

ENABLING THE ADOPTION OF CLIMATE RESELIENCE WATER-EFFICIENT SANITATION SOLUTIONS – DEVELOPMENTS IN GLOBAL POLICY AND PRACTICE

Jay Bhagwan and Philip Majeke

WPO and WRC

Ahmedabad 2026

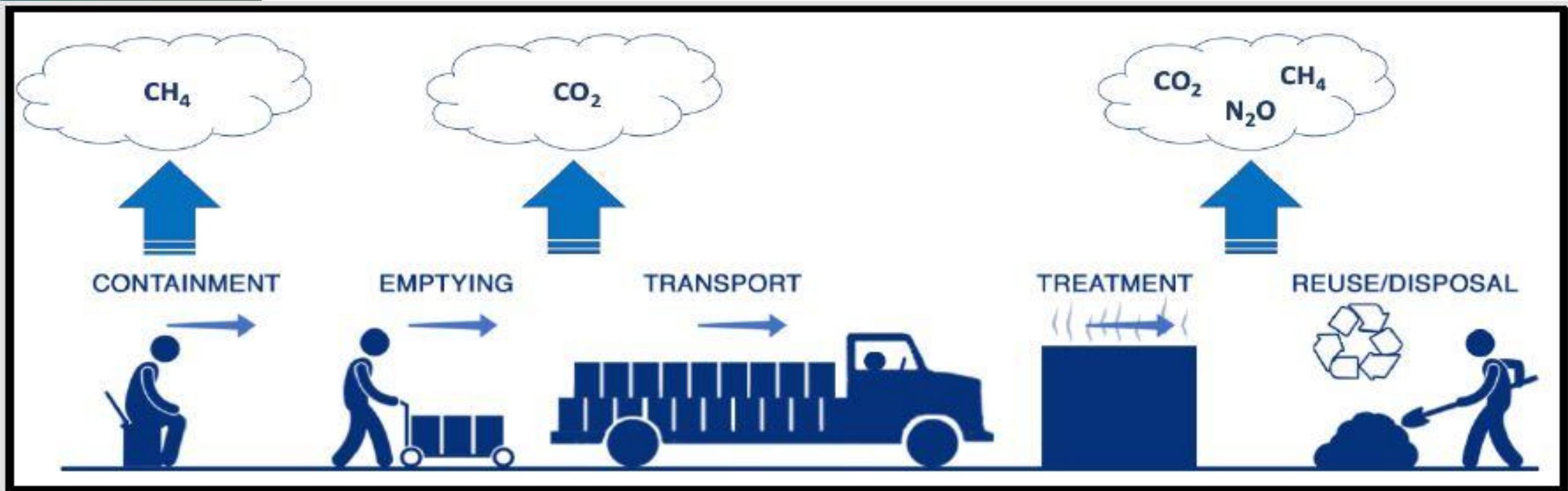


WATER
RESEARCH
COMMISSION



WATER PARTNERSHIPS OFFICE
a partnership between DWS, DBSA and SALGA

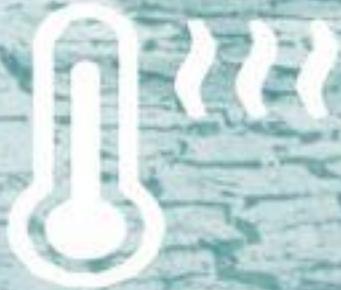
Sanitation activities drive climate change



- GHG emissions are associated with all stages of the sanitation value chain and contribute to 2-6% of global methane emissions and 1-3% of global nitrous oxide emissions
- Thus, increased access to sanitation could be linked to increased GHG emissions, unless the prevailing sanitation paradigm shifts to climate smart sanitation solutions

Impact of climate change on sanitation

EXTREME HEAT



- Reduced efficiency of biological wastewater treatments
- Increased odours from onsite sanitation systems
- Increased corrosion of sewers
- Increased evaporation in water bodies

WATER SCARCITY & DROUGHT



- Negatively affects water reliant sanitation systems (flush toilets, sewerage, treatment)
- Increased corrosion and clogging of sewers
- Concentrated wastewater and reduced capacity of receiving water bodies to dilute wastewater

INCREASED PRECIPITATION FLOODING & EXTREME WEATHER



- Damage to sanitation infrastructure
- Damage to auxiliary infrastructure which sanitation systems rely on
- Flooding of pit toilets, sewers, septic tanks causing spillage and contamination
- Treatment plants receive flows that exceed their design capacities, resulting in flows bypassing to water bodies and surroundings

The incentives...

**CLIMATE-RESILIENT WATER AND SANITATION
IS WORTH EVERY DOLLAR**

\$1 = **\$21**
SPENT ON WATER SERVICES RESILIENCE IN RETURN

\$1 = **\$62**
SPENT ON WATER FLOOD RESILIENT UPGRADES = SAVED IN FLOOD RESTORATION COSTS

Approaches to alleviate climate change in sanitation



MITIGATION

Mitigation infers to those technologies that results in lower release of greenhouse gases

Examples include:

- **Water reuse/recycling technologies**
- **Sludge beneficiation technologies (fertilizer, energy, biogas, etc..)**
- **Technologies that recover nutrients from urine**
- **Technologies that recover water and beneficiate sludge simultaneously**

ADAPTATION

Adaptation infers to those technologies that adjust to the current and future effects of climate change

Examples include:

- **Off-grid solutions as they are improve resilience during grid outages**
- **Technologies that require no water or are waterless in case of drought**
- **Non-sewered/decentralized/modular systems are considered less vulnerable**
- **Technologies that have adaptive capacity through potential design changes**

Shifting towards climate resilient sanitation



NDP2030, DWS 2016 National Master Plan and DTIC IPAP 2017 supports the shift towards CR waterless, off-grid sanitation systems and water recycling systems

Plan	Objective	Target
National Development Plan	<ul style="list-style-type: none">• Use of technologies that minimises use of water resources, encourages recycling and reuse• Achieve universal sustainable sanitation provision	2030
DWS National Water and Sanitation Master Plan (2016)	<ul style="list-style-type: none">• Achieve universal sustainable sanitation provision• Develop, demonstrate and validate appropriate alternative waterless and off grid sanitation solutions• Develop and demonstrate appropriate wastewater technologies for cost effectiveness, energy efficiency and beneficiation	2025
Industrial Policy Action Plan (2017)	<ul style="list-style-type: none">• Development of off-grid sanitation technologies that will lower water requirements for sanitation, enabling reallocation to alternative needs and economic sectors and more effective service delivery in rural, peri-urban and water-scarce areas	2020

Elements of climate resilient sanitation systems



Institutions, governance, and services

- Supportive policies and regulations
- Clear institutional responsibilities and flexible management and service delivery arrangements
- Risk and vulnerability informed planning and decision making
- Maintaining capacity for continual adaptation through M&E and learning
- Integrated action on the whole water cycle to protect services, environment and public health



Financing

Sustainable and responsive financing for both preventive measures and disaster responses



User and societal engagement

Creative, strength-based user and societal engagement and awareness



Infrastructure

Robust and repairable sanitation infrastructure options



OUR FOCUS

Source: UTS-ISF and UNICEF (2021). *Climate resilient urban sanitation in Indonesia: Hazards, impacts and responses in four cities*. Institute for Sustainable Futures, University of Technology Sydney: Sydney

What has been done? Policy Enablement

- Integrated Policy Action Plan and studies : States the Opportunity
- National Sanitation Integrated Plan and Norms and Standards aligned
- Regulations to incentivize uptake and disincentivize poor decision making where sewers are overloaded and no water supply is available - tackled through a **Department of Water and Sanitation Regulatory Framework**



SECTION B: ISSUING OF THE SOUTH AFRICAN NATIONAL STANDARDS SCHEDULE B.1: NEW STANDARDS

The following standards have been issued in terms of section 24(1)(a) of the Standards Act.

Standard No. and year	Title, scope and purport
SANS 30500:2019 Ed 1	<i>Non-sewered sanitation systems — Prefabricated integrated treatment units — General safety and performance requirements for design and testing.</i> Specifies general safety and performance requirements for design and testing as well as sustainability considerations for non-sewered sanitation systems (NSSS). A NSSS, for the purposes of this document, is a prefabricated integrated treatment unit, comprising frontend (toilet facility) and backend (treatment facility) components that a) collects, conveys, and fully treats the specific input within the system, to allow for safe reuse or disposal of the generated solid, liquid, and gaseous output, and b) is not connected to a networked sewer or networked drainage systems..

8) **Subject to sub-regulation (7) a Water Services Authority must consider-** in high and medium density formal settlements:

- (i) waterborne sewered sanitation provided that the wastewater treatment system and works have adequate capacity and is performing to acceptable standards under the National Water Act (read with regulation 10); or
- (ii) alternative water efficient sanitation solutions instead of waterborne sewered systems in **areas of dense formal and medium settlement where there is resource scarcity and or inadequate capacity or functionality** in the sewer system and or the wastewater treatment works.

in low density or sparsely populated settlements: water efficient sanitation solutions.

(9) **Water efficient sanitation solutions in sub-regulation (7) must be shown to include off-grid, on-site sanitation options such as Non-sewered Sanitation Systems (NSSS) as well as Decentralised Wastewater Treatment Systems (DWWTs).**

(10) A Water Services Authority may not unreasonably decline a property development to have a water efficient sanitation solution that is not connected to the central system where development will manage the system as a Water Services Intermediary and where the water uses of the system is authorised under the National Water Act.

(11) Whenever a Water Services Institution is providing new innovative non-sewered sanitation systems, such must be guided by the requirements of SANS 30500 for Non-Sewered Sanitation Systems or the “SANS 24521:2020 Guidelines for the management of basic on-site domestic wastewater services”, whichever is applicable.



Policy and Regulations

• Policy

- Regulatory Framework – Smart Sanitation (WESS)
- Research completed on Model Bylaws – UKZN
- Local government policy – UKZN – in progress (Use scale up partners as use cases)
- Taking lessons from Global Best Practice
 - San Francisco Public Utility (SFPU)
 - Implementation of WESS and Water Efficient Technologies within cities with higher demand

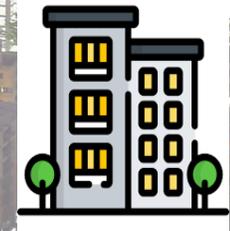
• Regulations

- Revised ISO 30500 standards for tech developers
- Water Efficient Labelling Scheme (WELS)
- General Authorisation (partial disposal)
- Flush guidelines
- Irrigation guidelines
- NEW- GBCSA – Water Efficiency Guideline



Market

- Market Segments
 - Schools/Communal hubs
 - Informal settlements (formalised and controlled)
 - Commercial nodes
 - New developments (estates, eco-estates, sanparks, eco-tourism zones)
 - Rural
 - Farm estates / Co-operatives
 - Apartments
- Market demand (aggregation of segments)
- High level studies done
 - Frost and Sullivan – WRC
 - Gates Foundation – completed a study as well
 - Technoeconomic evaluation
 - Markets Segment Factsheets – included in WESS Training (CEWAS/UKZN)



3. WPO WESS APPROACH (3/4)

Scaling Imperatives



- **Enabling environment**
 - Revised Norms & standards – new infrastructure must consider WESS, approval of new developments without adequate treatment capacity are prohibited
 - DWS are disseminating promotional info on the sanitation lifecycle and developing SFDs
 - A faecal sludge treatment strategy developed & guidelines on the go for the treatment of FS
 - A sanitation reference group est. to provide advice to the DWS DG on tech and uptake solutions
- WPO busy developing a **scale-up strategy**:
 - Establish the **pipeline** of NSSS opportunities within the **public and private sector and future hotspots (informal settlement, schools, private developments, etc.)**
 - Develop standardised documents for efficient roll-out of WESS by the public sector and service models
 - Creation of a platform/s conducive to scaled implementation wrt. full WESS life-cycle
- Training / awareness sessions on WESS to **incubate adoption**
- Develop an **enterprise model with a network of collaborators for the integrated delivery of WESS**. The network will include participating project sponsors, WPO, services providers, suppliers and custodians for the derisking of WESS projects, for best practise and continuous improvement.

Climate First Framework Introduction

- ❑ Systematic approach on how climate-related hazards can affect a sanitation technology and how the risks of these hazards can be reduced through technology design
- ❑ Identifies key climatic risks to manage, improve technology design, and consider relative merits of different technologies
- ❑ Applicable for onsite/decentralised containment and treatment technologies
- ❑ Can be used by anyone engaged in the development or implementation of sanitation technologies
- ❑ Developed by Institute of Sustainable Futures University of Technology Sydney (ISF-UTS) for the Bill and Melinda Gates Foundation (BMGF)

South African Sanitation Technology

1 Scoping

2 Hazardous events & trends

3 Hazards

4 Design features

5 Overall resilience



ClimateFIRST: Climate Framework to Improve the Resilience of Sanitation Technologies

Summary note | September 2023



Rating of NSS using Climate First Framework

Design Category	Resilience design feature
A. Avoiding exposure to hazards	1. Raising
	2. Burying
	3. Portability
	4. No/low Inputs
B. Withstanding exposure to hazards	5. Armouring and strengthening
	6. Oversizing
	7. Shapes that distribute pressure
	8. Circumvention
	9. Sealing and Barriers
C. Enabling flexibility	10. Adaptability
	11. Modular design
	12. Platform design
	13. Redundancy and diversity
	14. Signalling
D. Containing failures	15. Frangibility
	16. Fail-operational
	17. Decentralisation
E. Limiting consequences of complete failure	18. Safe disposal
	19. Reusable materials
	20. Fail-silence
	21. Repair speed
	22. Accessibility for rapid flaw detection and repair
F. Providing benefits beyond sanitation technology resilience	23. Reciprocity
	24. Hybridising
	25. Transformative capacity



Rating of NSS using Climate First Framework

Category	Resilience design feature	Clear	NEWgen	Aqounic	Dewdrop
A. Avoiding exposure to hazards	1. Raising	Y	Y	Y	Y
	2. Burying	Y	Y	Y	Y
	3. Portability	N	N	N	N
	4. No/low inputs	Y	Y	Y	Y
B. Withstanding exposure to hazards	5. Armouring and strengthening	Y	Y	Y	Y
	6. Oversizing	Y	Y	Y	Y
	7. Shapes that distribute pressure				
	8. Circumvention	N	N	N	N
	9. Sealing and Barriers	Y	Y	Y	Y
C. Enabling flexibility	10. Adaptability	Y	Y	Y	Y
	11. Modular design	Y	Y	Y	N
	12. Platform design	Y	Y	Y	Y
	13. Redundancy and diversity	Y	Y	Y	Y
	14. Signalling	Y	Y	Y	Y
D. Containing failures	15. Frangibility				
	16. Fail-operational				
	17. Decentralisation	Y	Y	Y	Y
E. Limiting consequences of complete failure	18. Safe disposal	Y	Y	Y	Y
	19. Reusable materials	Y	Y	Y	Y
	20. Fail-silence				
	21. Repair speed	Y	Y	Y	Y
	22. Accessibility for rapid flaw detection and repair	Y	Y	Y	Y
F. Providing benefits beyond sanitation technology resilience	23. Reciprocity	Y	Y	Y	Y
	24. Hybridising	N	Y	N	N
	25. Transformative capacity	N	Y	N	N
Overall Resilience Rating		High (17/25)	High (19/25)	High (17/25)	High (16/25)

Highlights

The selection of appropriate sanitation technologies should also be based on their vulnerability and adaptability to different climate scenarios apart from technical, financial, economic, social and environmental considerations. The selected sanitation technologies should have low vulnerability and high adaptability to climate change.

Existing infrastructure should be assessed for climate change resilience and robustness and be modified to reduce the adverse impacts of climate related events where possible.



WRC is demonstrating several NSS systems towards climate resilient and resource efficient sanitation value chain with each at advanced technology readiness levels.

Most of these technologies incorporates both mitigative and adaptive aspects of climate change and could be considered when selecting sanitation systems that considers future climatic projections to ensure sustainable sanitation systems in the mist of climate change.

Final thoughts

Various sanitation systems emit varying amounts of GHGs; therefore, technology choice during planning can exacerbate or alleviate climate change.

The selection of appropriate sanitation technologies should also be based on their vulnerability and adaptability to different climate scenarios, apart from technical, financial, economic, social, and environmental considerations. The selected sanitation technologies should have low vulnerability and high adaptability to climate change.

Existing infrastructure should be assessed for climate change resilience and robustness and be modified to reduce the adverse impacts of climate-related events where possible.

WRC is evaluating and demonstrating a number of technologies towards climate-resilient and resource-efficient sanitation value chains, each at advanced technology readiness levels.

Most of these technologies incorporate both mitigative and adaptive aspects of climate change and could be considered when selecting sanitation systems that consider future climatic projections to ensure sustainable sanitation systems in the face of climate change.