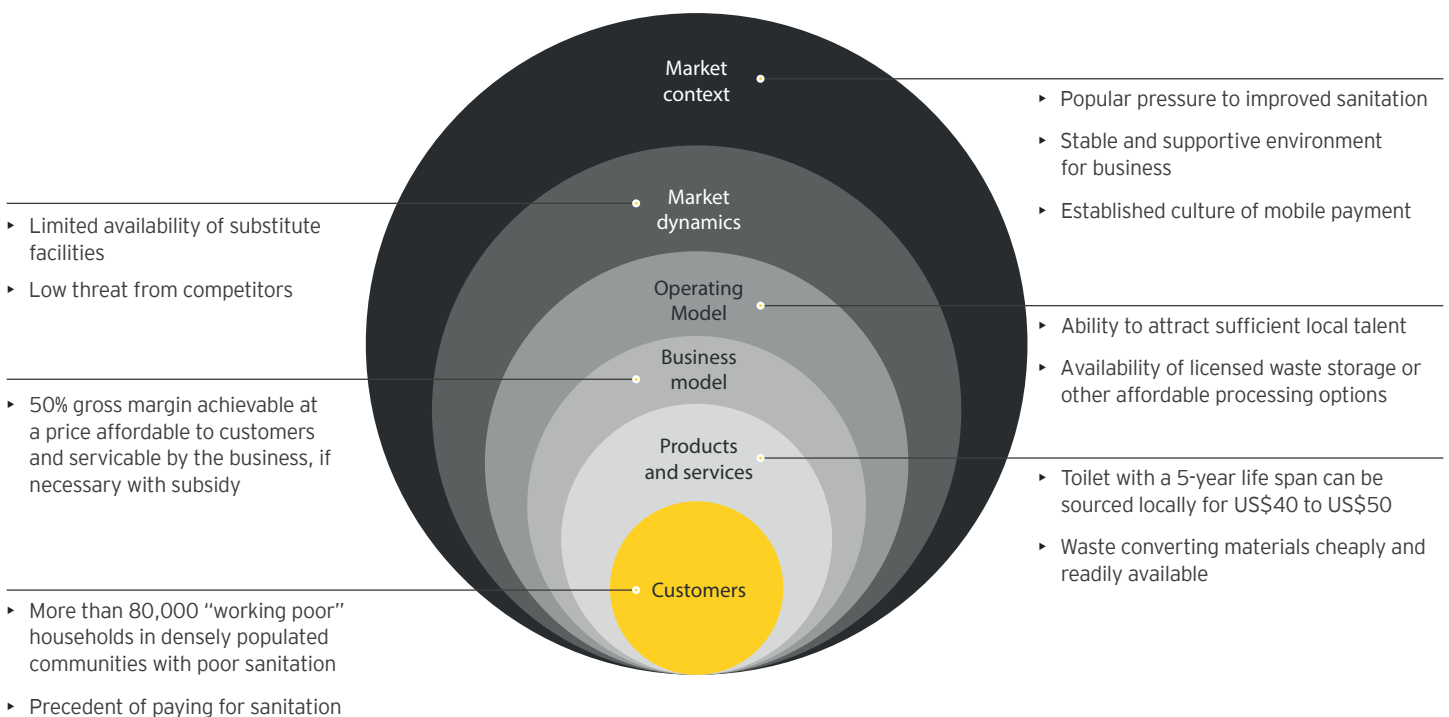
Given the complexity of the buying decision, and the challenge of finding a sufficient number and density of working poor households that are willing and able to pay for the privilege of in-home sanitation, market size really matters.

If CBS were delivered as a tendered service to a municipal authority (see Insight 8), very high customer densities could be easily achieved. But while there could be markets where CBS offers a sufficiently compelling proposition that a standalone, unsubsidized enterprise can establish a large market share (say 40% to 50%), a much smaller market share of 10% to 20% is more probable. That necessarily means finding larger markets.

Building on the critical success factors described above, EY developed an assessment tool to judge the potential viability of Clean Team's CBS model in new markets (see Figure 4). Coupled with this, EY also undertook a high-level assessment of more than 20 of the world's largest informal urban populations across Asia, Africa, and Central and South America<sup>9</sup> to gauge how many of these markets might support unsubsidised CBS enterprises (see Figure 5).

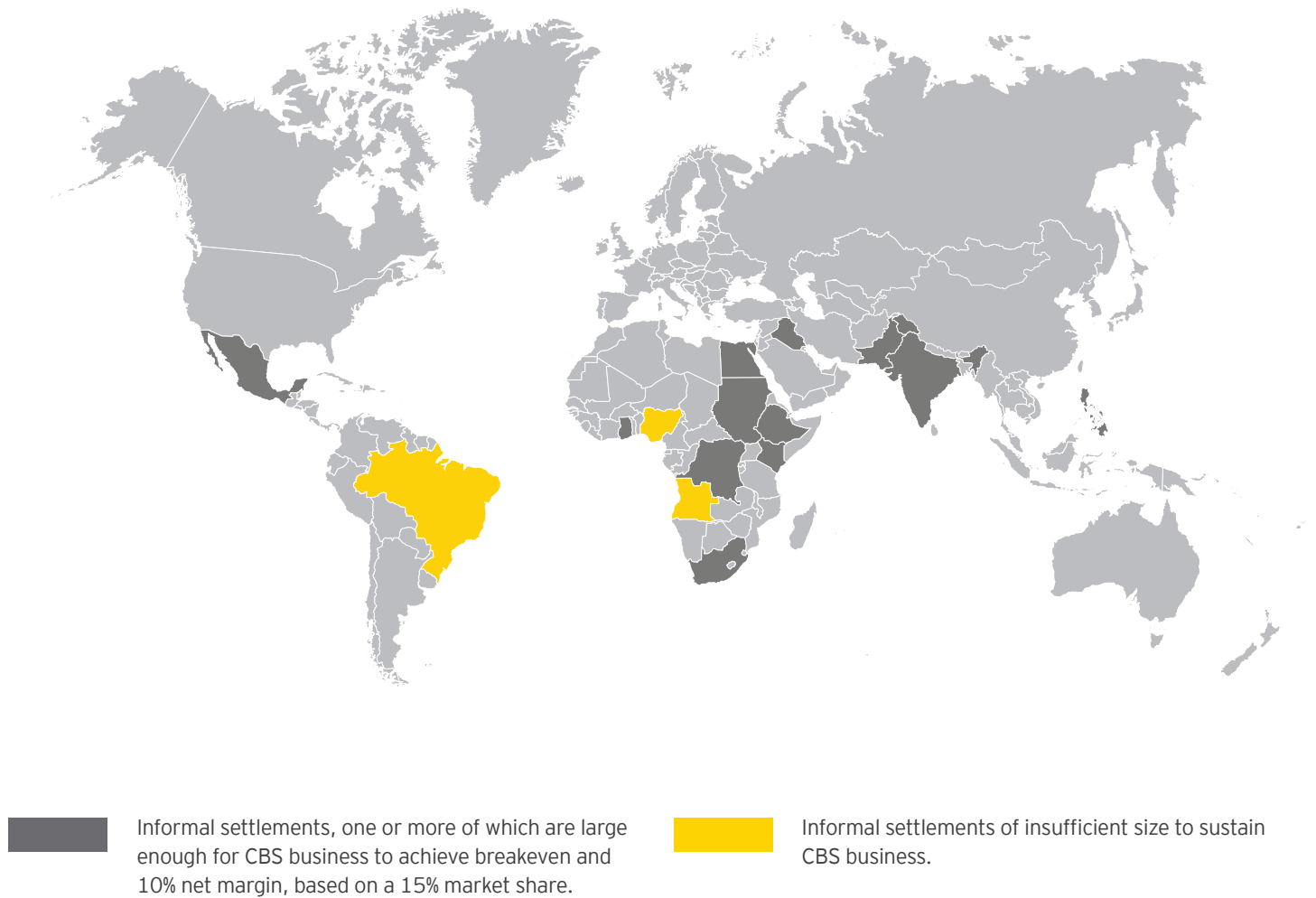
Assuming the ability to reach and maintain a 15% market share and to source toilets and cartridges at a landed cost of US\$40 to US\$50, our analysis suggests that 71% of those settlements would be large enough for the business to break even and 63% to achieve a 10% net margin. So while, in principle, there are enough feasible markets around the world to make CBS a promising solution, the viability of any given market should not be assumed.

**Figure 4:** Favorable market conditions for CBS





**Figure 5:** High level market share analysis of urban informal settlement populations



<sup>9</sup> Based on figures from the United Nations and World Bank.

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# Understand the power of partnership

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Even acting on all the insights above, it will still be extremely challenging to scale CBS solely as a private enterprise, dependent on unsubsidized revenue collected directly from customers. Given the sensitivities of the private enterprise model to market size and share, price and capital costs, a hybrid public-private partnership (PPP) model appears to offer a more promising avenue for demonstrating a sustainable, scalable and replicable approach to CBS.

## Insight 8: Actively pursue PPP opportunities

Estimated to pay off at a rate of up to nine to one, the case for public investment in sanitation is unequivocal. Yet what frequently stands in the way is that authorities simply don't have the large sums needed to pay for piped sanitation. In this context, the key point about CBS is that it offers the same benefits – the safe collection of waste and its transport to a place where it can be treated and re-used – at a fraction of the capital cost of sewers. This is a significant point and it's why municipal authorities should consider CBS carefully when thinking about how they can bring improved sanitation to their hardest-to-reach populations.

A PPP model of provision could be based on CBS providers contracting directly with authorities, installing and maintaining toilets, and managing waste collection for entire communities, in return for a monthly service fee. Municipal authorities could make service provision a more attractive proposition to local entrepreneurs in several ways – from directly subsidizing CBS providers' revenues, to bearing (or providing soft loans to meet) their upfront capital costs, to providing tax breaks.

Obvious benefits over the private enterprise model – higher customer densities, more straightforward and reliable revenue streams, and reduced customer acquisition and capital costs – would certainly reduce risk substantially and encourage more entrepreneurs and investors toward CBS. It could also lower costs and improve services for customers, with them not only benefiting from service quality being bound by service level agreements, but possibly even higher quality and more durable toilets made affordable through subsidization. Indeed, given the significant question mark over the likelihood of toilets of sufficiently low cost and long life spans, this may be the only way that CBS can be made viable in most circumstances.

Whereas the private enterprise model analyzed relies on indicative revenues of US\$8 to US\$9 per household per month, under a PPP model, a provider serving as few as 20,000 households could expect to achieve an EBIT margin of 14% at a price of slightly more than US\$7. Municipal authorities might wholly or partly fund that cost on behalf of their constituents, for instance using revenues generated through sanitation tariffs.

As shown in Figure 6, if a municipality undertaking its responsibility to ensure public health and provide safe sanitation services through CBS covers between US\$40,000 and US\$120,000 per month for 20,000 customers, monthly costs fall below the critical US\$5 mark to as low as US\$1. For relatively modest outlays of public funds it could be possible to bring CBS within reach of even those living at the very base of the pyramid.

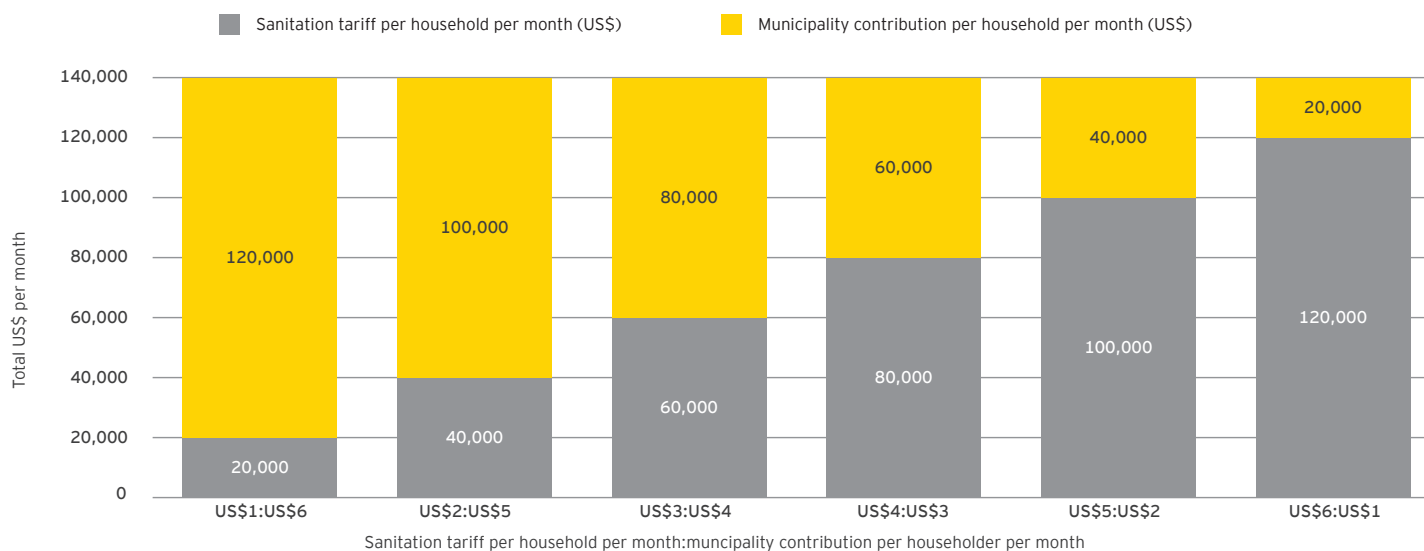
Perhaps most crucial, a PPP model would also provide the means to open up a wider range of markets for CBS. While large markets are a prerequisite for the private enterprise model, in order for businesses to attract and retain a viable number of customers at relatively low market share, PPP offers the ability to acquire an equal customer base in a much smaller area.

It all adds up to a strong case for WASH organizations to actively pursue opportunities to pilot PPP models, and signs are emerging that the appetite for such partnerships is growing. For example, following pilot testing in the Philippines, Laguna Water – itself a partnership between the Province Government of Laguna and Manila Water Philippine Ventures – is further expanding its pilot to bring CBS services to BoP households.

Elsewhere, Kenya's new Environmental Sanitation and Hygiene states that the government will work with county, municipal and community authorities to encourage PPP and incentivize private sector participation. This is another welcome development, indicative of the kind of supportive regulatory environment that can greatly increase the prospects for scaling CBS – one that Sanergy can use to partner with the Nairobi County government and expand its reach and impact in the city's informal settlements.



**Figure 6:** Subsidy options for a 14% EBIT margin CBS business serving 20,000 households<sup>10</sup>



## Conclusions

Against a backdrop of rapid urbanization, expected to see the number of people living in informal settlements double to two billion by 2030, it's unlikely that we will reach the Sustainable Development Goal of achieving access to adequate and equitable sanitation and hygiene for all without a viable, high-quality alternative to piped sanitation.

Uniquely suited to the challenges of densely populated areas that lack access to sewers and other on-site sanitation systems, CBS has the potential to be just such an alternative – provided it can be demonstrated as financially viable and capable of being replicated to a scale deserving of recognition as an improved sanitation facility.

The experience of working with Clean Team suggests that CBS shows sufficient promise to be well worth further active investment. With a rigorous focus on cost drivers and tightly run, customer-centric operations in suitable markets, it is possible to achieve a sustainable level of profitability. Furthermore, our market assessment suggests that the Clean Team model is also replicable, with a number of markets offering the kind of conditions necessary for CBS to survive and thrive.

However, a model based exclusively on provision by private enterprise still faces significant challenges. These not only include the availability of appropriate facilities for transfer, storage and treatment of waste at minimal capital cost, but also the (as yet unsolved) conundrum of how to produce a US\$40 to US\$50 toilet with a 5-year life span – vital to the economics of scalability when complexity effectively limits market share to around 10% to 20%.

These issues are only likely to be overcome through public private partnership with municipal authorities, which offers the possibility both to lower the up-front capital costs of toilets and waste disposal sites, and to achieve substantially larger market share. Crucially, it also opens up a wider range of markets to CBS by reducing the size of the population needed to establish a viable customer base. Coupled with much more reliable revenue streams, thanks to payment via sanitation tariffs, these benefits would also undoubtedly attract greater interest from social entrepreneurs and impact investors as potential providers and supporters of CBS services.

For all these reasons, municipalities and CBS organizations should treat the pursuit of opportunities to pilot PPP models as a top priority.

<sup>10</sup> These figures are based on estimated operating costs only. They exclude an estimated US\$2.5m to US\$3m of up-front capital requirement for the purchase of toilets, cartridges, vehicles and cleaning facilities, plus any capital or operating costs involved in waste storage or recycling.

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#### About WSUP

Water & Sanitation for the Urban Poor (WSUP) is a not-for-profit company that helps transform cities to benefit the millions who lack access to water and sanitation. We were created in 2005 as a response to the unprecedented urban explosion that has left cities unable to provide basic services, such as access to a toilet or drinking water, to low-income communities. We are based in the UK with offices in seven countries in sub-Saharan Africa and Asia. Since inception we have helped over 10 million people access better water and sanitation services. For more information visit [wsup.com](http://wsup.com).

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