

02/26/2025



Emerging Sanitation Technologies & Challenges for Scaling

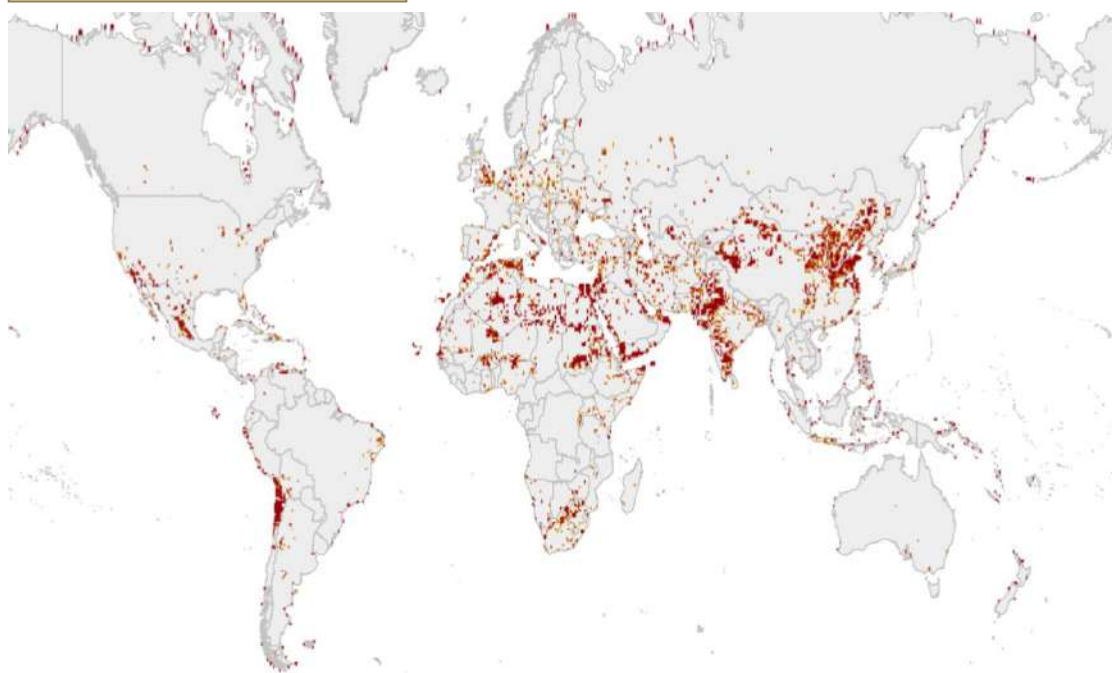
Roshan Shrestha

Deputy Director, Gates Foundation

Gates Foundation

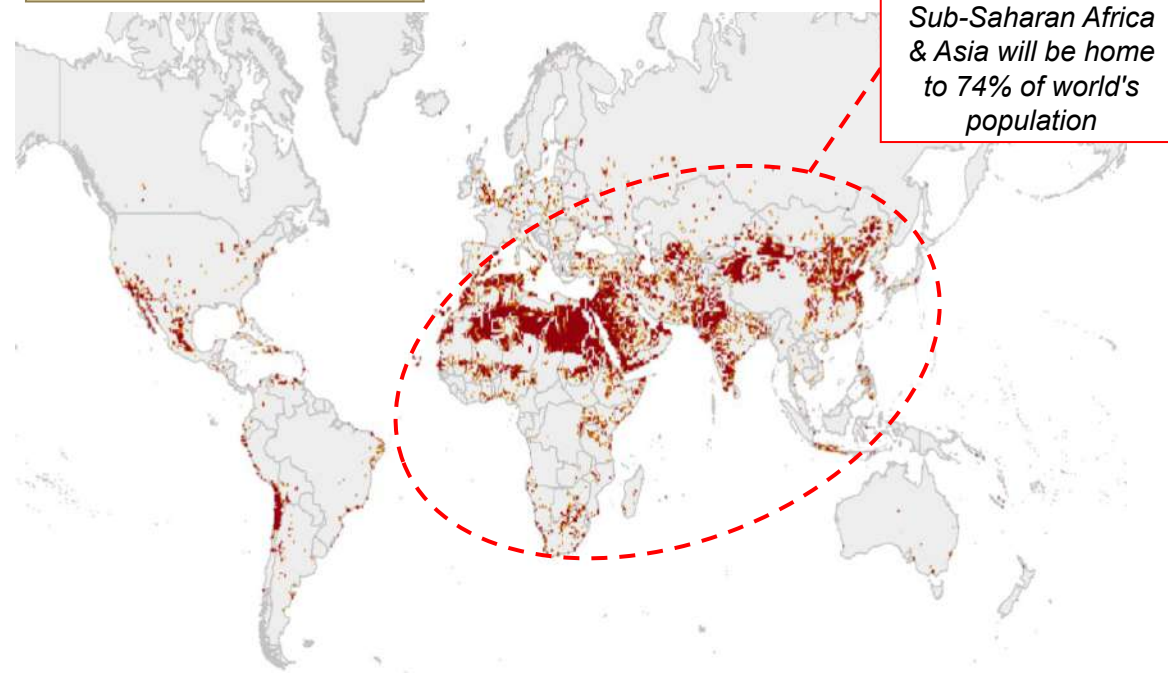
Sustainable Human Waste Management will be Required to Address Increasing Water Scarcity

Baseline: 2000



In 2000, ~1.7B people were living in water scarce areas

Future: 2030



By 2030, ~2.7B people will be living in water scarce areas

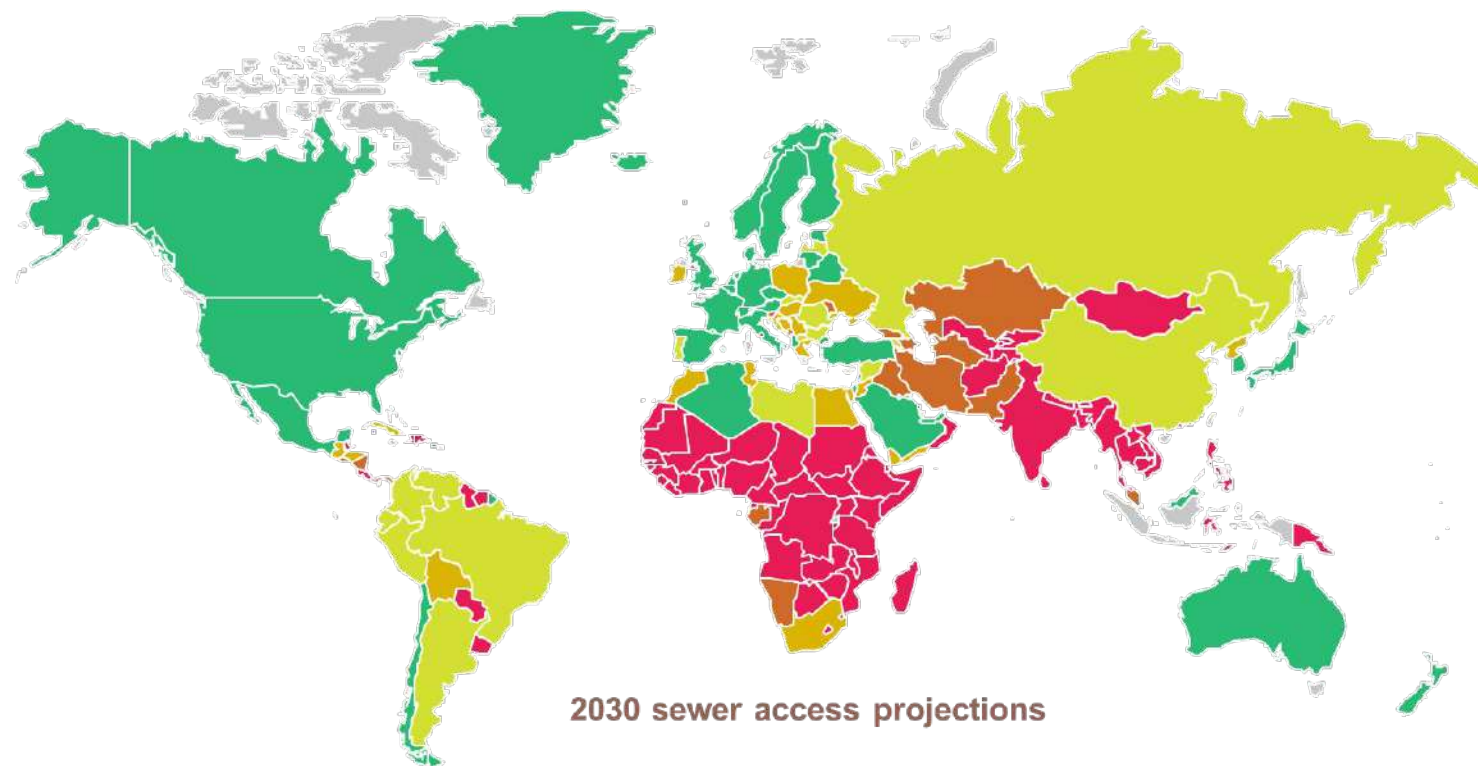
AVERAGE WATER AVAILABILITY PER PERSON

● <500m³ ● 500-1,000m³ ● 1000-1,700m³ ● >1,700m³

Source: "Water Scarcity Clock" (June 2022), World Data Lab

Sanitation Global Scenario

Sewers will reach few in many cities, indicating need for an alternative & innovative & decentralized sanitation solution



2030 sewer access projections

■ 0%-20%
 ■ 21%-40%
 ■ 41%-60%
 ■ 61%-80%
 ■ 81%-100%

Note: countries in gray do not have data reported. Source: JMP 2017 Report and 2021 Report; BCG analysis

Sanitation Tech Should Address



Conserves water

- Flush toilet experience without requiring any water connection
- Flush water is cleaned and reused, reducing household water needs, costs



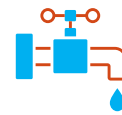
Eliminates pathogens

- Waste is treated on-site, no potential to spread disease
- Improves environmental safety
- All outputs are safe to handle



Operates off grid

- Operate off grid
- Eliminate need for external inputs such as water and energy
- Make portable and easy to install



Aging infrastructure

- Centralized wastewater treatment systems often at/near capacity
- Infrastructure repairs costly and disruptive



Low life-cycle costs

- Reduce need for pit emptying
- Ensure a sustainable business model, including maintenance via service providers



Growing population with urbanization

- Population growth frequently outpacing infrastructure growth
- 68% of global population projected to be urban in 2050

Gates Foundation Vision

The WSH strategy focuses on the Reinvented Toilet as a vital technology that can act as a “**Super Vaccine**”



Global climate challenges and related **water insecurity** create a vital need for innovated solutions in water and sanitation

The current sanitation crisis, worsened by **insufficient infrastructure**, requires sustainable and effective solutions that can adjust to changing environmental conditions and **meet the needs** of diverse populations



As the Foundation reduces **excreta-related preventable diseases** through successful vaccine development and vaccination campaigns, **poor sanitation can reverse the progress**, as demonstrated by the recent **cholera** outbreaks in Africa

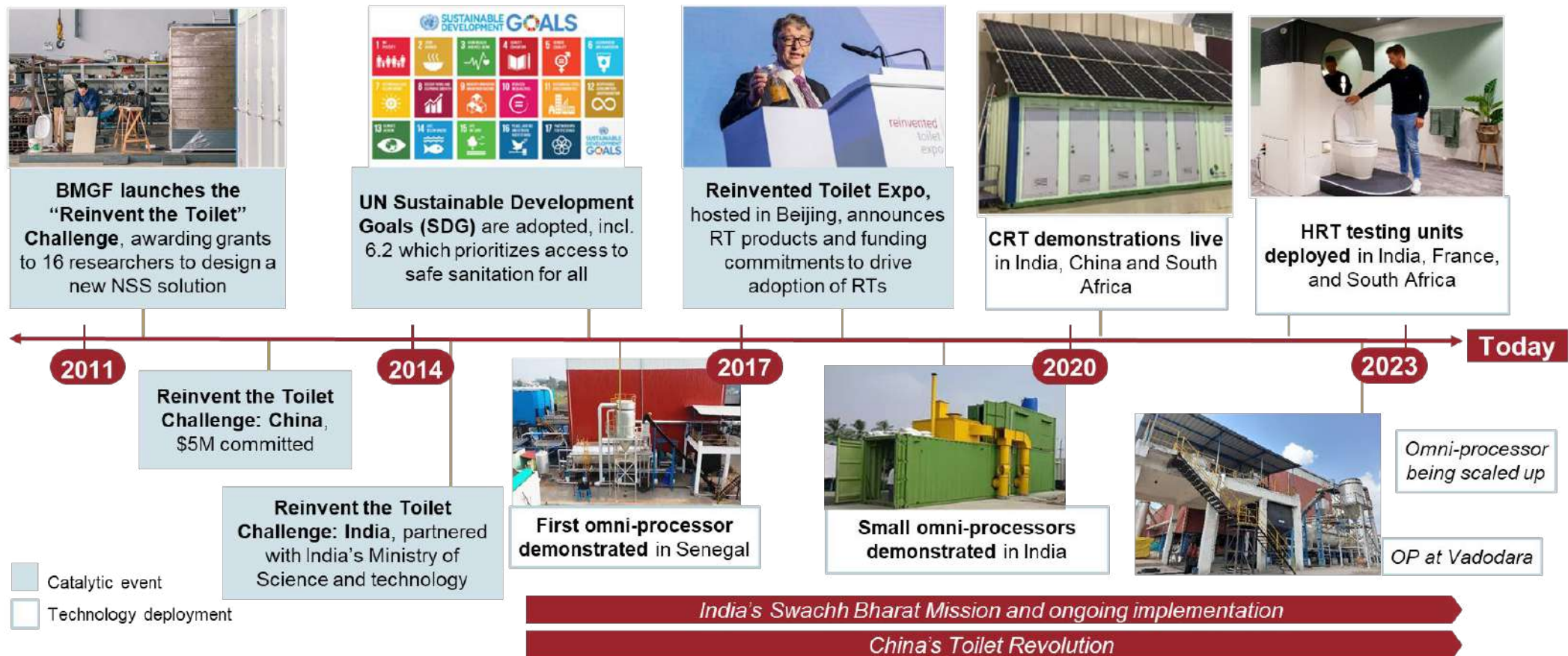
RTs that are practical and affordable and can be used in communities with limited resources can act as an effective barrier – or **super vaccine** – that stops the transmission of infectious and transmissible diseases that are carried by human excrement

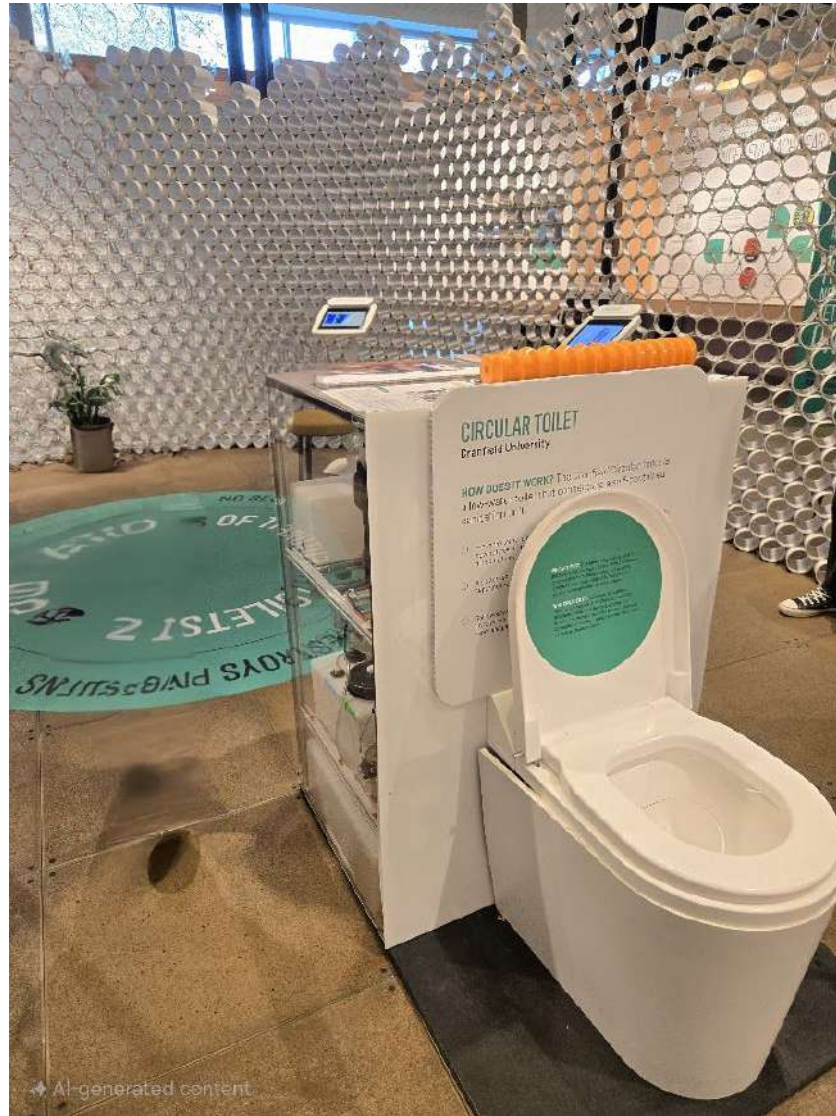


We seek to **transform the sanitation market** through the development and **commercialization of a breakthrough Reinvented Toilet technology**

The Reinvented Toilet will offer a complete, sustainable waste treatment and water regeneration solution: **eliminate pathogens**, **energy-efficient**, and able to operate **off-grid** (without sewer or piped water) and be affordable for poor communities.

Gates Foundation has Prioritized Transformation of Sanitation for Over a Decade





Transformative Technologies

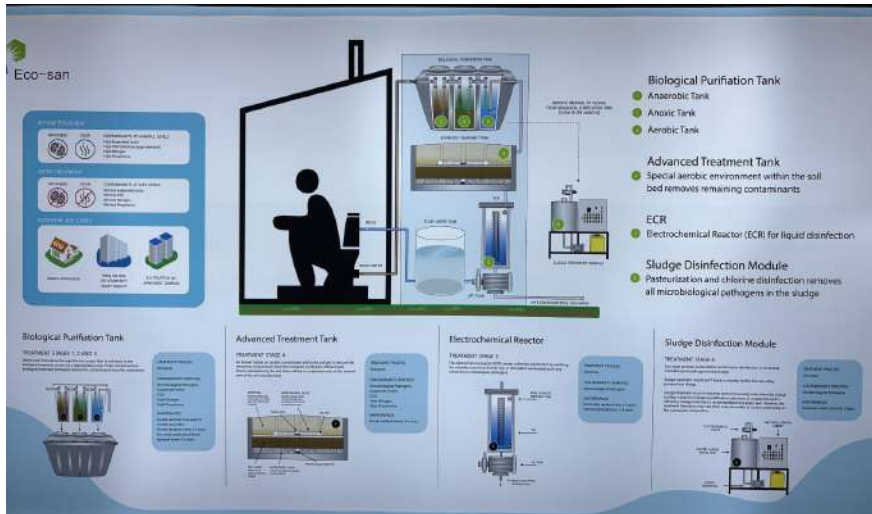


The **NEWgenerator™** (Nutrient, Energy, & Water) is a compact, modular, pre-fabricated, **off-grid** blackwater treatment solution. While providing an alternative to traditional sanitation, the system **recovers pathogen-free reusable water, nutrients, and energy**.



Zyclonic™ offers an **off-grid**, prefabricated wastewater treatment system, that transforms pre-treated black/greywater into **pathogen-free effluent**. It integrates into new or existing infrastructure, supplying water for **flushing and irrigation**.

Front-end and Back-end of Eco-san Solution



Transformative Technologies



Eco-san Solution's wastewater treatment reclaims **pathogen-free water for flushing**. The modular and pre-fabricated system integrates with water-borne toilets, emphasizing **off-grid compatibility** and eliminating water consumption during flushing.



Clear Recycling Toilets solution offers a **prefabricated**, modular closed-loop blackwater treatment system for recycling of **pathogen-free water for flushing** without external water supply. It prioritizes **off-grid compatibility**, while integrating into new or existing infrastructure.

Johkasou: Packaged Wastewater Treatment

Johka-sou; **Johka** = purification, **Sou** = tank (in Japanese).

Johkasou products are approved by the government of Japan and have been extensively deployed across Japan as part of government policy since 1970. In fact, more than 26% of Sewage in Japan is treated through Johkasou systems. Over 8 million Johkasou are running successfully in Japan, and several millions are installed in various other countries.



Long Life Product

Johkasou-STP is simplified product with High treatment performance and Long life. Structure calculation by National Building Authority of Japan. There are several installations which are 40-50 years old.



Quick & Minimal Maintenance

Only maintenance required is monthly removal of plastics and desludging every six months. Operators are not required for small and mid size packaged plants.



Japanese Technology

Daiki state of the art packaged STP designed in Japan is compact & housed in an FRP tank can be used in decentralized manner at any remote location.



No Leak & No Noisy Sound

Daiki packaged STP Plant does not emit any smell except during maintenance. Sound is lower than 50db, similar to that of a mobile phone vibration.



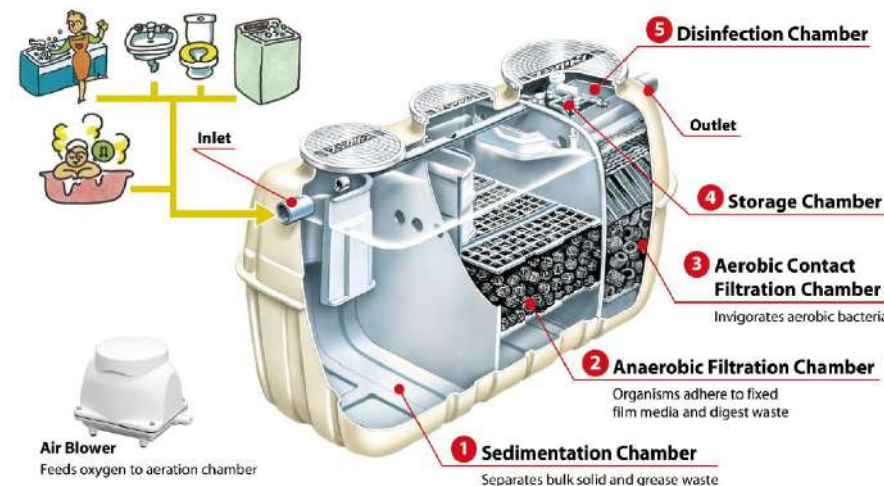
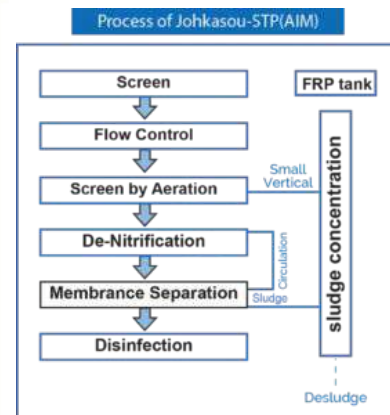
Meet Regulatory Standard

Daiki Packaged STP plants are designed to meet all output parameters as laid down by Indian Ministry of Environment, Forest and Climate Change (MoEFCC) and Pollution Control Board (PCB) norms.



High Treatment Performance

STP has been passing strict government inspection and test performance is approved by Japanese Government with continuous nitrification and denitrification process.



Emerging Sanitation Technologies

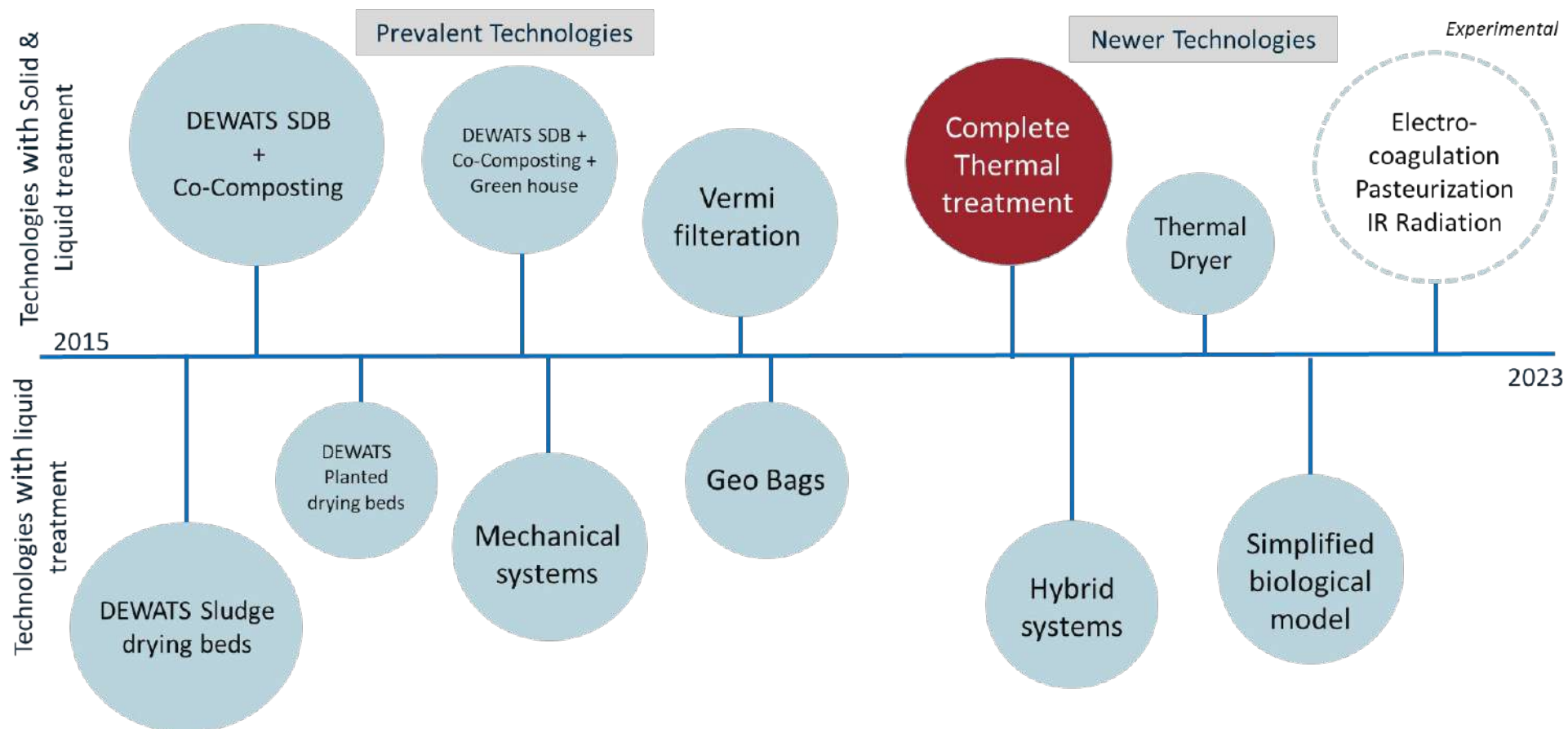


Climate-Wise Inclusive Sanitation technologies that are energy-efficient, low-emission, and suitable for households and communities.



12 on-site containment systems/technologies currently available in **Bangladesh**.

Evolution of FSM Treatment Technologies in South Asia



Glimpses of Municipal Level FSM Technology



FSTP, Khulna Bangladesh



Geotube bags



FSTP at Periyanaicken-Palayam (PNP)



Pyrolizer at Warangal, Telangana



Wai FSTP (Pyrolysis Technology)



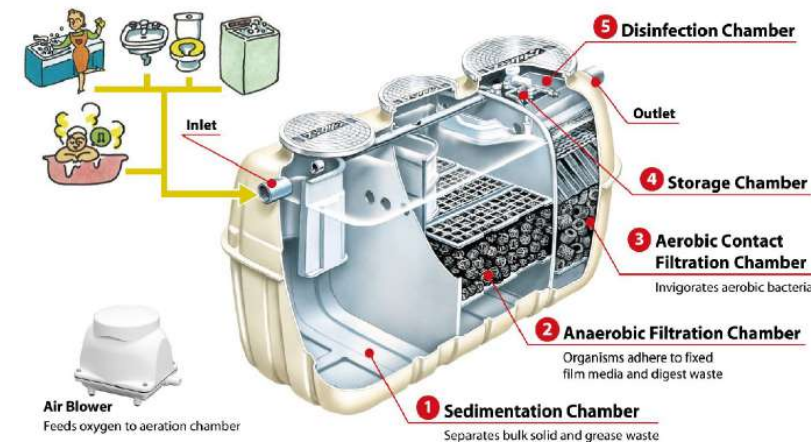
Omni Processor at Cox's Bazar

Challenges and Failures due to Lack of Standards and Regulations

- Wide range of solutions with diversified capital cost and also wide range of Operational cost due
- Complete Pathogen elimination, and limited treatment efficiency
- Possibility of faecal contamination during conveyance and after treatment disposal
- Inadequate regulations and lack of standardized operating procedures
- Time intensive process and subjected to climatic conditions
- Amount of biosolids generated and their safe disposal
- Green house gas emissions adding to Climatic vulnerabilities
- Skilled human resources required
- Exact quantification, Performance evaluation and assessments

Johkasou Act, 1983 for driving innovation and scaling

1. **Establishment of a dedicated government office and personnel:** The Johkasou Act led to the creation of the Office for Promotion of Johkasou in 1986, which guides and supports policy for Johkasou spread. By 2015, about 2,600 personnel were involved in the Johkasou administration at the central and prefectural levels.
1. **Mandatory Johkasou installation driving industry growth:** Under the Johkasou Act and Building Standards Act, Johkasou installation became obligatory, spurring industrial development and technological innovation.
1. **Product standardization and quality assurance:** Regulations on Johkasou structure, performance evaluation, and product qualification/registration ensure high-performance, cost-effective, and reliable systems.
1. **Strengthened industry oversight and service quality:** Registration/permission requirements for Johkasou businesses, technician training/examinations, legal inspections, and testing/certification systems improve service quality, enhance reliability and foster competition.



Adoption of International Standards:

Non-Sewered Sanitation Systems, FS Treatment Units & basic On-site Management

INTERNATIONAL STANDARD ISO 30500

First edition
2018-10

Non-sewered sanitation systems — Prefabricated integrated treatment units — General safety and performance requirements for design and testing

Systèmes d'assainissement autonomes — Unités de traitement intégrées préfabriquées — Exigences générales de performance et de sécurité pour la conception et les essais

INTERNATIONAL STANDARD ISO 31800

First edition
2020-08

Faecal sludge treatment units — Energy independent, prefabricated, community-scale, resource recovery units — Safety and performance requirements

Unités de traitement des boues de vidange — Unités préfabriquées et autonomes en énergie de récupération de ressources à l'échelle locale — Exigences de sécurité et de performance

INTERNATIONAL STANDARD ISO 24521

First edition
2016-09-01

Activities relating to drinking water and wastewater services — Guidelines for the management of basic on-site domestic wastewater services

Activités relatives aux services de l'eau potable et des eaux usées — Lignes directrices pour la gestion sur site des services d'eaux usées domestiques de base

ISO Standards – FSM Overlay

ISO 24521

ISO 30500

ISO 31800

CONTAINMENT



EMPTYING



TRANSPORT

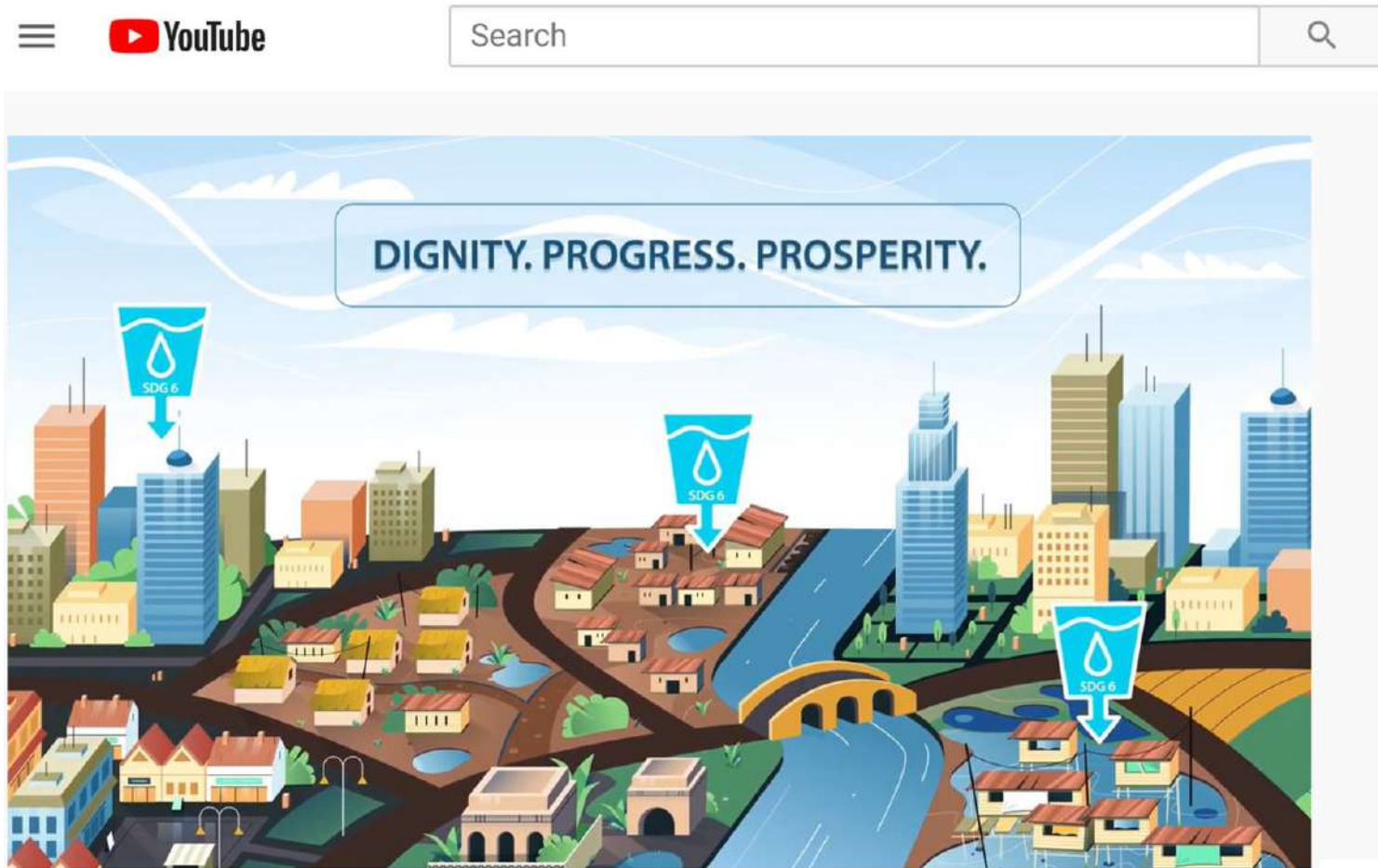


TREATMENT



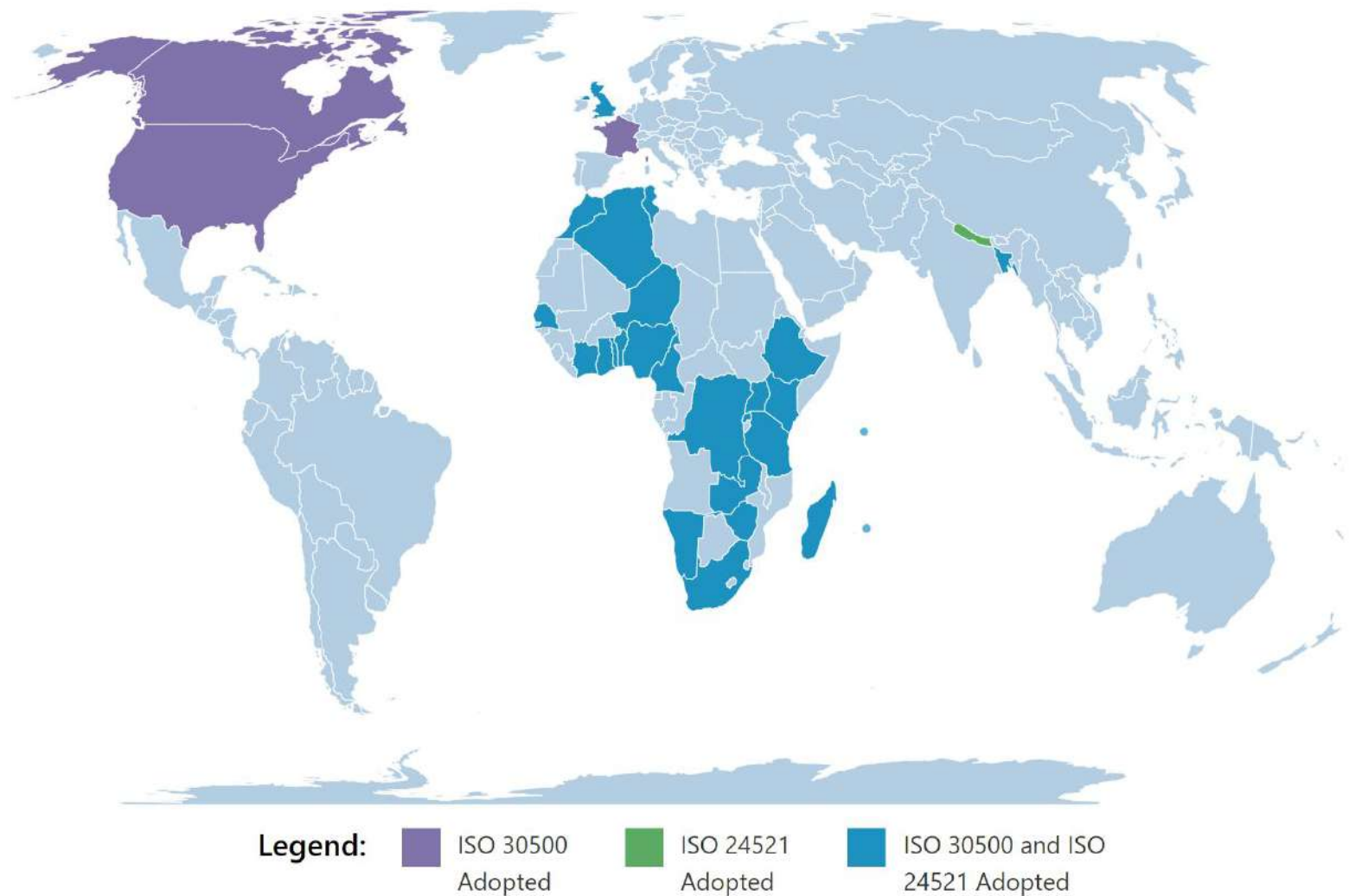
REUSE/DISPOSAL

Sanitation Standards in 2 minutes

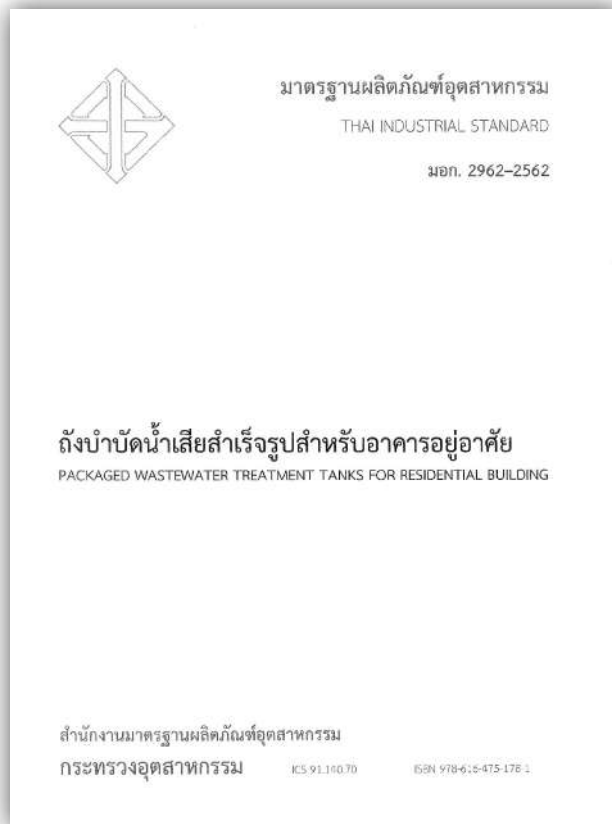


English

National Adoption of ISO 30500 & ISO 24521



Regional Standards, SEA & China Examples



These standards apply to prefabricated wastewater treatment tanks constructed of fiberglass or polyethylene or concrete, intended for residential use with a design flow not exceeding 10,000 liters per day. TIS 2962-2562 for Thailand market and SNI 9161:2023 for Indonesian market for testing prefabricated wastewater treatment products.

GB (GuoBao), ISO 30500 adoption in China.

New Non-Sewered Sanitation Industry



Enabling environment

Enhanced demand for affordable aspirational sanitation

Implementation of quality standards



Marketplace readiness

Supportive regulatory environment

Access to financing

Readily available competitive products



Thank You

Roshan Shrestha

Roshan.Shrestha@gatesfoundation.org

Convenors



Supporters



Gold Partners



Contributing Partner



Hospitality Partner



Payment Gateway Partner



Technical Partner



ISO Standards for Sanitation Technologies

ISO 30500

- ISO 30500 sets safety, performance, and sustainability standards for Non-Sewered Sanitation Systems (NSSS). It covers the design, testing, and integration of prefabricated units treating specific inputs for safe reuse or disposal (integrated or back-end only). The standard applies to systems not connected to sewer networks, defining input types and output quality requirements. It also covers system functionality, reliability, and environmental compatibility.

ISO 31800

- ISO 31800 outlines requirements for community-scale resource recovery fecal sludge treatment units serving 1,000 to 100,000 people. It applies to units treating fecal sludge in non-sewered, off-grid environments, emphasizing prefabrication and resource recovery. Safety, operability, and maintainability are addressed, along with output quality and environmental protection.

ISO 24521

- ISO 24521 provides guidelines for the management of basic on-site domestic wastewater services. It focuses on ensuring safe and effective wastewater management in residential settings, especially where centralized wastewater treatment systems may not be feasible or available.

FSTP – Hybrid System

- The **Periyanaickenpalyam (PNP)** FSTP is based on a mechanized system and employs a volute press for dewatering.
- The filtrate water undergoes treatment by Moving Bed Bio-reactor (MBBR) followed by pressure sand filtration and activated carbon filtration.
- The dewatered sludge is further dried in the FSTP area before being sent for co-composting.
- Screw press has a lower land requirement and capital cost compared to sludge drying bed.
- Screw press has a higher operation and maintenance cost due to electrical consumption and polymer consumption for sludge dewatering.



Comparative analysis of Screw Press Vs Drying beds		
Parameters	Conventional SDB 50 KLD	Screw press 50 KLD
Capital Cost (USD)	325000 $\cong$ (300K)	57175 $\cong$ (57K)
Operational Cost (USD)	6000	8475
Space (Sq Meters)	3165	50

Thermal FSTPs in India

Septage receiving station □ **Holding tank** □ **Dewatering unit** □ **Dryer** □ **Pyrolysis unit** □ **Wastewater treatment unit**

- Around 99 thermal-based Faecal Sludge Treatment Plants (FSTPs) are being implemented across various towns in Rajasthan.
- The technologies employed include pyrolysis-based omni-processors (P-OP) along with Moving Bed Biofilm Reactors (MBBR)
- The Thermal FSTPs are highly modular and are manufactured locally in India
- These Thermal FSTPs ensure resource recovery and recycle from Biochar and treated water
- They have very 60% lesser land requirement than convectional FSTPs

Estimated pricing	For thermal FSTP
Design Build (Capex) USD	Approx. 950 K
Desludging Cost USD	Approx. 240 K/ Anum
Operation Cost USD	Approx. 200 K/ Anum

