Training of Trainers on the Climate-Sanitation Nexus

Training Manual

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GGGI Introduction

The Global Green Growth Institute (GGGI) is a treaty-based, international intergovernmental organization committed to supporting and promoting strong, inclusive, and sustainable economic growth in developing countries and emerging economies.

Since its establishment as an international organization at the RIO+20 Conference in 2012, GGGI's membership has expanded significantly, from 18 founding signatories to 52 Members and 29 Partner States by the end of 2025. Drawing on a broad and diverse body of green growth experiences across regions, GGGI works closely with its Members and Partners to advance a transformative green growth agenda.

A distinguishing feature of GGGI is its in-country presence, which positions the organization as an independent, trusted advisor and strategic development partner embedded within Member and Partner governments. This unique arrangement enables GGGI to act as both an enabler and facilitator, delivering tailored policy advice and technical assistance. Its support encompasses the development of green growth strategies, policies, and regulatory frameworks; the mobilization of green investments; the implementation of green growth projects; and the strengthening of capacities and knowledge at sub-national, national, and regional levels.

Among its various initiatives, GGGI is actively engaged in enhancing sanitation systems across African countries, particularly through the promotion of circular and climate resilient sanitation models. These efforts go beyond the provision of basic sanitation infrastructure, focusing instead on the safe treatment, reuse, or disposal of human waste. In doing so, they contribute to both environmental sustainability and improved public health outcomes.

A notable example is the project titled "Promoting Inclusive City-wide Sanitation through Climate Resilience in West Africa", implemented in Senegal, Burkina Faso, and Côte d'Ivoire. This initiative aligns with national priorities and seeks to integrate sanitation into climate policy frameworks—especially in the context of upcoming revisions to Nationally Determined Contributions (NDCs). While attracting climate finance to the sanitation sector remains a challenge, the integration of sanitation into climate policies, backed by robust data and actionable strategies, significantly strengthens the sector's investment case.

AfWASA Introduction

The African Water and Sanitation Association (AfWASA) was established in 1980 to build partnership to ensure African people's sustainable access to potable water and sanitation services. AfWASA's vision is for leadership in capacity building of actors in the water and sanitation sector in Africa, building its strategy on the Africa Water Vision 2025, the solutions for the reach of the Sustainable Development Goals and the Agenda 2063. There is a need for new approaches and new forms of lessons to be learned as well as worldwide experiences to exchange to improve the performance of water supply and sanitation utilities in Africa and from this make water supply and sanitation services to the African populations more efficient for sustainable growth.

AfWASA's vision is to mobilize all the professional actors and stakeholders, as well as researchers and academia, young professionals, and women professionals around a strong membership to create the right dynamic to efficiently overcome the water and sanitation issues in Africa.

AfWASA has members comprised of Corporate, Affiliate and individual members and is headquartered in Abidjan, Cote d'Ivoire.

UPM Introduction

Established in Munich (Germany) in 1991 to contribute to climate protection and sustainable energy production, UPM Umwelt-Projekt-Management GmbH (UPM) is a boutique consulting firm specializing in climate change mitigation, adaptation, and sustainable development and is a leading player in international carbon trading markets. UPM established UPM Environment Engineering Project Management Consulting (Beijing) Co., Ltd, its subsidiary in China, in 2008 to support clients' servicing and project development in Asia.

UPM provides a service offering based on a powerful combination of expertise, experience, and dedication to fulfill our mission.

Climate Action Project Services, from climate action project idea development to credit trading.

UPM services include project development, carbon asset management, advisory, research, and capacity building. With a diversified portfolio of more than 30 registered CDM and Gold Standard projects, UPM can offer a broad range of carbon credits in mandatory and voluntary markets. Altogether, these climate action projects will save almost 30 million tCO_2-eq and generate multiple co-benefits that will substantially improve the lives of millions of people. UPM's service package covers the entire carbon offset value chain, with a particular emphasis on sustainability contributions and verifiable co-benefits of projects.

UPM's flagship project, the GS CDM Sichuan Poor-Rural Household Biogas Development Program of Activities (PoA), is one of the largest and most effective worldwide, with almost 400,000 participating low-income farmer households and annual GHG emission reductions of around 745,000 tCO_2-eq. The project is highly regarded among CSR practitioners for its significant GHG savings and for contributing to the achievement of 14 of the 17 United Nations Sustainable Development Goals (UN SDGs).

Consulting Services - Technical Assistance, Advisory, and Capacity Building for Public and Private Climate-SMART Sustainable Development Projects.

UPM's consulting services, built on 30 years of professional experience, successfully support clients in the public and private sectors in tackling energy, climate change, and sustainable development challenges. UPM collaborates with a well-established global network of the most reputable institutions and experts in renewable energy, sanitation, waste management, and rural development, and provides teams of experts composed of a combination of qualified internal and external consultants as required.

Regional Experiences: Asia (China, Bangladesh, Pakistan, Mongolia, Vietnam); Middle East (Iraq, Jordan, Lebanon, Saudi Arabia); Africa (Benin, Burundi, Burkina Faso, Comoros, Ghana, Ivory Coast, Madagascar, Malawi, Mali, Mauritius, Mauritania, Senegal, Sierra-Leone, South Africa), Pacific Islands (Samoa, Tonga), Central and South - America (Chile, Bolivia, Cuba)

Acronyms & Abbreviations

ACMI	African Carbon Markets Initiative
AfDB	African Development Bank
AfWASA	African Water and Sanitation Association
AUSII	African Urban Sanitation Investment Initiative
AWF	African Water Facility
BOD	Biological Oxygen Demand
CA	Corresponding Adjustments
CCP	Core Carbon Principles
CDM	Clean Development Mechanism
CER	Certified emission reduction
CH_4	Methane
CIF	Climate Investment Funds
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSO	Civil Society Organization
CO_2	Carbon Dioxide
CO_2-eq	Carbon Dioxide Equivalent
CSO	Civil Society Organization
CWIS	City Wide Inclusive Sanitation
DBSA	Development Bank of Southern Africa
DNA	Designated National Authorities
EAA	Eastern Africa Alliance on Carbon Markets and Climate Finance
ECAM	Energy Performance and Carbon Emissions Assessment and Monitoring Tool
ESAWAS	Eastern and Southern Africa Water and Sanitation Regulators Association
ETS	Emissions Trading Systems
EU	European Union
FSM	Fecal Sludge Management
GCF	Green Climate Fund
GEF	Global Environment Facility

GGGI	Global Green Growth Institute
GHG	Greenhouse Gases
GPRBA	Global Partnership for Results-Based Approaches
GS	Gold Standard
GWP	Global-Warming Potential
GWP	Global Water Partnership
ICVCM	Integrity Council for the Voluntary Carbon Market
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ITMO	Internationally Transferred Mitigation Outcomes
JI	Joint Implementation
JMP	Joint Monitoring Program
KIFFWA	Kenya Innovative Finance Facility for Water
LDCs	Least Developed Countries
LLCA	Locally Led Climate Action
LOA	Letter of Authorization
MCDA	Multi-Criteria Decision Analysis
MCF	Multilateral Climate Funds
MDB	Multilateral Development Bank
MRV	Monitoring, Reporting, and Verification
N_2O	Nitrous Oxide
NAP	National Adaptation Plan
NDC	National Determined Contributions
NGO	Non-Governmental Organization
OBA	Output-Based Aid
OECD	Organization for Economic Co-operation and Development
OSS	Sahara and Sahel Observatory
PACM	Paris Agreement Crediting Mechanism
PDD	Project Design Document
PIN	Project Idea Note
PMI	Partnership for Market Implementation
PoA	Program of Activities

PPE	Personal Protective Equipment
PSF	Private Sector Facility
PSAA	Project-specific Assessment Approach
RCC	Regional Collaboration Centre
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDG	Sustainable Development Goal
SEI	Stockholm Environment Institute
SFD	Shit-Flow-Diagram
SIDS	Small Island Developing States
SMART	Safe, Mitigative, Adaptive, Resilient, Transformative
SOP	Share of Proceeds
t CO_2-eq yr^{-1}	Tons of carbon dioxide equivalent per year
ToT	Training of Trainers
UDDT	Urine-Diverting Dry Toilet
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
US$	United States Dollar
UPM	UPM Umwelt-Projekt-Management GmbH
VCM	Voluntary Carbon Market
VCS	Voluntary Carbon Standard
VVB	Validation and Verification Bodies
WAA	West Africa Alliance on Carbon Markets and Climate Finance
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization

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1 Introduction

1.1 Background and context of the training

Despite growing challenges, the connection between climate change and sanitation, including its economic implications, remains poorly understood by many decision-makers. To address this, the Global Green Growth Institute (GGGI), with financial support from the Gates Foundation, is implementing the project "Promoting Inclusive City-Scale Sanitation through Climate Resilience in West Africa" in Senegal, Burkina Faso, and Côte d'Ivoire.

In line with the government's direction in the target countries, the project aims to mainstream sanitation into national policies, including through the revision of Nationally Determined Contributions (NDCs). Increasing the attractiveness of the sanitation sector for climate finance remains challenging. Raising the profile of sanitation in the NDC, accompanied by accurate estimations, a corresponding action plan and monitoring, reporting and verification (MRV) tools, will strengthen the case for more climate financing.

In addition to the targeted policy work, broader regional knowledge sharing and capacity building are key components of the project, to raise awareness across Africa and equip stakeholders to prioritize sanitation in climate strategies while improving access to climate finance. Human expertise is crucial to strengthening Africa's resilience. Investing in local training builds the capacity to implement both modern solutions and traditional knowledge. A skilled network of African trainers will help promote climate smart sanitation practices across the continent.

This project aims to achieve the following outcomes:

- Outcome 1: Enhanced understanding of climate-resilience opportunities in the sanitation sector in the region by strengthening the platform for sharing and knowledge approach to further the climate-sanitation nexus narrative.
- Outcome 2: Mainstreamed sanitation into national/local strategies, MRV systems, and updated NDCs.
- Outcome 3: Disseminated innovative and climate-friendly sanitation technologies suitable for local markets in the target countries.

Under Outcome 1, GGGI entered into a partnership with the African Water and Sanitation Association (AfWASA) to organize a regional capacity-building program on the climate-sanitation nexus. UPM Umwelt-Projekt-Management GmbH (UPM) was selected to conduct a 4-day Training of Trainers (ToT) on the topic.

1.2 Objectives of the Training of Trainers

The overall goal of this Training of Trainers is to enhance the understanding of climate-resilience opportunities in the sanitation sector in the region and to promote city-wide inclusive sanitation principles in Africa.

Further, the training aims to convey theoretical and practical knowledge on the interconnection between climate and sanitation, climate-SMART sanitation, climate finance, and carbon finance, which can elevate sustainable sanitation that benefits both the climate and sustainable development.

This user-friendly and practical training relies on the active participation, experience, and expertise of the trainees. Together, we aim to delve deeper into the topics and explore opportunities that are of interest to the trainees, their country, the sanitation sector, and the climate. Training of Trainers principles and techniques will be applied to equip trainees with valuable soft skills, in addition to theoretical and practical insights.

The national context of the trainees, as well as the diverse levels of awareness and knowledge among them, shape the training. The intention is that the trainees will leave this training motivated to apply the newly gained insights in their professional context, whether by sharing knowledge as a trainer or by implementing specific projects.

1.3 Structure and Learning Objective Description

The training program is structured over four days, with each day dedicated to a specific module. The trainees will explore a new theme each day, building a comprehensive understanding of the climate-sanitation nexus and its practical applications:

Day 1 - Module 1: Climate-Sanitation Nexus

Day 2 - Module 2: Climate-SMART Sanitation

Day 3 - Module 3: Climate Finance for Sanitation

Day 4 - Module 4: Carbon Markets for Sanitation

Below is a detailed overview of each module, including the learning objectives as well as the theoretical and practical components that will be addressed throughout the training.

Module 1: Climate-Sanitation Nexus

This module conveys a comprehensive understanding of the interlinkage between climate and sanitation. In this context, it aims to provide a deeper understanding of the relevance of the Sustainable Development Goals (SDGs) and Nationally Determined Contributions (NDCs). It includes practical aspects that enable trainees to evaluate the impacts of climate change on sanitation systems. Furthermore, the trainees will be able to align sanitation practices with the Sustainable Development Goals (SDGs) and country-specific Nationally Determined Contributions (NDCs). The individual elements of this module are:

Learning Objectives	Theoretical Aspects	Practical Aspects
• Understand the climate-sanitation-nexus • Understand the relevance	Understand the climate-sanitation-nexus • What is the nexus? Why is it relevant? Why do we need to build capacity in this topic? • Interconnections between climate and sanitation (impact of sanitation on climate, and climate impact on sanitation)	Understand the climate-sanitation-nexus • Evaluation of climate change impacts on sanitation systems Understand SDGs and NDCs • Understanding how sanitation is considered in country-

of Sustainable Development Goals (SDGs) and Nationally Determined Contributions (NDCs)	Understand SDGs and NDCs • Overview of SDGs 6 and 13, and their broader impact on other SDGs • Introduction of NDCs and sanitation targets within NDCs	specific NDCs and aligns with SDGs • Development of practical ideas how to advocate or implement sanitation-related climate actions

Module 2: Climate-SMART Sanitation

This module explains climate-SMART sanitation and provides an overview of solutions along the sanitation value chain. Furthermore, this module conveys know-how on how to design and evaluate sanitation solutions. The individual elements of this module are:

Learning Objectives	Theoretical Aspects	Practical Aspects
• Gain knowledge on climate-SMART sanitation systems approach • Know how to evaluate climate-SMART sanitation systems and solutions	Gain knowledge on climate-SMART sanitation systems approach : • Overview and brief description of climate-SMART sanitation approach and its relevance Know how evaluate sanitation systems and solutions: • Introduction of the methods and tools for baseline assessment based on the climate-SMART sanitation approach • Evaluation of climate-SMARTness of technology • Introduction to technology screening and short-listing method	Gain knowledge on climate-SMART sanitation approach tools and know how to evaluate systems and technologies • Sanitation technology GHG emissions calculation • Exercise to develop a sanitation solution specific to the participants sanitation challenge (action plan development) • Site visit that enables an onsite real-time assessment of a sanitation system

Module 3: Climate Finance for Sanitation

This module focuses on climate finance opportunities for the sanitation sector. It provides an overview of the evolution of climate finance from the Kyoto Protocol to the Paris Agreement, as well as national standards and developments. The module will provide trainees with insights into existing climate financing tools for sanitation projects or initiatives, enabling them to conduct eligibility assessments and elaborate on potential ideas that meet the funding criteria. The individual elements of the module are:

Learning Objectives	Theoretical Aspects	Practical Aspects
• Understand climate finance evolution • Be aware of existing climate financing tools for sanitation projects	Understand climate finance evolution • From Kyoto Protocol to Paris Agreement overview • National standards and developments • Opportunities and challenges related to climate financing Be aware of existing climate financing tools for sanitation projects • Overview of climate financing tools such as GCF, etc. • Requirements and processes to apply for climate finance sources	Understand climate finance & be aware of existing climate financing tools for sanitation projects • Eligibility assessment of sanitation projects for a selected climate finance program: Green Climate Fund • Development of ideas of sanitation projects/programs that could be financed by climate fund

Module 4: Carbon Markets for Sanitation

This fourth module conveys theoretical and practical knowledge on carbon markets. This will enable trainees to understand the purpose, benefits, and challenges of carbon markets. Furthermore, it provides insights into the development of carbon credit projects, from the initial project idea to the sale of carbon credits on carbon markets. The individual elements of the module are:

Learning Objectives	Theoretical Aspects	Practical Aspects
• Understand carbon markets • Understand carbon credit projects	Understand carbon markets • Explanation of carbon projects and carbon credits • Basics of carbon markets (evolution from Kyoto Protocol to Paris Agreement, differentiation between compliance and voluntary carbon markets, frameworks and standards, etc.) Understand carbon credit projects • Introduction to the carbon project cycle (from the development of a project idea to selling carbon credits on the carbon markets) • Relevant methodologies for sanitation projects • Carbon market eligibility and opportunities	Understand carbon markets & Understand carbon credit projects • Evaluation of carbon market eligibility for sanitation projects • Identify the type of project which could be registered as carbon credit project • Training/advocacy plan

Integrated Soft Skills Development

The training-of-trainers cultivates essential skills for effective knowledge transfer, collaboration, and problem-solving. The trainees will be equipped with the following competencies to lead future trainings and navigate complex stakeholder dynamics confidently:

- Communication Skills: Trainees will strengthen their public speaking abilities by having the opportunity to articulate ideas in a structured and clear manner when presenting to the other participants. They will also practice active listening, understanding new topics and content shared by the trainers and peers. These skills are reinforced through feedback sessions.
- Interpersonal Skills: The training emphasizes building connections with people from diverse backgrounds, fostering an inclusive learning environment. Participants will gain insights on techniques and strategies to consider diverse backgrounds. Collaborative exercises involve trainees working together in pairs and groups, encouraging joint problem solving and the co-creation of results.
- Critical Thinking: Trainees will be continuously encouraged to evaluate content critically and consider multiple perspectives. The training guides how to develop tailored action plans, applying the taught insight to practical scenarios relevant to the trainee's contexts.
- Learning and Teaching Methods/Techniques: The training curriculum encompasses a range of teaching methods, including presentations, group activities, and interactive exercises. These techniques will inspire trainees to design their own engaging, effective, and participant-focused future trainings.

By blending soft skills with theoretical and practical knowledge, trainees are equipped to inspire action in their communities.

2 Module 1: Climate-Sanitation Nexus

2.1 What is the Climate-Sanitation Nexus?

- **Understanding the Climate-Sanitation Nexus:** Definition, explanation and its relevance in addressing global challenges
- **The Importance of Capacity Building:** Why strengthening knowledge and skills in the Climate-Sanitation Nexus is crucial

The Climate-Sanitation Nexus refers to the interconnected relationship between sanitation systems and climate change. This nexus is critical for addressing global challenges because **sanitation systems contribute to and are affected by climate change** while also offering solutions for mitigation, adaptation, and resilience.

As climate change intensifies, integrating sanitation into climate action is essential for achieving *the Sustainable Development Goals (SDGs) and building resilience against climate risks. This is because sanitation provides vital health protection, enabling societies to flourish and thrive and better withstand shocks. Additionally, it protects* communities *from infectious disease outbreaks*.

However, the Climate-Sanitation Nexus has a complex nature and can be described as a "wicked problem"[1]:

- The interlinked nature of climate and sanitation issues means that the full scope and impact of the problem often becomes clearer as interventions are tried, and their outcomes are observed. The nexus is complex, and **its understanding is continuously evolving**.
- There is no clear point at which the nexus can be considered "solved". New challenges continue to emerge due to changing climate patterns, population changes, and shifting socioeconomic contexts. This is an **ongoing issue without a definitive endpoint**.
- **There is no right or wrong.** Solutions are to be judged on their relative effectiveness or acceptability. What works in one context may not be suitable in another, and solutions are instead evaluated as better or worse.
- **Each context presents unique and novel combinations** of climate impact, sanitation infrastructure, governance, and social factors. These solutions must be tailored to specific frame conditions. Previous experience may not always provide reliable guidance for new solutions.
- When large-scale sanitation interventions are implemented, they cannot easily be reversed or repeated. **Decisions are "one-shot operations," which can have lasting consequences**.

The Climate-Sanitation Nexus *affects all people, regardless of whether they have access to safely managed sanitation or not, and* whether *they reside in high-risk climate-impacted areas or not.* The following schema

[1] Based on the definition of a "wicked problem" by Rittel and Weber, applied to the Climate-Sanitation Nexus

shows the key strategy that each group can follow towards climate-SMART sanitation. Module 2 of this training introduces an approach to implement these climate-SMART strategies.

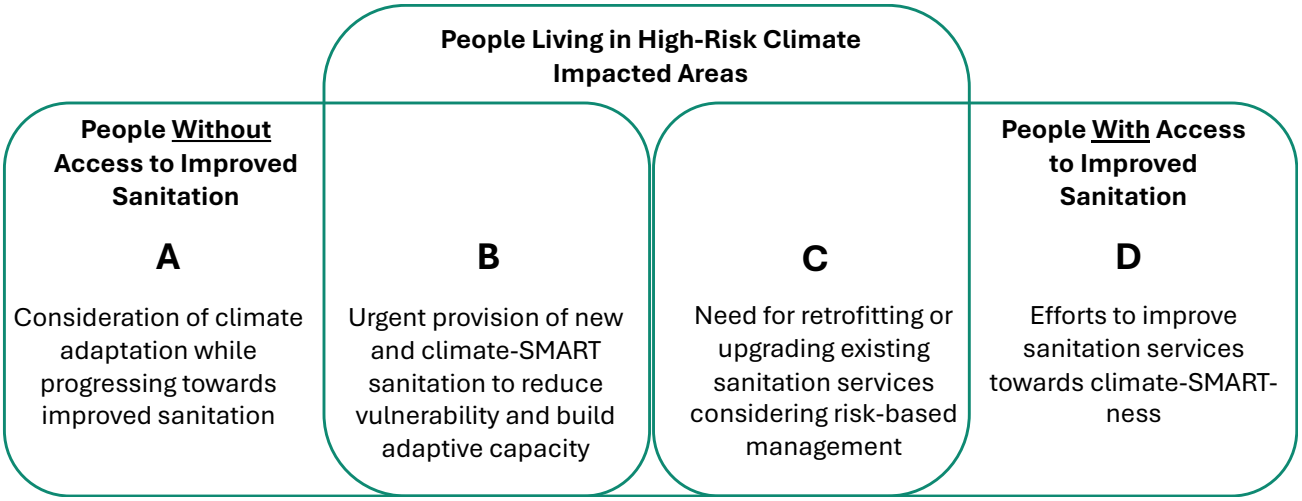


Figure 1: Grouping of the Population Based on Sanitation and Climate Conditions, and Key Strategies for these Groups towards Climate-SMART sanitation (Source: Adapted from SWA)

Building capacity on the Climate-Sanitation Nexus is essential to raising awareness of the importance of sanitation in climate-related topics. Awareness is a key factor in considering sanitation in national climate frameworks. Furthermore, it encourages the consideration of climate-SMART principles when designing and implementing sanitation systems, thereby ensuring that sanitation systems can withstand climate stressors, curb disease outbreaks, and safeguard vulnerable groups. In addition to exploring the approach to implement climate-SMART sanitation (Module 2), the manual provides insights into available climate financing for sanitation projects (Module 3) and the potential of carbon markets to create sustainable funding for climate-SMART sanitation solutions (Module 4).

In 2022, the Climate Resilient Sanitation Coalition (CRSC) was launched in response to the joint call for Action launched at COP27 under the vision of:

"Integrating sanitation into global and national climate policy & practice; and integrating climate into global and national sanitation policy & practice."

While the coalition is growing, its members currently represent nearly 35 organizations that implement climate-resilient sanitation programs in approximately 80 countries. (SuSanA)

Sources

SWA: Sanitation and Water for All: Water, Sanitation, and Hygiene services within the Framework of the Global Goal on Adaptation, https://www4.unfccc.int/sites/SubmissionsStaging/Documents/202305311322---UNICEF.pdf, 19.05.2025

SuSanA: Sustainable Sanitation Alliance: Climate Resilient Sanitation Coalition (CRSC), https://www.susana.org/community/themes/climate-resilient-sanitation-coalition#WebinarResources, 19.05.2025

2.2 What are the interconnections between climate and sanitation?

- How Sanitation Impacts the Climate: Overview of sanitation's contribution to GHG emissions and its role in climate change
- How the Climate Impacts Sanitation: Effects of climate change on sanitation infrastructure and service delivery

Climate and sanitation are deeply intertwined, with climate change and variability directly and indirectly affecting the safety, accessibility, and sustainability of sanitation systems, and inadequate or non-SMART sanitation contributing to climate impacts. Awareness of these interconnections is the first essential step towards achieving sustainable development.

How Sanitation Is Affecting the Climate

Globally, wastewater and sludge management are estimated to produce 257 million tons of CO_2-equivalent (CO_2-eq) annually, while non-sewered sanitation systems contribute approximately 267 million tons CO_2-eq each year. Combined, these emissions represent around 1.3% of total global GHG emissions—a share comparable to the aviation sector's CO_2 emissions. (Ritchie H., 2020)

In terms of methane, non-sewered sanitation alone is responsible for up to 4.7% of global anthropogenic methane emissions. (Cheng S, 2022)

At the city level, modeling in Kampala, Uganda, found that both sewered and non-sewered sanitation systems together could account for over 50% of the city's total GHG emissions. (Johnson J., 2022)

According to a 2024 GGGI 'Sanitation and Climate' assessment, liquid sanitation now accounts for about 7.7 % of Senegal's total GHG emissions—far higher than the ≈ 1 % reported in earlier inventories that ignored on-site systems. Methane contributes roughly 75 % of these sanitation emissions, nitrous oxide 24 %, and carbon-dioxide about 1 %." (GGGI, 2021)

Greenhouse gas (GHG) emissions from sanitation systems—such as methane and nitrous oxide—cannot be entirely avoided with current technology and biological processes. While sanitation currently contributes a smaller share of total GHG emissions compared to major sectors like energy or agriculture, it remains a significant source. This contribution is expected to grow in the coming years, particularly in regions such as South Asia and sub-Saharan Africa, where sanitation gaps persist, and populations are both growing and urbanizing. In these areas, increased reliance on pit latrines and septic tanks is projected to drive a rise in sanitation-related GHG emissions.

Eliminating open defecation and expanding access to safely managed sanitation is a key global sustainability goal that supports public health and environmental protection. However, open defecation, while contaminating soil and water, produces minimal direct methane emissions because human waste decomposes aerobically in the environment. The elimination of open defecation and achieving basic sanitation for everyone could result in a 55-million-ton increase in GHG emissions per year, based on a 2022 study (Source: Cheng). GHG emissions of 55 million tons CO_2-eq are equivalent to the annual GHG

emissions of about 8.1 million people at a global average per capita rate of 6.76 CO_2-eq (Source: EDGAR). This is nearly the population of Sierra Leone (8.46 million people in 2023) (Source: WB).

GHG emissions of nitrous oxide (N_2O), methane (CH_4) and carbon dioxide (CO_2) are generated along the entire value chain of sewered and non-sewered sanitation systems. Their combined impact is measured in CO_2 equivalents (CO_2-eq), a metric that standardizes emissions based on their global warming potential (GWP). The GWP describes the heat-trapping ability of a gas over its atmospheric lifetime relative to CO_2. The higher the amount of energy a gas can absorb, the larger its contribution to climate change:

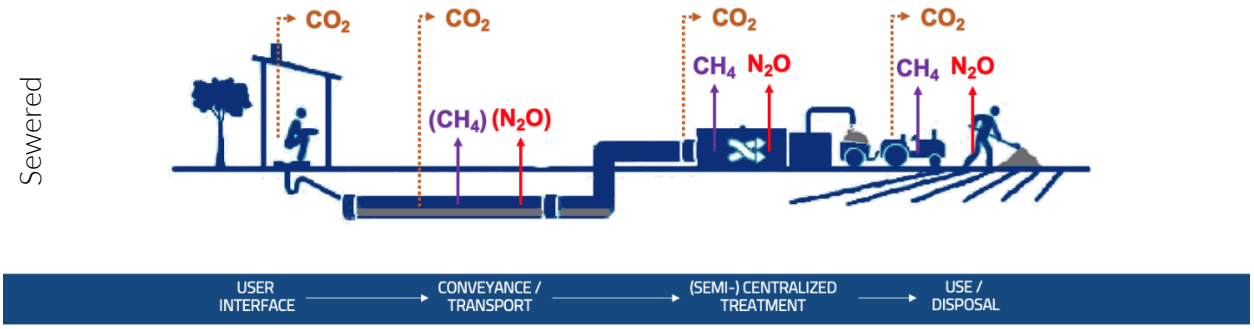
Table 1: Overview of the 3 main GHG caused by sanitation practices

Greenhouse Gas	Description	GWP values for 20- and 100-year time horizon (IPCC 6th Assessment Report (AR6)) (Source: GHG)
Methane (CH4)	• Occurs during anaerobic decomposition in contained systems (without oxygen) • Short-lived but potent GHG	GWP-20: 79.7 ± 25.8 GWP-100: 27 ± 11 (non-fossil)
Nitrous Oxide (N2O)	• Occurs during incomplete wastewater treatment and nitrogen-rich waste breakdown • Persistent GHG	GWP-20: 273 ± 118 GWP-100: 273 ± 130
Carbon Dioxide (CO2)	• Occurs during energy-intensive sanitation processes • Baseline GHG for GWP	GWP: 1

GWP-100 is most commonly used to show long term climate change impacts. GWP-20 prioritizes short-lived GHG and especially reflects methane's strong initial warming power. Methane is only stable for 12 years and absorbs higher amounts of energy at the beginning of its life in the atmosphere.

Methane emissions occur throughout both sewered and non-sewered sanitation value chain, primarily wherever human waste is stored or treated anaerobically (without oxygen). Nitrous oxide occurs during the biological treatment of nitrogen in wastewater and sludge. Its occurrence is linked to specific microbial processes and operational conditions. Last but not least, sanitation infrastructure often relies on energy-intensive processes causing carbon emissions, especially if the energy is sources from fossil fuels.

The following figure visualizes the sewered and non-sewered sanitation value chains with the respectively occurring GHG emissions at the different stages.



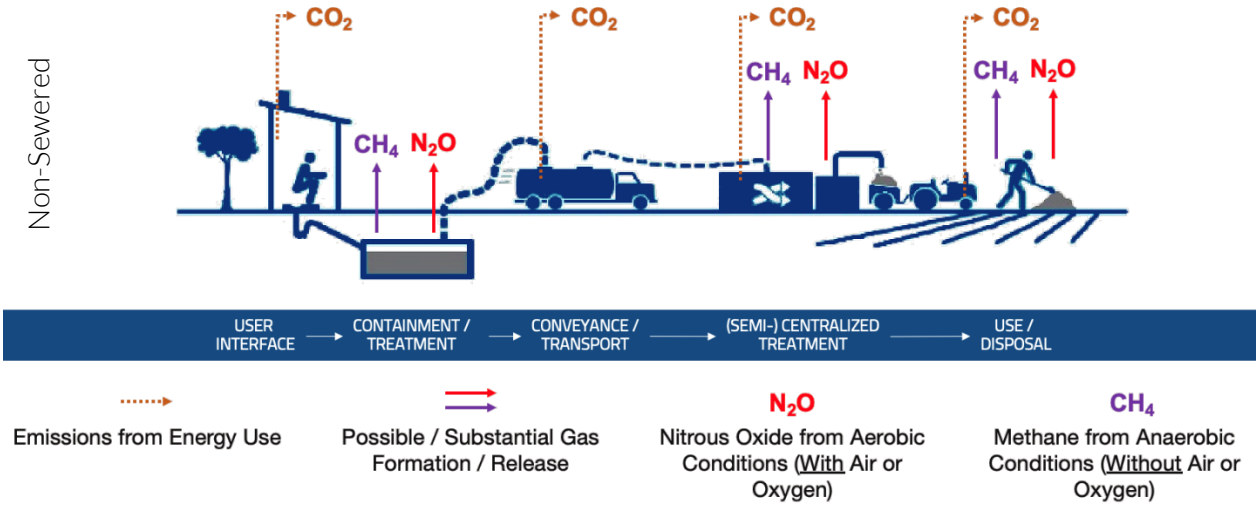


Figure 2: Possible Sources of GHG Emissions along the Sewered and Non-Sewered Sanitation Value Chain (Source: based on Lambiasi)

The *user interface* is often overlooked in the assessment of GHG emissions. However, at this first stage of the sewered and non-sewered sanitation value chain, it is essential to recognize the indirect emissions associated with the energy usage caused by flush toilets (CO_2 emissions).

- Sewered Sanitation Value Chain (Source: Lambiasi)

In the sewer-based sanitation value chain, the user interface is followed by ***conveyance/transport***. This stage is a significant source of methane emissions. Improper construction and insufficient maintenance of sewer lines leads to stagnation of wastewater in a closed environment resulting in anaerobic conditions. Nonetheless, there is spatial and temporal variation in the production of CH_4 within sewers. Factors influencing the generation of CH_4 include the hydraulic retention time, temperature, Chemical Oxygen Demand (COD) loading, and pipe area-to-volume ratio. Studies have also pointed out that underground gravity sewers are a likely source of nitrous oxide emissions due to nitrification and denitrification processes in biofilms.

At the ***(semi-)centralized treatment stage***, wastewater treatment units, as part of the sewered sanitation value chain, are the biggest source of N_2O emissions, particularly in biological treatment and nutrient removal processes. N_2O emissions are influenced by the availability of nitrite and organic carbon as well as temperature. Additionally, per capita protein and water consumption influences N_2O formation. In addition to biological processes, operational conditions such as irregular aeration flow and nitrification instability can influence N_2O emissions. The occurrence of CH_4 is highly dependent on the chosen treatment technology, and its release is related to the place of occurrence in the treatment process. Studies have indicated that digested sludge may still have high potential for producing residual CH_4 during storage. Therefore, CH_4 emissions can be considered depending on operational conditions and system configuration.

At the ***end-use/disposal stage***, sewer-based wastewater management systems yield effluents and sludge, both of which contribute to CH_4 and N_2O emissions. Effluent discharge into water bodies can cause eutrophication and increase N_2O emission. These N_2O emissions may vary seasonally and are influenced by environmental conditions (e.g. temperature variations, ambient pressure) and effluent quality. The

application of digested sludge to land typically results in low CH_4 and high N_2O emissions. The landfilling or storage of sludge can lead to significant CH_4 and N_2O emissions. Sludge can be used for energy generation via biogas technology or incineration, although both methods still risk generating emissions owing to leaks and incomplete combustion.

- Non-Sewered Sanitation Value Chain (Source: Liambiasi)

In a non-sewered sanitation value chain, the user interface is followed by ***containment and storage/treatment***. These on-site containment systems (e.g., septic tanks, pit latrines, and composting toilets) can generate both CH_4 and N_2O. The longer the waste is stored in sealed, oxygen-free conditions, such as in septic tanks or sealed pits, the more CH_4 is produced. At the same time, limited biological nitrogen transformation under anaerobic conditions causes N_2O. Although significant GHG emissions occur, there is insufficient data available to quantify these GHG emissions.

The fecal sludge from the containment is usually ***emptied*** manually or motorized and then ***transported*** by trucks or other types of vehicles to a (semi-)centralized treatment plant. The methods and extent of emptying and transport can vary greatly. There are no data on fugitive emissions from the transportation of fecal sludge, but these motorized transportation options are indirectly related to carbon emissions.

At the ***(semi-)centralized treatment stage***, emissions will depend on technology configuration and environmental conditions: anaerobic conditions facilitate CH_4 emissions, while biological treatment and nutrient removal processes facilitate N_2O emissions. However, if septic tanks and pit latrines are not emptied regularly, but instead sludge remains in these containment systems for a long time, the treatment takes place during the containment and storage phase.

Non-sewered sanitation systems produce liquid products, such as effluent, urine, and digestate, as well as semi-solid products, such as compost, sludge, or pit humus. At this ***use/disposal stage***, emissions, similar to sewered sanitation systems, depend on specific handling and environmental conditions.

The following figure compares the selected wastewater and fecal sludge management pathways and the potential for the occurrence of CH_4 and N_2O.

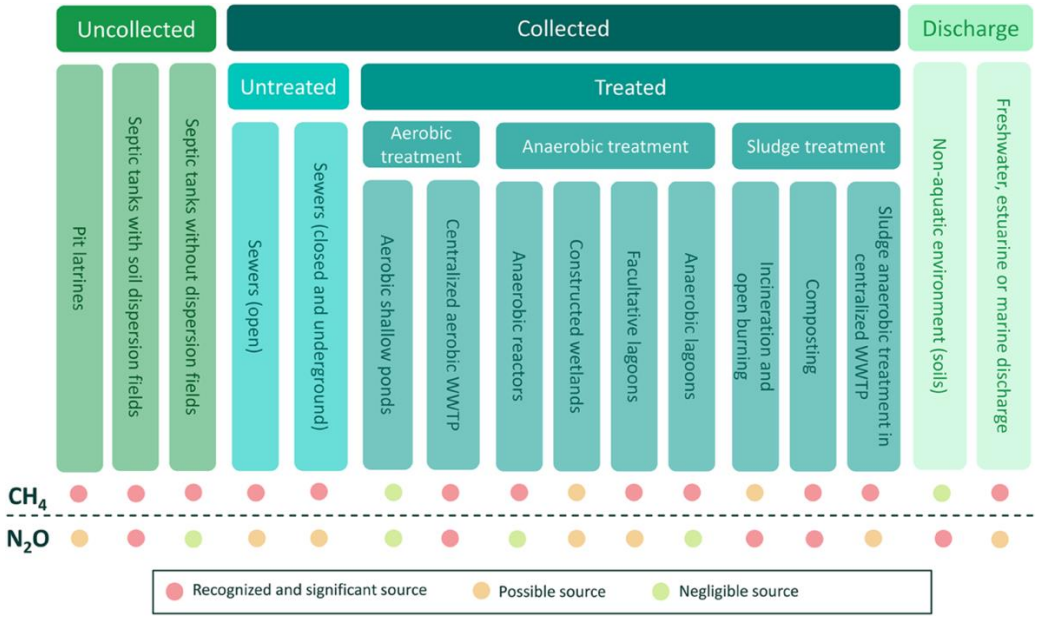


Figure 3: Methane and Nitrous Oxide Emission Potentials for Selected Wastewater and Fecal Sludge Management Pathways (Source: Lambiasi)

Wastewater treatment alone accounts for approximately 0.6% of global GHG emissions. Non-sewered sanitation systems are estimated to account for an additional 0.6% of the GHG emissions. (Source: Lambiasi) In regard to global anthropogenic methane emissions, non-sewered on-site sanitation contributes about 4.7% (range between 0.3 – 12.5%) (Source: Cheng). However, GHG emissions from sanitation systems are likely to be underestimated, particularly in non-sewered systems. Indications for underestimation are data gaps and outdated methodologies (IPCC guidelines primarily focus on centralized systems with limited emission factors for non-sewered technologies), underrepresented sources, and inconsideration of contextual factors.

The following figure shows the stage of the sewered and non-sewered sanitation value chain; the majority of GHG emissions occur, as well as the share between the three main GHG emissions occurring.

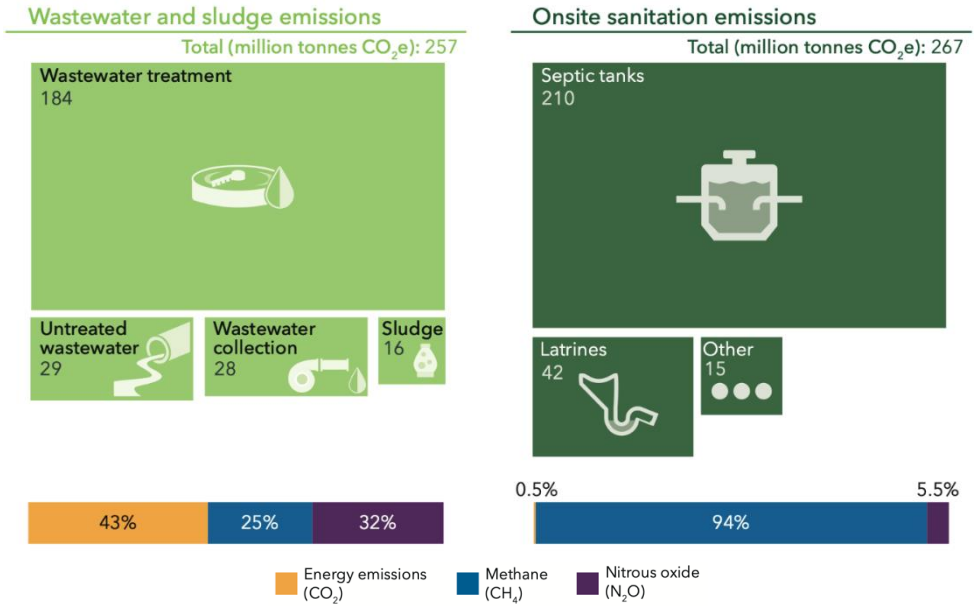


Figure 4: Overview of the GHG emissions caused by wastewater and non-sewered on-site sanitation practices (Source: GWI)

How Climate Change and Variability are Impacting Sanitation Systems

Climate is one of the core stress factors in sanitation. Climate change and variability create risks, heighten uncertainties, and can increase inequality in sanitation access. The impacts are direct through damage to infrastructure and indirect by influencing health, migration, and resource availability.

To better understand these effects, it is important to examine the types of climate hazards that threaten sanitation systems. Climate hazards are the potential occurrence of climate-related events, trends, or physical impacts that may cause loss of life, injury, or other health impacts, as well as damage and loss of property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. Hazards can be categorized into (i) slow-onset events such as droughts, sea-level rise, and salinization; (ii) acutely occurring shocks within a short timeframe, such as cyclones; (iii) trends over long-term time periods such as increases in average temperatures or average annual rainfall; and (iv) variability and unpredictability occurring in increased contrast between seasons.

The impacts of climate hazards are diverse.

- Impacts on physical access to sanitation: Climate hazards can damage or destroy sanitation facilities, disrupt their functionality, or make access difficult.
- Impact on access to local resources and markets: Climate hazards can disrupt access to markets that supply sanitation-related products and services. This is especially relevant for populations in remote areas, though not exclusively. The availability of water and other local resources for construction and operation of sanitation facilities can also be affected.

When sanitation systems are damaged—whether by structural failure, flooding, or extreme weather—people often resort to open defecation, and maintaining basic hygiene becomes difficult or impossible. This challenge is not limited to destroyed facilities alone; installations such as septic tanks, sewer networks, fecal sludge treatment plants (FSTPs), and wastewater treatment plants (WWTPs) can also be overwhelmed during floods, leading to overflow even if they remain technically accessible. As a result, untreated human waste can contaminate water sources, soil, and food supplies. Furthermore, the loss or severe disruption of sanitation infrastructure represents a loss of prior investment—a critical setback for vulnerable communities that may lack the resources needed for timely repair or replacement.

Arising from these consequences is the ultimate impact, such as the increased risk of diseases such as diarrhea, cholera, and other waterborne illnesses. Chronic health problems may occur from long-term exposure to fecal contamination, especially in children. Poor and marginalized communities are hit hardest, resulting in deepened social inequities and setbacks in achieving safe sanitation and the end of open defecation.

Table 2: Categorization of hazards, their impact on sanitation, consequences and ultimate impact (Source: based on IDS, WaterAid)

Hazard Category	Climate Hazard	Impact on Sanitation	Consequences	Ultimate Impacts
Slow Onset	• Sea-level rise • Salinization • Droughts	• Inundation and corrosion of infrastructure • Saltwater intrusion into systems • Gradual system degradation	• Reduced functionality and lifespan of sanitation facilities • Increased maintenance needs • Gradual contamination of water sources	• Increased disease risk • Higher costs and reduced access for vulnerable groups
Shock Events	• Floods • Cyclones • Hurricanes • Storm surges	• Sudden damage or destruction of facilities (e.g., toilets, latrines, treatment plants) • Overflow and spillage of untreated human waste • Blocked access routes	• Immediate loss of sanitation services • Open defecation due to inaccessible facilities • Environmental contamination	• Outbreaks of waterborne diseases • Acute public health emergencies • Loss of progress in sanitation coverage
Long-term Trends	• Increase of average temperature • Increase of average annual rainfall	• Altered water availability for sanitation • Increased stress on infrastructure • Shifts in suitability of sanitation technologies	• Reduced reliability of water-dependent sanitation • More frequent system failures or inefficiencies	• Need for adaptation • Need for investment • Widening inequities
Variability / Unpredictability	• Highly variable rainfall • Temperature swings • Unpredictable seasons	• Unpredictable stress on sanitation infrastructure • Difficulty in planning and maintaining services	• Inconsistent access to sanitation • Increased risk of overflows and dry system failures	• Health risks • Difficulty achieving and sustaining safe sanitation for all

In 2024, the Emergency Events Database (EM-DAT) recorded 393 natural hazard-related disasters (75 in Africa), excluding biological and extra-terrestrial hazards. These events have affected 167.2 million people (41.2 million in Africa). Especially in Africa, the number of affected people rose compared to the 2004-2023 average from 14.2% to 24.6% of the continental population. (Source: CRED)

Droughts and floods are among Africa's most severe climate hazards, each posing distinct yet interconnected threats to sanitation and public health. (WMO, 2022)

Recent severe example for drought was in Zambia 2023–24 El Niño, according to the government's Food Security Drought Response Plan, approximately 9.8 million people across 84 districts are exposed to drought conditions, with around 6 million severely affected and in urgent need of humanitarian assistance. The drought is most intense in the southern, central, and western regions—already among the country's most water-stressed areas. Prolonged dry spells have forced many households to rely on shallow, unprotected wells, contributing to increased reports of diarrhea and cholera. (acaps, 2025)

At the other extreme, floods can devastate infrastructure and overwhelm sanitation systems—often undoing years of investment in a single event. During the March–June 2024 El Niño rains, Kenya experienced widespread flooding that led to an estimated 291–315 deaths and displaced approximately 278,000–293,000 people. The floods severely damaged sanitation infrastructure triggered a heightened

risk of cholera, and prompted emergency WASH (Water, Sanitation, and Hygiene) interventions nationwide (UNICEF, 2024), including more than 20,000 school toilet blocks were damaged.

Together, these climate extremes—droughts and floods—continue to strain sanitation systems and public health across Africa, highlighting the urgent need for resilient infrastructure and adaptive, climate-informed management. (Elimu Bora Working Group, 2024)

The impacts of climate change and variability emphasize the importance of risk management and adaptation strategies for climate-SMART sanitation, including aspects of safety, mitigation, adaptation, resilience, and transformation. The detailed implications of climate-SMART sanitation are covered in Module 2.

The Impacts of Climate and Sanitation on livelihoods

People are at the center of the Climate-Sanitation Nexus. Climate hazards can affect people's livelihoods, which in turn affects their ability to meet their sanitation needs. The ways that sanitation, livelihoods and all other aspects of life are connected to climate change impacts are context-specific and difficult to predict.

Climate change is associated with significant uncertainty impacting sanitation planning and management. It is unknown how the climate will affect and change specific locations and how these changes will be felt. These climate uncertainties are affecting sanitation as well as urbanization, population growth, land-use, etc. It is impossible to predict and precisely plan for all direct and indirect impacts of climate change.

One of the major challenges created by climate uncertainty is the inadequate preparation of unexpected events. E.g. climate stress can affect food security in rural areas resulting in sudden spike of urban migration. These unexpected events can result in insufficient sanitation services and the implementation of inefficient, ad-hoc solutions. Another challenge is the paralysis to climate adaptation action if stakeholder wait for more clarity on the problem.

Climate change and variability affect sanitation users unequally. Also, the capacity to prepare for climate-related risks to health and sanitation varies across individuals and social groups. Structural deficits such as lack of income, education, health, political power, etc., must be considered to enable disadvantaged households to adapt to climate risks. The situation can further be worsened if development activities to alleviate poverty or address inequalities inadvertently puts groups at increased risk of future climate change.

Despite these challenges, a positive outlook is possible: by proactively identifying potential climate risks and vulnerabilities, stakeholders can conduct relevant planning and adopt adaptive approaches to sanitation. This enables communities to better prepare for uncertainties, protect livelihoods, and ensure that also the disadvantaged groups are included in climate-SMART solutions – ultimately turning risk into an opportunity for more inclusive, sustainable development.

We are currently trying to use anaerobic digestion, but it seems that this is worse for climate. Is that a correct assumption?

The climate balance of anaerobic digestion depends crucially on how the resulting methane is used. If methane is used for energy (e.g., to generate electricity or heat), the overall balance can be positive as fossil fuels are replaced. If there is no use but only

flaring, greenhouse gases are reduced, but the energy potential remains untapped. Uncontrolled methane leakage ("methane leakage") is particularly harmful to the climate because methane is a greenhouse gas that is many times stronger than CO_2.

Resources

- Global Water Intelligence: Mapping Water's Carbon Footprint – our net zero future hinges on wastewater, November 2022, Detailed breakdown of GHG emissions for wastewater treatment and on-site sanitation
  https://kh.aquaenergyexpo.com/wp-content/uploads/2023/01/Mapping-Waters-Carbon-Footprint-Our-Net-Zero-Future-Hinges-on-Wastewater.pdf
- Layla Lambiasi, Daniel Dddiba, Kim Andersson, Masud Parvage; Journal of Water & Climate Change: Greenhouse gas emissions from sanitation and wastewater management systems: a review, February 2024, A detailed explanation on GHG emissions occurring along the sewered and non-sewered sanitation value chain
  https://iwaponline.com/jwcc/article/15/4/1797/100495/Greenhouse-gas-emissions-from-sanitation-and_
- Stockholm Environment Institute: Methods for measuring greenhouse gas emission from sanitation and wastewater management systems, July 2024 – Overview of GHG measuring methods along the sanitation value chain
  https://www.sei.org/wp-content/uploads/2024/07/methods-greenhouse-gas-emissions-sanitation-sei2024-030.pdf
- World Health Organization (WHO): Discussion paper: Climate, Sanitation and Health (Draft), July 2019
  https://cdn.who.int/media/docs/default-source/wash-documents/sanitation/climate-sanitation-and-health.pdf
- WaterAid: Strengthening climate resilience through sanitation systems, Policy brief, July 2023 – Introduction of a possible approach to adapt sanitation systems to increase climate resilience
  https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/2023-08/Strengthening%20climate%20resilience%20through%20sanitation%20systems.pdf
- Frontiers of Sanitation: Innovations & Insights: Rural sanitation and climate change – putting ideas into practice, April 2021, – Barriers and actionable ideas concerning climate action in the rural sanitation sector
  https://opendocs.ids.ac.uk/articles/report/Rural_Sanitation_and_Climate_Change_Putting_Ideas_into_Practice_Assainissement_rural_et_changements_climatiques_Mettre_les_ide_es_en_pratique_Saneamento_rural_e_alterac_o_es_clima_ticas_Levar_as_ideias_a_pra_tica

Sources

acaps: ZAMBIA Update on the impact of drought 2025, https://www.acaps.org/fileadmin/Data_Product/Main_media/20250116_ACAPS_Zambia_-_Update_on_the_impact_of_drought_.pdf, 11.06.2025

Cheng: Shikun Cheng, Jinyun Long, Barbara Evans, Zhe Zhan, Tianxin Li, Cong Chen, Heinz-Peter Mang, Zifu Li: Non-negligible greenhouse gas emissions from non-sewered sanitation systems: A meta-analysis, September 2022, https://pmc.ncbi.nlm.nih.gov/articles/PMC9227720/, 19.05.2025

CRED: Centre for Research on the Epidemiology of Disasters (CRED), UC Louvain, USAID: 2024 Disasters in Numbers – A hot and stormy year, https://files.emdat.be/reports/2024_EMDAT_report.pdf, 19.05.2025

EDGAR: European Commission: EDGAR – Emissions Database for Global Atmospheric Research: GHG emissions of all world countries, 2023, https://edgar.jrc.ec.europa.eu/report_2023, 24.05.2025

Elimu Bora Working Group: The Impact Of 2024 Deadly Floods On Schools 2024, https://khrc.or.ke/wp-content/uploads/2024/07/The-impact-of-2024-floods-on-schools-1.pdf, 11.06.2025

GHG: GHG Management Institute: IPCC AR6 Methane GWP Tables, https://ghginstitute.org/ipcc-ar6-methane-gwp-tables/, 19.05.2025

GWI: Global Water Intelligence: Mapping Water's Carbon Footprint – our net zero future hinges on wastewater, November 2022, https://kh.aquaenergyexpo.com/wp-content/uploads/2023/01/Mapping-Waters-Carbon-Footprint-Our-Net-Zero-Future-Hinges-on-Wastewater.pdf, 19.05.2025

IDS: Institute of Development Studies at the University of Sussex, Frontier of Sanitation: Innovations & Insights: Rural sanitation and climate change – putting ideas into practice, April 2021, https://opendocs.ids.ac.uk/articles/report/Rural_Sanitation_and_Climate_Change_Putting_Ideas_into_Practice_Assainissement_rural_et_changements_climatiques_Mettre_les_ide_es_en_pratique_Saneamento_rural_e_alterac_o_es_clima_ticas_Levar_as_ideias_a_pra_tica/26432404, 19.05.2025

Johnson J., Zakaria F., Nkurunziza A.G., Way C., Camargo-Valero M.C., Evans B. "Whole-system analysis reveals high greenhouse-gas emissions from citywide sanitation in Kampala, Uganda" Nature 2022, https://www.nature.com/articles/s43247-022-00413-w, 11.06.2025

Lambiasi: Layla Lambiasi, Daniel Dddiba, Kim Andersson, Masud Parvage, Sarah Dickin; Journal of Water & Climate Change: Greenhouse gas emissions from sanitation and wastewater management systems: a review, February 2024, https://iwaponline.com/jwcc/article/15/4/1797/100495/Greenhouse-gas-emissions-from-sanitation-and, 19.05.2025

Lutkin T., Gordon E., Chater J., Thompson K. & Mouret S. 2022 Mapping Water's Carbon Footprint: Our Net Zero Future Hinges on Wastewater. Global Water Intelligence, Oxford, UK.

Ritchie H., Rosado, P. & Roser M. 2020. Emissions by sector, https://ourworldindata.org/ghg-emissions-by-sector, 11.06.2025

UNICEF: Kenya March-April-May 2024 Seasonal Floods Humanitarian Flash Update No. 2, https://www.unicef.org/media/159151/file/Kenya-Humanitarian-SitRep-Seasonal-Floods-Response-30-June-2024.pdf, 11.06.2025

WaterAid: WaterAid: Strengthening climate resilience through sanitation systems, Policy brief, July 2023,

https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/2023-08/Strengthening%20climate%20resilience%20through%20sanitation%20systems.pdf

WB: World Bank Group: Population, total – Africa, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=A9&most_recent_value_desc=false, 24.05.2025

WMO: State of Climate in Africa highlights water stress and hazards 2022, https://wmo.int/news/media-centre/africa-faces-disproportionate-burden-from-climate-change-and-adaptation-costs, 11.06.2025

2.3 What is the relevance of Sustainable Development Goals (SDGs)?

- **How SDG 6 (Sanitation) and SDG 13 Intersect:** Overview of SDG 6, targets 6.2 and 6.3 focusing on sanitation, and SDG 13 on climate action, and their shared relevance for sustainable development
- **How Sanitation-Related Climate Action Advances Development:** Exploration of how integrating climate action into sanitation drives progress for all 17 SDGs

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action under the resolution "Transforming our world: the 2030 Agenda for Sustainable Development" to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

With 17 comprehensive and holistic sustainable development objectives and 169 associated targets at its core, the 2030 Agenda builds upon and improves the preceding eight Millennium Development Goals (MDGs) signed in 2000, which primarily focused on social and economic development.

The novelty of the 2030 Agenda lies in the vision for the implementation of all SDGs in a universal, indivisible and consistent manner, leaving no one behind. *Universality* implies that no goal is more important than the others are, and that all SDGs must be simultaneously achieved at a global scale to attain sustainable development. *Indivisibility* implies that the SDGs implementation is a complex network of interdependent and interconnected interactions. *Consistency* implies that the targets are to be achieved vertically and horizontally, including all relevant actors at all scales.

The following figure shows the 17 global goals:

Figure 5: Overview of the 17 Sustainable Development Goals (Source: GlobalGoals)

The Climate-Sanitation Nexus focuses especially on the relation between SDG 6: Clean Water and Sanitation ("Ensure availability and sustainable management of water and sanitation for all") and SDG 13: Climate Action ("Take urgent action to combat climate change and its impacts").

Sanitation targets within SDG 6

SDG 6 includes targets for the water and sanitation sector. It is especially SDG targets 6.2 and SDG 6.3 that focus on sanitation. The table on the following page presents these two targets and their indicators. The current status of the targets reflects findings from a United Nations progress assessment published in May 2024. (Source: UN).

SDG 6.2 focuses on ending open defecation and aiming for safely managed sanitation. The term "Safely Managed" is defined by the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) as part of a sanitation service ladder that allows to benchmark and compare service levels across countries (see the following figure). In this context, JMP has reported country, regional and global estimates of progress on drinking water, sanitation and hygiene (WASH) since 1990.

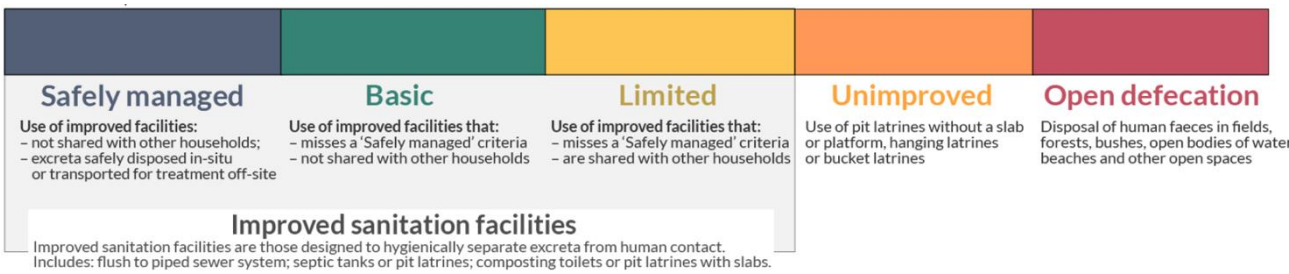


Figure 6: JMP Service Ladder for Sanitation (Source: OurWorld)

"Safely managed sanitation services" as mentioned in the indicator for SDG target 6.2 are improved sanitation facilities which are not shared with other households, and the excreta produced should either be treated and disposed of in situ, stored temporarily and then emptied and treated off-site, or transported through a sewer with wastewater and then treated off-site.

While SDG 6.2 and SDG 6.3 are particularly of interest when focusing on sanitation, the interlinkages within the Goal 6 need to be emphasized. Goal 6 cannot be achieved if each target is treated in isolation but rather seen as highly interdependent: Increased access to sanitation (SDG 6.2) must be matched by increased wastewater treatment (SDG 6.3) if good ambient water quality (SDG 6.3) and healthy water-related ecosystems (SDG 6.6) are to be sustained. Good ambient water quality greatly facilitates the provision of safe drinking water (SDG 6.1), which in turn must be provided sustainably (SDG 6.4), without negative consequences for water-related ecosystems (SDG 6.6). Increasing recycling and safe reuse (SDG 6.3) and water-use efficiency (SDG 6.4), under the right governance structure (SDG 6.5), makes more water available for drinking (SDG 6.1), and can reduce impacts on water-related ecosystems (SDG 6.6).

Table 3: Overview of SDG 6, targets related to sanitation

Targets (Directly related to sanitation)	Indicators	Current Status (Source: UN)
SDG 6.2 By 2030, achieve ***access to adequate and equitable sanitation*** and hygiene for all and ***end open defecation***, paying special attention to the needs of women and girls and those in vulnerable situations.	6.2.1 Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water.	• Between 2015 and 2022, the global population using safely managed sanitation increased from 49% to 57%. • To achieve universal coverage by 2030, current global rates of progress need to increase fivefold.
SDG 6.3 By 2030, ***improve water quality*** by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	6.3.1 Proportion of domestic and industrial wastewater flows safely treated. 6.3.2 Proportion of bodies of water with good ambient water quality.	• In 2022, among 73 reporting countries, 76% of total wastewater flows received at least some treatment. • Of the 42 countries that specified the level of treatment, 60% of total wastewater flows were safely treated (that is, at least secondary treatment). • As of 2023, 56% of water bodies assessed in 120 countries had good water quality. • However, countries with extensive monitoring programs show that water quality has been degrading since 2017.
SDG 6.A By 2030, expand ***international cooperation and capacity-building*** support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.	6.A.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan.	n.a.
SDG 6.B Support and strengthen the ***participation of local communities*** in improving water and sanitation management.	6.B.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management.	n.a.

SDG 13 and its role in achieving climate-related sanitation goals

The primary focus of global efforts regarding sanitation is to achieve universal access to safe and adequate sanitation, as emphasized in SDG 6. However, the increasing impacts of climate change pose significant risks to sanitation systems and progress towards SDG 6. This is where SDG 13 becomes highly relevant. SDG 13 calls for urgent action to combat climate change and its impacts, emphasizing the need to strengthen resilience, integrate climate measures into national policies, and enhance adaptive capacity across all sectors – including sanitation. This means that sanitation solutions should not only be safe and sustainable but also climate-resilient and low in emissions.

SDG 13 includes targets to strengthen resilience and adaptive capacity (SDG 13.1), integrate climate change measures into policies and planning (SDG 13.2), improve education, awareness and capacity (SDG 13.3), mobilize of climate finance (SDG 13.A) and to support the most vulnerable countries (SDG 13.B).

The following page shows an overview of SDG 13 with its targets, indicators and current status based on United Nations reporting.

For the Climate-Sanitation Nexus, all targets of SDG 13 are equally of interest. Each target addresses a different but interconnected dimension of how climate action and sanitation must work together for sustainable development:

- Target 13.1 – Strengthen resilience and adaptive capacity: Building resilience ensures that sanitation system can withstand and recover from climate-related hazards, protecting public health and the environment.
- Target 13.2 – Integrate climate change measures into policies and planning: For effective sanitation-related climate action, sanitation needs to be systematically included in national and local policies and strategies such as National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs).
- Target 13.3 – Improve education, awareness and capacity: Raising awareness and building institutional and community capacity, as intended with this training-of-trainers, is essential for developing sanitation-related climate action. Education and training empower stakeholders including policymakers, sanitation system operators, local communities, etc. The goal is to implement climate-SMART practices in the sanitation sector.
- Target 13.A – Mobilize climate finance: Climate finance enables countries to invest in upgrading and adapting sanitation systems to climate risks. Despite the increase in overall climate finance, sanitation receives only a minimal share of these funds. Module 3 will explore the connection in more detail.
- Target 13.B – Support for least developed countries (LDC) and small island developing states (SIDS): Many LDCs and SIDS face challenges in developing and implementing climate-SMART sanitation strategies. Training, knowledge-sharing and technical assistance are important to develop and implement effective, climate-adapted sanitation policies and infrastructure.

Table 4: Overview of SDG 13

Target	Indicators	Current Status (Source: UN)
SDG 13.1 Strengthen ***resilience and adaptative capacity to climate-related hazards*** and natural disasters in all countries.	13.1.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population. 13.1.2 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. 13.1.3 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies.	• The number of disaster-related deaths and missing persons per 100,000 population decreased by nearly half, from 1.62 (2005-2014) to 0.82 (2013-2022). • Despite this improvement, disasters still claimed an average of 42,553 lives annually between 2013 and 2022. • The number of people affected by disasters per 100,000 population increased by over two thirds, from 1,169 (2005-2014) to 1,980 (2013-2022). • In 2023, 129 countries reported adopting and implementing national disaster risk reduction strategies, up from 55 in 2015. • Among these, 122 countries emphasized promoting policy coherence with the SDGs and Paris Agreement.
SDG 13.2	13.2.1 Number of countries with NDCs, long-term strategies,	• The year 2023 was the warmest year on record, with global temperatures

Integrate climate change *measures into national policies, strategies and planning*.	national adaptation plans and adaptation communications, as reported to the secretariat of the UNFCCC. 13.2.2 Total GHG emission per year.	reaching 1.45°C above pre-industrial levels. (Close to the 1.5°C threshold outlined in the Paris Agreement.) • Despite reductions in emissions in some developed countries, GHG concentrations reached record highs in 2022. • Carbon dioxide levels, along with other GHG like methane and nitrous oxide, continued to rise. • Every major climate indicator was surpassed in 2023, reflecting intensifying impacts of climate change.
SDG 13.3 Improve *education, awareness-raising and human institutional capacity* on climate change mitigation, adaptation, impact reduction and early warning.	13.3.1 Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies, (b) curricula, (c) teacher education, and (d) student assessment.	• A study of over 530 grade 9 science and social science curricula found that (a) 69% made no reference to climate change, (b) 66% did not mention sustainability. • Three-quarters of countries reported plans to revise their curricula within the next 3 years with focus on climate change and sustainability.
13.A Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of *mobilizing jointly $100 billion annually* by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible.	13.A.1 Amounts provided and mobilized in US$ per year in relation to the continued existing collective mobilization goal of the US$ 100 billion commitment through to 2025.	• Climate finance provided by Annex I parties to the UNFCCC increased at a compound annual rate of 5% from 2015 to 2020, reaching US$ 41 billion. • The US$ 100 billion annual target set for 2020 was not met by 2021. • By 2021, climate finance provided and mobilized by developed countries reached US$ 89.6 billion.
13.B Promote *mechanisms for raising capacity* for effective climate change-related planning and management *in least developed countries and small island developing States*, including focusing on women, youth and local and marginalized communities.	13.B.1 Number of least developed countries and small island developing states with NDCs, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretariat of the UNFCCC.	n.a.

SDG interlinkages: Synergies and trade-offs in the Climate-Sanitation Nexus

The SDGs balance the three dimensions of sustainability: economic, social and environmental. However, when looking at the framework from a holistic perspective, interconnections go beyond this three-pillar conception, showing a more complex set of interactions recognized as the SDG interlinkages.

SDG interlinkages are the interaction between SDGs at goal-, target- or indicator-level. The relations are usually characterized as synergies or trade-offs. Synergies imply positive interactions where progress of one SDG contributes or enable progress on another one. Trade-offs imply negative interactions where progress of an SDG deteriorates progress towards another one. Given the complexity of the 2030 Agenda, synergies and trade-offs may occur at the same time.

Like the entire Climate-Sanitation-Nexus, the interactions of SDGs are context-dependent influenced by geographical settings, resource availability, economic and technological factors, governance and legislation in force and the time-horizon adopted for their evaluation.

E.g. when using the SDG interlinkages visualization tool developed by the European Commission KnowSDGs Platform, SDG 6.2 (Access to adequate sanitation and end of open defecation) has in total 344 interlinkages with other SDG targets. These 344 interlinkages include 290 synergies, 39 trade-offs and 15 not specified interactions, as visualized in the following figure. Many of these interactions are bidirectional, context-dependent and complex including indirect effects. In fact, if only interactions with clear direction of impact are included, the tool can determine 48 synergies and 6 trade-offs.

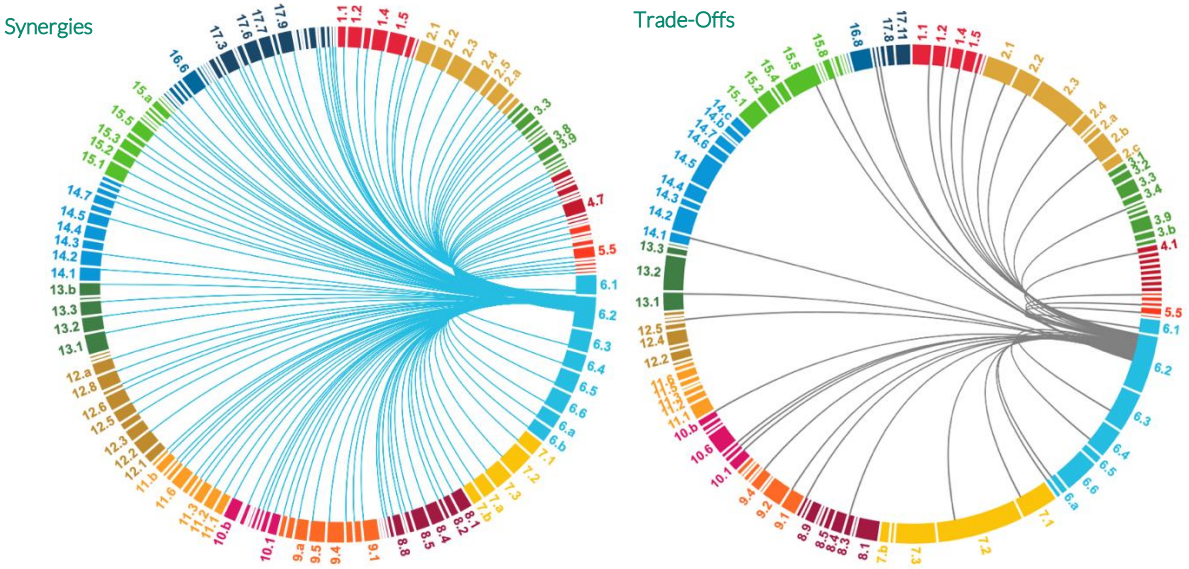


Figure 7: Overview of Synergies (left) and Trade-Offs (right) between SDG 6.2 and other Targets (Source: EC)

Another analysis based on a methodology developed at University College London (UCL) also showed that the goal of safe, inclusive and sustainable sanitation access for all has synergies with all 17 goals and 130 of 169 targets (77%), and trade-offs for 28 (17%) of the targets. UCL further identified that 83 targets (49%) call for action in the sanitation sector.

Available tools and analysis mainly focus on the interlinkage of one goal or target with other goals and targets. However, sanitation-related climate actions have significant synergies with most SDGs. The

following table lists selected synergies inspired by the previously mentioned ULC analysis and SDG interlinkages tool as well as the UN Water interlinkages analysis:

Table 5: Selected Impacts of Sanitation-Related Climate Action on the 17 SDGs

SDG	Clear Direction Impact of Sustainable Sanitation-Related Climate Actions (Selected Goal-Based Impacts)
	Improved sanitation and climate-SMART infrastructure reduces poverty by protecting vulnerable communities from health and economic shocks of climate-related disasters.
	Climate-SMART sanitation reduces contamination of water sources, ensuring safer irrigation for crops and livestock supporting food production.
	Improved sanitation reduces waterborne diseases and health risks, especially as climate change increases the frequency of floods and droughts that can spread contaminants.
	Climate-SMART sanitation in schools ensures attendance, particularly for girls, and support a healthy learning environment.
	Safe and accessible sanitation facilities empower women and girls, supporting their health, education and participation.
	Integrating climate adaptation and mitigation into sanitation systems strengthens the resilience and sustainability of water and sanitation services, while protecting water quality and reducing environmental risks.
	Promoting renewable energy use in sanitation reduces emissions, improves energy access and makes sanitation systems more sustainable and particularly valuable in rural or remote regions.
	Health, resilient populations and infrastructure support productivity and economic stability.
	Implementing climate-SMART sanitation systems and technologies aligns with the SD's target for sustainable infrastructure, technological advancement and increased resource efficiency.
	Prioritizing vulnerable populations in sanitation-related climate strategies helps close gaps in access and outcomes.
	Climate-SMART sanitation infrastructure enhances urban resilience and livability, reducing risks from flooding, droughts or other hazards.
	Climate-SMART sanitation systems can convert human waste into valuable products promoting circular and sustainable resource management.
	**Climate-SMART sanitation systems and infrastructure contribute to mitigation, adaptation and resilience to climate change.**
	Climate-SMART, low-emission sanitation protects ocean health by reducing pollution and safeguarding marine biodiversity, particularly from land-based activities like sanitation.
	Climate-SMART sanitation reduces the risk of contamination of soil and terrestrial ecosystems. It protects and restores ecosystems and biodiversity.
	Good governance in integrating sanitation-related climate policies fosters transparency, cooperation and effective institutions.
	Addressing sanitation and climate together encourages cross-sector and international collaboration.

What are the examples of trade-offs between SDGs?

An example of a trade-off between SDG 6.2 and SDG 13 is that a more extensive sanitation coverage (SDG 6.2) using waterborne systems can increase greenhouse gas emissions and water demand, undermining climate mitigation and adaptation goals (SDG 13). A second example is the installation of high-energy mechanized sewage treatment plants to improve safely managed sanitation, which can increase electricity consumption from fossil fuels. This improves health and sanitation outcomes (SDG 6.2) but increases CO_2 emissions if the power grid is carbon-intensive (trade-off with 13).

Resources

- European Commission: Uncovering SDG Interlinkages: interconnection at the core of the 2030 Agenda, 2023
  https://publications.jrc.ec.europa.eu/repository/handle/JRC134248
- UN-Water: Water and sanitation interlinkages across the 2030 Agenda for Sustainable Development, 2016
  https://www.unwater.org/sites/default/files/app/uploads/2016/08/Water-and-Sanitation-Interlinkages.pdf
- European Commission: KnowSDGs Platform – Knowledge base for the SDGs that provides tools and organizes knowledge on policies, indicators, methods and data to support the evidence-based implementation of the SDGs
  https://knowsdgs.jrc.ec.europa.eu
- University College London: Synergies and trade-offs between sanitation and the sustainable development goals, August 2020
  https://pmc.ncbi.nlm.nih.gov/articles/PMC10208324/pdf/ucloe-03-016.pdf
- WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP): Reports on country, regional and global estimates of progress on drinking water, sanitation and hygiene (WASH) since 1990
  https://washdata.org

Sources

EC: European Commission: KnowSDGs Platform – SDG interlinkages visualization tool – target level, https://knowsdgs.jrc.ec.europa.eu/interlinkages/targets, 19.05.2025

GlobalGoals: The Global Goals – Resources, https://www.globalgoals.org/resources/, 19.05.2025

OurWorld: Our World in Data: Water, Sanitation and Hygiene (WASH) Data Explorer: Number of people using safely managed sanitation services, 2022, https://ourworldindata.org/explorers/water-and-sanitation?Resource=Sanitation&Level+of+Use%2FAccess=Safely+managed&Residence=Total&Relative+to+population=Number+of+people&country=IND~USA~KEN~OWID_WRL~BGD~ZAF~CHN, 19.05.2025

UN: United Nations: General Assembly Economic and Social Council: Progress towards the Sustainable Development Goals – Report of the Secretary-General, May 2024, https://unstats.un.org/sdgs/files/report/2024/secretary-general-sdg-report-2024--EN.pdf, 19.05.2025

2.4 What is the interconnection between Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs) and sanitation?

- Understanding Nationally Determined Contributions (NDCs): What are NDCs and what is their role in global climate action under the Paris Agreement
- Role of National Adaptation Plans (NAPs): What are NAPs and how to they complement NDCs supporting the development of sanitation-related climate action
- Sanitation-Related Targets in NDCs and NAPs: Exploration of how countries integrate sanitation-related climate action in their NDCs and NAPs

Addressing the impacts of climate change on the sanitation sector and vice versa requires coordinated action at the national policy level. Two central instruments are the Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs). These frameworks are used to plan, implement and report mitigation and adaptation strategies. The NDC provides the political foundation, while the NAP offers the technical framework. As such, the two documents are complementary and, ideally, should always be developed together.

Nationally Determined Contributions

NDCs are the heart of the Paris Agreement. They embody efforts by each country to reduce national emissions, adapt to the impacts of climate change and contribute to the global goal of limiting temperature rise to 1.5°C. The Paris Agreement, Article 4, paragraph 2 requires each Party to prepare, communicate and maintain successive NDCs that it intends to achieve. These national climate plans can function as climate change mitigation and adaptation plans as well as national investment plans and national development plans.

The targets included by high income industrialized countries (Annex 1) are unconditional, while lower-middle income and low-income countries in many cases differentiate between conditional and unconditional targets:

- Unconditional targets: Targets that are implemented using a country's own resources and typically represent a baseline commitment. Unconditional targets often align with existing national development plans or legislation.
- Conditional targets: Targets that require financial aid, technology transfer or capacity-building assistance from other countries or organizations.

Every sector of society, including sanitation, must act to reduce emissions and adapt to climate impacts. Especially since the commitments as of now fall far short of what is needed to limit global temperature rise to the intended 1.5°C. With current plans and policies, the countries are on track for 2.6-3.1°C of warming. (Source: UNEP)

NDCs are submitted every five years to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat. Parties were requested to submit the third round of NDCs until February 2025 and every five years thereafter (e.g. 2030, 2035), regardless of their respective implementation time frames. The NDCs that are due in 2025 (referred to as NDC 3.0) and detail climate actions through 2035 will be significant to reach global climate goals. As of 24 May 2025, 22 countries have submitted their NDC 3.0. In Africa, this includes Zimbabwe, Zambia, and Kenya. (Source: UNFCCC)

National Adaptation Plans

National Adaptation Plans outline how countries will adapt to climate change in the medium- and long-term. They are designed to fit the unique challenges and climate risks that countries are facing and reduce vulnerabilities to protect people, livelihoods, infrastructure, economic activity and natural ecosystems. NAPs also enable governments to access climate finance, mobilize international support and coordinate efforts across different institutions. Many donors and funders require adaptation investments to be aligned with NAPs to ensure coherence and a positive contribution to achieving national priorities. (Source: UNDP)

The NAP process was formally established by the UNFCCC under the Cancun Adaptation Framework at COP16 in 2010. The Paris Agreement encourages countries to link their efforts on adaptation and mitigation, ensuring that national climate commitments and plans are aligned. While NDCs present a country's overall climate mitigation and adaptation commitments, NAPs provide specifics needed to guide adaptation priorities and implementation. NAPs can therefore be considered complementary to NDCs. The following figure shows the interlinkage between these two frameworks.

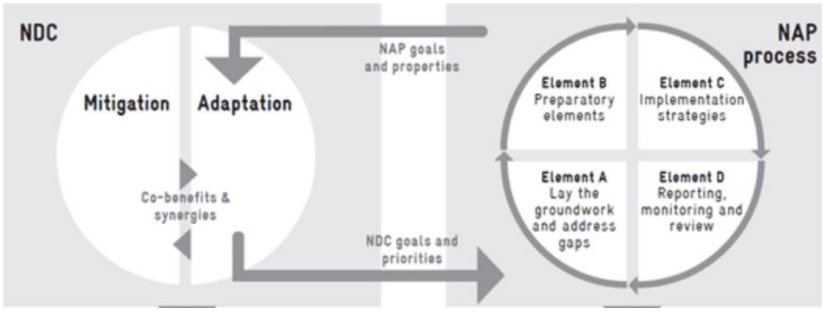


Figure 8: Visualization of the Interlinkage between NDCs and NAPs (Source: AC)

Different to NDCs, there is no fixed international schedule for how often NAPs must be submitted. Instead, the frequency and timing for updating and submitting are determined by each country's own national mandate. However, countries are encouraged to iteratively update their NAPs following the NAP Process (Source: UNFCCC2):

- Element A – Laying the groundwork and addressing gaps: Initiation of the NAP process by collecting and assessing existing information on climate impacts and vulnerability. Identification of gaps and capacity needs. Evaluation of development priorities and climate risks.
- Element B – Preparatory elements: Analysis of current and future climate scenarios. Assessment of vulnerabilities and identification of adaptation options at all relevant levels.
- Element C – Implementation strategies:

- Element D – Reporting, monitoring and review: Tracking and assessment of progress to update the NAP as needed and incorporate lessons learned to continuously improve adaptation efforts.

In Africa, as of March 2025, 22 out of 54 countries have submitted their NAPs. An additional 25 countries are in the process of formulating their plans, while 3 countries have drafts currently under review. Only Botswana, Angola, Djibouti and Libya have not initiated the implementation yet. (Source: NAP)

Funding for the formulation and implementation of NAPs has so far been provided by the Green Climate Fund, the Global Environment Facility and other bilateral donors. As of April 2025, GCF's Readiness Programme remains the only continuously available funding source for NAP formulation support, with US$3 million available per country. (Source: UNDP)

Sanitation-Related Climate Action in NDCs and NAPs

By the end of November 2024, 176 countries had submitted at least one round of NDCs (mandatory under Paris Agreement), while only 54 countries had developed and published a NAP (voluntarily) during the same period.

An analysis by WaterAid, covering seven NAPs and nine NDCs across nine countries, found that WASH measures are often insufficiently integrated. Common gaps include the absence of clear financing strategies, limited cross-sectoral coordination, and a lack of specific indicators to track progress.

This limited integration of WASH is further reflected in a 2024 analysis by the Stockholm Environment Institute (SEI), which found that out of 8,846 activities outlined in all NDCs, only 168 relate to sanitation and wastewater. Specifically, 36 focus on SDG 6.2 (increases access to sanitation), 122 on SDG 6.3 (wastewater treatment and resource recovery), and just 10 address both targets simultaneously. Within these sanitation-related activities, the predominant focus is on adaptation (69% of the activities), while 19% address mitigation and 12% are cross-cutting. This indicated that the sanitation sector's ability to contribute to global emission reduction goals remains overlooked at a policy level. Furthermore, the 168 sanitation related activities are initiated by 66 of the 144 countries who are included in the analysis. The region with the most sanitation activities is sub-Saharan Africa with 63 activities spread across 28 countries.

The quality and detail of activities can vary significantly. For example, actions might simply state the commitment to increasing the share of population with access to "improved sanitation", without describing the intended improvements and the steps to achieve them, nor including the linkage to climate resilience.

How can sanitation be included in the NDC agenda?

By explicitly including sanitation-related targets in NDCs and regular progress reports. In addition, cross-sectoral working groups and the promotion of synergies with other areas (e.g., health, education, and climate adaptation).

A good example is Uganda, where annual cross-sectoral meetings (including the water and sanitation sectors) are held with the participation of representatives of the ministries responsible for NDC and SDG reporting. They reviewed the progress, reconciled data, and determined the next steps. There are additional votes before the international climate conferences (COP).

Resources

- UN Climate Change: What are Nationally Determined Contributions (NDCs) under the international climate change process?
  https://www.youtube.com/watch?v=_n2mXeP3wh4

- NDC-SDG Connections Tool: Connecting climate action to the Sustainable Development Goals,
  https://klimalog.idos-research.de/ndc-sdg/#

- Stockholm Environment Institute: Integrating sanitation and climate change in national level policy frameworks, November 2024
  https://www.sei.org/wp-content/uploads/2024/11/sanitation-climate-national-policy-sei2024-052.pdf

- WaterAid: Integrating Climate Resilient Water, Sanitation and Hygiene into NAPs and NDCs – Guidelines for best practice – Guidance Document, 2024
  https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/2025-03/Guidance-for-integrating-climate-resilient-water-sanitation-and-hygiene-into-NAPs-and-NDCs.pdf

Sources

AC: Adaptation Community – tackling the effects of climate change: NAP & NDC – Aligning NAP and NDC for coherent Climate Adaptation Action, https://www.adaptationcommunity.net/nap-ndc/, 24.05.2025

NAP: NAP central – United Nations – Climate Change: NAP tracking tool: Status of NAP formulation of developing countries, https://napcentral.org/nap-tracking-tool, 24.05.2025

UNDP: UNDP – Global – Climate Promise: What are National Adaptation Plans and why do they matter, April 2025, https://climatepromise.undp.org/news-and-stories/what-are-national-adaptation-plans-and-why-do-they-matter, 24.05.2025

UNEP: UN Environment Programme (UNEP): Emissions Gap Report 2024, October 2024, https://www.unep.org/resources/emissions-gap-report-2024, 24.05.2025

UNFCCC: United Nations Framework Convention on Climate Change: NDC 3.0 Registry, https://unfccc.int/ndc-3.0, 24.05.2025

UNFCCC2: United Nations Framework Convention on Climate Change – LDC Expert Group: The National Adaptation Plan Process – A brief overview, December 2012, , 24.05.2025

Example: Uganda's NDC

Uganda submitted its updated NDC in 2022 and adopted its third National Action Plan (NAP) in 2021 for the period 2021-2025. It sets a positive example for NDCs including action frameworks with indicators, baselines and targets. It further includes sanitation-related climate mitigation as well as adaptation actions for target sectors and locations, as well as the use of specific technologies.

The following table shows an excerpt of one of the sector-specific priority adaptation actions focused on water and sanitation.

Table 6: Excerpt of the Priority Adaptation Actions for Water and Sanitation Sector Mentioned in Uganda's NDC from 2022

Sector: Water and Sanitation					
Outcome: A climate-resilient water and sanitation sector					
Priority Adaptation Actions	Indicator	Baseline	2025 Target	2030 Target	Target alignment
Increase access to sanitation and wastewater treatment infrastructure and services	Population with access to basic sanitation	18%	25%	68%	BFP 2022/23
	Population with handwashing facilities	36%	50%	To be determined	NDPIII
	Sewer service coverage	23%	31%		Annual Report 2020-NWSC
Scale-up Integrated Water Resources Management approach and use efficiency	Compliance with national water standards	61%	70%	80%	SPR and WESIP
	Water permit compliance	Abstraction (surface) 78%	82%	86%	NDPIII_PIAP
		Abstraction (ground water) 76%	81%	86%	NDPIII_PIAP
	Ambient water quality	0	8%	16%	WESIP
	Catchment management plans developed and implemented	17	21	23	NDPIII_PIAP, SDG 6.5 report
	Level of compliance of Catchment Management Plans (CMPs) to climate change adaptation	0	74	1000	Constructed

Specific technologies that are named as main mitigation policies and measures in the waste sector are e.g. school bio latrines (biogas digesters) that are supposed to improve cooking and sanitation conditions of schools. This is part of the Nationally Appropriate Mitigation Action (NAMA) and as one of many measures has potential to reduce emissions by 0.0006 $MtCO_2$-eq by 2030.

2.5 How to advocate for sanitation-related climate actions?

- **Developing Effective Advocacy for Sanitation-Related Climate Actions:** Introduction to practical strategies for promoting inclusion of sanitation in climate policies and for engaging diverse stakeholders in advocacy processes
- **Designing Actionable Sanitation-Climate Initiatives:** Outline how sanitation-related climate actions should be formulated

There is no one-size-fits-all approach to effective sanitation advocacy and regulation. Any action or framework must be designed and strengthened based on local contextual factors rather than importing international best practices. As a result, while many frameworks and approaches exist, they often provide broad guidance that may require careful adaptation to address specific local realities.

This chapter therefore proposes a dual approach. This dual approach proposes that regulatory foundations and climate-responsive implementation should evolve in tandem. For regulatory foundation, building blocks can be used as a diagnostic tool to determine what needs improvement. On the other hand, specific guidance through navigation and questions results in actionable outcomes providing answers on how to realize improvements.

The ESAWAS Building Blocks for Sanitation Regulation as Structural Foundation

To support effective sanitation regulation, the Eastern and Southern Africa Water and Sanitation Regulators Association (ESAWAS) outlines the following key building blocks. These building blocks, ranging from strong institutions and clear regulations to transparency and learning, require a foundation of policy provision and legal backing as an enabling environment. Regulation is seen to sit at the center of policymakers, service providers and users. All three stakeholder groups can both influence and be influenced by regulation.

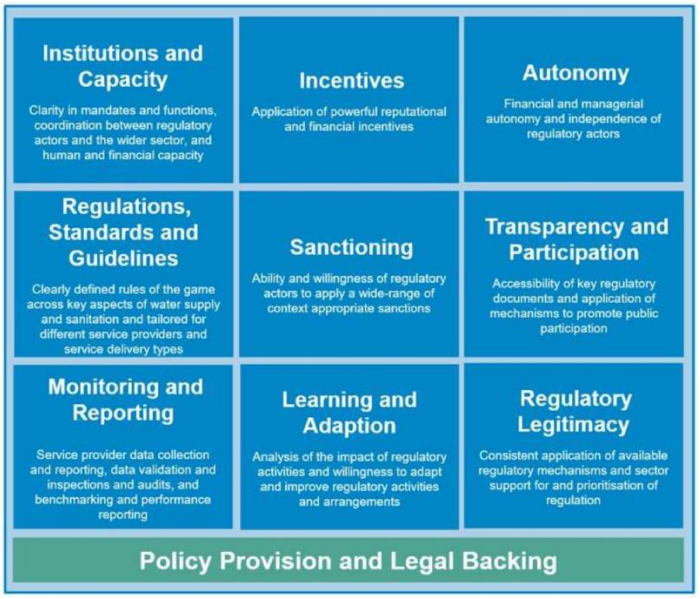


Figure 9: ESAWAS Building Blocks

The building blocks while breaking down the complexity of the topic are kept relatively general to ensure their applicability to the different regulatory frameworks utilized across Africa. In practice, these building blocks can be used as a diagnostic and planning tool based on which interventions can be prioritized and improvements coordinated. The following steps could be followed:

1. Assessment of strengths and weaknesses: Use the building blocks as a checklist to analyze where your country' or region' sanitation regulation is strong and where it needs improvement.

2. Gap analysis and vision setting: Set a vision (strategic objectives or reforms) for each building block based on its current state.

3. Contextualized intervention design: Adapt existing global frameworks to local needs based on the gap analysis and defined vision.

Actionable Climate-Specific Implementation

While the building blocks focus on providing a basis to create and maintain a strong regulatory foundation for the sanitation sector, it is equally important to focus on the content and implementation details as well. To effectively address sanitation's contributions to climate action, it is essential for activities to be specific and to include baseline data and relevant indicators where appropriate. This will allow the progress to be tracked.

In relation to enabling government bodies to develop NDCs that are specific, the NDC 3.0 Navigator can be used for assistance. The Stockholm Environment Institute (SEI) has provided guiding questions to reflect on integrating climate action into sanitation systems and vice versa based also on the Navigator. These guiding questions request context-specific answers that shall result in the definition of baselines, targets, indicators and monitoring mechanisms:

Table 7: SEI's Guiding Questions to prompt thinking on integrating climate action into sanitation systems and vice versa

Category	Guiding Questions
Assessment of climate risks	What climate risks (e.g. floods, droughts, temperature changes) are expected to impact sanitation systems?
Vulnerability and needs	Which communities or regions are most vulnerable to climate-related sanitation issues (e.g. infrastructure failure, challenges to service providers)?
Adaptation measures	What sanitation-specific adaptation measures can be implemented to strength resilience to climate impacts?
Co-benefits	How can sanitation interventions also contribute to other adaptation goals (e.g. health, biodiversity, ecosystem health, livelihoods, food security)?
Mitigation potential	What are the opportunities for reducing GHG emissions within the sanitation sector (e.g. through resource recovery, the use of aerobic treatment technologies, more frequent de-sludging of containments facilities, etc.)?
Institutional capacity	Are there gaps in institutional capacity or governance structures that hinder climate-resilient and low-emission sanitation implementation?
Monitoring and evaluation	How will progress on sanitation-related climate adaptation and mitigation measures be monitored and evaluated?
Financing	What financial resources are available or needed to scale up sanitation-related climate adaptation and mitigation measures?
International cooperation	How can international collaboration support the integration of sanitation into national adaptation and mitigation strategies, as well as the integration of climate action into sanitation strategies?

The guiding questions can be applied according to the following steps:

1. Gather stakeholders: Bring together government, sanitation experts, civil society and communities.
2. Realize policy dialogue: Use the guiding questions to structure a policy dialogue with the different stakeholders. (With focus on the NDC's, the NDC 3.0 Navigator can be used to extend the guiding questions and to support the development of contents. Find the link to the tool in the resources of this chapter.)
3. Develop specific, measurable actions: Based on the answers from the policy dialogue, define baselines and develop concrete targets and policy indicators as well as monitoring and reporting mechanisms.
4. Integrate actions into national policy frameworks: Integrate the formulated actions in NDCs, National Adaptation Plans (NAPs) and other sanitation- and climate-relevant frameworks.
5. Review, update and report: Follow the monitoring and reporting mechanisms put in place to keep track on the progress. Regularly revisit the questions and update actions as context and knowledge evolve.

Especially the last point emphasizes that sanitation services should be flexible and adaptable to address challenges of climate uncertainties. This includes the readiness to change the management and operation of sanitation services, continual learning, and solid understanding of sanitation system components.

As NDC 3.0 are to be submitted in 2025, sanitation stakeholders are encouraged to understand where the processes for NDC revision stand in their respective countries. The engagement with the respective responsible bodies shall ensure that the sanitation sector's potential for climate resilience and mitigation is fully integrated into climate and sanitation national policies and strategies. Expand the conception of sanitation emphasizing its simultaneous opportunities for

- Effective climate action through adaptation, mitigation and resilience,
- Improved human health through nutrition and disease prevention,
- Stronger economic growth by reducing losses and generating revenues, and
- Enhanced social equity by reducing inequalities.

Resources

- Eastern and Southern Africa Water and Sanitation Regulators Association (ESAWAS): The water supply and sanitation regulatory landscape across Africa – continent-wide synthesis report, June 2022
  http://www.ppa.pt/wp-content/uploads/2024/01/Esawas_Report_2022.pdf

- NDC 3.0 Navigator: A tool for the development of NDCs to be submitted in 2025, to support enhanced ambition and accelerate implementation
  https://ndcnavigator.org

KEY TAKEAWAYS

- Sanitation and climate change are closely linked – each affects the other ("the Wicked Problem").
- Climate-SMART sanitation solutions need to be considered to reduce GHG emission from conventional sanitation solutions and their impact on climate.
- Safe sanitation for all will cause a rise in GHG emissions and increase the impact of sanitation on the climate. Climate-SMART sanitation solutions need to be considered.
- Climate-related sanitation solutions must be flexible and context-specific – there is no one-size-fits-all solution.
- Everyone is impacted by the Climate-Sanitation Nexus, so strategies must be inclusive.
- Climate-SMART sanitation provides many synergies with all 17 Sustainable Development Goals.
- Sanitation needs to be more prioritized in National Adaptation Plans and Nationally Determined Contributions.
- A clear and strategically formulated strategy in NDC and NAP is very beneficial for applying for international funding.

3 Module 2: Climate-SMART Sanitation

3.1 What is climate-SMART sanitation?

- **Definition of climate-SMART sanitation:** Introduction and explanation of the SMART acronym
- **Designing climate-SMART sanitation systems**: Overview of the essential steps to apply a climate-SMART approach

As seen in the previous module, Climate change is intensifying the challenges faced by sanitation systems around the world. Increased flooding, prolonged droughts, and extreme weather events threaten the functionality and sustainability of sanitation services. These impacts are particularly severe in vulnerable regions where infrastructure is already under stress or lacking entirely.

In parallel, the sanitation sector itself contributes to climate change through the release of greenhouse gases such as methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). These emissions are often overlooked in national inventories, despite their significant contribution, particularly from on-site sanitation systems and poorly managed wastewater treatment.

To address both vulnerabilities and emissions, sanitation systems must evolve to become climate-SMART. This means that sanitation planning and implementation should be informed by climate risks, support adaptation and resilience, and contribute meaningfully to mitigation goals.

Traditional WASH planning frameworks, such as the Strategic Framework for Climate Resilient WASH developed by UNICEF and the Global Water Partnership (GWP), have primarily focused on climate adaptation and building resilience. While these frameworks acknowledge mitigation, they provide limited guidance on how to reduce emissions within sanitation systems. As a result, GHG reduction efforts in the sector often remain ad hoc or secondary.

This training module introduces a more comprehensive approach: climate-SMART sanitation. It aims to integrate mitigation as a core objective alongside adaptation, public health, and environmental protection.

The approach is grounded in five interlinked pillars, represented by the SMART acronym:

- **Safe**: Ensures the protection of health and dignity by breaking disease transmission pathways and safeguarding public health.
- **Mitigative**: Actively reduces greenhouse gas emissions (methane, nitrous oxide, CO_2) through measures such as biogas capture, aerobic treatment, and resource recovery.
- **Adaptive**: Designed to withstand and adjust to climate impacts such as increased rainfall, floods, or droughts, ensuring service continuity during adverse conditions.
- **Resilient**: Maintains functionality during and after climate shocks, with robust infrastructure, contingency planning, and rapid recovery mechanisms.

- **Transformative**: Implements circular economy solutions, such as resource recovery and reuse, to drive long-term sustainability, reduce environmental impact, and risk to public health.

These pillars form the foundation of climate-SMART sanitation. They will be explored in detail throughout this module, beginning with how to assess the current status—or baseline—of a sanitation system.

Climate-SMART Sanitation as a System Approach

The climate-SMART sanitation approach is not applied in isolation to infrastructure components—it is designed for systems. Under frameworks like Citywide Inclusive Sanitation (CWIS), the focus has shifted from building infrastructure to delivering services supported by robust enabling environments.

Sanitation is not merely about toilets, pipes, or treatment plants; it is a comprehensive service chain that includes containment, emptying, transport, treatment, and reuse or disposal. To be climate-resilient and low-emission, a sanitation strategy must address how all these components interact and function as a system, rather than just what is physically constructed.

Climate change introduces challenges that are systemic—affecting governance, operations, infrastructure, and behavior across the entire chain. As such, the climate-SMART approach emphasizes the need to strengthen the full sanitation system, from both a mitigation and adaptation standpoint.

At the same time, the approach is scalable. While it applies at the city or system level, it can also be implemented at smaller scales—for example, when evaluating or upgrading a single treatment facility. Later sections of this module will demonstrate how this flexibility is maintained in practice.

Another key advantage of this approach is that it supports alignment with climate finance mechanisms, such as the Green Climate Fund (GCF) and adaptation funds. These funding sources prioritize cross-cutting goals: emission reduction, adaptive capacity, and risk management. Infrastructure projects that neglect the broader system are unlikely to meet these criteria.

Designing and implementing climate-SMART sanitation systems follows three core steps:

1. Climate-SMART baseline assessment
2. Technical solution screening and shortlisting
3. Climate-SMART baseline improvement and verification

These steps form the methodological foundation for this module. The matrix below provides an overview of the process.

Table 8: Overview of the Three Steps to Implement a Climate-SMART Approach

Steps	Objectives	Core Activities (Examples)	Tool	Primary Outputs	Target Group
Climate-SMART Baseline Assessment	Create a full picture of current service, emissions, risks, and circular opportunities.	**Safe:** Evaluate the access to sanitation and % of excreta safely managed.	JMP Sanitation Ladder SFD	Baseline JMP dataset SFD diagram	Decision-makers, utilities, NGOs, developers
		Mitigative: Establish GHG emissions baseline.	ECAM v3	GHG inventory	
		Adaptive & Resilient: Conduct climate risk assessment.	UNICEF-GWP Risk Assessment	Risk scorecard	
		Transformative: Study reuse perceptions and market potential.	Reuse Perception Study. Driven Approach for Selection of Fecal Sludge Treatment Product.	Circular opportunity snapshot	
Technical Solution Screening & Short-listing	Identify technically sound, finance-ready solutions aligned with all SMART pillars.	Develop and apply criteria to screen and shortlist sanitation technologies. Planning adaptation measures Incorporate SMART criteria into selection using MCDA approach.	MCDA worksheet (weighted scoring) for technology screening For Adaptation and Resilience UTS ClimateFIRST Framework	Ranked shortlist with justification and context-based adaptation measures	Planners, engineers, developers
Climate-SMART Baseline Improvement verification	Quantify how shortlisted options perform compared to baseline; package evidence for decision-makers and funders.	**Safe:** Evaluate how interventions improve the access and safe management of excreta	JMP Sanitation Ladder SFD	Baseline vs projected JMP dataset Baseline vs projected SFD diagram	Decision-makers, doners, policy makers, planners
		Mitigative: Estimate potential GHG impact	ECAM v3	Baseline vs projected Risk scorecard	
		Adaptive & Resilient: Assess impact on climate risk profile	UNICEF-GWP Risk Assessment	Baseline vs projected Risk scorecard	
		Transformative: Quantify the potential output	To be considered in GHG Impact	Expected quantified outputs	

Note: The Climate-SMART baseline Improvement verification and monitoring are not detailed in this manual. After the project implementation, it is suggested to repeat the steps introduced in the baseline assessment to assess and visualize the potential impact.

Are all pillars of climate-SMART sanitation equal or should they have different priorities?

In principle, all categories are relevant, but in practice, for example, in multi-criteria analyses (MCDAs), certain aspects such as "safely managed" can be given greater weight. This should be transparently documented and justified (see how to address it in the documentation).

Spotlight: Citywide Inclusive Sanitation (CWIS)

Definition	CWIS stands for Citywide Inclusive Sanitation, a paradigm shifts in urban sanitation that aims to ensure everyone has access to safely managed sanitation services (Source: WB). This comprehensive approach prioritizes the needs and rights of all city residents, regardless of their socioeconomic status, gender, or gender, or ability. CWIS emerged as a response to the failure of conventional sewerage-focused approaches to address urban sanitation needs effectively (Source: ITN-BUET, 2023). Rather than viewing conventional sewerage and wastewater treatment as the only solution, CWIS promotes a range of solutions—both onsite and sewered, centralized or decentralized—tailored to the local context. The approach is technology agnostic and shifts away from traditional focus on hardware inputs, instead emphasizing how a city's service delivery system functions and interacts. CWIS focuses on service provision and its enabling environment, rather than simply building infrastructure. CWIS operates through a service framework consisting of three core outcomes and three core functions.(Source: CWIS Cities, 2021) Core Outcomes: • Equity - Ensuring access for all, with special attention to the poor, marginalized, and women and girls • Safety - Providing safe sanitation services • Sustainability - Creating environmentally and financially sustainable systems Core Functions: • Responsibility - Clear assignment of roles and duties • Accountability - Mechanisms for oversight and performance monitoring • Resource Planning and Management - Effective allocation and management of resources.

Sources

GWP/UNICEF, 2017: Global Water Partnership (GWP) & UNICEF. (2017). Linking risk with response: Options for climate resilient WASH (Technical Brief). Global Water Partnership

WB: World Bank, Citywide Inclusive Sanitation (CWIS) Initiative, https://www.worldbank.org/en/topic/sanitation/brief/citywide-inclusive-sanitation, 25 May 2025

ITN-BUET, 2023: Citywide Inclusive Sanitation (CWIS) for a Safe and Healthy Future, https://itn.buet.ac.bd/web/resources/cwis-for-a-safe-and-healthy-future/, 25 May 2025

CWIS Cities, 2021: CWIS Measurement, https://www.cwiscities.com/Pdf/Show?pdfFileName=CWISMeasurementNote2021Julyv3.pdf, 25 May 2025

3.2 How to assess climate-SMART sanitation systems baseline?

- **Understanding the relevance of conducting a climate-SMART sanitation systems:** introduction to tools and consideration for each pillar of the climate-SMART approach

A climate-SMART sanitation strategy must be grounded in a comprehensive understanding of the current state of the sanitation system. This baseline assessment enables planners and decision-makers to identify gaps, vulnerabilities, and opportunities for climate-responsive improvements.

This section proposes a diagnostic approach structured around the five SMART pillars—Safe, Mitigative, Adaptive & Resilient, and Transformative. Each pillar helps to identify specific dimensions of the baseline that must be understood before designing or selecting appropriate interventions.

• Safe – Assessing service levels using the JMP Sanitation Ladder provides a starting point for understanding access, safety, and equity. Complementary tools like the Shit Flow Diagram (SFD) help visualize how excreta are managed across the service chain—from containment to disposal or reuse. Indicators include the type of facilities used, extent of safely managed services, and key exposure risks such as open defecation or direct discharge.

• Mitigative – Baseline data should include an estimation of current greenhouse gas emissions from existing sanitation practices. This may involve identifying major emission sources—such as anaerobic decomposition in pits or untreated sludge—and calculating potential GHG contributions using simplified tools or proxy indicators.

• Adaptive & Resilient – Assess the system's exposure to climate risks (e.g., floods, droughts, groundwater vulnerability) and its capacity to withstand and recover from disruptions. This includes evaluating infrastructure siting and design, as well as institutional, financial, and community readiness to respond to shocks.

• Transformative – The potential for systemic improvement should also be reviewed. This includes evaluating whether the sanitation system is open to innovation, resource recovery, integration with other sectors (e.g., energy, agriculture), and alignment with long-term development and climate goals.

Data for this assessment can be gathered through document reviews, site visits, stakeholder consultations, and basic surveys. While high-resolution datasets may not always be available, even simple tools—when used systematically—can provide a reliable foundation for planning and prioritizing action.

Safe: Ensuring Public Health

The primary purpose of sanitation systems is to protect public health by preventing human contact with excreta and reducing environmental contamination. A climate-SMART approach begins by assessing whether this fundamental objective is being met.

To evaluate the current safety of sanitation services, the **Joint Monitoring Programme (JMP) Sanitation Ladder** provides a globally recognized framework for benchmarking and comparing sanitation service levels across countries. It categorizes sanitation services from **open defecation** (no service) to **safely managed sanitation** (the highest level) and directly supports the monitoring of SDG 6.2.1. The ladder helps establish clear baselines and targets, identifies service gaps, and guides investment and planning priorities.

The sanitation ladder can be applied at both single unit and system level. The goal is to ensure that all excreta are safely managed, with the minimum acceptable threshold being basic sanitation.

Table 9: JMP Sanitation ladders and corresponding SDG target

Service Level	Definition	SDG	Target
Safely Managed	Use of **improved facilities**, not shared with other households, with excreta safely disposed of in situ or treated offsite	6.2.1a	By 2030, all people should have access to safely managed sanitation services
Basic	Use of **improved facilities** that are not shared with other households	1.4.1	By 2030, ensure that all men and women, particularly the poor and the vulnerable, have equal rights to economic resources, **as well as access to basic services**, …
Limited	Use of improved facilities shared between two or more households		
Unimproved	Use of pit latrines without a slab/platform, hanging latrines, or bucket latrines		
Open Defecation	Disposal of human feces in open spaces (fields, forests, water bodies, etc.) or with solid waste		End open defecation

JMP defines improved sanitation facilities as those designed to hygienically separate excreta from human contact. These include:

- Flush/pour-flush toilets connected to sewer systems, septic tanks, or pit latrines,
- Pit latrines with slabs (including ventilated improved pit latrines),
- Composting toilets and innovative systems such as biogas toilets and those developed under the Reinvented Toilet initiative.

To assess how excreta are handled throughout the service chain, the **Shit Flow Diagram (SFD)**, also known as the Excreta Flow Diagram is an effective and widely used tool. The SFD provides a clear visual representation of excreta flows-from containment and emptying to transport, treatment, and final disposal or reuse-highlighting where safe or unsafe management occurs. It supports evidence-based planning and helps identify priority areas for intervention.

At a single unit scale, such as when reviewing a specific treatment plant, safety can be assessed by checking whether effluent consistently meets **national or WHO quality standards**. This step is crucial for identifying pollution risks and compliance gaps.

Importantly, the **safety** of a sanitation solution does not depend solely on technology. It is shaped by how infrastructure interacts with local **context** and how **services are managed**. Key influencing factors include:

- **Environmental context** - such as groundwater depth, soil conditions, proximity to water bodies, and population density.
- **User behavior** - including use, maintenance, and hygiene practices.
- **Service management** - covering operations, regulation, monitoring, and long-term maintenance responsibilities.

In summary, safety must be evaluated holistically by combining technical assessment with local context analysis and institutional capacity review-to ensure sanitation systems truly safeguard public and environmental health.

In Africa, safety-managed sanitation often focuses on the safety of sludge management and does not consider access to individual sanitation. Can we say that a system used by several people can be managed safely?

According to WHO/UNICEF JMP, "SAFELY MANAGED SANITATION" refers to the safe disposal and treatment of feces, regardless of whether the toilet is used individually or collectively. However, communal toilets are usually not counted as "safely managed" unless they are used and operated safely by a clearly defined user group. This assessment of JMP level is also a political position.

Fictional case study

Consider a fictional riverine community of 1,000 people in West Africa.

- The area is subject to **seasonal flooding** and **high groundwater vulnerability**, which increases the risk of contamination from on-site sanitation systems.
- Fecal sludge that is collected is treated in **drying beds**, with the resulting solids disposed of in a landfill.
- Based on the representative household survey, we have obtained the following result:

JMP Sanitation Ladder	% Population	Population
Safely managed (improved, not shared, safely disposed)	10%	100
Basic (improved, not shared, disposal uncertain)	20%	200
Limited (improved, shared≥2 HH)	20%	200
Unimproved (unlined pits)	40%	400
Open defecation/no facility	10%	100
Total	**100%**	**1000**

Initial Assessment Findings

Analysis of the survey data shows that 70% of the population lacks access to safely managed sanitation and would require priority intervention. To better understand risk along the sanitation chain, the community conducted a step-by-step assessment using the Groundwater Pollution Risk Estimation Tool, recommended by the SFD Initiative.

The outcome indicated a **significant risk of groundwater contamination**, particularly due to the combination of permeable soil, shallow water tables, and flood-prone conditions.

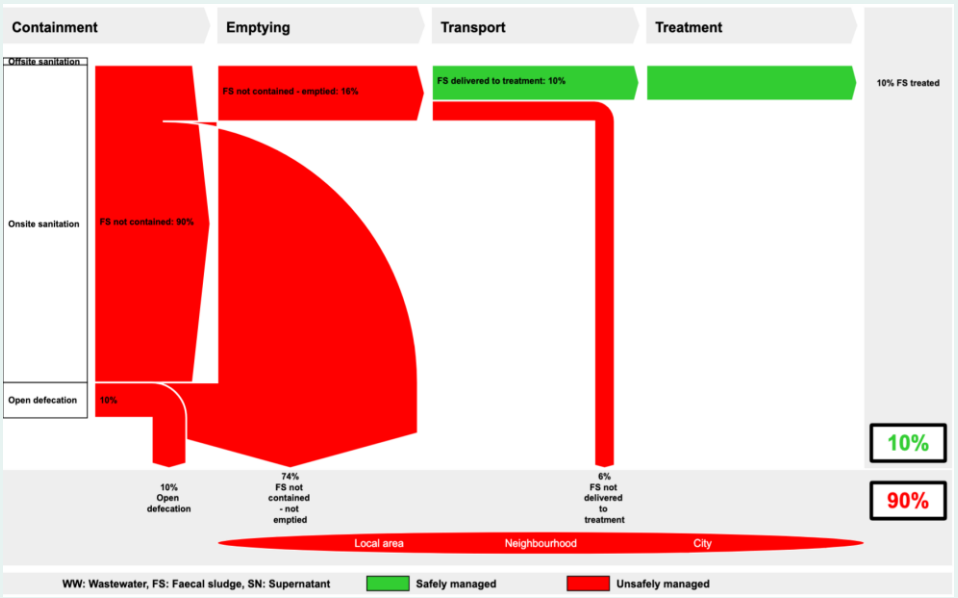
Service Chain Analysis and SFD Tool Application

Following guidance from the SFD methodology, a matrix was developed using household survey results and stakeholder interviews.

Containment			Onsite sanitation		
System type	Classification	Population	FS emptying	FS transport	FS treatment
System lable & description	Contained or Not contained	Proportion of population using this type of system	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated
T2A2C5 Septic tank conneced to soak pit, where there is a "significant risk" of groundwater pollution	Not contained	10%	50%	100%	100%
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a "significant risk" of groundwater pollution	Not contained	40%	30%	85%	85%
T2A6C10 Unlined pit, no outlet or overflow, where there is a "significant risk" of groundwater pollution		40%	25%	0%	0%
T1B11 C7 TO C9 Open defecation		10%	-	-	-

The corresponding Shit Flow Diagram (SFD) revealed key weaknesses:

- 90% of containment systems are not safely managed, primarily due to groundwater infiltration risks.
- Unlined pits and open defecation are clearly unsafe.
- Even lined pits and septic tanks with soak pits were deemed unsafe in this context due to structural permeability and leakage risk.
- While all septic tanks are emptied and treated, only 30% of sludge from pit latrines is emptied, and 85% of that is adequately treated.



Key Conclusions and Planning Implications

Phase 1: Immediate action is needed for 70% of the population to achieve safely managed sanitation. This includes expanding infrastructure, reducing open defecation, and increasing fecal sludge collection and treatment capacity.

Phase 2: The remaining 30% of the population require targeted interventions to reduce groundwater pollution risks, even if they already have access to improved facilities.

Mitigative: Reducing Climate Impact

A climate-SMART approach to sanitation must consider the greenhouse gas (GHG) emissions generated by different technologies and practices. Without mitigation measures, expanding access to sanitation can unintentionally increase emissions. This section presents the key concepts, tools, and illustrative case examples for understanding and addressing the climate impact of sanitation systems.

Key Greenhouse Gases from Sanitation Systems

Sanitation and wastewater management systems emit three main greenhouse gases:

- **Methane (CH_4):** Produced by anaerobic decomposition of organic matter in systems like septic tanks, pit latrines, and stagnant sewers. GWP100 = 28x CO_2.
- **Nitrous Oxide (N_2O):** Generated during nitrification and denitrification in biological treatment. GWP100 = 265x CO_2.
- **Carbon Dioxide (CO_2):** Includes both biogenic CO_2 (from natural processes, typically excluded from inventories) and fossil CO_2 (from energy used in operations).

Understanding the sources and pathways of these gases is essential for selecting technologies that reduce climate impacts.

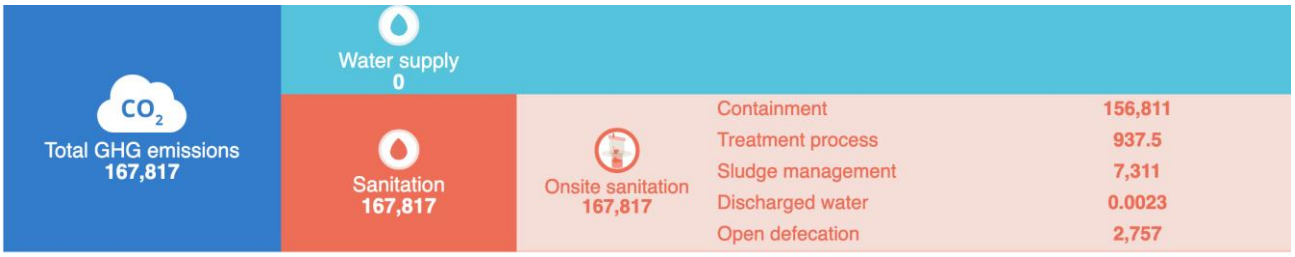
Methane emissions from sanitation systems may increase as countries progress toward SDG 6.2 (universal access), particularly when anaerobic technologies are used. However, these emissions are not inevitable. Technological solutions—including aerobic treatment systems that minimize methane production, as well as systems that capture and utilize methane as a renewable energy source—can significantly reduce or even avoid these emissions. Captured methane can also serve as a substitute for fossil fuels, thereby further reducing overall greenhouse gas emissions. The effectiveness of any mitigation effort depends on the initial baseline and the choice of technologies and management practices. The effectiveness of any mitigation measure may also influence the availability of climate finance (funding eligibility criteria) or access to carbon finance via carbon credits. More details on this can be found in Modules 3 and 4.

Using ECAM for Emissions Assessment at System Level

The **ECAM (Energy and Carbon Assessment Methodology)** tool supports the assessment of GHG emissions from urban water and sanitation systems. Developed in alignment with **IPCC guidelines**, ECAM covers the entire sanitation service chain:

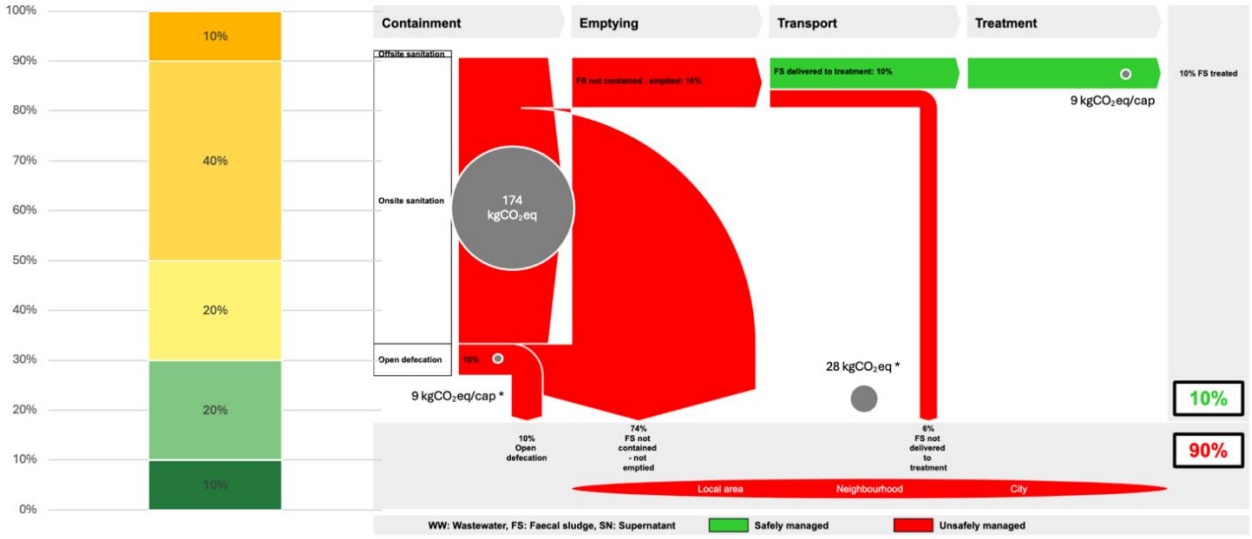
- On-site sanitation
- Sewer networks
- Collection and transport
- Treatment processes
- Reuse and disposal

ECAM uses country-specific defaults and system configurations to streamline the assessment process. Results are presented both as total GHG emissions and broken down by source (e.g., collection, treatment, reuse), as illustrated in the image below.



Practical Application of ECAM and SFD

It can be used in conjunction with visual tools like the SFD (Shit Flow Diagram) to overlay service flow with emissions data. The following example is based on the fictional case study of the "safe" chapter hereabove.



In a case previously introduced under the "Safe" pillar, a community with 90% sanitation coverage was found to have only 30% safely managed sanitation. The corresponding SFD and ECAM outputs highlighted the following:

- Despite high coverage, the 90% of excreta are unsafely managed, primarily due to high groundwater contamination risk
- Most emissions (174 kg CO_2-eq/person/year) come from on-site systems (pit latrines and septic tanks)
- Frequent flooding and infiltration increase methane emissions due to anaerobic conditions

Comparatively, a household with a septic tank and constructed wetland had lower emissions (120 kg CO_2-eq/person/year) due to better containment and less exposure to flooding.

Summary and Planning Implications

- Emissions often rise as service access expands unless mitigation is built in.
- Technologies like dry or composting toilets, aerobic treatment, or biogas recovery systems can significantly reduce emissions.
- Tools like ECAM support scenario analysis, helping planners select low-emission solutions tailored to local conditions.

A table of default emission factors (e.g., methane per kg BOD) is available in ECAM and can be used for preliminary assessments, though not as a substitute for detailed inventories.

Ultimately, the effectiveness of climate mitigation in sanitation depends on the combination of baseline conditions, technology selection, and management quality.

Who controls the input into the IPCC database?

There is a peer review process at the UNFCCC.

Adaptive and Resilient: Building Climate-Ready Sanitation Systems

A climate-SMART sanitation system must not only reduce emissions but also remain functional and safe under evolving climate conditions. This requires systems that are both adaptive and resilient:

The Intergovernmental Panel on Climate Change (IPCC) describes:

- Adaptation as "*the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities,"* while
- Resilience as "*the capacity of systems to cope with hazardous events while maintaining essential functions."*

Climate hazards such as floods and heatwaves threaten all parts of the sanitation chain. Adaptation should consider both long-term trends (e.g., rising temperatures) and sudden events (e.g., storm surges). Technologies alone are insufficient as resilience depends on context, operations, and governance.

Risk Assessment and intervention prioritization at the system level

To support risk-informed planning and prioritization, the UNICEF–GWP Strategic Framework for WASH Climate Resilient Development offers a widely recognized approach. It supports:

- System-wide risk assessments
- Prioritization of adaptation interventions
- Integration of climate risks into planning, design, and monitoring across the sanitation service chain

At the core of the framework is the risk equation:

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$

This formulation allows a structured analysis of how different threats may impact sanitation services under specific environmental and social contexts.

To operationalize the framework, a step-by-step risk assessment approach is used:

1. Identifying relevant hazards,
2. Assessing the exposure of sanitation system components,
3. Evaluating their vulnerability,
4. Calculating an overall risk score to prioritize interventions.

This structured approach enables planners and implementers to identify weak points in their systems and take targeted action to protect public health and service continuity under climate stress.

An example of how this structured process is applied is shown in the following illustrative case study, which highlights how these steps can be adapted to a real-world context.

Illustrative Case: Risk Assessment in a West African River Floodplain

To demonstrate the use of this framework, a fictional case study is presented below.

Context: A community is located on a low-lying floodplain in West Africa. It experiences intense rainfall and flooding during bimodal rainy seasons, while the dry season brings extreme heat and humidity. Climate projections indicate worsening rainfall extremes and longer dry seasons.

Step 1: Identify Relevant Hazards

Hazards are grouped as environmental, biological/chemical, and human-induced. In this scenario:

- **Environmental**: River flooding, intense pluvial rain, drought, heat-humidity stress
- **Biological/Chemical**: Groundwater contamination
- **Human-induced**: Poor fecal sludge management (FSM)

Each hazard is scored based on **frequency**, **intensity**, and **future trend** (on a 1–3 scale). The **hazard score** is their average.

	1	2	3
Frequency	> 5 years	1 – 5 years	Annual/seasonal
Intensity	< 1 week	1 week	>1 week
Future projection	Decreasing	Stable	Increasing

Hazard group	Specific hazard	Frequency	Intensity	Future projection	Hazard score*	Rationale
Environmental	Riverine Flooding (peak ~1 m inundation)	2	2	3	2.3	Annual rainy season overtopping of banks; wetter futures in IPCC projections
Environmental	Pluvial downpour (> 50 mm h^{-1} bursts)	2	2	3	2.3	Frequent intense storms in wet seasons; heavy-rain events are intensifying
Environmental	Drought/water scarcity (short dry spells)	2	1	2	1.7	Dry season occurs most years but is short; no change in the future is expected
Environmental	Heat–humidity stress (THI > 30)	3	3	3	3.0	Prolonged high THI impacts workers, sludge-drying; heat days projected to increase
Bio/Chemical	Groundwater contamination	3	3	3	3.0	Shallow aquifer and leaching from pits; population growth + floods will exacerbate contamination
Human-induced	Poor FSM practices	3	2	3	2.7	Many pits never desludged, leading to overflows; stable unless FSM services are expanded

Secondly, the **overall hazard score** is assigned to the sanitation element to obtain the **Specific Hazard Score**, as shown in the following table. The specific Hazard Score is calculated as an average.

	Riverine Flooding	Pluvial downpour	Drought / water scarcity	Heat–humidity stress	Groundwater contamination	Low fecal sludge management	Specific Hazard Score
On-site containment (pits & tanks)	2.3	2.3	1.7	0	3.0	2.7	2.0
Open defecation	2.3	2.3	0	0	3.0	2.7	1.7
Emptying teams & FSM ops	2.3	2.3	0	3.0	0	2.7	1.7

Treatment facility	2.3	2.3	0	3.0	0	2.7	1.7

Step 2: Assessing the exposure of sanitation system components,
The three exposure categories are:

- **Physical:** Latrines, sewers, treatment plants.
- **Environmental:** Proximity to water sources.
- **Social:** Populations dependent on the system.

Each exposure risk is scored based on **Physical design**, **proximity**, and **affected population** (on a 1–3 scale). The **exposure score** is their average.

	1	2	3
Physical design	Robust	Partially robust	Fragile/makeshift
Proximity	>1 km	0.5 – 1 km	< 0.5 km
Affected pop.	<10 %	10 – 30 %	> 30 % relying on

	Physical	Proximity	Affected pop.	Exposure Score	Rationale
On-site containment (pits & tanks)	2	3	3	2.7	Unlined and lined pits (2); all are <0.5 km from river (3); >30 % of households rely (3).
Open defecation	3	3	2	2.7	Makeshift sites (3); directly in flood zone (3); 10 % of pop. practice OD (just at 10 % threshold →2).
Emptying teams & FSM ops	3	3	3	3.0	Most Makeshift/manual equipment (2); Heat–humidity stress (THI > 30, ~90 days yr^{-1}) (3); 100 % of Emptier affected.
Treatment facility	2	2	3	2.3	Partially flood-protected plant (2); ~0.5–1 km upslope (2); treats ~50 % of sludge (>30 % reliance →3).

Step 3: Evaluating their vulnerability
The four categories are:

- **Physical:** Infrastructure age, material quality.
- **Environmental:** Degradation of water sources, soil stability.
- **Social:** Community maintenance practices, awareness.
- **Financial:** Budget for repairs, insurance coverage.

Each vulnerability is scored based on **Physical (age)**, **organizational (O&M)**, **Financial** (repair funds/insurance) and **environmental** (site stability) (on a 1–3 scale). The **exposure score** is their average.

	1	2	3
Physical (age)	< 5 yrs.	5–15 yrs.	> 15 yrs.
Organizational (O&M)	preventive maintenance	on demand maintenance	neglected maintenance
Financial (repair funds/insurance)	adequate budget/insurance	partial/unstable funding	no dedicated funds, uninsured
Environmental (site stability)	stable soils/low salinity	mixed/moderately degrading	highly eroding, flood-prone soils

	Physical	Organizational	Financial	Env.	Vulnerability score*	Rationale
On-site containment (pits & tanks)	3	3	3	3	3.0	Mostly old/unlined pits; no routine maintenance; no repair funds; soils highly eroding and flood-prone.
Open defecation	3	3	3	3	3.0	Makeshift sites; no O&M or community oversight; no budget; located on unstable, flood-washed banks.
Emptying teams & FSM ops	3	2	2	3	2.5	Manual, fragile equipment; community-led but irregular maintenance; fees unstable; crews work in unstable, flooded terrain.
Treatment facility	2	2	2	2	2.0	Concrete plant ~10 yrs. old; operator-run with routine O&M; budget covers minor repairs; site on stable ground.

Step 4: Calculating an overall risk score to prioritize interventions

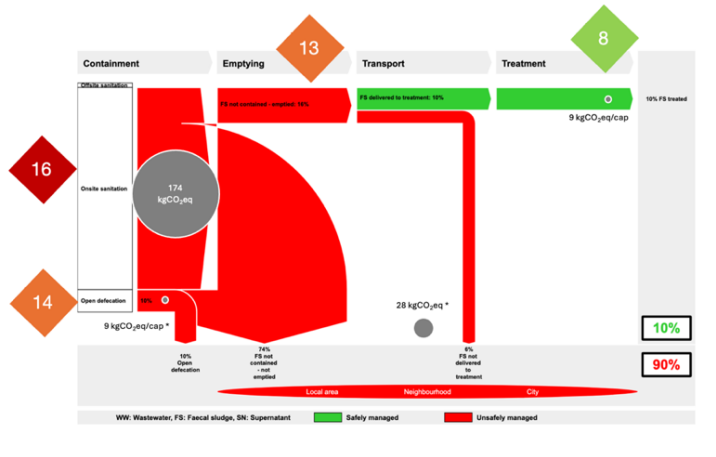
Overall risk score (Risk = Hazard × Exposure × Vulnerability) of the different elements in the sanitation system from the given context

	Hazard	Exposure	Vulnerability	Risk score*	
On-site containment (pits & tanks)	2.0	2.7	3.0	16	>15
Open defecation	1.7	2.7	3.0	14	10 – 15
Emptying teams & FSM ops	1.7	3.0	2.5	13	
Treatment facility	1.7	2.3	2.0	8	< 10

Interpreting the Results

The highest risk is found in **on-site containment systems**, followed by open defecation and sanitation workers. The **treatment facility** has the lowest relative risk due to its more protected siting and better operational stability.

For effective communication, the results can also be linked to tools like the SFD or GHG baseline to identify vulnerable points across the sanitation service chain.



How can the results of the three tools (SFD, ECAM, and UNICEF-GWP RISK ASSESSMENT) be visualized in a unique graph?

Integration must be performed manually. Depending on the target audience, one might want to change the number of risk assessments to wording for easier comprehension. In addition, the tools are not only useful for baseline and design support but also for creating great data and visualization that can be used for advocacy.

Transformative: Shifting the paradigm

Sanitation is a fundamental pillar of human well-being and public health. Traditionally, however, sanitation systems have focused almost exclusively on the safe disposal of human waste, often ignoring its potential as a valuable resource. Climate-SMART sanitation challenges this conventional view. Instead of seeing waste as something to be removed, it adopts a circular economy mindset—recognizing opportunities to recover, reuse, and reintegrate waste into productive systems.

Yet transformation in sanitation goes beyond technology and resource recovery. It also occurs when a community transitions from no or limited access to sanitation to basic or improved services. This kind of shift represents a major leap in dignity, equity, and health outcomes—even if high-end technologies are not immediately involved.

Driving Transformation Through User Acceptance

At the heart of any sustainable sanitation solution is the acceptance and involvement of the people it is meant to serve. Whether introducing new technologies or promoting resource recovery, user perception and behavior play a critical role.

Household-Level Acceptance

Understanding how people perceive sanitation byproducts, such as biogas, compost, or protein feed, is essential. Household surveys are typically used to assess public willingness to adopt and use these products.

For example, imagine a survey exploring the willingness to use biogas derived from treated fecal sludge. The results might look like this:

Table 10: Example Result of HH Acceptance Survey on the use of biogas

Product	% Willing to Use	Key Concern	What would change your mind?	%
Biogas	80 %	Cookstove to expensive	Free Cookstove	45

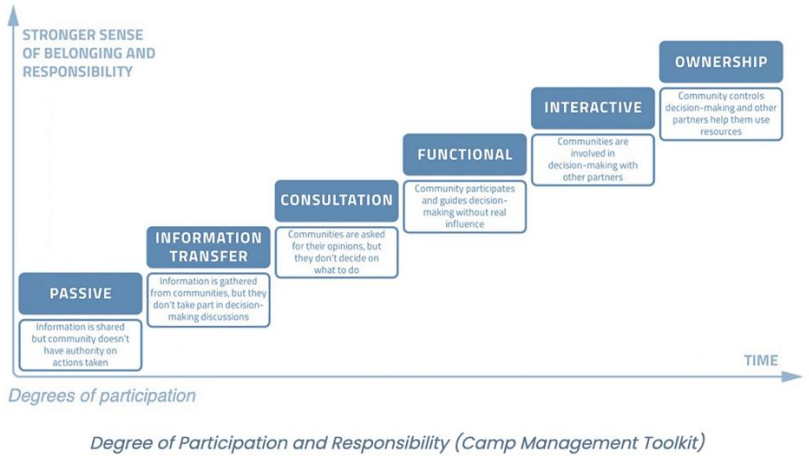
In this fictitious example, acceptance of biogas is relatively high. A prefabricated biogas digester could be a good fit for the context. However, if such systems are introduced through subsidies or donations, fostering a sense of ownership is critical. One strategy might involve requiring recipients to participate in training sessions on system operation and basic troubleshooting—ideally with a short test at the end.

A real-world example of this approach comes from North Sydney, where residents receive a 50% subsidy for a compost bin only after completing a tutorial and passing a quiz (link: https://compostrevolution.com.au/northsydney/?srsltid=AfmBOop6agZ5N_wZANbX13SKkU5KZrqZsqNE3srKDzTw4yH5eq51nVWD).

If acceptance is initially low, targeted social marketing campaigns can help build trust and awareness. Tactics may include demonstration projects, community events, and dedicated information sessions.

Community-Level Acceptance

At the **community level**, acceptance is often reflected in levels of participation. Active involvement in planning, implementation, and operation fosters a sense of ownership and responsibility—key ingredients for long-term project success.



Degree of Participation and Responsibility (Camp Management Toolkit)

Figure 10: Degree of Participation and Responsibility

Seven principles can help build public support and acceptance:

1. **Engage early**: Inform the public at the earliest stages of the project and continue communication throughout.
2. **Take concerns seriously**: Acknowledge fears or criticism openly.
3. **Foster dialogue**: Encourage one-on-one conversations with community members.
4. **Involve people actively**: Make the project participatory.
5. **Leverage local events**: Use festivals, fairs, or public gatherings to spread information.
6. **Use existing materials**: Rely on proven communication and promotional tools.
7. **Inspire enthusiasm**: Highlight the benefits and opportunities of circular sanitation systems, such as biogas.

Unlocking Value Through the Circular Economy

A shift toward circular sanitation includes recognizing that human waste, when properly treated, can be a source of valuable products. **Eawag's market-based approach** provides a practical framework to assess the economic feasibility and scalability of such reuse options.

Instead of viewing waste as a cost, this method identifies opportunities to produce marketable outputs—such as fuels, fertilizers, electricity, protein, and building materials—and evaluates them based on market demand, competitiveness, and user acceptance.

The process involves three main steps:

Step 1: Estimating Market Size

The first step involves assessing the economic potential of various reuse products. It includes four sub-steps:

1. **Identify Reuse Products and Substitutes**

   Match each reuse product (e.g., biogas) with a conventional alternative already in the market (e.g., LPG).

2. **Estimate the Substitute Market Size**

   For each substitute, define the annual market volume and price to determine baseline value.

3. **Apply an Adjustment Factor**

   Because recovered products may differ in quality, performance, or convenience, an adjustment factor is applied, usually less than 1. This accounts for:

   - Lower energy content (e.g., 70% methane in biogas)
   - Limited processing or storage
   - Regulatory or user barriers

   *The **adjusted volume** = Substitute annual volume × Adjustment factor*

4. **Calculate Realistic Market Size**

   Multiply the adjusted volume by the market price of the substitute:

   $$\textit{Market Size} = \textit{Adjusted Volume} \times \textit{Substitute Price}$$

Table 11: Example of Market Size Calculation

Recovery Product	Substitute	Sub. annual volume	Sub. price	Adj. factor	Adj. volume	Market size
Char	Charcoal	15,000 t	0.12 US$/kg	0.9	13,500 t	US$1,620,000
Biogas	LPG	8,000 t	0.60 US$/kg	0.7	5,600 t	US$3,360,000
Electricity	Grid power	50,000 000 kWh	0.10 US$/kWh	0.5	25,000,000 kWh	US$2,500,000
Protein (BSF/fish)	Soybean meal	1,200 t	0.50 US$/kg	0.5	600 t	US$300,000
Compost	NPK Fertilizer	8,000 t	0.10 US$/kg	0.6	4,800 t	US$480,000
Reclaimed water	Irrigation	n.a.	n.a.	n.a.	n.a.	n.a.

Step 2: Evaluating Market Attractiveness

Market size alone does not determine **viability**. This second step looks at the attractiveness of each product's market for investment and scale-up. Two scores are considered:

- **Size Score (1–5):** Reflects economic volume (Higher market value = Higher score)
- **Growth Score (1–5):** Reflects forecasted market expansion (Faster-growing markets = Higher score)

These are averaged into a **Combined Attractiveness Score**.

Table 12: Example of Market Attractiveness Calculation

Recovery Product	Market size	Size score (1–5)	Forecast growth	Growth score (1–5)	Attractiveness Score
Char	US$1,620,000	3	2 % / yr	2	2.5
Biogas	US$3,360,000	5	3 % / yr	3	4
Electricity	US$2,500,000	4	6 % / yr	5	4.5
Protein (BSF/fish)	US$300,000	1	4 % / yr	4	2.5
Compost	US$480,000	2	1 % / yr	1	1.5

Based on this illustrative example, biogas and electricity emerge as the most promising reuse products, balancing current market value with strong growth potential.

Conclusion

Transformative sanitation goes beyond just treating waste—it redefines it as a valuable resource and a catalyst for social equity. Whether through resource recovery like biogas or compost, or by simply ensuring access to safe and dignified sanitation for underserved communities, the shift is both technological and societal. Embracing circular, climate-SMART sanitation systems enable not only environmental and economic gains but also promotes dignity, health, and sustainable development for all.

Resources

- UNICEF-GWP Risk assessment for WASH
  https://www.gwp.org/globalassets/global/toolbox/publications/technical-briefs/gwp_unicef_guidance-note-risk-assessments-for-wash.pdf

- UNICEF-GWP Strategic Framework for WASH Climate Resilience
  https://www.gwp.org/en/WashClimateResilience/

- Groundwater pollution risk estimation
  https://www.sleigh-munoz.co.uk/sfd/database/gw-helper.php

- The JMP ladder for sanitation
  https://washdata.org/monitoring/sanitation

- ECAM Tool
  https://climatesmartwater.org/ecam/

- IPCC Wastewater Treatment and Discharge
  https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/5_Volume5/19R_V5_6_Ch06_Wastewater.pdf

- IPCC Constructed Wetlands for Wastewater Treatment
  https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Chp6_Constructed_Wetlands.pdf

- IPCC Biological Treatment of Solid Waste
  https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_4_Ch4_Bio_Treat.pdf

- SFD Manuals, Tools and Report Templates
  https://sfd.susana.org/knowledge/how-to-get-started

- SFD: Online Training
  https://sfd.susana.org/knowledge/online-training

- Ewag's Market Driven Approach for Selection of Faecal Sludge Treatment Products
  https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/EWM/Market_Driven_Approach/market_driven_approach.pdf

- Ewag's Market Driven Approach Data Collection Tool
  https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/EWM/Market_Driven_Approach/data_collection_tool.xlsx

3.3 How to assess if sanitation technologies are climate-SMART?

- Applying the climate-SMART approach at technology and service level: considerations and tools

While the climate-SMART sanitation approach is ideally applied at the system level, it can also be used to evaluate individual services or technologies.

The table below presents key steps for applying the approach at this level. Though not comprehensive, it provides an illustrative example of how the framework can be put into practice.

Table 13: Key Steps for Evaluating Sanitation Services and Technologies Using the Climate-SMART Sanitation Approach

Technology / Service Type	Safe	Mitigative	Adoptative & Resilient	Transformative	Target Group
Toilet / Containment	Is it an improved facility (JMP Definition) Does the containment have high risk for groundwater pollution (SFD groundwater risk assessment) Is the construction according to the building code, …	Baseline GHG emission Net Difference (t CO_2-eq yr^{-1}) to the baseline	Risk assessment and change to the baseline, what type of adaptation measures might be necessary (based on the local context)	Resource recovery Increased dignity or equity	Users, masons/ contractor, local authorities
Emptying and Transport	Technical Solution: Avoiding the contact of sludge and emptier (mechanical options) Service: % pits/tanks emptied safely by trained operators PPE compliance & spillage control % of Vaccinations	Fuel baseline for vacuum trucks vs Route optimization or E-vehicle Net Difference (t CO_2-eq yr^{-1})	Operability during floods/ extreme heat Alternative routing & contingency plans Climate-risk scorecard improvement	Improved work conditions for operators. Affordable, inclusive tariffs Digital FSM platform opportunities	Private desludging firms, operators
Treatment Facility	Effluent meets national / WHO standards Is the treatment process complete or only partial	Process GHG baseline Biogas capture & energy recovery potential Net Difference (t CO_2-eq yr^{-1})	Risk assessment and change to the baseline, what type of adaptation measures might be necessary (based on the local context)	Resource recovery option and market demand Community co-management models	Utilities, plant managers, regulators
Reuse / Disposal	Product quality meets national or WHO reuse guidelines	Does the product substituting other products that have higher GHG emission impact i.e. avoided fertilizer emissions Or does Carbone sequestration take place (i.e. biochar) Net GHG benefit per ton reused)	Diversification of nutrient / water sources or other produced Improves soil moisture retention Market resilience to climate shocks	Resource recovery business revenue streams	Farmers, entrepreneurs, agri-businesses, investors

The following sections provide example of climate-SMART sanitation approach applied at technology and service level. based on a set of pre-selected technologies.

Safe: Ensuring Public Health

Ensuring public health is the core objective of any sanitation system. A technology is considered safe when it effectively prevents human contact with excreta and minimizes environmental contamination. In addition to the JMP Sanitation Ladder introduced in the previous chapter, a set of supplementary criteria can be used to assess the safety of individual technologies or services. The list below provides indicative examples to support this evaluation.

Toilet / Containment:

- JMP Sanitation ladder (From open defecation to safely managed)
- Risk for Groundwater Pollution
- Building Codes

Emptying and Transport:

- Avoiding the contact of sludge and emptier (mechanical options)
- PPE compliance & spillage control
- Vaccinations

Treatment Facility:

- Complete or partial treatment
- Effluent meets national / WHO standards
- Product quality meets national or WHO reuse guidelines.

Reuse / Disposal:

- Product quality meets national or WHO reuse guidelines.

Quick assessment to set of pre-selected technologies.

Table 14: Safe - Quick assessment to set of pre-selected technologies

Technology	Safe	Notes
Prefabricated biodigester HH	Conditional	According the JMP sanitation ladder it is considered as improved sanitation facility, if the facility is limited or basic will depend on number of families using the Anaerobic digestion alone does not sufficiently reduce pathogens. Effluent my require additional treatment if the risk for groundwater pollution is considered as high-risk. Sludge also needs proper post-treatment (e.g., composting) before use as a soil improver. Quality assurance is supported by standardized sizes and controlled manufacturing
Constructed Wetland	Conditional	Requires pre-treated fecal sludge and is used a part of the treatment process and not standalone. Effectiveness depends on design and loading rates.
Prefabricated pit toilet	Conditional	According the JMP sanitation ladder it is considered as improved sanitation facility, if the facility is limited or basic will depend on number of families using the If fully sealed and watertight, can be considered safe, but will require **emptying and treatment services.** if the structure has permeable walls, an open bottom, or an overflow system, safety depends on local environmental and soil conditions.
Locally manufactured	Conditional	Reduce human contact with waste if properly used.

vacuum equipment		Requires strict adherence to PPE protocols and measures for preventing and managing spillage.
Off-site anaerobic co-digestion	Conditional	Safety depends on whether appropriate sludge and effluent management systems are in place i.e. post-treatment to fulfill the required disposal/reuse requirement. Do the outputs (sludge/effluent) fulfill national / WHO requirement

Sanitation technologies and services must be evaluated across the entire sanitation chain—from toilet use to final reuse or disposal—to ensure public health protection. The "safety" of each technology or service is not absolute but context-dependent, influenced by design, operation, maintenance, environmental conditions, and compliance with national or WHO standards. A technology considered "safe" under one condition may not be safe under another without appropriate treatment, containment, or management practices.

Mitigative: Reducing Climate Impact

Greenhouse gas emissions from sanitation systems are determined by both the underlying technology and the operational practices applied throughout the service chain. To ensure robust and internationally comparable GHG inventories at the sector level, practitioners should refer to established guidelines such as the IPCC Guidelines for National Greenhouse Gas Inventories (2006, 2019 Refinement). (IPCC, 2019) These guidelines provide tiered methodologies and emission factors for key sanitation technologies, though there is a recognized need for more empirical data and updated factors for non-sewered and innovative systems. Recent sectoral reviews and technical guidance. (Ddiba D., 2024) Further summarize available measurement approaches and highlight the importance of adapting inventories to local technology mixes and practices. (Hao X., 2024) Practitioners are encouraged to use these resources included in the toolbox and contribute new data where possible to strengthen the evidence base for mitigation planning in the sanitation sector.

Sanitation systems can be both a source of greenhouse gas (GHG) emissions and an opportunity for climate mitigation. Assessing the mitigative potential of a technology involves understanding how it contributes to, or reduces, emissions such as methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2).

Illustrative Case: The Impact of Technology Choice on Emissions

Scenario 1: Baseline Conditions

In a fictional community of 1,000 people, living in dry climate:

- 70% use unlined pit latrines (no flush water)
- 30% practice open defecation

Estimated emissions: **24,520 kg CO_2-eq/year or 24.5 kg CO_2-eq per capita**

Scenario 2: Improved Access Without Mitigation

The entire community shifts to septic tanks and low-flush toilets. While water use is reduced and effluent infiltrates safely, emissions increase significantly:

Estimated emissions: **137,751 kg CO_2-eq/year, or 138 kg CO_2-eq per capita**

Scenario 3: Improved Access With Mitigation

Instead, if the same community adopts well-managed composting toilets:

Estimated emissions drop to **597 kg CO_2-eq/year, or 0.6 kg CO_2-eq per capita**

This example illustrates how sanitation technology choices dramatically influence climate outcomes, underscoring the need for emissions-informed planning.

Overview of potential technical mitigative application along sanitation type

Table 15: Overview of potential technical mitigative application along sanitation type

Technology / Service Type	Mitigative	Notes
Toilet / Containment	Avoidance (UDDTs)	Prevents methane via aerobic conditions
	Capture/Utilization (biogas)	Converts methane to energy, may substitute other fossil fuel
	Reduction (system shift)	Composting/UDDTs reduce emissions vs. septic tanks
Emptying and Transport	Avoidance (electric/manual)	Avoids fossil fuel emissions
	Reduction (i.e. route optimization)	Reduces fuel consumption and emissions per trip.
Treatment Facility	See containment	
	Sequestering	Biochar production locks carbon into a stable form, sequestering it in soil
Reuse / Disposal	Avoidance (reusing water or nutrient)	Reduces demand for synthetic fertilizers and irrigation water — which have high GHG footprints.

Application to a set of pre-selected technologies

Table 16: Mitigative - Quick assessment to set of pre-selected technologies

Technology	Mitigative	Notes
Prefabricated biodigester HH	YES – if biogas is used (or flared)	Small anaerobic digesters avoid fugitive CH_4 from feces/manure and displace firewood, LPG or coal when the gas is burned for cooking or heating. Programs like in Sichuan, China document 1–6 t CO_2-eq saved hh^{-1} yr^{-1}.
Constructed Wetland	Conditional	CH_4 and N_2O emissions vary by design and loading: vertical-subsurface flow ≪ horizontal-subsurface ≪ surface-flow systems. Pretreating sludge (e.g. via an upstream biodigester) sharply lowers CW GHGs. Net mitigation therefore depends on (i) baseline disposal path and (ii) whether wetland outputs (e.g. reeds) replace other resources.
Prefabricated pit toilet	Conditional	Methane emissions from prefabricated pit latrines depend on factors such as latrine type, sealing, water use, and local conditions. Sealed, watertight latrines promote anaerobic conditions, leading to higher methane (CH_4) emissions. In contrast, dry and well-ventilated toilets—like urine-diverting dry toilets (UDDTs)—maintain aerobic conditions and therefore produce little or no emissions
Locally manufactured vacuum equipment	Conditional	Emissions depend on baseline conditions and the energy source for pumping and transport—renewables lower emissions, while fossil fuels increase them. The impact also varies compared to previous waste collection methods.
Off-site anaerobic co-digestion	YES – if biogas is used (or flared)	Reduces GHG emissions by capturing methane for use as fuel. It also diverts organic waste from landfills, preventing further methane release, and substitutes fossil fuels, lowering overall emissions.

Improving access to sanitation can unintentionally increase greenhouse gas (GHG) emissions if mitigation is not integrated into technology selection and system design. Sanitation systems must be assessed not only for safety but also for their climate impact. Mitigative choices—such as composting toilets, biogas capture, energy-efficient transport, and aerobic treatment—can dramatically reduce emissions. Without these measures, even well-intentioned upgrades (e.g., septic tanks) may lead to significantly higher emissions. Therefore, integrating climate mitigation strategies across the sanitation service chain is essential for building truly sustainable systems.

Adaptive and Resilient: Building Climate-Ready Sanitation Systems

As seen in the previous chapter, sanitation systems are increasingly exposed to climate-related risks such as flooding, droughts, extreme heat, and high winds. To ensure long-term functionality, sanitation technologies must be designed not only to operate under current conditions but also to **adapt to changing climates** and **withstand disruptions**.

The **UTS ClimateFIRST Framework** provides a structured, five-step process to assess the resilience of sanitation technologies and identify practical adaptation measures. It guides practitioners through:

1. **Scoping** the assessment by defining which components of the system are evaluated.
2. **Identification of Hazardous events & trends (HETs)** relevant to the specific location.
3. **Rating the impact** of each hazard on system components.
4. **Determining adaptation measures** to avoid, withstand, or recover from damage.
5. **Judging overall resilience**, using a built-in scoring tool (not shown in this example).

The example below illustrates how these steps can be applied to assess a **prefabricated pit latrine**. Please note that this is for demonstration purposes and does not reflect a full site-specific evaluation.

Step 1: Scoping the assessment (example prefabricated pit latrine)

Table 17: Scoping Example

Technology / option	Components IN scope	Components OUT of scope
Prefabricated pit toilet	Pit-lining, slab, super-structure, vent pipe	Off-site sludge treatment.

Step 2: Identification of Hazardous events & trends (HETs)

The climate analysis for the area indicates six HETs are material:

- Flooding – riverbank overtopping & flash floods (≤ 1 m depth)
- Short dry spells (≈ 1 week) – intermittent low inflow & drying
- Extreme heat & high THI – >35 °C, THI > 30
- Strong gusty winds – embedded convective storm bursts

Step 3: Rating the Impacts of Hazards on System Components

Color key: H = high-impact, M = moderate, L = low

Table 18: Rating of Impacts of Hazards on System Components Example

Hazard	Rating	Rationale
Flooding	H	Floodwater can enter via superstructure, filling pit; buoyant force may crack lining.
Short dry spells	L	No functional impact.
Extreme heat	L	Minor odor increase; structure unaffected.
Strong wind gusts	M	Lightweight roofs/doors susceptible.

Step 4 – Adaptation Measures

- **Avoid:** Elevate slab 0.5 m; seal drop-hole with flip-cap.
- **Withstand:** Reinforced outer supports to prevent pit wall collapse from water pressure in the ground. Anchor the roof panels.
- **Flexibility / fast recovery**: Detachable prefab superstructure for quick swap after storm damage.
- **Contain:** Gasketed pit cap for emergency closure before flood onset.
- **Limiting the consequences of complete failure:** Add a small, sealed overflow chamber adjacent to the main pit that captures excess sludge during flooding or overfilling, reducing spill risk.
- **Fast recovery:** Use modular superstructure panels that can be easily replaced if damaged and install a visible fill-level indicator for quick detection of overflow risk.
- **Providing benefits beyond resilience**: Integrate a hand-washing tap on the same plinth and utilize the greywater for irrigation; add a rainwater collection system.

Note: Step 5 of ClimateFIRST ("Judging Overall Resilience") uses auto-generated scoring from the tool and is not shown here. A download link is available in the resource section.

Climate change poses multiple risks to sanitation systems, including flooding, heat, drought, and storm damage. To ensure long-term functionality, sanitation technologies must be both adaptive—designed to respond to changing climate conditions—and resilient—able to maintain essential functions during and after extreme events. The ClimateFIRST framework helps systematically assess climate hazards and identify adaptation strategies, such as elevating infrastructure, reinforcing components, and enabling rapid recovery. Building climate-ready sanitation requires planning beyond mere functionality, ensuring systems can withstand and recover from climate shocks while offering additional co-benefits for communities.

Transformative: Shifting the paradigm

Sanitation technologies can do more than just meet minimum service standards—they can **transform** systems by enabling new ways of thinking, organizing, and delivering services. A technology is considered transformative when it contributes to **long-term**, **systemic change** in how sanitation is accessed, managed, and valued.

Transformative impact may come through various pathways. This includes **resource recovery** (e.g., biogas, compost, protein) that creates local **revenue streams** and responds to **market demand**; the **digitalization of fecal sludge management (FSM)** through platforms that improve efficiency and transparency; and the implementation of **affordable, inclusive tariffs** that expand access.

Other key aspects include **improved working conditions for sanitation operators**, the promotion of **community co-management models**, and services that **enhance dignity and equity**, especially for underserved or marginalized groups.

Tools introduced in the **system-level baseline assessment**—particularly those related to **user acceptance** and **circular economy potential**—can also be applied at the **technology or service level** to assess transformative potential in more targeted ways.

Application to a set of pre-selected technologies

Table 19: Transformative - Quick assessment to set of pre-selected technologies

Technology	Transformative	Notes
Prefabricated biodigester HH	YES – if biogas is used (or flared)	Clear paradigm shift when biogas is recovered for cooking or heating, reducing reliance on wood or fossil fuels and lowering GHG emissions.
Constructed Wetland	Yes – if	Becomes transformative when integrated into circular systems, e.g., using effluent for irrigation or biomass as fodder or addition to compost.
Prefabricated pit toilet	Conditional	Potentially transformative if replacing open defecation or unsafe pits; shift is greater if combined with waste collection, treatment, and reuse.
Locally manufactured vacuum equipment	Conditional	Potentially transformative if replacing unsafe manual emptying, supporting safer working conditions, and enabling reuse-oriented waste logistics.
Off-site anaerobic co-digestion	YES – if biogas is used (or flared)	Captures methane for energy, supports circular economy, reduces waste volumes, and lowers emissions

Transformative sanitation goes beyond just treating waste—it redefines it as a valuable resource and a catalyst for social equity. Whether through resource recovery, such as biogas or compost, or by simply ensuring access to safe and dignified sanitation for underserved communities, the shift is both technological and societal. Embracing circular economy concept, climate-SMART sanitation systems enable not only environmental and economic gains but also promotes dignity, health, and sustainable development for all.

Resources

- ClimateFIRST Guidelines and Tools
  https://www.uts.edu.au/case-studies/climatefirst-outputs

- Guidelines for Carbon Accounting and Emission Reduction in the Urban Water Sector
  https://iwaponline.com/ebooks/book/913/Guidelines-for-Carbon-Accounting-and-Emission

- Methods for measuring greenhouse gas emissions from sanitation and wastewater management systems
  https://www.sei.org/wp-content/uploads/2024/07/methods-greenhouse-gas-emissions-sanitation-sei2024-030.pdf

Sources

IPCC: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventory, 2019 https://www.ipcc.ch/site/assets/uploads/2019/12/19R_V0_01_Overview.pdf, 11.06.2025

Ddiba D., Rahmati-Abkenar M., Liera C. Methods for measuring greenhouse gas emissions from sanitation and wastewater management systems, 2024 https://www.sei.org/wp-content/uploads/2024/07/methods-greenhouse-gas-emissions-sanitation-sei2024-030.pdf, 11.06.2025

Hao X., Liu R. Guidelines for Accounting and Emission Reduction In the Urban Water Sector 2024 https://iwaponline.com/ebooks/book/913/Guidelines-for-Carbon-Accounting-and-Emission, 11.06.2025

3.4 Example of Climate-SMART Technologies

This chapter presents examples of proven household-based sanitation technologies and their ratings based on an analysis using the Climate-SMART approach outlined in the previous chapter. As noted, the Climate-SMARTness of a system or technology depends on the initial baseline or business-as-usual scenario. Nevertheless, some technologies inherently demonstrate safe, mitigative, adaptive/resilient, and transformative characteristics. Identifying these characteristics can help determine what additional measures, if any, are needed to improve performance—particularly in terms of adaptation and resilience. For instance, over eight hazardous climate events and trends have been identified, leading to approximately 255 possible unique combinations.

Presentation of the sanitation technologies

1. Prefabricated Household Biodigester

A prefabricated biodigester is a sealed, anaerobic system designed to treat household toilet waste and often organic household and agricultural waste. It breaks down organic material to produce biogas (mainly methane), which can be used for cooking. While it offers moderate pathogen removal, further treatment is usually required for the effluent. The system reduces greenhouse gas emissions by capturing and using methane, offsetting fuel use and is especially effective when paired with water-efficient toilets. Prefabricated units are quick to install and adaptable to different terrains with structural modifications.

2. Constructed Wetland (Sanitation Garden)

Constructed wetlands use engineered soil-plant systems to treat wastewater (greywater or supernatant from septic tank or biogas digester) through natural processes. Wastewater flows through layers of sand, gravel, and vegetation that filter and break down contaminants. Pathogen removal is high, especially with vertical subsurface flow designs. Wetlands require pretreatment for raw blackwater but are resilient to seasonal water variability and can support local ecosystems. They also offer climate mitigation benefits when well-designed, particularly when the treated water is reused for irrigation or vegetation is harvested.

3. Prefabricated Pit Toilet

A prefabricated pit toilet is a modular sanitation unit that collects human waste in a sealed or lined underground pit. While considered improved sanitation, it has limited pathogen reduction in fresh layers and requires periodic emptying. If combined with flush systems, it can emit significant methane; however, emissions drop sharply with dry or aerated designs. These toilets are easily deployable, making them suitable for emergency settings or rural areas, and can be adapted for flood- or drought-prone zones.

4. Urine-Diverting Dry Toilet (UDDT)

The UDDT separates urine and feces at the source, promoting aerobic decomposition and dry storage of waste. This separation prevents methane generation and facilitates nutrient recovery from urine. After 6–12 months of storage, the treated waste is largely pathogen-free and safe for reuse. UDDTs require no water, making them highly suitable for arid regions. With proper sealing

and elevation, they are resilient to flooding and ideal for off-grid sanitation solutions with minimal environmental impact.

5. Composting Toilet

Composting toilets use aerobic processes to decompose human waste into stable, nutrient-rich compost. With proper moisture and airflow control, they eliminate pathogens over time and prevent methane emissions. These systems require no water and are best suited for locations with space for storage and compost use. Resilience features like elevated vaults and stormwater diversion enhance performance in extreme weather. Composting toilets support circular sanitation by returning nutrients to the soil.

6. Worm (Vermi-) Composting System

Worm composting systems use earthworms and microbes to break down organic waste in an aerobic environment. These systems are highly effective at stabilizing fecal matter and producing high-quality vermicompost, though full pathogen removal may require additional treatment. Best suited for moderate-volume, well-managed installations, worm composting can handle variable inputs and requires liquid management and occasional sludge. The resulting compost has high agricultural value and can support local livelihoods.

Presentation of the Climate-SMARTness of the presented sanitation technologies

Symbol	Meaning
	Safely Managed JMP definition
	Positive / strong performance / Improved sanitation (JMP)
	Moderate
	Negative / high risk
	Caution required
	High caution required
	Key drought measure
	Key flood measure

Technology	Safe	Mitigative	Adaptive & Resilient	Transformative
Prefabricated biodigester HH	🟢 **JMP**: Improved Sanitation 🟡 **Pathogen Removal Rates:** E. coli: 60–95% removal; Helminth eggs (e.g., Ascaris): 90–99% , post-treatment required 🟨 **Sludge (not very frequent) and Effluent Management Required**	🟢 Capturing and utilizing methane (not 100% as leaks are typical from 1-5 % for well managed digesters) 🟢 Further mitigation also by displacing firewood, LPG or coal when the gas is burned for cooking or heating. Programs like in Sichuan, China document 1–6 t CO_2-eq saved hh^{-1} yr^{-1}.	🌻 If paired with pour flush / manual vacuum flush / urine flush toilets to minimize water consumption. 🫧 if some adjustments are considered incl. elevation, waterproofed (incl seals for in – outflows; anchoring …)	🟢 Clear paradigm shift when biogas is recovered for cooking, reducing reliance on wood or fossil fuels and lowering GHG emissions.
Constructed Wetland (Sanitation Garden)	🔵 **JMP:** Safely Managed 🟢 **Pathogen Removal Rates:** *E. coli*: 90–99% removal; Helminth eggs (e.g., Ascaris): 95–100% , 🟥 **Pre-treatment required for blackwater**	🟥 For blackwater pre-treatment is required and the type of pre-treatment will impact the overall mitigation potential compared to the baseline For the wetland will depend on the flow type 🟢 Vertical subsurface flow EF 0.006 kg CH_4/kgBOD5 🟡 Horizontal subsurface flow EF 0.06 kg CH_4/kgBOD5 🔴 Surface flow EF 0.24 kgCH_4 / kgBOD_5	Handles variable inflows (heavy rain, drought) and enhances local water retention 🌻 If some adjustments are made, drought-resilient vegetation, greywater irrigation, and evaporation reduction (mulching) 🫧 if some adjustments are considered incl. elevation and bunding, overflow channels, erosion control & flood-tolerant plant species:	🟡 Becomes transformative when integrated into circular systems, e.g., using effluent for irrigation or biomass as fodder or addition to compost 🟢 Clear paradigm shift for vertical subsurface flow reduces GHG emissions
Prefabricated Pit Toilet	🟢 **JMP:** Improved Sanitation 🔴 **Pathogen Removal Rates:** While pathogen levels decrease with time, the upper layers of pit contents (where fresh	🔴 High emission due to anaerobic conditions if used with (pour) flush EF 0.42 kg CH_4/kgBOD_5	Prefabricated units can be quickly installed in emergencies or relocated in response to climate hazards 🌻 Water-efficient and suitable for areas with water scarcity and greywater or	🟡 Potentially transformative if replacing open defecation or unsafe pits; shift is greater if combined with waste collection, treatment, reuse.

	feces are deposited) contain high concentrations of viable pathogens. 🟥 **Sludge and Effluent Management Required**	🟡 Reducing will require forced aeration powered by solar (assumed to be likely like aerated lagoon EF0.06 kg CH_4/kgBOD_5 or without flush water EF 0.06 kg CH_4/kgBOD_5	rainwater collection can help to bridge droughts, otherwise best to use urine flush toilet or toilet without flushing interface 🫧 if some adjustments are considered incl. raised Installation, sealing of the inflow incl backflow prevention, drainage systems.	
Urine Diversion Dry Toilet (UDDT)	🟢 **JMP:** Improved Sanitation 🟢 **Pathogen Removal Rates:** E. coli: 99–100% removal Helminth eggs (e.g., Ascaris): 99–100%, If stored (after 6–12 months of storage) 🟨 **Sludge Management Required**	🟢 Prevents methane via aerobic conditions, EF 0 kg CH_4/kgBOD_5 (if not flooded and kept dry)	🌞 No water needed, requires adequate airflow 🫧 if some adjustments are considered incl. raised Installation, sealing of the inflow incl backflow prevention for urine discharge, sealed, watertight vaults or containers, stormwater diversion	🟢 Clear paradigm shift, reduces water and emissions reduction, further if urine is stored it can be used as nutrient
Composting Toilet	🟢 **JMP:** Improved Sanitation 🟢 **Pathogen Removal Rates**: E. coli: 99–100% removal Helminth eggs (e.g., Ascaris): 99–100%, If stored (after 6–12 months of storage) 🟨 **Sludge Management Required**	🟢 Prevents methane via aerobic conditions, EF 0 kg CH_4/kg$BOD5$ (if not flooded and kept dry)	🌞 No water needed, requires adequate airflow 🫧 Elevated, Flood-Proof Superstructure, Compost Vault Backup, stormwater Diversion	🟢 Clear paradigm shift, reduces water and emissions, further the compost can be used as soil amendment
Worm Composting	🟢 **JMP:** Improved Sanitation 🟡 **Pathogen Removal Rates**: E. coli: –100% removal Helminth eggs (e.g., Ascaris): 80–95%, 🟨 **Sludge (not very frequent) and Effluent Management Required (if flush)**			

3.5 Technical Solution Screening & Short Listing

- Understanding how to apply a structured screening process to identify context-appropriate and climate-SMART sanitation options

Following the baseline assessment, a wide range of potential technical options can be identified to address the sanitation needs of a given context. These may include various forms of on-site or decentralized systems, designed to improve safety, reduce climate impact, enhance resilience, and enable resource recovery.

To move from a broad list of options to a more targeted and feasible set of solutions, a structured screening and shortlisting process is applied. This process helps identify which technologies best align with climate-SMART sanitation goals, based on context-specific needs and priorities.

A common and practical approach is to use Multi-Criteria Decision Analysis (MCDA), which allows for a transparent comparison of options using a defined scoring framework. Each option is evaluated against key criteria—such as safety, climate mitigation, resilience, and transformative potential—and these criteria are then weighted according to their relative importance.

The process typically follows four main steps:

1. Define a scoring framework based on the climate-SMART pillars, assigning scores (e.g., 1–5) that reflect how well each option performs in each category.
2. Score each option against the defined criteria, using available data or expert judgement.
3. Assign weights to the criteria based on the local priorities and policy goals (e.g., prioritizing health or emissions reduction).
4. Calculate weighted scores to produce a ranked shortlist of preferred solutions.

This method supports evidence-based decision-making by balancing multiple objectives—public health, climate action, resilience, and long-term sustainability—and helps ensure that selected technologies are both feasible and future-ready. MCDA evaluations should be carried out across the entire sanitation value chain to support comprehensive system design.

Example of an application of the MCDA

The following example demonstrates how the MCDA framework can be applied to the technologies assessed in the previous chapter.

Step 1: Defining a scoring framework

Table 20: Scoring Definition Example

Sore	Safe	Mitigative	Adaptive & resilient*	Transformative
5	Fully watertight/flood-proof	Net-zero or net-negative GHG	Engineered for extreme events	High-value recovered product or energy
4	Good containment, minor leak risk	Strong CH_4/N_2O avoidance or capture	Flood-protected components	Valuable soil amendment or fuel
3	Partial lining	Moderate GHG reduction	Some Flood-protected components	Useful but low-value recovery
2	No lining	Limited GHG reduction	Minimal adaptation	Little to no recovery
1	No containment	No benefit or high emissions	Vulnerable	Pure disposal

** Note: Adaptive measures can be enhanced over time in alignment with the climateFIRST framework; the current assessment focuses on built-in features.*

Step 2: Score different technologies

Table 21: Technology Scoring Example

Technology	Safe	Mitigative	Adaptive & resilient*	Transformative
Composting Toilet	5	5	4	4
UDDT	5	5	4	4
Lined Pour-Flush Pit	4	1	2	1
Prefab Household Biodigester with Constructed Wetlands	5	5	4	5
Dry Prefab Pit Toilet	4	2	4	1
Septic Tank with Constructed Wetlands Constructed Wetlands	5	1	4	2

Step 3: Weight the criteria

Use a 100-point allocation.

Table 22: Weighting Criteria Example

Criteria	Weight %
Safe	35
Mitigative	25
Adaptive / Resilient	25
Transformative	15

Step 4: Score each option to derive a shortlist

Table 23: Scoring and Shortlisting Example

Technology	Safe	Mitigative	Adaptive & resilient*	Transformative	Score
Composting Toilet	1.75	1.25	1	0.6	4.6
UDDT	1.75	1.25	1	0.6	4.6
Lined Pour-Flush Pit	1.4	0.25	0.5	0.15	2.3
Prefab Household Biodigester with Constructed Wetlands	1.75	1.25	1	0.75	4.75
Dry Prefab Pit Toilet	1.4	0.5	1	0.15	3.05
Septic Tank with Constructed Wetlands Constructed Wetlands	1.75	0.25	1	0.3	3.3

It is recommended to consider the top 3 scorers **plus** any option that lies within 10 % of the third-placed score (for a longer list).

KEY TAKEAWAYS

- Expanding access to safely managed sanitation remains a fundamental development and public health priority.
- Climate-SMART sanitation applies a holistic approach—Safe, Mitigative, Adaptive, Resilient, and Transformative—to align sanitation systems with climate goals.
- Baseline assessments (e.g., JMP, SFD, ECAM) are critical to identify service gaps, emissions, and climate vulnerabilities.
- Technology choices must be context-specific and evaluated for climate compatibility using structured decision-making tools.
- Effective planning requires a systems approach that includes infrastructure, operations, governance, and climate resilience.
- Climate-SMART sanitation approach applies to the whole value/service chain
- Projects demonstrating GHG reductions and adaptation benefits, from well-grounded baseline assessment and a realistic project scenario, can access climate finance and carbon credit opportunities.

4 Module 3: Climate Finance for Sanitation

4.1 What is climate finance, and why does it matter for sanitation?

- **Understanding Climate Finance:** Definition, explanation, and its role in addressing climate challenges faced by the sanitation sector
- **Understanding the impacts of climate change on global sanitation and the linkage between them**
- **Opportunities stemming from climate finance:** What does it provide for the sanitation sector?
- **Challenges concerning climate finance and sanitation:** Where are the shortcomings of global climate finance in the context of sanitation?

With a global urgency to significantly reduce emissions across all sectors, large-scale investments are required to facilitate mitigation activities and adaptation measures that mitigate the impacts of climate change. **Climate finance is defined to the financial instruments or assets that facilitate mitigation and adaptation actions to address climate change.** It can involve local, national, or international financing, drawn from public, private, and alternative sources of financing to support climate change mitigation and adaptation.

Water is the key indicator of climate change's impact, as droughts accelerate water scarcity and inhibit safe sanitation and hygiene practices, flooding leads to water contamination, thus spreading water-borne diseases within communities, and the increased rates of glacial melting due to global warming causes sea levels to rise, consequently leading to the salinization of aquifers in coastal areas which large amounts of the global population depend on for drinking water.

This extremely delicate relationship between climate change, water, and sanitation emphasizes the need to invest in climate-SMART WASH services worldwide, as a crucial step towards solving and adapting to the global climate crisis and this linkage has received increased attention in recent years. Additionally, sanitation systems contribute to greenhouse gas emissions thus intensifying climate change. Recent studies show that the wastewater sector is responsible for approximately 1.3% of global greenhouse gas emissions *(Source: Ritchie, 2020)*, with increased global contributions projected by current trends. They are also severely affected by extreme and slow-onset events caused by climate change, such as increasing temperatures, sea level rise, salinization, and desertification, all of which hinder their accessibility and functionality, further underlining the importance of climate finance for sanitation.

Investment in climate-SMART and low-carbon sanitation services yields numerous benefits for climate action as they foster community resilience thereby reducing socio-environmental vulnerability and help to lower GHG emissions through concepts such as resource recovery and reuse *(Source: SEI, 2024)*. According to the African Union, every US$1 invested in climate-resilient water and sanitation returns at

least US$7 in socio-economic benefits through improvements in health, food security, education, gender equality, and the achievement of the Sustainable Development Goals (SDGs) *(Source: African Union, 2023)*. Some of the benefits that climate finance can bring are as follows:

- Access to dedicated climate funds: Climate finance opens up the possibility of improved access to financing for climate change mitigation and adaptation efforts in the water, sanitation, and hygiene (WASH) sectors of low- and middle-income countries, with continued investments in the sector.
- Technological solutions: Climate finance promotes and supports the development of innovative mitigation technologies and the scaling of existing solutions within the sanitation sector.
- Utilization of innovative or blended finance: By combining funds from public sources (such as governments or development banks) or philanthropic organizations with private sector investment, climate projects can be made significantly less risky and more appealing to private investors who might otherwise avoid them due to financial or political risks. Public or philanthropic funds are often provided in the form of grants or guarantees to attract private sector investment.

There are, however, several challenges concerning climate finance and sanitation. Although it is universally understood that building the climate resilience and adaptability of the global WASH) The sector notably contributes to global adaptation and mitigation goals; however, only 0.3% of global climate finance is allocated towards water supply and sanitation *(Source: UNICEF, 2021)*. There are several reasons why the climate finance allocation for global water supply and sanitation remains critically low:

- Financial structures: Climate finance provided in the form of loans is unsuitable for water and sanitation services as the full costs are challenging to recover from users *(Source: IRC, 2023)*.
- Unbalanced priorities: Climate finance prioritizes mitigation over adaptation, with global adaptation finance diminishing in importance, from 7% in 2019-2020 to 5% of total climate finance in 2021-2022 *(Source: Global Center on Adaptation, 2024)*.
- Policy Inadequacy: Deficient incorporation of climate considerations into sanitation policies, and vice versa, has led to weak synergies between SDGs 6 and 13, resulting in sanitation initiatives receiving only a minimal portion of climate finance *(Source: SEI, 2024)*.
- Difficulty in accessing climate funds: Procedures for accessing climate funding are time-consuming, often complicated, and considerably costly, with large-scale infrastructure projects generally being prioritized, disadvantaging smaller or decentralized projects *(Source: IRC, 2023)*. For example, Green Climate Fund (GCF) proposals cost approximately US$ 1 million to prepare *(Source: Dickin, S., Bayoumi, M., Giné, R. et al., 2020)*.

General note: The concept of "climate-resilience", which is a term adopted by many in the climate financing domain and one that appears throughout this Module, is encompassed by the climate-SMART approach defined in Module 2.

What is climate finance in the sanitation sector?

Climate finance refers to the financial resources and instruments available to promote climate-change mitigation and adaptation measures. In the sanitation sector, this includes targeted investments to promote climate-resilient and low-emission sanitation systems through innovative technologies, infrastructure, capacity building, and integration into national climate strategies.

Why has the sanitation sector received little climate finance so far?

Only approximately 0.3% of global climate finance goes to water and sanitation. The reasons include the previous focus on energy and transport, lack of integration of sanitation targets into national climate strategies (NDCs), and lack of data on the climate impacts and benefits of sanitation projects.

What types of projects are typically funded in the sanitation sector?

The types of projects typically funded by climate finance in the sanitation sector are for example:

- Construction or modernization of climate-resilient sanitation infrastructure (e.g. flood-resistant systems)
- Integration of circular economy (e.g. reuse of treated wastewater, biogas production)
- Capacity building and community engagement
- Projects that address both adaptation and mitigation.

Sources

Ritchie, 2020: Hannah Ritchie (2020) : "Sector by sector: where do global greenhouse gas emissions come from?", https://ourworldindata.org/ghg-emissions-by-sector, 29.05.2025

SEI, 2024: Stockholm Environment Institute (SEI) (2024) : "Integrating Sanitation and Climate Change in National Level Policy Frameworks", https://www.sei.org/wp-content/uploads/2024/11/sanitation-climate-national-policy-sei2024-052.pdf, 29.05.2025

African Union, 2023: African Union (2023) : "Global leaders say Africa can achieve water security by 2030, present three pathways supported by action plan", https://au.int/sites/default/files/pressreleases/42711-pr-PR-_World_Water_Day_2023.pdf, 29.05.2025

UNICEF, 2021: UNICEF (2021): "Why Water, Sanitation and Hygiene Must Be Top of Your Agenda" , https://www.unicef.org/media/109481/file/WASH%20Climate%20Paper.pdf, 29.05.2025

IRC, 2023: van Lieshout, R , "Financing water and sanitation resilience contributes to climate mitigation and adaptation - so where is the money?", https://www.ircwash.org/resources/financing-water-and-sanitation-resilience-contributes-climate-mitigation-and-adaptation-so, 29.05.2025

Global Center on Adaptation, 2024: Global Center on Adaptation (2024) : "State and Trends in Climate Adaptation Finance 2024", https://gca.org/wp-content/uploads/2024/04/State-and-Trends-in-Climate-Adaptation-Finance-2024.pdf, 29.05.2025

Dickin, S., Bayoumi, M., Giné, R. et al., 2020: Dickin, S., Bayoumi, M., Giné, R. et al. : "Sustainable sanitation and gaps in global climate policy and financing." npj Clean Water 3, 24 (2020), https://doi.org/10.1038/s41545-020-0072-8, 29.05.2025

4.2 How has climate finance evolved globally?

- **Understanding the role of climate finance over the years:** How has climate finance sat within global agreement frameworks since the Kyoto Protocol to present day?
- **Global climate fund allocation towards sanitation:** What is the distribution of climate mitigation and adaptation finance for sanitation

Since its early role as a mitigation-focused concept for global climate action commitment under the Kyoto Protocol, which came into force in 2005 and ended in 2020, climate finance has evolved over the years into a comprehensive adaptation-inclusive framework of the Paris Agreement, focusing on accelerating climate mitigation and adaptation efforts, particularly in developing nations through extensive finance mechanisms.

Climate Finance under the Kyoto Protocol

The Kyoto Protocol urged countries to meet their targets primarily through national measures, however it also established the following three key financial mechanisms:

Table 24: The three key financial mechanisms under the Kyoto Protocol

The Clean Development Mechanism (CDM)	The Clean Development Mechanism (CDM) allowed developed countries with emissions reduction commitments under the Protocol to invest in emission-reduction projects in developing countries. Additionally, it established the concept of certified emission reduction (CER) credits, which were awarded to such projects, each credit being equivalent to 1 ton of CO_2, which could in turn be counted towards meeting the Protocol targets. The mechanism provided industrialized countries some flexibility with achieving their emissions targets whilst promoting sustainable development alongside emission reductions. Project activities such as renewable energy, waste management, and methane capture and utilization amongst others were eligible under the CDM on the conditions that they mitigate at least one of the six identified GHGs, which include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCSs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), and they contribute to sustainable development of the host country. Over the active period of the CDM, over 8,000 projects in 111 countries have reduced or avoided 2 billion tons of CO_2-equivalent and enabled investment of up to $304 billion in climate and sustainable development projects worldwide, reducing emissions and improving the health and lives of millions of people. Although, it is no longer operational, and discontinued issuing CERs at the end of 2020, due to the expiration of the Kyoto Protocol's commitment period, it has certainly contributed to the global awareness of and action on climate change, through the thousands of projects it enabled. This has subsequently highlighted the importance of climate action globally, encouraging companies, organizations, and individuals to take voluntary action to reduce their carbon footprints.

Joint Implementation (JI)	The Joint Implementation (JI) mechanism was very similar to the CDM, with the key difference being that it enabled developed countries with emissions reduction commitments under the Protocol to invest in emission-reduction projects in other committed developed countries. It allowed project implementing countries to earn emissions reduction units (ERUs) from such projects, each credit equivalent to 1 ton of CO_2, which could subsequently be counted towards meeting the Protocol targets. The mechanism offered a cost-efficient means of partly fulfilling emissions reduction commitments between Protocol committed nations, whilst benefitting the host nation with foreign investment and technology transfer. Its operation too, was terminated due to the expiration of the Kyoto Protocol's commitment period in December 2020.
The Adaptation Fund (AF)	Established in 2001 under the Kyoto Protocol, the Adaptation Fund was introduced to finance adaptation projects and programs in developing countries that are vulnerable to the adverse effects of climate change. It was initially financed with the proceeds from the CDM and later was additionally supported through voluntary contributions from governments and the private sector (Source: UNFCCC, 2025). Its operation is still active despite the expiration of the Kyoto Protocol's commitment period in 2020, as it was decided to serve the efforts of the Paris Agreement, a decision which was made effective in January 2019. Although the fund provided a novel and predictable source of finance for adaptation in vulnerable countries, overall funding levels were limited compared to global needs. The fund has had more of an active role under the Paris Agreement, having committed US$1.25 billion in grants for climate adaptation and resilience programs in developing countries to date, serving over 46 million total beneficiaries globally (Source: Adaptation Fund, 2025).

Climate Finance under the Paris Agreement

In contrast to the Kyoto Protocol that focused mostly on addressing GHG emissions of developed countries to tackle climate change, the Paris Agreement places emphasis on the need for developed countries to provide financial support to assist developing countries in implementing mitigation and adaptation actions to tackle the detrimental effects of climate change globally.

The Agreement builds upon the UNFCCC's Financial Mechanism, which facilitates the provision of financial resources to developing countries through several dedicated funds and its two operating entities, consisting of the Global Environment Facility (GEF) and the Green Climate Fund (GCF).

The GEF was established as an entity to solely address global environmental challenges focusing on biodiversity, climate change, land degradation, and pollution. It is currently active and has 186 participating countries with over 1,700 active projects across 149 countries. Funding through the GEF is provided by participating donor countries via World Bank administered trust funds which replenish every four years and are made available to developing countries to meet the international objectives set out by the Paris Agreement. The current GEF replenishment cycle known as GEF-8, which is active from 2022 until 2026, has mobilized US$5.33 billion from 29 donor nations. The resource allocation of the GEF-8 can be seen in the figure below.

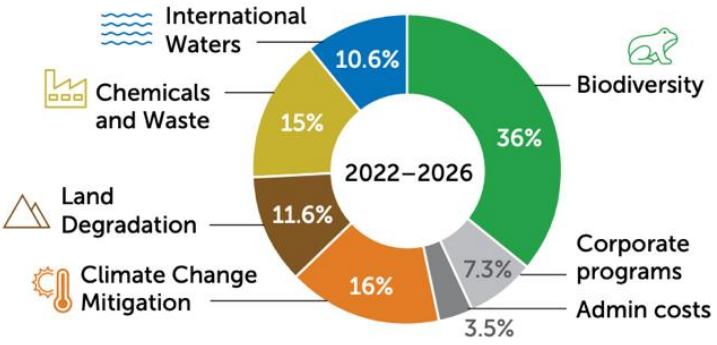


Figure 11: GEF-8 Resource Allocation (Source: GEF, 2025)

The GCF was introduced in 2010 at COP16 and became fully operational in 2015 as a dedicated fund to support developing countries shift to low-emission and climate-resilient pathways. It is the world's largest climate fund and a fundamental component of the Paris Agreement. As of October 2024, the GCF has mobilized a total of US$15.9 billion for 266 active projects and programs in 133 countries, with an overall worth of US$62.1 billion. It is currently in its second replenishment period with the GCF well-positioned to deliver further support to developing countries to achieve their climate ambitions. Additionally, the fund is mandated to equally invest its resources to mitigation and adaptation projects and programs, with at least half of its adaptation resources to be invested in the most climate vulnerable countries, which include Small Island Developing States (SIDS), Least Developed Countries (LDCs), and African States *(Source: Green Climate Fund, 2025)*. This growing emphasis on furthering climate adaptation efforts in developing countries portrays the evolution of the role of climate finance as an enabler primarily for mitigation activity during the early years under the Kyoto Protocol, to a much more holistic instrument, fundamental to achieving highly ambitious objectives set by international climate conventions and agreements like the Paris Agreement.

More recently, the "Baku Climate Unity Pact", a key outcome of COP29 which was held in Baku, Azerbaijan in November of 2024, places climate finance at the heart of the international agreement and climate discussion. As part of the agreement on the New Collective Quantified Goal (NCQG) on climate finance, an ambitious goal had been set at the conference to scale up finance to developing countries, from public and private sources, to US$1.3 trillion per year by 2035 (Source: UNFCCC, 2024). Furthermore, it was also agreed that developed nations will provide a minimum of US$300 billion in climate finance annually, from public sources, by 2035, thereby tripling the previous US$100 billion annual commitment for global climate finance, targeting the prompt advancement of climate mitigation and adaptation efforts in vulnerable developing countries. The climate finance agreements reached in Baku aims to extensively ramp up climate action, as stronger national climate plans, in the form of NDCs, are established and submitted this year.

Global Climate Fund Allocation Towards Sanitation

The majority of mitigation finance focuses on activities in the energy and transport sectors with only 4% reaching the water and sanitation sector, according to a 2024 report prepared by the Organization for Economic Co-operation and Development (OECD), which presents the state of global climate finance between 2016 and 2022, as can be seen in the following figure.

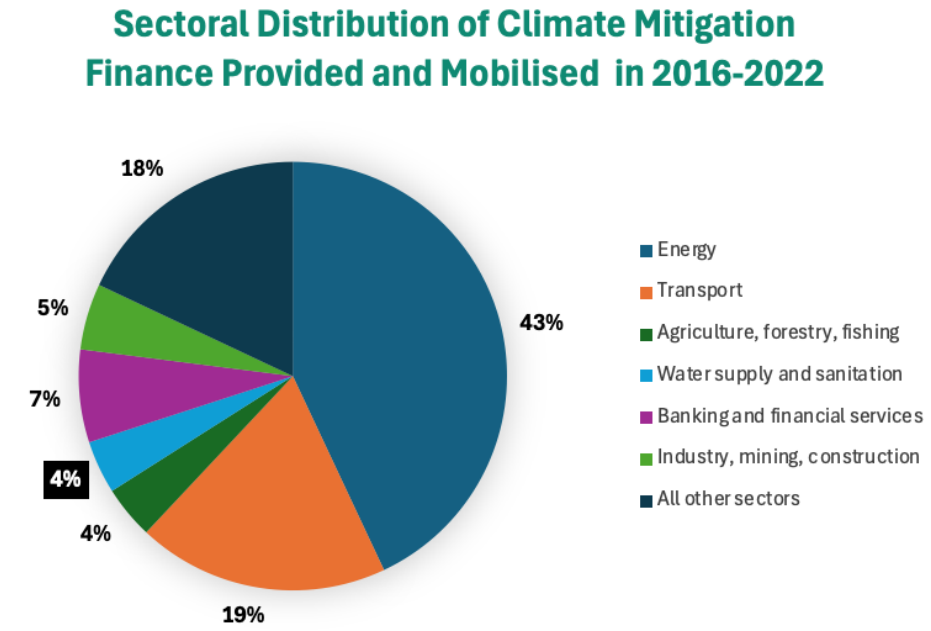


Figure 12: Sectoral Distribution of Climate Mitigation Finance Provided and Mobilized in 2016-2022 (Source: OECD, 2024) (Note: "All other sectors" mainly includes activities targeting multisector, general environment protection, government and civil society, social infrastructure and services, and disaster preparedness)

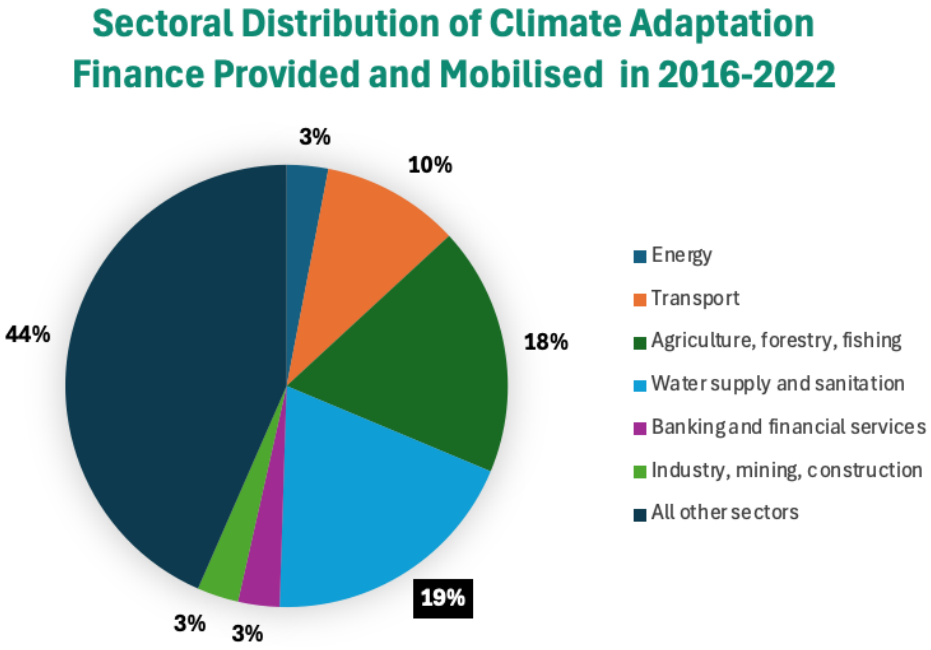


Figure 13: Sectoral Distribution of Climate Adaptation Finance Provided and Mobilized in 2016-2022 (Source: OECD, 2024) (Note: "All other sectors" mainly includes activities targeting multisector, general environment protection, government and civil society, social infrastructure and services, and disaster preparedness)

Between 2016 and 2022, 19% of adaptation finance went to the water supply and sanitation sector, making it the biggest single sector financed. These investments aim to enhance and drive climate resilience in the sanitation sectors of developing countries by implementing robust and sustainable sanitation solutions. In comparison, only 4% of mitigation finance went towards water supply and sanitation,

indicating that sanitation projects have made greater impact with climate adaptation efforts and highlighting the fact that financiers have placed a focus on climate adaptation efforts concerning the water and sanitation sector.

Resources

- UNICEF (2021): "Why Water, Sanitation and Hygiene Must Be Top of Your Agenda"

  https://www.unicef.org/media/109481/file/WASH%20Climate%20Paper.pdf

- Global Center on Adaptation (2024) : "State and Trends in Climate Adaptation Finance 2024"

  https://gca.org/wp-content/uploads/2024/04/State-and-Trends-in-Climate-Adaptation-Finance-2024.pdf

- Stockholm Environment Institute (SEI) (2024) : "Integrating Sanitation and Climate Change in National Level Policy Frameworks"

  https://www.sei.org/wp-content/uploads/2024/11/sanitation-climate-national-policy-sei2024-052.pdf

- OECD (2024), Climate Finance Provided and Mobilised by Developed Countries in 2013-2022, Climate Finance and the USD 100 Billion Goal, OECD Publishing, Paris.

  https://doi.org/10.1787/19150727-en

Sources

Falk, Joern & Angelmahr, Martin & Schade, Wolfgang & Schenk-Mathes, Heike, 2021: Socio-economic impacts and challenges associated with the electrification of a remote area in rural Tanzania through a mini-grid system. Energy, Ecology and Environment. 6. 10.1007/s40974-021-00216-3.

UNFCCC, 2025: Adaptation Fund (https://unfccc.int/Adaptation-Fund, 29.05.2025

Adaptation Fund, 2025: Press Release, "Adaptation Fund Receives First New US$13 Million Pledge for 2025 from Sweden, Hoping to Set Tone for Rest of Year" https://www.adaptation-fund.org/adaptation-fund-receives-first-new-us-13-million-pledge-for-2025-from-sweden-hoping-to-set-tone-for-rest-of-year/, 29.05.2025

GEF, 2025: "The GEF At a Glance" (https://www.thegef.org/sites/default/files/documents/2025-04/GEF-brochure-apr25-01.pdf , 29.05.2025)

Green Climate Fund, 2025: "About GCF" (https://www.greenclimate.fund/about, 29.05.2025

UNFCCC, 2024:, "COP29 UN Climate Conference Agrees to Triple Finance to Developing Countries, Protecting Lives and Livelihoods", https://unfccc.int/news/cop29-un-climate-conference-agrees-to-triple-finance-to-developing-countries-protecting-lives-and

OECD, 2024: Climate Finance Provided and Mobilised by Developed Countries in 2013-2022, Climate Finance and the USD 100 Billion Goal, OECD Publishing, Paris (https://doi.org/10.1787/19150727-en., 29.05.2025

4.3 What climate financing tools are available for sanitation projects?

- Understanding the types of Climate Financing Options relevant and commonly adopted for sanitation projects: Overview of multilateral climate funds and how they operate
- Understanding other alternative financing options that are commonly used to fund climate-related sanitation projects

Types of Climate Financing for Sanitation Projects

A recent report prepared by the OECD in 2024 examines the state of global climate finance between 2013-2022, based on the various channels of funding, financing instruments used, and the climate action sector funded. This provides a quick insight into how climate finance is provided and mobilized in recent years, as presented in the following figure.

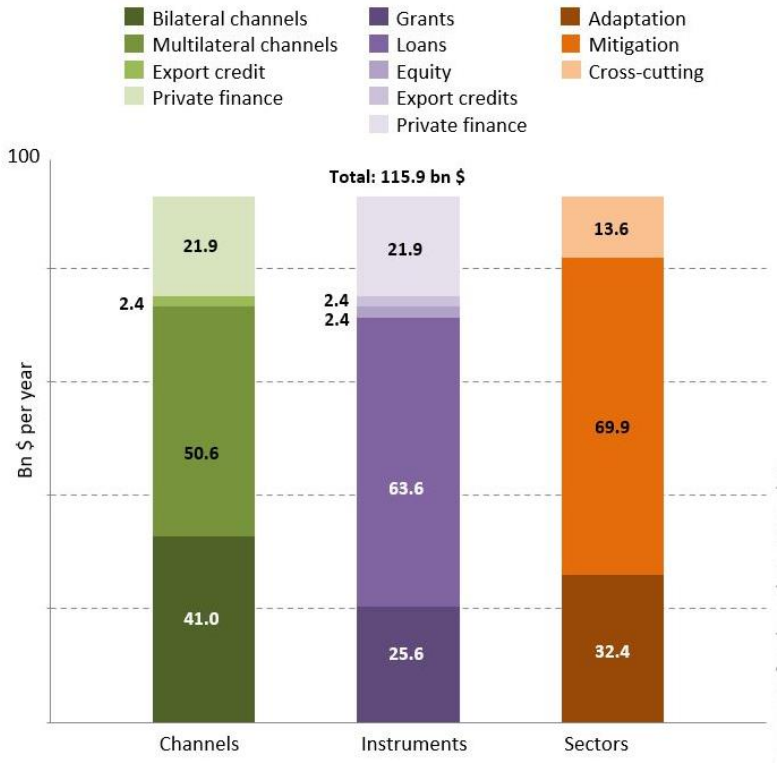


Figure 14: State of Climate Finance 2020-2022 (Source: Deutsche Klimafinanzierung, 2024)

It can be observed that a significant portion of global climate finance is provided through bilateral and multilateral channels, the overall funding is provided largely in the form of loans and grants, and climate mitigation activities receive majority of the funding.

Despite representing only 0.3% of global climate finance, funding for sanitation projects has gained momentum in recent years. Several financing mechanisms now exist to support climate adaptation and mitigation through climate-SMART sanitation solutions.

1) Bilateral Climate Agreements

Bilateral climate agreements involve direct financial support from one country to another to address climate change challenges involving sanitation, enabling countries to collaborate on implementing climate-SMART sanitation projects globally. Climate finance through bilateral agreements is generally provided in the form of grants and loans, and the primary role of bilateral climate agreements is to facilitate and support the international exchange of climate mitigation and adaptation efforts. Such agreements are particularly suitable for financing climate-SMART sanitation projects in regions lacking domestic funding, on the basis that the projects align with both the host country's development goals and the donor country's climate objectives. Whilst historically bilateral climate agreements have prioritized climate mitigation activities, there is a growing emphasis placed on enhancing climate adaptation and resilience in vulnerable regions of the world.

2) Multilateral Climate Funds (MCFs)

Multilateral climate funds are international financial entities that provide financing, largely in the form of grants, to various developing countries to foster climate mitigation and adaptation. They are the most widely involved means of climate financing and often work with a variety of partners including national and regional development banks, multilateral development banks (MDBs), and the private sector to mobilize additional funding for climate action. The primary aim of MCFs is to support developing countries in their efforts to mitigate and adapt to climate change, by translating ambitious NDC commitments into tangible climate actions.

There are four MCFs central to financing global climate action in commitment with international climate conventions and agreements like the Paris Agreement. These are the:

a. Green Climate Fund (GCF)

b. Adaptation Fund

c. Global Environment Facility (GEF)

d. Climate Investment Funds (CIF)

However, the GCF is the only entity out of the four with a defined focus and strategy on climate-SMART sanitation and shall be explored further. The Adaptation Fund, GEF, and CIF on the other hand, recognize and address sanitation as a sub-component of broader water, urban, or climate adaptation strategies, and not as a strategic focus on its own. Nonetheless, recent developments from COP29 such as the significantly increased global climate finance commitment and emphasis on advancing climate adaptation could mean that the other MCFs may be more relevant for the climate-sanitation nexus in upcoming years.

The Green Climate Fund (GCF) is the world's largest climate fund, mandated to finance climate change mitigation and adaptation activities in developing countries, thereby enabling realization of their ambitious NDCs towards climate-resilient pathways.

The GCF operates on a country-driven approach where developing countries are given the responsibility to lead GCF programming and implementation. The country ownership of GCF financing decisions allows developing countries to match their NDC ambitions with climate action effectively. It is in its second

replenishment period, known as GCF-2 (2024-2027), and so far, a total of US$10.62 billion has been pledged to the fund, on course to surpass the US$10 billion pledged over its initial GCF-1 period (2020-2023) *(Source: Green Climate Fund, 2025)*. The GCF is mandated to invest its resources equally to mitigation and adaptation and additionally, at least half of its adaptation resources are required to be invested in Small Island Developing States (SIDS), Least Developed Countries (LDCs), and African states, which are most vulnerable to climate change.

The GCF explicitly recognizes sanitation as a sector that requires immediate focus and support within its overarching goal to advance the transitioning towards a low-carbon and climate-resilient future globally, especially in countries most vulnerable to the detrimental effects of climate change. To further support its prioritization of the sanitation sector, it has developed the *"Water Security Sectoral Guide"* which provides guidelines for designing effective and impactful climate-resilient sanitation projects, and the "GCF Readiness Programme" initiative, offering support to developing countries in accessing GCF funding support and strengthening their institutional capacities and strategic frameworks for climate action. These support mechanisms are further discussed in the *GCF Spotlight* section of this chapter.

An additional relevant MCF is the African Water Facility (AWF).

The African Water Facility (AWF) is Africa's primary funding entity for water and sanitation projects across Africa and is managed by the African Development Bank (AfDB). The strategic vision of the AWF places emphasis on accelerating the implementation of projects that improve accessibility to adequate water and sanitation services, whilst enhancing climate resilience. AWF's projects often focus on the integration of sanitation improvements in community spaces, highlighting the role of sanitation in broader climate adaptation and resilience strategies.

AWF projects to date have directly impacted 29 million people across Africa, with over 148 projects in 52 countries and US$2.2 billion of finance provided, in the form of grants. On average, each US$1 contributed by the AWF has attracted US$32 in additional follow-up investments *(Source: AWF, 2025)*.

3) Other Types of Climate Financing

Although most global climate funds are managed and provided by MCFs in the form of grants, alternative financing options are also adopted to accelerate the successful implementation of attractive climate-SMART sanitation projects. Let us briefly look at some of the commonly applied alternative options.

- Concessional Climate Finance

Concessional climate finance is often provided through loans under terms that that much more favorable than standard commercial loans, including lower interest rates and longer repayment periods. They are most widely used by major financial institutions such as bilateral and multilateral development banks, for the financing of worthy projects in developing countries to accelerate development objectives.

Concessional climate finance targets high-impact climate projects responding to critical global challenges such as climate change mitigation, adaptation, and related development issues including water, sanitation, and education. It is most effective in cases when climate resilience measures require high upfront costs, affordability constraints in vulnerable communities need to be considered, and addressing critical climate-related sanitation challenges may otherwise be unviable without such support. An example of a

concessional climate finance sanitation project would be a project in a developing country that builds climate-SMART sanitation infrastructure in areas that are vulnerable to flooding.

Climate finance with a concessional component has historically aimed to provide services for underserved groups. In general, the more restricted a country's access to capital, the greater its eligibility for concessional funding—helping to ensure that investments effectively support national priorities. However, it is worth noting that nearly 42% of international concessional climate finance has historically focused on mitigation activities, leaving a significant gap in funding for adaptation and resilience. Furthermore, from the limited global adaptation finance available, significant amounts go to the water sector with only a small fraction reaching the WASH sectors of low-income countries (Source: Water Aid, 2021).

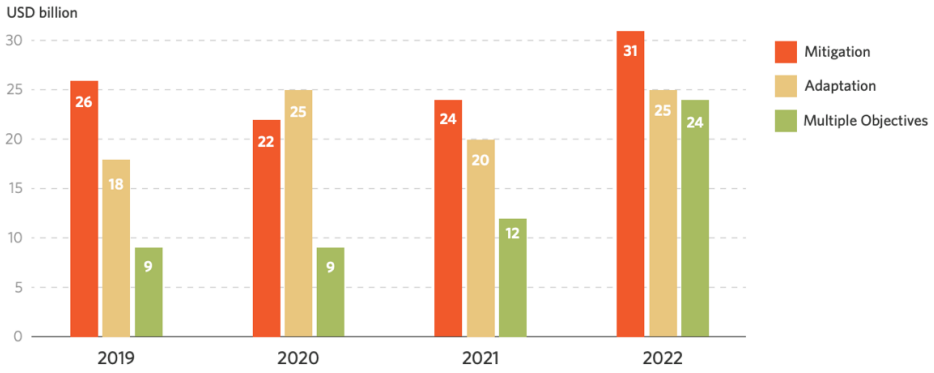


Figure 15: International concessional climate finance by use (2019-2022, US$ billion) (Source: Climate Policy Initiative, 2024)

Although global climate finance has significantly increased over the years, most of its growth is due to an increase in mitigation finance, with the largest growth in the renewable energy and transport sectors, leaving the WASH sector relatively under financed in comparison, as can be seen in the following graph.

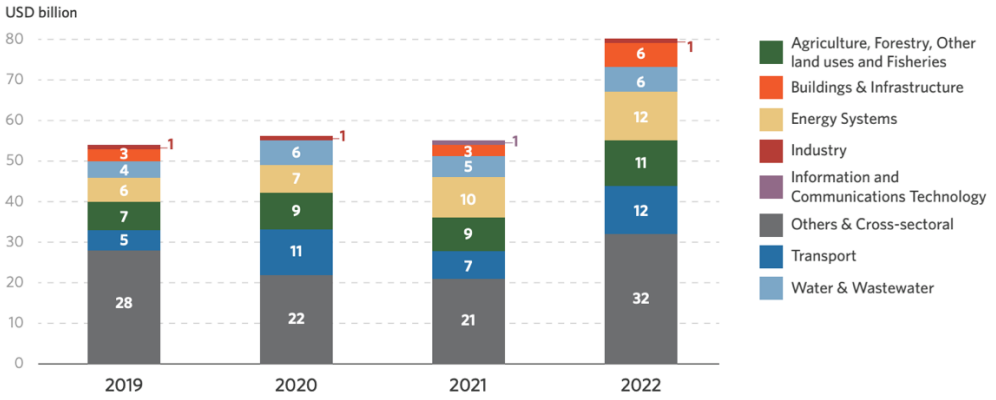


Figure 16: International concessional climate finance by sector (2019-2022, US$ billion) (Source: Climate Policy Initiative, 2024)

- Blended Climate Finance

Blended climate financing involves combining public, philanthropic, and private capital to fund climate-SMART projects that struggle to attract purely commercial investment. It provides an opportunity for the public sector to leverage their own funds by drawing additional private funds by providing publicly sourced capital that has a high tolerance to financial risk, such as grants or subsidies, to attract private investment

as their risk is minimized. The main objective of blended financing is to allow public or philanthropic funds to absorb financial risks thereby providing a financial environment where the private sector is more willing to participate in.

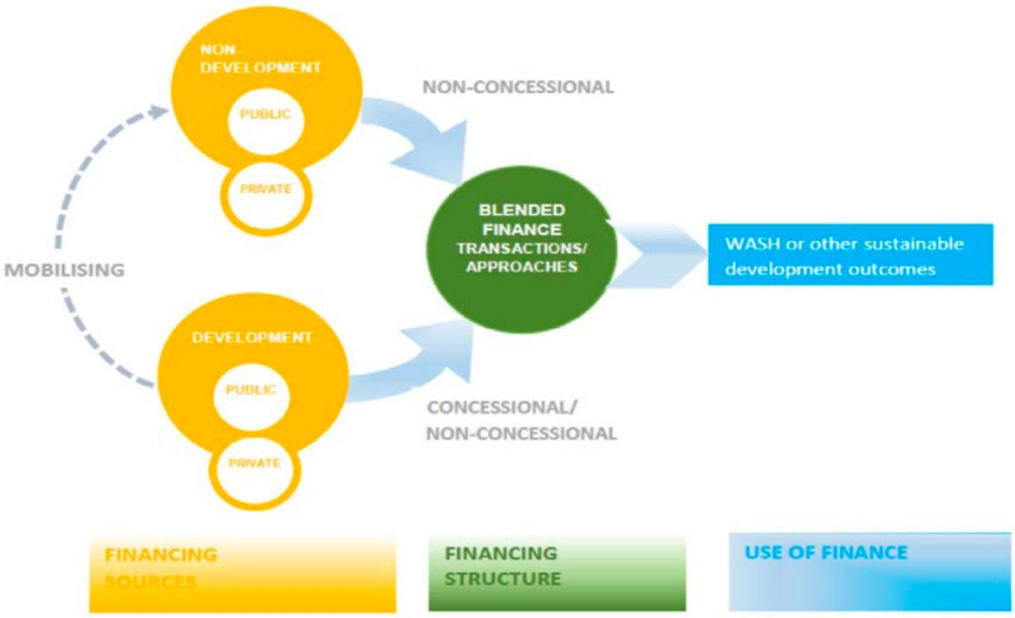


Figure 17: Blended finance structure (Source: Water Aid, 2021)

The blended element can manifest in several ways:

i) Risk Mitigation: By allowing public or philanthropic funds to absorb the brunt of the initial financial risks, private capital can be mobilized to support climate-SMART sanitation projects effectively and sustainably.

ii) Return Enhancement: Grants and concessional loans provided by public or philanthropic financial institutions can improve cash flows, thereby attracting private investors seeking market-rate returns.

iii) Technical Support: Grants provided by public or philanthropic financial institutions can fund feasibility studies, capacity building, and project preparation activities, reducing upfront costs for interested private investors.

Blended financing can be impactful in developing countries where private investors are not always ready to undertake low-carbon and climate-SMART investments in sanitation solutions due to their lack of market knowledge or capacity, or to avoid the potential financial risks of investing in such projects alone *(Source: World Bank Group, 2018)*. It can potentially catalyze private investment and enhance efficiency, effectiveness, and development impact through a collaborative investment approach. It is a suitable form of financing when :

- There is a high level of perceived investment risk involved, normally due to political instability, currency fluctuations, or untested technologies.
- The sanitation infrastructure involves long payback periods.
- Low-income households are unable to pay market rates for the sanitation services.

- Innovative untested technologies require technical assistance to demonstrate scalability before attracting purely commercial funding.

- Community/Civil Society Organization (CSO) Climate Financing

Community or Civil Society Organization (CSO) climate financing involves the mobilization and deployment of community-based financial resources to support climate change mitigation and adaptation projects, particularly at the local level. It can play a pivotal role in bridging the gap between international climate finance and vulnerable communities by leveraging their deep understanding of local contexts, needs, and vulnerabilities to design and implement effective community-led solutions tailored for the local context. This method of climate financing ensures local ownership, sustainability, and long-term benefits whilst addressing the urgent need for climate-SMART WASH services.

Community climate financing can involve direct community fundraising, funding from donors and philanthropic sources, or accessing international climate funds such as the GCF through accredited entities. Most commonly, grants provided by governments, development banks, or philanthropic organizations can be utilized for planning, capacity building, and direct project funding when communities lack the means to repay loans.

Additionally, community loan funds, also known as revolving loan funds, can serve as an effective alternative to finance community-based climate sanitation projects. The loans are typically offered with affordable interest rates and consist of public and private sector finance that is recycled as the loans are repaid, creating a sustainable financing environment to ensure the longevity of appropriate community-led climate-SMART sanitation solutions.

Community climate financing is a suitable option when projects require deep engagement with local communities to ensure solutions are context-specific, in areas where populations are especially vulnerable to climate impacts and may be overlooked by larger top-down funding mechanisms, and for piloting innovative technologies and solutions that may not initially attract large-scale public or private investment.

An example of such financing in action is the Gungano Urban Poor Fund installing dry toilets in areas of Zimbabwe that are prone to flooding. More information on the project can be found by visiting the following link: **https://www.wri.org/insights/getting-locally-led-adaptation-right-examples-around-world**

- Green Banks

Green Banks are national, dedicated, mission-driven catalytic financial institutions, often public or nonprofit entities, that are established to facilitate and leverage private investment in low-carbon and climate-resilient projects across various sectors including water and sanitation. They primarily use financing as opposed to grants, mainly through the provision of loans, meaning that eventual repayment of capital is expected, with the overarching objective being to maximize the impact of each dollar that a green bank deploys. Consequently, green banks typically focus on markets where there is a potential for payback and on technically viable projects that are well past the research and development stage. Green bank funds are recycled through loan repayments, thus enabling the continuation of lending and promoting viable, bankable, and impactful projects.

Funding support from green banks are suitable for sanitation projects in cases when there is a gap or failure in the domestic market in that traditional lenders avoid projects due to credit risks or lack of standardized financial models, and when it is required to focus on accommodating low-income and disadvantaged communities.

The *African Green Banks Initiative*, established by AfDB and launched in 2022 at COP 27 in Egypt, is a continent-wide effort aiming to build an ecosystem of green banks throughout Africa and addressing the difficulties faced by African nations in securing financing to support their low-carbon and climate-resilient transitioning pathways. Its primary objective is to mobilize additional climate finance to advance climate mitigation and adaptation efforts in the continent, by leveraging private and public sector investments that support African countries' climate ambitions in line with their NDCs.

To address the lack of climate finance in Africa, four green banks have been launched under the initiative in Côte d'Ivoire, Benin, Egypt, and Morocco, through partnership with existing financial institutions. For instance, the green bank set up in Côte d'Ivoire was done so in partnership with the National Investment Bank (BNI). The initiative has set a target to support the creation of an ecosystem of green investment facilities worth up to US$1.5 billion across the continent by 2030, so that each green bank formed under the initiative will be capable of mobilizing and raising funds that can then be invested in transformative climate projects across Africa.

Spotlight: The Green Climate Fund (GCF)

Strategic Vision for Sanitation	A sanitation system is recognized by the GCF as one that protects and promotes human health by providing a clean environment, breaks the cycle of disease, and is universally accessible, especially by underserved and marginalized communities (Source: Green Climate Fund, 2024). Sanitation is integrated into its broader water security strategy, placing an emphasis on climate-resilient designs. The operation of GCF support for sanitation projects and programs revolves around three key objectives for the sector: i) **Encouraging the use of innovative technologies, service models, and community involvement** to create adaptive, resilient, and sustainable sanitation systems and to contribute to build community and ecosystem resilience. ii) **Anticipating and preparing for climate impacts**, ensuring systems and services are not just functional but robust against future scenarios. iii) **Integrating sanitation within the wider context of climate goals**, promoting sustainable practices, and reducing the carbon footprint. It is through the pursuit of these sanitation objectives that the GCF aims to create enabling financing settings to provide alternative funding options for the successful establishment of climate-resilient sanitation infrastructure. Additionally, GCF has developed a *"Water Security Sectoral Guide"*, with input from UNICEF and WHO, providing guidelines for designing climate-resilient sanitation projects. The Water Security Sectoral Guide also outlines the *GCF Investment Pathway for Sanitation*, which further helps in defining what is to be achieved by projects suitable for GCF finance, and consists of the *two paradigm shifting pathways* as follows: i) **Enhance water conservation, water efficiency, and water reuse** through demand management, decentralized operation models and resource recovery. ii) **Strengthen integrated water resources management**, preserving and promoting water resources and enhanced resilient water supply and sanitation services which are protected from water-related disasters.
Who Can Apply?	The GCF provides climate finance to developing countries exclusively through its network of Accredited Entities, which consist of public or private, international, national, and regional institutions and NGOs. Organizations must demonstrate strong financial management and specialized capacities in driving climate action to become an accredited partner of the GCF to receive funding for approved projects. Once approved, they may develop funding proposals to be considered by the GCF and oversee, supervise, manage, and monitor their respective GCF-approved projects and programs. Some examples of accredited entities partner to the GCF include the African Development Bank (AfDB), Development Bank of Southern Africa (DBSA), Sahara and Sahel Observatory (OSS), and the United Nations Development Programme (UNDP). Entities may seek accreditation to the GCF through institutional accreditation or the Project-specific Assessment Approach (PSAA). Detailed information on accreditation through the PSAA method can be found via the following link: Green Climate Fund (2025), "Project-specific Assessment Approach", https://www.greenclimate.fund/projects/psaa The list below includes all African entities accredited by the Green Climate Fund (GCF) to implement and manage projects across the continent, as of May 2025. - Africa Finance Corporation (AFC), Nigeria, https://www.africafc.org - African Development Bank (AfDB), Cote d'Ivoire, https://www.afdb.org - Agency for Agricultural Development of Morocco (ADA), Morocco, https://www.ada.gov.ma - Attijariwafa Bank (AWB), Morocco, https://www.attijariwafabank.com - Banque Nationale de Développement Agricole (BNDA), Mali, https://www.bnda-mali.com - Banque Ouest Africaine de Développement (West African Development Bank) (BOAD), Togo, https://www.boad.org - Centre de Suivi Ecologique (CSE), Senegal, https://www.cse.sn - CRDB Bank PLC, Tanzania, https://crdbbank.co.tz - Development Bank of Nigeria PLC, Nigeria, https://www.devbankng.com - Development Bank of Rwanda (B.R.D) PLC, Rwanda, https://www.brd.rw - Development Bank of Southern Africa (DBSA), South Africa, https://www.dbsa.org

	- Development Bank of Zambia (DBZ), Zambia, https://dbz.co.zm - Eastern and Southern African Trade and Development Bank (TDB Group), Mauritius, https://www.tdbgroup.org - Ecobank Ghana Limited (EGH), Ghana, https://ecobank.com/gh/personal-banking - ECOWAS Bank of Investment and Development (EBID), Togo, https://www.bidc-ebid.org - Environmental Investment Fund (EIF), Namibia, https://www.eif.org.na - Fonds d'Intervention pour l'Environnement (FIE), Burkina Faso, https://www.fie-burkina.org - Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles (FIRCA), Cote d'Ivoire, https://firca.ci - Fonds National pour L'Environnement (FNEC), Benin, https://fnec.bj - Infrastructure Development Bank of Zimbabwe (IDBZ), Zimbabwe, https://www.idbz.co.zw - KCB Bank Kenya Limited (KCB Kenya), Kenya, https://ke.kcbgroup.com - La Banque Agricole (LBA), Senegal, https://www.labanqueagricole.sn - Ministry of Environment (MOE) of Rwanda, Rwanda, https://www.environment.gov.rw - Ministry of Finance and Economic Cooperation (MOFEC) of Ethiopia, Ethiopia, https://www.mofed.gov.et - Moroccan Agency for Sustainable Energy S.A. (Masen), Morocco, https://www.masen.ma - National Environment Management Authority (NEMA), Kenya, https://www.nema.go.ke - Sahara and Sahel Observatory (OSS), Tunisia, https://www.oss-online.org - South African National Biodiversity Institute (SANBI), South Africa, https://www.sanbi.org - The Ministry of Water and Environment (MWE) of Uganda, Uganda, https://www.mwe.go.ug - Zambia National Commercial Bank PLC (ZANACO), Zambia, The complete list is available here: https://www.greenclimate.fund/about/partners/ae.
GCF Resource Mobilization	The GCF accepts contributions from developed countries party to the UN Framework Convention on Climate Change (UNFCCC) as well as public, non-public, and alternative sources including countries not party to the UNFCCC. These contributions may be made in the form of grants, capital or loans and there is no limit to the amount a contributor may provide. The World Bank serves as the trustee of the GCF and its functions in this capacity include the receipt, holding, and investment of financial contributions from contributors, and the transfer of financial resources subject to approval by the GCF. Currently in its second replenishment period running from 2024 to 2027, the GCF-2 aims to further strengthen the GCF's ability to empower climate action in developing countries, with 34 countries pledging a total of US$10.62 billion to support the paradigm shift towards low-emission and climate-resilient development pathways in developing countries vulnerable to climate change effects, with a projected mitigation of 1.5-2.4 gigatons of carbon dioxide equivalent and enhancing the resilience of up to 900 million people *(Source: Green Climate Fund, 2025)*. 42% of GCF's climate financing is provided in the form of grants and often focus is placed on community-led projects in underserved countries *(Source: Green Climate Fund, 2025)*.
GCF Private Sector Financing	The GCF has established a dedicated division, called the Private Sector Facility (PSF), which is devised to fund and mobilize private sector actors including investors, project sponsors, and financial institutions The PSF mobilizes private capital by promoting investment through low-interest and long-tenor project loans, risk mitigating guarantees, and grant-based capacity building programs. The PSF combines these elements to mainstream climate change considerations in the financial systems of developing countries and aims to scale private investments into high-impact climate-resilient technologies and solutions as it is not enough to rely solely on the resources of public institutions alone. The GCF portfolio consists of 66 private sector projects with a total of US$6.1 billion allocated for such projects. Out of the GCF financed private sector projects, two specifically aim to relieve the stress put on by climate change on the water and sanitation sectors of over thirty climate-vulnerable countries, including African states such as Côte d'Ivoire, Kenya, Djibouti, Nigeria, Gabon, Uganda, Sierra Leone, Botswana, Namibia, Madagascar, South Africa, Egypt, Tunisia, and Morocco. The private sector projects focusing on building climate-resilient water and sanitation sectors are: • FP190: Climate Investor Two (CI2) Dedicated fund that aims to support the private sector to develop and construct climate-resilient infrastructure projects in developing countries in the water, sanitation, and ocean sectors • FP254: GCF-IFC Scaling Resilient Water Infrastructure (RWI) Facility Aimed at addressing water scarcity by developing and deploying resilient water infrastructure in 12 countries around the world including Côte d'Ivoire, Gabon, Morocco, and Egypt

	Together they hold a total project value of over US$2 billion with 55.4 million beneficiaries. Further detailed information on the projects can be found via the following links. • GCF Private Sector Project: FP254: GCF-IFC Scaling Resilient Water Infrastructure (RWI) Facility • GCF Private Sector Project: FP254: GCF-IFC Scaling Resilient Water Infrastructure (RWI) Facility Highlight Video (https://youtu.be/6kme0Ee1bi4?si=vicsbvX_4TjOP0gp) • GCF Private Sector Project: FP190: Climate Investor Two (CI2) • GCF Private Sector Project: FP190: Climate Investor Two (CI2) Highlight Video (https://youtu.be/yaiZklAh1mA?si=qmdKYwwcCeSiARXH)
GCF for the Community	Climate finance has historically been driven primarily by international and national actors, often excluding local stakeholders' inclusion in planning, implementation, and monitoring activities. To address this, the GCF is fully committed to Locally Led Climate Action (LLCA), and its support for locally-led adaptation projects doubled in 2024 *(Source: Green Climate Fund, 2025)*. The GCF 2024-2027 Strategic Plan spotlights locally led action, and its investment and support for such projects are based on three key requirements: i) Empowering local actors to drive climate action: Local actors must be strongly involved throughout the entire project cycle, and investments should leverage local, traditional, and indigenous knowledge and customs. ii) Climate finance or decision-making to the lowest appropriate level: Local actors must have direct access to GCF climate funding and should be involved in deciding how and where the funds are utilized. iii) Building capacity for Locally Led Climate Action: Investments must address structural inequalities, enable decentralization, and focus on the local capacity needs. Examples of LLCA projects that could potentially seek GCF funding involve: • Infrastructure development projects such as building new sanitation facilities or upgrading existing facilities in areas where access is limited. • Community-based hygiene promotion and behavior change campaigns and education. • Capacity building and sustainability efforts such as training local staff on the operation and maintenance of sanitation facilities, engaging local authorities in the management of sanitation facilities, and community participation to encourage community involvement in the planning, implementation, and sustainability of sanitation projects.
GCF Additional Support	To further assist developing countries in strengthening their institutional capacities, governance mechanisms, and strategic frameworks for climate action, and accessing GCF funding support, the GCF has established its *"Readiness Programme"* initiative, which provides grants and technical assistance – up to US$1 million per country per year. The initiative operates under a country-driven approach to ensure that the support provided is tailored to a country's national needs and priorities and is accessible to all developing country parties to the UNFCCC. The GCF Readiness Programme can play a crucial role in supporting enhancing project preparation activities in the sanitation sector through i) Capacity Building: Helping sanitation sector stakeholders assess climate risks, understand adaptation needs, and incorporate these considerations into sectoral strategies and policies. ii) Facilitating Access to Finance: Supporting the accreditation of national or regional entities and improving their ability to develop high-quality project proposals, thus increasing the likelihood of securing GCF funding for sanitation initiatives. iii) Provision of Technical Assistance and Guidance: Provision of practical guidelines for designing climate-resilient sanitation projects to ensure projects are robust, bankable, and aligned with GCF investment criteria. iv) Support with the Development of Project Pipelines: Helping to identify, design, and prioritize sanitation projects that address climate vulnerabilities. v) Knowledge Sharing and Promotion of Best Practices: Encouraging the sharing of lessons learned and best practices across countries and sectors, striving for continuous improvement in climate-resilient sanitation solutions. Further information on the Readiness Program can be accessed via the following link: https://www.greenclimate.fund/readiness

Spotlight: The African Water Facility (AWF)

Strategic Vision for Sanitation	With a primary objective to mobilize investments in Africa's WASH sector, aligned with "African Water Vision 2025", "Africa 2063: the Africa We Want", and Sustainable Development Goal 6, AWF seeks to collaborate with African states and key stakeholders to prepare climate-resilient WASH projects for further investment and to scale up catalytic interventions (AWF, 2025) . The links for the aligned strategic documents are available in the Resources section of the module. The AWF focuses its activities and operations based on four strategic priorities, identifies as their four strategic pillars, which together provide a comprehensive approach to preparing sustainable sanitation projects, whilst strengthening the investment-enabling environment: I. **Project Preparation:** A focus on financing the preparation of WASH development projects and securing follow-on investment for implementation through institutional support and capacity building to manage and regulate WASH resources investments. Typically, 75% of the overall program budget is allocated to project preparation by the AWF. II. **Catalytic Investments**: Fostering and spreading innovation by replicating and piloting innovative sanitation solutions, thereby providing evidence for private stakeholders to invest through deployment of small but catalytic investments, thus enabling cofinancing between public and private entities. Generally, 15% of the overall program budget is allocated to these catalytic investments by the AWF. III. **Investment Promotion**: Increasing the number of public and private investment opportunities by establishing a networking platform to market investment project opportunities and connect project sponsors with potential investors. 10% of the overall program budget is allocated to investment promotion by the AWF. IV. **Water Governance**: Establishing guidelines through which decisions for the management of WASH resources and services are taken and implemented, by establishing mechanisms for cross-sectoral coordination and stakeholder engagement, and strengthening capacities and knowledge of relevant institutions through the exchange of knowledge and information on water resources and WASH.
Who Can Apply?	Eligibility to receive AWF grants or technical assistance requires recipients to be regional member countries of the AfDB, political subdivisions or agencies working within these countries, or regional agencies or institutions concerned with water resource development in Africa. The grants are awarded to various institutions based on specific criteria outlined below *(Source: AWF, 2025)*. • **Government and Regional institutions** o Central or local African governments and municipalities o Regional, sub-regional, and sectoral organizations such as Regional Economic Organizations (REOs) and River Basin Organizations (RBOs) • **NGO and Civil Societies** o African NGOs committed to Africa's or national development priorities, with proposed activities that will be implemented in Africa o Must be Africa-based or can provide evidence of partnership with African institutions o Must show the existence of sound financial systems, including clear accounting and budgeting standards, financial statements, a transparent budgeting process, audited accounts and other indicators that confirm their capacity to assume fiduciary responsibility for AWF resources o Must provide evidence of competence, based on past performance, to carry out proposed activities under AWF funding support o Must demonstrate credibility, knowledge of local values, networks and structures required to carry out the indicated activities under AWF funding support o Must have their proposals supported by the national government as evidenced by a letter signed by the appropriate official of the government, at the Ministerial level, indicating that the country supports the request as being consistent with national priorities. This letter must be sent together with the application for AWF support. Additional to applicant eligibility criteria, AWF has established project eligibility criteria. For a project to be eligible for financing under the AWF, the proposed activities must meet one of the four strategic pillars and prioritize issues such as climate change, social and gender equality, and environmental protection. AWF considers the following aspects for the eligibility of projects seeking financing support:

	• Project must be consistent with national priorities and regional consensus • Credibility, ownership, and commitment of the beneficiary is considered • The effectiveness and sustainability of the institutions and investments concerning the proposed project are considered • The opportunity for effective implementation is assessed
AWF Resource Mobilization	The AWF mobilizes resources through partnerships with bilateral and multilateral donors, such as the Danish Government and the Nordic Development Fund, and serves as an executive agency of the AfDB. The investment approach of the AWF aims to secure financing for climate-resilient water and sanitation services in Africa by focusing on three primary themes (Source: AWF, 2023): • Targeting investors: Creation of tools to target and foster relationships with suitable investors throughout the project cycle. • Streamlining processes: Development of tools and processes to enhance the efficiency and quality of project identification, preparation, and implementation. • Aligning with country priorities: Selection of projects that specifically align with country governments' interests and are more resilient to changes in country priorities. The AWF offers grants of between €50,000 and €5,000,000 to fund both climate change adaptation and mitigation-focused WASH projects across the African continent, supporting projects that fall under its priority areas, such as: • Rural and Urban WASH • Integrated Water Resources Management (IWRM) • Investment Promotion for water and sanitation projects • Policy, Legal and Institutional Reform • Environmental Management • Developing and Implementing a Regulatory Framework • Capacity Building • Knowledge and Information Building or Dissemination For further information on the AWF project pipeline, please visit the link in the Resources section of the chapter. Additionally, the AfDB after recognizing the importance of dedicated financing for urban sanitation in Africa, established the "***African Urban Sanitation Investment Initiative***" *(AUSII)* in 2019, through the AWF, with support from the Gates Foundation. The AUSII operates as a dedicated urban sanitation financing window of the AWF, with an aim to increase the scale and impact of investments in urban sanitation across Africa, through the creation of an enabling financing environment tailored to the needs of the recipient countries.

*Figure 18: The AUSII Mission (*Source: *AUSII, 2023)*

Currently, AUSII operates through the provision of non-reimbursable grants and technical assistance and is currently being piloted with urban sanitation projects in seven countries – Cote d'Ivoire, Kenya, Uganda, Zambia, Mauritania, Ghana, and Togo with a particular focus on inclusive on-site sanitation and fecal sludge management.
It started with an initial US$30 million for its grant and technical assistance function, with an aim to mobilize US$320 million for investments in urban sanitation during the first ten years of its operation *(Source: AWF, 2025)*.
For more information on AUSII, please visit the link in the Resources section of the module.

AWF Private Sector Financing	AWF's core funding is grant-based and often directed at public sector entities, with only 2 out of 50 projects mobilizing private finance (Source: AWF, 2023). However, the AWF Investment Promotion Approach and Action Plan (2023-2028) explores private finance as an additional focus of investment promotion, and due to the limited amounts of public finance available, recognizes the need for private investment to further enhance the water sector in Africa.

Climate Financing for Sanitation at-a-Glance

Table 25: Climate Financing Options for Sanitation

Financing Type	Entities	Primary Financing Instruments	Climate Action Focus (i.e. Mitigation/Adaptation - if applicable)	Relevant Sanitation Projects	Funding Range per project	Who is Eligible
Bilateral Climate Agreements	National Development Agencies (country-specific)	Grants and loans	Currently slightly favors mitigation projects over adaptation	Large-scale national sanitation projects	Dependent on involved parties and the needs of the project	Local governments of developing countries
Multilateral Climate Funding	GCF	Grants	Mitigation and Adaptation projects mandated to be equally invested in	Large-scale national sanitation projects	Up to US$1.5 million per application for project preparation activities (Overall funding is dependent on the needs of each project)	GCF Accredited Entities
	AWF		Applicable for both mitigation and adaptation projects	National sanitation projects involving urban and rural WASH	€50,000 - €5,000,000	Member countries of the AfDB, NGOs and CSOs concerned with water resource development in Africa
Concessional Climate Financing	Multilateral development banks (MDBs) such as the AfDB	Concessional loans	Currently slightly favors mitigation projects over adaptation	Sizeable sanitation projects with repayment capacity	Dependent on involved parties and the needs of the project	Developing country governments and organizations working with MDBs
Blended Climate Financing	Public, private, and NGOs	A mixture of instruments that can include grants, loans, and equity	Applicable for both mitigation and adaptation sanitation projects	De-risked, innovative, and scalable sanitation solutions	Dependent on involved parties and the needs of the project	Public and private organizations
Community/ CSO Climate Financing	Communities, NGOs	Grants, community loan funds	Applicable for both mitigation and adaptation sanitation projects	Small-scaled locally owned sanitation solutions	Dependent on involved parties and the needs of the project	Not-for-profit organizations and community groups
Green Bank Climate Financing	Green Banks	Mainly loans but can also include equity investments	Applicable for both mitigation and adaptation sanitation projects	Sanitation projects with repayment capacity	Dependent on involved parties and the needs of the project	State, local, and regional governments of developing countries

Resources

- Green Climate Fund (2025), "Status of Pledges and Contributions" https://www.greenclimate.fund/sites/default/files/document/2025-status-pledges-website-march-31.pdf

- Green Climate Fund (2024), Annex III Water Security Sectoral Guide: GCF Water Project Design Guidelines https://www.greenclimate.fund/sites/default/files/document/gcf-water-sector-project-design-guidelines-part-3.pdf

- African Water Facility, "Our Impact" https://www.africanwaterfacility.org/en/our-impact

- African Water Facility Strategy 2017-2025, p. 7 https://www.africanwaterfacility.org/sites/default/files/2023-12/AWF_Strategy_2017-2025_-_Final_0.pdf

- African Water Facility, "Eligibility Criteria" https://www.africanwaterfacility.org/en/eligibility-criteria#:~:text=To%20be%20eligible%20to%20receive,water%20resource%20development%20in%20Africa.

- African Water Facility, "Investment Promotion Approach and Action Plan 2023-2028" https://www.africanwaterfacility.org/sites/default/files/2024-09/investment-approach-and-action-plan-2023-2028-african-water-facility.pdf

- African Water Facility, "Africa Urban Sanitation Investment Initiative" https://www.africanwaterfacility.org/sites/default/files/2023-12/AUSII%20Brochure_2023.pdf

- Water Aid (2021), "Blueprint: financing a future of safe water, sanitation and hygiene for all" https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/blueprint-financing-a-future-of-safe-water-sanitation-and-hygiene-for-all.pdf

- Climate Policy Initiative (2024), "Understanding Global Concessional Climate Finance 2024" https://www.climatepolicyinitiative.org/wp-content/uploads/2024/10/Understanding-Global-Concessional-Climate-Finance-2024.pdf

- World Bank Group (2018), "Strategic Use of Climate Finance to maximize Climate Action" https://www.climatepolicyinitiative.org/wp-content/uploads/2024/10/Understanding-Global-Concessional-Climate-Finance-2024.pdf

- World Resources Institute (2022): "Getting Locally Led Adaptation Right: Examples from Around the World" https://www.wri.org/insights/getting-locally-led-adaptation-right-examples-around-world

Sources

AWF, 2023: African Water Facility, "Investment Promotion Approach and Action Plan 2023-2028", https://www.africanwaterfacility.org/sites/default/files/2024-09/investment-approach-and-action-plan-2023-2028-african-water-facility.pdf, 25 May 2025

AWF, 2023: African Water Facility: "Africa Urban Sanitation Investment Initiative", https://www.africanwaterfacility.org/sites/default/files/2023-12/AUSII%20Brochure_2023.pdf, 25 May 2025

AWF, 2025: African Water Facility, "Our Impact" https://www.africanwaterfacility.org/en/our-impact, 25 May 2025

AWF, 2025: African Water Facility Strategy 2017-2025, p. 7 https://www.africanwaterfacility.org/sites/default/files/2023-12/AWF_Strategy_2017-2025_-_Final_0.pdf, 25 May 2025

AWF, 2025: African Water Facility, "Eligibility Criteria" https://www.africanwaterfacility.org/en/eligibility-criteria#:~:text=To%20be%20eligible%20to%20receive,water%20resource%20development%20in%20Africa. , 25 May 2025

AWF, 2025: African Water Facility: "About AUSII" https://www.africanwaterfacility.org/en/about-ausii, 25 May 2025

Climate Policy Initiative, 2024): "Understanding Global Concessional Climate Finance 2024", https://www.climatepolicyinitiative.org/wp-content/uploads/2024/10/Understanding-Global-Concessional-Climate-Finance-2024.pdf, 25 May 2025

Deutsche Klimafinanzierung, 2024: "OECD: Climate finance cracks the 100 billion mark" https://www.germanclimatefinance.de/2024/06/01/oecd-climate-finance-cracks-the-100-billion-mark/#:~:text=The%20next%20problem:%20Around%2070,crises%20at%20the%20same%20time, 25 May 2025

Green Climate Fund, 2024: Annex III Water Security Sectoral Guide: GCF Water Project Design Guidelines https://www.greenclimate.fund/sites/default/files/document/gcf-water-sector-project-design-guidelines-part-3.pdf, 25 May 2025

Green Climate Fund, 2025: "Status of Pledges and Contributions" https://www.greenclimate.fund/sites/default/files/document/2025-status-pledges-website-march-31.pdf, 25 May 2025

Green Climate Fund, 2025: "Resource Mobilisation: GCF-2" https://www.greenclimate.fund/about/resource-mobilisation/gcf-2, 25 May 2025

Green Climate Fund (2025): "Green Climate Fund announces support for adaptation, endorsement of COP initiatives" https://www.greenclimate.fund/news/green-climate-fund-announces-support-adaptation-endorsement-cop-initiatives, 25 May 2025

Water Aid, 2021: "Blueprint: financing a future of safe water, sanitation and hygiene for all", https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/blueprint-financing-a-future-of-safe-water-sanitation-and-hygiene-for-all.pdf, 25 May 2025

World Bank Group, 2018: "Strategic Use of Climate Finance to maximize Climate Action", https://openknowledge.worldbank.org/server/api/core/bitstreams/925165ce-e2d9-58a8-82d0-ff695b66ddc2/content, 25 May 2025

4.4 How can we assess and develop sanitation projects for climate finance?

- Understanding Green Climate Fund's strategy towards financing climate-resilient sanitation: Overview of the Investment Criteria and Expected Project Outcomes
- Learning how to develop climate-resilient sanitation projects that better align with the Green Climate Fund

Requirements for Sanitation Projects Seeking Green Climate Fund Approval

1) GCF's Investment Approach Towards Climate-Resilient Sanitation

As mentioned briefly in the previous chapter, the GCF defines a sanitation system as one that protects and promotes human health by providing a clean environment and breaks the cycle of disease. Additionally, it must be resilient to the impacts of climate change, such as increased rainfall, flooding, or droughts, meaning that systems should be designed in such a manner as to function effectively under varying climatic conditions and be adaptable to any future changes.

The GCF has established six investment criteria that guide its financing decisions to fund sanitation projects. These requirements aim to ensure that initiatives seeking GCF's support contribute to broader climate goals while addressing immediate needs fittingly.

The six GCF investment criteria are as follows *(Source: Green Climate Fund, 2024)*:

i. Impact Potential: The extent to which the sanitation project can achieve significant climate change adaptation and mitigation benefits. This can mean
   - Enhancing the resilience of sanitation infrastructure to climate impacts like floods and droughts,
   - Enhancing water conservation
   - Reducing gas emissions through energy-efficient treatment processes
   - Applying treated wastewater and fecal by-products to soil and agricultural lands

ii. Paradigm Shift Potential: Sanitation projects are evaluated on their ability to drive systematic change and safeguard long-term sustainable development, so projects are required to incorporate innovative concepts, such as circular economy, to treat and repurpose waste as a valuable resource, while being scalable to potentially be replicated or expanded to other regions.

iii. Sustainable Development Potential: Co-benefits of the sanitation project are assessed, including social, environmental, ad economic impacts. This may include
   - Enhancement of public health by reducing disease outspread

- Creation of jobs through the construction and maintenance of sanitation facilities and provision of sanitation services
- Economic benefits such as boosted tourism from cleaner environments

iv. **Needs of the Recipient:** Focus is placed on addressing the specific vulnerabilities and needs of the communities involved, particularly those most affected by climate change. Sanitation projects are expected to target underserved populations, ensuring access to resilient and sustainable sanitation services that protect them from climate-related threats such as flooding and water scarcity.

v. **Country Ownership:** Sanitation projects must be aligned with national climate strategies such as NDCs and the involvement of local stakeholders. They should be integrated into national and local development plans, have an element of community participation, and build local capacity to manage and sustain the sanitation infrastructure over the long term.

vi. **Efficiency and Effectiveness:** The sanitation project's cost effectiveness and capability of its financial structure to achieve the intended results are to be carefully assessed. Projects are required to demonstrate efficient use of resources and ensure that the financial models utilized are sustainable, thereby enabling successful long-term operation and maintenance of the sanitation facilities.

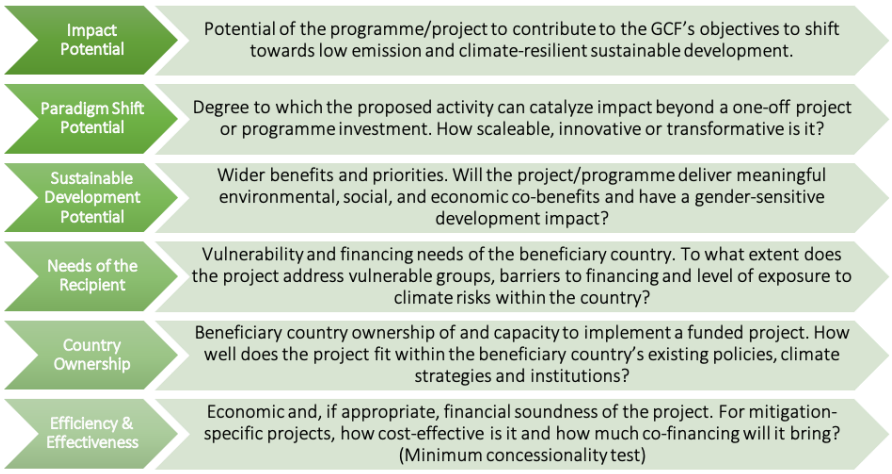


*Figure 19: Outline of GCF Investment Criteria (*Source: *MEA, 2021)*

2) What GCF expects from Potential Climate-Resilient Sanitation Activities

Furthermore, the GCF has established five specific strategies in the form of key outcomes it expects potential climate-resilient sanitation activities to deliver, and key enablers required to facilitate these outcomes. By focusing on the following areas, GCF aims to support and help create resilient, sustainable, and inclusive sanitation systems that successfully address the impacts of climate change.

Table 26: Key outcomes and Key enablers of GCF expected climate-resilient sanitation activities

Key Outcomes	Key Enablers
• Climate-resilient Infrastructure and Services: Building new or upgrading existing sanitation infrastructure, to achieve synergies between adaptation and mitigation, and withstand climate-related impacts along the entire sanitation chain. Examples include: o Decentralized climate-resilient sanitation and wastewater treatment o Flood-resistant sanitation systems o Raised latrines, sealable and removable containment, vacuum sewer systems, corrosion resistant design, and application of treated wastewater and fecal sludge by-products • Circular Economy and Integrated Management: Integrating sanitation with broader health, water, food, and energy security to ensure protection of ecosystems. GCF further emphasizes that is it essential in the urban context, to consider sanitation alongside wider urban services and development processes. Some examples of such integration can involve: o Efficient wastewater treatment ensuring safe reuse of treated water for potable, industrial, and agricultural uses in water-scarce regions o Preventing water- and excreta-related diseases through effective sanitation and wastewater management o Utilizing treated wastewater for agricultural irrigation, thus enhancing safe food production and security o Generating biogas from adequate sanitation systems and wastewater treatment plants, thus contributing to renewable energy supplies and reducing GHG emissions	• Community Engagement and Capacity Building: Empowering local communities through communication of climate risks and training and involvement in the planning and maintenance of resilient sanitation systems ensures sustainability and resilience of projects by leveraging local knowledge and fostering ownership. • Policy, Regulatory and Governance Support: Assisting governments in formulating and implementing policies that promote climate-resilient sanitation services and practices. Examples of such efforts could include: o Ensuring projects align with and strengthen relevant climate policies and plans, particularly NDCs o Ensuring policy frameworks promote safe circular economy approaches o Mainstreaming climate-resilient sanitation into regulations, guidelines, standards, and codes of practice at every step of the sanitation service chain • Monitoring and Evaluation: Implementation of robust systems for operational monitoring of climate-resilient sanitation systems, evaluating the impacts of climate change on sanitation, and evaluating the impacts of climate-resilient sanitation on community resilience. Data-driven activities ensure continual improvement and adaptation.

3) Additional Considerations for GCF Sanitation Proposals

Additional to the investment criteria and key strategies the GCF looks for in climate-resilient sanitation proposals, there are some other requirements that must be considered.

- Proposals must incorporate a climate risk assessment of the project, following the structure of the risk approach promoted in the "Global Water Partnership (GWP) /UNICEF WASH Climate Resilient Development Strategic Framework (2022)". The strategy can be found in the Resources section of the module for further reading. Essentially, the risk assessment must aim to answer the following questions:
    - How is the project vulnerable to climate change through sanitation-related hazards like drought, floods, and water stress?

- What are the impacts of the current and future climate on the project and the likelihood of inadequate performance of the project due to these impacts?
- *Mitigation:* How can the project contribute to reducing CO_2, CH_4, and N_2O emissions?
- *Adaptation:* How can the sanitation sector improve the performance of the project under climate induced hazards?

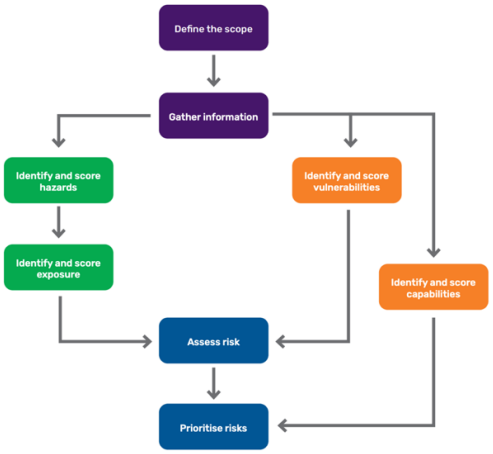


*Figure 20: Risk Assessment Approach (*Source: *GWP/UNICEF, 2022)*

- Sanitation proposals should also clearly state if they are seeking co-financing and how this is planned to be leveraged.
- As mentioned in the *GCF Water Security Sectoral Guide*, it is critical that climate-resilient WASH projects aim at improving the health and resilience of the concerned communities by addressing the entire WASH system, cross-cutting between climate adaptation and mitigation. As such, it is highly recommended and advisable that project developers explore demonstrating health benefits and impacts of their projects to strengthen the project's position, thus opening up opportunities for funding support.

Developing a GCF Proposal: A Step-by-Step Walkthrough

The GCF Water Project Design Guidelines lay out a clear, stepwise process for climate-resilient sanitation project development, offering guidance on various aspects that are required for a proposal to be successful and ensuring alignment with GCF investment criteria and key strategies.

The process is summarized and outlined below.

1. Define the vision on climate-resilient sanitation
    - Develop a **vision statement** that defines the key issues the project responds to and how it aims to contribute to climate resilience in sanitation.
2. Build the climate science articulation and the resulting problem statement
    - The **climate science articulation** provides a scientific basis for climate decision making, relying on past and current data on the climate system as well as projected impacts, to ensure that the project responds directly to specific climate change challenges. Supporting

information should be gathered from credible internationally peer reviewed climate data. The articulation should include:

- Assessment of present conditions, including climate hazards currently faced by sanitation systems
- Scenario planning outlining possible future problems
- Have an *Adaptation Component* that presents credible climate science and evidence to determine climate hazards, providing a robust assessment of exposure, impacts, vulnerability, and disaster risks
- Have a *Mitigation Component* that assesses energy efficiency in sanitation and wastewater processes and understand how they can contribute to reducing GHG emissions, through data collection of direct GHG emissions across the entire value chain, analysis of the collected data to highlight key areas where emissions can be mitigated, and evaluation of the existing sanitation technologies in place.
- *Climate risk assessment* of the project following the structure of the risk approach promoted in the "Global Water Partnership (GWP) /UNICEF WASH Climate Resilient Development Strategic Framework (2022)"

3. Identify Priority Measures and Strategies

   - Outline a robust set of measures that collectively and comprehensively address underlying climate risks and barriers and maximize sustainable development benefits.
   - The proposed measures should be built upon stakeholder consultation and reflect the priorities of key national stakeholders involved.

The following table can be used as a reference guide for key considerations to keep in mind when planning a climate-SMART sanitation project proposal for GCF funding, ensuring alignment with GCF investment criteria and the overall climate and sanitation strategy.

Table 27: Examples of Considerations Under the GCF Investment Criteria (Source: Green Climate Fund, 2024)

GCF Investment Criteria	Sub-criteria to Consider
Impact Potential (Mitigative, Adaptive, Resilient)	Mitigation impact indicator: - Project proposals should describe the expected reductions in emissions resulting from reducing GHGs through improved treatment processes Adaptation impact indicator: - Improving the resilience of sanitation infrastructure to climate impacts like floods and droughts
Paradigm Shift Potential (Transformative)	- Innovation - Potential for expanding the scale and impact of the proposed project - Potential for replicating proposed project elsewhere within the same sanitation sector as well as to other sectors, regions or countries - Contribution to the creation or strengthening of knowledge, collective learning processes, or institutions - Sustainability of outcomes and results beyond completion of the intervention - Circular economy component (e.g. biogas, nutrient recovery, wastewater reuse)
Sustainable Development Potential (Safe, Mitigative, Adaptive, Resilient)	- Expected positive environmental impacts - Expected positive social and health impacts - Expected positive economic impacts - Potential for reduced gender inequalities in climate change impacts and/or equal participation by gender groups
Needs of the Recipient (Adaptive, Resilient)	- Scale and intensity of exposure of people to risks derived from climate change - Level of social and economic development of the country and target population - Opportunities for the fund to overcome specific barriers to financing - Opportunities to strengthen institutional and implementation capacity in relevant institutions - Focus on addressing specific vulnerabilities and needs of underserved communities concerning sanitation that are affected by climate change - Strong Project proposals should describe the country's financial, economic, social and institutional needs and the barriers to accessing public, private and other international sources of climate related finance - How the proposed intervention will address the identified needs and barriers.
Country Ownership (Adaptive)	- Objectives are in line with priorities in the country's national climate strategy - Strong sanitation focused climate proposals should clearly alignment with the country's NDC and other relevant national plans, and/or climate change policies. - Effective sanitation projects will be integrated into national/local development plans, help build capacity to manage and sustain services over time and will have been developed in consultation with local stakeholders.
Efficiency and Effectiveness (Adaptive, Resilient)	- Cost-effectiveness of the project - Potential to catalyze and/or leverage investment - Expected economic and financial internal rate of return - Financial viability in the long run - Sanitation projects need to demonstrate efficient use of resources ensuring financial models are sustainable. - Projects should describe how the proposal applies and builds on the best practices in the sector. - Enable long term operation and maintenance of the facilities.

How can a country or organization access climate finance?

- Project development: Identification and elaboration of an eligible project
- Accreditation: Cooperation with an institution accredited by the GCF
- Application: Submission of a project proposal that meets the GCF criteria
- Proof of climate relevance: Presentation of climate impact and adaptation needs in the application.

What are typical challenges when applying for climate finance for sanitation projects?

- Proof of direct climate relevance
- Integration into national strategies (for example NDCs)
- Complexity of application processes
- Ensuring co-financing and sustainability
- Lack of local capacity for project development and monitoring.
- Size and paradigm-sift at sector level

What role does monitoring, reporting, and verification (MRV) play in climate finance?

MRV is essential for documenting the effectiveness, climate impact, and progress of a project. Only resilient MRV systems can prove the effect to donors and funds. This is a key prerequisite for disbursement and continuation of climate finance.

How can projects increase the chance of receiving funding from the GCF?

- Clear focus on climate impact and adaptation
- Proof of innovation and transformation potential
- Integration into national climate policy and NDCs
- Involvement of local actors and stakeholders
- Development of robust MRV systems
- Ensuring co-financing and sustainability.

Resources

- Green Climate Fund (2024), Annex III Water Security Sectoral Guide: GCF Water Project Design Guidelines https://www.greenclimate.fund/sites/default/files/document/gcf-water-sector-project-design-guidelines-part-3.pdf
- Multilateral Environmental Agreements – Republic of Trinidad and Tobago, "Climate Finance from the GCF" https://meastt.gov.tt/mea-focal-areas/the-green-climate-fund/climate-finance-from-the-gcf/
- Global Water Partnership/UNICEF (2022), "WASH Climate Resilient Development Strategic Framework" https://www.gwp.org/globalassets/global/about-gwp/publications/unicef-gwp/gwp_unicef_strategic_framework-2022-edition.pdf

Sources

Green Climate Fund, 2024: Annex III Water Security Sectoral Guide: GCF Water Project Design Guidelines https://www.greenclimate.fund/sites/default/files/document/gcf-water-sector-project-design-guidelines-part-3.pdf, 25 May 2025
GWP/UNICEF, 2022: Global Water Partnership/UNICEF (2022), "WASH Climate Resilient Development Strategic Framework" https://www.gwp.org/globalassets/global/about-gwp/publications/unicef-gwp/gwp_unicef_strategic_framework-2022-edition.pdf, 25 May 2025
MEA, 2021: Multilateral Environmental Agreements – Republic of Trinidad and Tobago, "Climate Finance from the GCF" https://meastt.gov.tt/mea-focal-areas/the-green-climate-fund/climate-finance-from-the-gcf/, 25 May 2025

4.5 What can we learn from real-world examples?

- **Learning from real-world cases of innovative climate financing to fund WASH initiatives in developing countries:** What were the existing challenges, how they were overcome, and what lessons can be learned?

This chapter explores two real-world cases where innovative climate financing was adopted to fund WASH initiatives in developing countries. The following examples of WASH projects were supported by innovative climate financing under challenging circumstances where public funds alone would not have been sufficient to drive systematic change in the sector. The initiatives were executed in low- and middle-income countries to offer WASH services to low-income, marginalized, and/or underserved populations. By examining the results and reception of each initiative, lessons can be learned to foster a deeper understanding of key considerations when developing initiatives in the WASH sector through innovative climate financing.

Blended finance approach - Bangladesh Output-Based Aid (OBA) Sanitation Microfinance Project

Background

The World Bank led Global Partnership for Results-Based Approaches (GPRBA) partnered with the Government of Bangladesh, through the Palli-Karma Sahayak Foundation (PKSF), to provide financial support to 170,000 impoverished households in rural Bangladesh for the construction of low-cost hygienic latrines.

The project aimed to facilitate subsidies for the households through the mobilization of commercial finance from microfinance institutions. Working through microfinance institutions was an ideal mechanism for reaching the intended households, as it has become a broad-based policy instrument to reach and assist the poor population and has also proven successful in empowering poor rural women in household decision-making processes.

The Challenge

With only 63% of Bangladeshis having access to improved, unshared sanitation facilities before the project, there was an urgent need to shift focus to improve the quality of sanitation facilities and practices. Furthermore, low-income households, which are most vulnerable to the effects of climate change, are generally located in rural coastal areas. Though assigned the role of service providers, many local governmental institutions also lacked the technical or financial capacity to deliver and sustain high-quality WASH services to meet the needs of their entire populations.

The Solution

The project employed a blended finance approach, combining grant funds with private finance to achieve a total project cost of US$25 million, thereby enabling subsidies for poverty-stricken households to access sanitation loans for the purchase of improved latrines.

The project promoted the construction of offset pit latrines, with the option to install dual pit latrines, as shown in the figure below. Offset pit latrines are easy to clean, and the option of dual pits enable households to use a second chamber when the first one is filled.

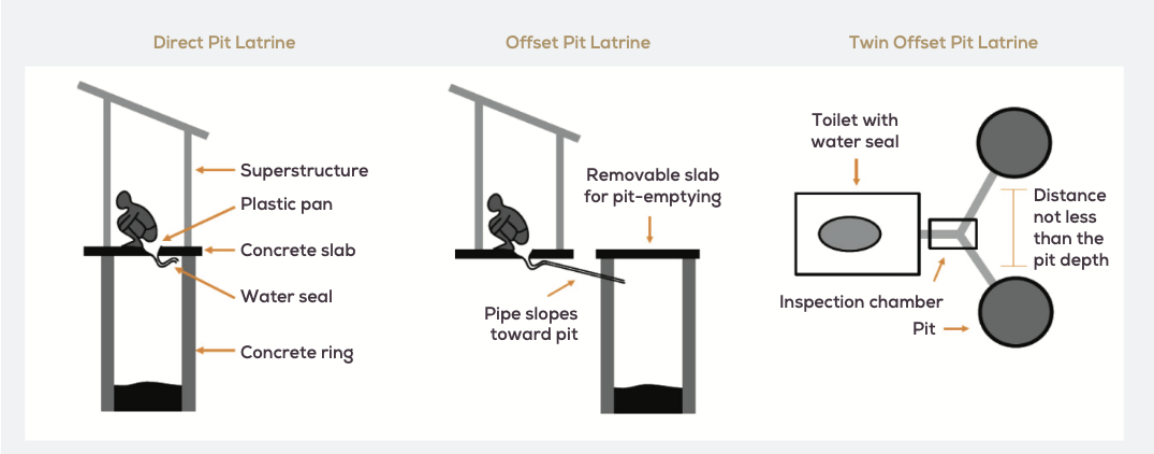


Figure 21: Improved latrine Design adopted by the OBA Project (Source: World Bank Group, 2020)

In vulnerable flood prone areas and especially during the monsoon season, there is high risk of water entering the latrine and contaminating the waste. Therefore, the constructed systems took this into consideration and raised the toilet structures and pits above the potential flood level. In addition, the use of durable materials like reinforced concrete or sturdy wooden structures can withstand heavy rain, wind, and potential flooding. The following images show the types of latrine systems constructed.

Figure 22: Types of Hygienic Latrines Deployed under the Bangladesh OBA Sanitation Project (Source: World Bank Group, 2020)

Financing Arrangement

GPRBA contributed US$3 million in the form of an output-based aid (OBA) grant, which helped to leverage an additional US$22 million in commercial sanitation loans from microfinance institutions.

The OBA grant is a form of results-based financing in which subsidies are paid to service providers based on the achievements of pre-set project targets. For this particular project, the OBA subsidies were used to:

- **Partially cover the cost of loans taken out by households to purchase improved latrines by covering loan interest for poor households:** This reduces the risks for microfinance institutions while also making the loans more affordable.
- **Partially cover the total capital cost of the improved latrines:** With the subsidy equaling the interest amount of the loan provided, the loans were promoted as "interest-free loans" with the opportunity to be paid in installments.

The Results

The project successfully funded the promotion and construction of 170,679 latrines over a 9-month period, surpassing its 170,000 target, which is a major accomplishment compared to other sanitation programs in the country. Over 750,000 people were provided with access to improved hygienic sanitation facilities under the project, achieving a 99.99% satisfaction rate for both the installation process and the functionality of the systems. Furthermore, 96% of the sanitation loans were taken up by female borrowers.

The loans were used by households to pay trained and pre-certified local construction firms of their choosing, to carry out the construction of improved hygienic latrines, and Only 0.83% of the customers had overdue loans *(Source: World Bank Group, 2020)*.

The OBA grant to microfinance institutions was a successful innovation for mobilizing commercial capital and achieving project objectives, with the initial US$3 million invested by the World Bank leveraging an additional US$22 million in private investment.

The project also developed the capacities of small businesses in rural areas through the training of local entrepreneurs on the construction and sale of improved hygienic latrines.

Lessons to be Learned

The Bangladesh OBA Sanitation Project demonstrated how carefully designed public funding can mobilize significant commercial resources to greatly improve the sanitation sector withing a country. Various success factors contributed to the project's impactful results:

- The carefully considered combination of sanitation loans favorable for both households and small businesses created incentives for microfinance institutions to invest in the construction of improved sanitation.
- Greater engagement of women and local entrepreneurs led to investments in the construction and widespread deployment of higher quality latrine facilities catered for the specific needs of the population.

It was through the innovative nature of the financing model, in combination with the integration of climate and sanitation focuses that the funding was possible, thus resulting in the successful implementation of the project.

However, the project results also highlight a limitation in that it was less able to reach the ultra-poor population that are not part of local credit groups. In order to increase the reach of such programs to cater to all economic groups of the population, instruments such as social safety net programs and local government subsidies need to be incorporated into the OBA grant structure to further reduce the costs bore by the customers.

Blended Finance - Kenya Innovative Finance Facility for Water (KIFFWA)

Background

The Kenya Innovative Finance Facility for Water (KIFFWA) was set up in 2016 with funding support from the Embassy of the Kingdom of the Netherlands (EKN) in Nairobi, with a purpose to draw private and commercial finance into the WASH sector of Kenya. KIFFWA targets projects across all water sub-sectors, including sanitation, drinking water supply, irrigation, hydropower, and water resource management.

KIFFWA was not originally established to invest in the implementation of water-related projects, but merely to fund early-stage project preparation activities. Since 2018 however, it is also mandated to intervene throughout the entirely of the project preparation stage.

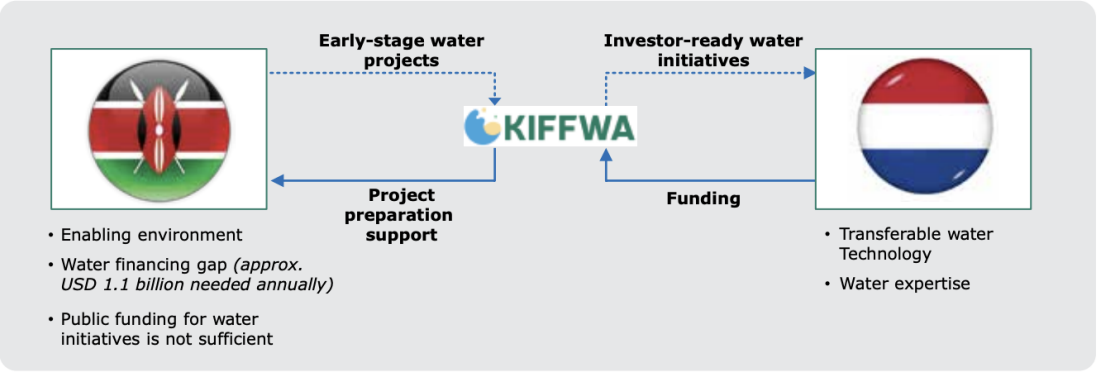


Figure 23: The KIFFWA Initiative (Source: KIFFWA, 2022)

The Challenge

Large investments are urgently required in the WASH sector of Kenya, which cannot be borne by the public sector alone due to budget constraints. Additionally, the sector lacks bankable projects that have the potential to attract private investors. This has resulted in a poor track record regarding private-led investment in the country, as historically the government has carried out nearly all investment projects for the sector.

The Solution

KIFFWA recognized the private investment gap in the WASH sector of the country and designed itself to help de-risk private and commercial capital, which could potentially attract developers to co-invest in projects by mobilizing commercial finance, utilizing blended financing concepts. It aims to bridge the gap by:

- Providing early-stage capital to cover project identification and preparation costs
- Providing technical, legal, and financial expertise in project preparation activities
- Supporting project developers in mobilizing commercial finance

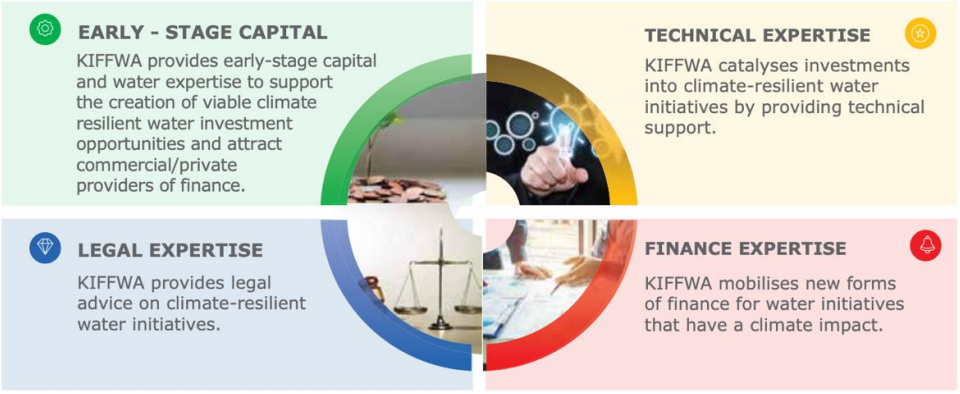


Figure 24: KIFFWA Services for Project Developers (Source: KIFFWA, 2022)

Financing Arrangement

In 2016, EKN provided €15 million (approximately US$19 million) in seed funding to help launch KIFFWA, aiming to support water sector projects and attract over €145 million in commercial investment. This initial seed funding enabled early-stage project identification and preparation.

KIFFWA funds a maximum of 50% of the project development budget and the funding is provided under the following conditions:

- Projects must operate within water-related sectors such as sanitation and hygiene, hydropower, drinking water, irrigation, and water resource management.
- Projects are required to demonstrate financial viability and deliver positive social, economic, and climate benefits.
- Funding can be used for technical studies, legal advisory and structuring support, financial modeling, and fundraising activities.
- Repayment terms are negotiated and agreed upon between the lead developer and KIFFWA after financial close.

The Results

As reported in 2021, operation of KIFFWA has led to the mobilization of US$315 million of commercial investment from a development budget of US$19 million spanning across 17 projects *(Source: IWC, 2021)*. Primarily, it has worked on "greenfield" projects, which involve building water and sanitation infrastructure on previously undeveloped land. It has largely focused on drinking water projects and underperformed with delivering specific development outcomes in sanitation, with only one dedicated sanitation project, yet to reach financial close.

Despite the lack of assessable outcomes in sanitation, KIFFWA has played an important role in the water sector in Kenya. It has had several impacts on the sector such as:

- Raising awareness on the potential of WASH developments for future investors
- Enhancing and mobilizing local ecosystems and stakeholder cooperation and influencing policy changes that benefit the sector

Lessons to be Learned

KIFFWA continues to be relevant with its objective to mobilize private sector finance, which is lacking and needed in the Kenyan context. However, there are some important considerations to make to adopt such a financing model to drive impactful developments in the sanitation sector.

- A country's historic dependence on public spending for WASH sector developments greatly influence how quickly and effectively such a model can be implemented.
- Knowledge of the local context is critical for blended finance initiatives to thrive in. A strong technical partner who understands the local WASH sector and finance contexts is vital.
- A mixture of finance and local industry expertise is critical for the identification of local resources and their management.
- The relationship between the project planning entity and other aid entities in the concerned project setting should be fostered to ensure that potential collaboration with these other entities can be effective.
- Planning stages for WASH sector greenfield projects are often extensive and take long amounts of time to come to life, especially in contexts with poor track records of private-led financing of the sector.
- Blended finance for WASH operates most effectively within a strong and supportive enabling environment and models such as KIFFWA, in its current form, require continual funding for operational support. For example, additional public funding support would allow for investing in underfinanced priority areas such as sanitation.

Resources

- World Bank Group (2020), "Bangladesh OBA Sanitation Microfinance Program" https://www.gprba.org/sites/default/files/publication/downloads/2020-09/Bangladesh-sanitation-GPRBA-case-study.pdf

- Kenya Innovative Finance Facility for Water, "KIFFWA Brochure" https://kiffwa.com/wp-content/uploads/2022/07/KIFFWA-Brochure.pdf

- International Water Centre (2021), "Case Study Assessment: Blended Finance in WASH – Lessons for Development Partners" https://watercentre.org/wp-content/uploads/2024/04/Blended-Finance-for-WASH-Lessons-for-Development-Partners-Final-Report-Public.pdf

Sources

IWC, 2021: International Water Centre (2021), "Case Study Assessment: Blended Finance in WASH – Lessons for Development Partners" https://watercentre.org/wp-content/uploads/2024/04/Blended-Finance-for-WASH-Lessons-for-Development-Partners-Final-Report-Public.pdf, 25 May 2025

KIFFWA, 2022: Kenya Innovative Finance Facility for Water, "KIFFWA Brochure" https://kiffwa.com/wp-content/uploads/2022/07/KIFFWA-Brochure.pdf, 25 May 2025

World Bank Group, 2020: "Bangladesh OBA Sanitation Microfinance Program" https://www.gprba.org/sites/default/files/publication/downloads/2020-09/Bangladesh-sanitation-GPRBA-case-study.pdf, 25 May 2025

KEY TAKEAWAYS

- Climate finance is an essential component of the Climate-Sanitation Nexus and is an enabler to deliver context-specific and appropriate sanitation solutions to regions vulnerable to the effects of climate change and lacking as well domestic funding to address challenges faced concerning sanitation due to climate change.
- Climate finance is continually evolving and is starting to place an emphasis on climate adaptation and recognize the importance of promoting climate-SMART sanitation , to ensure that immediate and future global sanitation needs are met, however a funding gap still exists when compared to other climate mitigation-focused sectors such as energy and transport.
- Local context is critically important and so, climate financing initiatives require strong local partners who understand the local WASH and finance contexts and enabling environments,
- There is no one-size-fits all approach regarding climate financing methods, however lessons can be learnt from innovatively funded climate-SMART projects that can provide great insights into how they can be effectively implemented and the considerations that must be made.

5 Module 4: Carbon Markets for Sanitation

5.1 What are carbon credit projects and carbon credits?

- **Introducing Carbon Credits and Carbon Credit Projects:** Definition of carbon credits and carbon credit projects
- **Explaining CO_2 Equivalent:** Understanding the standard measure for comparing greenhouse gas emissions
- **Highlighting Benefits of Carbon Credits:** Key advantages of using carbon credits to fund and enhance climate initiatives

Climate action can be a challenge. A government or company might have identified its emissions sources, calculated GHG emissions, and implemented reduction and avoidance measures. However, in most cases, some unabated emissions that can neither be reduced nor avoided yet due to technological or financial restrictions remain. While new technologies and measures are being developed that will further support achieving reduction goals, these unabated emissions can be compensated (or offset) by purchasing and retiring an equivalent amount of carbon credits from internationally recognized *carbon credit projects*.

Carbon credit projects are verified activities of environmental conservation, energy efficiency or renewable energy which reduce, avoid, or remove GHG emissions from the atmosphere and contribute to the mitigation of climate change by issuing verified and certified carbon credits. The investment in such project activities (also called carbon finance) helps governments and companies to achieve their legally required or voluntarily imposed emission reduction targets and to promote sustainable development in developing countries.

In addition to the climate impact, carbon credit projects are commonly associated with environmental and social impacts, as well as sustainable development. For example, a project that includes the distribution of clean cooking stoves enhances air quality and may result in the development of infrastructure that creates employment opportunities, enables education, improves living conditions for local communities, in particular for women, and reduces the consumption of natural resources like firewood.

Carbon credits can be categorized according to three different dimensions: (i) type of mitigation, (ii) type of process/storage, or (iii) level of implementation. The following diagram shows the different categories and provides examples of project types and an estimate of carbon credit issuance volumes:

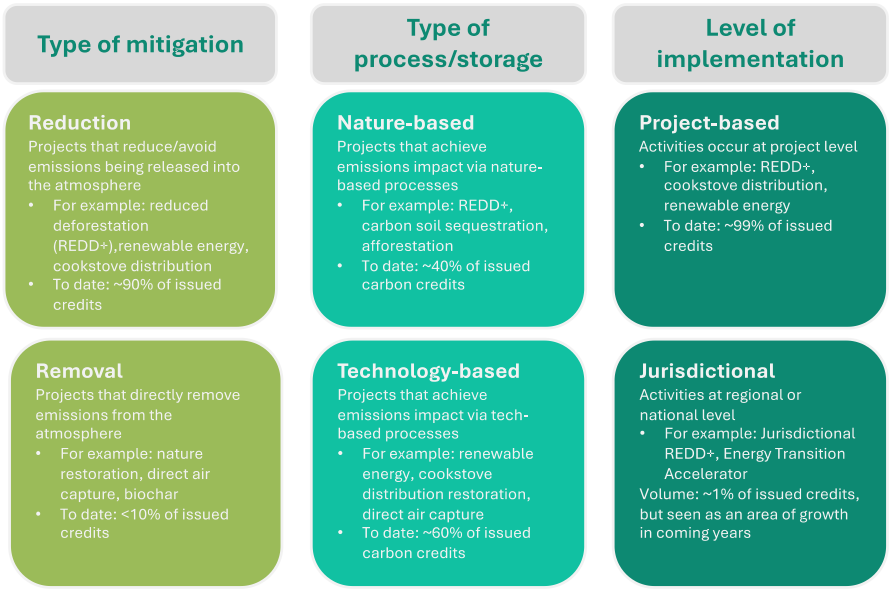


Figure 25: Overview of the Different Types and Categorizations of Carbon Credits (Source: MSCI)

With respect to the type of mitigation, **sanitation carbon credit projects** focus on **emission reduction** by actively managing human waste to prevent methane and nitrous oxide emissions that might otherwise result from unmanaged or outdated anaerobic decomposition in septic tanks or untreated wastewater.

Regarding the type of process or storage, sanitation projects can be classified as either **nature-based or technological**, depending on the specific treatment or management approach employed. For example, carbon credits projects might be considered nature-based if biological processes, such as those involved in constructed wetlands, are utilized. If mechanical processes such as advanced wastewater treatment plants or biogas capture systems are implemented, the carbon credit can be classified as technology-based.

In terms of implementation, sanitation interventions are predominantly realized through **time-bound**, project-based approaches, often lacking long-term institutional integration, sustainable financing mechanisms, or alignment with national adaptation and development planning frameworks.

The classification of carbon credits is relevant for project developers, carbon credit buyers, regulators, and investors, as each type offers distinct climate, social, and economic co-benefits, as well as different risks and permanence profiles. The classification is not only relevant for market differentiation and buyer preferences but also relates to regulatory and corporate net-zero strategies. Many potential buyers or partners for carbon credits are setting specific requirements for the types of credits they are looking for or they use to meet their climate commitments or net-zero targets.

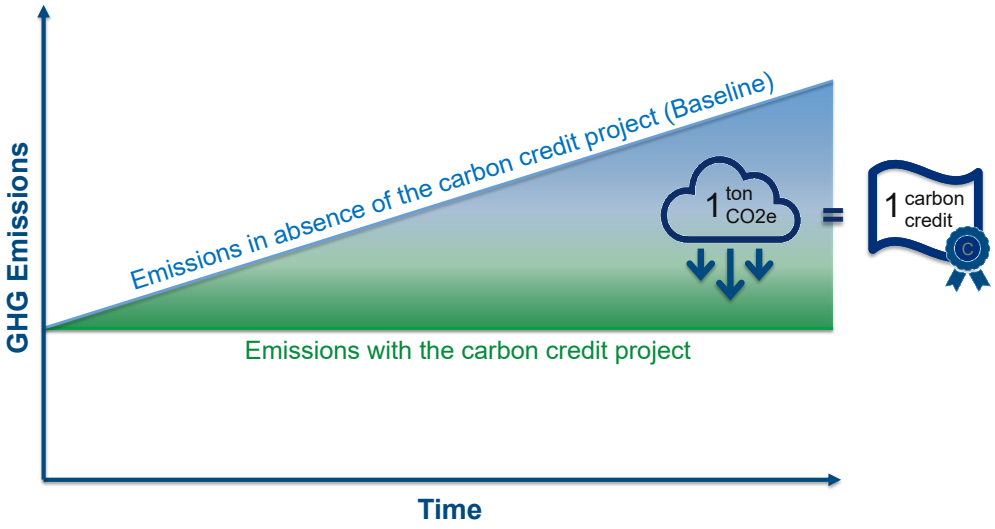
To accurately track and compare the impact of diverse climate actions, a standard metric is required. That is where the concept of carbon dioxide equivalent (CO_2 equivalent or CO_2-eq) comes in. As a reminder from Module 1 (Climate-Sanitation Nexus), CO_2-eqq is a metric measure used to compare the emissions from various GHG based on their global-warming potential (GWP). By converting amounts of other gases to the equivalent amount of carbon dioxide with the same GWP, evaluation, reporting and offsetting emissions across projects and sectors is made possible:

$$(Million\ Metric\ Tons\ of\ CO_2eq\ ) = (Million\ Metric\ Tons\ of\ a\ Gas) * (GWP\ of\ the\ Gas)$$

Table 28: GWP values of main Greenhouse Gases (IPCC AR6)

Greenhouse Gas	GWP values (IPCC 6th Assessment Report (AR6))	
	20-year time horizon	100-year time horizon
Methane (CH_4)	GWP-20: 79.7 ± 25.8 (non-fossil)	GWP-100: 27 ± 11
Nitrous Oxide (N_2O)	GWP-20: 273 ± 118	GWP-100: 273 ± 130
Carbon Dioxide (CO_2)	GWP: 1	GWP: 1

A carbon credit is a verified and tradeable certificate representing the reduction (avoidance) of 1 tCO_2-eqq from being put into the atmosphere, or the removal of 1 tCO_2-eqq from the atmosphere.



Carbon credits, also known as CO_2 certificates or carbon offsets, are tradable units that represent the reduction, avoidance or removal of one ton of carbon dioxide or an equivalent amount of another greenhouse gas. These credits are generated by climate action projects that either reduce existing emissions or prevent future emissions, such as in renewable energy, reforestation, or energy efficiency. The targeted use of carbon credits offers several scientifically recognized advantages for financing and enhancing climate initiatives.

One key benefit is that carbon credits enable companies and countries to finance emission reductions where they can be achieved most cost-effectively. This allows them meeting their reduction targets at much lower costs in comparison to carrying through their own abatement measures. This supports the implementation of projects that would not have been realized without this additional funding (the principle of additionality, see chapter 5.4). Projects must meet strict criteria, including verifiability and permanence of the emission reductions, which are independently verified. This ensures that credited reductions are real and long-lasting (World Bank, 2023).

On the demand-side and from the perspective of a buyer in, for example, a developed country, carbon credits provide an opportunity to offset (still) unavoidable emissions and thus achieve ambitious climate targets such as net zero in time and at reasonable cost and effort. By establishing an adequately high internal carbon price, they create incentives for faster decarbonization of their businesses and can allocate meaningful funds to certified best-practice mitigation projects. Studies indicate that companies using carbon credits at scale reduce their emissions on average twice as fast as those that do not (Ecosystem Marketplace, 2023). Beyond direct emission reductions, carbon credits can also help meet regulatory requirements and improve corporate reputation among customers, investors, and partners.

On the supply-side and from the perspective of a seller in a e.g. developing country, carbon credits can provide a reliable and performance- or results-based financing mechanism that supports the operational stability of climate action projects throughout the entire crediting period. Since carbon credits are only issued, when verifiable greenhouse gas (GHG) reductions are achieved, this model creates a strong incentive for effective project implementation, precise monitoring, verification and reporting (MRV), and full compliance with international carbon market standards.

The income generated from the sale of carbon credits can be used to cover essential operational and maintenance costs, fund local employment, and support ongoing verification and reporting efforts—elements that are often underfunded in development or infrastructure projects. Especially in contexts where traditional or government funding is limited, carbon finance can ensure the continuity of services such as waste treatment, wetland management, or decentralized energy systems. Moreover, for many projects, carbon revenues serve as a critical financial bridge during the early years of implementation, enabling the initiative to scale, stabilize, or prepare for long-term integration into national systems or user-financed models after the crediting period ends.

All in all, carbon credits are an important means of global climate finance as they can channel substantial public or private sector funds via different carbon markets to the most successful mitigation projects in developing countries. This helps achieving both the objectives of the Paris Agreement, NDCs and the UN Sustainable Development Goals (SDGs).

However, the actual climate impact of carbon credits strongly depends on the quality and integrity of the underlying projects. Reductions can be overestimated, and sometimes significant concerns regarding verification and additionality of the projects can be discussed. For the buyers and users of carbon credits this poses a risk of greenwashing with potential reputational damage, and can undermine trust in carbon credit projects and the carbon market in general to the detriment of climate protection (West et al., 2023).

Sources

MSCI: MSCI: Understanding Carbon Markets, December 2024

Newell: Richard G. Newell, William A. Pizer, Daniel Raimi: Carbon Markets – Past, Present and Future, December 2012 https://media.rff.org/documents/RFF-DP-12-51.pdf, 25 May 2025

World Bank. 2023. State and Trends of Carbon Pricing 2023. World Bank. http://hdl.handle.net/10986/39796, 25 May 2025

Ecosystem Marketplace (2023). Voluntary Carbon Market Insights. https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-market-report-2023/, 25 May 2025

West et al., 2023: West, T. A. P., et al. (2023). Overstated carbon emission reductions from voluntary carbon markets. Science, 380(6649), 141-145. https://www.researchgate.net/publication/344246090_Overstated_carbon_emission_reductions_from_voluntary_REDD_projects_in_the_Brazilian_Amazon, 25 May 2025

5.2 Basics of Carbon Markets

- **Carbon Market Evolution:** Overview of the evolution of carbon markets from the Kyoto Protocol to Paris Agreement Article 6
- **Main types of Carbon Markets:** Understanding the different carbon markets and their implications
- **Carbon Credit Standards:** Overview of major frameworks

The Evolution of Carbon Markets

Carbon markets are carbon pricing mechanisms enabling governments and non-state actors to trade carbon credits. The aim is to achieve climate targets and cost-effectively implement climate actions. The history of carbon markets goes back to the 1980s.

The 1980s and 1990s witnessed a growing awareness of climate change risks and the associated need to reduce GHG emissions. This led to international agreements, such as the 1992 UN Framework Convention on Climate Change (UNFCCC), where nations committed to limiting greenhouse gas (GHG) emissions. During the same period, emission trading emerged as a practical and increasingly popular policy tool for addressing pollution control, influenced by programs such as the U.S. acid rain trading system and the Montreal Protocol, which regulates substances that deplete the ozone layer. This set the stage for carbon markets, culminating in the 1997 *Kyoto Protocol*, which set up a system of emissions limits for a basket of six GHGs (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and Sulphur hexafluoride) for developed countries, mechanisms for those developed countries to trade their emissions limits, and mechanisms for developed countries to offset their emissions by financing emissions reductions in developing countries. (Source: Newell)

Due to a complex ratification process, the Kyoto Protocol entered into force on 16 February 2005. It places a heavier burden on developed countries under the principle of "common but differentiated responsibility and respective capabilities", because it recognizes that these countries are largely responsible for the high levels of GHG emissions in the atmosphere. While the countries were supposed to meet their targets primarily through national measures, the Protocol offers additional means to meet targets by way of three market-based mechanisms:

- International Emissions Trading: Allowed countries with surplus emission units to sell them to others that were over their limits.
- Clean Development Mechanism (CDM): Enabled developed countries to invest in emission-reduction projects in developing countries and count the resulting reductions toward their targets.
- Joint Implementation: Permitted developed countries to carry out emission-reducing projects in other developed countries and share the resulting credits.

The *Paris Agreement*, adopted in 2015 and entered into force in 2016, marked a significant evolution in global climate governance and the role of carbon markets. Unlike the Kyoto Protocol, which set binding emissions targets only for developed countries, the Paris Agreement requires all countries to set and regularly update their climate targets, known as Nationally Determined Contributions (NDCs). The NDCs,

including type, ambition, and scope of targets, are self-determined by countries, rather than being based on internationally agreed carbon budgets for each country. However, the achievement of NDCs is not legally binding.

A key innovation of the Paris Agreement is Article 6, which established new frameworks for international carbon markets. It allows Parties to voluntarily cooperate to achieve their emission reduction (mitigation) targets set in NDCs. Especially Article 6.2 and Article 6.4 are of significant interest for carbon markets:

- Article 6.2 – Basis for country-to-country emissions trading: Article 6.2 consists of an overarching framework for voluntary cooperation between countries to achieve global climate goals and sets the rules for international cooperation on the trading of mitigation outcomes. It enables nations to trade emissions reductions bilaterally and introduces the concept of Internationally Transferred Mitigation Outcomes (ITMOs), which are authorized by the relevant host country and can be traded amongst other countries to support the achievement of their NDCs. This mechanism relies on a robust accounting framework to avoid double-counting of emissions, ensuring transparency and environmental integrity.

- Article 6.4 – International mechanism for trading of carbon credits by countries or companies: Article 6.4 establishes a centralized international crediting mechanism, as a successor to the Kyoto Protocol's Clean Development Mechanism, also known as the Paris Agreement Crediting Mechanism (PACM). Under Article 6.4, project developers can generate carbon credits from approved GHG mitigation activities, which can be purchased by countries, companies, or individuals. The mechanism requires greater host country involvement, due to the need to approve projects seeking registration and to authorize the transfer of Article 6.4 Emission Reductions (A6.4ERs) as ITMOs generated by the projects.

- Corresponding Adjustments (CA): To prevent emissions reductions being claimed more than once, Article 6 introduces an accounting mechanism called a corresponding adjustment. By design, a CA aims to ensure that the same ton of CO_2-eq avoided or removed cannot be counted by more than one country toward its national climate target. CAs represent a key element of authorization in the Article 6 framework. For example, if a carbon credit project in country A sells credits with CA authorization, it means the country A government cannot claim the emissions that project reduces against their own national climate target. At the same time, a CA enables another country to use Rwanda's emission outcomes toward its target. (Source: MSCI)

Overview of the Main Existing Carbon Markets

There are two primary types of carbon markets: compliance markets and voluntary markets. Compliance carbon markets are created based on national, regional and/or international policy or regulatory requirements. Voluntary carbon markets – national and international – refer to the issuance, buying and selling of carbon credits, on a voluntary basis. Both types play a critical role in mobilizing resources for climate action and supporting global emission reduction targets.

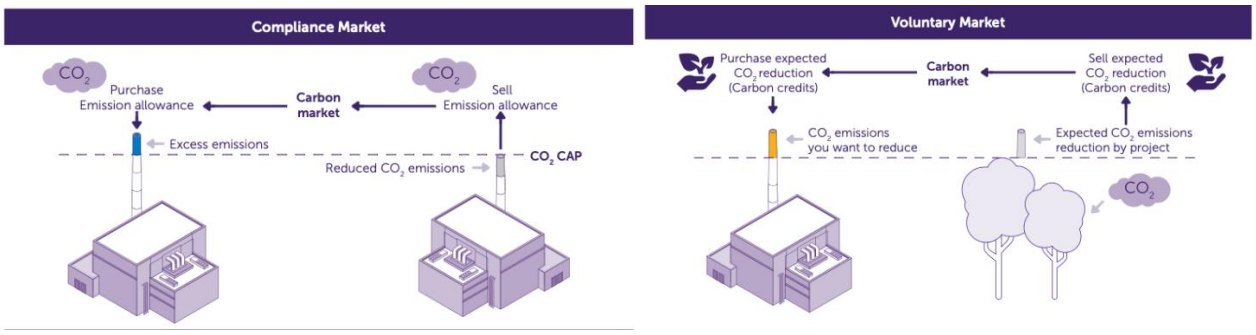


Figure 26: Compliance (left) and Voluntary (right) Carbon Markets (Source: AFM)

In mandatory or ***compliance carbon markets***, the government prescribe a set amount of carbon emissions, a so-called maximum "cap". Companies are obliged to hold one permit for every ton of emissions they release. They may receive, buy or trade permits and their value represents the carbon price. This principle of "Cap-and-Trade" is applied in so called Emissions Trading Systems (ETS). Another carbon pricing instrument under the compliance market is the carbon tax. With a carbon tax, the government sets a tax rate and companies covered by the tax are obliged to pay this amount for every ton they emit. (Source: ICAP2) Based on a Status Report from 2025 from the International Carbon Action Partnership about Emissions Trading Worldwide, 38 ETS are in force, 11 ETS are currently under development and 9 more are under consideration. However, there is no ETS yet established in Africa. (Source: ICAP) Instead, South Africa has established a carbon tax, and several countries do consider or are developing ETS or carbon tax mechanisms. See the following map for an overview of existing ETS and carbon tax mechanisms around the world. Both, ETS and carbon tax, are implemented by the countries with the objective to meet their emissions reduction targets fixed in the Nationally Determined Contributions (NDCs).

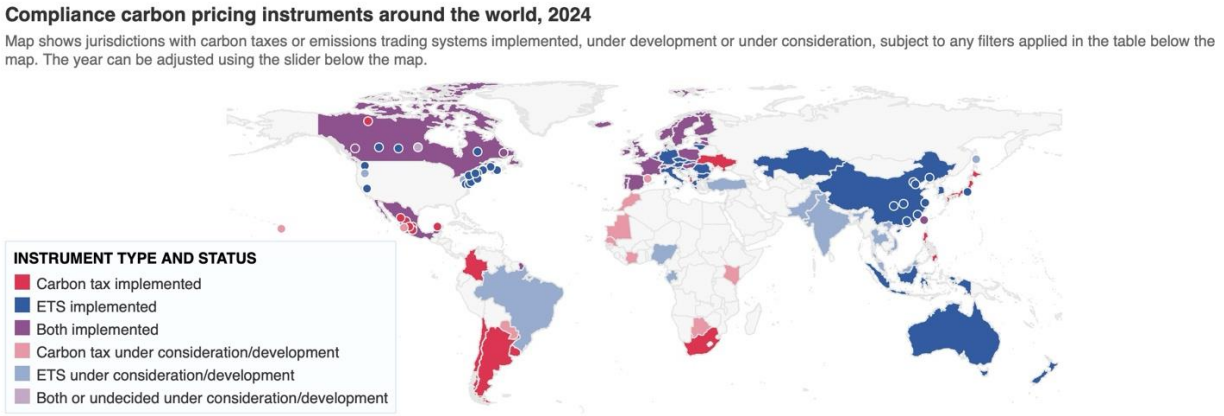


Figure 27: Global Map of Carbon Taxes and Emissions Trading Systems (Source: WB)

The ***voluntary carbon market (VCM)*** doesn't apply fixed allowances or permits under a cap-and-trade system but instead functions under a project-based framework. The emphasis is on individual projects or initiatives aimed at emission reduction or removal. While the voluntary market is notably smaller in scale compared to the compliance market, it is expected to grow further in the forthcoming years.

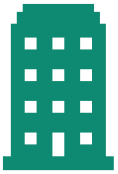
Over the years, two programs for offsetting CO_2 emissions have been established within the VCM. The first is a reduction/avoidance program that aims to reduce/avoid emissions by improving or replacing existing processes. It has been active for many years and can be considered the original approach within the VCM. The second program, which has mainly gained importance in the last three to four years, is based on removal projects that aim to absorb greenhouse gases from the atmosphere, e.g., through technology-based projects such as carbon capture and storage (CCS), biochar or reforestation. Businesses striving towards net zero tend to consider removal projects. Businesses whose goals are to achieve carbon-neutrality will consider reduction projects for delivering CO_2-eq offsetting. (Source: Deloitte)

In addition to the two main types of carbon markets, the ***Paris Agreement Article 6*** introduces new international mechanisms that can interact with both compliance and voluntary markets. Article 6, as introduced in the upper section on the evolution of carbon markets, creates a framework for countries to trade emissions reductions to help meet their NDCs. Its mechanisms, such as ITMOs, can be used by governments under the compliance market and, also, by voluntary buyers if authorized by the host country.

Other frameworks that span or connect both main carbon markets are ***international sectoral carbon markets*** such as CORSIA for aviation. These sectoral carbon markets often align with international agreements or sector-specific regulations. They can use carbon credits from both voluntary and compliance systems, depending on the rules set by the sector or international body.

The following table summarizes key aspects of the two main carbon markets and the frameworks that connect them.

Table 29: Key Aspects of Voluntary and Compliance Carbon Markets as well as Carbon Markets under Paris Agreement Article 6 and International Sectoral Carbon Markets

 Voluntary Carbon Markets	 Compliance Carbon Markets	 Carbon Markets under Paris Agreement Article 6	 International Sectoral Carbon Markets
Self-regulated and non-mandatory	Legally mandated with strict oversight	Governed by international rules under Article 6 of the Paris Agreement	Sector-specific rules that are often international
For corporate responsibility and branding	To meet legal emission limits and to enforce GHG emission reductions	Facilitating international cooperation and allowing trading between countries	To address sectoral GHG emissions
Any company, NGO or individual can participate	Regulates industries and governments	Concerns national governments and authorized entities	For companies within a specific sector
Small market size	Large market size	Growing, global scope	Market size varies by sector
Applies voluntary standards such as Verified Carbon	Applies national / regional frameworks such as EU ETS	Applies UNFCCC guidance and Article 6 rules	Applies sectoral agreements such as CORSIA for the aviation sector

Standard (VCS) and Gold Standard (GS) No enforcement. Only risk is reputational.	Enforced with legal penalties for non-compliance.	Requires international reporting and verification.	Enforces sector-specific compliance mechanisms.

Carbon Credit Standards

A standard provides the specific set of criteria, methodologies and requirements that projects or credits must meet to be recognized as valid within a given framework.

Key standards include the concept of the Clean Development Mechanism (CDM) that is being phased out and replaced by the new mechanism under Article 6.4 of the Paris Agreement.

As of 2025, this transition process is ongoing. The transition rules are outlined in the UNFCCC document "Transition of CDM activities to the Article 6.4 mechanism", the most recent version of which (version 5) was published on 16 May 2025. The deadline to submit a transition request for CDM project activities or Programs of Activities (PoAs), excluding afforestation and reforestation (A/R) projects, passed on 31 December 2023. A list of "CDM activities requested for transition to the Article 6.4 mechanism" is available on the UNFCCC website. Host Parties must provide their approval to the UNFCCC Supervisory Body for the transition of CDM activities to the Article 6.4 mechanism by 31 December 2025. Once this approval is granted, the transition process proceeds through several stages, including the submission of additional documentation, the substantive assessment of the transition request, the option to request a review of the request, and the finalization of the transition.

As of 16 May 2025, a total of 634 CDM project activities, including CPAs under PoAs, in African countries had submitted transition requests. Among these, 152 projects received host Party approval. Of those, 128 were pending additional documentation from project participants, 21 had completed the substantive check, and 3 were under review. The remaining 482 projects were still awaiting host Party approval. Further details can be found in the Article 6 pipeline on the UNEP CCC website (unepccc.org).

Regarding certification under the Article 6.4 mechanism, the UNFCCC has already issued several procedures and standards, with further guidance—including methodologies, tools, guidelines, and forms—expected to be published progressively. According to version 5 of the transition document, a CDM project activity or PoA (and its CPAs) approved for transition may continue using its current CDM methodology until the earlier of either the end of its current crediting period or PoA period, or 31 December 2025. After that date, it will be required to apply an Article 6.4 mechanism methodology. As of June 2025, methodologies under the A6.4 mechanism have not yet been made available, and the A6.4 registry is not yet operational.

Voluntary carbon markets operate outside of regulatory requirements and are complemented by independent standards, while the quality of the applied standards can vary. However, it is strongly recommended to always use the highest quality standards, which might enable access to both markets, voluntary and compliance. Notable standards include the Verified Carbon Standard (VCS) by Verra and Gold Standard for Global Goals (GS4GG) by Gold Standard (GS). Additional examples are presented in the table below.

Some of the high-quality voluntary standards, such as VCS and GSCC, are also being accepted in some compliance markets, especially in countries with more flexible offset policies such as South Africa. GS has been aligning with the Paris Agreement by publishing procedures that enable host country authorizations under Article 6 to be attached to credits. On 24 April 2025, it released version 3.1 of its requirements for Article 6–authorized credits, including an authorization checklist and supporting documentation; compliant GSVERs will be marked accordingly in the GS Impact Registry (registry.goldstandard.org).

Verra has introduced Article 6 authorization labels to identify VCUs based on mitigation type (reduction/removal), activity type (nature-based or technological), authorization scope (e.g., for NDC, CORSIA, or voluntary use), and sustainable development benefits. Project proponents may apply for up to three labels—"Article 6 authorized – NDC use," "Article 6 authorized – international mitigation purposes," and "Article 6 authorized – other purposes"—either during or after project approval. Verra assesses these applications based on submitted letters of authorization and, if approved, displays the Article 6 label publicly in its registry. Verra applied this label for the first time in 2023 to VCUs from the DelAgua Live Well Clean Cookstove Programme in Rwanda, based on a letter of authorization from the Rwanda Environment Management Authority, confirming Rwanda's intent to apply corresponding adjustments in its Paris Agreement reporting.

In the voluntary markets, rules, criteria, and methodologies vary depending on the standard provider. This lack of clarity and harmonization not only prevented scaling up the VCM but also resulted in an increasing skepticism around the quality of its carbon credits. In response, several new quality initiatives emerged. On the supply-side, the most prominent one is the Integrity Council for the Voluntary Carbon Market (ICVCM). The ICVCM operates as an independent non-profit governance body working to establish and maintain worldwide standards for integrity in the voluntary carbon market. It has developed the *Core Carbon Principles (CCPs)* to help buyers and intermediaries identify high-quality carbon credits. These CCPs are not a framework or standard themselves, but are ten fundamental, science-based principles that are used by the ICVCM to assess the most relevant carbon crediting schemes, as well as the most common mitigation project types and their applied emissions reduction or removal methodologies. In can be observed that more and more carbon credit buyers (not only in the VCM) ask for CCP-approved carbon credits. (Source: ICVCM)

In a similar non-profit approach but focusing on the demand-side, the Voluntary Carbon Markets Integrity Initiative (VCMI) has recently presented its "Claims Code of Practice", to provide end-users of carbon credits with the necessary guidance on how to make credible claims about the climate and SDG impacts associated with their carbon credit investments. (Source: VCMI)

In addition, some for-profit carbon credit rating agencies have entered the VCM in recent years. The most well-known are BeZero, Calyx Global, Renoster and Sylvera and the results of their GHG and SDG impact ratings are becoming more important for carbon credit sellers and buyers alike. Therefore, top-tier ratings of carbon credits might soon also be required in the eligibility criteria of compliance markets.

New frameworks, especially regarding Paris Agreement Article 6, will further blur the lines by allowing carbon credits to be used for both voluntary and compliance purposes, depending on national rules and corresponding adjustments. (Source: Thyssen)

The following overview of carbon markets under the Paris Agreement's climate regime summarizes how the different carbon markets are interlinked and what types of carbon credits can be used for what purposes in these markets subject to obtaining host country authorizations or not. In this context, it is important to point out that all authorized Internationally Transferred Mitigation Outcomes (ITMOs),

regardless of the PA Art. 6 mechanism or VCM standard they originate from, will always require a host country corresponding adjustment to avoid double counting prior to being used in any foreign sponsor country for meeting NDC, CORSIA or voluntary carbon offset targets. These ITMOs can then not be used anymore by the host country to meet its NDC. In contrast, non-authorized carbon credits, e. g. GS VERs, VCS VCUs, GCC ACCs or Art. 6.4 ERs and Mitigation Contribution Units (MCUs) will only be usable for voluntary contribution claims (end-user supports climate action abroad in project countries), domestic or regional schemes or results-based finance (RBF).

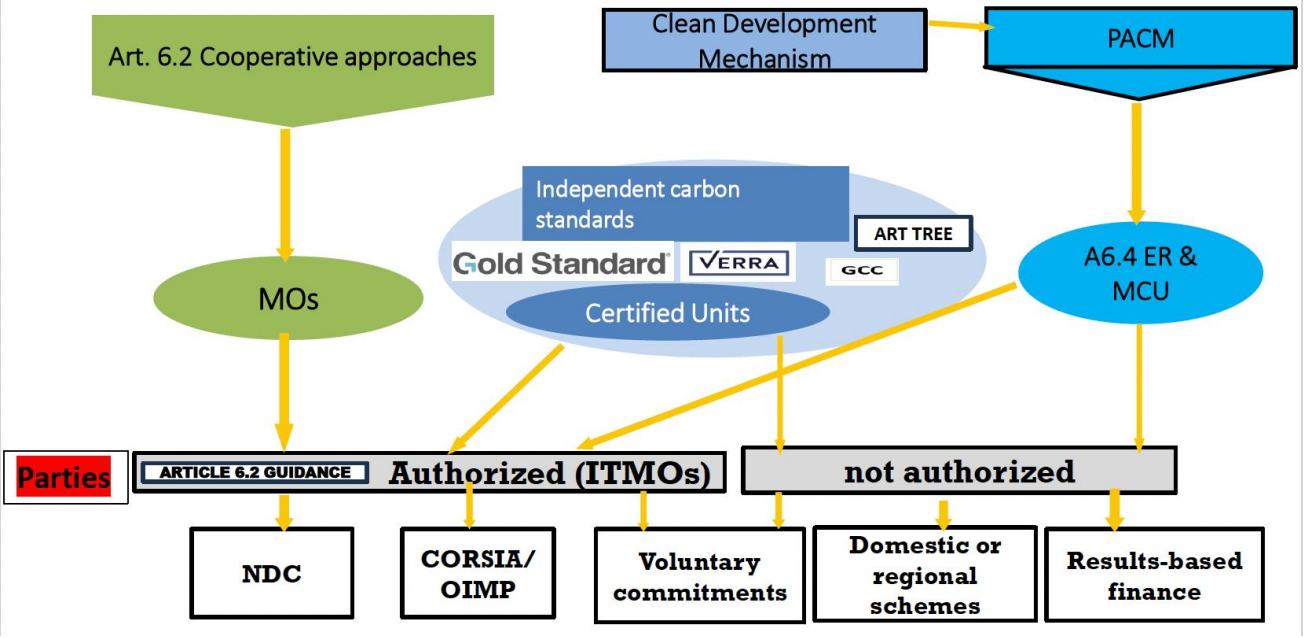


Figure 28: Carbon Markets under the Paris Agreement's Climate Regime (Source: Mbaye)

Table 30: Overview of Essential Standards for the Compliance and Voluntary Carbon Market

Category	Clean Development Mechanism (CDM)	Article 6.4 Paris Agreement Crediting Mechanism (PACM)	Cooperative approach - Article 6.2 mechanism	Gold Standard for Global Goals (GS4GG)	VERRA Verified Carbon Standard (VCS)	Global Carbon Council (GCC)	Puro.earth
Governance	UNFCCC (United Nations)	UNFCCC through an Article 6.4 Supervisory Body (Paris Agreement)	Multiple Countries (bilateral/multilateral "cooperative approach") Both the host country and the acquiring country must authorize the transaction and its use	Gold Standard Foundation (NGO, founded by WWF and partners)	Verra (Non-profit).	Gulf Organisation for Research & Development (GORD), Qatar	Puro.earth (Subsidiary of Nasdaq)
Scope	Compliance (Kyoto Protocol). The CDM is no longer operational	Compliance and Voluntary (Paris Agreement). The Article 6.4 Mechanism Agreement that replaces the CDM. Article 6.4 allows projects of all Parties.	Focusing on Compliance (bilateral). It can use existing voluntary market frameworks (e.g., VERRA, Gold Standard) or domestic/regional schemes.	Voluntary & Compliance (via Article 6) Focuses on environmental integrity and sustainable development of projects.	Voluntary & Compliance (via Article 6) It is the most widely used reduction mechanism globally.	Voluntary & Regional Compliance (MENA focus) First voluntary carbon offset mechanism in the MENA.	Voluntary (Carbon removals focus)
Project Types	Covers 15 sectoral scopes, a wide range of fields like energy, industry, transportation, and agriculture, forestry, etc.	Aligns with Paris goals; likely similar to CDM + removals	Depends on the bilateral or multilateral agreement signed between Parties.	Renewable energy, energy efficiency, forestry, waste-to-value/energy, water, cookstoves, etc.	AFOLU (forestry, agriculture), renewable energy, cookstove, , waste-to-value/energy, water, blue carbon, etc.	Similar to CDM. All CDM methodologies apply under GCC	Tech-based removals (biochar using biomass waste, sewage sludge, etc., mineralization), engineered solutions, e.g. Carbonated building materials, Bioenergy with

Category	Clean Development Mechanism (CDM)	Article 6.4 Paris Agreement Crediting Mechanism (PACM)	Cooperative approach - Article 6.2 mechanism	Gold Standard for Global Goals (GS4GG)	VERRA Verified Carbon Standard (VCS)	Global Carbon Council (GCC)	Puro.earth
							Carbon Capture and Storage (BECCS) and Direct Air Capture (DAC)
Carbon Credit Type	CERs (Certified Emission Reductions)	A6.4ERs (Article 6.4 Emission Reductions)	Mitigation Outcomes; or ITMO (Internationally Transferred Mitigation Outcome)	GS CERs, GS VERs	VCUs (Verified Carbon Units)	ACCs (Accredited Carbon Credits)	CORCs (CO2 Removal Certificates)
SDG Requirements	Host country determines sustainable development contribution (indicated in LOA)	Must align with host country NDCs and SDGs	Article 6.2 does not explicitly mandate SDG alignment, while mitigation projects under the mechanism often generate co-benefits that advance the SDGs (e.g. SDG13).	Mandatory contribution to ≥3 SDGs (incl. SDG13)	Encouraged but not mandatory	Aligns with host country SDGs	Focus on removal innovation; SDGs optional
Key Features	First global compliance mechanism; transitioning to Article 6.4	Successor to CDM under Paris; aims for "no double-counting"	Authorization from both the host and acquiring countries, corresponding adjustments to avoid double - counting	Strong emphasis on sustainable development goals; high environmental and social standards.	Largest voluntary registry; accepts diverse project types	MENA-focused; aligns with CORSIA and Paris Agreement	Specializes in carbon - removal projects
Website	https://cdm.unfccc.int	https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism	https://unfccc.int/process/the-paris-agreement/cooperative-implementation	https://www.goldstandard.org	https://verra.org/programs/verified-carbon-standard/	https://www.globalcarboncouncil.com	https://puro.earth/

Resources

- The Integrity Council for the Voluntary Carbon Market (ICVCM): Core Carbon Principles, Assessment Framework and Assessment Procedure, January 2024 https://icvcm.org/wp-content/uploads/2024/02/CCP-Book-V1.1-FINAL-LowRes-15May24.pdf

Sources

AFM: The Dutch Authority for the Financial Markets (AFM): Voluntary Carbon markets – Supervisory Issues, 2023 https://www.afm.nl/~/profmedia/files/rapporten/2023/occasional-paper-handel-in-co2.pdf, 27.05.2025

Deloitte: Tim Archer: Understanding the Compliance and Voluntary Carbon Trading Markets, July 2023 https://www.deloitte.com/uk/en/services/risk-advisory/blogs/2023/understanding-the-compliance-and-voluntary-carbon-trading-markets.html, 27.05.2025

ICAP: International Carbon Action Partnership (ICAP): Emissions Trading Worldwide – Status Report 2025, April 2025 https://icapcarbonaction.com/system/files/document/250409_icap_sr25_final.pdf, 27.05.2025)

ICAP2: International Carbon Action Partnership (ICAP): Brief 8# - Emissions Trading and Carbon Tax: Two Instruments, One Goal, https://icapcarbonaction.com/system/files/document/20_icap_briefs-8_updated-2021.pdf, 27.05.2025

ICVCM: The Integrity Council for the Voluntary Carbon Market: The Core Carbon Principles https://icvcm.org/core-carbon-principles/, 27.05.2025

MSCI: Understanding Carbon Markets, December 2024

Thyssen: ThyssenKrupp: Carbon Markets in Transition: Where will the overlap of compliance and voluntary carbon credit markets lead? https://www.thyssenkrupp-materials-trading.com/carbondesk/en/carbon-credit-blog/carbon-markets-im-umbruch:-wohin-fuehrt-die-ueberlappung-von-compliance-und-voluntary-carbon-credit-maerkten, 27.05.2025

VCMI: Voluntary Carbon Markets Integrity Initiative: Claims Code of Practice, November 2023, v.2 https://vcmintegrity.org/vcmi-claims-code-of-practice/, 12.06.2025

WB: World Bank Group: State and Trends of Carbon Pricing, 2024 https://openknowledge.worldbank.org/server/api/core/bitstreams/253e6cdd-9631-4db2-8cc5-1d013956de15/content, 27.05.2025

5.3 Carbon Market Opportunities for African Carbon Credit Projects

- **Global Carbon Markets:** Current status, key trends, and major opportunities
- **Carbon Markets in Africa:** Current status, key trends, and major opportunities
- **Pipeline of African projects under Art. 6.2 and 6.4:** Learn about Africa's activities under these new mechanisms
- **Remaining Challenges:** What obstacles for developing Africa's carbon markets still needs to be overcome

Global Carbon Markets – Current State, Key Trends and Major Opportunities

Global carbon markets play a key role for achieving the Paris Agreement objective of net-zero GHG emissions on global scale by 2050 and for promoting sustainable development according to the UN's Agenda 2030. Although both challenges are long-term targets, early climate and SD action is required and will be rewarded by carbon markets given the urgency of the global warming and development problems and the enormous benefits of effective solutions for those countries where these measures are implemented. These clear perspectives and sound fundamentals represent a major business opportunity for owners of climate-smart and sustainable sanitation projects in Africa who are considering an engagement in foreign carbon markets around the globe.

Several leading consulting firms and financial services companies have recently underpinned this positive long-term outlook for the world's mandatory and voluntary carbon markets which are projected to grow by five to 50 times already by 2030 and might support local communities and SDGs even more (Source: ACMI).

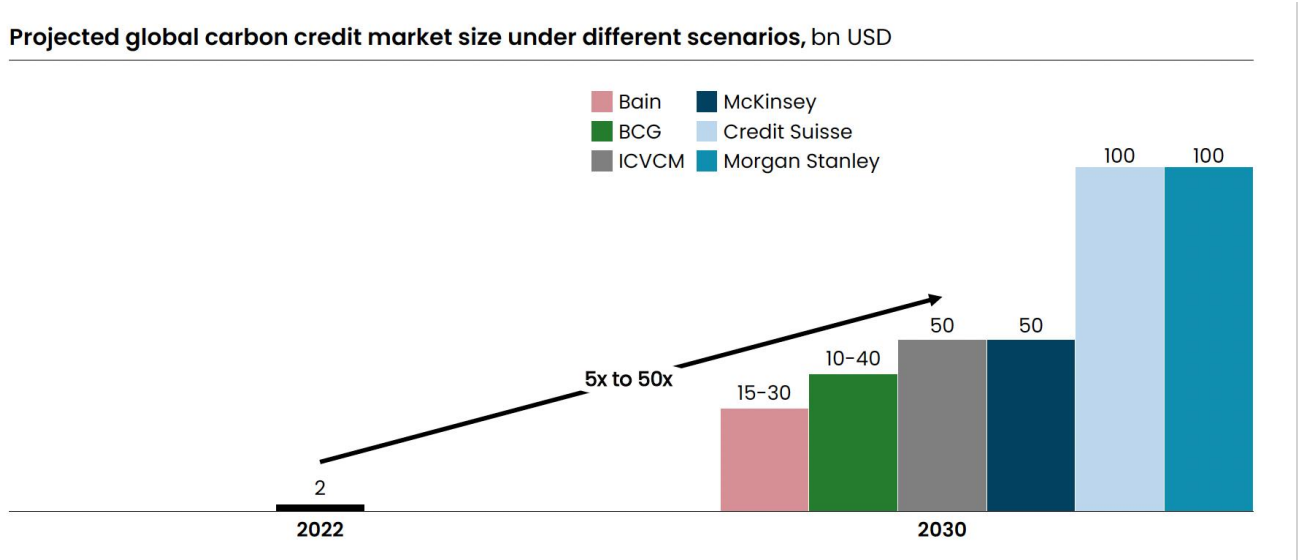


Figure 29: Outlook for the global carbon markets until 2030 (Source: ACMI)

Of course, precise market projections over a longer time horizon are difficult due to many unknowns and uncertainties. However, even though the underlying assumptions and scenarios for decarbonization paths and the climate ambition of governments and companies differ and lead to a large bandwidth of projected growth rates, there is a clear consensus among the forecasters about a strong upward trend for global carbon markets until 2030 and, most likely, also beyond. On average, this will be reflected both in larger volumes of carbon credit transactions and in higher prices for carbon credits.

Despite the long-term positive outlook, 2023 has seen a slight slowdown in carbon markets – globally there was a 22% reduction in demand in 2023, while supply has still increased by 9%, leading to prices that have largely returned to 2021 levels.

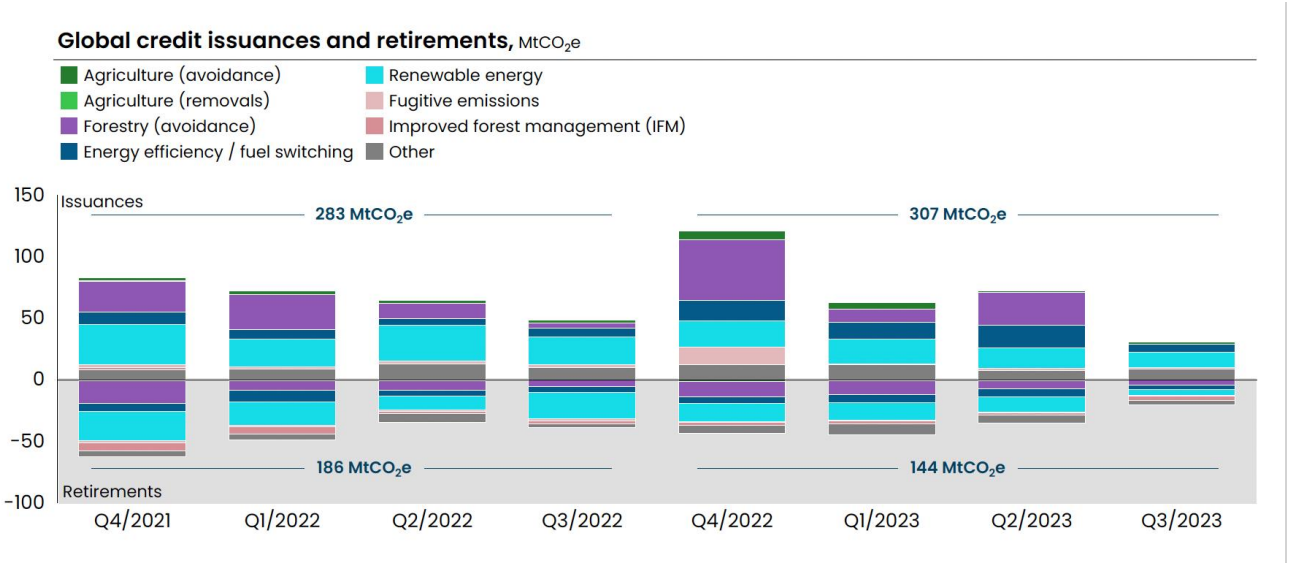


Figure 30: Global carbon market slowdown in 2023 (Source: ACMI)

According to ACMI, two critical setbacks have driven the recent slowing of the global carbon market: (1) concerns about credit integrity and (2) adverse macroeconomic conditions.

First, substantial concerns have been raised about the integrity of both credit supply and credit demand. On the supply side, several investigative publications have raised concerns that a substantial share of carbon credit projects for avoiding deforestation (REDD+) overstated their true emission-reduction potential. Concerns have also been raised about the integrity of other project types, such as cookstove projects, and scrutiny has led Verra to recently deactivate its methodology for avoidance credits from rice farming. On the demand side, intense debate has emerged around the role of carbon credits in greenwashing, with frequent claims made that businesses use credits as an excuse to keep polluting.

Second, macroeconomic growth has slowed globally, with markets under pressure due to recent geopolitical tensions. Declines in growth have been sharpest in high-income countries, thereby squeezing corporate budgets in the countries that demand the bulk of carbon credits.

On the other hand, ACMI identifies four supportive driving forces which will help unlocking the full growth potential of global carbon markets over the next decade: (1) a greater focus on integrity, (2) favorable government regulation, (3) increased trading under Article 6, and (4) more ambitious climate action among businesses.

First, carbon markets have responded to recent criticism by establishing the foundations for a more sophisticated, transparent, and high-integrity market with the ICVCM's Core Carbon Principles, the VCMI Code Claims of Practice and the SBTi's revision of its Corporate Net Zero Standard.

Second, governments are establishing favorable regulations that can fuel carbon credit demand by helping businesses use carbon credits to achieve emission reductions. Singapore, for example, has designed regulations allowing companies to use high-integrity carbon credits from abroad to compensate up to 5% of their payments to Singapore's carbon tax. This kind of regulatory effort can further boost demand for carbon credits and send a valuable market signal of trust in credits.

Third, the Paris Agreement's Art. 6.2 and Art. 6.4 market mechanisms will become operative in the coming years, the first projects will get certified and will obtain issuance and consequently there will be a growing number of transactions involving Art. 6.2 and Art. 6.4 ERs supporting the growth of global carbon markets.

Fourth, increasingly ambitious corporate climate targets will likely fuel demand for carbon credits. Thousands of companies have now made commitments to net zero, with over 2,000 companies' targets being validated by SBTi, the major measurement and validation body for climate targets. This increased ambition is likely to translate into higher carbon credit demand, particularly as businesses seek to offset any residual emissions that they struggle to decarbonize

These global carbon market opportunities will most likely also affect African carbon markets positively, generating multiple development benefits across the continent

Carbon Markets in Africa – Current State, Key Trends and Major Opportunities

In Africa, carbon credits obtained by African climate action projects have been delivering significant impacts for local people and communities and providing numerous green growth opportunities for many years. Given Africa's unique social, economic, and environmental context, many of the positive SDG impacts generated by carbon credit projects are particularly high for African countries and their inhabitants (see next figure).

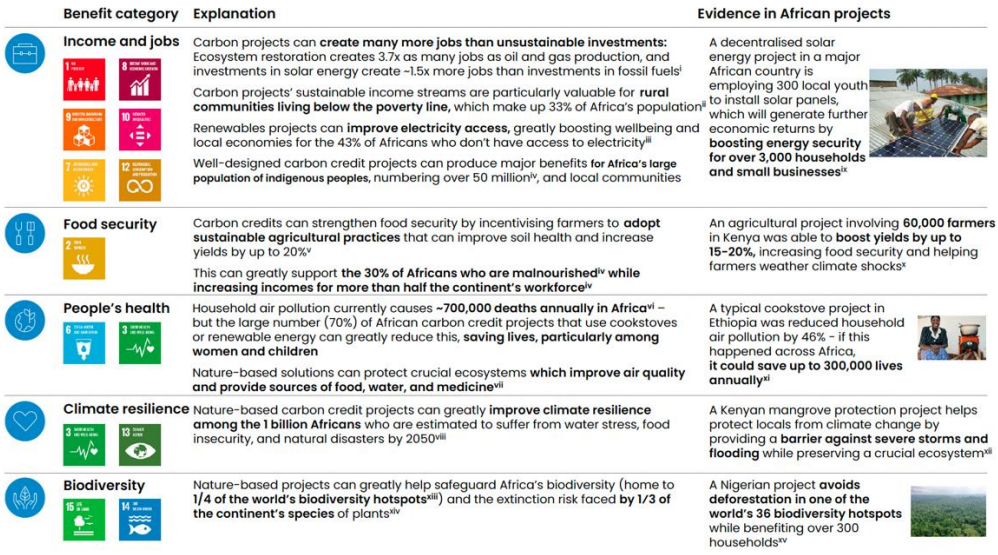


Figure 31: Main SDG impacts generated by African carbon credit projects in Africa (Source: ACMI)

Beyond these benefits, carbon markets also provide an attractive opportunity for Africa to unlock green growth. More specifically, carbon credits present a scalable instrument for effective climate finance in Africa that will strongly promote decarbonization on the continent. They also mitigate the continent's risk of 'carbon lock-in,' whereby high-emissions energy infrastructure built today causes society to remain dependent on fossil fuels for decades. Instead, Africa can learn from undesirable developments in the industrialized world and focus directly on the most innovative and best-available technologies for a sustainable low-carbon future. (Source: ACMI).

In comparison to the rest of the world, carbon markets in Africa are still in their infancy and much smaller in size. African carbon markets currently only represent 16% of the global market indicating a significant potential for growth. Africa's mandatory and voluntary carbon markets combined issued approximately 50 $MtCO_2$-eq of credits and retired an estimated 25 $MtCO_2$-eq in 2022/2023 (see figure below). This is below the market's technical potential. The total technical potential for VCM is 2,400 $MtCO_2$-eq by 2030.

In addition, carbon markets in Africa have been quite resilient in a challenging international market environment. While a downward trend in global carbon markets could be observed since 2022, this did not affect Africa. As the next figure illustrates, both issuance and retirements of African carbon credits have remained quite stable between 2022 and 2023.

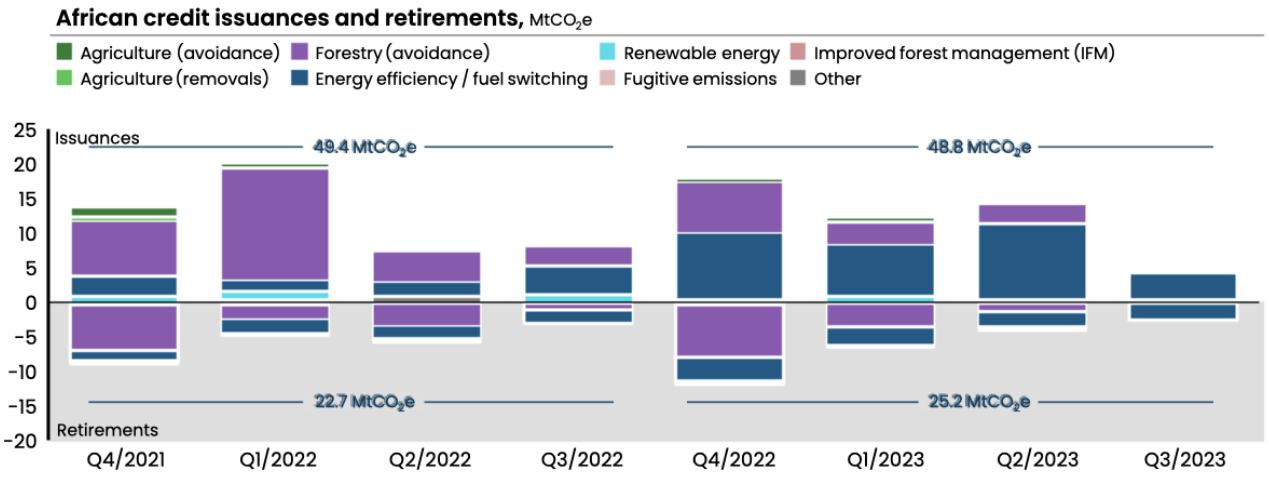


Figure 32: African Credit Issuances and Retirements

Considering the robustness and untapped potential of African carbon markets, it is not unlikely, that Africa will emerge as a major player in global carbon markets by 2030. However, this requires that Africa integrates into the global carbon economy by establishing favorable government regulation and policies incentivizing climate action among businesses. This includes increased trading under the Paris Agreement's Art. 6 mechanisms, implementing robust carbon pricing approaches for domestic carbon markets, developing reliable carbon credit issuance frameworks and facilitating accessible financing options. (Source: ACTN)

The emerging carbon markets in Africa are undergoing a very dynamic development. The number of African countries with new carbon market regulations is continuously increasing in the past years. The following figure shows a selection of activities that were initiated by different African governments to develop new carbon market regulations and aim towards exploiting their full potential for African economies and societies:

Kenya	Recently passed the **Climate Change (Amendment) Act, 2023, with support from ACMI through USAID, SIDA, and partners.** This bill:[i] • Establishes a publicly accessible **National Carbon Registry** where each carbon project is registered with the state • Requires all carbon projects to obtain an environmental impact assessment • Retains an **annual social contribution,** whereby 40% of credit earnings from land-based projects and 25% from non-land-based projects must go to local communities • Forms the starting point for its draft carbon markets regulation – this is currently under public consultation, and the consultation is set to help scrutinise stipulations on benefit sharing, the taxation of credit proceeds, and the creation of a limited framework for monitoring, reporting, and verification (MRV)[v] Hosted the world's **largest voluntary carbon credit auction** in June 2023 – selling 2.2 $MtCO_2e$ of credits in one day, with 70% of credits coming from Africa.
Ghana	• Published an administrative structure and draft law for the country's participation in **bilateral trading of credits under Article 6.2** of the Paris Agreement, with Ghana becoming the first country to fully authorise a credit transfer in late 2022[vi] • Established the **Ghana Carbon Registry,** an online database for verifying and tracking projects' GHG emissions reductions and associated carbon credits • Became one of the first two countries to sign an agreement with Singapore, whereby Singaporean companies can use high-integrity Ghanaian credits to compensate up to 5% of their domestic carbon tax payment requirements
Senegal	Validated a national strategy for trading carbon credits under Article 6, including a budgeted medium-term roadmap for establishing the infrastructure to trade credits internationally
Zambia	Established eligibility criteria and an approval process for exporting carbon credits while simultaneously outlining a carbon credit market roadmap to increase clarity for investors[x]
Mozambique	Formed the **Inter-ministerial Taskforce on Carbon Markets,** which is developing Mozambique's carbon market regulation in close collaboration with donors, the private sector, and key convenors – including ACMI
South Africa	• Launched a carbon tax in 2019, has **increased tax rates on carbon emissions in the past year,** and laid out a long-term tax path that will lead to progressive increases over the coming decades, partly addressing concerns that tax-free thresholds and rebates have led to a lower effective tax than the official rate[vii] • Johannesburg Stock Exchange launched a voluntary market allowing local participants to trade carbon credits directly[viii]
Egypt	Launched a voluntary carbon market exchange in late 2022 allowing local participants to trade carbon credits directly[ix]
Zimbabwe	Recently implemented carbon market regulation that stipulates a **30% levy of carbon credit proceeds** (originally a 50% levy was announced, which was reduced following some media criticism of the policy) through an environmental tax and requires all project developers to invest 25% of their remaining earnings in community projects[iii]
Tanzania	Tanzania's **Carbon Trading Regulations** formalise the Government's role in carbon markets, and require:[iv] • All carbon credit projects to submit an **extensiveapplication** to the Minister for the Environment, including a Project Concept Note, a Letter of No Objection, and a Project Document paperwork – some recent media has criticised the level of paperwork required • 61% of land-based carbon projects' **revenues to be channelled to property owners** involved in the project

i. Bowmans Law Kenya (2023). 'Kenya opens a path to carbon trading: Proposed Climate Change (Amendment) Bill, 2023.'
ii. UN (2023). 'Ghana authorizes transfer of mitigation outcomes to Switzerland.'
iii. Bloomberg BNN (2023). 'Zimbabwe Publishes Regulations for Carbon-Credit Projects.' Bloomberg (2023). 'Rule That Rocked Global Carbon Market Softened in Zimbabwe.'
iv. Velma Law Tanzania (2023). 'Control and Management of Tanzanian Carbon Trading Regulations 2022.' The East African (2023). 'Inside Tanzania, Kenya rules to tap carbon credits windfall.'
v. Acorn Law (2023). 'Kenya's emerging regulation on carbon trade.' Bowmans Law (2023). 'Kenya: Development of carbon project and trading legal framework: Enactment of the Climate Change (Amendment) Act, 2023.'
vi. UN (2023). 'Ghana authorizes transfer of mitigation outcomes to Switzerland.' Note that methodologies for rice farming carbon credits, such as the Ghana-Switzerland project, have recently come under scrutiny regarding integrity, as indicated by Carbon Pulse (2023). 'UNDP, Switzerland defend rice farming methodology amid Verra decision to halt use.'
vii. IMF (2023). 'South Africa Carbon Pricing And Climate Mitigation Policy.'
viii. Johannesburg Stock Exchange News (2023). 'JSE collaborates with Xpansiv to launch voluntary carbon market to advance South Africa's carbon credit capabilities.'
ix. Baker McKenzie (2023). 'Egypt: A voluntary carbon market.'
x. Carbon Pulse (2023). 'Zambia advances on international carbon trading with strengthened Article 6 framework.'

Figure 33: List of Selected Activities of African Nations Regarding Carbon Markets (Source: ACMI)

There are several African countries that are actively working to prepare for Article 6 implementation by developing national strategies and frameworks for generating carbon credits. These frameworks require to include general rules for carbon credit activities, as well as specific requirements for project registration, ITMO authorization, tracking and bilateral cooperation. Countries are further required to make strategic choices about granting ITMO authorizations and approving activities under the PACM. Some countries have adopted lists that outline which activities or sectors are eligible ("positive lists") or ineligible ("negative lists") for ITMO authorization.

The carbon credit landscape in Africa has evolved across each stage of the value chain. The following figure shows key player along this value chain as of 2024.

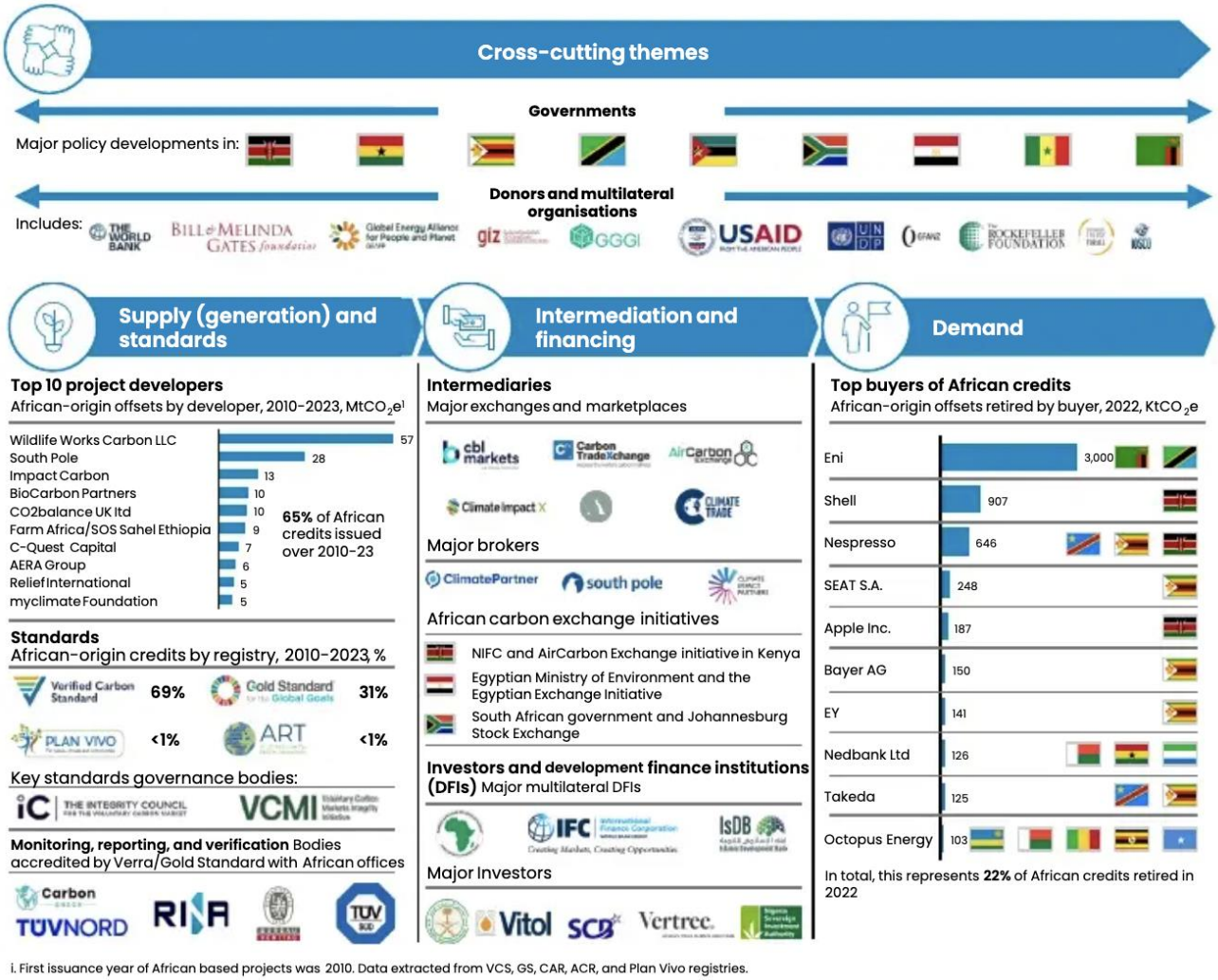


Figure 34: Main Players Across the African Carbon Markets Value Chain (Source: ACMI)

Notable initiatives that support the advancement of carbon markets in Africa are

- Africa Carbon Markets Initiative (ACMI): The ACMI is a multi-stakeholder initiative established during COP27 in 2022 and launched in 2023 to accelerate the development of robust, transparent, and high-integrity voluntary and compliance carbon markets across Africa. ACMI is supported by organizations such as Sustainable Energy for All (SEforALL), the United Nations, the Global Energy Alliance for People and Planet, etc. The ACMI works with government, project developers and communities to increase supply and demand for African-sources carbon credits. It further assists countries in developing legal and regulatory structures for carbon trading. (Source: ACMI)

- West African Alliance on Carbon Markets and Climate Finance (WAA): This Alliance was established in 2017 by and for West African countries, with the objective to strengthen the region's position in international carbon markets and enhancing the access to result-based climate finance for implementing NDCs. The Alliance includes 16 West African countries (Benin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo). Since the adoption of Article 6 of the Paris Agreement, the Alliance prioritizes preparing member countries for the new international carbon market mechanisms and

ensuring African interests are represented in global negotiations. Another main objective is the establishment of national platforms in each member country. These platforms shall serve as hubs for consultation; capacity building and project support related to carbon markets. (Source: IKI, WAA)

- Eastern Africa Alliance on Carbon Markets and Climate Finance (EAA): The WAA acted as a blueprint for the formation of the EAA. The EAA was launched in 2019. Its founding members include Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda and Sudan. The Alliance aims to equip member states to meet their mitigation targets as outlined in the NDCs, support the transition from the CDM to Article 6 mechanisms under the Paris Agreement, and foster unified regional approach to carbon markets and climate finance. (Source: EAA)

- Southern Africa Alliance on Carbon Markets and Climate Finance (SAA): Following the examples of the EAA and the WAA, there are plans to establish the Southern Africa Alliance on Carbon Markets and Climate Finance (SAA). In December 2024, the first UNFCCC focal point and stakeholder meeting organized by the African Climate Policy Centre (ACPC) has taken place in Victoria Falls, Zimbabwe. It shall cover countries within the Southern Africa Development Community (SADC) region not catered for by the other two organizations. (Source: SAA)

In addition, it is worth mentioning the UNFCCC Regional Collaboration Centres (RCCs). These support climate action worldwide by helping countries implement the Paris Agreement. Since the Agreement's adoption in 2015, the RCCs serve as regional hubs, delivering technical assistance, fostering capacity-building, and strengthening partnerships and networks to meet national and local climate action needs. For Sub-Saharan Africa, there are two: RCC West and Central Africa and the RCC East and Southern Africa.

The Partnership for Market Implementation (PMI), administered by the World Bank, is also strongly engaged in Africa. It is the successor of the Partnership for Market Readiness (PMR). The PMI has two overarching objectives: assist client countries design and deploy carbon pricing policies appropriate to their domestic context; and catalyze the development of the next generation of international carbon markets. The PMI currently supports more than 32 countries through national and regional programs, thereof many in Africa.

Last not least, events such as the Carbon Markets Africa Summit, to be held in Johannesburg from October 21 to 23, 2025 might help to exchange experience and to unlock Africa's carbon market potential.

The activities of African countries under the Paris mechanisms underpin that meaningful progress has been made.

The pipeline of African carbon credit projects under Art. 6.2 and Art. 6.4

Based on a large amount of data about Art. 6 activities collected by UNEP Copenhagen Climate Centre (UNEP-CCC), Carbon Pulse and the International Emissions Trading Association (IETA) it is possible to visualize Africa's involvement in these new mechanisms.

The analysis of the bilateral agreements (BAs) and Memoranda of Understanding (MoUs) signed between countries intending to trade ITMOs under Article 6.2 of the Paris Agreement reveals that, so far, 98 agreements have been concluded between 60 different countries. Thereof, 28 agreements (29%) include a host party from Africa. Among these, Ghana, Kenya and Senegal are the most active, followed by

Morocco, Rwanda and Zambia. On the side of the buying countries, nearly all demand comes from the following countries: Japan, Norway, Republic of Korea, Singapore, Sweden and Switzerland (see table below):

Table 31: Bilateral Agreements under Art. 6.2 involving African Countries (Source: UNEP-CCC)

Buying Party	Host Region	Host Sub-region	Host Party ▲	Projects
Norway	Africa	Western Africa	Benin	-
Japan	Africa	Eastern Africa	Ethiopia	-
Republic of Korea	Africa	Middle Africa	Gabon	-
Liechtenstein	Africa	Western Africa	Ghana	-
Republic of Korea	Africa	Western Africa	Ghana	-
Singapore	Africa	Western Africa	Ghana	-
Sweden	Africa	Western Africa	Ghana	3
Switzerland	Africa	Western Africa	Ghana	10
Japan	Africa	Eastern Africa	Kenya	2
Singapore	Africa	Eastern Africa	Kenya	-
Switzerland	Africa	Eastern Africa	Kenya	-
Switzerland	Africa	Eastern Africa	Malawi	1
Norway	Africa	Northern Africa	Morocco	-
Singapore	Africa	Northern Africa	Morocco	-
Switzerland	Africa	Northern Africa	Morocco	1
Kuwait	Africa	Eastern Africa	Rwanda	-
Singapore	Africa	Eastern Africa	Rwanda	-
Sweden	Africa	Eastern Africa	Rwanda	-
Japan	Africa	Western Africa	Senegal	-
Norway	Africa	Western Africa	Senegal	-
Singapore	Africa	Western Africa	Senegal	-
Switzerland	Africa	Western Africa	Senegal	3
Japan	Africa	Northern Africa	Tunisia	-
Monaco	Africa	Northern Africa	Tunisia	-
Switzerland	Africa	Northern Africa	Tunisia	-
Norway	Africa	Eastern Africa	Zambia	-
Singapore	Africa	Eastern Africa	Zambia	-
Sweden	Africa	Eastern Africa	Zambia	-

As part of the Article 6.4 activity cycle, project proponents need to submit prior consideration notifications. This is to demonstrate that the benefits of participating in the mechanism were taken into account before implementing the activity. With the last update on 29 April, a total of 1,018 notifications for projects were submitted and published for prior consideration notifications. This includes 810 projects and 208 programs. The graph below shows the geographical distribution of the proposed activities and Africa's share with 195 notifications, most of them for projects in Kenya (28), Nigeria (28), Zambia (20), Uganda (14), Mozambique (12) and the Democratic Republic of the Congo (12).

Most of these projects have already begun a few years ago. However, the deadline for these retroactive notifications has passed. From now, proponents need to submit the notification no later than 180 days after the start of the project.

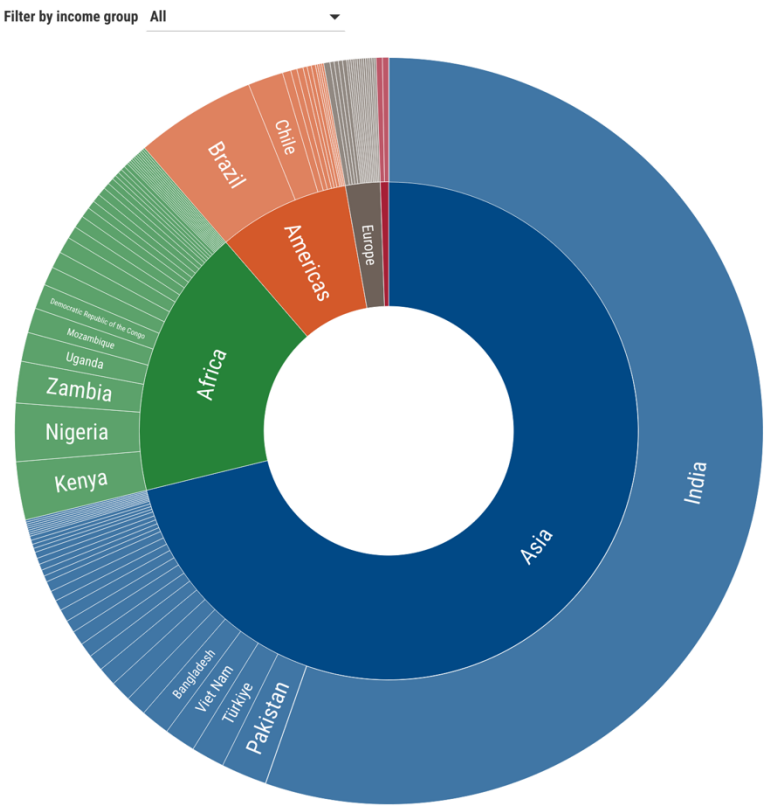


Figure 35: Art. 6.4 prior consideration notifications per region and country (Source: UNEP-CCC)

To complete the picture, the following two figures illustrate in what sectors intended African Art. 6.4 projects and programs plan to mitigate GHG emissions.

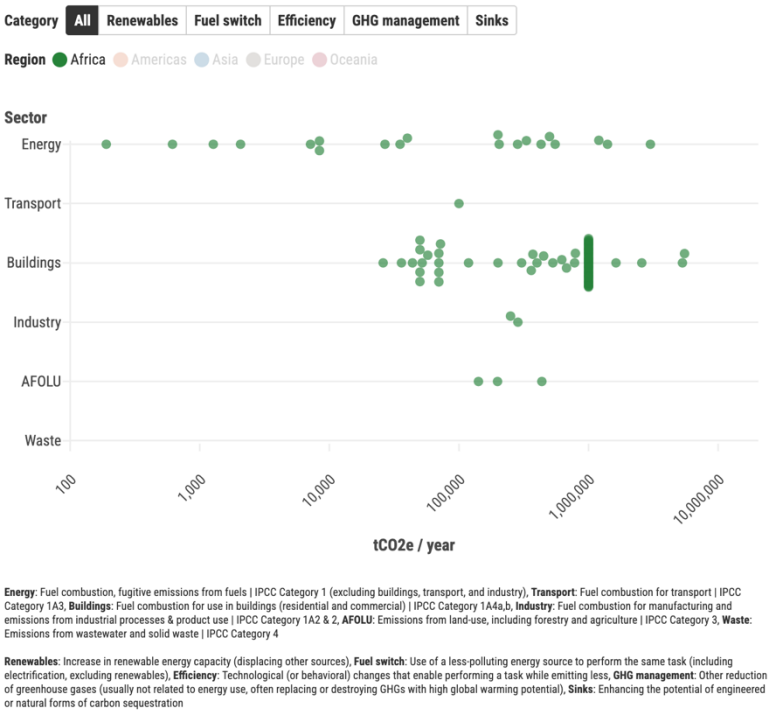


Figure 36: Art. 6.4 prior consideration notifications for African projects per sector and annual emissions reduction (Source: UNEP-CCC)

As can be seen, most proposed African project activities under Art. 6.4 shall take place in the sectors of energy and buildings and estimated annual emission reductions span from a few hundred tCO_2-eq per year to almost 10 million tCO_2-eq per year.

The situation changes for African programs under Art. 6.4. Here, most programs seek to abate GHG in the sectors of transport and buildings and much less in the energy sector, although the largest program with an expected annual emissions reduction of 100 million tCO_2-eq per year shall become active in this sector.

Up to now, there are nearly no Art. 6.4 projects or programs planned in the waste sector and nearly all projects in the buildings sector are not related to sanitation but rather to clean cook stoves and safe drinking water.

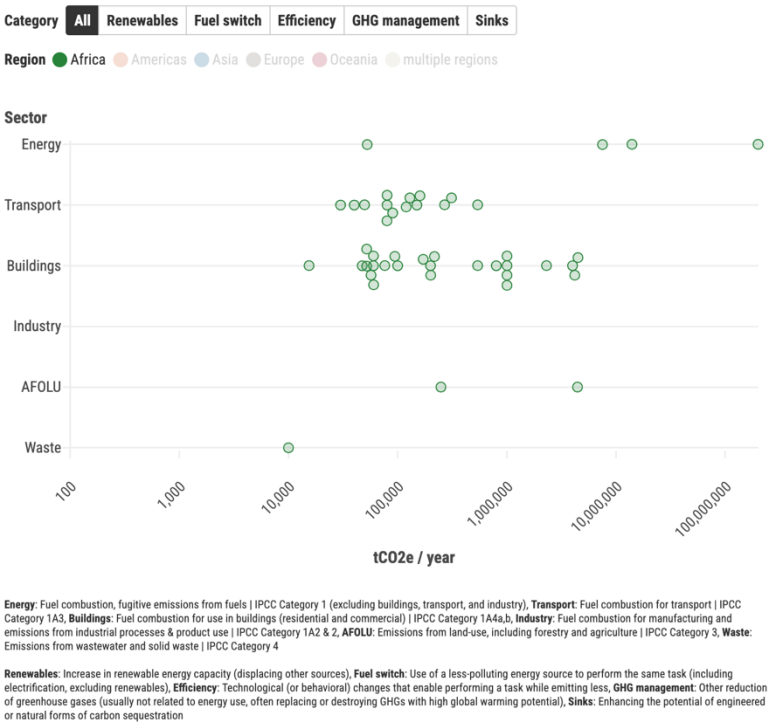


Figure 37: Art. 6.4 prior consideration notifications for African programs per sector and annual emissions reduction (Source: UNEP-CCC)

Another indicator for Africa's strong interest in Art. 6 mechanisms are the Letters of Authorization (LoAs) allowing the transfer of ITMOs from a host country to a buyer country. Despite a large number of countries and project developers indicating their interest in Article 6 participation, only a few LoAs have been provided so far, but, among these, most come from African host countries, namely Rwanda (6), Madagascar (5), Ghana (3), Malawi (2), Ethiopia (1), Benin (1), Togo (1), Gambia (1), Sierra Leone (1) Tanzania (1). Apart from Ghana, all of these are related to GS or VCS projects seeking compliance with Paris Agreement rules. (Source: IETA)

And, finally, many African countries have submitted Designated National Authorities (DNAs) to the UN under Article 6.4. The DNA is the entity or organization that has been granted responsibility to approve and authorize participation in carbon market projects under the Paris Agreement. Therefore, submitting a DNA is a key requirement for participation by a country in Article 6. (Source: Carbon Pulse)

Remaining Challenges for carbon markets in Africa

On the global level, one of the main challenges is the ongoing transition from the Clean Development Mechanism under the Kyoto Protocol to the Article 6.4 mechanism of the Paris Agreement. While CDM methodologies can still be applied until the end of 2025, there is uncertainty as countries and project developers await the finalization of new Article 6.4 methodologies and guidance. The transition requires existing CDM projects to adapt to stricter requirements. After 2025, all transitioned projects must adopt Article 6.4 methodologies, which may involve significant adjustments to project design and documentation.

Corresponding adjustments (CA) – the process by which countries adjust their emissions inventories to avoid double counting of Internationally Transferred Mitigation Outcomes (ITMOs) – are becoming a key requirement for participation in Article 6 markets. Several African countries, including Kenya and Rwanda, have begun developing regulatory frameworks and processes for granting CAs, but implementation varies across the continent. The ability to offer CAs is increasingly important for accessing premium markets and bilateral deals, but it requires robust tracking systems and clear national policies.

The international carbon voluntary market and compliance markets are both seeing rapidly evolving requirements. New standards and rating systems are emerging to ensure the environmental integrity and quality of carbon credits. Project developers and host countries must stay up to date with these changes, as buyers increasingly demand high-integrity credits that meet stringent criteria for additionality, permanence, and sustainable development impacts. This trend is reinforced by the growing influence of independent ratings agencies and the adoption of best-practice guidelines. As mentioned earlier, the Core Carbon Principles (CCPs), which serve as indicators of high-integrity standards and carbon credits, are particularly noteworthy.

The development of carbon markets in Africa is hindered by several structural and operational challenges**.** A central barrier to the development of carbon markets is the lack of coherent and harmonized regulatory structures across the continent. These gaps are still significant, although initiatives like the ACMI aim and support governments to align market regulations.

There are additional concerns is the integration of local knowledge, needs, and rights in the project implementation. Many carbon credit projects fail due to the lack of involvement of the communities that they are supposed to benefit. Greater collaboration between African governments, research institutions, and the private sector are needed to develop context-specific solutions and build local expertise to drive market development.

Other challenges include financial constraints. For example, the funding required for the adaptation and mitigation projects included in the NDCs is often lacking. Also, inadequate infrastructure for monitoring, reporting and verifying emissions reductions is another challenge that undermines the ability of African nations to fully engage in global carbon markets.

Finally, a growing concern—both in Africa and globally—is the commodification of natural resources through carbon credit schemes. By assigning a monetary value to carbon, there is a risk of prioritizing profit over environmental and social sustainability. Ecosystems might be exploited, rather than protected. The involvement of international actors also raises environmental and social concerns. Foreign companies might purchase land in African nations, as is the case e.g. in Tanzania and Mozambique, to establish carbon credit projects. Local communities affected by these projects claim to not benefit from the financial returns generated. That resulted in the allegation that carbon markets become another form of "carbon

colonialism", where wealth generated from Africa's land goes in the hands of foreign investors. (Source: ACTN)

Resources

- Gold Standard: Carbon Market Regulations Tracker
  https://www.goldstandard.org/carbon-market-regulations-tracker

- World Bank Group: State and Trends of Carbon Pricing Dashboard
  https://carbonpricingdashboard.worldbank.org/

Sources

ACMI: Africa Carbon Markets Initiative: Africa Carbon Markets: Status and Outlook Report 2024-2025

ACTN: Africa Carbon Market Network: 2025 Africa Carbon Market Outlook, https://drive.google.com/file/d/1XIKjsnxi723SyrKMuYSqzh0ex-WTOoJc/view, 29.05.2025

Carbon Pulse: Article 6 Portal, https://carbon-pulse.com/article-6-portal/, 12.06.2025

Diagne, El Hadji Mbaye: Establishment of the Southern Africa Alliance on Carbon Markets and Climate Finance. Article 6 of the Paris Agreement, Victoria Falls, 18-19 December 2024, https://uneca.org/eca-events/sites/default/files/resources/documents/ACPC/1stUNFCCC/establishment_of_the_southern_africa_alliance_on_carbon_markets_and_climate_finance_el_hadji_mbaye_diagne.pdf, 12.06.2025

IETA: International Emissions Trading Association: LoA Tracker, https://airtable.com/app0HOAgk39HNmcKq/shryyT1QgyujQSfkg/tblZVLcLeLRLYDTLY/viwg6zqXIO1U8OTyp?blocks=hide, 12.06.2025

UNEP-CCC: UNEP Copenhagen Climate Centre: Article 6 Pipeline, https://unepccc.org/article-6-pipeline/, 12.06.2025

UNFCCC: United Nations Framework Convention on Climate Change: Designated National Authorities (DNAs)

5.4 What is the carbon credit project cycle?

- **Stakeholder Environment along the Carbon Credit Project Cycle:** Learning about the different stakeholders and their roles.
- **Carbon Credit Project Cycle:** What are the main steps and timelines from project identification to credit issuance.

Carbon credit projects can range in scale from very small – on the order of a few hundred tons of CO_2-eq avoided per year – to very large – with millions of tons avoided per year. Carbon credits are also sometimes produced by large-scale "Programs of Activities" (PoA) which aggregate together many similar small projects or coordinated efforts across entire jurisdictions. For example, a household biogas program that installs digesters in thousands of homes across a region would qualify as a PoA.

Designing, implementing and operating carbon credit projects of any scale or set-up requires the involvement of several parties. The parties differ from project to project. However, some general categories and types of market players can be defined as shown in the following figure.

Figure 38: Overview of the Main Parties Involved in the Carbon Credit Project Cycle.

With these roles in mind, it's important to note that while the exact steps may differ depending on the chosen framework and standard, the carbon credit project cycle can generally be summarized in three main stages: (Source: MSCI, COG)

1. **Origination – Project Creation and Registration:** This initial phase involves the identification of a project, developing a concept note, defining a baseline scenario, choosing a methodology, and conducting stakeholder consultations (feedback from impacted local communities and other relevant stakeholders).

All these elements are documented in a so-called Project Design Document (PDD). The PDD outlines the project's expected emissions reductions, methodologies, monitoring plans, and social or environmental impacts.

After the project owner has written the PDD, an independent crediting program-approved third-party auditor, so called Validation and Verification Bodies (VVBs), conducts the project validation. This project validation includes a desk review of the PDD, on-site visits and interviews with project stakeholders, a public comment period after the PDD has been made available on the internet, resolution of outstanding issues and the issuance of a final validation report written by the VVB. Subsequently, PDD and validation report are submitted to the chosen registry administration for review and registration.

For some registries like the CDM or crediting projects through Article 6 of the Paris Agreement, host country approval may be required. The project documentation must be submitted to the relevant authority, which checks the project activity against national rules and regulations and confirms the project's compliance with the host country's sustainability and development criteria. This screening process and host country requirements vary from country to country. Voluntary crediting projects generally do not need host country approval.

Once the registry has approved the project, it is officially registered.

2. Project Operation – Credit Issuance: Project operation may commence once the project is registered. Some registries may allow a project to be implemented before it is registered but will identify requirements to ensure the integrity of these projects. Projects also must commence implementation within a short period following successful registration (e.g., six months) as a project's circumstances and program eligibility can change over time.

   The operation needs to consider ongoing monitoring and verification, typically on an annual basis. The number of carbon credits issued in a year is determined by the amount of verified emissions reductions or removals that have occurred. These records, maintained in a monitoring report, must be in accordance with the parameters and procedures laid out in the project's methodology.

   A project owner must make the trade-off between having more frequent carbon credit income (more frequent monitoring reports) and lower administrative costs (less frequent monitoring reports). The monitoring period length is typically defined in each project methodology and varies by project type.

   The monitoring that the project owner has done is then evaluated and approved by a VVB during the project verification stage. The VVB undertakes a desk review of the monitoring report and might also conduct site visits, if appropriate. The VVB summarizes his review in a verification report that is submitted to the registry. After the final review by the registry, carbon credits are issued to the registry account of the project owner.

3. Transaction & Offsetting – Credit Retirement: In this third stage, the project owner sells the carbon credits to a buyer. Often, intermediaries such as traders are used for this commercialization. When a buyer uses a carbon credit to compensate their emissions, the carbon credit is considered retired and is permanently removed from circulation in the registry. This ensures that every carbon credit is only used once, maintaining the integrity of the carbon market.

The following figure visualizes the different steps, responsible parties (listed on the left side) and shows an estimated timeline.

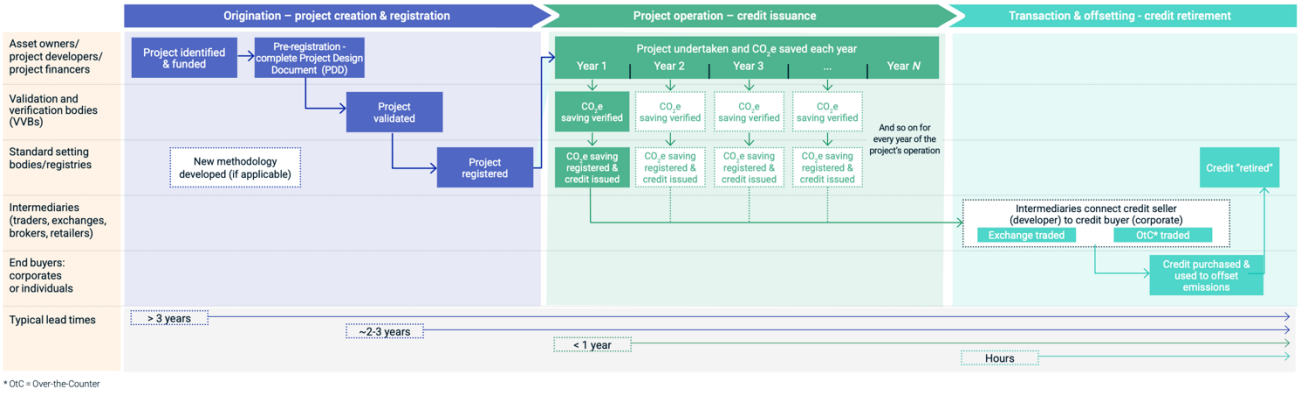


Figure 39: Visualization of a Typical Carbon Credit Project Cycle (Source: MSCI)

The creation and registration of a new carbon credit project can take several years and involves extensive documentation. Ideally, the registration as a carbon credit project should already be anticipated during the early planning phase of a project. If the registration process is initiated once a project is in implementation or operation, it might not fulfill the requirements of certain standards.

Sources

COG: Carbon Offset Guide: What is the Carbon Crediting Project Cycle, https://offsetguide.org/what-is-the-carbon-crediting-project-cycle/, 29.05.2025

MSCI: MSCI: Understanding Carbon Markets, December 2024

Gold Standard: Gold Standard for Global Goals Principles & Requirements, https://globalgoals.goldstandard.org/standards/101_V1.0_TC_PAR_Principles-Requirements.pdf, 13.06.2025

VERRA: VCS Standard“ (Version 4.7, April 2024), https://verra.org/programs/verified-carbon-standard/, 25 May 2025

GCC: Project Standard“ (Version 4.0, Stand 2023), https://www.globalcarboncouncil.com/how-gcc-works/gcc-2-0/, 25 May 2025

5.5 How can a sanitation project be checked for its carbon market eligibility?

- Eligibility criteria for carbon credit projects: Learning about the key parameters that determine whether a project can qualify for carbon credits.
- Methodology selection: Understanding how to identify and apply approved carbon credit methodologies.
- Eligibility process: Learning about the detailed steps necessary prior possible project registration.

In general, for carbon credits to be issued, it is necessary for the project to be registered within internationally recognized standards, each with different requirements and eligibility criteria. Some of these eligibility criteria are common to all projects:

- Project Description: A detailed project description at the outset is essential because it forms the technical, methodological, and climate-effective basis for certification. It enables the verification of additionality and climate benefits, the application of standardized methods, and transparent verification by independent bodies.

- Additionality: An additional project is one that would not have occurred without the incentive provided by carbon credit revenues. It is typically assessed once by a crediting program when a proposed project is submitted for approval and registration. If credits are issued to projects that are not additional, then purchasing those credits instead of reducing one's emissions will make climate change worse – because total emissions to the atmosphere would be lower if the purchaser had simply reduced their inventory emissions. In practice, determining whether a proposed project is additional requires comparing it to a hypothetical scenario without revenue from the sale of carbon credits. (Source: Broekhoff)

- Baseline scenario: A baseline scenario, also called "business as usual" scenario, is a description of the situation and outcome most likely to occur, under conditions where the intended carbon credit project is absent while holding all (or most) other factors constant. A properly elaborated baseline scenario will specify these "other factors" along with the outcome. For a given baseline scenario, an approved methodology is chosen accordingly to estimate baseline emissions and thereby quantify GHG emissions caused by the baseline and intended intervention. (Source: GHG)

- Approved methodology: For each carbon credit-generating activity, there are an infinity of approved methodologies. It is necessary that the project executes all the rules and requirements of the chosen methodology. If no suitable methodology exists, one can be developed. However, developing a methodology can take between one to two years and requires sector-wide collaboration. (Source: WayCarbon); A methodology is required to quantify and monitor emission reductions from a climate mitigation project under the corresponding standard. It defines how to establish the baseline scenario (emissions without the project) and outlines procedures for measuring, monitoring, and verifying actual reductions. The methodology ensures that emission reductions are credible, transparent, and standardized. Without the application of an approved methodology, a project cannot be registered

under the respective standard and is therefore ineligible to generate carbon credits for use in the VCM or compliance schemes.

- Early consideration: Early Consideration refers to the requirement that the potential for greenhouse gas (GHG) emission reductions — and the possible use of carbon credits — is explicitly considered at the earliest stages of project planning and design. This is a core requirement under carbon crediting mechanisms such as Verra's VCS or the Gold Standard, primarily to ensure the principle of additionality and the credibility of baseline assumptions. The key wording in a project description is therefore something like this:
    - *The potential for GHG mitigation and the use of carbon finance was considered during the early design stage of the project, prior to any binding financial or construction commitments. This allowed for the integration of emission reduction opportunities and ensured compliance with eligibility and methodological requirements under the selected carbon standard.*

In addition to these, and even if they do not fit into specific eligibility criteria, it is important to emphasize that projects must demonstrate they are not registered in any other program or credit generation standard, beyond demonstrating the effectiveness guarantee to avoid double counting of carbon credits. Further, it is common to frame the project co-benefits applying the Sustainable Development Goals.

For Article 6.4 or A6.2 projects, more specific aspects need to be checked to confirm eligibility, incl.:

- NDC alignment: Confirm the project aligns with the host country's climate policies (NDCs) and that the host country authorizes international transfer of credits.
- Environmental and Social safeguarding assessment: Adhere to environmental and social safeguards, including human rights, labor standards, and biodiversity protection.
- Sustainable Development Goals (SDGs) assessment: Highlight contributions to Sustainable Development Goals (SDGs) to enhance the project's credibility.
- Host Country Approval/Authorization: Secure authorization from the host country's government, which may require alignment with national climate policies and NDCs.
- Buyer Engagement: For Article 6.2 projects, engage a buyer (e.g., another government, corporation) willing to use ITMOs to meet their climate targets/obligations (e.g., NDCs, corporate carbon neutrality goals).

Following the initial screening, the subsequent steps for confirming full eligibility are as listed below.

Methodology selection:

The approved methodologies under the CDM form the basis for most methodologies. The methodologies available there are subject to a continuous process of adaptation and evaluation. These methodologies also form the basis for other established standards. Some standards offer individual special methodologies, restrict the applicability of some CDM methodologies, or exclude certain technologies and thus the

associated methodology. When searching for a suitable methodology, it is therefore advisable to first check the availability and applicability of CDM methodologies. The CDM provides a very user-friendly approach to identifying the right methodology via the CDM Methodology Booklet. (Source: CDM.UNFCCC.int).

In the first step, you will usually find more than one methodology that comes closest to your own project approach or project design. In the second step, each methodology must be read through carefully. One section describes the project eligibility criteria in detail. All identified methodologies from step one should be examined closely. Often, it is only small details that make the difference. If you are unsure at the outset which direction to take, it can also be helpful to look for comparable projects and check which methodologies are used there. There are now countless methodologies available, but if you still cannot find a suitable one, you can always develop a new one. However, this is not recommended because, as already mentioned, the development time and therefore also the costs are difficult to calculate.

As mentioned in chapter 5.2, CDM project approved for transition may continue using their current CDM methodology latest by 31 December 2025; after that, an Article 6.4 mechanism methodology must be applied (currently not available).

Alternatively, you can also contact the standards directly or some experienced project developer and ask for help. They are usually very helpful and will ask the right questions to identify the appropriate methodology.

Preliminary Assessment of Project Feasibility and Market Potential:

Based on the project description, the additionality justification, the baseline description, a credible early consideration statement, and the methodology selection and host Party authorization, an initial projection of the potential emission reductions can be made. In addition, the project certification effort (time and costs) can be estimated based on the project description and the methodology. Finally, the information can be used to define the potential target markets for the carbon credits more precisely. Based on all this information, a very initial assessment of the financial viability and the general eligibility of the project activity can be made and the basic feasibility can be assessed. This should be done before conducting or commissioning a detailed feasibility study.

Project Idea Note (PIN):

A PIN is a concise, early-stage document that outlines the basic concept of a climate protection project. It is used to determine whether a proposed project has the potential to qualify for carbon crediting and climate finance. The PIN serves as a preliminary communication tool directed toward certification bodies (such as Verra or Gold Standard), potential investors, donors, national authorities (Designated National Authorities, DNAs), or technical partners. Its primary purpose is to provide a quick and structured overview of the project idea, including its expected emission reductions, technology, and implementation context, allowing stakeholders to assess whether the project warrants further development and investment.

The PIN typically includes key information such as the project title, location, implementing organization, and current development status. It describes the core activities and technologies involved, the estimated

annual and total greenhouse gas (GHG) emission reductions, the expected baseline scenario, and a preliminary justification of additionality. It may also reference a relevant carbon methodology (if already identified), outline financing needs, and summarize anticipated co-benefits or environmental and social impacts.

To ensure readability and efficiency, a PIN should be limited to a maximum of four pages. This brevity allows stakeholders to assess the project's relevance and feasibility quickly, making the PIN a strategic starting point for attracting interest, initiating due diligence, and preparing a full Project Design Document (PDD).

The procedure described up to here should be feasible with a good basic understanding of the carbon markets. However, it is advisable to consult an experienced project developer as early as possible. For the following steps it is recommended to work with a professional consulting firm, specialized on carbon crediting projects.

Feasibility study:

A feasibility study for a climate mitigation project is a critical step in assessing whether a project idea is technically, economically, environmentally, and socially viable, particularly in the context of carbon market participation. It provides a structured analysis to determine if the project should move forward to the design and implementation phase or be revised or abandoned.

Key aspects to be evaluated include:

1. Technical feasibility: This involves analyzing whether the proposed technology or intervention is proven, scalable, and appropriate for the local context. It includes considerations such as availability of infrastructure, technology compatibility, access to materials or energy sources, and the capacity of local institutions or operators. Technical risks, operational complexity, and maintenance requirements are also evaluated.

2. Greenhouse gas (GHG) mitigation potential: A core component is the estimation of the expected emission reductions based on a suitable CDM or voluntary standard methodology. This includes defining the project boundary, identifying the baseline scenario, and assessing the additionality and permanence of the mitigation impact. Without significant and verifiable reductions, carbon finance is not feasible.

3. Financial and economic feasibility: This includes a detailed cost-benefit analysis, covering capital expenditure (CAPEX), operational costs (OPEX), revenue streams (e.g., carbon credits, co-products, energy sales), and financing mechanisms. Key metrics include internal rate of return (IRR), net present value (NPV), and payback period. Sensitivity analysis should explore how changes in carbon price or input costs affect financial viability.

4. Regulatory and legal feasibility: The project must comply with national and international regulations, including environmental permits, land use laws, and sector-specific licensing. Legal ownership of emission reductions, land tenure, and potential conflicts with existing policies must be clarified.

5. Environmental and social safeguards: Impacts on ecosystems, biodiversity, water use, and air quality must be evaluated, along with potential risks to local communities. The study should assess stakeholder

acceptability, gender implications, and co-benefits such as job creation or health improvements. Projects that present high social or ecological risks may face delays or reputational damage.

6. Institutional and organizational capacity: The implementing entity's experience, governance structure, and project management capacity are essential. The study should determine whether the organization has the resources and expertise to carry out monitoring, reporting, and verification (MRV) over the crediting period.

Based on these assessments, the feasibility study should provide a clear recommendation. A positive decision is justified when the project demonstrates strong GHG reduction potential, robust financial returns (even under conservative scenarios), manageable risks, and stakeholder support. Additionally, if the project aligns with a recognized carbon standard and has a suitable methodology available, this strengthens the case.

Conversely, a project should not proceed if emission reductions are marginal or unquantifiable, if financial viability is highly sensitive to carbon prices, or if there are major technical, legal, or social risks that cannot be mitigated. In such cases, redesign or alternative financing approaches may be more appropriate. The feasibility study serves as a decision-making tool to ensure that climate projects are impactful, fundable, and implementable under real-world conditions.

Alternatively, it is recommended to have a look at the Guidance for preparing a pre-feasibility study under the Simplified Approval Process from the GCF. (Source GCF) The Guidance is meant to help to apply for GCF funding for smaller scale projects and programs, it is specifically designed for adaptation or mitigation initiatives.

Risk assessment:

Climate protection projects are exposed to a variety of risks that can affect their environmental integrity, financial viability, and long-term sustainability. Identifying and addressing these risks early in the project cycle is essential to ensure successful implementation and eligibility for carbon crediting. The risk assessment is a crucial part in the feasibility study, because of its importance it shall be highlighted here in an extra chapter.

- Technical risks may arise from the failure of key technologies, inadequate maintenance, or a mismatch between the project design and local conditions. These can be identified through a thorough technical feasibility study, pilot testing, and consultation with sector experts. Mitigation measures include selecting proven technologies, training local operators, and ensuring access to spare parts and technical support.

- Financial risks include unstable carbon markets, fluctuating prices for carbon credits, and unexpected costs during implementation. These can be managed through conservative financial modeling, diversification of revenue streams (e.g., energy sales, service fees), and performance-based contracts with investors or developers.

- Regulatory and policy risks stem from changes in national climate policy, taxation, or land use laws that may affect project eligibility or profitability. Ongoing monitoring of policy developments and engagement with government stakeholders can reduce exposure.

- Environmental and social risks include unintended harm to ecosystems or communities, such as displacement, water conflicts, or biodiversity loss. These risks are best identified through environmental and social impact assessments and mitigated via safeguards, stakeholder consultations, and grievance mechanisms.
- Carbon crediting risks, such as rejection by a standard or invalidation of credits, can occur if methodologies are applied incorrectly or MRV fails. These can be minimized by working with experienced consultants, adhering strictly to carbon standards, and maintaining high-quality documentation.

A structured risk assessment matrix, updated regularly, is a practical tool for identifying, evaluating, and managing project risks throughout the lifecycle.

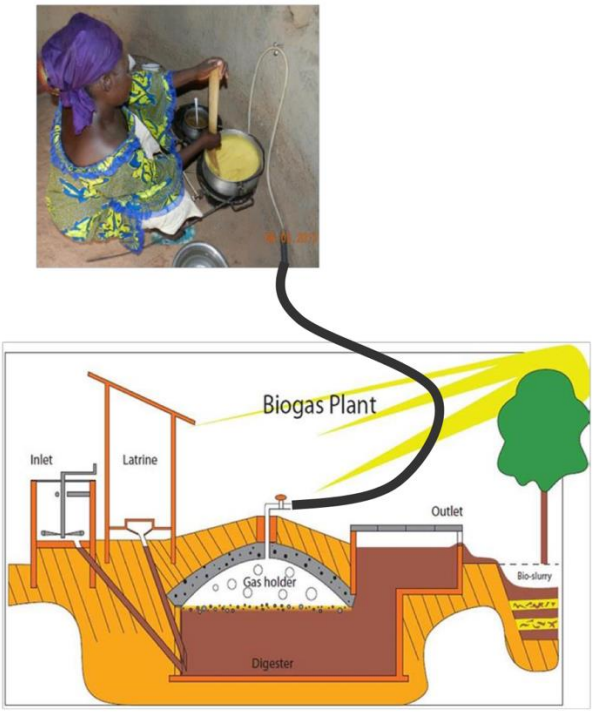
Involvement of national and local authorities:

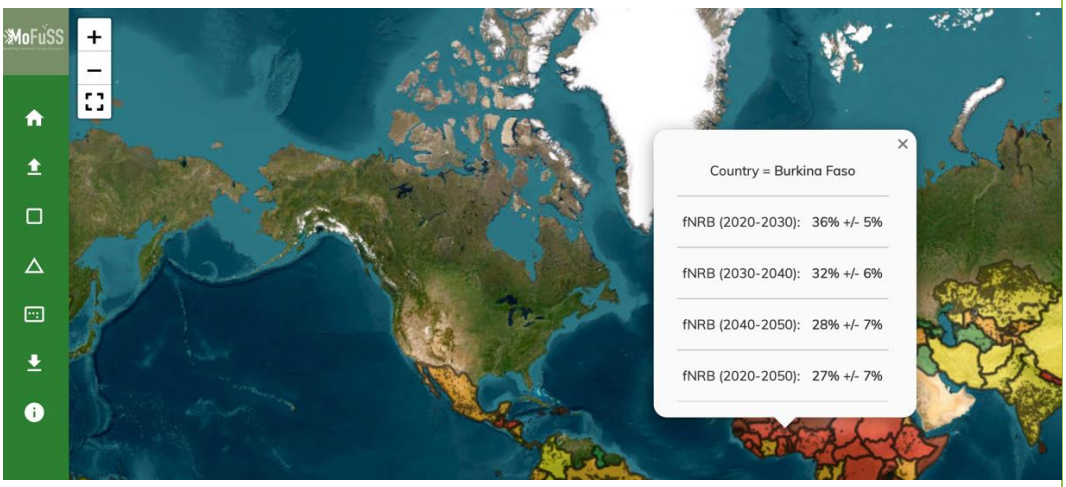
Involving official authorities early in the development of a climate protection project under certification standards such as Gold Standard or Verra is crucial for ensuring regulatory alignment, securing political acceptance, and facilitating long-term project sustainability. National governments, particularly through their Designated National Authorities (DNAs), play a central role in approving and overseeing climate mitigation activities within their jurisdiction. Although Gold Standard and Verra operate independently of the UNFCCC, both encourage early communication with relevant national or subnational bodies, especially in light of evolving Article 6 frameworks under the Paris Agreement.

Authorities should be contacted at the outset of project planning—ideally during or immediately after the Project Idea Note (PIN) stage. This timing allows project developers to verify whether the proposed activity aligns with national climate and development priorities and to clarify legal and administrative conditions, such as land use rights, environmental permitting, and emission reduction ownership. In some cases, formal letters of no-objection or host country approvals may be required, particularly if emission reductions are to be transferred internationally as Internationally Transferred Mitigation Outcomes (ITMOs).

The process of engagement varies by country but typically includes written communication with the DNA or relevant ministry, followed by submission of project documentation and possibly stakeholder consultations. According to the World Bank's 2022 "Guidance on Cooperative Approaches under Article 6," early government engagement helps prevent legal conflicts, ensures double counting is avoided, and strengthens project credibility with investors. Therefore, integrating official authorities early and transparently is both a procedural necessity and a strategic advantage in the carbon project lifecycle. (Source: World Bank (2022))

Spotlight: West African Biodigester Program of Activities

Name	West African Biodigester Program of Activities
Standards & ID	CDM POA: 9977 West African Biodigester Program of Activities) https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/R5G6I8MTCA129VPYOQJ0XHNL4ZEDUW/view?cp=1 CDM CPA: CPA 9977-P1-0001-CP1 (National Biodigester Programme Burkina Faso – CPA01) https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/OZDCSWJ4N0L6HVEU579MYR3XQGK21T/view
Location	Burkina Faso, Benin
Technology	Replaces non-renewable fuelwood, used for cooking, and kerosene, used for lighting, with renewable biogas at household level, by installing a biogas cookstove and a biodigester for households which have at least 2 heads of cattle. Biodigesters produce biogas from human, animal or plant waste. 
Methodology	AMS I.E version 11 - Switch from non-renewable biomass for thermal applications by the user (AMS I.E methodology has been rejected by ICVCM CCP: https://icvcm.org/assessment-status/)
Registration	24 Jun 2014
Duration (POA period)	24 Jun 2014 to 23 Jun 2021 (renewal period: 24 Jun 2021 - 23 Jun 2028 (provisional)
CER buyers	The Certified Emission Reductions in this project are procured by the World Banks Carbon Initiative for Development (Ci-Dev). On December 30, 2016, Ci-Dev signed an Emissions Reductions Purchase Agreement (ERPA) with the SNV Netherlands Development Organization for the purchase of certified emission reductions (CERs) to be generated by biogas digesters installed in rural households in Burkina Faso through the end of 2024 (https://www.snv.org/update/snv-signs-agreement-burkinas-biogas-carbon-credits)
Project size	• Some 8,000 digesters have been installed by Jan 2017, while 40,000 digesters are to be completed by 2024 in the POA. • As per the CERs issuance records and MRs, as of Dec 2020, 10,632 units have been installed for CPA001 (in Burkina Faso and Benin). As per the construction records of CPA001 (indicated in

	the ER sheet of last MP), the number of constructed units from year 2014 to 2019 is around 1,400 to 1,700 units per year and in year 2020, it's around 700 units. • The latest update on the biogas digesters installation is not found.
ER Estimation	As per monitoring reports published: One digester generates 3.62 ton CO_2-eq emission reduction per digester per year (the Fraction of non-renewable biomass (fNRB) is 90%, sourced from national default value of CDM Tool33).
CERs issuance	Has been completed for the monitoring period up to end of 2020.
Transition to A6.4	Ongoing, applicable period is 01 Jan 2021 to 23 Jun 2021, currently waiting for host Country approval.
Notes	After transition to A6.4 and during PoA renewal period, updated fNRB shall be used. As per the MoFuSS model, the fNRB is around 27% to 36% (https://www.mofuss.unam.mx/mofuss-ds/)  As per the "Information Note - Development of default values for fraction of non-renewable biomass", version 01, published by UNFCCC in Oct 2023, Appendix 1, the fNRB in Burkina Faso is 27%. With the updated fNRB, the ER per digester will be decreased to around 1.05 to 1.4 tCO2-eq per year.

Sources

Broekhoff: Derik Broekhoff, Michael Gillenwater, Tani Colbert-Sangree, Patrick Cage; GHG Management Institute, Stockholm Environment Institute (SEI): Carbon Offset Guide, February 2025, https://offsetguide.org/wp-content/uploads/Guides/Carbon_Credit%20Guide_EN.pdf, 29.05.2025

GHG: GHG Management Institute: What is a baseline? , March 2022, https://ghginstitute.org/2022/03/14/what-is-a-baseline/, 29.05.2025

WayCarbon: Way Carbon: What are the prerequisites for eligibility of a carbon credit?, December 2022, https://waycarbon.com/blog/what-are-the-prerequisites-for-eligibility-of-a-carbon-credit/, 29.05.2025

UNFCCC: CDM Methodology Booklet; May 2025, https://cdm.unfccc.int/methodologies/index.html?utm_source=chatgpt.com, 25 May 2025

GCF: Guidance for preparing a pre-feasibility study under the Simplified Approval Process; May 2025 https://www.greenclimate.fund/sites/default/files/document/guidance-preparing-pre-feasibility-study-under-simplified-approval-process.pdf, 25 May 2025

World Bank: Guidance on Cooperative Approaches under Article 6 of the Paris Agreement. (2022)

5.6 Marketing and Carbon credits sales

- **Sales channels for carbon credits:** Learning about the different sales channels and who uses them.
- **Price of carbon credits:** Understanding factors that impact the pricing of carbon credits.
- **Eligibility of carbon credits:** Find out what criteria carbon credits need to meet to become eligible in different carbon markets.

The marketing and sale of carbon credits is a rapidly evolving field. There are a variety of sales channels that can be used by project owners and buyers to transact. Each channel comes with its own dynamics, and the pricing can vary significantly depending on the chosen channel.

Sales Channels to Carbon Credits

One prominent approach is for investors or businesses to purchase carbon credits bilateral directly from project owners. When businesses buy credits directly from project owners, they ensure that most of the credit's value goes directly towards the project, rather than to intermediaries. This is a great benefit of buying credits directly, as long as companies have the technical knowledge required to assess the quality of projects. Direct deals often involve contracts with complex structures that require thorough due diligence and legal expertise.

However, many project owners do not sell their credits directly, or only work with very large buyers. For project owners to set up the processes and infrastructure to sell directly is not trivial, and many owners choose to outsource this to third parties, including marketplaces, exchanges, and brokers.

Using one of the outsourcing options results in an increased price due to intermediary margins and/or transaction fees.

The following table provides a description for the different sales channels and typical buyers that use these channels.

Table 32: Overview of Different Sales Channels for Carbon Credits (Source: Based on Abatable)

Sales Channel	Description	Typical Buyer
Bilateral directly between project owner and investors	• Buyer contracts directly with project owner. • Provides greater transparency and ensures more funds go directly to the project. • Wholesale price, generally cheaper than secondary market.	• Usually large corporates. • Governments.
Commodity Brokers / Traders	• Brokers act as intermediaries, sourcing carbon credits and negotiating deals on behalf clients. • Personalized service and access to exclusive projects. • Wholesale price plus intermediary margin (broker commissions or fees)	• All types (corporates, governments, individuals, NGOs, …).
Carbon Market Exchanges	• Formal trading platforms such as Xpansiv CBL or AirCarbon Exchange (ACX). • Wholesale price plus exchange transaction fee.	• Traders, financial institutions, corporates seeking standardized or large-volume credits.

	• Suitable for large, standardized transactions and financial players.	
Marketplaces	• Wholesale price plus marketplace fees and transaction costs. • Online platforms that connect buyers and sellers. • Offer a wide range of project types and vintages. • Allow for smaller transactions and more project-specific selection.	• Small and medium sized enterprises, NGOs, individuals, corporates seeking specific project characteristics or smaller volumes.

The complexity behind the pricing of carbon credits

Carbon credit prices are dynamic, fluctuating based on a range of variables, from project-specific attributes to broader market dynamics. The following figure shows an excerpt of the price development at the voluntary carbon market drawn from a range of market participants. It shows the high volatility and complexity of the price development.

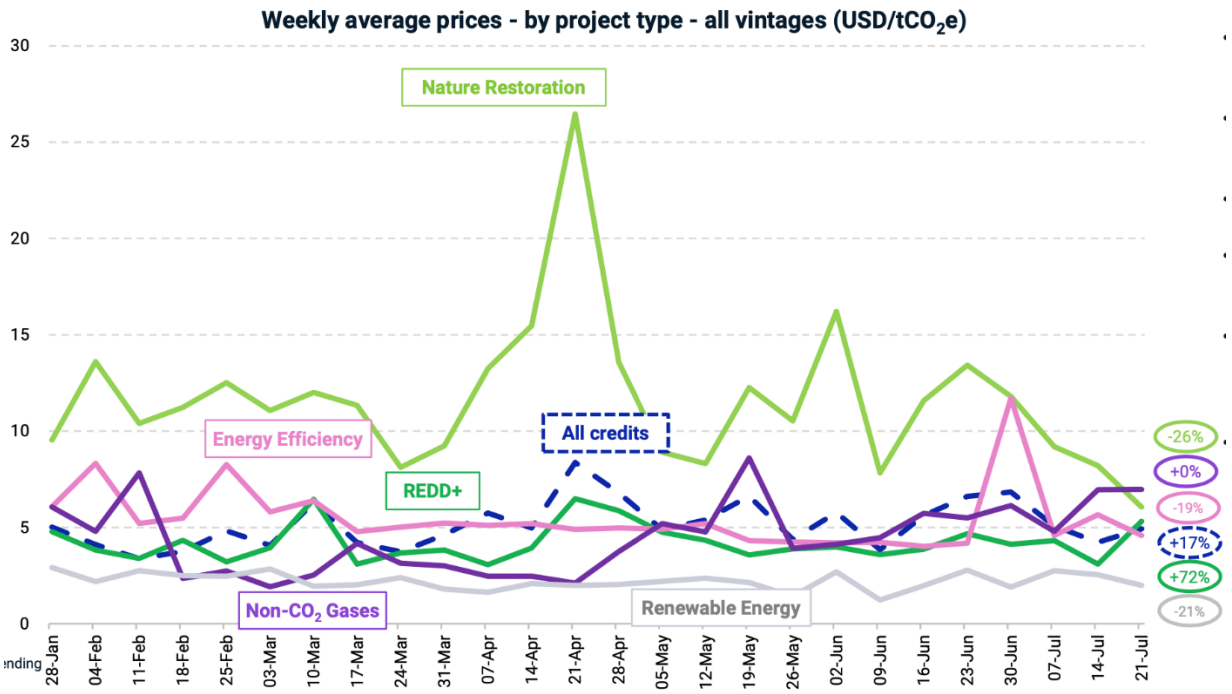


Figure 40: Weekly Average Carbon Credit Prices by Project Type at the Voluntary Carbon Market from January to July 2024 (Source: MSCI)

In the voluntary carbon market, price transparency is limited, with transaction details often kept private, abstract and anonymous. A lot of analysis is done by a variety of agencies resulting in key factors that can be identified to influence the pricing of carbon credits. These pricing factors are listed in the following table.

Table 33: Overview of Essential Pricing Factors for Carbon Credits (Source: Based on Abatable2)

Pricing Factor	Influence on Carbon Credit Price
Project type	• Renewable energy credits are typically traded at lowest price due to integrity concerns regarding additionality. • Engineered removal credits with high permanence trade at a high price reflecting the technology-development. • The methodology's complexity, additionality, and permanence also influence the value.

Region	• The location of a carbon credit project can influence its price. However, the impact of location on prices is much less compared to the influence of the project type. • Credits from locations with strong governance, clear regulations, and robust verification standards may tend to attract higher prices.
Vintage (Age of a carbon credit)	• Newer credits from recent projects often bring higher prices because they might align with current scientific understanding and corporate reporting standards.
Integrity	• Credits with the highest integrity, as measured by rating agencies such as BeZero, Calyx Global, MSCI, Renoster or Sylvera, are historically traded at a higher price. • Carbon credit integrity does not have a strong correlation with price, given the absence of any widely accepted quality standard. However, this might change with Core Carbon Principles (CCP) label.
Co-benefits	• Projects with more certified co-benefits, such as helping to achieve on or more of the UN's Sustainable Development Goals, result in higher carbon credit prices. • Possible certifications include Verra's Climate, Community and Biodiversity (CCB) or Sustainable Development Verified Impact Standard (SD VISTa).
Corresponding adjustment	• Few carbon credits have traded with a corresponding adjustment, but those that have, have commanded higher prices. • It refers to an accounting mechanism established under Article 6 to prevent double counting of emissions reductions.
Certifying standard	• Carbon credits issued under leading standards or mechanisms usually achieve higher prices than others. Accordingly, new projects should ideally be developed under premium standards, such as GS or VCS or Art. 6.4.
Volume	• Large, bulk sales may come with discounts, while smaller, specialized batches may command a higher price, especially if the project is small-scale or high impact.

While these pricing factors allow a structured approach to price assessment, carbon credit prices are nevertheless also influenced by market conditions, demand trends, and regulatory changes. The minimum price of carbon credits might often reflect the costs of project implementation and verification, especially in case of project cost-based pricing. In the case of direct or brokered deals, the price is set through negotiations between the buyer and seller.

As a project owner, the following steps could be followed to determine a carbon credit price:

1. Assess the full project costs, including development, monitoring, verification, and desired profit margin.
2. Benchmark against similar projects in the market, considering factors such as project type, location, and other relevant pricing elements.
3. Highlight and certify any unique co-benefits or SDG contributions.
4. Consult with intermediaries or brokers active in the target market to gain insights into current demand trends and buyer preferences.

Eligibility of carbon credits in different carbon markets

For the successful commercialization of Africa sanitation carbon credits their eligibility for use in different carbon markets will be of utmost importance. Ideally, new projects should be designed from inception in a way that their expected carbon credit stream can be used in all four main carbon markets as shown in the diagram below:

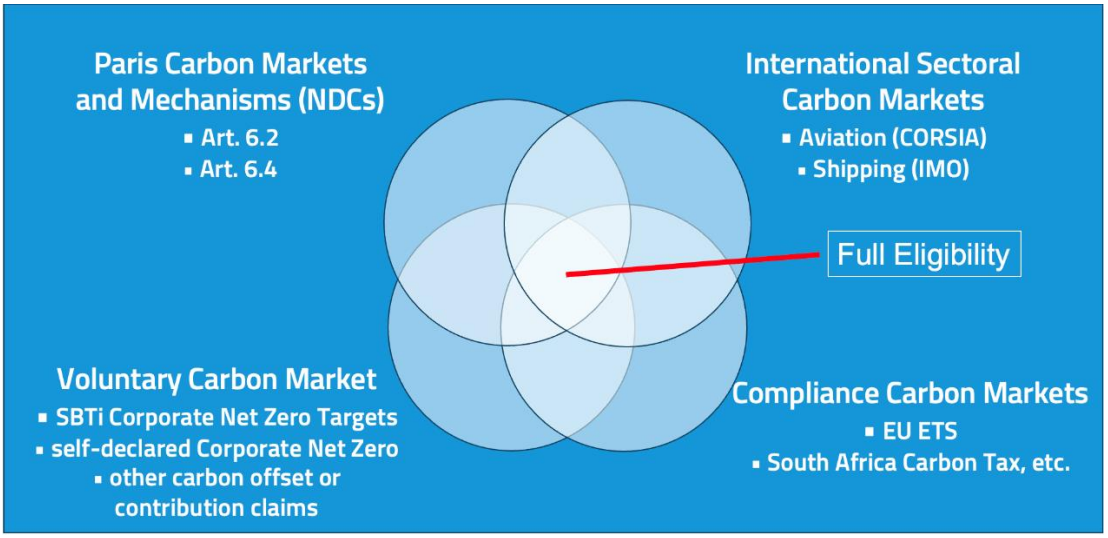


Figure 41: The four main carbon markets and carbon credit eligibility (Source: UPM)

While it will probably not be possible to achieve full eligibility in all these four potential carbon markets, project developers should aim at getting their carbon credits eligible in as many markets as possible.

In the voluntary carbon market, carbon credit demand is primarily determined by the preferences of companies with net zero targets, either under the Science-based Targets Initiative (SBTi) or self-declared, or with other voluntary climate action objectives. Usually, these companies launch annual carbon credit purchase tenders for spot or forward delivery in which they specify the eligibility criteria for carbon credits in a detailed manner. Their specification can cover the full range of the pricing factors, mentioned above in Table 19.

As the Paris Agreement carbon markets for Art. 6.2 ERs and Art. 6.4 ERs are still not fully operative and no transactions involving these carbon credits have been completed, the eligibility criteria required by sovereign or corporate buyers planning to use these are not that transparent yet. It is to be expected that some buyers will accept Art. 6.2 ERs or Art. 6.4 ERs as such, provided the necessary host country authorizations and corresponding adjustments have been provided, but others might determine further requirements, like additional certifications (e. g. GS) or ICVCM CCP approvals.

For international sectoral carbon markets, the Carbon Offset and Reduction Scheme for International Aviation (CORSIA) has been established and is currently in phase 1 (2024-2026). This phase is still voluntary for CORSIA-covered airlines, whereas phase 2 (2027-2035) will be mandatory. For phase 1, CORSIA eligible units are accepted from the following standards or mechanisms: American Carbon Registry (ACR), Architecture for REDD+ Transactions (ART), Climate Action Reserve (CAR), Global Carbon Council (GCC), the Gold Standard (GS) and the Verified Carbon Standard (VCS), provided they started their first crediting period from 1 January 2016 and only for vintages 2021-2026. All carbon credits supplied need to have a host country authorization for use in CORSIA and for corresponding adjustments. In addition, some project types and methodologies are ruled out. In contrast to CORSIA, the sectoral carbon market for international shipping still has a long way to go before becoming operative but once this has been accomplished it will also create large carbon credit demand.

The South African Carbon Tax is a good example for a compliance carbon market and the only one active in Africa as per today. South Africa was the first country in Africa to introduce a carbon tax in 2019 and is currently the 12th largest GHG emitter in the world. The carbon tax is seen as a key tool to help achieve its

Nationally Determined Contributions to the Paris Agreement, which it updated to commit to reducing its GHG emission to 350-420MtCO_2-eq by 2030 and reach carbon neutrality by 2050. The country has outlined its intent to perform corresponding adjustments in accounting for NDC targets. South Africa introduced an official tax rate of R120 (approx. $7) per ton of CO_2-eq, but the government took the step of increasing it to R134 (about $8) per ton by the end of 2022.

According to section 13 of the Carbon Tax Act, taxpayers may offset up to 5% of their taxable emissions. Offsets of approved projects (as listed in the Department of Minerals Resources and Energy's Carbon Offset Administration System (COAS), and guidance can be found under the . Guidance around project approval includes:

- Approved projects include CDM, VCS, Gold Standard projects, but also leaves space for other standards to be approved by the Minister of Energy or a delegated authority;
- Carbon avoidance, reduction or removal activities must have been carried out on or after 1 June 2019;
- Offset activities must have taken place in the Republic of South Africa.

Currently, 104 active CDM, GS or VCS projects in South Africa meet these eligibility criteria.

The EU Emissions Trading Scheme (EU ETS) could also become a relevant target market for African carbon credits. The EU ETS has ruled out the use of CDM CERs in the past to avoid oversupply and weak prices of European Allowances (EUAs), but its regulatory authorities are recently considering allowing Art. 6.4 ERs for compliance use, if this new mechanism proves to be robust enough with respect to its climate change mitigation and SDG impact performance. Should a positive decision be taken, this can generate meaningful carbon credit demand.

For developers of African sanitation projects, it will be highly recommendable to seek either a certification of their projects under leading and fully Paris-aligned standards, such as GS, VCS or GCC or develop these directly under Art. 6.4 because this approach will maximize the likelihood of successful carbon credit sales. The market for bilateral cooperative approaches under Art. 6.2 might also be attractive but, so far, demand just comes from a few sovereign buyers.

Furthermore, it will be indispensable to permanently monitor the most relevant carbon markets and their evolving eligibility criteria to make the necessary adjustments to project development and carbon credit marketing.

When is the best time to sell carbon credits?

The market for emission certificates is volatile and depends on political and economic factors. There is no guaranteed optimal time. Monitoring the market and advice from experts are recommended.

Is there a market-exchange platform?

- Yes, there are both official exchanges (for example European Energy Exchange, Gold Standard Registry) and over-the-counter (OTC) markets. Optimal conditions are often achieved through OTC trading.
- Exchanges cannot replace the individual adaptation of an offer to the specific requirements of a tender.

Are the transactions taxed? Is there a share of the proceeds taken by other entities?

Yes, transactional, administrative, or certification fees are often charged by registrars or third-party vendors.

This depends heavily on standards and national regulations. Some standards claim a Share of Proceeds (SOP) upon initial issuance of credits, while transfers are usually free of additional fees (with the current exception of the Gold Standard). In the case of Article 6 certificates, some host countries claim share of proceeds (SOP). However, transfers themselves are usually free of fees.

is Art. 6.2 the only opportunity for a country to purchase credit?

No, in addition to Article 6.2 (bilateral agreements), there is also Article 6.4 (a central UN mechanism) and voluntary markets. Countries can acquire certificates in several manners. Please refer to figure 28 in the Training Manual.

Sources

Abatable: Abatable: How to find and evaluate carbon credits, https://abatable.com/blog/find-evaluate-carbon-credits/, 29.05.2025

Abatable2: Abatable: What factors influence the price of a carbon credit, https://abatable.com/blog/understand-factors-influencing-carbon-credit-prices/, 29.05.2025

Allied Offsets: Scheme Spotlight: South African Carbon Tax, https://blog.alliedoffsets.com/scheme-spotlight-south-africas-carbon-tax-coas), 11.06.2025

ICAO: International Civil Aviation Organization: CORSIA Eligible Emissions Units, October 2024 https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA%20Eligible%20Emissions%20Units/CORSIA_EEU_Oct2024.pdf

MSCI: MSCI Carbon Markets: Voluntary Carbon Credit Prices – Weekly Market Report – Week 29, July 2024

KEY TAKEAWAYS

- Carbon credits can provide a reliable and performance-based financing mechanism that supports the operational sustainability of climate projects throughout the crediting period.
- Article 6 unlocks new and sustainable financing opportunities — success depends on how governance challenges are addressed.
- Africa holds significant untapped potential for carbon credit projects due to its vast natural resources and mitigation opportunities—but realizing this potential requires stronger institutional capacity, access to financing, and equitable participation in global carbon markets.
- Integrating sanitation into carbon credit frameworks can unlock new funding streams and accelerate access to climate-smart sanitation solutions—particularly when emissions reductions from waste treatment are rigorously quantified and verified.
- Carbon credit prices are dynamic, fluctuating based on a range of variables, from project-specific attributes to broader market dynamics.
- The complexity and frequently changing rules of various carbon markets pose significant challenges, making it essential to stay informed about the latest standards and often requiring external expertise for effective guidance.

6 Glossary

Adaptation Fund	A global fund introduced in 2001 to finance adaptation projects and programs in developing countries that are vulnerable to the adverse effects of climate change. *It was initially financed with the proceeds from the CDM and later was additionally supported through voluntary contributions from governments and the private sector.*
African Water Facility (AWF)	Africa's primary funding entity for water and sanitation projects across Africa, placing an emphasis on accelerating the implementation of projects that improve accessibility to adequate water and sanitation services, whilst enhancing climate resilience.
African Urban Sanitation Investment Initiative (AUSII)	A dedicated urban sanitation financing window established by the African Water Facility aimed at improving urban sanitation in Africa.
Article 6.2 (Paris Agreement)	Allows countries to trade emissions reductions bilaterally or multilaterally through Internationally Transferred Mitigation Outcomes (ITMOs), helping them achieve their climate targets while ensuring transparency, environmental integrity and no double counting.
Article 6.4 (Paris Agreement)	Establishes an UN-supervised global carbon market mechanism, where emission reduction projects generate credits that can be traded internationally, with oversight to ensure environmental integrity and avoid double counting.
Bilateral Climate Agreements	A climate financing agreement involving direct financial support from one country to another to address climate change challenges, enabling countries to collaborate on implementing climate projects globally.
Blended Climate Finance	A type of climate financing that involves public or philanthropic sources of funding being leveraged to absorb financial risks, thereby providing a financial environment where the private sector is more willing to participate and invest in.
Carbon Credit	A certificate representing one metric ton of carbon dioxide (or equivalent GHG) reduced or removed from the atmosphere, which can be traded or used to offset emissions.
Carbon Credit Project	An initiative or activity that generated measurable and verifiable emission reductions, resulting in carbon credits.
Chemical Oxygen Demand (COD)	Measure of the amount of oxygen required to chemically oxidize organic and some inorganic substances in water and wastewater.

Clean Development Mechanism	A mechanism under the Kyoto Protocol allowing developed countries to invest in emission reduction projects in developing countries and earn certified emission reduction credits to help meet their own targets.
Climate Finance	Financial resources provided to support mitigation and adaptation actions addressing climate change, especially in developing countries, including grants, loans, investment and guarantees.
Climate-Sanitation Nexus	The interconnected relationship between sanitation systems and climate change.
Climate-SMART Sanitation	Sanitation systems that are safe, mitigative, adaptative, resilient and transformative.
Community/Civil Society Organization (CSO) Climate Financing	A type of climate financing that involves the mobilization and deployment of community-based financial resources to support climate change mitigation and adaptation projects, particularly at the local level. *Community climate financing can involve direct community fundraising, funding from donors and philanthropic sources, or accessing international climate funds.*
Concessional Climate Finance	A type of climate financing that involves the provision of loans under terms that that much more favorable than standard commercial loans, including lower interest rates and longer repayment periods. *They are most widely used by major financial institutions such as bilateral and multilateral development banks, for the financing of worthy projects in developing countries to accelerate development objectives.*
Denitrification	Biological process in which bacteria convert nitrate (NO3-) into nitrogen gas (N2) under anoxic (oxygen-poor) conditions.
Green Banks	Green Banks are national, country-driven, dedicated, catalytic financial institutions designed to address domestic market gaps, take ownership of climate finance and leverage public and private investments in low carbon and resilient projects. They provide financing through loans as opposed to grants, with expectation of repayment to maximize the impact of each dollar that they deploy into a viable, bankable, and impactful project.
Green Climate Fund (GCF)	The world's largest dedicated climate fund, established under the UNFCCC in 2010, to support developing countries in reducing GHG emissions and adapting to climate change by financing low-emission and climate-resilient projects.
Green Climate Fund (GCF) Investment Criteria	Six set requirements that guide the GCF's financing decisions to fund sanitation projects. *These are the (i) Impact Potential, (ii) Paradigm Shift Potential, (iii) Sustainable Development Potential, (iv) Needs of a Recipient, (v) Country Ownership, (vi) Efficiency and Effectiveness*
High-risk climate impacted area	High-risk climate impacted areas describe locations where the combination of hazards, exposure and vulnerability can be considered significant resulting in a high likelihood of negative impacts on people, livelihoods, ecosystems or infrastructure.

Improved sanitation	Improved sanitation facilities are those designed to hygienically separate human excreta from human contact.
Joint Implementation (JI)	*A mechanism under the Kyoto Protocol that enabled developed countries with emissions reduction commitments under the Protocol to invest in emission-reduction projects in other committed developed countries.*
Kenya Innovative Finance Facility for Water (KIFFWA)	*A program that co-develops water initiatives in Kenya, managed by the Netherlands Water Partnership (NWP) with funding and support from the Dutch Embassy in Kenya. It provides early-stage capital, finance and technical expertise to support the creation of viable water investment opportunities and attracts private sources of funding.*
Kyoto Protocol	An international treaty adopted in 1997 that committed industrialized countries to legally binding targets for reducing GHG emissions.
Multilateral Climate Funds (MCFs)	International financial entities that provide financing, largely in the form of grants, to various developing countries to foster climate mitigation and adaptation.
National Adaptation Plan (NAP)	A strategic plan developed by a country to identify and address its medium- and long-term priorities for adapting to the impacts of climate change.
Nationally Determined Contributions (NDCs)	Climate action plans submitted by countries under the Paris Agreement, outlining their targets and measures for reducing GHG emissions and adapting to climate change.
New Collective Quantified Goal (NCQG)	A climate finance target adopted at COP29 in Baku aiming to increase climate finance to at least US$300 billion per year by 2035.
Nitrification	Biological process in which specialized bacteria convert ammonia (NH3) into nitrite (NO2-) and then into nitrate (NO3-), typically under aerobic (oxygen-rich) conditions.
Paris Agreement	A global accord adopted in 2015 under the UNFCCC, in which nearly all countries agreed to limit global warming to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C.
Safely-managed sanitation	Safely-managed sanitation is defined as the use of improved sanitation facilities that are not shared with other households and where excreta is safely disposed of in site (on-site) or transported and treated off-site.
United Nations Framework Convention on Climate Change (UNFCCC)	International treaty adopted in 1992 to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous human interference with the climate system.

7 Facilitator Package - Agenda, Scripted Guidance for Exercise, Trainee Handouts

7.1 Module 1 – Climate-Sanitation Nexus

7.1.1 Agenda

Time	Session	Objectives and Format	Materials
08:30 am	Registration and Welcome		
09:00 am	Welcome and opening	• GGGI & AfWASA opening remarks • Host country government representative • Group photo	
11:00 am	Tea/Coffee Break		
11:15 am	Introduction to the ToT	Presentation of Trainers, Training background & objectives, Training Need Assessment and main topics to be covered	M1 PPT 1
11:30 am	Introduction of the participants	Group introduction (Tour-de-table) and collection of participants' expectations	M1 PPT 1 M1 Intro
12:00 pm	Understanding the Climate-Sanitation Nexus	Develop a common definition of the climate-sanitation-nexus, the interconnectivity of climate and sanitation and its implications (Group exercise)	M1 PPT 1 M1 Exercise 1
12:30 pm	Introduction to the Climate-Sanitation Nexus	Summarize key concepts and interconnections between climate and sanitation (Presentation and Q&A Session)	M1 PPT 2
01:00 pm	Lunch Break		
02:00 pm	Energizer	the UN SDGs challenge!	M1 PPT 3
02:15 pm	Introduction to SDGs and NDCs	Basic understanding of SDG 6 and 13 and NDCs (Presentation and Q&A Session)	M1 PPT 3
02:35 pm	Mapping Sanitation and Climate: How SDG 6.2 is addressed in NDCs	Clear understanding of how sanitation (SDG 6.2) aligns with NDCs (Guided Group exercise 2 with presentation)	M1 PPT 3 M1 Exercise 2
03:35 pm	Tea/Coffee Break		
03:50 pm	Scaling Up Impact: Developing an Outreach/Training Plan	Consolidate learning on the Climate-Sanitation Nexus and translate insights into a training or advocacy plan. (Intro by trainer and group exercise)	M1 PPT 4 M1 Exercise 3
04:50 pm	Wrap-up and Closing remarks	Feedback and Reflection on the expectations.	
05:00 pm	End of M1		

7.1.2 Scripted Guidance for Exercises and Trainee Handouts

Introduce Yourselves

- What is your name?
- Where are you from?
- What is your current employment?
- What are your main expectations for this Training-of-Trainers? (world cloud-mentimeter)

Understanding the Climate-Sanitation Nexus

Exercise objective	Develop a shared definition of the Climate-Sanitation Nexus and understand the interconnections between sanitation and climate.
Anticipated time	30 minutes
Group division and focus areas	Divide participants into four groups, each addressing a unique aspect of the Nexus through an Impact diagram.
Group assignments with guiding questions *(No. of groups tbc)*	Group 1: Defining the Climate-Sanitation Nexus • Guiding question: What are the key components and interactions that define the Climate-Sanitation Nexus? • Suggestion for the impact diagram: Show climate variables and sanitation systems, and the connecting elements. • Keywords: interdependence, feedback loops, co-benefits, human health, environmental health, vulnerability, emissions, policy, resilience Group 2: Climate impacts on sanitation • Guiding question: How does climate change affect sanitation infrastructure, access and health outcomes? • Suggestions for the impact diagram: Show how climate-related events affect sanitation services. E.g., flooding damages latrines, droughts limit water supply for hygiene.

- Key words: infrastructure damage, access disruption, contamintation, health risks, displacement

Group 3: Sanitation's impact on climate

- Guiding question: In what ways does the sanitation sector contribute to climate change?
- Suggestions for the impact diagram: Trace emission from various sanitation processes. E.g. methane from anaerobic processes in septic tanks, carbon dioxide from energy use in treatment plants.
- Key words: methane, nitrous oxide, carbon dioxide, energy consumption, treatment methods, open defecation

Process

1. In preparation of the exercise, pre-label 3 flipcharts with the different guiding questions. Further, provide empty sticky notes or moderation carts as well as some moderation carts that have the key words.
2. In the introduction of the exercise, include showing an example impact diagram to clarify the intended format for all participants.
3. Each trainer will be present at one of the flipcharts to guide and moderate the group work. The trainer's task is to explain again the task of necessary, encourage writing down key words and facilitate the discussion between the participants, and make sure that the participants stick to the topic. The trainer is also the time keeper.
4. Split the entire group in relatively equal amount of people if not done by the participants themselves.
5. Group work: for about 10 minutes, the participants should discuss their topic and fill the flipchart with key words, arrows, etc. to show the relation between key words. An impact diagram shall be created.
6. Rapid gallery walk: Each group leaves one member behind (declared as the "host") to explain their diagram to the other arriving participants. The other members split and visit the two other posters (each for about 5 minutes). The member left behind explains the diagram and other can make suggestions, ask questions and add connections.
7. Lightning presentations: The host from each group gives a 1-minute summary of what their diagram shows, as well as best comment or question that they might have received.
8. Group synthesis: One of the trainers closes the exercise by leading a quick reflection. Ask e.g. "Can someone try to define the Climate-Sanitation Nexus in one sentence?"

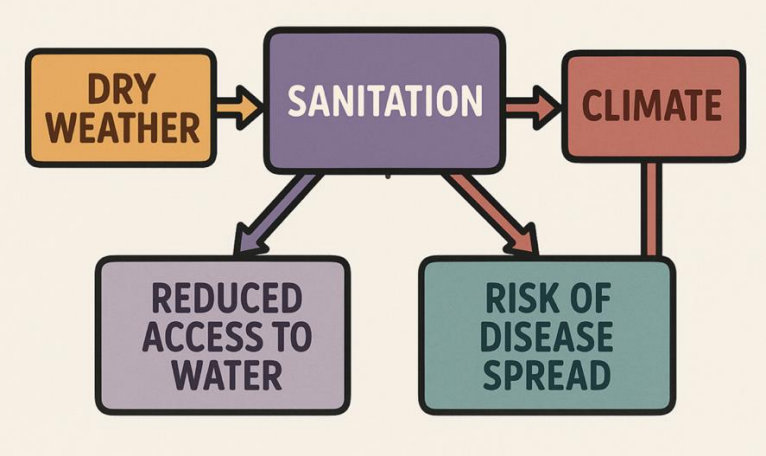
M1 EXERCISE 1 HANDOUT

Understanding the Climate-Sanitation Nexus

- ✓ Find yourself in one of the groups in front of one of the flipcharts.
- ✓ Together with your group answer the question on the flipchart by creating an impact diagram.
- ✓ You have 10 minutes.
- ✓ Name a host for your group who remains with the flipchart / question. The others rotate to the flipcharts. 5 minutes each.
- ✓ Don't forget to make use of the keywords that are provided for each group.

What is an impact diagram?

A simplified example



M1 ENERGIZER

The UN SDGs challenge

- One volunteer at a time names the SDGs (in any order).
- They keep going until they get one wrong or pause too long.
- Then the next person continues from where they left off.
- Goal: Together, name all 17 SDGs!

Goal #	Title
1	No Poverty
2	Zero Hunger
3	Good Health and Well-being
4	Quality Education
5	Gender Equality
6	Clean Water and Sanitation
7	Affordable and Clean Energy
8	Decent Work and Economic Growth
9	Industry, Innovation and Infrastructure
10	Reduced Inequality
11	Sustainable Cities and Communities
12	Responsible Consumption and Production
13	Climate Action
14	Life Below Water
15	Life on Land
16	Peace, Justice and Strong Institutions
17	Partnerships for the Goals

M1 EXERCISE 2 SCRIPT

Mapping Sanitation and Climate: How SDG 6.2 (sanitation) is addressed in NDCs (CHAPTER 4)

Exercise objective	Achieve a clear understanding of how SDG 6.2 (sanitation) is addressed in each country's Nationally Determined Contributions (NDCs) and develop advocacy and implementation ideas to integrate sanitation-related climate action.
Anticipated time	60 minutes
Group division	Participants (2 or more) are grouped and select one country.
Group assignments with guiding questions	Each group/pair will prepare a flipchart of providing an overview for their country to be presented to the other participants. Guiding questions for each group/pair: • What are the major sanitation-related challenges in your country? →list or mind map of country-specific sanitation issues • To what extent is sanitation mentioned or prioritized in your country's NDC? Does it mention SDG 6.2 or related climate adaptation/mitigation actions (e.g., wastewater, hygiene, resilient infrastructure) →summary of where and how sanitation is mentioned (or not) • Based on your search, what are key gaps or opportunities for stronger integration of sanitation? • What actions could you advocate for or implement to better integrate sanitation into climate action in your country?
Process	1. The trainers introduce the exercise and provide handouts (ideally online to facilitate easier search of NDCs) with the guiding questions, QR codes / links to access NDCs and QR codes / links to access assisting tools for this exercise. 2. Each group/pair has 30 minutes to answer the guiding questions and prepare a flipchart page that can be presented. 3. Each pair/group provides a 1-minute summary for their respective country pointing out a key sanitation challenge, how their NDC handles it (or not) and their top proposed action. 4. The results for each country can be hung ideally on the wall for the remain of the day, so that participants can also read it later and compare with their own country.

M1 EXERCISE 2 HANDOUT

Mapping Sanitation and Climate: How SDG 6.2 (sanitation) is addressed in NDCs

- Understand how sanitation (SDG 6.2, see Module 1 for specific target formulation) is reflected in your country's NDC.
- Identify key sanitation challenges in your national context.
- Propose practical advocacy and implementation actions to strengthen sanitation-related climate action

You have 30 minutes to complete the exercise.

1. Form a pair or group with others and select one country.
2. Prepare a one-page flipchart overview for your country answering the following questions (by discussing it with your group/partner and using recommended tools):
   - *What are the major sanitation-related challenges in your country?*
   - *To what extent is sanitation mentioned or prioritized in your country's NDC? Does it mention SDG 6.2 or related climate adaptation/mitigation actions (e.g., wastewater, hygiene, resilient infrastructure)*
   - *Based on your search, what are key gaps or opportunities for stronger integration of sanitation?*
   - *What actions could you advocate for or implement to better integrate sanitation into climate action in your country?*
3. You have one-minute to present the result of your group to the room

Access to your country's NDC: https://unfccc.int/NDCREG

Burkina Faso

Cameroon

Côte d'Ivoire

Ethiopia

Ghana

Kenya

Malawi

Senegal

Uganda

Zambia

Helpful tools for NDC analysis

Climate Watch NDC Explorer: Gives you the opportunity to search keywords in NDCs (e.g., sanitation, WASH)

https://www.climatewatchdata.org/ndcs-explore

NDC-SDG connections tool: Explores links between NDCs and SDG goals or targets

https://klimalog.idos-research.de/ndc-sdg/sdg/6/country:AVERAGE

SWA Country Profiles: Search your country and find a country-level sanitation and water policy info

https://www.sanitationandwaterforall.org/impact/document-library

M1 EXERCISE 3 SCRIPT

Scaling Up Impact: Developing an Outreach/Training Plan

Exercise objective	To consolidate learning on the Climate-Sanitation Nexus and translate insights into a training or outreach plan. Develop a mini training or outreach plan targeting decision makers, local authorities, etc.
Anticipated time	60 minutes
Group division	Participants form small groups based on country of origin or work context.
Guiding scenario	The participants have just completed a Training-of-Trainers on the Climate-Sanitation Nexus. Now, it's their turn to design an awareness session to engage with local decision-makers, sanitation planners, climate policy officials, etc.
Process	1. As trainer introduce the exercise (see presentation 4 for Module 1). Provide training template outline to participants (see next page). 2. Provide participants about 30 minutes to fill training plan template. 3. Let selected people roleplay the scenario for 10 minutes. Another person can impersonate the target audience and play the role. 4. Participants reflect and provide feedback on approach.

M1 EXERCISE 3 HANDOUT

Scaling Up Impact: Developing an Outreach/Training Plan

Why this exercise:

- ✓ Many stakeholders are still unaware of how climate and sanitation are interconnected.
- ✓ Sanitation is often overlooked in climate policies like Nationally Determined Contributions (NDCs) and National Adaptation Plans (NDPs).
- ✓ YOU – as trainers and advocates – can change this by influencing local and national decision makers.

Learning objectives:

- ✓ Apply training plan to prepare approach, key messages, etc. tailored to a specific stakeholder.
- ✓ Communicate the Climate-Sanitation Nexus clearly and persuasively.
- ✓ Handle objections and questions effectively.
- ✓ Reflect on strategies to improve real-life outreach.

How to advocate for sanitation-related climate actions

- Developing Effective Advocacy for Sanitation-Related Climate Actions: Training Manual, Chapter 2.5 P29 - ESAWAS Building Blocks
- Designing Actionable Sanitation-Climate Initiatives: Training Manual, Chapter 2.5 P30 - SEI's Guiding Questions to prompt thinking on integrating climate action into sanitation systems and vice versa.

Training plan development

Element	Content
Define your Target audience	Ask yourself • Who are you trying to influence? • What role do they plan in sanitation or climate policy? • What decision or actions can they take?
Define the Objective of the approach	Clarify • What exactly do you want your target audience to do or understand? • How will this contribute to integrating sanitation in climate policies or actions?
Select an appropriate Format	Chose a format that matches the target audience, their time, interest and level of engagement

	Target audience	Primary interests	Communication style	Recommended format
	Decision makers	Policy relevance, public visibility, political risks/opportunities	High level, concise, action-oriented, value-driven	Short briefings, high-level roundtables, field visits with media potential
	Technical staff	Technical feasibility, scientific and operational accuracy	Detailed and evidence-based, solution-oriented, analytical and practical	Workshops, technical presentations, planning sesssions
	Project managers	Delivery times, resource allocation, managing partnerships	Pragmatic and goal-focused, structured	Working meetings, reporting frameworks, action plans
	Business people	Return on investment, market opportunities, risk management	Data-drive, results- and partnership-oriented	Roundtables, pitch
Develop Key messages	Develop key messages that are clear, relevant and backed by evidence. Use language in relation to your target audience.			
Build Arguments & content	Support your key messages with local data or examples, case studies from similar contexts, maps, infographics, etc. These contents should reflect the primary interests of your target audience.			
Choose engagement methods and support tools	Decide how to deliver your key messages and content: • Interactive: discussion, Q&A, poll, … • Visual: flipchart, power point, video, maps, … • Collaborative: group work, planning exercise Supporting tools could be • One-page briefs • Handouts • Templates			
Anticipate Objections & reactions	List likely doubts or resistance points.			
Define Follow-up	Plan how you will sustain interest and remain in contact with your target audience.			

Training/advocacy plan Example

Element	Example
Target audience	Mayor of a small town that is affected by seasonal flooding
Objective of the approach	Raise awareness how climate-SMART sanitation can mitigate local climate impacts and should be included in the local climate adaptation strategy
Format	One-on-one dialogue during a municipal planning meeting
Key messages	• Sanitation upgrades reduce environmental damage during climate shocks. • Access to climate finance may be possible if sanitation is included in climate adaptation strategy
Arguments & content	• Evidence: Past flooding events caused latrine overflows, contaminating water sources. • Climate-SMART sanitation solutions can be affordable and scalable.
Methods / support	• Visuals: local flood maps, impact diagram • Success stories from similar towns
Objections & reactions	• "This is a health issue, not my responsibility." • "The community has other priorities."
Follow-up	• Offer short technical consultation to show sanitation-climate links. • Follow-up briefing notes and potential funding information

Template: Scaling Up Impact- Developing an Outreach/Advocacy Plan

Element	Content
Target audience	
Objective of the approach	
Format	
Key messages	
Arguments & content	
Methods / support	
Objections & reactions	
Follow-up	

7.2 Module 2– Climate-SMART Sanitation

7.2.1 Agenda

Time	Session	Objectives and Format	Materials
08:30 am	Registration and Welcome		
09:00 am	Opening Remarks	Short recap of first day, review expectations, agenda and objectives of the day	M2 PP1 M1 Recap
09:30 am	Understanding of Climate-SMART Sanitation	Current knowledge of climate-SMART sanitation (Group interactive brainstorming session- word cloud)	M2 PP1 M2 Intro
09:45 am	Introduction to Climate-SMART Sanitation Approach	Understanding of climate-SMART sanitation approach. (Presentation and Q&A Session)	M2 PP1
11:15 am	Tea/Coffee Break		
11:30 am	Assessment Methods for Climate-SMART Sanitation Technology & System	Overview of existing assessment methods for sanitation technologies and systems regarding their climate "smartness". (Presentation and Q&A Session)	M2 PPT2
12:30 am	Field visit briefing	Introduction to visit and assessment handout by ONAD representative	M2 PPT3 M2 Exercise 1
01:00 pm	Lunch Break		
02:00 pm	Field visit	Visit of a real example and can practice a real-time assessment regarding the climate-smartness of a system On-site visit with review of the system • Presentation on the system • Apply the Climate-SMART approach	M2 Exercise 1
05:00 pm	End of D2		

7.2.1 Scripted Guidance for Exercises and Trainee Handouts

- Sanitation and climate change are closely linked – each affects the other ("the Wicked Problem").
- Climate-SMART sanitation solutions need to be considered to reduce GHG emission from conventional sanitation solutions and their impact on climate.
- Safe sanitation for all will cause a rise in GHG emissions and increase the impact of sanitation on the climate. Climate-SMART sanitation solutions need to be considered.
- Climate-related sanitation solutions must be flexible and context-specific – there is no one-size-fits-all solution.
- Everyone is impacted by the Climate-Sanitation Nexus, so strategies must be inclusive.
- Climate-SMART sanitation provides many synergies with all 17 Sustainable Development Goals.
- Sanitation needs to be more prioritized in National Adaptation Plans and Nationally Determined Contributions.
- A clear and strategically formulated strategy in NDC and NAP is very beneficial for applying for international funding.

INTERACTIVE BRAINSTORMING SESSION

What features and characteristics, according to your understanding, could define a climate-SMART sanitation value chain?

Activity Instructions

- Each participant will contribute keywords or short phrases (word cloud on mentimeter).

EXPERIENCE SHARING

- Group interactive brainstorming session
- Can you think of any technologies or systems in your country that align with the Climate-SMART Sanitation approach?
- (voluntary sharing , notes added to one board /screen + feedback of the trainer)

M2 EXERCISE 1 HANDOUT

SMART Analysis of a Fecal Sludge Treatment Station using a question matrix.

Observe, analyze, and gather information based on the climate SMART approach provided in the handout

Answer as many questions as you can from each section of the matrix (technical, ecological, operational). Take notes and photos (if allowed). Record your answers in bullet points, these will be used in later group work. If you cannot answer a question, please note it.

S	M	A	R	T
Safe	**Mitigative**	**Adaptative**	**Resilient**	**Transformative**
1. Is the treatment process fully completed or only partially treated? 2. What is the final destination of the effluent? If it is reused or discharged, does it comply with national discharge standards? 3. How is the sludge managed? Is it disposed of in a landfill or reused? If reused, does it meet the national quality standards for reuse? 4. Does the Fecal Sludge Treatment Plant (FSTP) have a Standard Operating Procedure (SOP) in place? 5. Do the operators wear appropriate Personal Protective Equipment (PPE), and are they vaccinated as per health and safety guidelines?	1. What are the specific treatment steps involved in the process? 2. What is the average volume of fecal sludge received for treatment? Is this data documented? 3. What is the average quality of fecal sludge received in terms of BOD (or COD) and Total Nitrogen (TN)? Is this information documented? 4. What is the quality of the treated effluent in terms of BOD (or COD) and TN? Is this data documented? 5. What is the quantity and quality of the sludge that is either disposed of or reused? Is this information documented?	What adaptation and resilience measures can be implemented to address these HETs, categorized under the following strategic objectives: - Avoid: What actions can be taken to prevent the occurrence of these hazards? - Withstand: What systems or reinforcements can be put in place to ensure the FSTP continues to operate during hazardous events? - Flexibility: How can the system be designed or managed to adapt to varying conditions or unexpected changes? - Contain: What measures can limit the spread or escalation of the impact within the plant or to the surrounding environment? - Limit the consequences: What strategies can reduce the severity of outcomes if a hazard occurs? - Fast recovery: What procedures or resources are needed to ensure rapid restoration of normal operations? - Provide co-benefits beyond resilience: (covered in transformative part)		1. Does the system include any form of resource recovery (e.g., energy, water, nutrients)? If not, what opportunities for resource recovery could be explored or implemented? 2. What additional measures would you recommend to enhance safety for workers, protect the environment, and improve public health outcomes?

Template to be used during the site-visit (next page)

S	M	A	R	T
Safe	**Mitigative**	**Adaptative**	**Resilient**	**Transformative**

7.3 Module 3– Climate Finance for Sanitation

7.3.1 Agenda

Time	Session	Objectives and Format	Materials
08:30 am	Registration and Welcome		
09:00 am	Opening Remarks	Short recap of second day, review expectations, agenda and objectives of day 3	M2 PPT4
09:30 am	Follow-up site visit	Summarize the assessment conducted during the field visit and propose solutions toward a Climate-SMART sanitation approach	M2 PPT4
10:30 am	Scaling Up Impact: Outreach/ Training Plan	Consolidate learning on Climate-SMART Sanitation by developing a training plan on climate-SMART approach	M2 PPT4 M2 Exercise 2
11:00 am	Tea/Coffee Break		
11:15 am	Understanding Climate Finance	Current knowledge about climate finance.	M3 PPT1
11:30 am	From Kyoto to Paris: Evolution of Climate Finance	Gain insights about climate finance and understand the implications. (Presentation and Q&A Session)	M3 PPT1
12:15 pm	International Climate Financing Tools for Sanitation	Overview of existing climate financing tools for sanitation. (Presentation and Q&A Session)	M3 PPT2
01:00 pm	Lunch Break		
02:00 pm	Energizer	Climate Finance Acronyms Trivia	M3 PPT 3
02:15 pm	Green Climate Fund Sanitation Project Alignment	Assess a project's alignment with the Green Climate Fund Investment Criteria. (group exercise and presentation by trainees)	M3 PPT 3 M3 Exercise 1
03:30 pm	Tea/Coffee Break		
03:45 pm	Developing Sanitation Project Ideas targeting GCF funding	GCF Project pitching challenge (group exercise)	M3 PPT4 M3 Exercise 2
04:45 pm	Wrap-up and Closing remarks	Feedback and Reflection on the expectations.	
5:00 pm	End of D3		

7.3.2 Scripted Guidance for Exercises and Trainee Handouts

• Expanding access to safely managed sanitation remains a fundamental development and public health priority.

• Climate-SMART sanitation applies a holistic approach—Safe, Mitigative, Adaptive, Resilient, and Transformative—to align sanitation systems with climate goals.

• Baseline assessments (e.g., JMP, SFD, ECAM) are critical to identify service gaps, emissions, and climate vulnerabilities.

• Technology choices must be context-specific and evaluated for climate compatibility using structured decision-making tools.

• Effective planning requires a systems approach that includes infrastructure, operations, governance, and climate resilience.

• Climate-SMART sanitation approach applies to the whole value/service chain

• Projects demonstrating GHG reductions and adaptation benefits, from well-grounded baseline assessment and a realistic project scenario, can access climate finance and carbon credit opportunities.

FOLLOW_UP OF THE FIELD VISIT

- Summarize the information and propose solutions to improve the limitations (30 min.)
- Presentation (per group – 30 min + summary by trainer)

TRAINING/ADVOCACY PLAN

"You are a trainer/advocate for climate-SMART sanitation. You want to convince a decision-maker to consider applying Climate-SMART Sanitation Approach." 30 min. only

1. Form a group.
2. Agree on who is your target audience. Fill the training plan template accordingly.
3. Presentation: Present your training plan and arguments to convince/train your target audience of the importance of the Climate-SMART Sanitation Approach.
4. Reflection and feedback.

M2 EXERCISE 2 HANDOUT

OUTREACH PLAN TEMPLATE

Element	Content
Target audience	
Objective of the approach	
Format	
Key messages	
Arguments & content	
Methods / support	
Objections & reactions	
Follow-up	

WHAT DOES CLIMATE FINANCE MEAN TO YOU?

Mentimeter /Word Cloud

Climate Finance Acronym Trivia

Decode the jargon – one acronym at a time!

Instructions:

- You'll be shown an **acronym related to climate finance**.
- **Each table will have 30 seconds** to discuss and agree on what the acronym stands for.
- When time is up, **each table will share their answer.**
- After all tables have shared, we'll reveal the correct answer and provide a short explanation of its relevance.

(Reference acronym table – Training Manual)

Green Climate Fund Sanitation Project Alignment

"You are to assess one of three provided real-world sanitation project cases for their alignment with the GCF Investment Criteria and Expected Outcomes."

1. Form a group.
2. Read through the sanitation project case provided and identify aspects of the project that align with the GCF Investment Criteria and if the project fulfils aspects of the Expected Outcomes using the checklists provided. You may note the specific aspects of the project for each of the investment criteria and expected outcomes in the empty column of the checklists. (30 minutes)
3. Share your findings from the assessment discussing how the project fulfils the criteria (20 minutes)
4. Reflection and feedback. (10 minutes)

M3 EXERCISE 1 HANDOUT

Green Climate Fund Sanitation Project Alignment

Introduction Brief

Assessing climate-resilient sanitation projects against the Green Climate Fund's investment criteria and expected project outcomes is increasingly vital, as communities worldwide are facing intensifying challenges from climate change, particularly in water and sanitation sectors. The Green Climate Fund (GCF) plays a pivotal role in financing initiatives that foster a paradigm shift toward low-carbon, climate-resilient development in sanitation. To ensure the effectiveness and strategic alignment of funded projects, the GCF has developed the Water Security Sectoral Guide, which provides design guidelines for climate-resilient sanitation projects, and comprises of a thorough investment criteria approach as the basis for project assessment and approval for funding support. Additionally, it has established certain expected outcomes that climate-resilient sanitation projects should seek to deliver.

This practical exercise is designed to equip participants with the skills to critically assess real-world climate sanitation projects through the lens of the GCF's investment criteria approach and expected project outcomes. By analyzing actual project examples, participants will deepen their understanding of how to evaluate proposals for alignment with GCF priorities and international best practices.

Objectives of the Exercise

- Familiarize participants with the GCF's Six Investment Criteria and their application in project evaluation.
- Develop practical skills to assess the alignment of climate sanitation projects with GCF requirements, including impact potential, paradigm shift, sustainable development, recipient needs, country ownership, and efficiency/effectiveness.
- Highlight best practices and common challenges in developing projects for GCF funding, drawing on real-world case studies and guidelines.

Context and Relevance

Sanitation projects that integrate climate adaptation and mitigation strategies-such as flood-resistant infrastructure, water conservation, and community capacity building are essential for building resilience in vulnerable communities. The GCF's investment framework emphasizes not only technical soundness and innovation but also alignment with national climate strategies, stakeholder engagement, and long-term sustainability.

Structure of the Exercise

Participants will be presented with examples of climate sanitation projects, including their specific contexts, proposed solutions, and impacts made. They will be provided with two checklists containing GCF investment criteria and expected key outcome indicators to assess project alignment with the GCF. Using the GCF's Six Investment Criteria as an assessment framework, participants will:

1. Analyze projects and assess GCF alignment in relation to each criterion and if the projects fulfill aspects of the expected outcomes.

2. Discuss how projects address climate risks, promote sustainable development, and foster country ownership.
3. Evaluate the scalability, replicability, and effectiveness of project interventions.
4. Reflect on recommendations for improving project alignment with GCF standards.

By the end of this exercise, participants will be able to systematically assess climate sanitation projects for GCF alignment, enhancing their capacity to develop, review, or advocate for high-impact, fundable proposals in the climate and sanitation sectors.

1. Alignment with GCF Investment Criteria

GCF Investment Criteria	Description	Indicators	Case Specific Aspects
Impact Potential	The extent to which the sanitation project can achieve significant climate change adaptation and mitigation benefits	• Enhancing the resilience of sanitation infrastructure to climate impacts like floods and droughts • Enhancing water conservation • Reducing gas emissions through energy-efficient treatment processes	
Paradigm Shift Potential	Sanitation projects are evaluated on their ability to drive systematic change and safeguard long-term sustainable development	• Adoption of circular economy to treat and repurpose waste as a valuable resource • Potential for replicating proposed project elsewhere • Sustainability of outcomes and results beyond completion of the intervention	
Sustainable Development Potential	Co-benefits of the sanitation project are assessed, including social, environmental, ad economic impacts.	• Enhancement of public health by reducing disease outspread • Creation of jobs through the construction and maintenance of sanitation facilities and provision of sanitation services • Economic benefits such as boosted tourism from cleaner environments • Potential for reduced gender inequalities in climate change impacts and/or equal participation by gender groups	
Needs of the Recipient	Focus must be placed on addressing the specific vulnerabilities and needs of the communities involved, particularly those most affected by climate change.	• Ensuring vulnerable underserved communities access to resilient and sustainable sanitation services that protect them from climate-related threats such as flooding and water scarcity. • Opportunities to strengthen institutional and implementation capacity in relevant institutions	

Country Ownership	Sanitation projects must be aligned with national climate strategies such as NDCs and the involvement of local stakeholders.	• Effective sanitation projects should help build capacity to manage and sustain services over time and should be developed in consultation with local stakeholders.	
Efficiency and Effectiveness	The sanitation project's cost effectiveness and ability to demonstrate efficient use of resources to achieve the intended results are to be carefully assessed.	• Potential to catalyze and/or leverage investment • Financial viability in the long run • Enable long term operation and maintenance of the facilities.	

2. Alignment with GCF Expected Project Outcomes

Key Outcome	Description	Indicators	Case-specific Aspects
Climate-Resilient Infrastructure and Services	Building new or upgrading existing sanitation infrastructure, to achieve synergies between adaptation and mitigation, and withstand climate-related impacts along the entire sanitation chain	• Decentralized climate-resilient sanitation and wastewater treatment • Flood-resistant sanitation systems • Raised latrines, sealable and removable containment, vacuum sewer systems, corrosion resistant design, and application of treated wastewater and fecal sludge by-products	
Circular Economy and Integrated Management	Integrating sanitation with broader health, water, food, and energy security to ensure protection of ecosystems.	• Preventing water- and excreta-related diseases through effective sanitation and wastewater management • Utilizing treated wastewater for potable, industrial, and agricultural uses in water-scarce regions • Biogas generation from sanitation systems and wastewater treatment plants	

Case 1: Janicki Omni Processor in Dakar, Senegal

Context & Challenge

Dakar, Senegal's largest city, is home to over 3.5 million people and accounts for roughly half of the country's urban population. However, the expansion of sewer infrastructure has not kept up with the city's rapid urban growth. Currently, 54% of urban residents in Senegal rely on on-site sanitation (OSS), a figure that increased by 9% between 2000 and 2015. Effective OSS requires a comprehensive fecal sludge management (FSM) system, covering everything from emptying septic tanks and latrines to transporting, storing, and treating the waste. Despite this need, it was estimated that almost 70% of fecal sludge in Dakar is disposed of unsafely. While there are four fecal sludge treatment plants (FSTPs) operating in Senegal, they are struggling to handle the volume of waste delivered. Moreover, the dewatered fecal sludge, often used as fertilizer, are not free of pathogens.

The Project Solution

Developed by Sedron Technologies in collaboration with the Bill and Melinda Gates Foundation (BMGF), the Janicki Omni Processor (J-OP) is a community-scale treatment system designed to convert fecal sludge, biosolids, and various waste streams into clean water, electricity, and ash. When installed in communities lacking adequate sanitation, either as a standalone unit or alongside a fecal sludge treatment plant (FSTP) or wastewater treatment plant (WWTP), the J-OP is capable of completely eliminating pathogens, thereby promoting better public health and environmental outcomes.

The revenue generated from selling the system's end products can help cover operational expenses or even support a sustainable business model. Excess electricity produced can be sold or used to meet the facility's own energy needs. The water output meets both World Health Organization (WHO) and U.S. Environmental Protection Agency (EPA) standards for drinking water, while the resulting ash can be marketed as fertilizer. Depending on the characteristics of the input waste, a single J-OP can serve communities with populations in the hundreds of thousands.

The project involves the deployment of a pilot-scale unit of the system intended to demonstrate technical viability and achieve integration with the existing fecal sludge management ecosystem. The pilot unit was

installed adjacent to an FSTP in Dakar, Senegal in 2015 to provide a consistent source of dewatered fecal sludge, along with filtrate treatment in the nearby WWTP.

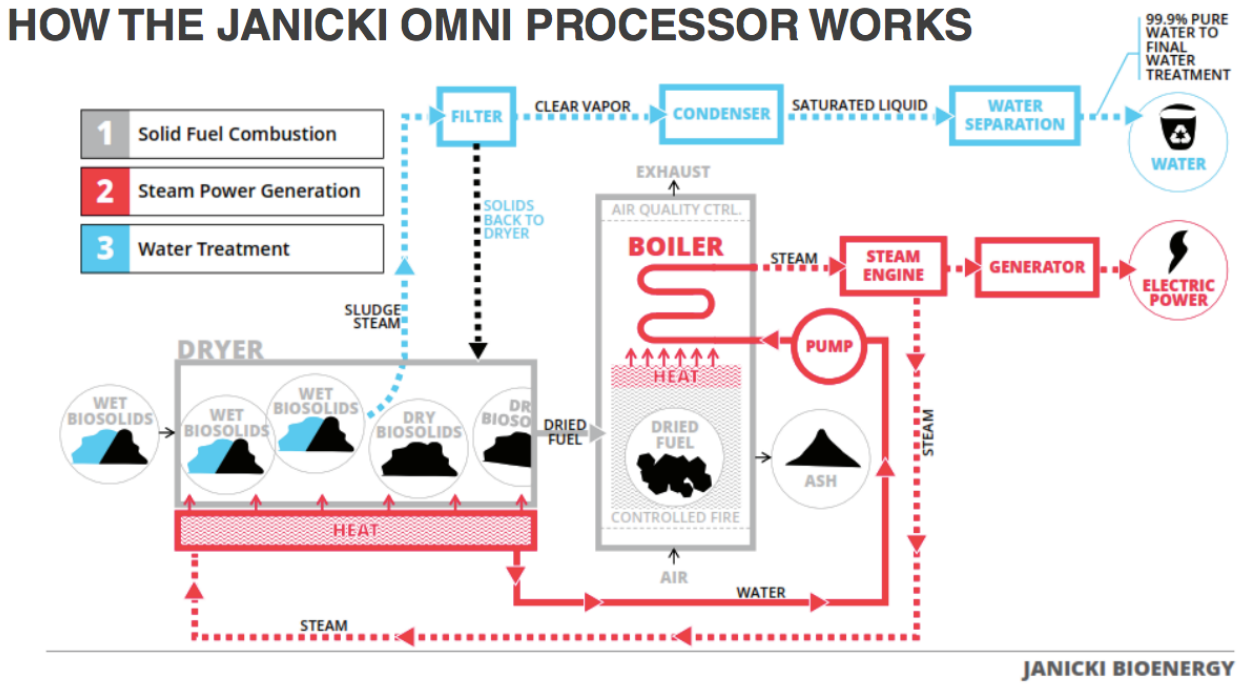


Fig. Operation of the Janicki Omni Processor

The Project Impact

Since its deployment, the pilot unit has successfully delivered the following benefits:

- Operational Impact: The system processed an estimated 700 metric tons of fecal sludge in its first year of operation.
- Waste-to-Value: The system generates pathogen-free ash and potable water as end products of its operation.
- Capacity Building and Local Empowerment: The project provided programmatic and technical learning opportunities to the local operators and concerned stakeholders in the WaSH sector of the region.
- Scalability: The system has shown its technical viability, making progress towards commercial installation that can be scalable to various contexts.

Case 2: Vacuum Sewer System in Shoshong, Botswana

Context & Challenge

Shoshong, a village situated on the edge of the Kalahari Desert in Southern Africa, is home to over 15,000 people. The government initiated a comprehensive health and sanitation project for the entire village, which included the provision of clean water and wastewater management. To enhance hygiene and minimize soil contamination, most of the old pit latrines were to be replaced with water-borne toilets. The initial plan for a gravity sewer system would have required more than 100 km of deep sewer lines and over 20 flushing vessels, consuming over 100,000 liters of water each week to prevent sediment build-up and blockages. Given the anticipated challenges in installation, limited water availability, and high operational costs, a more sustainable alternative is required.

The Project Solution

Vacuum sewerage offers numerous ecological and economic advantages over conventional systems, such as open latrines or pit latrines, especially in densely populated villages and cities in Africa. Leakage from conventional gravity sewerage systems can lead to contamination of both groundwater and soil, particularly in areas where the groundwater table is high. This issue is especially critical in small agricultural villages that depend on groundwater for irrigation and drinking water. Compared to conventional gravity systems, vacuum systems are potentially more environmentally friendly, offer better protection for public health, prevent groundwater exfiltration, and can be installed relatively quickly and easily.

Vacuum sewer systems operate by using differential air pressure, specifically, a maintained vacuum with negative pressure, to transport wastewater from individual collection points to a central vacuum station, rather than relying on gravity as in conventional sewer systems. The mixture of air and sewage is then rapidly transported through an airtight network, towards a central vacuum station, where the necessary negative pressure is maintained by vacuum pumps and sewage is collected for further pumping to a treatment plant.

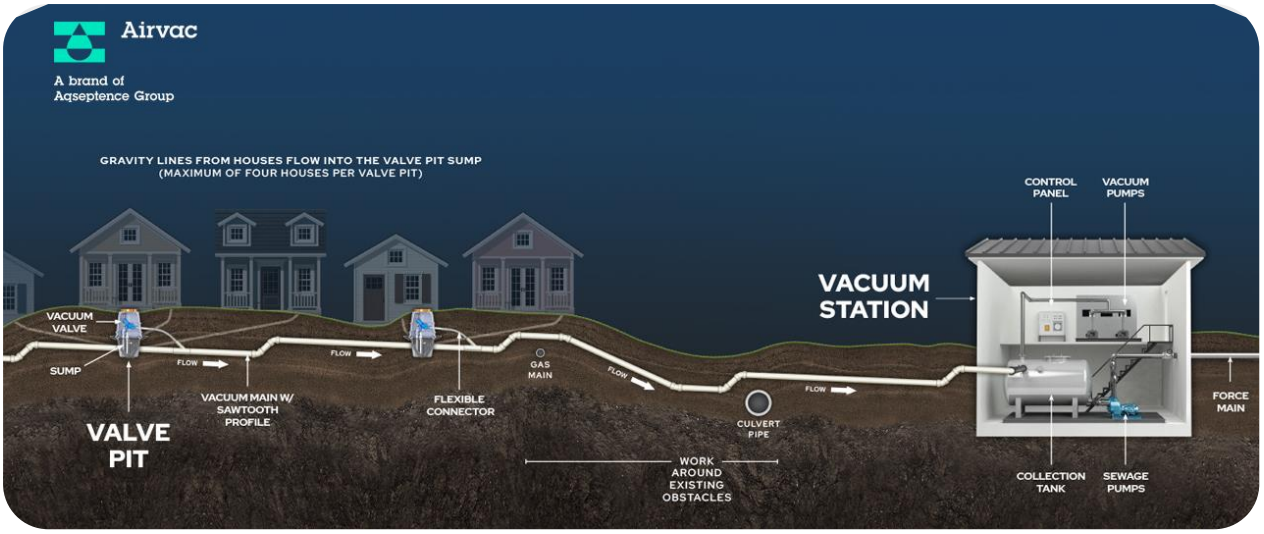


Fig. Operation of a Vacuum Sewerage System

To minimize installation and maintenance expenses, a decision was made to implement a vacuum sewer system for at least 50% of the project area, serving approximately 8,000 people. Over 55 km of small-diameter vacuum sewers were installed at an average depth of 1-1.5 m, allowing for easier and less intensive trenching. This approach enabled the use of local labor instead of relying on heavy trenching equipment. The vacuum sewer system was completed and became operational after just seven months of construction.

The Project Impact

Given the flat terrain of the village and the considerable distances between the households, the vacuum sewer system proved to be the ideal solution. Since its implementation, the project has delivered the following benefits:

- Reduction of Greenhouse Gases: The vacuum system transports fecal sludge quickly from households via an airtight network to the vacuum station, and ultimately to the treatment plant, thus preventing anaerobic decomposition and the emission of potent gases such as methane (CH4) and nitrous oxide (N2O) that were otherwise generated from the use of the existing pit latrines connected to a dry sewer system.
- Pollution Prevention: The airtight and closed nature of the vacuum system prevents contaminated wastewater from entering the groundwater or the environment, thus protecting soil, water resources, and the health of the concerned community.
- Water Savings: Compared to conventional ducts, vacuum sewer systems require 80-90% less rinse water, thus the volume of saved flushing water is significant.
- Low Energy Consumption: The central vacuum pumping station is the only component of the entire system that requires electricity, with the electricity cost of the entire system reported to be less than €4 per day. Furthermore, the energy required for the system can be provided via solar power.
- Capacity Building and Local Empowerment: The project provided technical learning opportunities to the local operators, as the vacuum system is fully operated successfully by locally educated and trained staff.
- Scalability: The successful implementation and operation of the vacuum sewer system shows that it can be scalable to various contexts

Case 3: Sichuan Household Biogas Programme in China

Context & Challenge

The rural areas in Sichuan Province are among the least developed in China. The average annual per capita income for poor farmer household in Sichuan is approximately €500, and the province contains 43 counties that have been officially defined as national poverty counties in order to qualify for economic assistance from the government. Sichuan is also highly vulnerable to natural disasters. In 2008, a heavy earthquake claimed the lives of nearly 70,000 people and left another 4.8 million homeless. In addition, an estimated 12 million animals of productive livestock were killed during the devastating event.

The Project Solution

To make people's lives better while helping to protect the earth's climate, UPM's Sichuan Household Biogas Programme of Activities (PoA) provides up to one million low-income rural households in China's Sichuan province with proven and reliable biogas digesters and efficient biogas cook stoves.

The digester tanks are fed with animal manure, previously just discharged into open pits, and convert it into clean and affordable biogas to be used conveniently for cooking, heating, or lighting instead of coal and firewood. After switching to biogas, each participating smallholder farmer family saves approximately 2 tCO_2-eq of methane and carbon dioxide emissions year by year. All biogas equipment distributed under this programme is installed and maintained by the Sichuan Rural Energy Office (SREO) via its dense network of local service centers and its many certified biogas technicians all over Sichuan.

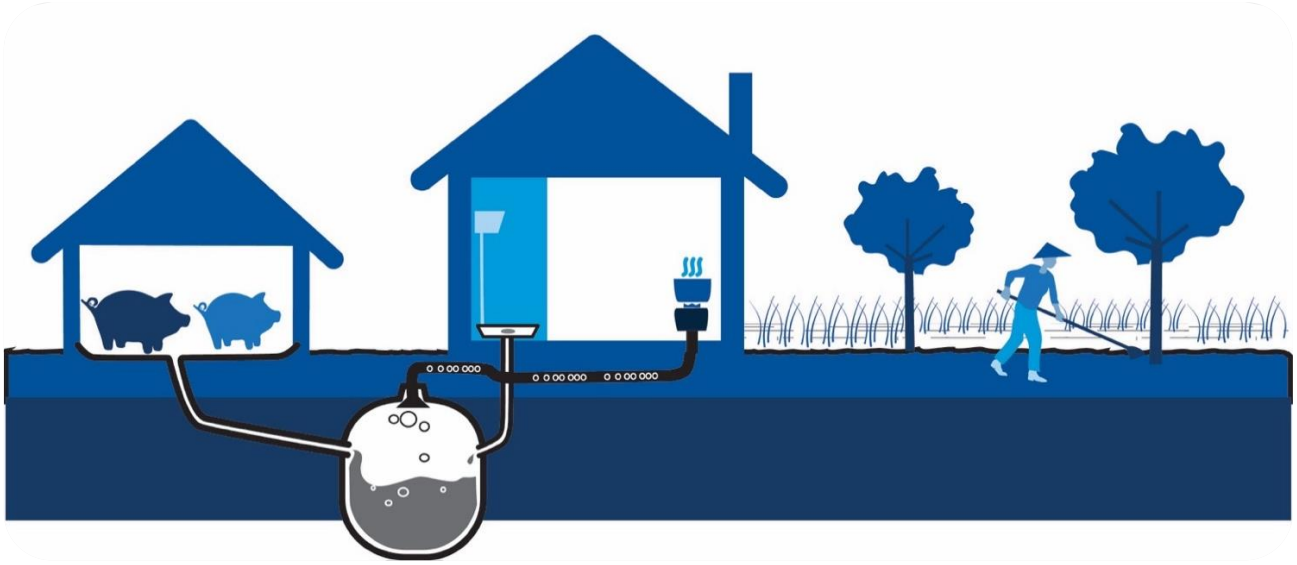


Fig. A Typical Biogas Digester System implemented through the PoA

The Project Impact

UPM's Sichuan Household Biogas PoA substantially improves the lives of up to 400,000 smallholder households or 1.2 million deprived people and verifiably made the following impacts:

- Health Impact: The operation of biogas digesters results in the avoidance of untreated manure, which improves human health due to reduced indoor air pollution and improved hygiene at the farmers' premises.
- Reduction of Greenhouse Gases: The PoA continually saves approximately 800,000 tCO2-eq of greenhouse gas emissions annually and reduces annual coal consumption by about 340,000 tons.
- Environmental Impact: Improved waste management and sanitation services, enabled by digester systems delivered through the programme, have resulted in the protection of soils and water resources, proving beneficial for both people and the environment.
- Waste-to-Value: The biogas digesters generate high-quality organic fertilizer from digestate, greatly reducing the need to use harmful chemical fertilizers and pesticides. It is reported that almost 100,000 tons of chemical fertilizer are replaced by superior and more environmentally friendly organic fertilizer produced by the biogas digester systems.
- Energy Impact: All PoA households have access to clean, reliable, convenient, and affordable biogas for cooking, lighting, or heating.
- Economic Impact: An estimated 10,000 total jobs related to construction and maintenance of biogas plants have been created by the project in the local biogas sector.
- Natural Resource Impact: Due to the PoA, annual firewood-use decreases by approximately 690,000 tons.
- Capacity Building and Local Empowerment: As part of the programme, all participating households have been trained in biogas digester and cook stove use. Additionally, almost 2,000 people have also been qualified as biogas technicians under the programme.

M3 EXERCISE 2 SCRIPT

Pitch Your Project" Challenge - Developing Sanitation Project Ideas targeting GCF funding

Introduction Brief

Developing climate-resilient sanitation projects that are aligned with the Green Climate Fund's investment criteria and expected project outcomes is critical, as the Green Climate Fund (GCF) plays a pivotal role in financing initiatives that foster a paradigm shift toward low-carbon, climate-resilient development in sanitation.

To ensure the effectiveness and strategic alignment of funded projects, the GCF has developed the Water Security Sectoral Guide, which provides design guidelines for climate-resilient sanitation projects, and comprises of a thorough investment criteria approach as the basis for project development, assessment and approval for funding support. Additionally, it has established certain expected outcomes that climate-resilient sanitation projects should seek to deliver.

This practical exercise is designed to help participants familiarize with the GCF's strategy towards climate-resilient sanitation and be able to develop and review high-impact, fundable proposals in the climate and sanitation sectors, through the lens of the GCF's investment criteria approach, thereby enhancing and promoting the development of aligned climate-resilient sanitation projects that will have greater chances of GCF approval.

Objectives of the Exercise

Familiarize with the GCF's Investment Criteria and Expected Outcomes, and how to develop sanitation projects accordingly.

Be able to clearly articulate and present the core problem, your proposed solution, and the expected project impacts to a broad audience.

Structure of the Exercise

Participants will be required to brainstorm sanitation project ideas that align with GCF Investment Criteria and Expected Outcomes. With the two checklists containing GCF Investment Criteria and Expected Key Outcome Indicators provided as supplement to Exercise 1 for guidance, each group is to develop a climate-resilient sanitation project targeting GCF funding and briefly pitch their project to the room. The structure of the exercise is as follows:

1. Form groups
2. Familiarize yourself with the GCF Investment Criteria and the Expected Outcomes (please refer to supplementary checklists provided Exercise 1 or section 4.4 of the Manual) to help brainstorm sanitation project ideas that target GCF funding. (20 minutes)
3. Pitch your project to the room, discussing how the project fulfils the criteria and delivers the expected outcomes. How you pitch is entirely up to you. Participants in the audience are encouraged to ask questions as if they were part of the GCF project review committee. (20 minutes)

By the end of this exercise, participants will be able to develop and review high-impact, fundable proposals in the climate and sanitation sectors, through the lens of the GCF's investment criteria approach, thereby enhancing and promoting the development of aligned climate-resilient sanitation projects that will have greater chances of GCF approval.

7.4 Module 4– Carbon Markets for Sanitation

7.4.1 Agenda

Time	Session	Format	Materials
08:30 am	Registration and Welcome		
09:00 am	Opening Remarks,	Recap of previous day, review expectations, agenda and objectives of day 4	M4 PPT1
09:30 am	Principles of Carbon credits and Carbon Markets	Understand the principle of carbon credit and carbon markets (Presentation & QA)	M4 PPT1
10:15 am	Carbon Markets in Africa	Learning what is happening in the carbon space in African countries (group exercise)	M4 PPT1 ex Exercise 1
11:00 am	Tea/Coffee Break		
11:15 am	Understanding Carbon Projects	Introduction of Carbon credit project cycle and eligibility criteria (presentation + Q&A)	M4 PPT2
11:45 am	Evaluation Steps of Carbon Market Eligibility for Sanitation Projects	Understand how to assess a sanitation project's carbon market eligibility (Presentation and discussion led by trainer)	M4 PPT2 HANDOUT
01:00 pm	Lunch Break		
02:00 pm	Energizer:	Carbon Market Bingo	M4 PPT3
02:15 pm	Understanding Marketing & Sales of Carbon Credits	How to market and sales the credits (Presentation & QA)	M4 PPT3
02:30 pm	Real-world success story	Explore practical examples of successfully registered sanitation projects and gain insight on key factors contributing to their success. (Presentation and Q&A)	M4 PPT4
03:00 pm	Tea/Coffee Break	Break – Opportunity for networking and reflecting	
03:30 pm	Scaling Up Impact: Developing an Outreach/Training Plan	Consolidate learning on the Carbon Markets for Sanitation and translate insights into a training or advocacy plan. (group exercise)	M4 Exercise 2
04:00 pm	Wrap up of the day	Wrap up of the day + Key learning of the day	
04:10 pm	Evaluation and Closing Remarks	• Trainer summarizes their impressions • Review expectations • Evaluation of the 4-day ToT.	
05:00 pm	End of D4 and TOT		

7.4.2 Scripted Guidance for Exercises and Trainee Handouts

• Climate finance is an essential component of the Climate-Sanitation Nexus and is an enabler to deliver context-specific and appropriate sanitation solutions to regions vulnerable to the effects of climate change and lacking as well domestic funding to address challenges faced concerning sanitation due to climate change.

• Climate finance is continually evolving and is starting to place an emphasis on climate adaptation and recognize the importance of promoting climate-SMART sanitation , to ensure that immediate and future global sanitation needs are met, however a funding gap still exists when compared to other climate mitigation-focused sectors such as energy and transport.

• Local context is critically important and so, climate financing initiatives require strong local partners who understand the local WASH and finance contexts and enabling environments,

• There is no one-size-fits all approach regarding climate financing methods, however lessons can be learnt from innovatively funded climate-SMART projects that can provide great insights into how they can be effectively implemented and the considerations that must be made.

<u>Country evaluation on Carbon Market Status Quo</u>

1. Has the country ratified the Paris Agreement? If so, when?
2. What nationally determined contributions (NDCs) has the country submitted, and are they legally anchored in national law? Is there a national climate law or framework that explicitly references the Paris Agreement?
3. What sector-specific regulations (e.g. sanitation) contribute to NDC implementation?
4. Which specific laws or regulations have been enacted to implement the NDC targets?
5. Which specific laws or regulations have been enacted to implement carbon credit projects (voluntarily and/or compliance)? Has the country adopted a carbon pricing mechanism (e.g. emissions trading system, carbon tax) linked to its Paris goals?
6. What legal structures exist to support participation in Article 6 mechanisms (e.g. carbon markets, ITMOs, Corresponding Adjustment)?
7. What are the identified legal or institutional gaps that hinder full implementation of the Paris Agreement in this country?
8. Are there any carbon credit projects in the country registered? Under which standard?
9. Who are the main actors in the carbon market in your country?

M4 ENERGIZER

Carbon Market Bingo!

Please prepare your cards, our next activity will help consolidate your understanding of carbon market terms.

Instructions:

- Each group receives a Bingo card filled with basic terms related to the carbon market.
- The trainer will read out simple definitions, one at a time.
- If you have the term that matches the definition, mark it off on your card.
- The first person to complete a full line (horizontal, vertical, or diagonal) shouts "Bingo!" and wins a small prize or bragging rights!

Methodology **Méthodologie** A technical document developed for carbon projects that outlines the standardized procedures for quantifying greenhouse gas (GHG) emission reductions. This includes defining project boundaries, establishing baselines, demonstrating additionality, and setting requirements for monitoring, reporting, and verification.	**Voluntary Carbon Markets** **Marchés Volontaires du Carboné** Markets in which carbon credits are issued, bought, and sold on a voluntary basis, allowing companies and individuals to offset their emissions beyond regulatory requirements.	**Article 6.2** A framework under the Paris Agreement enabling voluntary cooperation between countries to meet climate goals. It sets the rules for the international transfer and use of mitigation outcomes (ITMOs).	**Article 6.4** A centralized crediting mechanism established under the Paris Agreement to succeed the Kyoto Protocol's Clean Development Mechanism (CDM), allowing the generation of tradable emission reduction credits from verified climate action.	**Corresponding Adjustments** **Ajustements correspondants** A mechanism to ensure the integrity of carbon markets by preventing double counting of emissions reductions. When emission reductions are transferred between countries, the host country must make an adjustment to its national emissions balance.
Compliance Carbon Markets **Marchés Réglementés du Carbone** Carbon markets established through national, regional, or international regulations, where entities are legally required to meet emission reduction targets and can trade carbon credits to comply.	**Baseline** **Scénario de référence/base** An estimate of the GHG emissions that would have occurred in the absence of a project. It serves as a reference point to quantify the project's emission reductions.	**Early Consideration** **Considération Préalable** A requirement that the potential for GHG reductions—and the intention to generate carbon credits—must be integrated into the project's design and planning process from the outset.	**Additionality** **Additionnalité** The principle that a project must demonstrate that it would not have occurred without the financial incentive provided by the revenue from carbon credits.	

M4 EXERCISE 2 SCRIPT

TRAINING/ADVOCACY PLAN

(See HANDOUT DAY 1 /M1 Exercise 3) - 30 min. only

You are a trainer/advocate for carbon finance for sanitation. You want to convince a decision-maker to consider carbon finance for their sanitation project ."

1. Form a group.
2. Agree on who is your target audience. Fill the training plan template accordingly.
3. Presentation: Present your training plan and arguments to convince/train your target audience of the importance of the Carbon Project for Sanitation.
4. Reflection and feedback.

M4 EXERCISE 2 HANDOUT

OUTREACH PLAN TEMPLATE

Element	Content
Target audience	
Objective of the approach	
Format	
Key messages	
Arguments & content	
Methods / support	
Objections & reactions	
Follow-up	

M4 RECAP

- Carbon credits can provide a reliable and performance-based financing mechanism that supports the operational sustainability of climate projects throughout the crediting period.
- Article 6 unlocks new and sustainable financing opportunities — success depends on how governance challenges are addressed.
- Africa holds significant untapped potential for carbon credit projects due to its vast natural resources and mitigation opportunities—but realizing this potential requires stronger institutional capacity, access to financing, and equitable participation in global carbon markets.
- Integrating sanitation into carbon credit frameworks can unlock new funding streams and accelerate access to climate-smart sanitation solutions—particularly when emissions reductions from waste treatment are rigorously quantified and verified.
- Carbon credit prices are dynamic, fluctuating based on a range of variables, from project-specific attributes to broader market dynamics.
- The complexity and frequently changing rules of various carbon markets pose significant challenges, making it essential to stay informed about the latest standards and often requiring external expertise for effective guidance.

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