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South African Sanitation Technology Enterprise Programme

Building Climate Resilient and Sustainable Sanitation Infrastructure through Innovative Technologies Towards Circular Economy

DBSA - 2nd Annual Infrastructure Research Colloquium

9 April 2024

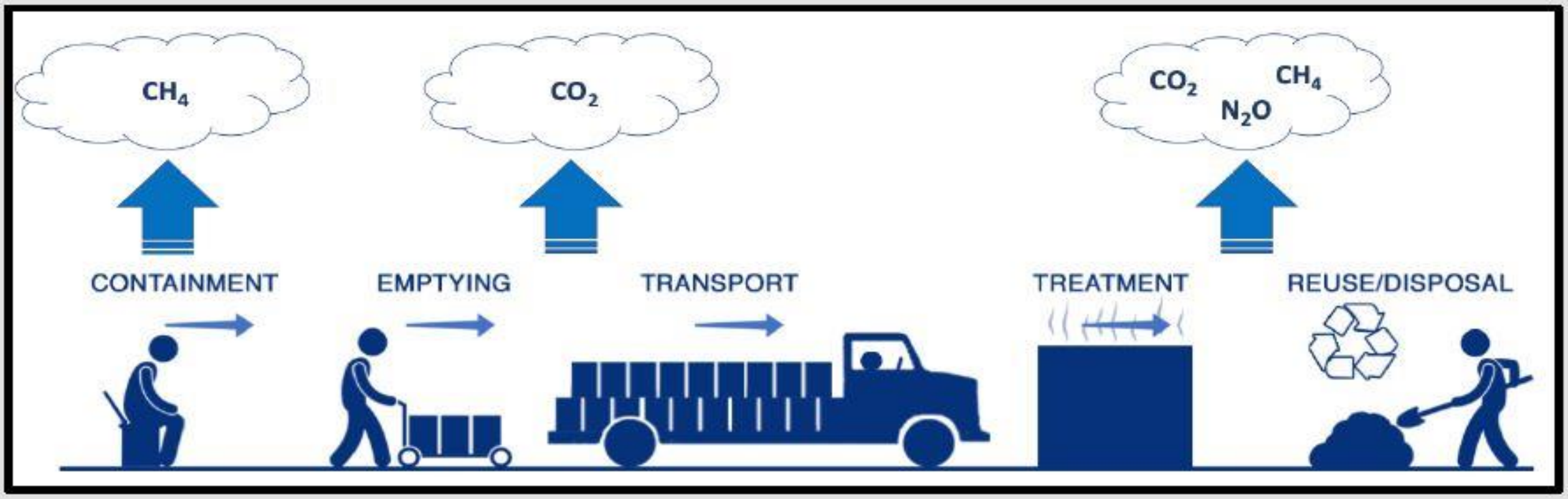
WATER RESEARCH COMMISSION

BILL & MELINDA GATES foundation

science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

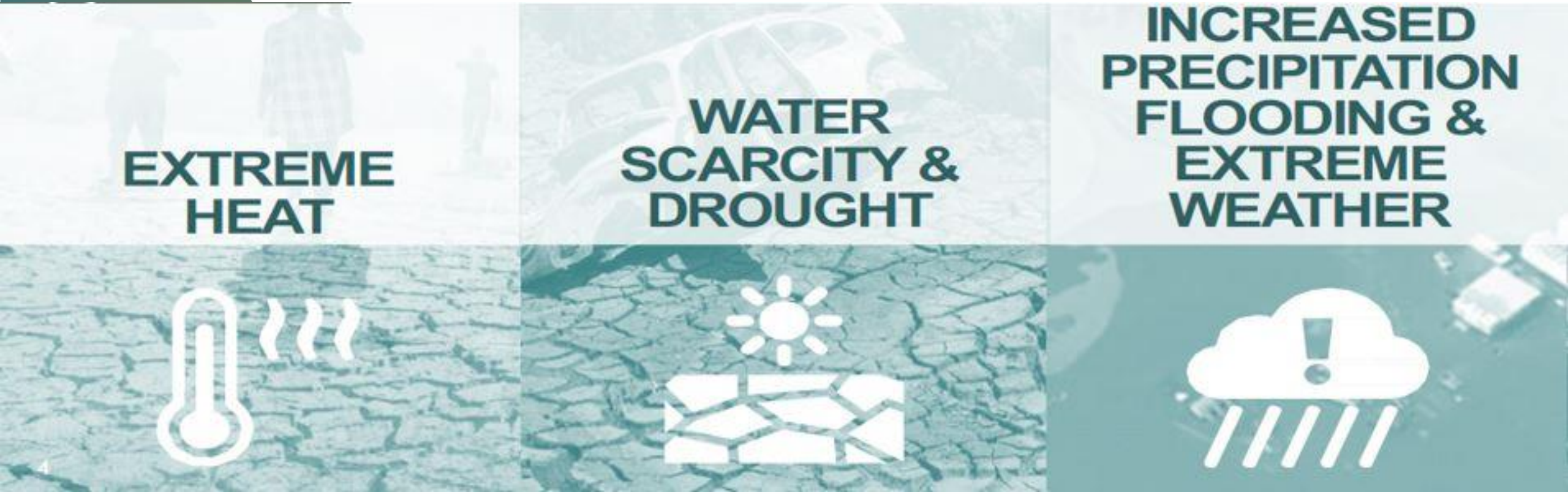
Sanitation activities drive climate change



- GHG emissions are associated with all stages of the sanitation value chain and contributes 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



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

- 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

- 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

Impact of climate change on sanitation…

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On a recent visit to Durban, South Africa, I met a grandmother whose community had been hit hard by flooding. Already reeling from disaster, she woke up one day to find her toilet had been washed away. With the closest facilities now one kilometre away — too far to walk — she was left with no option but to go in the open. (Doulaye Kone, Deputy Director WASH, Bill and Melinda Gates Foundation)

Perfect Storm: Durban floods, climate change and coastal resilience

Poor climate adaptation, outdated infrastructure served as catalysts for KZN floods

Shifting towards climate resilient sanitation

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

Plan	Objective	Target
National Development Plan	• 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)	• 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)	• 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

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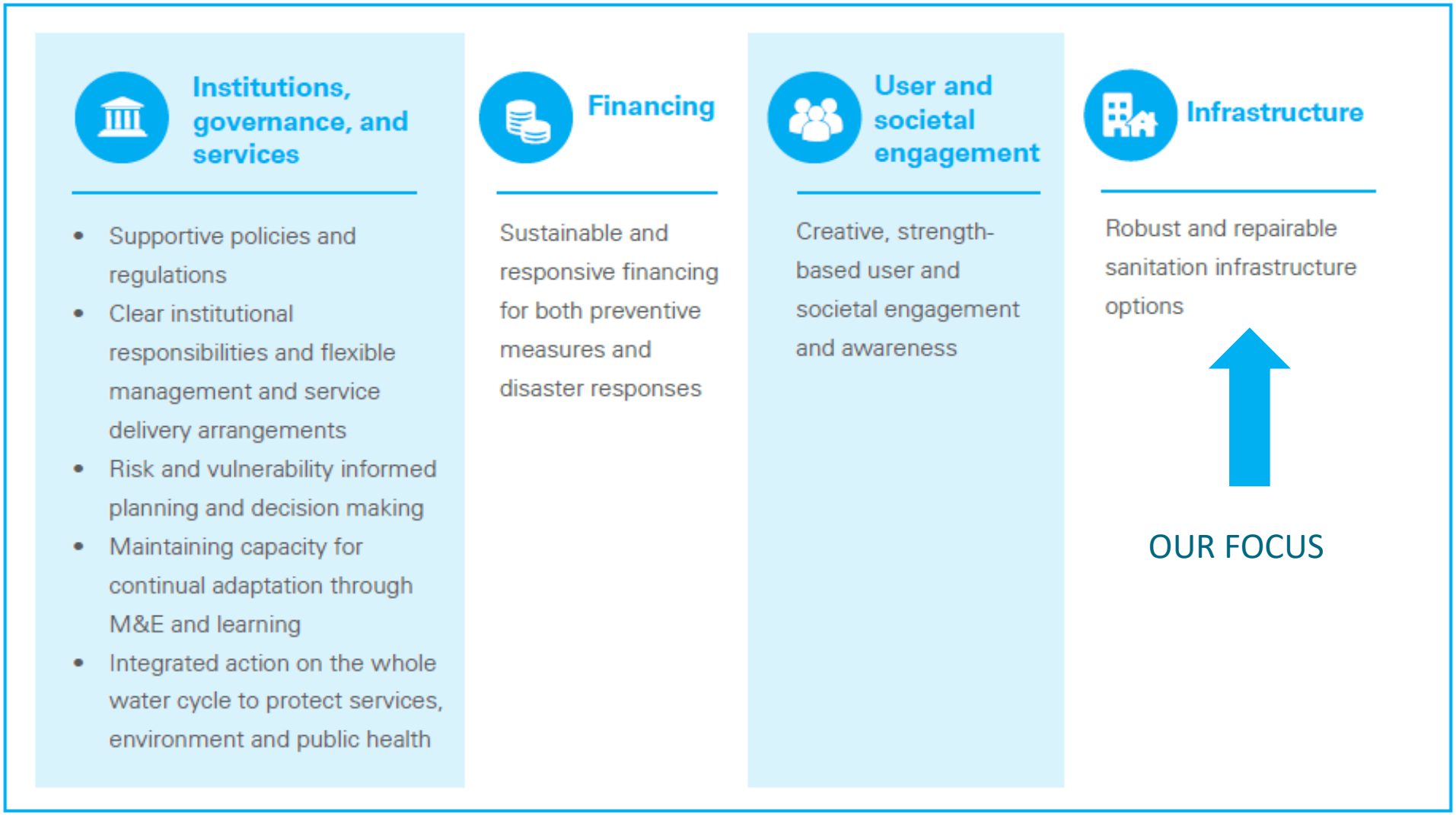

Source: UTS-ISF, UI and UNICEF (2021). Climate resilient urban sanitation in Indonesia: Hazards, impacts and responses in four cities. Institute for Sustainable Futures, University of Technology Sydney: Sydney

Climate First Framework Introduction

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- 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)

1. Scoping
2. Hazardous events & trends
3. Hazards
4. Design features
5. Overall resilience

Rating of NSS using Climate First Framework

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1. Scoping
2. Hazardous events & trends
3. Hazards
4. Design features
5. Overall resilience

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

NSS Systems within WRC SASTEP

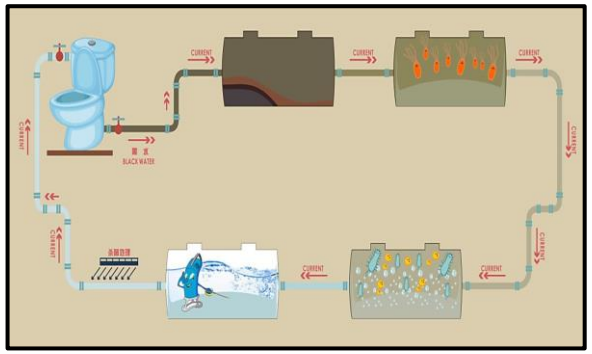
> Recovers and re-uses water (closed loop system)

> Can be set up off-grid set-up (no connection to water, sewer and electricity)

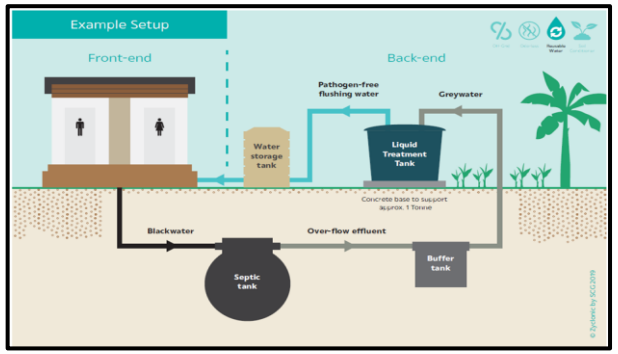
> Provides full flushing sanitation solution

> No need reticulation infrastructure

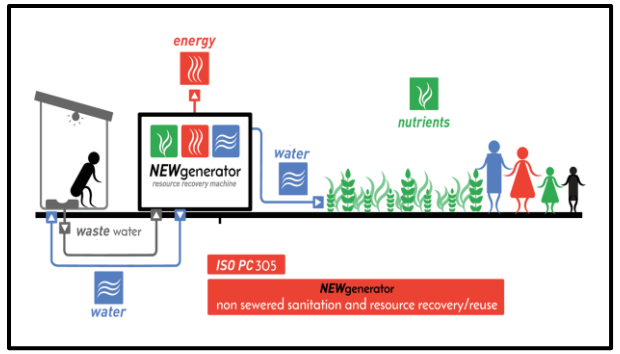
Clearwater
- Demonstrated
- Locally manufactured
- Uptake began



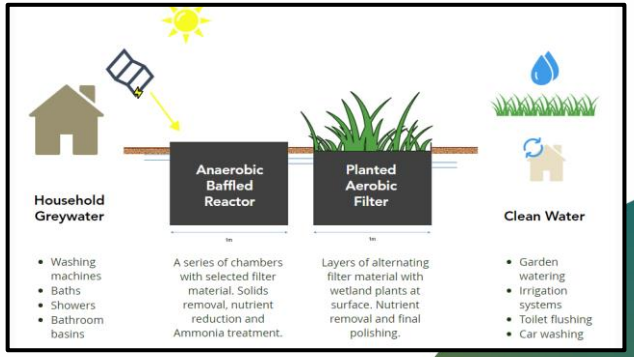
Aquonic
- Demonstrated
- Locally manufactured
- Uptake began



NEWgenerator
- Demonstrated
- Locally manufactured
- Uptake began



Dewdrop
- Demonstrated
- Locally manufactured
- Yet to be taken up



Climate resilience rating of NSS

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)

Overall Climate Resilience Rating of NSS

- The NSS technologies had **64 - 76%** (16-19 out of 25) climate resilient design features in the climate resilient framework developed by UTS.
- Each system had at least one resilient design feature under all the 6 climate resilience design categories and thus all the technologies were rated **high** in terms of overall resilience.
- All the NSS systems scored 33% in the resilient design category of **containing structures** which should be the areas of optimization and improvements in the future by designers and implementers.

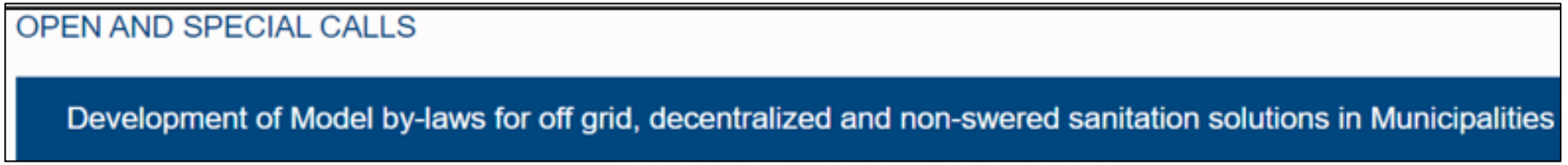
Institutional and governance support

- DWS policy and regulatory support for NSS

Green Drop Regulation being amended to include NSS

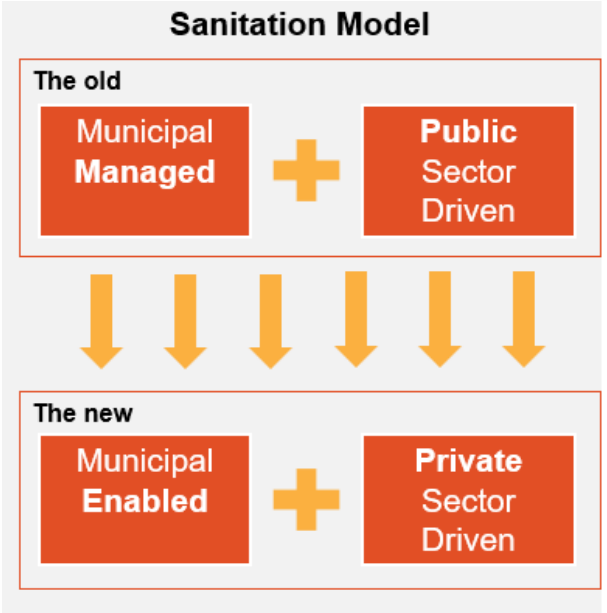
- Off-grid policy/by-laws for NSS in municipalities

ToR initiated for developing a set of model bylaws for the implementation of off grid, decentralised and non-sewered sanitation solutions in municipalities



Financing

- WRC, BMGF & WPO developed framework to set up NSS sub-programme within the Water Partnerships Office (WPO)
- Supported by DWS and SALGA
- BMGF & WPO signed an agreement to support NSS Programme with feasibility assessments and structuring finance for WSAs, DBE, Water Boards interested in NSS



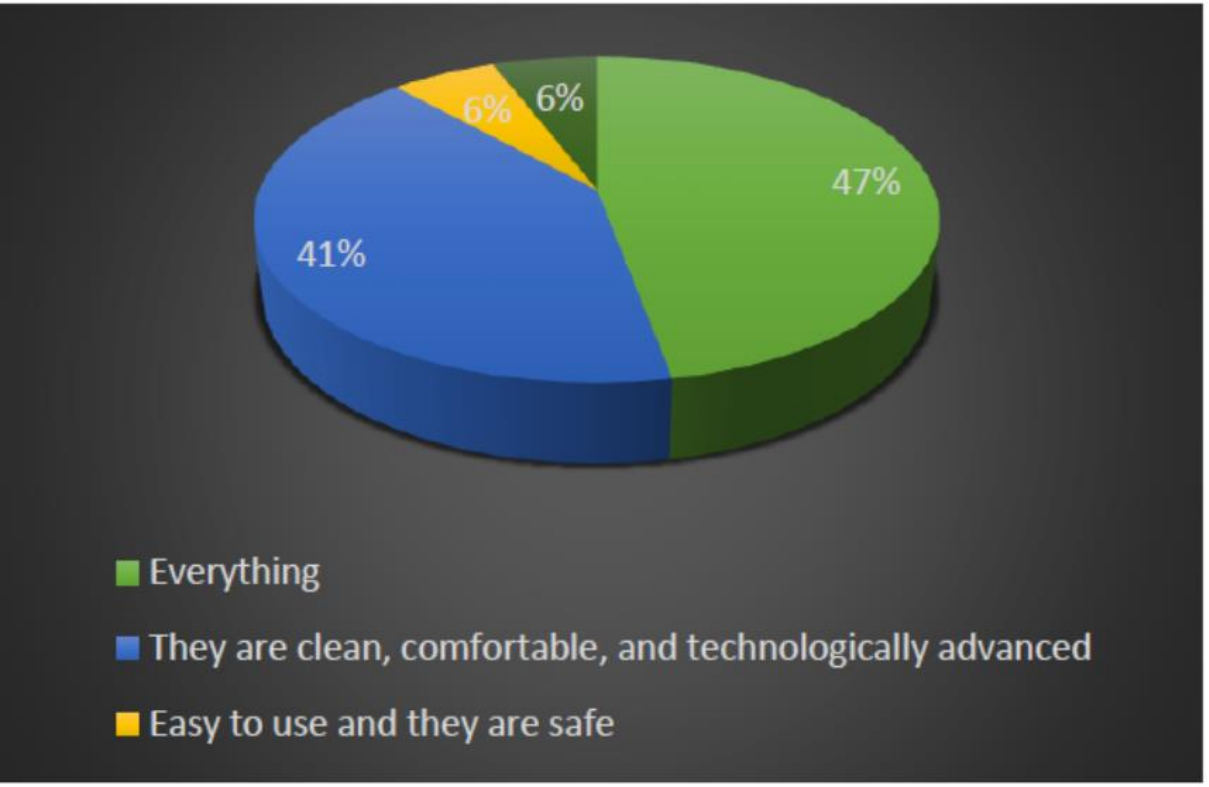
OFF-GRID SANITATION

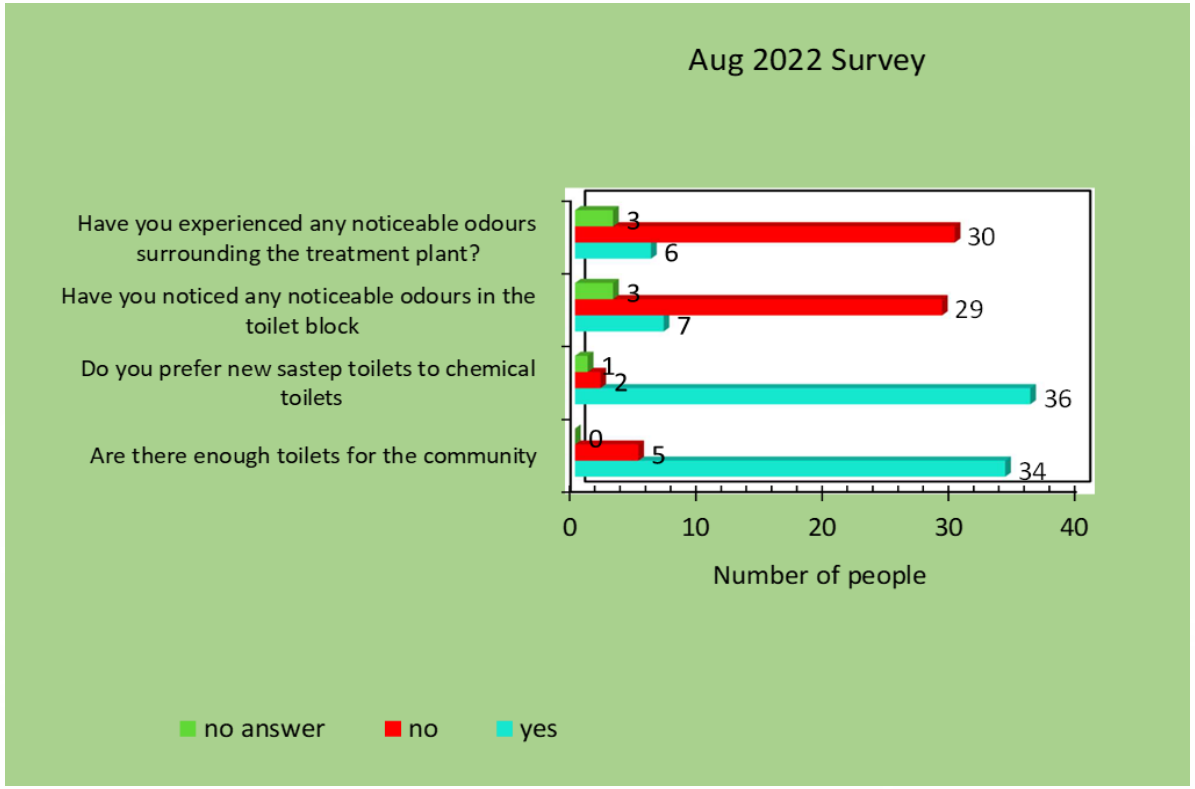
DBSA

NON-SEWERED SANITATION PROGRAMME

	Description
Initiative	• **Off-grid / non-sewered sanitation** provision to communities
Description	• Provision of **alternative and innovative sanitation technology** in support of the **Sanitation Economy** … toilet economy + circular sanitation economy + smart sanitation economy • A transformational vision for business engagement in sanitation in SA
Potential developmental impact	• Sanitation solutions for **climate change** • Sanitation solutions for **water security** • Sanitation solutions for **food security** • Sanitation solutions for the **health sector** • Sanitation solutions for **female health and empowerment** • Sanitation solutions for **smart city infrastructure** • **Small business development** • **Job creation** – women and youth employment • Opportunity for Government to deliver sanitation services **faster** & at a **lower cost** to approx. 2.8 million households
Partners	• COGTA & DHSWS • WRC • SASTEP • Bill & Melinda Gates Foundation

Societal and user engagements





- 2 User experience survey conducted (beginning and towards the end)
- NSS widely accepted by the users in current demo sites

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Final thoughts

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 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 continued...

THANK YOU

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Contacts

Mr Phillip Majeke – SASTEP Commercialisation Manager (phillipm@wrc.org.za)

Ms Ednah Mamakoa – SASTEP Technical Officer (ednahm@wrc.org.za)