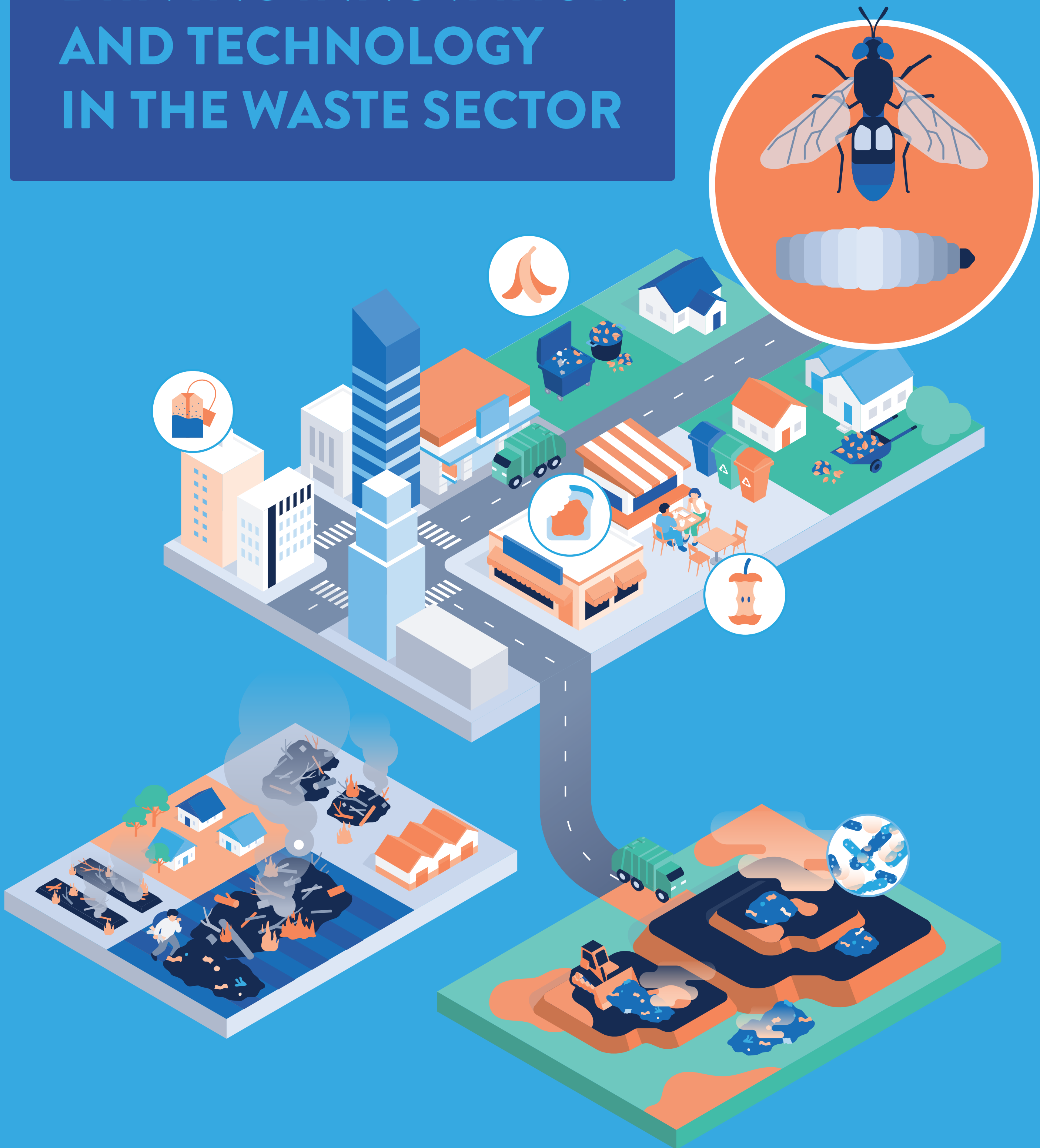
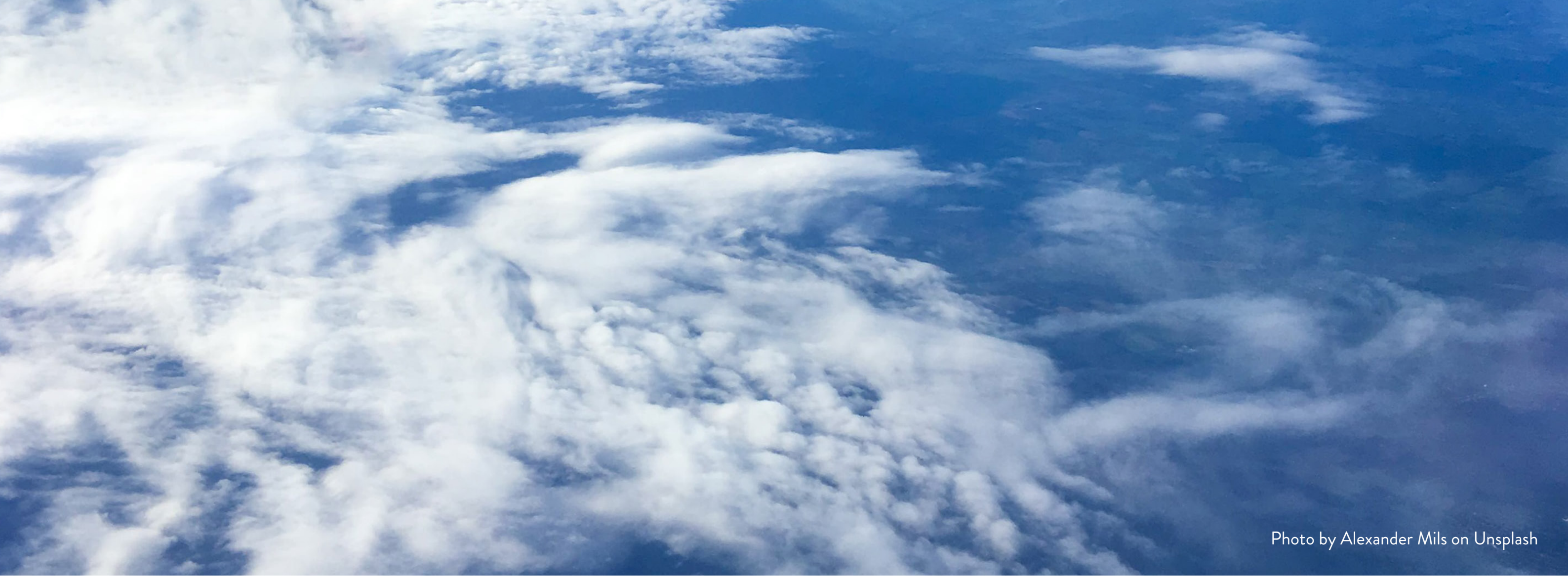
CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

a UNEP convened initiative

SCALING UP UNDERFINANCED SLCP MITIGATION SOLUTIONS:

# DRIVING INNOVATION AND TECHNOLOGY IN THE WASTE SECTOR





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# ABOUT THE CCAC-TEAP

**In 2023, the CCAC established its Technology & Economic Assessment Panel (CCAC-TEAP) to develop and share knowledge with countries about promising, innovative and underfinanced short-lived climate pollutant (SLCP) mitigation measures which can improve both climate and air quality outcomes. The CCAC-TEAP is Co-led by Ireland and Senegal.**

The CCAC-TEAP will identify and assess proven and scalable practices and technologies that can be commercialized in the short- to mid-term (1 to 3 years) and the mid- to longer term (4 to 5 years) to achieve SLCP mitigation targets. The CCAC-TEAP will then support CCAC country partners in building the business case for a range of mitigation measures to attract the investment required to scale up implementation. The CCAC-TEAP will also help guide international financial institutions in funding mitigation solutions, support countries in deciding which technical solutions to implement, and scale up implementation by connecting investment with national political priorities.

Waste emissions comprise at least 3% of global greenhouse gas (GHG) emissions, with landfills accounting for 20% of global methane emissions. As satellite data becomes increasingly detailed, landfills are being recognized as major sources of methane and tropospheric ozone. Many countries are seeking solutions to divert organic waste from landfills to significantly reduce these emissions and the rate of climate change, improve public health and prevent crop loss. Key barriers include technical capacity and financial support. This first CCAC-TEAP working brief outlines two low-cost, effective and scalable solutions to address organic waste which are currently underfinanced: black soldier fly technology as an upstream solution, and biocovers on landfills as a downstream solution.

As a next step, the CCAC-TEAP intends to broaden this work by examining other promising solutions, and developing more in-depth assessments as appropriate, outlining the business case with a detailed cost assessment by archetype to determine where and how these solutions could be made most effective. Interested CCAC Partners are encouraged to engage with the CCAC-TEAP to share knowledge of existing successful examples of these technologies to help support increased finance and scale up.

# WASTE AND THE CIRCULAR ECONOMY

There is increasing international pressure to take action on dumpsites and uncontrolled landfills, which for many countries remain the principal end point for municipal solid waste (MSW). Management of solid waste poses challenges for municipalities due to concerns over revenue and cost recovery, collection rates, and managing increasing volumes of complex waste. In addition, there is increasing awareness that landfills and waste systems are significant contributors of methane emissions that increase the rate of climate change and are precursors of tropospheric ozone – which causes premature death and non-communicable disease, and disrupts photosynthesis, thereby reducing crop production and damaging ecosystems.

The cycle of organic matter is disrupted in our urban societies, agricultural practices, and lifestyles. Organic waste in disposal sites produces leachate and methane, accelerating climate change, air pollution and soil depletion thereby resulting in health and environmental impacts. But organic waste does not need to be a climate and waste management problem. When integrated into circular economy practices, organic waste can become an adaptation and mitigation resource to reduce methane emissions, create jobs, and boost community resilience.

Managing organic waste properly by separation and valorization (i.e., composting and generating biogas or animal feed) will mitigate methane generation while generating useful resources that are otherwise wasted. By using compost or digestate in landscaping and urban gardening, cities and countries can mitigate the methane emissions from their disposal sites, adapt to climate change, improve air quality and living conditions, and create jobs. High quality compost and digestate also improves agriculture, food security and soil health. Compost or digestate can also support afforestation and soil restoration as important climate change adaptation measures.

There are a variety of solutions available for addressing organic waste upstream. Prevention strategies include sustainable food cold chains, food preservation, food banking and behavior changes in homes to reduce food waste. Once organic waste is generated, options include composting, anaerobic digestion, and utilising organic waste as animal feed. In recent years, the use of black soldier flies (BSF) has gained significant recognition because it facilitates the treatment of organic waste from diverse sources and yields multiple commercial by-products – creating a source of income and jobs, and contributing to a circular economy.

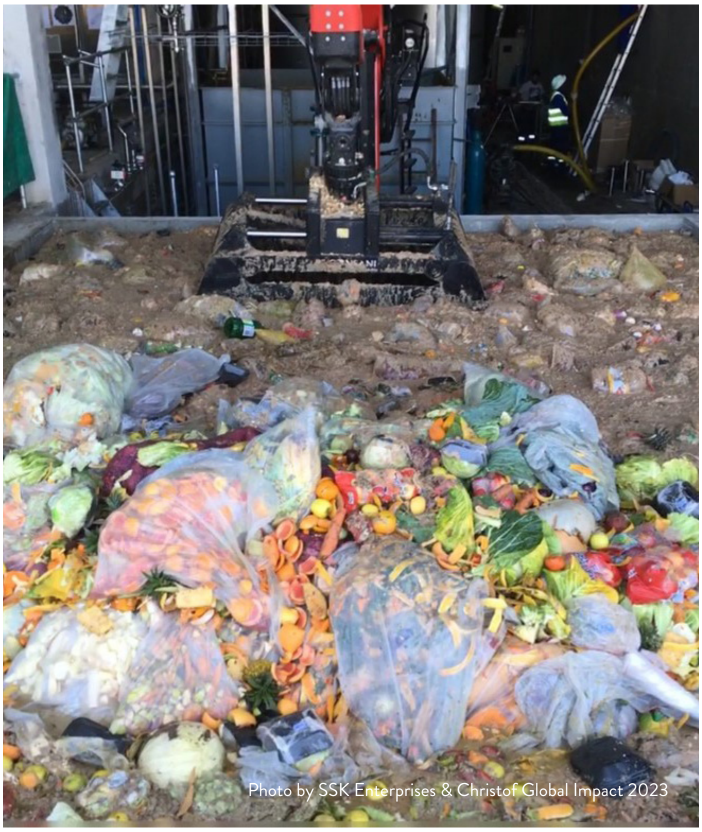
Photo by SSK Enterprises & Christof Global Impact 2023

There are also a number of solutions available to address methane emissions downstream. Current and future landfills will release emissions that require prevention and mitigation. This can be achieved by reducing the deposal of organic waste in these sites. Existing landfill emissions can be mitigated, in part, through biocovers. Biocovers are waste materials such as low-quality biodigestate and compost spread over landfills to encourage biotic methane consumption. Biocovers offer cost-effective landfill methane solutions for lower-income countries and municipalities pursuing organic waste diversion and emissions reductions. For many countries, biocovers are also a long-term methane reduction solution as they can oxidise methane throughout the entire landfill lifecycle, including after landfill closure. In landfills with low and declining methane gas loads, biocovers may be the more appropriate cost-effective approach.

# BLACK SOLDIER FLY (BSF) TECHNOLOGY


Photo by Stefan Diener/Eclose GmbH 2023


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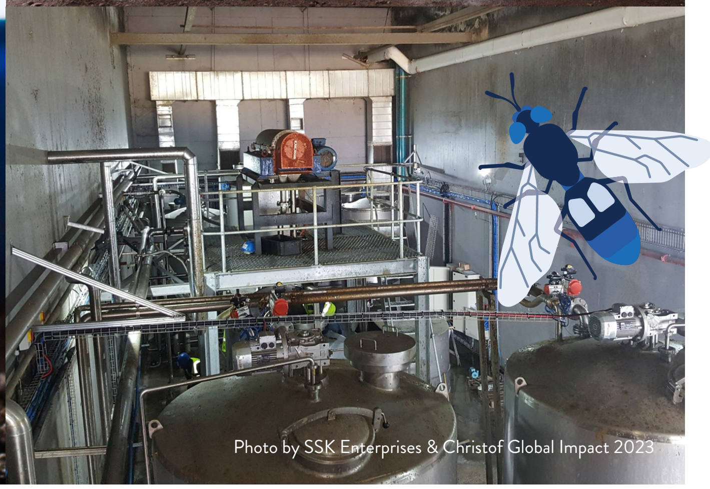
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## HOW DO BLACK SOLDIER FLIES PROCESS ORGANIC WASTE?

The use of black soldier flies (Hermetia illucens) in waste management replicates their natural reproduction cycle of black soldier flies. In nature, the adult fly lays around 500-900 eggs on or near organic residues. The larvae feed on this organic material, aiding in its decomposition and nutrient recycling for plants. However, in nature, the conditions for these eggs and larvae are unpredictable and often suboptimal due to factors like temperature, humidity, predators, and the type of organic waste. As a result, only a small number of eggs typically survive to become adult flies capable of reproduction. In a BSF plant, the environmental conditions are optimised to increase thesurvivability of the larva. The main difference between the natural and commercial lifecycle of the insect is that in a BSF plant, most of the larvae are harvested before they reach the pre-pupae stage. The larva becomes protein and can be sold for animal feed or insect oil.


Photo by Marek Studzinski on Unsplash
Photo by SSK Enterprises & Christof Global Impact 2023

## WHERE WILL BSF TECHNOLOGY WORK?

Importantly, BSF plants can be tailored to diverse contexts. BSF plants can be very small, for example for households or small commercial waste generators, or large-scale industrial plants – the latter being able to process hundreds of tonnes of organic waste per day. Centralised solutions with high process capacities seem to be more suitable for urban situations, where large quantities of organic waste can be mobilized with reasonable logistic costs. Decentralised BSF concepts are more suitable for rural settings, where organic waste concentration is low and more dispersed.

## WHAT IS THE MITIGATION POTENTIAL OF BSF TECHNOLOGY?

Studies to measure the methane mitigation potential of BSF technology are nascent but very promising. The most comprehensive research to date by Mertenat et. al., 2019 compares GHG emissions from BSF technology with traditional composting processes. The study shows that during the organic waste treatment process the emissions from BSF plants are less than half of the emissions of traditional composting. This analysis was undertaken for an BSF plant in Indonesia and is site specific.

## WHAT IS THE JOB POTENTIAL OF BSF TECHNOLOGY?

BSF technology offers formal employment opportunities for skilled and unskilled men and women in the areas where the projects take place. Decentralised plants can offer excellent opportunities for unskilled workers to own, operate, and maintain the plants.

## WHAT IS THE BUSINESS CASE FOR BSF TECHNOLOGY?

Black soldier flies rapidly reduce organic waste while creating high-quality pet, fish and poultry food, insect oil, biofuel, and high-quality compost to improve soil health. Black soldier flies are found worldwide, and profitable business models can be established in both temperate and tropical conditions. BSF output products have substantial global demand, with positive market forecasts. In addition to animal feed, the increasing world population and evolving dietary habits are poised to significantly raise the demand for protein in the coming decades. Insect oil is not only a valuable resource for the pharmaceutical industry but can also be used as animal feed or in biodiesel production. Additionally, organic fertiliser produced as a by-product can enhance soil health, contributing to the sustainable transformation of the agricultural sector.

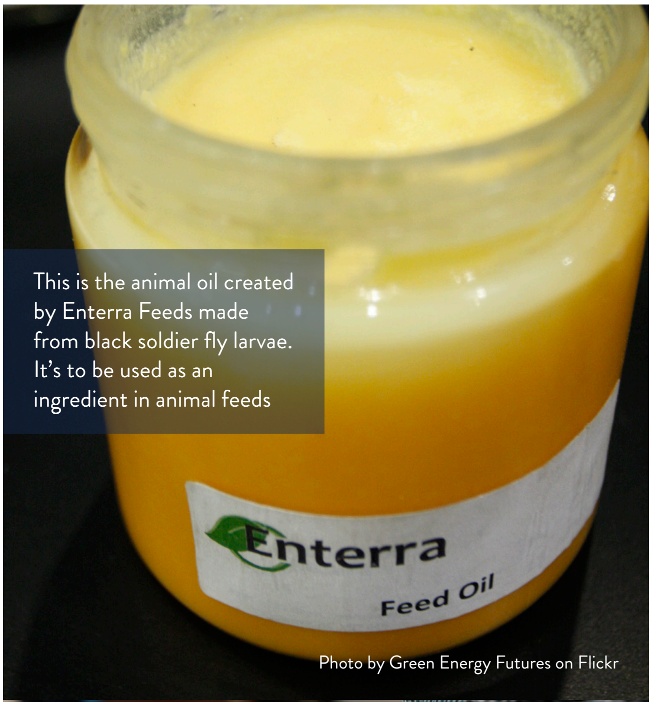
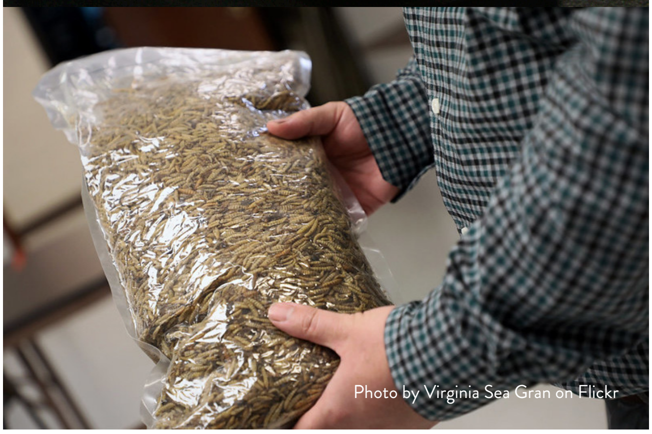



Photo by Green Energy Futures on Flickr



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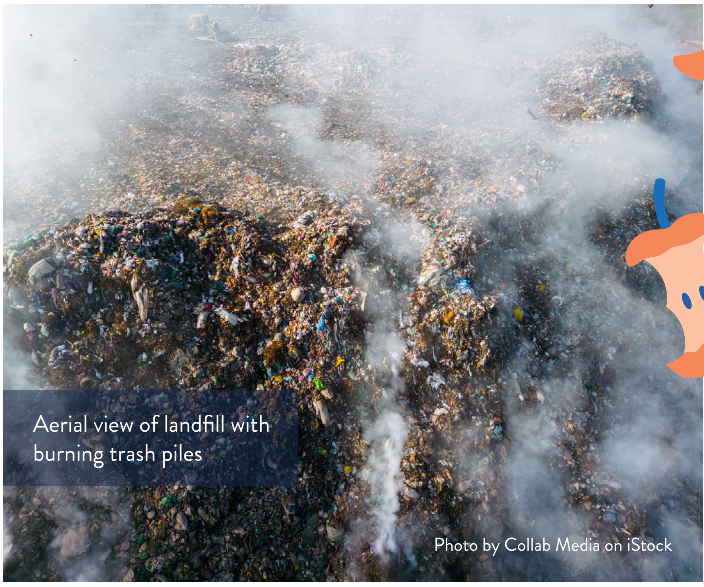
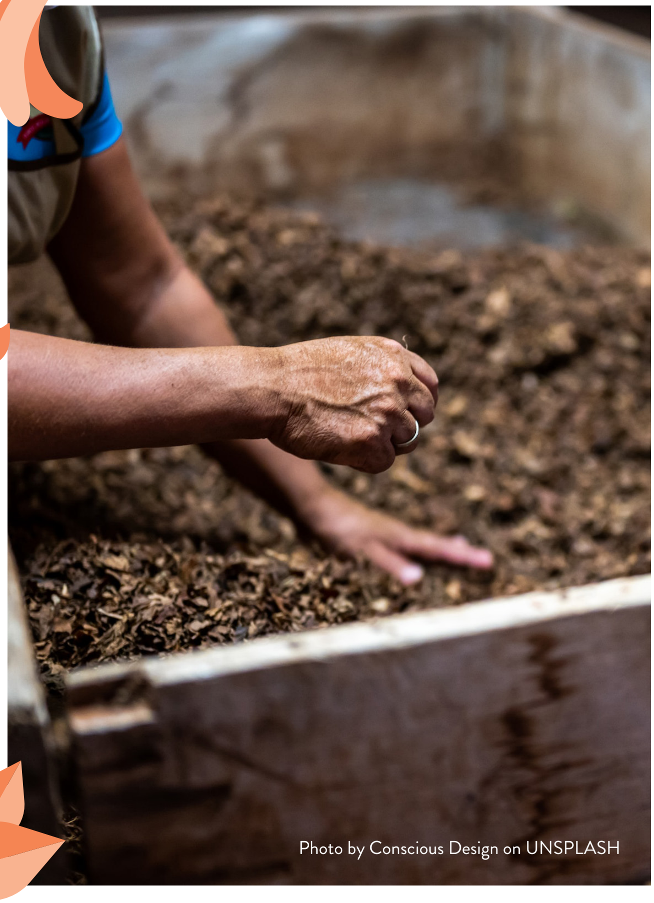
The CCAC is currently supporting a study in Lima, Peru, on the BSF technology to determine the best way to implement the solution to treat the city's organic waste. "The project titled "Linking Waste Management and Protein Production Through Insect Technology" aims to show the feasibility by developing the business model and concept design for a centralised BSF plant for the treatment of organic waste in Lima. The project aims to show that BSF plants have a strong business case that can be later upscaled and replicated in other large cities in Peru and Latin America.

# BIOCOVERS



Aerial view of landfill with burning trash piles

Photo by Collab Media on iStock



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## WHAT ARE BIOCOVERS AND HOW DO THEY WORK?

Landfill biocovers are relatively simple and locally engineered biotic systems that use combinations of organic materials to cover the surface of landfills. This creates biologically active layers that disperse methane and oxidise organic waste reducing dangerous greenhouse gases, particularly methane. Biocovers act as vast and adaptable biofilters, protecting the climate from landfill emissions.Materials can range from a distributed layer of gravels, to the use of sand, and various sources of compost and organic materials, including woody compost, composted food waste and other rich organic material.

## WHERE WILL BIOCOVERS WORK?

Biocovers require certain contextual factors. These include control of emissions at aging landfills with declining gas production in which landfill gas capture is not financially or commercially viable, or at smaller-scale landfills with no commercially viable landfill gas system in place. Given that methane emissions from landfill surfaces are the single largest contributor to climate change from waste, biocovers can significantly reduce the environmental impacts of landfill gas emissions, but mitigation may be highest where biocovers are combined with gas collection systems – especially in the active phase of landfills.

## WHAT IS THE MITIGATION POTENTIAL OF BIOCOVERS?

The mitigation performance of biocovers is dependent on both the physical and the chemical properties of landfill cover materials such as soil type, moisture content, density, organic and nutrient content, and so on. Additionally, environmental conditions such as temperature and precipitation can impact the performance of landfill cover soils in terms of oxidising methane. The strongest mitigation potential is derived from dense and older compost, given its moisture retention and density which supports the microbiological activity essential for methane oxidation.

If managed and designed properly, biocovers can significantly reduce methane through oxidation for several decades, given the approach can be locally managed and adapted to changes in landfill growth and structure over time. Biocovers have demonstrated high mitigation potential in landfill contexts as diverse as the United States, India, Republic of Korea, Thailand, the Mediterranean region and Europe.

## WHAT IS THE BUSINESS CASE FOR BIOCOVERS?

Costs vary depending on local availability of materials. If local compost is available, it can both significantly reduce costs and increase mitigation performance. Beyond installation, additional costs include maintenance e.g., watering the oxidising materials in dry climates and measuring effectiveness over time, but overall biocovers are considered highly cost-effective solutions.

In addition, biocovers should also be considered a potential source of finance, including through carbon credits and sectoral investments such as through Article 6 of the Paris Agreement. Initial research suggests that biocovers are worthy of greater analysis in terms of their measurable contribution to mitigation over several decades and are therefore relevant to ongoing developments in climate finance. This may be a potential motivation for developing countries to close their waste dumps using biocover systems. Finally, as noted by the IPCC in 2007, biocovers may also be further assessed as potential sinks for emissions (IPCC), especially if combined with vegetative cover.

In developing and emerging economies in particular, closing or upgrading open and uncontrolled landfills is an potential option to reduce greenhouse gas emissions with appropriate and affordable technologies. , but provides potential for significant mitigation funding to finance the closure of problematic and dangerous landfill sites. Biocovers are also strongly aligned with efforts to shift away from 'collect and dump' waste management practices towards valorisation of organic waste through compost, and support of the development of the circular economy.

# FUTURE ENGAGEMENT

Interested CCAC Partners are encouraged to engage with the CCAC-TEAP to contribute knowledge of existing successful examples of BSF technology and biocovers to a database of ongoing projects to track best practices and lessons learned to increase finance and scaled-up implementation. A useful next step will be to collect and analyze data by archetype to further develop the business case, identify interested countries and determine where investments can leverage the greatest impact for both the local and global communities.

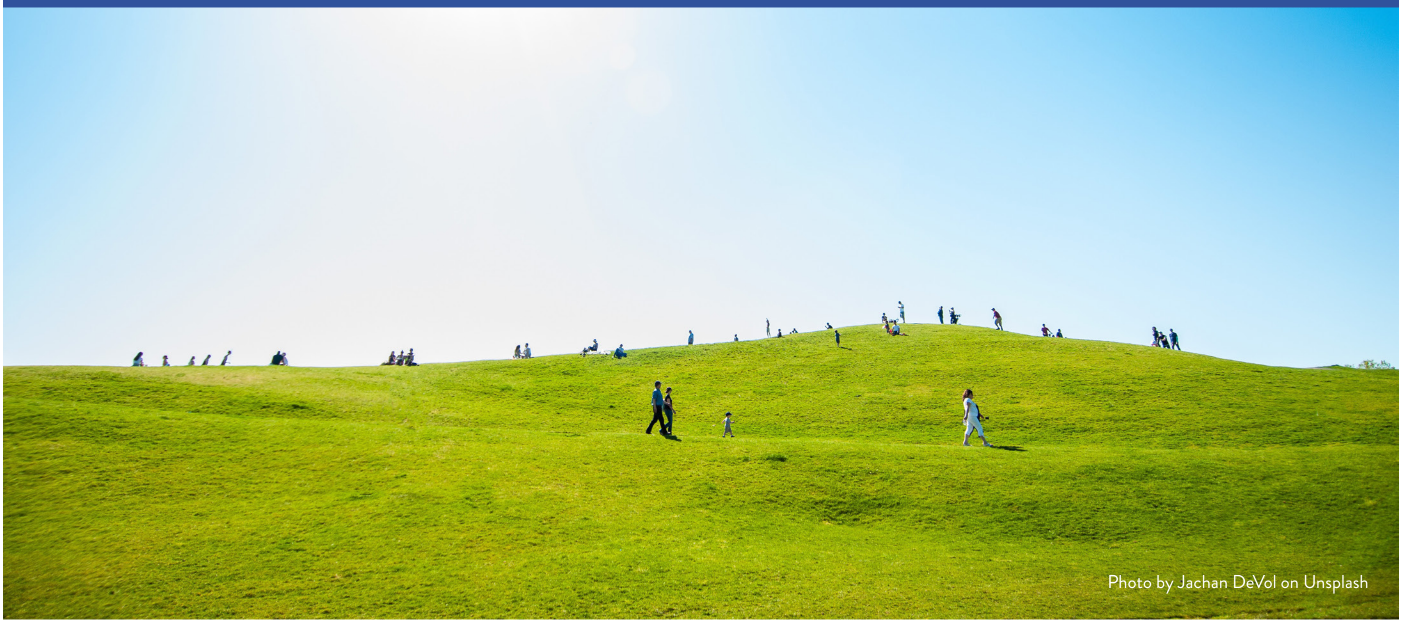

Photo by Jachan DeVol on Unsplash

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**BSF technology**

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# ABOUT THE CCAC

The UNEP-convened Climate and Clean Air Coalition (CCAC) is a voluntary partnership of more than 160 stakeholders including more than 80 country partners seeking to reduce methane and other short-lived climate pollutants (SLCP) to limit global warming to 1.5°C. Through its Trust Fund, the CCAC supports countries to reduce SLCP emissions across sectors by 2030, while advocating for elevated ambition and advancing the latest in policy-relevant science. Different funding windows exist, including for institutional strengthening, national planning, policies and regulation as well as sectoral transformation.

Following a decade of success in raising global methane ambition, the CCAC Secretariat is also providing secretariat functions to the Global Methane Pledge (GMP), a voluntary commitment of more than 150 countries to reduce global methane emissions by at least 30% by 2030 compared to 2020 levels.

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