LESSON LEARNT

CBSA
Container Based Sanitation Alliance

Photo: Sanergy

SECURING CARBON REVENUE FOR SANITATION

Recent successes from container-based sanitation, 2025

Securing carbon revenue for sanitation

Lessons from recent successes in container-based sanitation

Key messages

Sanitation operators have accessed the carbon market: The Sanergy Collaborative earned the first carbon credits for container-based sanitation (CBS) and related treatment; SOIL has demonstrated an alternative, flexible model for smaller implementers by selling its climate impact directly, outside of formal carbon markets.

Access to carbon markets remains challenging for smaller sanitation providers: This is due to high upfront costs, complex methodologies, and strict eligibility criteria.

Carbon finance is a supplementary revenue stream: It is not a full cost-recovery solution for most sanitation models: bridge and working-capital solutions help but do not eliminate structural funding needs.

Lessons for sanitation implementers

Plan early: Assess potential (do your activities genuinely reduce emissions compared to business-as-usual?) and capacity: engage experienced consultants, have a dedicated staff lead, prepare key audit documents early.

Align carbon projects with your activities: Ideally, use a treatment plant construction or expansion, and have robust data systems to have sufficient monitoring early on.

Enhance carbon credit value: For instance by: demonstrating sanitation's co-benefits such as public health, gender equity, and climate resilience; incorporating local emissions data; and by building trusted relationships with buyers.

Current developments

A new sanitation carbon methodology is under development: It is being developed by Gold Standard, aligned with Article 6.4, and could lower barriers and expand eligibility for small-scale sanitation providers.

Digital Monitoring, Reporting, and Verification (dMRV) can lower costs: Protocols and wider adoption are still emerging. Several pilot projects and emerging platforms like Cavex show promise.

Container Based Sanitation Alliance, November 2025

The social and environmental co-benefits of sanitation projects can increase carbon prices: This is done through certification schemes. However, most are still in the testing phase.

Biochar presents a promising opportunity for premium carbon removal credits: However, several barriers remain, including certification frameworks that are not designed for sanitation-derived feedstocks and assumptions about scale that may not reflect decentralised service realities.

Emerging opportunities

We need better, evidence-based emission values for sanitation: Updated IPCC methane values would improve greenhouse gas emissions calculations and credit issuance, potentially increasing revenue.

Aggregation of credits through intermediaries may be essential for sanitation to access carbon markets: Volume thresholds remain a barrier for individual implementers. Intermediaries could help but barriers to cross-border grouped projects need to be overcome.

Alternative sanitation approaches offer potential for generating carbon credits: For instance, vermicomposting toilets, ISO 30500-compliant “reinvented” toilets and biogas capture at treatment plants for wastewater and faecal sludge.

Innovative finance tools could help: For instance Carbon Streaming Agreements, Advance Purchase Mechanisms and Advance Market Commitments can help sanitation actors bridge the gap between project launch and carbon revenue; results-based payments for verified methane emission reductions (through mechanisms like GCF’s REDD+ strategy) can help de-risk the voluntary market.

Articles 6.2 and 6.4 of the Paris agreement have much larger financial potential: This requires higher volume of emission reductions, countries to add sanitation to their NDCs, and strong government leadership.

About this document

This brief is aimed at WASH implementers, government actors, and sector funders interested in leveraging carbon financing to support non-sewered and container-based sanitation (CBS) systems. It draws on Sanergy's[1] recent success in accessing carbon credits, highlighting key enablers and challenges to support replication by other sanitation projects. It also showcases SOIL's (Sustainable Organic Integrated Livelihoods) innovative approach of generating climate revenue by directly selling its carbon impact – bypassing the complexities of voluntary carbon markets – a model which may better suit smaller implementers. Finally, it presents emerging sector opportunities and pathways.

Acknowledgements

This brief was written by Madeleine Edgeworth (consultant for CBSA) and edited by Rémi Kaupp (CBSA Executive Director) and Isabella Montgomery (CBSA Programme Manager).

Contributions by Haroon Dawood (Director of Carbon Projects, Sanergy); Sasha Kramer (Co-founder and Executive Director, SOIL); Raluca Anisie (Impact Specialist, Mosan); Seoyi Kim (World Bank) and Bapon Fakhruddin (Green Climate Fund). We would like to thank the following organisations for their valuable insights, experiences, and contributions: Sanergy and SOIL for generously sharing their first-hand experiences in accessing carbon finance through both market-based and alternative approaches; Mosan for its early leadership in developing emissions quantification methodologies tailored to CBS and for kindly sharing their journey towards accessing carbon credits for biochar; and Promethium Carbon for their technical expertise and guidance in exploring viable carbon methodologies, scope for a new methodology and methodology adaptations and registry options for the sanitation sector.We also thank the Waterloo Foundation and Aqua for All for funding this work.

[1] The Sanergy Collaborative or "Sanergy" includes Fresh Life who deploy and service CBS toilets, Regen Organics who treat waste and sell reuse products, and Circular Impact who mobilises carbon finance.

Table of contents

Introduction

Sanitation for climate action

Sanitation contributes up to 2% of global greenhouse gas (GHG) emissions – comparable to aviation – yet receives little attention in climate mitigation. The primary source of emissions is anaerobic decomposition of faecal waste stored for extended periods and/or without treatment. The Global Methane Pledge, signed by over 150 countries, commits to cutting methane emissions by 30% by 2030, highlighting the value of addressing emissions from sectors like waste and sanitation.

Efforts to measure and verify carbon emission reductions are reshaping climate policy and finance**.** International frameworks like the Paris Agreement (Articles 6.2 and 6.4) push governments to cut emissions, mobilise finance, and scale sustainable development. At the same time, companies face mounting pressure from regulators, investors, and consumers to meet net-zero goals and show measurable climate action.

Low-emission sanitation options such as CBS, frequently collected non-sewered sanitation (NSS), and sewer systems with waste treatment and resource recovery, can significantly reduce methane and nitrous oxide emissions[2]. These systems also offer climate adaptation benefits (e.g., decentralised, flood-resilient services) and support the circular economy through compost, biogas, biochar, and nutrient recovery.

Climate finance

Carbon credits are tradable certificates representing one tonne of avoided or reduced CO_2-equivalent (tCO_2e) emissions. Credits are generated when emission reductions are measured using approved methodologies, independently verified, and certified by recognised carbon standards. Regulated markets (e.g. the United Nations Framework Convention on Climate Change (UNFCCC's) Article 6.4 of the Paris Agreement[3]) enable governments to meet climate targets.

In parallel, voluntary markets serve corporations, institutions or individuals seeking to offset their GHG emissions or contribute to the reduction of GHGs within their jurisdictions, as well as companies seeking net-zero commitments or compliance with carbon pricing policies (e.g., emissions trading systems or carbon taxes). This opens a pathway for

[2] Whole-system analysis reveals high greenhouse-gas emissions from citywide sanitation in Kampala, Uganda. *Communications Earth & Environment volume 3, 80 (2022)*

[3] The Paris Agreement (adopted in 2015) is a legally binding treaty under the UNFCCC. It builds on the UNFCCC's principles and sets targets for limiting global warming. Article 6.4 establishes a centralised UN mechanism for the trading of carbon credits, referred to as the Paris Agreement Crediting Mechanism, succeeding the Clean Development Mechanism (CDM) under the Kyoto Protocol.

countries and project developers to access additional revenue streams through the reduction of GHG emissions. Typical sale prices range from $6/$8 for usual credits, to $20 / $30 for higher-integrity credits with social or environmental co-benefits.

The opportunity

Despite sanitation's mitigation potential, the sector remains largely absent from the carbon market. Most WASH-related credits to date focus on water access or treatment. NSS systems are often excluded due to gaps in approved methodologies and limited sector engagement. Targeted interventions across stakeholder groups could expand opportunities for sanitation projects to access climate finance. Since 2019, CBSA and its members have pioneered new approaches to accessing climate finance for sanitation. Key milestones achieved so far are shown in table 1 below. While carbon standards haven't yet fully evolved to the distinct needs of NSS, progress is being made. CBS organisations are leading the way – Sanergy and SOIL have successfully accessed carbon finance through distinct, pioneering approaches.

Table 1: Key milestones in CBS carbon measurement and revenue

2017-2019	SOIL worked with Rebecca Ryals (University of Hawai'i, University of California, Merced) to directly measure GHG emissions (carbon dioxide, CO_2; methane, CH_4; and nitrous oxide, N_2O) from its sanitation operations in Haiti. Emissions were also measured from alternative waste disposal sites to be able to assess the emissions avoided compared to usual practices.
2018-ongoing	Mosan has been conducting extensive research on pyrolysing CBS waste and applying the resulting biochar in field settings.
2019-2020	CBSA commissioned Lauren Harroff (née Lauren Trondsen) to develop an emissions calculator based on emission factors and assumptions about waste characteristics and energy use drawn from the International governmental panel on climate change (IPCC), the CDM, and peer-reviewed literature. The tool estimates emissions from a sanitation service and was applied to four CBSA member organisations, showing that CBS can significantly reduce GHG emissions compared to a typical practices. A summary of the work can be viewed in this poster presentation.
2020-2021	Mosan and ETH Zürich, supported by CBSA and partners (led by Daniela Seitz), developed a methodology to quantify emissions from CBS – laying the foundation for climate mitigation in the sector. Access Daniela's dissertation on this method.
2021-2022	CBSA commissioned South Pole to assess the financial viability of carbon credits for CBS, with a working group of CBSA members: Clean Team, Loowatt, Sanivation, Sanergy, and SOIL. It confirmed potential financial viability but noted high costs and complex requirements. Access the briefing paper.
2023-ongoing	Mosan started producing biochar from sewage sludge, to significantly increase its production volume faster than with CBS waste alone. Mosan began working with carbon project developers to register a biochar project for sales of carbon removal credits. Progress remains slow and uncertain given the high upfront certification costs that incentivise carbon developers to prioritise rapid, high-return projects over the gradual, community-based scaling typical of sanitation related systems.
2022-2024	CBSA engaged Promethium Carbon to assess the value of developing a new carbon methodology tailored to frequently emptied NSS systems, evaluate suitable carbon registries, and draft a scope for a new methodology or revisions to existing ones. The outputs of this work are presented in section 4.

1. Case study: Sanergy's first verified credits for CBS

In November 2024, Sanergy became the first organisation to be issued carbon credits for CBS operations. A total of 6,643 credits were issued in 2024 under Verra's Verified Carbon Standard (VCS), marking a major milestone for the sector. Around 20,000 more credits are expected in 2025. The project is registered for a seven-year crediting period, twice renewable, during which Sanergy aims to generate an average of 30,000 carbon credits annually as operations scale.

Sanergy registered their methane avoidance carbon project with Verra using the CDM methodology "ACM0022 Alternative waste treatment processes", which applies to treatment of organic waste that otherwise would have decayed anaerobically in sludge pits or a solid waste disposal site (i.e., a landfill). The project focuses on the treatment of human waste from CBS systems using black soldier fly larvae, composting, and briquetting, as well as waste from alternative sources, including food waste, wood dust, sugarcane bagasse and slaughterhouse waste. Read more about how the methodology works and which tools can be used to estimate emission reductions on the Verra website.

Regen Organics treatment centre in Kenya. Credit: Sanergy Collaborative

Timeline

Sanergy's journey from initial internal analysis to the issuance of carbon credits took approximately 24 months, with pre-feasibility work starting in the summer of 2022. This timeline is typical, as illustrated in the table below.

Table 2: Typical timeline for carbon project registration with Verra

Phase	Key activities	Typical duration	Notes
1. Scoping & feasibility	- Internal analysis - Preliminary emissions assessment - Feasibility study	2-4 months	Includes screening eligibility, methodology selection, and feasibility work.
2. Project registration & validation	- Draft Project Design Document (PDD) - Engage Validation and Verification Body (VVB) - Validation audit - Register with registry under the relevant standard (e.g. VCS, under Verra)	12–18 months	Timing depends on audit length and rounds of clarification with the VVB and the carbon registry.
3. Verification	- Monitor emissions - Submit for credit verification	6–12 months (can overlap with validation)	Monitoring can begin during or, ideally, prior to registration.
4. Credit issuance	- Final review by registry - Receive credits	1 day to 2 months	Issuance depends on timely registry processing.
5. Credit sale / retirement	- Credits sold, traded, or retired	Variable	Market demand, pricing, and buyers influence this phase.

Costs

Developing a carbon project involves significant upfront and ongoing costs. For Sanergy, the initial project development required an investment of approximately $120,000. In addition, annual monitoring and verification – essential for ensuring the integrity and credibility of the credits – is expected to cost around $50,000 per year over the project's first monitoring period.

For comparison and broader context, the GSMA's guide The Voluntary Carbon Market: A Guide for Startups provides examples of cost structures from other carbon projects.

More detailed information about Sanergy's carbon initiative, including its methodology and credit issuance, can be found on Verra's website under the Verified Carbon Standard Project: Sanergy Composting Group Project.

Key enablers and systemic challenges

Sanergy's successful registration and issuance of carbon credits was enabled by a combination of technical, operational, and strategic factors:

Clear and verifiable emissions reductions: Sanergy's CBS model reduced emissions by preventing the anaerobic decomposition of faecal waste – a major source of methane. Frequent waste collection every 1 to 2 days from container-based toilets avoided the creation of anaerobic conditions, while typical practices[4] (e.g., public latrines, unemptied or infrequently emptied pit latrines and septic tanks) were demonstrably high-emitting. This clear contrast supported robust emissions avoidance calculations.[5]

Sufficient scale to ensure financial viability: Sanergy operates many CBS toilets and provides a large-scale CBS service which includes co-treatment of organic waste streams (e.g., animal waste and other biodegradable inputs), significantly increasing total eligible emissions reductions. This scale was critical to make the investment in carbon credit registration economically viable considering upfront and ongoing monitoring costs.

Funding base to manage upfront costs: The size and operational maturity of Sanergy enabled them to absorb the substantial upfront costs associated with project validation, monitoring systems, and third-party verification.

Organisational capacity and access to expertise overcome technical complexity: Navigating the carbon registration process is technically complex and often far outside the typical skill set of WASH providers. Hiring experienced carbon consultants can significantly accelerate progress – helping to avoid delays, reduce revision cycles with the VVB and registry of choice, and streamline overall communication. Sanergy's success was supported by early engagement with a knowledgeable consultant. However, even with external support, a dedicated internal lead also proved essential to coordinate efforts, provide sector-specific context, and maintain continuity throughout the process.

Methodology fit: Existing carbon methodologies were not originally designed with sanitation specifically in mind. ACM0022, the methodology used by Sanergy, was originally

[4] The scenario that would exist if the project activity was not taking place, known as the "baseline scenario". For CBS, this is the sanitation options that customers would otherwise be using – usually pit latrines with infrequent emptying, septic tanks and open defecation.
[5] Emissions reductions (avoided) = Baseline emissions – project emissions

intended for composting and waste treatment facilities. Adapting it to a CBS model required innovative framing of the project to demonstrate how it fit within the bounds of the methodology. This underscores the need for either revised methodologies or new ones tailored to sanitation systems.

Aligned timing with infrastructure expansion and technology framing: Sanergy's carbon project development was strategically timed with the commissioning of a new treatment facility, which was critical to meeting the requirements of the carbon credit registry and standard they selected. This alignment ensured compliance with carbon crediting requirement that the treatment facility must begin operations no more than two years before the project is validated. Select carbon credit standards require novel infrastructure or technology upgrades and require that projects be validated within two years of implementation. For sanitation, the "infrastructure / technology" can refer to either the toilet or the treatment facility. Limiting creditable units to toilets installed within two years can severely constrain the volume of eligible emissions reductions, undermining potential financial viability. However, if the treatment facility is framed as the central project technology, it may allow for inclusion of all waste processed there – regardless of when toilets were installed – offering greater credit potential, though registry rules must be carefully adhered to.

Additional enablers: accelerating and enhancing project success

While certain conditions are essential for carbon credit project success, several additional factors can significantly accelerate timelines and increase income:

Proactive data gathering to streamline auditing and strong monitoring systems and organised data management: One of the most time-consuming aspects of project validation is compiling the required data and documentation for audit and verification. For Sanergy, this included calibration certificates for monitoring equipment (e.g. weighbridges which had to be sourced from government agencies), waste collection logs and official weighbridge records, treatment plant specifications, and historical service coverage (see table 3 below).

Auditors closely scrutinised the integrity of data collection and monitoring systems, especially around ensuring aerobic treatment and proper measurement protocols. Projects with proactive data gathering and well-organised monitoring and data management systems can significantly reduce validation and verification timelines (see Sanergy's advances in digital data management below). In practice, less time is spent on writing documents and more on locating and preparing credible supporting evidence.

Sanergy's advances in digital data management

Sanergy is digitalising its hand-written data to improve the efficiency, accuracy, and timeliness of its operations, while still prioritising staff safety in challenging environments. Operating in the informal settlement of Mukuru, where smartphone or tablet use in the field poses risks, Sanergy's frontline teams collect waste volume data via handwritten forms. To streamline the process without compromising staff security, Sanergy partnered with Vera Solutions and Captricity to digitise these paper records.

Using Captricity's optical character recognition technology, handwritten forms are scanned, converted to digital data, and uploaded directly into Sanergy's Force.com system – reducing data entry time from 4.5 hours to just 15 minutes per day. This shift not only provides near real-time access to waste collection data but also frees up staff time for critical tasks like quality control and operations support. As Sanergy scales, it continues to explore digital tools that fit its operational context, ensuring both data integrity and staff safety. Find out more about Sanergy's approach on the Verra website

Strong relationships with potential carbon credit buyers: Sanitation carbon credits represent a new market with no established pricing. While some demand exists, selling credits at a premium remains challenging due to limited buyer familiarity. Early sales of sanitation-related carbon credits, such as those by Sanergy, were made possible through trusted relationships with buyers already active in the voluntary carbon market and familiar with Sanergy's work. These buyers understood and valued both the emissions impact and the broader social and public health co-benefits of CBS. In contrast, outreach without prior engagement has proven less effective, and large traditional credit buyers focused solely on carbon volume are likely to overlook the added value CBS systems deliver. Demonstrating these co-benefits and building relationships early-on with values-aligned buyers could improve sales potential and pricing over time.

Demonstrable co-benefits aligned with the SDGs: Linking sanitation interventions to broader development outcomes can increase the appeal of carbon credits to values-driven buyers and funders. Highlighting public health improvements, gender equity, and resilience outcomes can help achieve higher "premium" pricing.

Pricing considerations and market positioning: Projects like Sanergy's have aimed to price credits above the typical waste sector average ($20/tonne vs. the standard $5–10/tonne for typical waste/landfill methane credits) based on their significant social and environmental co-benefits. For premium pricing to become more widespread, these co-benefits must be better recognized and valued by buyers.

Table 3: Core documentation required for Verra VCS registration

Data needed	Types of documents required
1. Project design and description	- Project Design Document (PDD, registry template)
2. Baseline scenario	- Survey data or government stats on user toilet types - Evidence on what happens to waste in absence of project
3. Emission reduction calculations	- Emissions calculation spreadsheet or tool - Documentation of assumptions (e.g., decay factors)
4. Waste volumes and treatment data	- Daily/monthly logs of waste treated - Weighbridge or volume records - Facility operational data
5. Equipment and measurement accuracy	- Calibration certificates for any measurement equipment used e.g. weighing scales, flow meters, sensors - Maintenance logs - Standard Operating Procedures for data collection
6. Location and facility data	- Site maps - Photos of treatment infrastructure
7. Monitoring and data management plan	- Monitoring protocol (aligned with methodology) - Quality Assurance / Quality Control procedures - Roles and responsibilities in data collection
8. Stakeholder engagement	- Consultation meeting minutes and pictures - Stakeholder feedback forms - Clear and available grievance mechanism - Letters of support from local authorities
9. Environmental and social safeguards *(if applicable)*	- Impact assessments - Gender equity indicators - Co-benefit reports (if using SD VISta[6] or Gold Standard for Global Goals)
10. Registry and buyer information *(if applicable to demonstrate additionality)*	- Memorandum of Understanding or intent letters - Evidence of revenue use or reinvestment in project activities
11. Demonstrate additionality	- Business-as-usual cost-revenue modelling - Contracts with carbon credit buyers

[6] SD VISta certifies the contributions of a project towards meeting specific Sustainable Development Goals (SDGs). Read more in section 4.

3. Case study: SOIL's direct climate partnerships

SOIL (Sustainable Organic Integrated Livelihoods), a research-driven CBS provider, pioneered the direct sale of carbon offsets from its CBS services in Haiti, bypassing traditional carbon markets. Their approach is grounded in rigorous academic research and peer-reviewed publications, based on two years of direct emissions measurements.

By diverting human waste from unmanaged open environments and stabilisation ponds to aerobic composting and treatment, SOIL's CBS service prevents emissions typically associated with these systems. SOIL's CBS operations reduce approximately 3,800 tCO_{2e} each year, primarily by avoiding methane emissions common in unmanaged sanitation.

In 2019, researchers published the findings of their direct emissions measurements in Haiti (see publications below).

Offset sales began shortly after, primarily through a direct partnership with a mission-aligned buyer. Since 2020, Global Water Intelligence has purchased offsets at $30/tonne, generating $30,000 annually – about one-third of SOIL's potential. Fully realised, carbon revenues could reach more than $100,000 per year, covering at least 10% of CBS service costs.

Emissions measurements at SOIL's composting site in Haiti. Credit: SOIL

Global Water Intelligence, committed to offsetting the emissions generated by its events, was attracted to direct offsets as a model that ensured funds would directly support organisations creating measurable social and environmental impact. Rather than purchasing credits through a third-party broker – who often retain up to 40% in fees[7] – the company chose to buy offsets directly from SOIL. This ensures that 100% of the offset payment goes toward supporting SOIL's climate mitigation efforts.

SOIL aims to expand sales by engaging with conferences and direct buyers more proactively. See SOIL's blog, How SOIL's Composting Toilets are Cutting Global Emissions.

Process

Unlike standard crediting under major registries, SOIL's model is grounded in peer-reviewed research and direct measurement, offering a rigorous yet flexible option for smaller implementers and values-aligned buyers. The full development process, from research design to offset sales, took approximately 3-4 years.

Development of a robust emissions reduction methodology: Over a two-year partnership with researchers at the University of Hawai'i and University of California Merced, SOIL co-developed a methodology for quantifying greenhouse gas reductions from its CBS operations in Haiti. The research focused on direct measurements of CH_4, N_2O and CO_2 emissions avoided during waste treatment and composting. Findings were published in Nature Climate, a well-respected, peer-reviewed scientific journal, providing credibility and transparency to SOIL's offset offering. This included two key publications, Greenhouse Gas Fluxes from Human Waste Management Pathways in Haiti and Climate Change Mitigation Potential in Sanitation via Off-site Composting of Human Waste.

Simple, transparent sales process: Following publication of the research, Global Water Intelligence approached SOIL and the sales process moved quickly. Each year, the buyer calculates the emissions it seeks to offset, and SOIL issues a corresponding invoice based on the agreed price per tonne. This direct and efficient arrangement eliminates the need for intermediaries and transaction complexity.

SOIL's direct sales approach provides a transparent and effective alternative to the traditional carbon credit system. It enables companies to support measurable emissions reductions while advancing broader social and environmental goals. For SOIL, revenue from offset sales help to expand operations, improve waste collection, reduce water use,

[7] Secretive Intermediaries: Are carbon markets really financing climate action?

and create nutrient-rich compost – contributing to sustained climate mitigation and community benefits.

Costs

The total cost of SOIL's emissions reductions research was approximately $100,000. An academic partnership significantly reduced the financial burden of early-stage project development, with the partner covering around 90% of costs: $60,000 in staff time, $25,000 in materials, and $5,000 in travel. SOIL's direct contribution was approximately $10,000 for research oversight and coordination. There are no ongoing monitoring costs additional to SOIL's usual operations.

Key enablers and challenges

Academic partnerships and peer-reviewed publications: SOIL partnered with a biogeochemist who had a research interest in GHG emissions to co-develop a direct measurement methodology. This academic collaboration was essential, as the partner secured funding for the multi-year research, led the scientific design, and was the primary author on peer-reviewed publications in Nature. The partnership bridged SOIL's operational and research expertise with scientific rigor, enabling credible and transparent emissions quantification foundational to the carbon offsets sold.

In-house research team with operational coordination: SOIL is a research-driven organisation with in-house research capacity that played a critical role in inputting into and managing the research process. Close collaboration between SOIL's research and operations teams was critical to enable data collection throughout ongoing operations without compromising the quality of data or the speed and effectiveness of sanitation services.

Direct measurements: Unlike many carbon methodologies that rely on modelling, SOIL's research directly measured project emissions from compost bins, as well as alternative waste treatment (baseline) emissions from waste stabilisation ponds and open dumping areas. This primary data gave strong credibility and transparency to SOIL's offset claims.

Relationships with alternative waste management entities: To accurately calculate emissions reductions, SOIL needed to establish a baseline scenario reflecting how waste would be managed without their intervention. Gaining access to these treatment sites was essential for collecting primary emissions data. This required building strategic relationships with the entities managing those sites and securing approval to conduct on-site measurements. Early engagement with these stakeholders is critical for any organisation seeking to replicate this approach.

Supportive buyer: SOIL's ability to secure direct carbon sales was enabled by a buyer willing to engage early, trust in research-based methodologies, and prioritise high-impact, direct investments over conventional market routes.

Logistics and equipment access: Obtaining emissions data required specialised equipment not readily available in Haiti. Samples were shipped internationally, adding complexity and cost.

Limited direct data from front-end sanitation: There is a lack of direct emissions measurements from front-end sanitation sources such as pit latrines and CBS containers. To date, SOIL's research has focused on treatment and composting stages, leaving a gap in understanding emissions earlier in the sanitation chain. Addressing this gap will require new studies – planned in collaboration with Cornell University – to strengthen the overall emissions profile and improve the accuracy of calculations.

Market limitations: While SOIL's model delivers both climate and social benefits – making it effective for organisations seeking to offset emissions and support social impact – it may face limitations when buyers require recognition under voluntary standards or sustainability reporting frameworks. These often require standardised verification, formal documentation, and third-party assurance.

4. Opportunities: minimising barriers, maximising access

Climate finance is no longer theoretical for sanitation – it is already happening, and other providers can learn from and build on these early efforts.

While recent breakthroughs are encouraging, they often benefited from enabling conditions that are missing for many implementers – i.e. large-scale infrastructure, a new treatment facility, strong emissions research, or aligned buyers. Sanergy and SOIL demonstrate what is possible but also underscore the need for targeted strategies and sector-wide support to expand access. In addition, the voluntary carbon market remains risky due to its volatility, driven by limited trust in the rigour and credibility of credits – particularly whether they reflect real, additional emissions reductions – and the risk of greenwashing by companies not directly reducing their own emissions. For further detail on barriers to access, see the CBSA briefing paper*:* Unlocking carbon credits for sanitation.

This section outlines existing and emerging opportunities to help more sanitation providers engage with and benefit from carbon markets.

Ongoing sector initiatives

A new sanitation carbon methodology: Gold Standard is developing a dedicated methodology for non-sewered sanitation and reuse systems, co-developed with the support of CBSA and Sanergy.

This is expected to:

- Align with Article 6.4 of the Paris Agreement methodology requirements[8]
- Simplify monitoring, reporting, and verification (MRV)
- Better capture emissions from anaerobic waste decomposition
- Potentially include of N_2O in baseline emissions from sanitation systems (not included in CDM methodology ACM0022)
- Broaden access to the CBS and NSS sector
- Reduce complexity in proving additionality
- Widen the scope with respect to the application of products from treated waste.

[8] Article 6.4 recently included provisions to recognise “suppressed demand” - a concept critical for projects in underserved communities such as sanitation improvements in low-income regions, which provides clarity on methodology requirements and opens pathways for the relevant project types.

Digital MRV and emerging carbon registries: Efforts are underway to digitise monitoring, reporting, and verification (dMRV)[9] to lower costs and streamline carbon certification. Pilot initiatives are testing dMRV tools:

- Promethium Carbon has developed a registry, the Inclusive Carbon Standard (ICS), that includes fully digital workflows. ICS seeks to lower the cost of issuing carbon credits by streamlining project registration and credit issuance through technology. Key innovations include simplified methodologies and contents of project documentation, automated document generation via an online platform, and digital data collection using tools such as the Internet of Things.
- SustainCERT, a verifier originally launched by Gold Standard, has developed a digital platform to automate and simplify emissions verification in 2023. Under this model, project developers create a digital system tailored to their methodology, which is accessible to verifiers for real-time review. The platform automatically checks data quality based on the selected standard, enabling quicker spot checks and credit issuance. This approach improves transparency, reduces errors, and has the potential to significantly accelerate project validation
- Gold Standard has launched a pilot programme to test dMRV solutions as part of its strategy to digitise climate and sustainable development impact certification. Running until October 2026, the pilot aims to improve accuracy, transparency, and efficiency in monitoring carbon credits and sustainable development impacts. The initiative integrates with the SDG Impact Tool to streamline data reporting, enhancing global emission reduction efforts. One of the priority methodologies is ACM0022 for alternative waste treatment – relevant to sanitation organisations.

Co-benefits and tagging: Project co-benefits can enhance the value of associated carbon credits. Sanitation has several social and environmental co-benefits.

The monetisation of the co-benefits of an emission reduction project can be done in two ways:

1. Some carbon standards are designed to capture social co-benefits:
   - Gold Standard: Originated as a social-benefit label for CDM projects; now issues its own credits.
   - Plan Vivo: Focuses on assessing poverty reduction through community-led projects that deliver equitable benefits and support rural development.

[9] Monitoring, reporting and verification is the process to track, assess, and validate data related to GHG emissions and emission reductions within a specific carbon standard or framework

2. Projects can be “tagged” to prove that certain social benefits are derived from the implementation of emission reduction projects. Existing tagging schemes include:
    - SD Vista certification: Measures and certifies the contributions of a project towards meeting specific SDGs.
    - Climate, Community & Biodiversity Standard (CCB): The CCB Standard certifies positive impacts on communities and ecosystems. It can be paired with carbon standards like the Verified Carbon Standard (VCS) to recognise both emissions reductions and co-benefits. Projects that meet the requirements of both can be certified under each standard independently.
    - W+: Measures the impact of projects on women’s empowerment and increased gender equality, focusing on areas such as income and livelihood, time, health, leadership, education, and food security.

Updated emission factors: Current IPCC emission factors significantly underestimate methane emissions from unmanaged sanitation systems.[10] Ongoing efforts – such as the SCARE research project – are working to improve emissions estimates for on-site sanitation with direct emission measurements. Early findings show wide variability in containment types and in methane emissions at different times of the year, particularly in temperate climates, although medians are in line with previous empirical studies (not yet acknowledged by the IPCC) suggesting that revised emission factors could more accurately reflect real-world conditions.

In parallel, the Climate Resilient Sanitation Coalition open working group on emissions is exploring ways to feed this emerging evidence into the IPCC Emission Factor Database. Updating IPCC emissions factors could significantly improve carbon credit accuracy and increase feasibility for smaller non-sewered and CBS providers.

New eligible activities: biochar and resource recovery: Biochar projects that convert sanitation waste into stable carbon forms show strong potential for carbon sequestration. By permanently removing carbon from the atmosphere, they can generate carbon removal credits – which are typically valued more highly than avoidance credits, which only prevent emissions from occurring. Refer to the box below for information on experiences and challenges of trying to register a biochar project from CBS operator, Mosan, and what is needed to enable this to happen.

[10] Johnson, J., Zakaria, F., Nkurunziza, A.G. *et al.* Whole-system analysis reveals high greenhouse-gas emissions from citywide sanitation in Kampala, Uganda. *Commun Earth Environ* **3**, 80 (2022).

Carbon removal credits from biochar production with sanitation feedstock: insights from Mosan

Some CBSA members are exploring the potential of biochar as a carbon mitigation strategy, with Mosan working towards generating carbon removal credits for biochar produced using faecal sludge sourced from rural and peri-urban wastewater treatment plants and CBS waste. As carbon markets increasingly favour removal credits over avoidance credits – due to their perceived measurability and lower reputational risk – biochar may offer a more reliable avenue for carbon finance in the sanitation sector.

Mosan has conducted extensive research on pyrolysing CBS waste and applying the resulting biochar in field settings since 2018. In 2023, it expanded operations to treat additional sewage sludge, significantly increasing its impact in the sanitation sector and directly addressing local needs in the Atitlán region of Guatemala. Additionally, Mosan co-processes agricultural waste including coconut husks, which improves biochar quality by enhancing water retention and structure, while also increasing its carbon content and therefore carbon storage potential.

Mosan has designed and built its own customized top-lit updraft (TLUD) pyrolysis reactor, which integrates a drying system to dry faeces and co-substrates as coconut husks. Research conducted with university partners, including Zurich University of Applied Sciences, confirmed that the carbon removal achieved with its process is permanent, with an estimated duration of 500–1,000 years. Furthermore, the research validates pyrolysis as an effective treatment for contaminating materials like sludge, effectively eliminating toxins, microplastics, pharmaceuticals and pathogens.

However, realising this potential has proven challenging. Existing certification frameworks are typically designed for large-scale industrial production, which does not align with the distribution of the sanitation-related feedstock in rural areas. Effectively managing diverse waste collection points necessitates a decentralized approach. This involves establishing smaller treatment sites that may not individually process enough volume to make carbon credit certification viable on their own. As such, outputs must be aggregated at a larger post-processing centre, and the scaling profile is expected to be gradual as these decentralised systems are implemented.

Biochar produced by Mosan. Credit: Mosan

Looking ahead: What could help sanitation to access carbon finance

Alternative sanitation approaches generating carbon credits: Carbon credits have been successfully generated from sanitation systems that limit emissions through frequent collection and aerobic treatment – approaches well-suited to container-based models, but not always appropriate in other contexts.

Biogas capture projects at large-scale wastewater treatment plants are already established in the carbon market, with credits issued for methane recovery and use from anaerobic digestion. Faecal sludge treatment plants could also generate credits, if they have a sufficient scale to meet certification thresholds. Looking ahead, other sanitation systems – including ISO 30500-compliant “reinvented” toilets, vermicomposting toilets and decentralised treatment plants for wastewater and faecal sludge – may hold untapped potential for carbon finance, particularly as methodologies evolve to accommodate smaller, modular, and decentralised models.[11,12, 13]

Smaller carbon registries for faster, lower-cost entry points: Alternative registries such as Regen Registry can lower transaction costs and reduce project lead times, though credit prices may be less predictable. These registries could be promising for early pilots or niche sanitation interventions.

[11] Mojtaba Maktabifard, et al., Net-zero carbon condition in wastewater treatment plants: A systematic review of mitigation strategies and challenges, Renewable and Sustainable Energy Reviews, Volume 185, 2023, 113638
[12] Lanqing Li et al., Carbon neutrality of wastewater treatment - A systematic concept beyond the plant boundary, Environmental Science and Ecotechnology, Volume 11, 2022, 100180, ISSN 2666-4984
[13] Ezio Ranieri et al., Compensatory measures to reduce GHGs in wastewater treatment plants in Southern Italy, Journal of Water Process Engineering, Volume 60,2024,105128,ISSN 2214-7144

Innovative finance tools to de-risk early-stage carbon projects: New funding models could help sanitation actors bridge the gap between project launch and carbon revenue:

- Carbon Streaming Agreements offer upfront capital in exchange for future credit revenue. Example: Carbon Streaming Corporation
- Advance Purchase Mechanisms provide early cashflow based on fixed-price forward contracts. Example: CrossBoundary
- Advance Market Commitments create long-term buyer coalitions to signal demand in emerging sectors like sanitation. Example: Frontier (by Stripe)

For further information, refer to USAID's Carbon Finance Playbook: Demystifying the capital raising process for Nature-based Carbon Projects in Emerging Markets.

Aggregation and technical intermediaries: Aggregation through umbrella or grouped carbon projects could be a practical route for small-scale sanitation providers to access carbon markets. By combining multiple low-emission activities under a single project, these models help meet minimum volume thresholds and reduce per-unit transaction costs. A central aggregator coordinates project registration, MRV, and credit issuance, while participants contribute activities and share in the benefits. Revenue can be distributed based on emissions reduced or other agreed metrics. Standardised methodologies and centralised MRV enhance trust and transparency – critical for participating in both voluntary and regulated markets, such as Article 6.2, Article 6.4, and CORSIA.

Carbon aggregators like South Pole and EcoSecurities are already applying these models, bundling smaller carbon projects to meet registry requirements. And Sanergy's carbon avoidance project was registered as a grouped project, but restricted to Kenya. While this structure offers potential, cross-border grouped projects present a number of complexities, such as establishing different baselines and tax implications, which have limited sanitation implementers from trialling this solution to date.

Results-based climate finance: In addition to carbon revenues, SOIL and Sanergy have also mobilised outcomes-based funding. For outcomes-based *climate* finance, the carbon credit verification process could be used as a trigger for performance-based disbursement to de-risk investment. Instead of selling carbon credits on the voluntary market where prices can be volatile, the verification process can be used to trigger payments from outcomes-based climate finance, providing a more reliable way to fund projects based on emissions reductions.

Some decentralised sanitation solutions, such as CBS, are strong candidates for this funding, because they combine methane mitigation with climate resilience, as recognised in Green Climate Fund (GCF) guidelines. REDD+ (Reducing emissions from deforestation

and forest degradation in developing countries) is a UNFCCC-supported international climate framework that helps developing countries reduce GHG emissions through a three-phase approach: readiness (building data systems and institutional capacity), implementation (policy and technology deployment), and results-based payments (compensation for verified emission reductions).

A similar phased model could apply to the sanitation sector. For example, Sanergy and SOIL have already completed Phase 1 (and elements of Phase 2) by developing emissions methodologies, collecting baseline data, and establishing monitoring tools – positioning them to access results-based finance under a future Phase 3. The GCF's REDD+ strategy provides results-based payments for verified emission reductions, at rates such as $5 per tonne of CO_2e. A comparable mechanism for sanitation could enable actors to receive direct payments for each tonne of methane avoided or destroyed.

To access climate finance, particularly from sources like the GCF, sanitation actors should align their projects with key national and international climate planning frameworks. These include Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), and Low-Emission Development Strategies (LEDS). Projects that contribute to both mitigation and adaptation outcomes are especially well-positioned, as the GCF prioritizes proposals with co-benefits across these areas.

National alignment for compliance carbon market readiness: Sanitation could be included in bilateral or multilateral cooperation under Article 6.2 of the Paris Agreement, if participating countries agree and the activity aligns with their NDCs – highlighting a flexible pathway for crediting emissions reductions from sanitation interventions. To achieve this, sanitation actors must work with governments to ensure inclusion in national carbon strategies, and sanitation-specific methodologies compatible with regulated markets should be developed.

Positioning for compliance markets: Regulated frameworks like the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and Article 6.4 of the Paris Agreement offer access to higher-value carbon credits but come with stricter requirements, making sanitation methane-avoidance credits more challenging to qualify. These include project scale, robust monitoring, reporting, and verification systems, and formal approval of sanitation-related credit types and methodologies under national carbon strategies or Article 6 implementation plans. For example, the UK ETS Authority said that it would require projects to prove they can store carbon for a minimum of 200 years for them to be included in the ETS. This would eliminate avoidance credits, typically generated by sanitation projects (except for biochar production). Public agencies can play a key role in leading or facilitating access – for example, through initiatives like Klik Foundation's Article 6.2 projects internationally.

Contact CBSA at contact@cbsa.global

Keep up with all CBSA's latest work at cbsa.global and by signing up to CBSA's newsletter.

cbsa.global

CBSA
Container Based Sanitation Alliance