CBSA
Container Based Sanitation Alliance

BRIEFING PAPER
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Unlocking carbon credits for sanitation

Study finds carbon credits can provide a viable revenue stream for container-based sanitation providers in urban areas

Key messages

Unmanaged sanitation is a major contributor to the climate crisis

Sanitation is estimated to contribute 4% of global manmade greenhouse gas (GHG) emissions, including 2-6% of global methane and 1-3% of global nitrous oxide emissions. These largely stem from anaerobic digestion in pit latrines and septic tanks that are not frequently emptied, and from wastewater treatment plants lacking methane capture.

Active management through frequent emptying almost eliminates emissions

By quickly collecting and treating waste, actively managed sanitation systems such as Container Based Sanitation (CBS) reduce the anaerobic degradation that produces these gases. Working with the carbon finance consultancy South Pole, we studied five CBS operators and found that their projects would eliminate 79% to 93% of baseline emissions, depending on the treatment methods used and contextual parameters.

Five CBS services studied could earn carbon credit income of US$2.4 million over five years, at US$3-30 per toilet per year, at current scale up projections

Our study of five CBS operators shows that carbon credits can provide a viable revenue stream for providers operating at a sufficient scale, particularly when co-treating other waste. Modelling CBS scale up projections using existing carbon credit methodologies, the five services examined would collectively earn US$2.4 million in eligible carbon credit revenue over five years for approximately 81,000 toilets and co-treated solid waste, using average 2022 carbon prices.

Profitability is limited by the exorbitant cost of certification, which reduces potential profit by 40%, and the significant monitoring burden

The annual cost of validation and verification alone is around US$53,000 per organisation under the Gold Standard. Add to that issuance fees, revenues for the services examined reduced by 40% over five years, at close to a million US dollars, leaving a surplus of US$1.4 million. To reach a surplus after paying these fees, the five CBS operators studied would need to install and operate an additional 4,000 to 20,000 toilets to their current operations (depending on the type of toilet and treatment process used). The study did not include monitoring costs, which can be significant (unless registries allow new digital approaches).

Improving baseline data, co-treating other waste and monetising social impact can substantially increase revenues

The carbon credits that can be claimed could increase by 30% with more accurate baseline data, as current IPCC figures significantly underestimate the full extent of emissions in containment. Collecting and treating additional waste such as food or animal waste can significantly improve the viability of a carbon credits project for sanitation providers due to the large increase in scale of treated waste and resulting emission reductions, highlighting

potential complementary co-treatment business models for enterprises seeking to maximise carbon credit revenue. Furthermore, projects with positive social impacts have been sold for higher prices which could potentially provide further additional revenue for CBS projects.

Current rules prevent existing toilets from earning carbon credits; including them could increase revenue by almost 50%

Carbon credit registries typically do not allow existing infrastructure to be eligible for carbon credits, under the principle of additionality, affecting incumbent sanitation operators, who will have to scale significantly to generate revenue.

Carbon credits can be a significant step towards accessing other climate funds

Pursuing carbon credits revenue can be risky but can be a meaningful step towards structuring sanitation projects to meet the rigorous requirements of other sources of climate finance, such as the Green Climate Fund (GCF) which, to date, have remained largely out of reach to the water, sanitation and hygiene (WASH) sector.

Mitigation and adaptation go hand-in-hand for sanitation

Sanitation is an essential public good, which has to be publicly funded; carbon credits may reduce the funding gap but won't eliminate it. Ensuring residents have safe, actively managed sanitation is also essential for climate resilience, as CBS has shown to be for flood-prone areas and water-scarce areas.

Recommendations

Municipalities and utilities

- Acknowledge sanitation's contribution to the climate crisis.
- Incentivise climate-smart sanitation in policy, regulation and concessional contracts.
- Ensure off grid sanitation services regularly remove sludge (e.g. with small containers to encourage frequent emptying) and treat it to reduce GHG emissions.

National governments

- Align sanitation policies with climate commitments and include them in National Adaptations Plans (NAP).
- Include sanitation emissions in Nationally Determined Contributions (NDC), as less than 0.2% of current NDC activities are sanitation related.

Investors, funders and lenders

- Support climate-smart and -resilient sanitation by incorporating climate change mitigation outcomes as essential criteria for sanitation investments, loans, and funding.
- Support sanitation providers to scale services and unlock carbon credits as an additional revenue stream, reducing the burden on public or aid funding.
- Fund research that improves the accuracy of GHG emission estimates for off grid sanitation, to increase related eligible emission reductions and potential income.

Intergovernmental Panel on Climate Change (IPCC)

- Update the IPCC guidelines so that the emission factors (EFs) and methane correction factor (MCF) used to calculate methane production are based on up-to-date empirical data.

Carbon credit issuing companies

- Reduce the complexity and cost of certifying smaller-scale projects.
- Allow digital solutions that reduce the complexity and cost of monitoring.

Researchers

- Undertake empirical and modelling work to update estimates of greenhouse-gas emissions from off-grid sanitation (as is currently being undertaken by the SCARE project).
- Study the extent to which scheduled or frequent emptying reduces emissions.

In addition to advocating for the above, the CBSA is:

- Working to make carbon offset methodologies more accessible to CBS operators by simplifying the process and maximising the amount of emission reductions eligible for carbon credits.
- Mitigating the risk of pursuing this revenue for CBS providers, including by producing a carbon credit certification guide and exploring a potential aggregator role for CBSA.
- Supporting CBS operators to register carbon credits projects and derive as much value as possible from them.

Contents

Why carbon credits?

While actively managed sanitation such as Container Based Sanitation (CBS) can significantly reduce greenhouse gas emissions, a lack of funding is hindering the proliferation of services. The Container Based Sanitation Alliance (CBSA) undertook a feasibility study to explore whether carbon credits[1] could provide a profitable revenue stream to help to reduce the funding gap and enable scale up of CBS services.

Sanitation and the climate crisis

Sanitation produces carbon emissions along the whole chain: direct emissions (gases produced by decomposing organic matter), operational emissions (such as electricity or transport) and embodied carbon (emitted during construction of infrastructure). Recent research from the Climate And CosTs in Urban Sanitation (CACTUS) project and the Kampala study have shown that direct emissions are significantly higher than operational and embodied emissions.

When faecal sludge or wastewater undergoes anaerobic digestion (typically in wet pits, septic tanks, and anaerobic treatment), it produces methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). Methane emissions are the second largest greenhouse gas (GHG) driver of global warming and have 80 times the warming power of carbon dioxide over the first 20 years after reaching the atmosphere. In 2021, the Intergovernmental Panel on Climate Change (IPCC) called for methane to be urgently tackled. Nitrous oxide is even worse, with a warming power of 265 times that of carbon dioxide.

Sanitation contributes 2-6% of global methane emissions and 1-3% of global nitrous oxide emissions. As urban populations grow, the use of pit latrines, septic tanks, and waste-settling ponds will increase sanitation-related GHG emissions.

The current values used for estimating sanitation emissions significantly underestimate the volume of methane emissions generated by off grid sanitation. In Kampala, half the city's emissions are due to sanitation despite the city having many other sources of emissions. In Senegal, urban sanitation produces 1.7 Mt CO_2e/year,[2] which is around 6% of the emissions included in the country's pledge to reduce emissions (i.e. the Nationally Determined Contributions (NDC) document). Worldwide, just eliminating open defecation will add 55 Mt CO_2e/year and yet it must be done.

Despite this, awareness is lacking on the links between sanitation and the climate crisis. Minimal inclusion of sanitation in climate policy and financing, including in NDC climate pledges and National Adaptation Plans (NAPs), means that little funding from climate finance, which aims to assist developing countries in adaptation and mitigation practices to counter climate change, reaches water and sanitation projects. The need for awareness-raising and scaling climate-smart approaches to the sanitation crisis has never been more urgent.

[1] See The Ultimate Guide to Understanding Carbon Credits for a definition of key terms.

[2] A CO_2 equivalent (CO_2e) is a unit of measurement that is used to standardise the climate effects of various greenhouse gases. See What are CO_2 equivalents?

Container Based Sanitation

CBS is an innovative solution in which an operator provides a sanitation service featuring toilets with sealable, removable containers that are emptied regularly for the safe disposal or reuse of waste (Figure 1). This is suitable for challenging geographies where low-income communities are often forced to live, including informal and densely populated urban areas as well as areas with rocky or unstable soil conditions, high water tables, limited water availability, challenging topographies, or vulnerability to flooding.

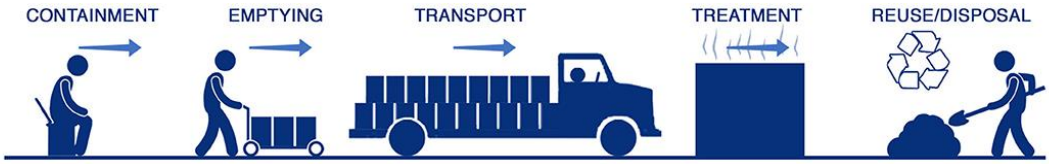


Figure 1. The CBS value chain

CBS has been recognised as one of the safely managed sanitation chains to achieve SDG 6.2 by WHO, UNICEF, UN-Habitat and the World Bank, and is part of the variety of approaches to achieve City-Wide Inclusive Sanitation (CWIS).

By frequently collecting and treating waste, and often separating faeces from urine, CBS services reduce anaerobic degradation and related emissions. Methane and nitrous oxide emissions are most significant during containment (especially wet) and treatment. Figure 2 shows the GHG contributions from methane produced by various sanitation systems, highlighting off grid sanitation as by far the largest methane production trigger. CBS is also climate resilient – well suited to water-scarce environments and drought as well as a hygienically safe and resilient option in flood-prone areas, supporting adaptation as well as mitigation.

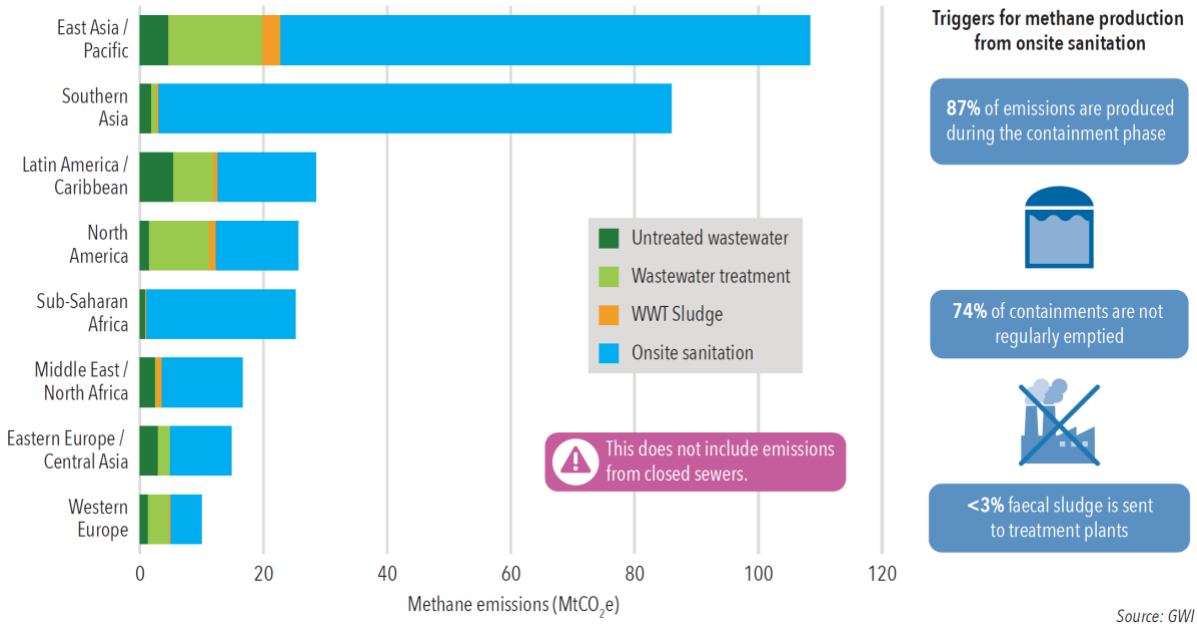


Figure 2. Illustration of the enormous contribution of onsite sanitation to methane emissions compared to sewerage, due to lack of frequent emptying services and waste treatment. Adapted from Global Water Intelligence – Managing water's carbon footprint.

In 2016, several CBS operators created the Container Based Sanitation Alliance (CBSA), to exchange knowledge and work collectively to scale CBS. The CBSA has been looking into the climate change mitigation potential of CBS in several ways. In 2020, we developed a calculator tool to measure CBS greenhouse gas emissions using emission factors and assumptions about waste characterization and energy from the IPCC, the Clean Development Mechanism (CDM) and peer-reviewed literature. We found that CBS systems can significantly reduce GHG emissions from sanitation, estimating that the four operators studied collectively mitigated **44,000 tCO_2e over a year, representing a 60% to 96% emission reduction,** confirming CBS as a climate-smart solution. Research in Haiti has shown a GHG reduction potential for CBS of 126 kg CO_2e per person per year.

The sanitation funding gap and carbon credits

Providing public goods such as safely managed sanitation services to low-income residents requires ongoing and significant public funding, whichever system and service options are chosen. However, current funding streams are still heavily geared towards centralised sewerage systems, rather than off-grid solutions, at the detriment of low-income urban residents.

As a result, there is a large funding gap between the cost of service provision, and the revenue currently derived mostly from user fees and the sale of by-products. The CBSA has been looking at ways to reduce this funding gap, including with non-traditional finance. Climate funds should in theory be another option to fund sanitation, but in practice little has reached the sector. Given the GHG emission reductions offered by CBS, we have considered carbon credits.

In 2022, the CBSA led a feasibility study to understand whether carbon credits could become a viable income stream for sanitation providers and help to reduce the funding gap. This brief describes the results of this study, and the actions needed to make carbon credits accessible to sanitation providers, providing an addition revenue stream.

What we did

CBSA worked with the carbon finance consultancy South Pole to analyse the potential emission reductions of five CBS services over the coming five years and understand whether carbon credits could be a viable income stream.

The project consisted of four stages:

1. **Baseline equations and literature review (Box 2)**: All applicable methodologies and tools identified and used were from UNFCCC Clean Development Mechanism (CDM). These methodologies provided the relevant equations and default values to conduct the mock emission reduction calculations (stage 3). Additional resources (see research in box 2) were used to determine several default factors for the baseline calculations.
2. **Service analysis (Box 1)**: South Pole analysed each CBS provider's project activities and pre-intervention conditions to determine the baseline scenario in the target area (e.g. Shit-Flow Diagrams, types of toilets, water table levels) and identify the sources of GHG emissions.
3. **Mock emission reduction calculations**: South Pole simulated emission reduction calculations based on growth and treatment projections over five years, as shared by each CBS provider, and along the entire sanitation chain. Emission reductions compare the baseline emissions (emissions avoided i.e. emissions which would have been produced in the absence of the operators' projects) and project emissions (emissions created by project activities based on the projected CBS service expansion):

   Emission Reductions = Baseline Emissions – Project Emissions

   Baseline emissions included waste decomposition in wet and dry pits and in septic tanks, based on likely toilet usage and water table levels,[3] and assuming no emptying; solid waste treatment or disposal as currently practised in studied cities (typically burning on site, stockpiling in anaerobic conditions, or landfill disposal); current chemical fertiliser use; and current fuel use patterns (crude oil, fuel oil or LPG).

Box 1: Services examined

This study considered how five CBS operators were planning to scale, with new or upgraded treatment methods in some cases:

Clean Team, Ghana: A urine-diverting toilet collects solid and liquid waste separately. The faeces are covered with sawdust and taken to drying beds at the treatment plant, to subsequently be composted.

Loowatt, Madagascar: Faeces and urine are both captured in a thin polyethylene film in single-hole toilets. At nearby treatment facilities, the film is separated from the faeces and urine. The waste is then anaerobically digested to produce biogas burned in boilers for heat generation.

Sanergy Collaborative, Kenya: A urine-diverting toilet collects solid and liquid waste separately. The urine is discharged to a sewer drain while the faeces are transported to the treatment facility, where it is mixed with organic food waste and manure from pig farms. The mixed waste is fed to black soldier fly larvae which are then dried, pasteurized, and packaged for sale as animal feed. 50% of the remaining organic matter is composted and 50% is dried and compressed into briquettes.

Sanivation, Kenya: This study included both Sanivation's CBS services where a urine-diverting toilet collects solid and liquid waste separately, and their waste-to-value treatment plants where faeces are treated and combined with other organic waste residues such as sawdust to make briquettes. The briquettes replace non-renewable firewood in industrial boilers and curb deforestation.

SOIL, Haiti: A urine-diverting toilet collects solid and liquid waste separately. The faeces are covered with a dry carbon-based cover material and urine is collected in a one-gallon jug. Excreta are thermophilically composted, and the liquid waste is disposed of locally via soil infiltration.

[3] A higher water table leads to higher emissions where the containment of human waste is not sealed, e.g. in unlined pit latrines.

Project emissions were calculated including, transport, and treatment and reuse methods: composting, briquetting, incineration, leakage in methane capture, fuel consumption, electricity consumption, Black Soldier Fly (BSF) treatment, and fertilizer use. The number of toilets already serviced by CBS members up to the end of 2021 were not included, as typically only new installations are eligible for credits.

4. **Carbon credits revenue estimations**: Revenue estimates were calculated for the two largest established registries on the voluntary carbon market, the Verified Carbon Standard (VCS) and the Gold Standard (GS), for each operator, considering:

    a. Potential income from carbon credits: the number of carbon credits was based on emission reductions and the eligibility of those ERs under specific carbon credit schemes, as well as the likely sale price of the carbon credits using average prices for Gold Standard and VCS carbon credits in 2022, USD$10 and USD$7 respectively.
    b. Likely costs of becoming certified: using known certification costs (including validation, monitoring, verification, issuance fees) from VCS and GS, for a small-scale scheme that is verified on an annual basis.

Unless stated otherwise, in this brief we are presenting the best-case scenario under the Gold Standard. The study did not include ongoing monitoring costs, which vary significantly between providers and were out of the scope of the South Pole study.

Box 2: Literature review: methodologies and tools

CDM large scale methodology ACM0022: Alternative waste treatment processes

CDM small-scale methodologies:

- AMS-III.H: Methane recovery in wastewater treatment, V19
- AMS-III.D: Methane recovery in animal manure management systems, V21
- AMS-I.C: Thermal energy production with or without electricity, V22
- AMS-I.E: Switch from non-renewable biomass for thermal applications by the user, V12
- AMS-III.F: Avoidance of methane emissions through composting, V12
- AMS-III.E: Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment, V17

Tools:

- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- CDM tool 04: Emissions from solid waste disposal sites, v08
- CDM tool 13: Project and leakage emissions from composting, v02
- CDM tool 14: Project and leakage emissions from anaerobic digesters, v02
- CDM tool 03: Project or leakage CO_2 emissions from fossil fuel combustion, v03
- CDM tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, v03
- CDM tool 12: Project and leakage emissions from transportation of freight, v1.1

Research:

- The Characterization of Feces and Urine: Literature Review to Inform Advanced Treatment Technology
- The SFD Promotion Initiative report, Cap-Haïtien Haiti
- Black Soldier Fly biowaste treatment – Assessment of global warming potential
- Anaerobic digestion is the dominant pathway for pit latrine decomposition and is limited by intrinsic factors
- CDM Grid Emission Factor for the Republic of Kenya

What we found

Our study shows that carbon credits can generate revenue for actively managed sanitation. However, several obstacles hinder the full potential, including inaccurate baseline default values, restrictive registry regulations, and exorbitant certification costs.

Based on the assumptions detailed in Box 3, our findings reveal:

Registries recognise the significant emission reductions of actively managed sanitation, at 240,672 tCO_2e over five years

Simulating emission reductions based on growth projections, the CBS services would save a cumulative total of 240,672 tCO_2e over five years whilst growing to 81,000 toilets, the equivalent of 617 million miles driven by an average gasoline-powered passenger vehicle. This brings in US$3-40 per toilet per year for an average of 86 $kgCO_2e$ per person per year. This variation is due to some toilets being used by one household or by several, and by the differing treatment methods used.

This figure includes the co-treatment with non-faecal waste in the case of some operators.

These significant savings are based on estimates using IPCC default values, showing that emissions are reduced by 79% to 93% compared to the baseline, consistent with our previous study.

The five CBS providers studied could earn US$2.4 million in carbon credit revenue for eligible emission reductions over five years

Carbon credits can generate additional revenue. Several (Box 2) existing methodologies were used to show the viability of generating revenue. Modelling these with carbon credit pricing at the time of research, at US$10 under the Gold Standard, the five services examined collectively earned US$2,406,717 in eligible carbon credit revenue over five years for approximately 81,000 toilets (Figure 3) and associated co-treatment with solid waste.

Box 3: Assumptions in baselines

Open defecation The baseline assumed that people currently practising open defecation would use a pit latrine or septic tank, in the absence of CBS services, given the human rights imperative and urban trends. While open defecation is not considered a source of methane, human waste management systems must be in place. The number of people practising open defecation was distributed proportionally among the baseline systems.

Baseline waste degradation This study took a conservative approach (avoiding overestimating the viability) by assuming that faeces and urine are not emptied from baseline sanitation systems. This would typically happen every few years when waste is disposed of and could generate more methane. Therefore, baseline emissions are likely higher, and reductions have likely been underestimated.

Baseline waste transportation To align with the previous assumption, emissions from transportation required to empty baseline systems have not been included. However, these emissions would be negligible due to the much larger global warming impact of methane and nitrous oxide produced by CBS toilets.

Anaerobic environment in stockpiles For operations that use sawmill residues for briquette production, the study assumed that the sawmill residues would have otherwise been left to decompose in anaerobic conditions as this was the baseline situation in the relevant context.

Woody biomass cover material Where woody biomass was used as a cover material, the study assumed it would have been burned or left to decay under aerobic conditions if it hadn't been used as cover material, and that there was no decrease in carbon pools (as per methodology rules).

Baseline onsite sanitation systems The baseline was based on CBS provider knowledge of the target intervention areas, including from Shit-Flow Diagrams. However, in practice, a baseline study of a population that accurately represents a CBS provider's existing and potential customer base would be needed.

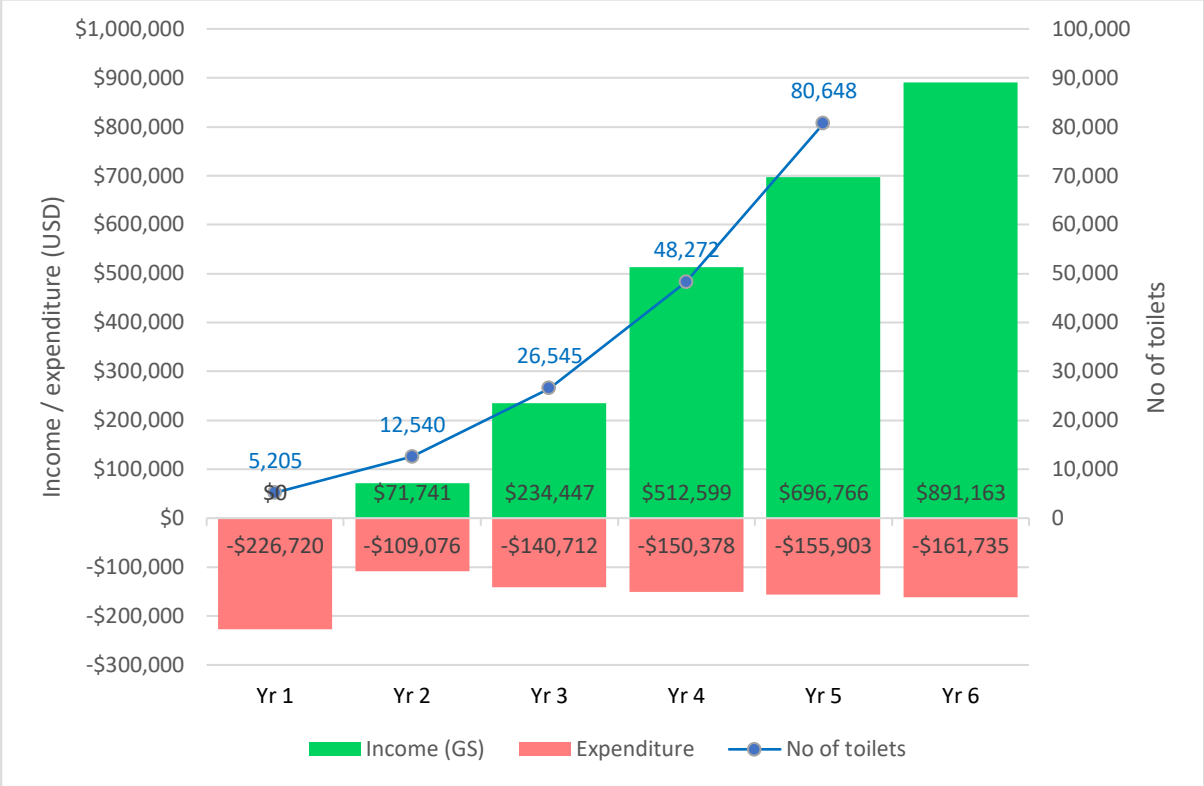


Figure 3 Estimated future annual income and expenditure (with Gold Standard) and number of eligible toilets based on projected scale up of five CBS providers' services. Note that income is only realised the year *after* the toilets are eligible. Monitoring costs were not included as part of expenditure so actual expenditure is expected to be higher.

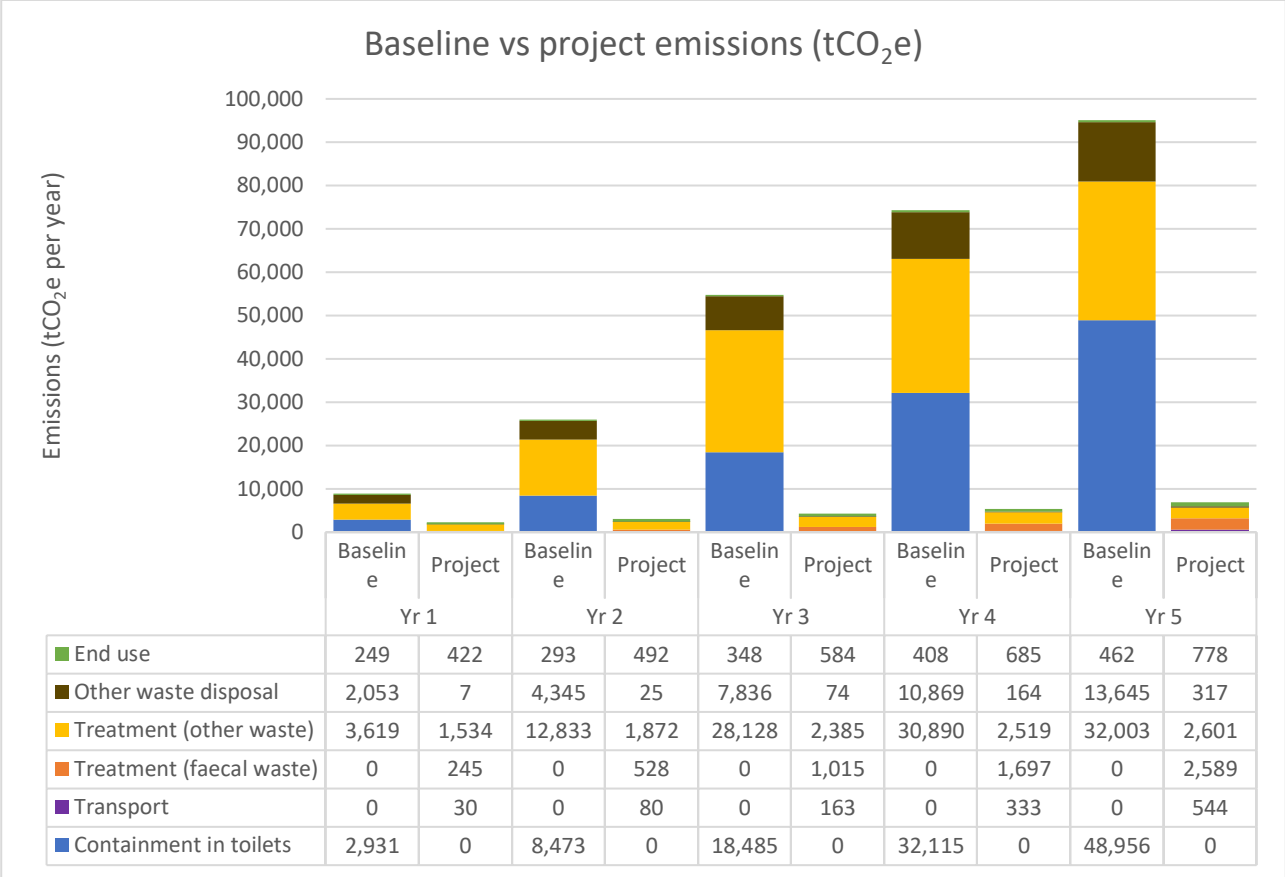
Revenues can increase with co-treatment of other organic waste

The core business of the CBS providers consists of providing a service for the containment and collection of human waste for subsequent proper management through different types of innovative treatment activities. However, most operators provide additional services such as the collection and co-treatment of other types of organic waste including food, agricultural residues, and manure from pig farms.

Figure 4 shows that baseline emissions come mainly from degradation of faecal waste in containment in toilets (dark blue in baseline column), and from the treatment or disposal / dumping of additional waste (orange and brown in baseline column). It also shows that co-treatment of other types of organic waste significantly increases emission reductions, due to both the increased amount of waste treated and the greater volumes of end products (such as co-compost) derived. This means that collecting and treating additional food or animal waste can significantly improve the viability of a CBS carbon credits project.

Some reuse products do not necessarily reduce emissions themselves. For instance, in this study's modelling, organic compost derived from CBS waste contains less nitrogen than the chemical fertiliser it would replace; so higher quantities would need to be used, with a corresponding increase in end use emissions. While this is largely offset by reduced emissions from containment and treatment, it shows that some treatment methods may bring higher carbon credit revenue. Fuel switch seems to be the most promising. However, this study's modelling is partly contingent on technology being retrofitted or installed specifically designed to use alternative fuel for

projects treating waste to create fuel as per current rules. Under the VCS, this must also take place in a Least Developed Country. Further research is needed to understand whether the eligibility of reuse product emission reductions can be improved so that it is more accessible to sanitation providers.



	Yr 1 Baseline	Yr 1 Project	Yr 2 Baseline	Yr 2 Project	Yr 3 Baseline	Yr 3 Project	Yr 4 Baseline	Yr 4 Project	Yr 5 Baseline	Yr 5 Project
End use	249	422	293	492	348	584	408	685	462	778
Other waste disposal	2,053	7	4,345	25	7,836	74	10,869	164	13,645	317
Treatment (other waste)	3,619	1,534	12,833	1,872	28,128	2,385	30,890	2,519	32,003	2,601
Treatment (faecal waste)	0	245	0	528	0	1,015	0	1,697	0	2,589
Transport	0	30	0	80	0	163	0	333	0	544
Containment in toilets	2,931	0	8,473	0	18,485	0	32,115	0	48,956	0

Figure 4 Baseline vs Project emissions (tCO2e per year). This shows how emissions happen along the value chains, from containment in toilets, to transport of waste and disposal/dumping or treatment with eventual disposal or reuse. Treatment includes electricity and fossil fuel use. "Other waste" refers to woody biomass, pig manure and food waste. "Other waste disposal" shows how other waste would be disposed of in the baseline (typically dumping and left to decay, or open burning); and "end use" considers how re-use products made from both waste streams are used in project, and what they replace in the baseline.

Revenues can increase with the recognition of CBS social impact

South Pole's calculations do not model the higher pricing given to projects with a significant social impact, some of which are marketed for $20 to $45 by the Gold Standard. Considering the many additional benefits of safely managed sanitation, including the fulfilment of rights, health, safety, inclusion and the environment, further investigation is needed into the potential additional revenue this can provide.

The current rules and costs of the carbon credits ecosystem significantly restrict the potential revenue:

1. Eligibility rules prevent taking into account existing toilets; adding them would increase revenue by almost 50%. This restricts carbon credits revenue to new projects only.

To calculate eligible emission reductions, only new toilets and treatment plants were taken into account: carbon credit registries typically do not allow existing infrastructure to be eligible, under the principle of additionality in current methodologies. This affects mainly incumbent sanitation operators, who have to scale significantly to generate revenue.

If the current CBS operators' toilets and waste levels were eligible, **the total emission reductions and revenue would be 48% higher**, at more than 355,000 tCO_2e and $3.5million respectively.

2. The financial viability of pursuing carbon credits is limited by the exorbitant cost of certification which reduces revenues by 40%, close to a million US dollars over five years

The certification process is extremely expensive which has a significant impact on profitability and the feasibility of a carbon credits project for smaller-scale projects. There are fees at every step, from one-off consultancy fees for developing a Project Design Document to recurring registry and third-party auditor fees. The costs to the five services over five years is US$944,524 under the Gold Standard, close to a million US dollars, reducing revenues by 40% over five years and leaving a reduced profit of US$1,390,452 (Figure 3).

To make a surplus, services need to reach 4,000 to 20,000 toilets served (depending on the treatment process used and the number of users per toilet), in addition to the start level. As this is equivalent to a small neighbourhood, this scale makes pursuing carbon credits interesting for both sanitation providers seeking to expand as well as for municipalities and utilities.

3. A third of potential emission reductions are not recognised: revenues could increase substantially with more accurate default values

More emissions could be eligible with improved data. The values used to calculate the baseline emissions were taken from IPCC guidelines. However, it is acknowledged, including by the IPCC itself, that these values are inaccurate and outdated.[4] Using robust and up-to-date research from a recent study in Kampala,[5] we have compared the emission reductions derived by South Pole to a potential baseline using figures from Kampala. We estimate that the emission reductions that are currently eligible represent only 70% of potential emission reductions, as the baseline is under-estimated (Figure 5).

[4] A recent study determined that the MCF value in the IPCC guidelines is based on "some limited experimental work carried out primarily in the US." It further highlights that the IPCC itself suggests that there is an uncertainty of 30% and 50% in its emission factor (EF) and COD estimates respectively. The IPCC guidelines also consider nitrous oxide (N_2O) emissions from baseline sanitation systems as negligible despite recent research showing the contrary.

[5] The Kampala study undertook end-to-end analysis to estimate emissions from all stages of the sanitation-service chain found in typical off grid sanitation systems.

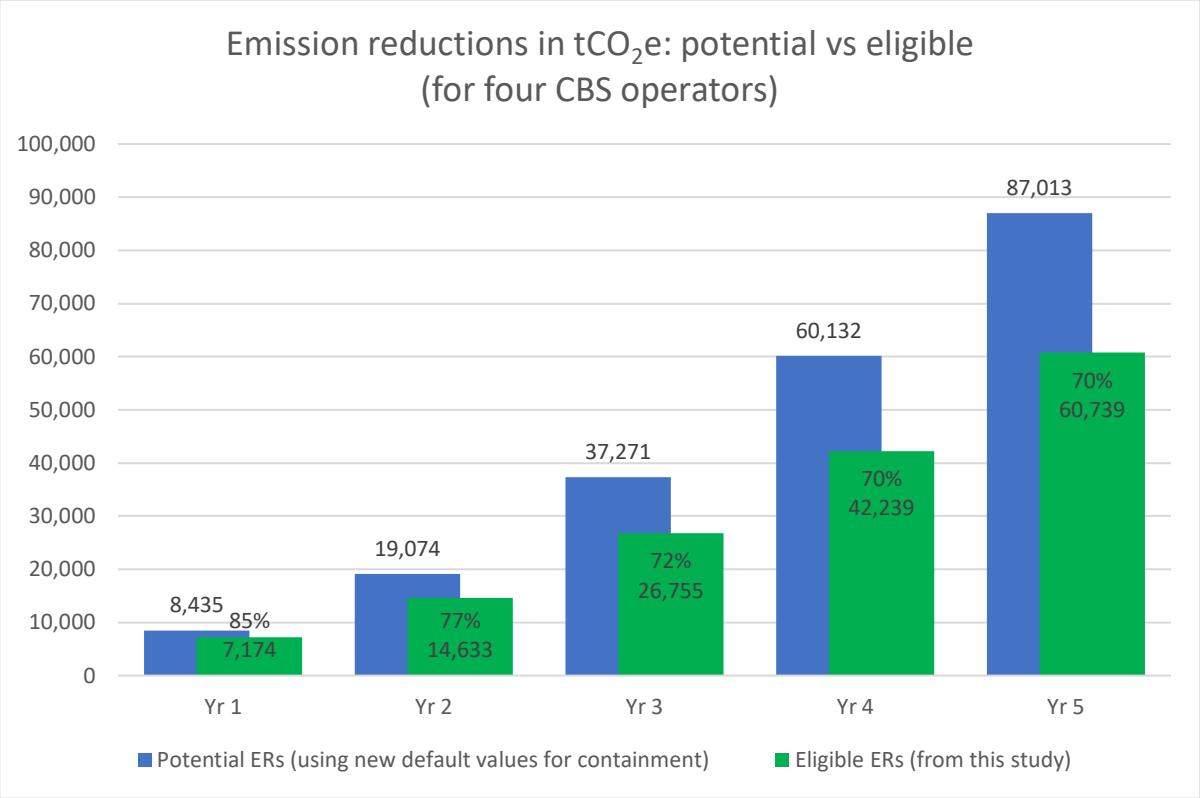


Figure 5 Potential and eligible emission reductions, in tCO_2e, for four of the five operators (due to data availability). Potential emission reductions are calculated using new default values for methane production available in the Kampala study; eligible emission reductions are as per this study's available methodologies. This comparison is done by CBSA and is not part of South Pole's work.

Pursuing carbon credit revenue is risky but revenues can pave the way to unlocking wider climate finance

The voluntary carbon credit market is a volatile market. Revenue figures are based on the average values for VCS and for Gold Standard, which were higher during the study than in 2023, but this could change at any time. However, with climate finance remaining stubbornly out of reach for sanitation and the wider WASH sector, offsetting provides added recognition of the emissions reductions brought by actively managed sanitation and unlocks a form of climate finance. A common reason given for the lack of climate finance for sanitation is that projects are not well structured to qualify. Key to this is knowledge of robust baseline and operational data as well as a detailed overview of the full sanitation chain, including the final disposal and reuse of human waste. Pursuing the process of carbon certification relies on having this data in place, which sets sanitation projects up to meet the rigorous requirements for pursuing other climate finance.

Box 3: Study limitations

Baseline calculations The emission factors (EF) and especially the methane correction factor (MCF) of septic tanks and pit latrines used to calculate baseline emissions for this study were taken from IPCC guidelines, which underestimate the significance of methane emissions from offgrid sanitation systems. The IPCC guidelines also consider nitrous oxide emissions from baseline sanitation systems as negligible despite recent research showing the contrary. The South Pole study considered N_2O emissions in project emissions but not baseline emissions. Ongoing research is expected to change these figures in the near future, for instance from the *Sanitation and Climate Change: Assessing Resilience and Emissions (SCARE)* project.

Lack of carbon methodology specific to off-grid sanitation A key hurdle for offgrid sanitation providers to claim carbon credits stems from the lack of a methodology that is specific to their activities which means that the emission reductions arising from frequent emptying are not easily or fully accounted for.

Emission reductions from the end use of biomass or biogas Under current rules, emission reductions can only be claimed for fuel switch if technology specifically designed to use alternative fuel is installed or retrofitted. Under the VCS, this must also take place in a Least Developed Country. South Pole used a hypothetical scenario in which heat generation technology was installed to estimate the potential emission reduction.

Compost as a replacement for synthetic fertilizer Only the VCS recognizes the emissions benefits of using compost to replace synthetic fertilizers and reduce associated nitrous oxide emissions. While this study considered the emission savings from replacing synthetic fertiliser, South Pole has not included them in our final feasibility calculations because the rules require evidence of changes in soil management that is beyond the control of sanitation providers.

Black Soldier Fly (BSF) Emissions reductions of replacing conventional animal feed with BSF larvae was not included in the GHG emission savings because there is insufficient data to compare the emissions from BSF feed to emissions from conventional feed, despite conventional feed being associated with high GHG emissions.

Monitoring costs The report's analysis doesn't include the costs associated with monitoring emissions. This cost can be significant, but is also very specific to each organisation's operations and is complex to design for each organisation and so fell beyond the scope of this study. It also has not included account opening or Annual Registry Account costs as it is possible that these could be covered centrally by the CBSA.

What's next?

Despite actively managed sanitation significantly reducing emissions, providers face barriers and risks at every stage of the expensive, lengthy and antiquated certification process. CBSA is taking key steps to address these and urgently calling on key stakeholders to play their part.

As an alliance of sanitation providers undertaking ground-breaking work on the climate impact of sanitation and the potential of carbon credits, we recognise the key role we can play to drive progress forward. Our next steps include working to:

1. **Reduce complexity**

We are working to develop a carbon methodology (or significantly revise a current methodology) specifically tailored to the needs of off grid sanitation providers to attempt to address eligibility barriers and make the process of applying for carbon credits easier. The complex nature of carbon credit certification can make the process confusing and easily misunderstood. There is generally heavy reliance on expensive consultants familiar with the rules, systems and terminology to navigate the terrain. This comes at a significant expense and is out of reach to smaller-scale providers. CBSA will develop clear step-by-step guidance to make it easier to gain access to carbon credits. This will include a calculator tool to help CBS providers understand whether carbon credits could provide a viable revenue stream for their operations.

2. **Reduce expense**

To leverage economies of scale and reduce the costs of certification, we will explore the potential for CBSA to act as a centralised intermediary to open and manage a registry account for CBS projects. Furthermore, we will look at what role CBSA can play to manage the account for the registry in a centralised way, including: paying registry fees, managing validations managing issuance payments and potentially selling credits to final buyers. We will also investigate the potential of digital monitoring, reporting and verification (dMRV) tools to create efficiencies and reduce the cost of measuring, reporting, and verifying emission reductions.

3. **Increase eligible emission reductions through improved baseline data**

We will support research to inform carbon credit models better suited to actively managed sanitation, including developing improved classifications of human waste, defining what would be considered frequently emptied and assessing whether and how N_20 emissions from human waste can be taken into consideration and monitored. In the meantime, we will support CBS providers to use the most up to date data based on national studies and information from credible sources, such as the Climate And CosTs in Urban Sanitation (CACTUS) project and the Kampala study. We will also call for further research and funding to support this and promote new and emerging research such as the *Sanitation and Climate Change: Assessing Resilience and Emissions (SCARE)* project.

4. **Mitigate the risks of pursuing carbon credits**

With fluctuating prices and little transparency on pricing and broker mark up, there remain risks in pursuing a revenue stream subject to the dynamics of market forces. CBSA will further explore the cost-benefit of pursuing this revenue stream and investigate ways to mitigate the risks, including whether being selective about buyers who may be interested in projects with high social impact could reap higher prices, longer-term commitment, and greater rewards.

Beyond these actions, we have to acknowledge that the potential of carbon credits is still limited by these variables. For this reason, the CBSA is exploring additional revenue streams, and we recognise that more action is needed at a sectoral level to drive change.

5. **Calling for urgent action from the following stakeholders:**

Municipalities and utilities

- Acknowledge sanitation's contribution to the climate crisis.
- Incentivise climate-smart sanitation in policy, regulation and concessional contracts.
- Ensure off grid sanitation services regularly remove sludge (e.g. with small containers to encourage frequent emptying) and treat it to reduce GHG emissions.

National governments

- Align sanitation policies with climate commitments and include them in National Adaptations Plans (NAP).
- Include sanitation emissions in Nationally Determined Contributions (NDC), as less than 0.2% of current NDC activities are sanitation related.

Investors, funders and lenders

- Support climate-smart and -resilient sanitation by incorporating climate change mitigation outcomes as essential criteria for sanitation investments, loans, and funding.
- Support sanitation providers to scale services and unlock carbon credits as an additional revenue stream, reducing the burden on public or aid funding.
- Fund research that improves the accuracy of GHG emission estimates for off grid sanitation, to increase related eligible emission reductions and potential income.

Intergovernmental Panel on Climate Change (IPCC)

- Update the IPCC guidelines so that the emission factors (EFs) and methane correction factor (MCF) used to calculate methane production are based on up-to-date empirical data.

Carbon credit issuing companies

- Reduce the complexity and cost of certifying smaller-scale projects.
- Allow digital solutions that reduce the complexity and cost of monitoring.

Researchers

- Undertake empirical and modelling work to update estimates of greenhouse-gas emissions from off-grid sanitation (as is currently being undertaken by the SCARE project).
- Study the extent to which scheduled or frequent emptying reduces emissions.

This study's findings provide added impetus for action. While there can be scepticism regarding carbon offsetting, it is currently the only way for sanitation to access a form of climate finance and it paves the way for sanitation to access official sources further down the line. The recognition of emissions savings in monetary terms will provide added credibility, interest and investment in CBS and other climate-smart sanitation systems among some audiences and will incentivise other forms of off-grid sanitation to improve climate impacts by ensuring waste is quickly treated.

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Find this report online on https://cbsa.global/carboncredits

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