Financing Climate-Resilient Urban Water Reuse Infrastructure: A Strategic Framework for Sustainable Water Management

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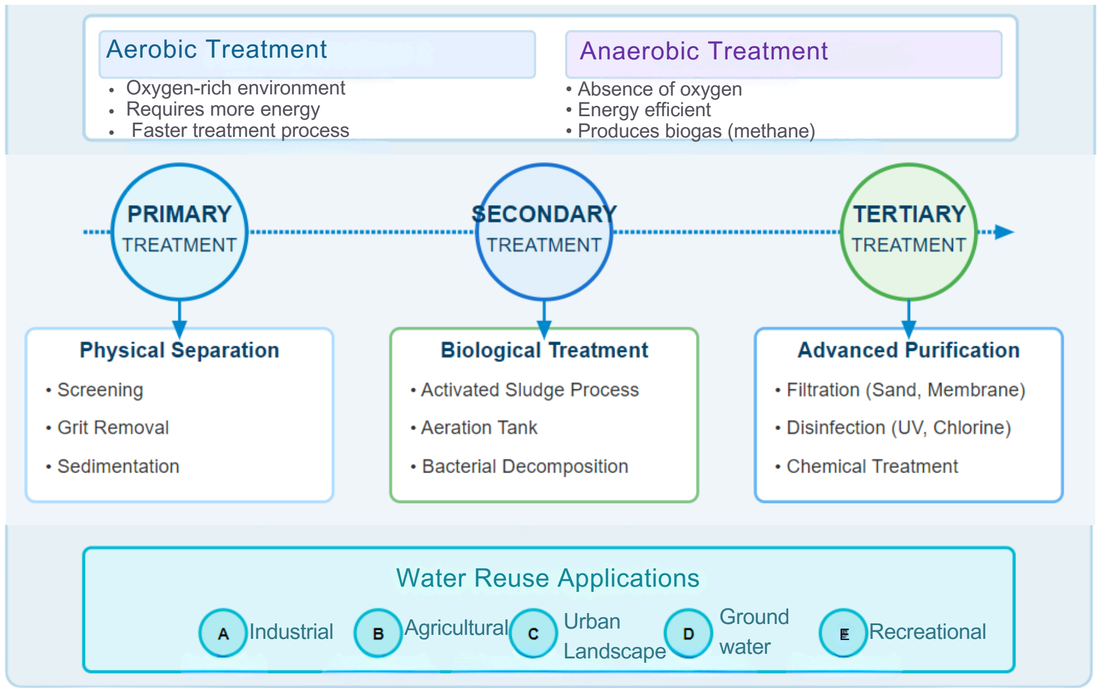
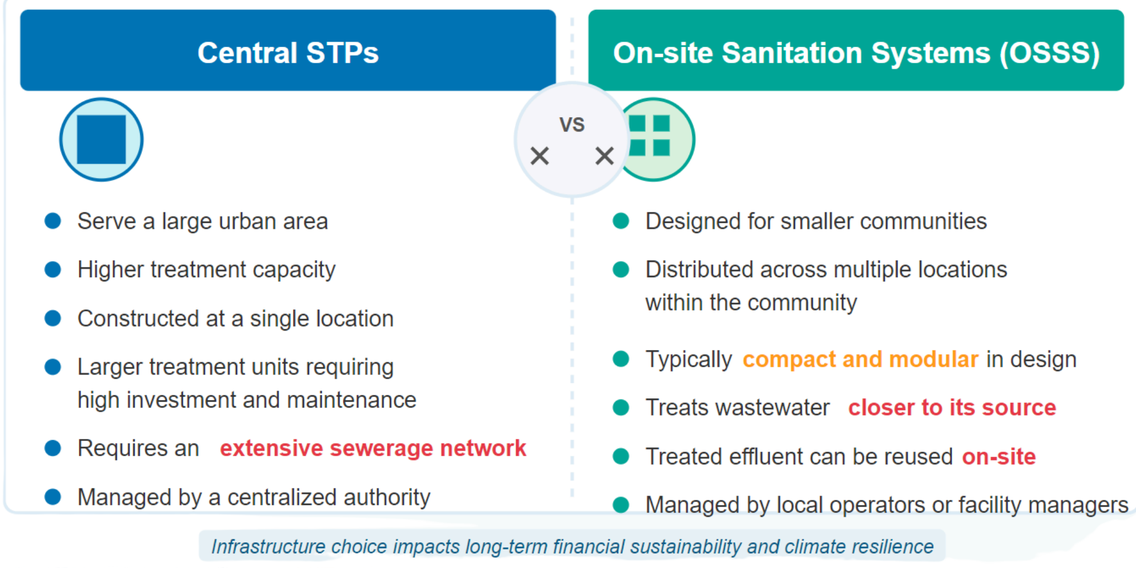
Wastewater Treatment Process for Sustainable Water Reuse

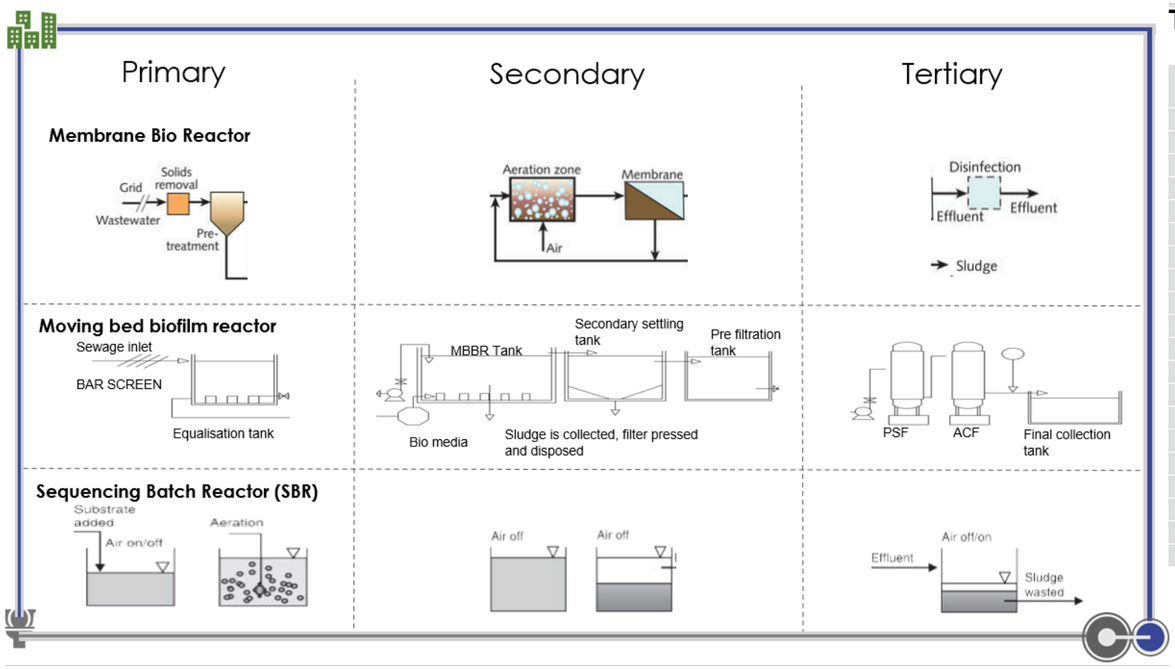


Economic Insight: Freshwater ₹12/unit vs. Treated Wastewater ₹45/unit - Strategic Investment Opportunity

Wastewater Treatment Infrastructure: Centralized vs Decentralized



Infrastructure choice impacts long-term financial sustainability and climate resilience

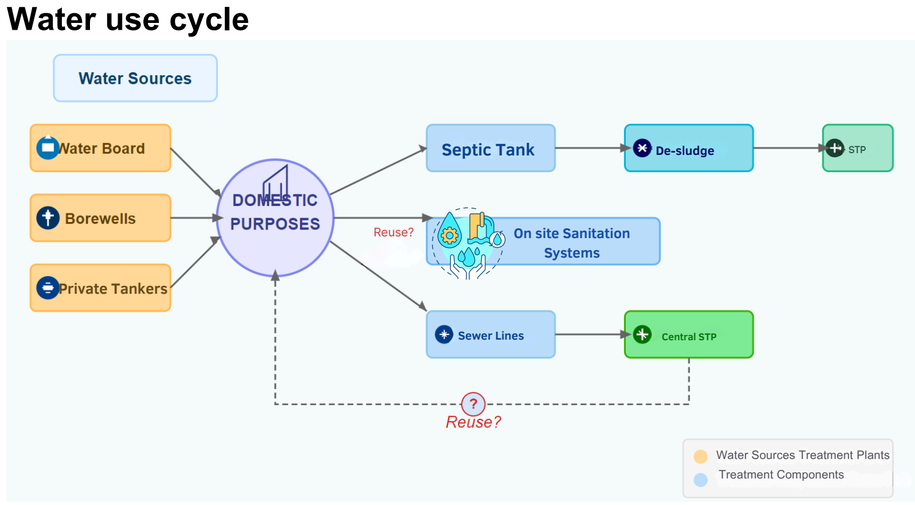


Technology requirements and cost variation

Factors	Units	MBR	MBBR	SBR	ASP	UASB	WSP
Land requirement	m²/(MLD)	450	550	550	730-1010	1100	6100
Capital cost	$ldcs/MLD	506	182	194	182	182	106
Civil construction	% and $lacs/MLD	60% (304)	60% (109)	60% (116)	60% (109)	60% (109)	60% (64)
Machinery (E&M)	% and $lacs/MLD	40% (202)	40% (73)	40% (78)	40% (73)	40% (73)	40% (42)
O&M costs	$ldcs/MLD	11	27	20	27	27	20
Labour costs	($locs/pq)/MLD	nil	1.01	0.87	1.41	1.41	1.08
Electricity requirements	(kWh/d)/MLD	302	223	153	185	125	6
Electricity costs	($locs/pq)/MLD	11	8	6	7	5	-
Chemical costs	($locs/pq)/MLD	nil	9	5	9	11	12
Civil works maintenance	($locs/pq)/MLD	nil	3	2	4	5	3
E&M works maintenance	($locs/pq)/MLD	nil	1	2	1	1	0
Annual repair costs	($locs/pq)/MLD	nil	4	4	5	5	-

Source: Performance evaluation of sewerage treatment plants, CPCB, 2013

Water use cycle



Why do we need to treat and reuse water

The water supply in Hyderabad, like in many other cities, faces various challenges and issues:
Rapid urbanization: Increased demand for water, resulting in inadequate supply to meet the needs of the expanding population.
Depleting water resources: Hyderabad primarily relies on surface water sources like the Krishna and Godavari rivers, as well as groundwater extraction. Overexploitation of groundwater has led to declining water tables and the depletion of aquifers.
Unequal distribution: Scarcity is often experienced more severely in low-income neighborhoods and informal settlements. These marginalized communities may face limited access to safe drinking water and inadequate sanitation facilities, leading to health and hygiene issues.
Water pollution: Pollution lakes and rivers, is a significant problem. Industrial discharge, improper waste management, and untreated sewage can contaminate water sources, making them unfit for consumption and exacerbating water scarcity issues.

Why Wastewater is not Reused in general

Not all citizens are well informed about reuse of wastewater

- **Absence of Mandatory Law**/Regulation in place
- **Non prevalence of standard Reuse practices** for referral

Citizens who Acknowledge Reuse of Wastewater avoid reusing owning to

- **Expenses incurred** in treating wastewater are comparatively Higher
- **Distrust in the Quality** of treated wastewater
- **Poorly Designed STP** by Builder
- **Poor O&M** by Operators

Why Wastewater is not reused

Not Treated at The first place

Not built by the **builder**

- RWAs blame the builder for the Absence of STPs
- **Space constraint** - occupies significant Car spaces
- **Higher CapEx costs**
- **Design specifications not mentioned** in the building codes
- **Absence of Inflow and outflow meters** leads to non adherence to the set lpcd rates hence extra consumption of cheaper freshwater which eradicates the need to treat the water

Not operated by **RWAs** due to:

- **Odour and noise** disturbances
- **Poor** standards and design of **STPs constructed**
- **Absence of Regular Audits** or checking/supervision
- **Lack of operational knowledge**
- **Expenses**

Operation and Maintenance:

- **Difficulty in Hiring** O&M operators due to **unauthorised** hiring and **payment Expenses**
- **OpEx costs**
- O&M operators are **not licensed** leading to poor quality of treated water and consequently distrust among the citizens to reuse

Treated but not Reused

Not built by the **builder**

- **Non existence of mandated law**/regulation to Reuse the Treated water
- **No provision for filtration and tertiary treatment** by the builder
- Absence of **connecting treated water lines** from the STP to the household

The **general distrust** among the **Citizens**

- **Absence of Chemical treatments** and verified and validated Tests
- **No incentives/Rebates** in property or other taxes
- **Cost of using fresh water is cheaper**

Treatment Costs comparison

	units		100pcd	150pcd	200pcd	250pcd	300pcd
Fresh water cost	₹/KL	10	12	12	22	22	
25HH	Treated Water cost/KL	₹/KL	261	176	134	109	92
	Electricity	₹/KL	3	3	3	3	3
	Chemicals & Repairs	₹/KL	4	4	4	4	4
	Operation and Maintenance	₹/KL	254	169	127	102	85
100HH	Treated Water cost/KL	₹/KL	71	49	39	32	28
	Electricity	₹/KL	3	3	3	3	3
	Chemicals & Repairs	₹/KL	4	4	4	4	4
	Operation and Maintenance	₹/KL	63	42	32	25	21
250HH	Treated Water cost/KL	₹/KL	32	24	20	17	15
	Electricity	₹/KL	3	3	3	3	3
	Chemicals & Repairs	₹/KL	4	4	4	4	4
	Operation and Maintenance	₹/KL	25	17	13	10	8
500HH	Treated Water cost/KL	₹/KL	20	15	13	12	11
	Electricity	₹/KL	3	3	3	3	3
	Chemicals & Repairs	₹/KL	4	4	4	4	4
	Operation and Maintenance	₹/KL	13	8	6	5	4
1000HH	Treated Water cost/KL	₹/KL	13	11	10	10	9
	Electricity	₹/KL	3	3	3	3	3
	Chemicals & Repairs	₹/KL	4	4	4	4	4
	Operation and Maintenance	₹/KL	6	4	3	3	2

Financing mechanisms

Financing Model	Process	Example	Implementation Process in India
Blended Finance	Combines public, private, and donor funds to de-risk investments in STPs and water reuse.	Kenya's Water Fund: Used donor grants + private investments to build wastewater treatment in urban slums.	The government provides concessional loans via NIIF (National Investment and Infrastructure Fund). [Source: NIIF Annual Report] - Development banks (e.g., World Bank) co-invest with the private sector. [Source: World Bank India]
Green Bonds	Bonds issued to raise capital for environmentally sustainable projects like STPs.	IREDA Green Bonds (India): Raised $300M for green energy & wastewater projects.	- SEBI-regulated Green Bond framework for infra projects. [Source: SEBI Guidelines] - Municipal corporations issue bonds for STP funding (e.g., Pune, Hyderabad). [Source: MoHUA]
Municipal Infrastructure Funds	City-level funds pool money from taxes, water tariffs, and development fees to finance STPs.	Sydney Water Fund ($32B): Used tariffs + municipal debt for STP upgrades.	- Smart Cities Mission allocates funds for wastewater infra. [Source: Smart Cities Mission India] - Property tax surcharges are used in cities like Bengaluru. [Source: BWSSB]
Performance-Linked Financial Instruments	Ties financial returns to the efficiency of water reuse and STP operations.	China's PPP Model: Payments to STP operators based on water quality outcomes.	- Viability Gap Funding (VGF) for private STP operators with efficiency-linked payouts. [Source: NITI Aayog] - Urban Local Bodies (ULBs) introduce performance-based contracts. [Source: Jal Shakti Ministry]
Policy Interventions	Regulations and incentives (tax rebates, subsidies, mandates) to promote STPs.	Singapore's Water Efficiency Incentive: Tax rebates for industries adopting water recycling.	- 50% capital subsidy for decentralized STPs under AMRUT 2.0. [Source: MoHUA] - Mandatory reuse for large projects in Tamil Nadu. [Source: TNPCB]
Cost-Benefit Analysis	Evaluates economic benefits (reduced freshwater use, lower pollution) vs. costs (CAPEX, OPEX).	California's Water Recycling: $1 invested = $4.3 in long-term benefits.	- NITI Aayog's framework for STP cost-benefit models. [Source: NITI Aayog] - State-specific studies (e.g., Maharashtra) justify reuse mandates. [Source: Maharashtra State Water Policy]