Moving towards Climate resilient WASH services

NFSSM Alliance Learning Lab

November 2024

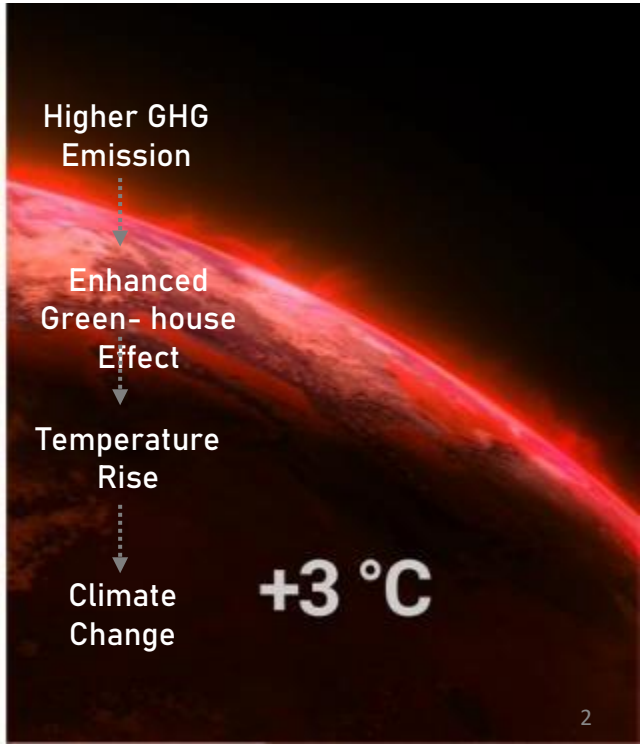
CWAS CENTER FOR WATER AND SANITATION | CRDF CEPT RESEARCH AND DEVELOPMENT FOUNDATION | CEPT UNIVERSITY

United Nations
Climate Change

*Long-term alteration of temperature and typical weather patterns in a place is **CLIMATE CHANGE!***
*Rise in **Greenhouse Gases Emissions** is the major reason behind this rapid climate change…..*

Anthropogenic Emissions

Resulting from or produced by human activities



GLOBAL ACTION

United Nations Framework Convention on Climate Change

KYOTO PROTOCOL

G20

OECD

iea International Energy Agency

MAJOR ECONOMIES FORUM ON ENERGY AND CLIMATE

Kyoto Protocol

It is a legally binding agreement to reduce industry based GHG emissions.

First Commitment Period - 2008-12

- Reduce emissions by 5% compared to 1990 levels

Second Commitment Period - 2017-20

- Reduce emissions by 18% compared to 1990 levels

Paris Agreement

- The Paris Agreement is a **legally binding international treaty on climate change**. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.
- Its goal is to **limit global warming** to well below 2, **preferably to 1.5 degrees Celsius**, compared to pre-industrial levels.

INDIA's NDC – Nationally determined contributions

India is 3rd largest GHG emitter among all the countries.

2,953 Mt CO_2e overall emissions

Energy sector the largest contributor

1. **Reduce the emissions intensity of its GDP to 45% below 2005 levels by 2030.**
2. **Achieve about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.**
3. **Create an additional carbon sink of 2.5-3.0 billion tonne of carbon dioxide equivalent through additional forest and tree cover by 2030.**
4. **Propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LiFE' – 'Lifestyle for Environment' as a key to combating climate change.**

Focusing on Carbon capture usage and storage technologies

Sector specific targets for all action and strategies

Focus on research and innovation towards clean fuel technologies

Focus on international cooperations and financial credit flows

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1876119

Climate response:

ADAPTATION

In *human systems*, the process of adjustment to actual or expected *climate* and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

MITIGATION

A human intervention to reduce emissions or enhance the sinks of greenhouse gases. Mitigation measures are technologies, processes or practices that contribute to mitigation, for example, renewable energy (RE) technologies, waste minimization processes and public transport commuting practices.

RESILIENCE

Climate resilience is the ability of communities, businesses, and governments to: Anticipate climate risks and hazards, Prepare for and respond to climate-related events, Absorb shocks and stresses, Transform development pathways, and Withstand the impacts of climate change

WASH sector most vulnerable to climate change

Water sector

1. Water scarcity and increased water demand
2. Contamination of water sources
3. Breakdown of physical infrastructure

Sanitation sector

1. Lack of access to public sanitation facilities
2. Sewer system and onsite system overflow
3. Damage to wastewater treatment facilities
4. Contamination and public health issues

Delhi Floods, 2023 – Water Treatment Plants are dysfunctional; sewage mixing with flood water

Chennai floods, 2021 and drought, 2019

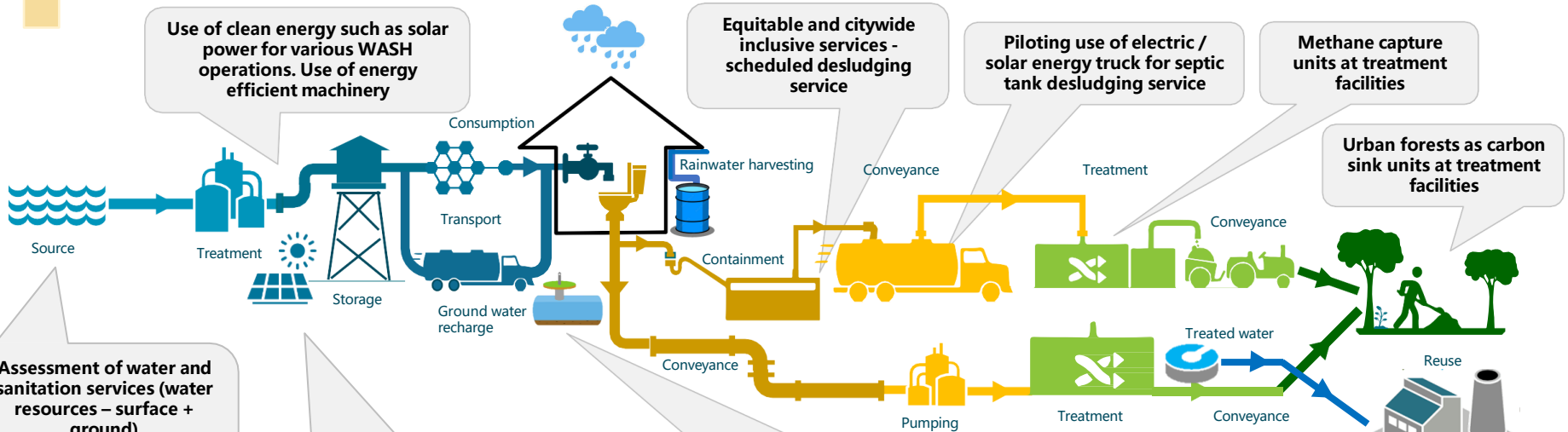
Kerala floods, 2018 – Access to sanitation facilities

Uttarakhand, 2023 - Cloud burst destroys city infrastructure and services

Latur, 2016 - Water delivered through trains during drought

Need adaptive and mitigative efforts across the WASH chain

GHG emission estimates across the WASH service chain



Augmenting Water resource across the WASH service chain

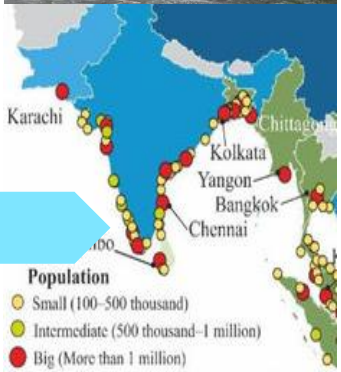
ADAPTIVE efforts for WASH

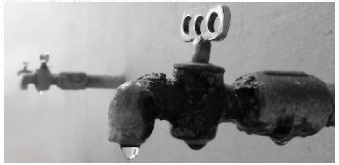
Access to services as an adaptive measure
The vulnerable are more affected...

Access for the low-income groups

Droughts and heatwaves affect **low-income groups disproportionately**

Those without access to services are more vulnerable to climate change





Need for climate resilience

Need **"climate-proof" WASH infrastructure** and services - self reliant infrastructure in terms of resilience to extreme weather events, sustainability of sources and energy dependency

Access to own toilets – critical for adaptation !

How to access community toilets in floods?

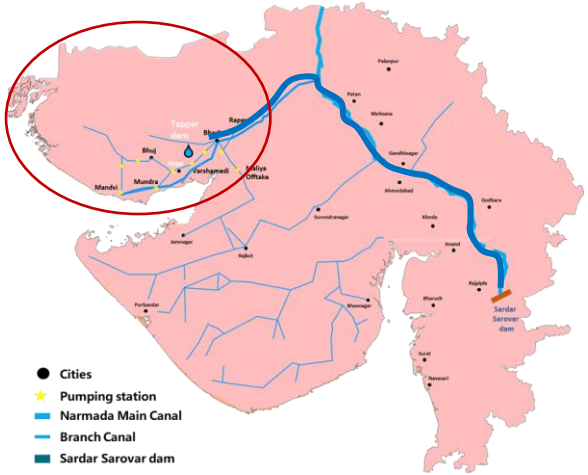
What happens to septic tanks in floods?

COVID lockdown – those with own toilets more secure

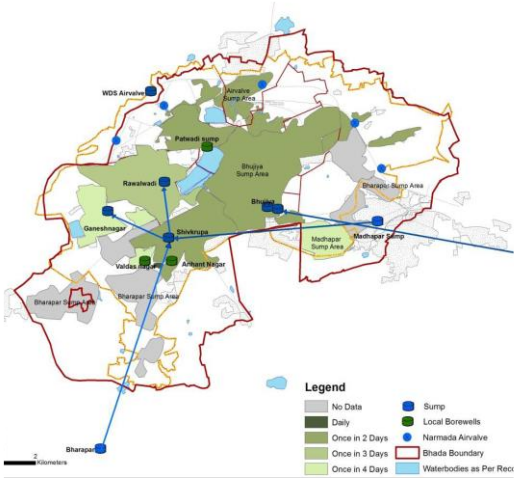
During drought, those without access to taps at home more vulnerable

Need to strengthen own water sources!

Water brought from distant Narmada …



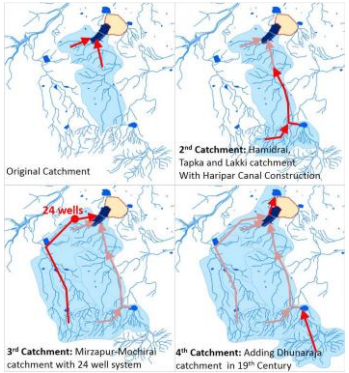
And yet, Kutchh cities are not able to supply water daily …



Climate vulnerability, “non-water days” and private water markets

Rejuvenation of local water bodies to ensure alternative supply as well as health of groundwater

Revival of local, traditional sources



Repairing traditional lake catchment system developed by old rulers

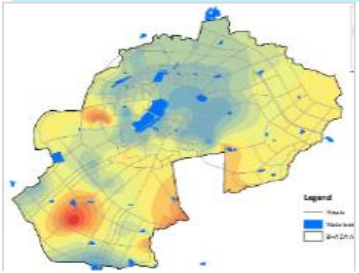
De-silting lakes with public participation

Revival of old unused well for decentralized piped supply for a slum

Rainwater Harvesting

Student managed rain water harvesting in school for drinking water supply

Groundwater recharge



Ensuring viability of groundwater borewells through water level monitoring and recharge activities

Flood control through GW recharge for a housing colony

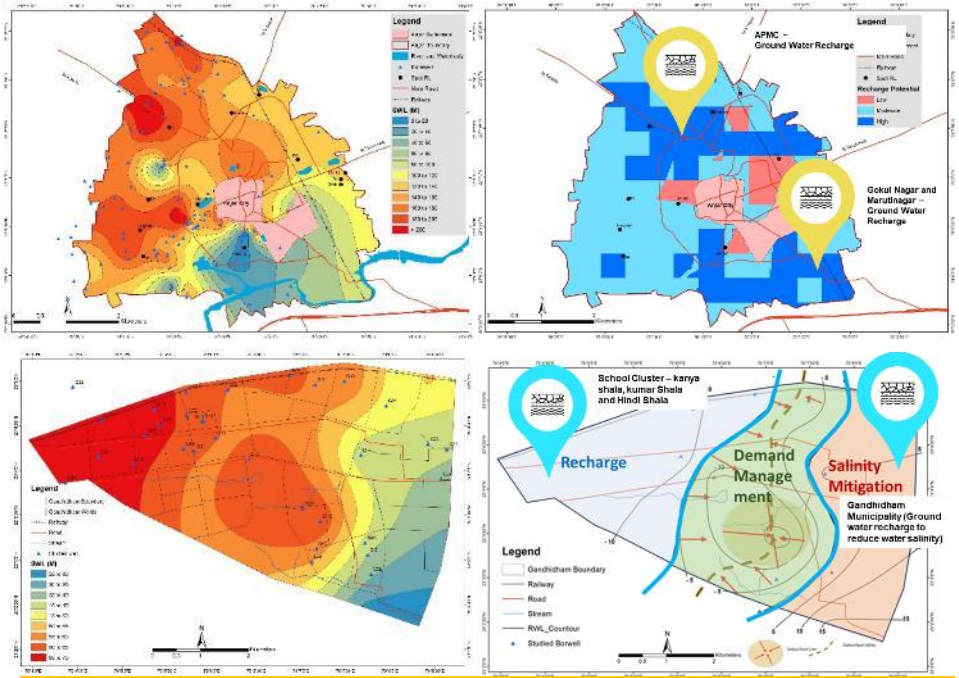
Wastewater Reuse

Greening by DEWATS

Through...

- Citizen Involvement
- Pilot project demonstrations

Geohydrological study for understanding aquifer and watershed of cities leading to groundwater recharge strategies



Identification of potential water recharge sites....

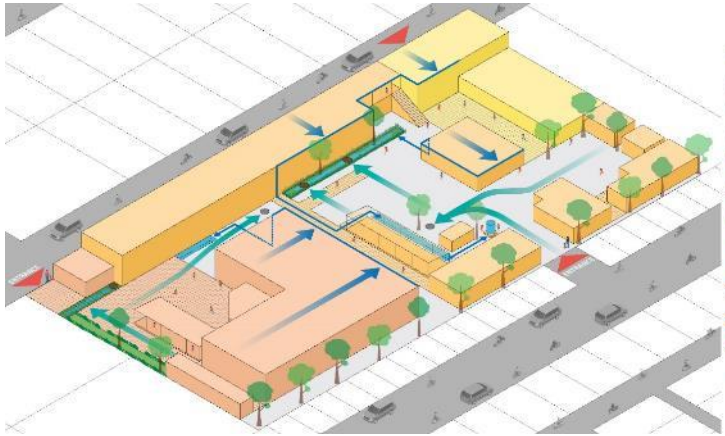
Zone-wise Groundwater recharge structure strategy

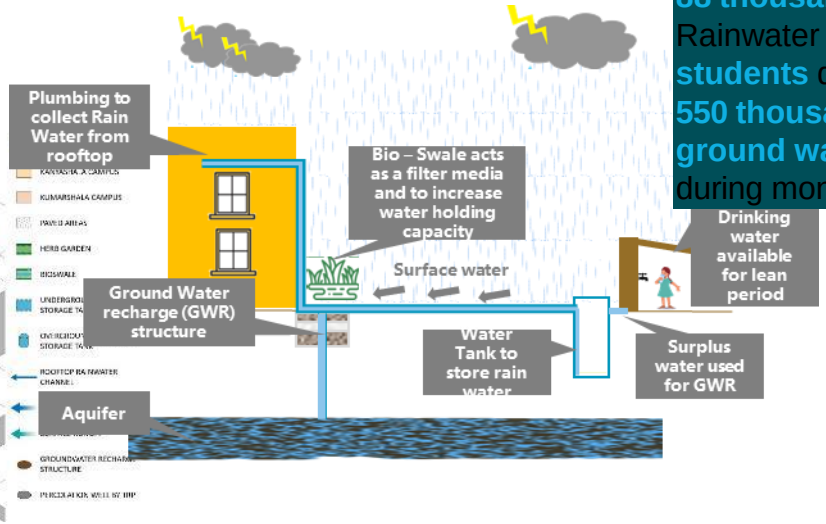
Addressed multiple issues:

Water scarcity, urban flooding, and groundwater depletion

Rainwater harvesting for drinking water needs during lean period

Household / Institutional level





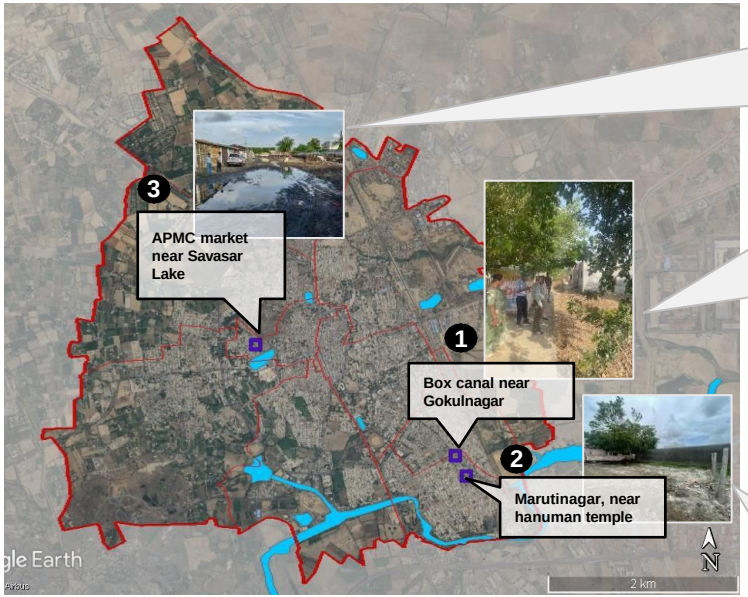
88 thousand liters of Rainwater available for **3000+ students** during lean period; **550 thousand liters** of **ground water recharged** during monsoon

3 school cluster

Municipal Council

Urban Flooding mitigation through Ground Water Recharge (GWR)...

- **Mitigating urban flood** scenario, while exploring the **concept of Sponge cities** through **ground water recharge** structures
- **35 Million liters** of **ground water recharged** during monsoon
- Identify **urban flood locations** in consultation with city authorities, FGDs with citizens and field visits
- Develop **Ground water recharge** structures



Locations of Pilot on use of storm water for GWR and urban flood control in Anjar

- *APMC is the Vegetable market*
- *The premises is located at lower elevation than the adjoining areas*
- *Due to this water gets accumulated during the monsoon season*
- *Causing sanitation issues*

- *The area is low laying, also the sewage pumping station is located in this area*
- *During monsoon water gets flooded up to 4-5 feet height*
- *Also unhygienic condition is created due to mixing with sewer line*

- *The area is low laying, also new developments in and around the area has blocked its natural drainage pattern*
- *Water flood the area up to 4-5 feet, which takes almost 5-6 to recede*
- *Causing breeding grounds for mosquitoes*

Gender empowerment and strengthening livelihoods : Engaging women's Self-Help Group for O&M of WASH infra

- Women SHGs have been formally engaged by the ULBs for operation and maintenance of the urban forest. For which 'SHG only' tenders were floated, and work orders were given.
- In all the cities contracts for the SHGs have been renewed based on the good work done by the women SHGs
- SHG women have also been engaged for operations and maintenance of MHM machines in community and public toilets in Vita and Wai.
- Exposure visits and trainings have also been conducted.





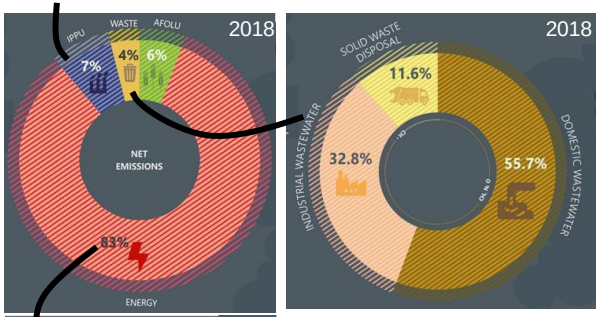




WASH is also a contributor to GHG emissions...

Mitigation needs

4% direct emissions in India due to waste sector



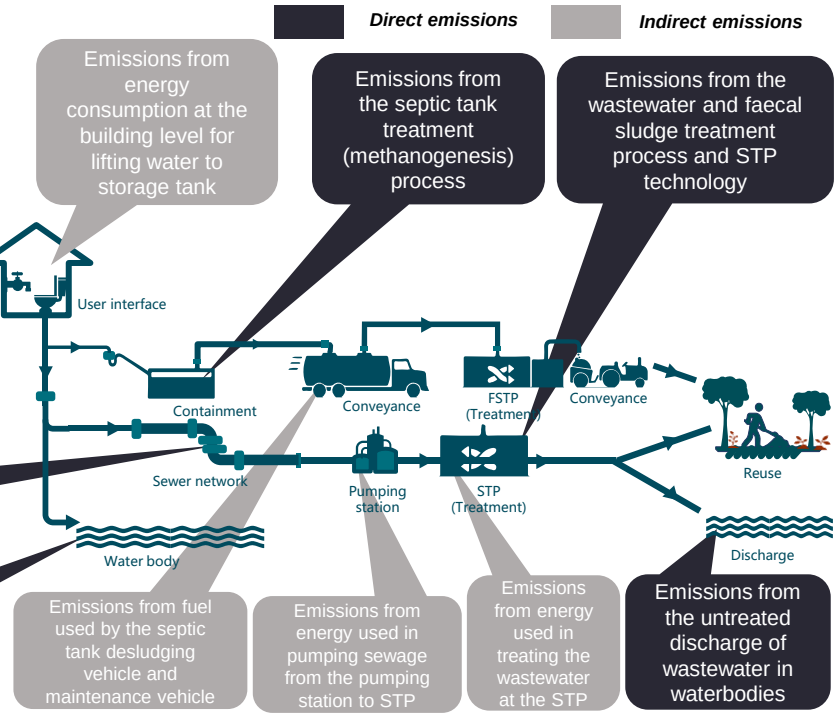
Direct emissions : Wastewater (domestic and industrial) is a high contributor in waste sector in India

40% to 60% of the electricity consumed by a municipal corporation is spent towards the operation of water / sewage pumping

Indirect emissions: Significant portion of electricity consumed by WASH services

CH4 and NOx gas emissions from WASH which trap much more heat than CO2

Direct and Indirect GHG emissions across sanitation value chain



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Net Zero

- Carbon net zero
- Net zero carbon
- Net zero

At global level, net zero emissions are achieved when emissions of greenhouse gases (GHGs) from human activities to the atmosphere are balanced by anthropogenic removals, meaning withdrawal of GHGs from the atmosphere as a result of deliberate human activities over a specified period (IPCC, SR15).

Zero carbon

- Zero emissions comittment

At the most basic level, something which emits no GHG emissions during its use phase, for example, electricity from wind turbines could be called ‘zero carbon electricity’.

Carbon

We often talk about ‘carbon’ as a shorthand term for carbon dioxide (CO2), which is the primary greenhouse gas responsible for climate change. However, it is also used to describe the entire range of greenhouse gases when discussing carbon emissions

Carbon Neutrality

A carbon neutral footprint is one where the sum of GHG emissions produced is offset by natural carbon sinks **and/or carbon credits.**
The rules around carbon neutrality are less strict than for Net Zero Carbon as they allow to claim neutrality in ways such as buying offsets for avoided emissions, rather than eliminating their own emissions.

Carbon Neutrality is an intermediate recurring goal which is part of the larger goal of Net Zero.

Source: Glossary of carbon neutrality -EN.pdf, https://ourworldindata.org/greenhouse-gas-emissions#total-greenhouse-gas-emissions

Dynamics of Water and sanitation value chain varies...

GHG emission estimates across the WASH service chain

Usage of electricity for water treatment

Energy used for pumping the water

Through the onsite sanitation systems through the biological anaerobic decomposition of organic matter

Use of fuel for transportation of faceal matter

Component rarely followed mostly discharge in open environment

Source

Treatment

Storage

Transport

Consumption

User Interface

Containment

Conveyance

Treatment

Conveyance

Reuse

Conveyance

Pumping

Treatment

Conveyance

Emissions through the water vapours

Use of fuel for transporting the water through the tanker supply

Through pipe leakages and improper maintenance of sewer

Emission of methane and nitrous oxide through improper treatment and management of wastewater treatment

Quantification of emissions is essential

Emissions by sanitation value chain.
Methane CH4, Nitrous Oxide N2O

Emission through the fuel and generation of electricity, which is then used in water and wastewater service chain.
Carbon Dioxide CO2.

Different levels and methodologies of GHG emissions quantification

Tier 1 (International level factor) *Tier 2 (National level factors)* *Tier 3 (local level factors)*

IPCC provides methodology for emission inventory

2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Provides empirical methodology to estimate emissions using country level factors….

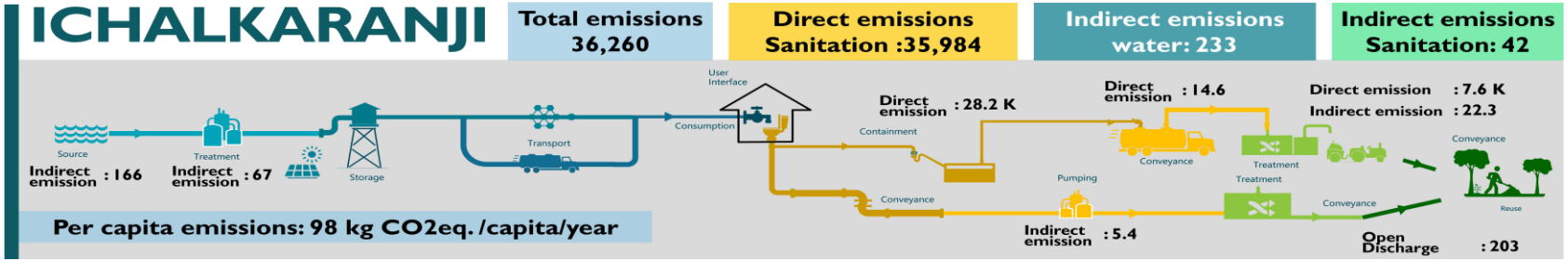
However, this requires localization for action at city level

Various studies are carried out to understand the emissions from sewered and non-sewered sanitation facilities

Sr. No	Name of study	Country	Study on what aspect	Observation
1	Greenhouse Gas Emissions from Blackwater Septic Systems	Vietnam	Septic tank	**Regular desludging reduces the GHG emissions** from the onsite systems
2	Emissions from onsite sanitation system in USA	USA	Septic tank	The emission **factor is overestimated in the IPCC** methodology and needs to be revised in the IPCC methodology
3	Spatial and temporal variation of GHG emission for onsite sanitation system	Ireland	Septic tank	**Various parameters have different impact** on GHG emissions from onsite systems
4	Assessment of Sanitation GHG emissions in Senegal	Senegal	On site system	The **sanitation sector's contribution to NDC is 7.5 %** as per the empirical estimation
5	Greenhouse gas fluxes from human waste management pathways	Haiti	On site system	The **construction material of the pile impacts on the GHG** emissions and its concentration
6	Methane Emissions from Municipal Wastewater Collection and Treatment Systems	USA	Sewer Line	The **emissions for the sewer network are underestimated** and unaccounted, as per the current empirical estimate of the IPCC
7	Methane monitoring system for continuous multi-channel sampling	Japan	Anaerobic system	Development of prototype for on-field methane estimation
8	Whole-system analysis reveals high greenhouse gas emissions, Kampala	Uganda	On-site sanitation system	Emissions from the **overall sanitation sector are underestimated** and contextualised emission factors are essential for accurate emission estimation

To derive local emission factors, activity is initiated to measure emissions from septic tanks

Initial GHG estimates using IPCC empirical quantification . . .



On-field GHG estimates using gas analysers...

- Septic tank samples selected across various locations and different typologies
- Methane measurements from morning 7 am to 7 pm at an interval of one hour
- Methane emissions from septic tanks ranging from 100 ppm to 10,000 ppm
- Septic tanks deslugded within 1 to 5 years showcase less emissions as compared to other septic tanks which are never desludged

Moving towards climate inclusive WASH services . . .

Energy Transition

Nature Based Solutions

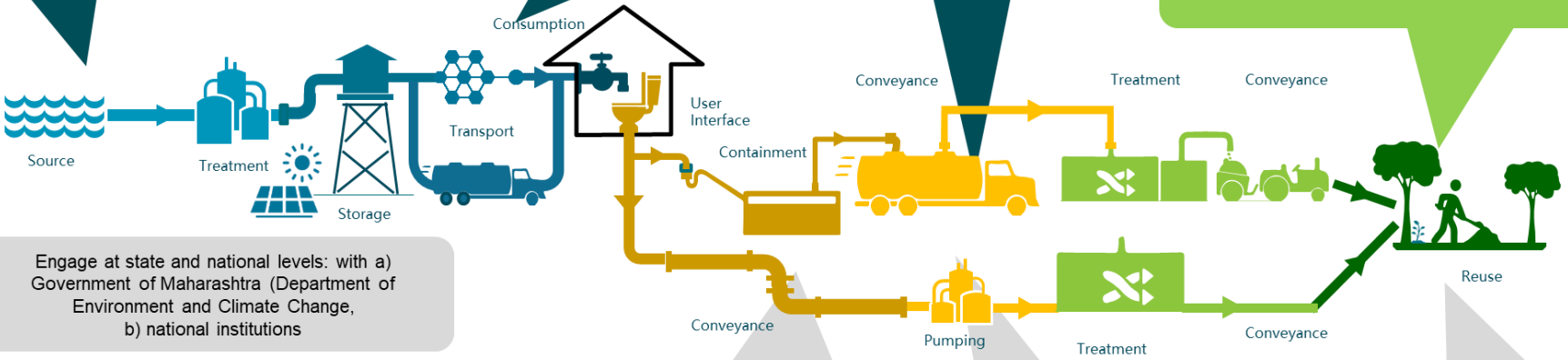
Inclusive services

Assessment of water and sanitation services and emissions in operations – energy and water audit

Use of clean energy such as solar power for various WASH operations. Use of energy efficient machinery

Piloting use of electric / solar energy truck for septic tank desludging service and electric charging station

Urban forests as carbon sink units at treatment facilities



Engage at state and national levels: with a) Government of Maharashtra (Department of Environment and Climate Change, b) national institutions

Equitable and citywide inclusive services - Plan for citywide scheduled desludging service in consultation with city governments

Safaimitr suraksha -Sanitation worker safety training and sensitization

Gender Empowerment - Plan for involving SHGs in consultation with city governments - NULM convergence

Technical support and capacity building for municipal staff

Transaction advisory support to ULBs

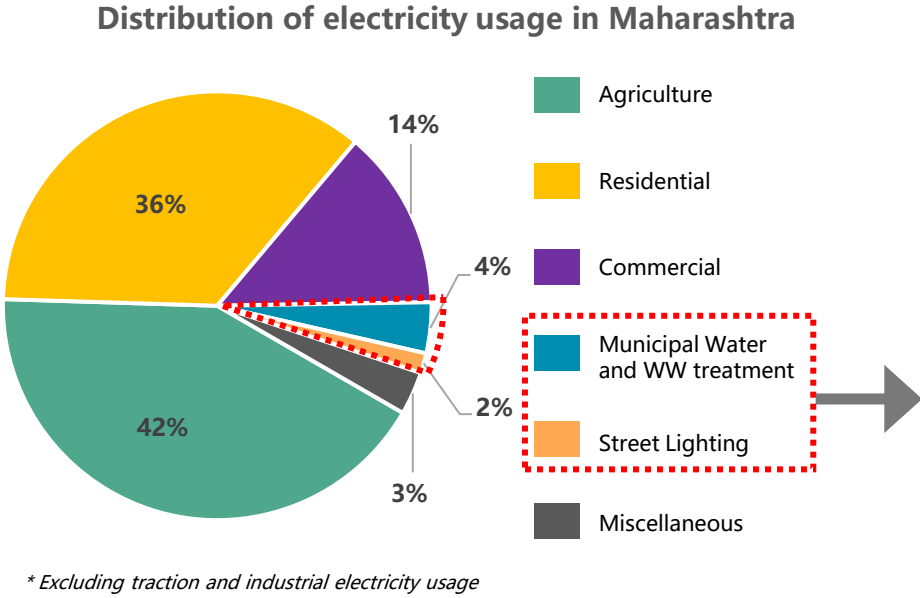
Action-research on emerging topics

Scaling up through partnership at statelevel

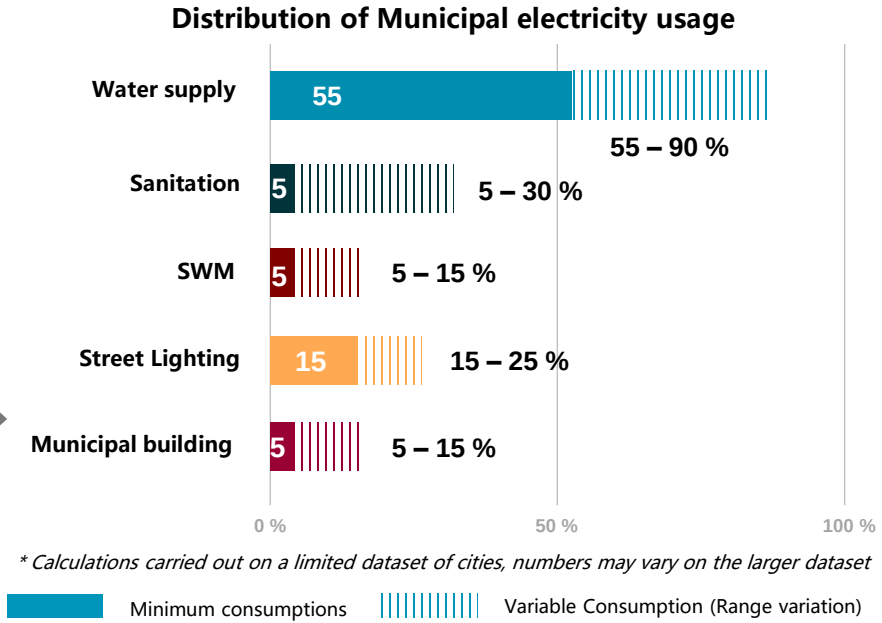
Small and Medium towns of Maharashtra acting as “Urban laboratories” for building climate responsive WASH services…

- 6 Small and Medium towns **ranging from 40,000 to 4 lakh population** setting up examples of building climate responsive WASH services.
- Towns are located in **different climate conditions** facing drought as well as flood situations
- All towns have **different WASH services context in terms of services provision** both onsite and offsite water and sanitation services.
- Initiatives taken up in towns provide **cross sectoral impacts.**

Small and Medium size towns can contribute to national and international commitments..



** Excluding traction and industrial electricity usage*



** Calculations carried out on a limited dataset of cities, numbers may vary on the larger dataset*

- **Municipal service accounts for 6 % of total electricity consumption, out of which WASH services contribute about 40 – 70 % of total energy consumption and about 50 to 70 % of municipal energy cost.**
- **The energy cost for provision of WASH service ranges between INR 200 - 1000 lakhs per year in small and medium towns.**

- Source: Central Electricity Authority. (2023). All India Electricity Statistics - General Review. New Delhi: Ministry of Power, Government of India. Retrieved from https://cea.nic.in/wp-content/uploads/general/2023/GR_Final.pdf; Electricity department, Ichalkaranji Municipal Corporation – 2022 -2023; Electricity department, Vita Municipal council – 2022 – 2023; Electricity department, Karad Municipal Council – 2022 – 2023; * - approx. estimate based on common class factors derived based on electricity consumption across different class of cities in Maharashtra state.

Solar powered STPs / FSTPs and WTPs

- Solar panels have been installed at the FSTPs, STPs, WTPs, Water pumping locations, ESRs.
- Panels are placed on the existing available infrastructure.
- In some pilots, the solar power generated covers the entire electrical consumption for the maintenance and operations of these plants, with any surplus energy being sent back to the grid.

Wai FSTP – 30Kw

Ichalkaranji WTP– 81 Kw

Karad STP– 72 Kw

Sinnar FSTP – 15 Kw

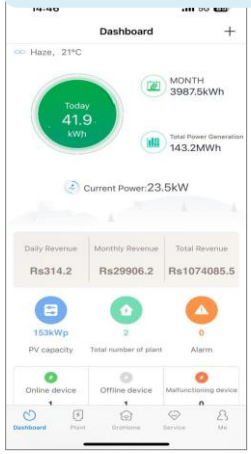
Vita FSTP and Pumping stations – 30 Kw

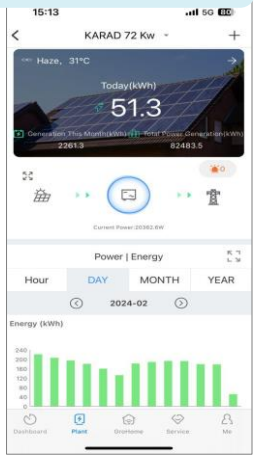
Satara FSTP – 30 Kw

Expanded FSTP of 30 KLD with green house solar dryer. Beautifying area around FSTP site

Energy transition for city level infrastructure to reduce CO2 emissions

Online monitoring system





Through our efforts

20 % reduction in dependency on conventional energy source of municipal services as per current usage.

Clean energy generated till July 2024

332 MWH

Clean energy generation potential over 25 years

8301 MWH

Emission reduction Potential over 25 years

6807 tons CO2

INR 6.25Cr saving Over 25 years

Through leveraged projects

- **280 Kw Solar park at Karad STP** : INR 2 Cr
- **800 Kw PPP Solar installation** at water and wastewater plant at Ichalkaranji under discussion : INR 4.2 Cr
- **10 Kw solar at Water pumping station** in Vita : INR 10 lakhs

Clean energy to be installed

1090 KW

Clean energy generation potential over 25 years

35,000+ MWH

Emission reduction Potential over 25 years

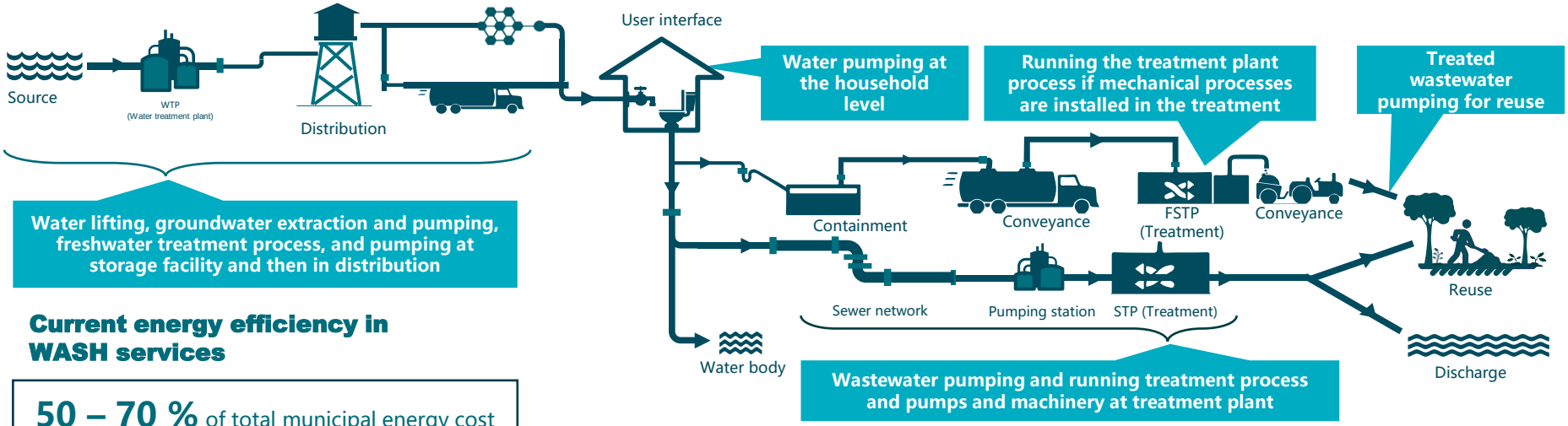
28,000+ tons CO2

INR 25 Cr saving Over 25 years

Energy audit can assist in improving energy efficiency across the WASH value chain

WASH energy consumptions are expected to be doubled by 2030

Sources of electricity consumption across the WASH services



Water lifting, groundwater extraction and pumping, freshwater treatment process, and pumping at storage facility and then in distribution

Wastewater pumping and running treatment process and pumps and machinery at treatment plant

Current energy efficiency in WASH services

50 – 70 % of total municipal energy cost is incurred in energy required for WASH service delivery

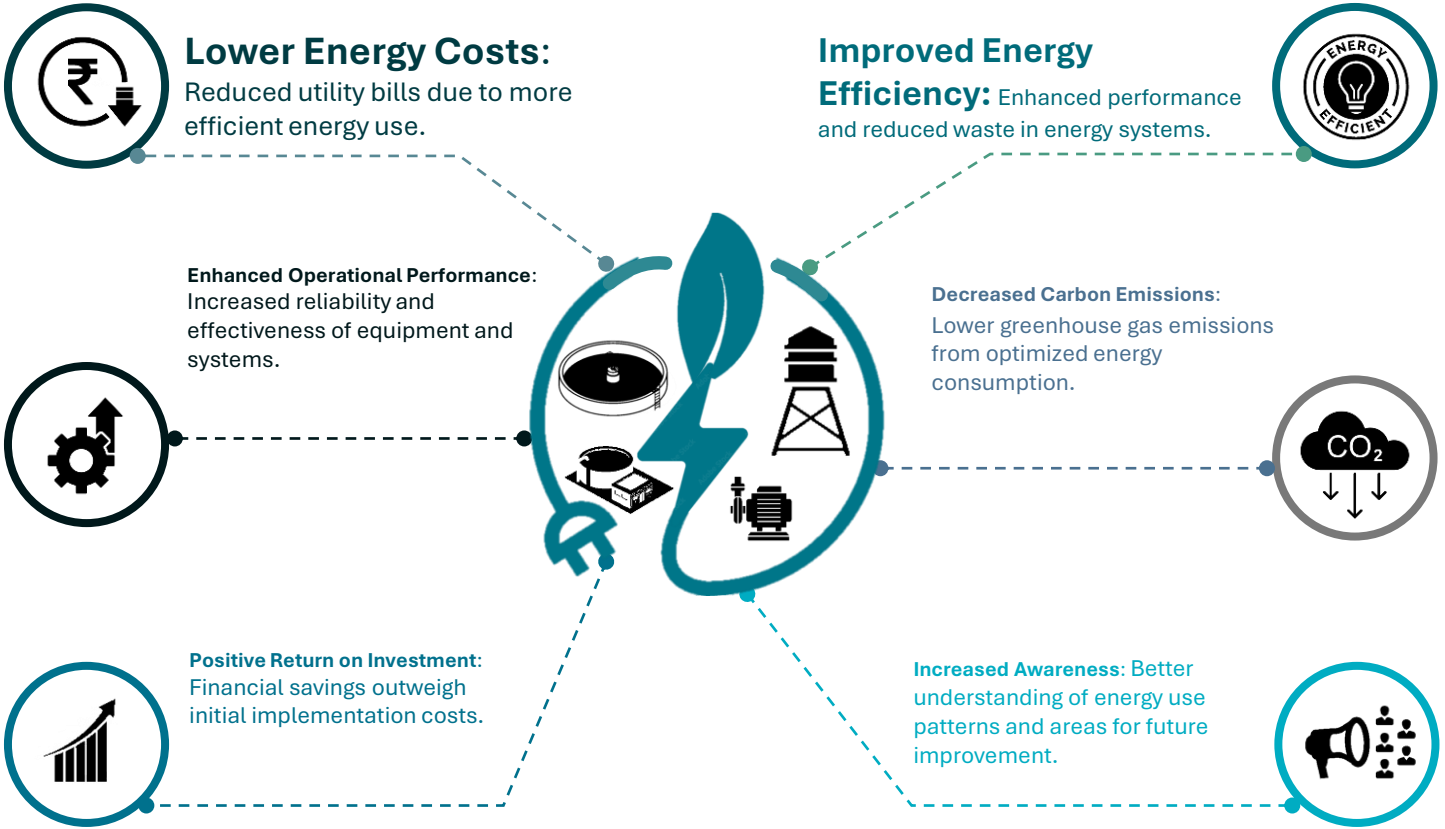
Energy use efficiency ranges between **40 to 80 %**

Reasons for higher energy cost

1. Poor efficiency of pumps
2. Poor daily O & M of pumps
3. Higher water NRW

Solution: An annual preliminary energy audit followed by a detailed energy audit with improvement in the WASH service delivery component with detailed action plan based on energy audit findings.

Impacts of carrying energy audits in WASH services



Urban forest (carbon sinks) at FSTP where treated wastewater is reused

- The treated wastewater is used to irrigate urban forests developed adjacent to treatment facilities.
- Urban forests involve planting saplings, primarily of local indigenous varieties, on clean land generally situated close to the FSTP/STP.
- Almost **19,764 Sq.mt**. barren area developed to urban forest in all the six cites with total **10,306 tree**s planted, and **80 million liters** of fresh water has been saved.

Scaling up practice and contributing the national goals

State level initiative

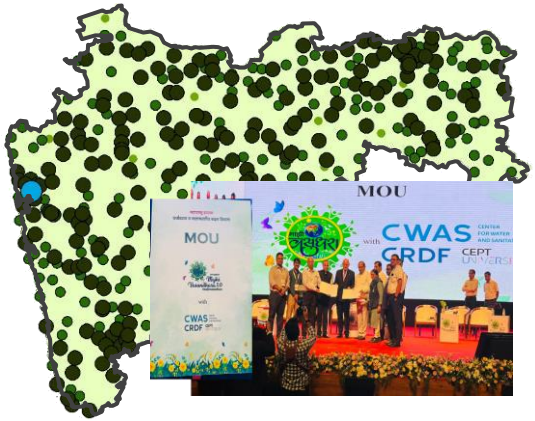
Majhi Vasundhara

A Maharashtra govt initiative for tackling climate change

In 2023, provided funding for **75 MW solar**

Climate mitigation funds

Exploring various financing sources in form of climate funds, mitigation funds and financing from multilaterals



417 cities in Maharashtra

CWAS has recently signed an MoU with Environment and Climate Change Department of Government of Maharashtra for supporting activities related to climate change and WASH under Majhi Vasundhara

Similar practice can be replicated in cities of global south, which can assist in improving the basic service delivery through using the clean sources of energy.

Help in moving towards targets of SDG

Source : https://majhivasundhara.in/en; https://mnre.gov.in/

Partnerships and Collaboration to attain Scale . . .

BILL & MELINDA GATES foundation

HSBC

Celebrating 10 years HT Parekh FOUNDATION

माझी वसुंधरा

Government of Maharashtra

एकच लक्ष्य शहरे स्वच्छ
स्वच्छ महाराष्ट्र अभियान (नागरी) २.०

वाई नगरपरिषद वाई, जि. सातारा W.M.C

सिन्नर नगरपालिका बहुजन हिताय बहुजन सुखाय स्थापना - १८६०

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Thank you

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About us

The Center for Water and Sanitation (C-WAS) at CEPT University carries out various activities – action research, training, advocacy to enable state and local governments to improve delivery of services.

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