Moving Towards Climate Resilient WASH

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Center for Water & Sanitation

Global South Academic Conclave on WASH and Climate 2025

21st - 23rd February 2025, Ahmedabad

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.**

Moving towards climate inclusive WASH services

Energy Transition

Nature Based Solutions

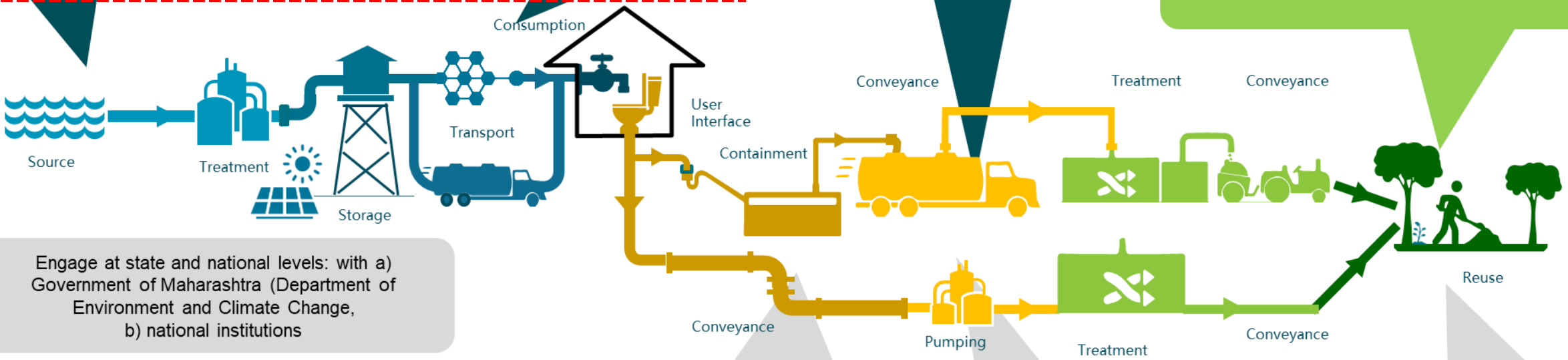
Inclusive services

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

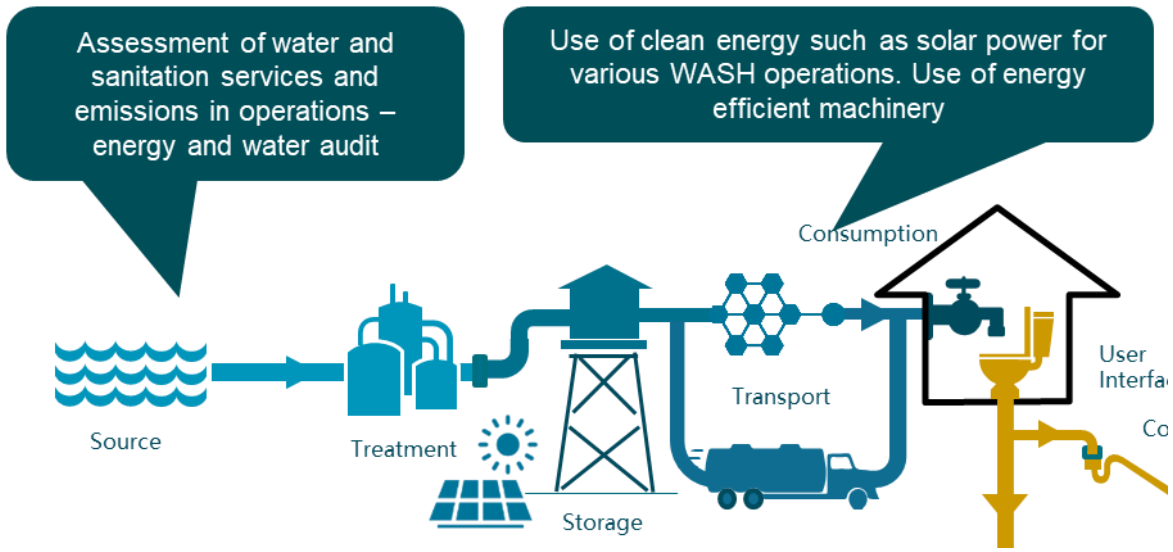
Technical support and capacity building for municipal staff

Transaction advisory support to ULBs

Action-research on emerging topics

Scaling up through partnership at statelevel

Energy Transition efforts broadly focused on energy audit and use of solar power for WASH operations



Energy Audit for WASH operations

- Assessment of electricity consumption for WASH operations
- Walk through energy audit mainly for pumps
- Recommendations on pump replacement
- Capacity strengthening of ULB officials

Solar powered WASH infrastructure

- Solar powered FTSPs/ STPs and WTPs
- Model PPP solar tender
- SHG engagement for maintenance of solar panels

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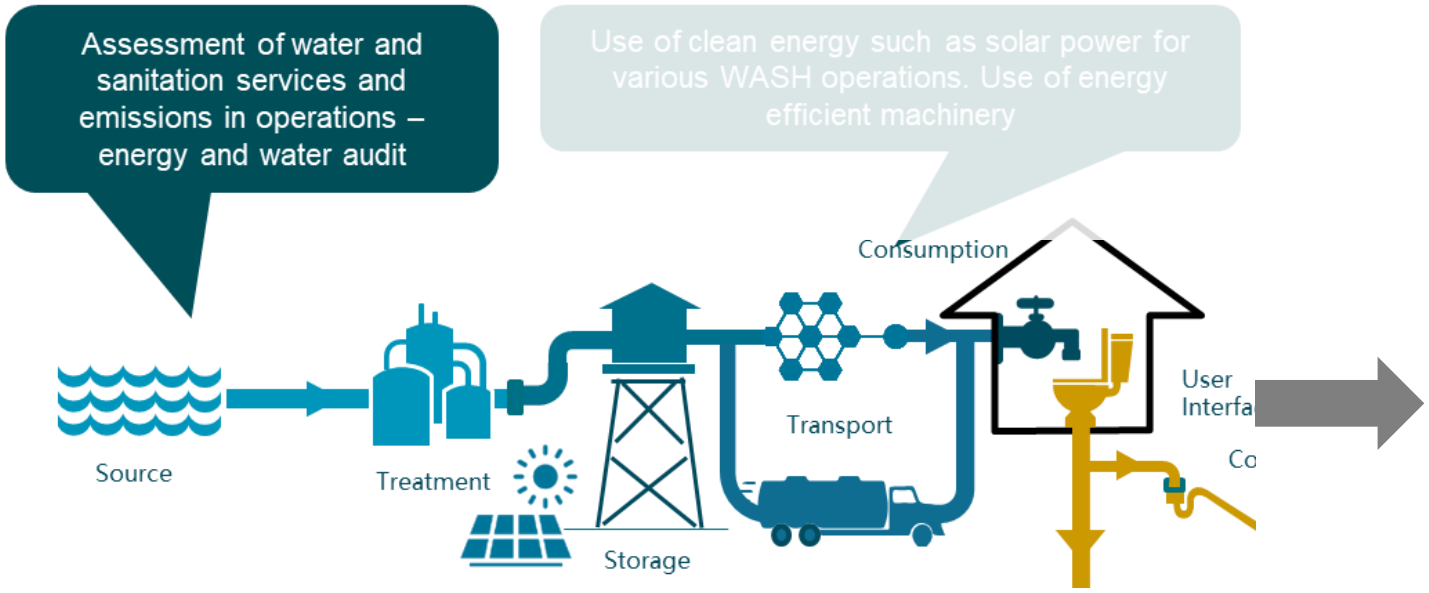

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Understanding Energy Audits & Addressing Energy Losses: Adopting the Walkthrough Method for Water and Sanitation services

WASH services contribute 40 to 90 % of total municipal energy consumption; Different classes of urban local bodies have different energy consumption patterns for various municipal services

An Energy Audit is a systematic assessment of an energy system to ensure optimal efficiency. It identifies energy usage patterns and savings opportunities in a building or plant, providing crucial insights for effective energy management.

Energy loss in industrial processes is inevitable, but its economic and environmental impact is significant. Improving energy efficiency reduces losses, as higher losses lead to lower efficiency.

Release of green house gases resulting in global warming

Objective is to conduct a walkthrough energy audit to identify opportunities for energy efficiency and areas of energy wastage within the Water and Sanitation value chain.

Energy savings directly linked to de-carbonisation, be it electricity or any carbon-emitting fuels"

METHODS TO CONDUCT ENERGY AUDIT

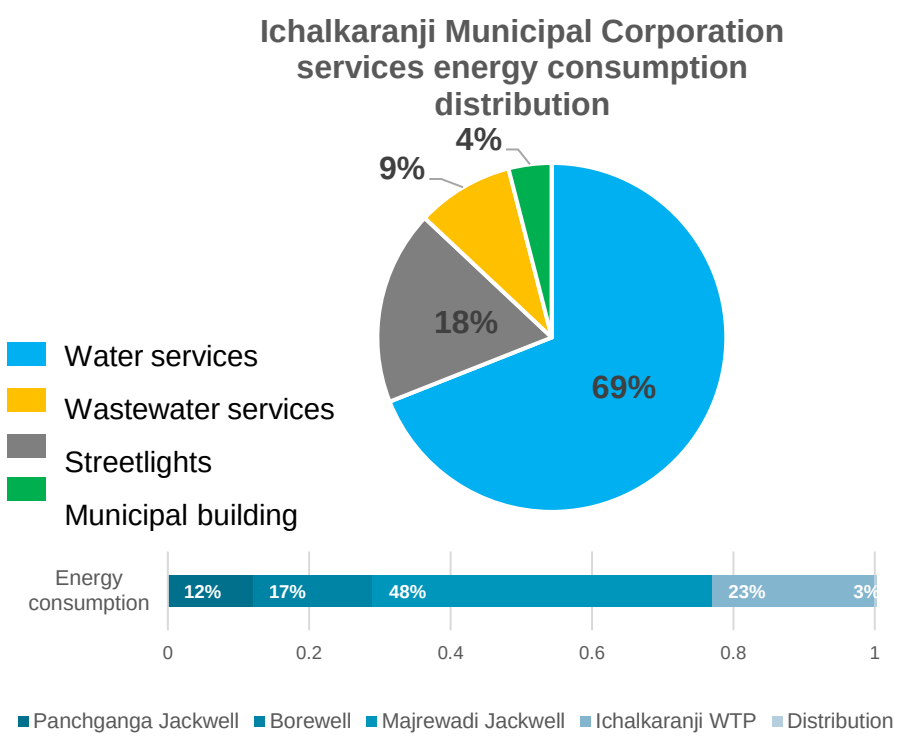
WALK-THROUGH ENERGY AUDITS

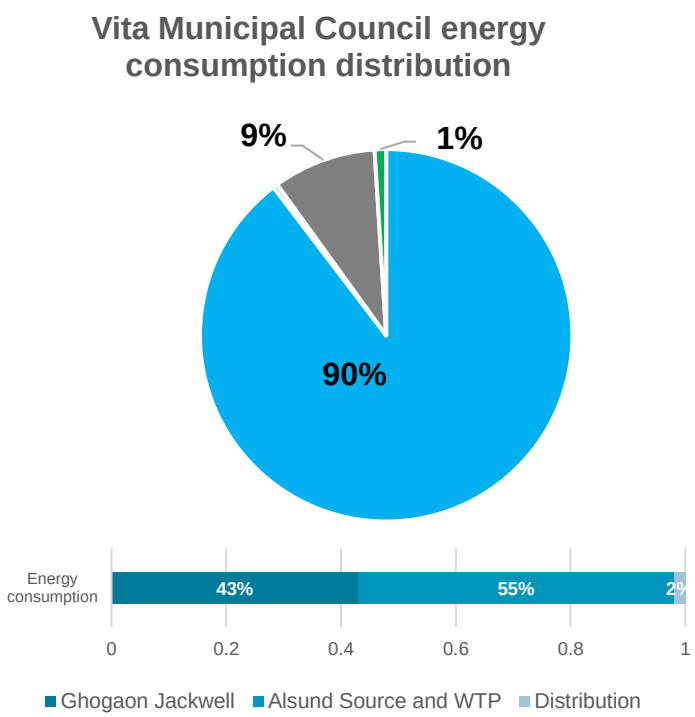
TARGET ENERGY AUDITS

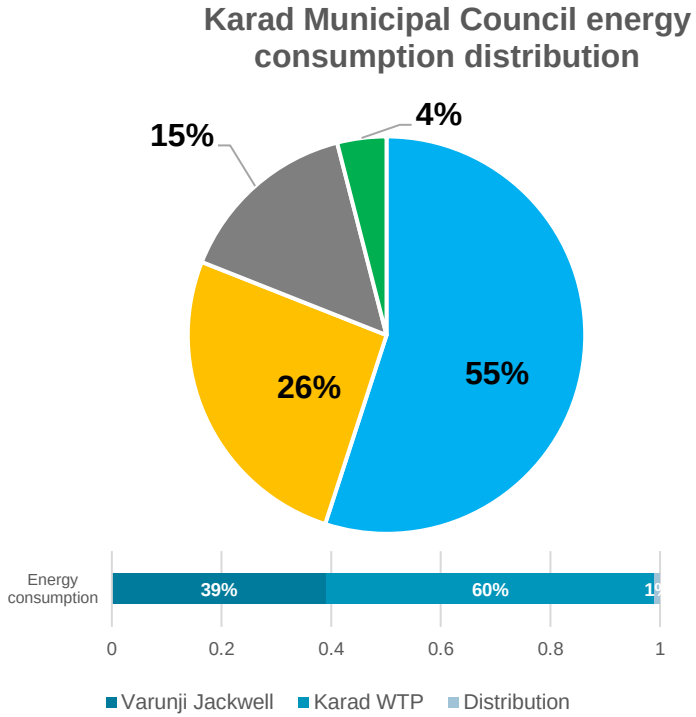
DETAILED ENERGY AUDITS

The Walk-Through Survey audit analyzes energy bills, visits the facility, and interviews key decision-makers. It provides a report on energy usage, a benchmark, and recommendations for cost-effective energy efficiency improvements.

Approach: Assessment of energy consumption for municipal service delivery done for Ichalkaranji, Vita and Karad







Water supply and sanitation systems are major users compared to energy usage by other municipal facilities

The reasons for having high energy consumption were identified such as

Distance of water sources	Poor electrical units (pumps) efficiency	Higher NRW and water losses

Source : Ichalkaranji Municipal Corporation – 2022 -2023; Vita Municipal council – 2022 – 2023; Karad Municipal Council – 2022 – 2023

Approx NRW is 25.5 % in nagar panchayats of Maharashtra.

Lessons learnt: Enhancing pump efficiency and SOP trainings

Energy audits highlight how pump replacement or maintenance reduces costs and energy use in water and sanitation systems

Ichalkaranji:
The water supply system consumes **1000+ MWh/month** (₹82L), while sanitation **uses 140+ MWh/month (₹16L).** **Pump efficiency is below 50%**, and replacements can **cut energy use, improve efficiency, and reduce costs**. **Trained personnel** are crucial for optimal pump operations.

Karad:
Water supply consumes **230+ MWh/month** (₹18L) with **<40% pump efficiency**; replacements can **boost efficiency and cut costs**. Sanitation uses **105 MWh/month** (₹13L), with **pumping stations at just 10% efficiency**, requiring upgrades for savings.

Vita:
Water supply consumes **657+ MWh/month** (₹54L) with **<45% pump efficiency**; replacements can **improve efficiency and reduce costs**. Onsite sanitation uses minimal electricity, but **desludging vehicles consume 800–1000L diesel/year**; fuel use can be **cut through maintenance and route optimization**.

- **3 cities**
- **More than 30+ Pumps assessed**

Total cost for replacement of 25 pumps for all 3 cities is 8 Cr which would lead to a saving of 15 Cr

Standard Operating Procedure Training Workshop on Pump Operations – Key Highlights

- **Workshop Objective:** The SOP training aimed to equip ULB engineers and pump operators with practical knowledge to improve pump efficiency and optimize daily operations.
- **Energy Audit Insights:** Preliminary energy audits in Vita, Karad, and Ichalkaranji highlighted the critical role of pump efficiency in energy savings for water and sanitation infrastructure.
- **Key Takeaways:** Participants learned how pump efficiency directly impacts energy conservation, sustainability, and cost-effectiveness of water and sanitation services.
- **Organizing Partners:** The workshop was conducted by CWAS, CRDF, CEPT University, Majhi Vasundhara, and Ichalkaranji Municipal Corporation, in collaboration with **Kirloskar Brothers Ltd.**

Recommendations for better Energy Efficiency: Cost & Savings Analysis

	Vita	Karad	Ichalkaranji
	6 pumps replacement and **install APFC** Panel at the water supply source	**13** pumps replacement across water & sanitation chain	**6** pumps replacement across water & sanitation chain & APFC Panel installation
	Cost of Pump Replacement and APFC panel **Rs. 64 Lakhs**	Cost of Pump Replacement **Rs. 5 Crore**	Cost of Pump Replacement **Rs. 2.8** Crore
	Estimated energy saving per year **Rs.48 Lakhs**	Estimated energy saving per year **Rs.13 Crore**	Estimated energy saving per year **Rs.2 Crore**

Why Pump Replacement Costs and Energy Savings Differ Across Cities

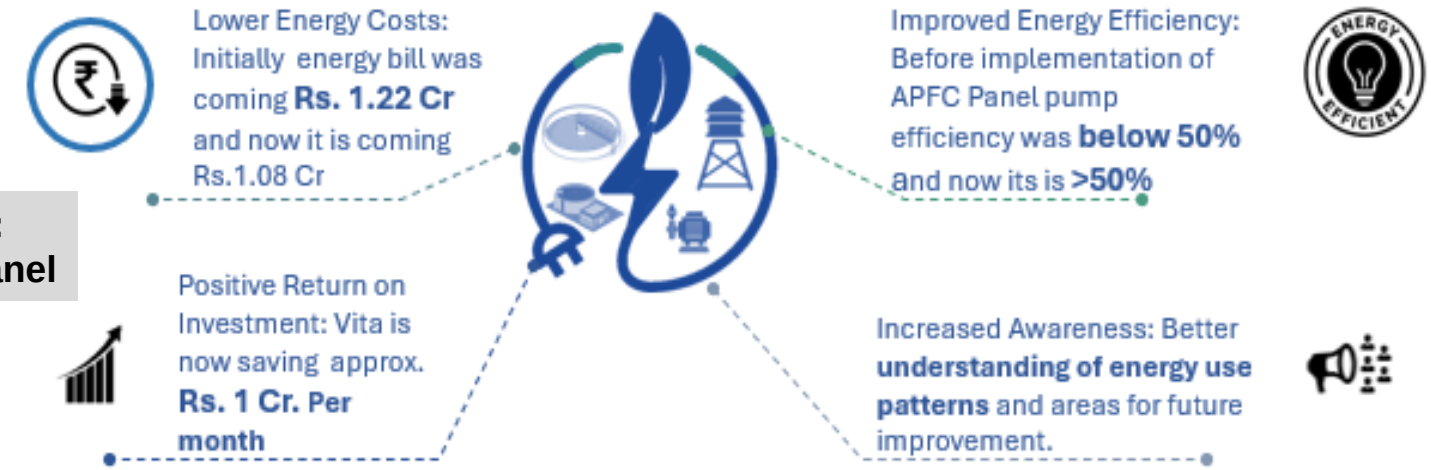
The cost and energy savings from pump replacement vary due to key operational factors such as **total dynamic head, distance from the water source, and system efficiency**:

- **Vita:** The water source is **45 km away**, with a high head of **190m**, leading to greater energy consumption. Due to these constraints, **pump replacement costs ₹64 lakh, yielding energy savings of ₹47 lakh annually**.
- **Karad:** The water source is just **5 km away**, with a lower head, allowing for efficient energy use. While the **pump replacement cost is ₹5 crore, the energy savings are ₹13 crore annually**, justifying the higher investment.
- **Ichalkaranji:** With a **98m head and 18 km distance**, the system operates more efficiently than Vita but requires improvements.

The **higher head and longer distance in Vita** increase energy demand, making APFC panels a quick-win solution. In contrast, Karad's **lower head and distance enable high returns from pump replacement** despite the higher upfront cost.

Impacts: Improvements in energy efficiency, case of Vita city

Recommendation 1: Installation of APFC Panel



APFC Panel installed at water supply source & WTP

- **APFC (Automatic Power Factor Correction) panels installed at two locations** improved pump efficiency, saving **₹14 lakh/month** with a **payback of 2-3 months** on a **₹35 lakh investment**.
- Instead of pump replacement, **APFC panels corrected power factor (PF)** from **0.83 to 0.99**, reducing **penalty charges**. Previously, ULB paid **₹1.06 lakh in excessive demand charges**, which has now reduced to **₹16,470** post-installation.
- This **cost-effective solution** optimizes power usage and eliminates penalties.

Recommendation 2: Replacing Pump

- **Replacement of 20 HP pump** with 45% efficiency at FSTP, saving **₹61,000 per year** with payback period of 15-17 months

Photo of vita fstp pump to be added

Installing an **APFC panel is a faster, cost-effective**, and system-wide solution for energy savings. **Pump replacement** is necessary only when pump inefficiency is a major contributing factor to excessive energy consumption

Potential Scale Up ideas for conducting Energy audits for WASH

Replicability of Energy Audit Study

1.DIY Energy Audit Tool: A simple tool is being developed by CWAS to help ULB engineers conduct **preliminary energy audits** independently.

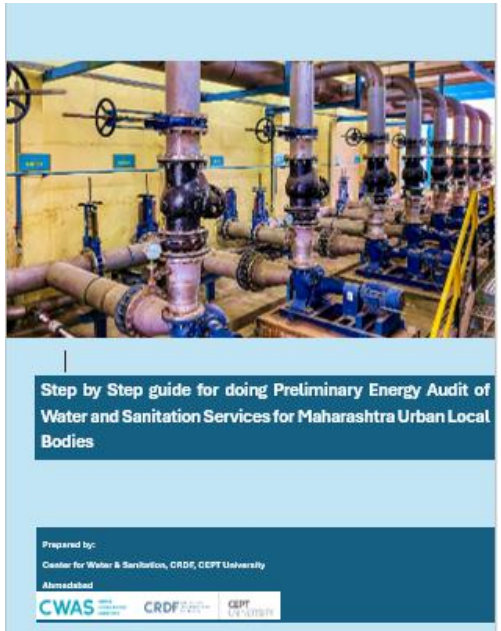
2.ULB Capacity Building: Training workshops have enhanced engineers' skills, ensuring **continuous internal assessments** for energy efficiency.

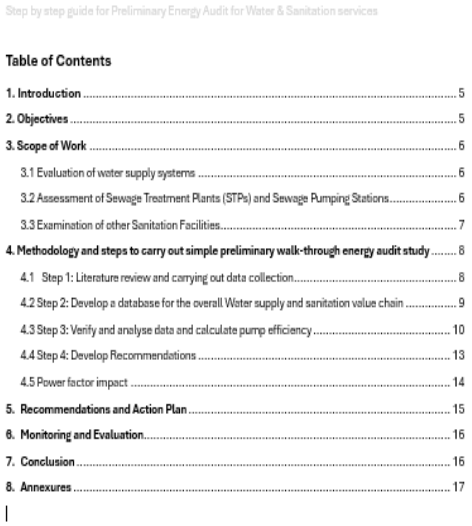
3.Standardized Approach: The methodology used in Vita, Karad, and Ichalkaranji can be **replicated in other ULBs**, enabling structured energy audits across cities.

Scalability of Energy Audit Study

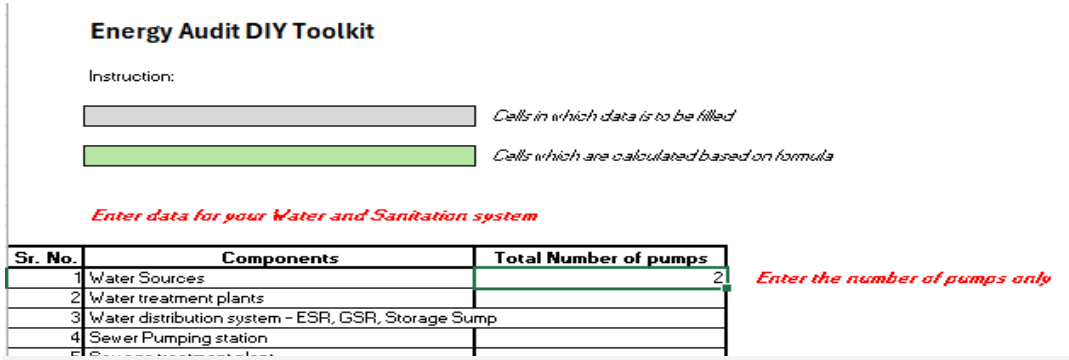
1.Statewide Implementation: The DIY tool will be introduced across **multiple ULBs**, making energy audits a **standard practice** in municipal operations.

2.MEDA Partnership for GR Compliance: Partnering with **MEDA (**Maharashtra Energy Development Agency) **- empanelled agencies** allows ULBs to conduct **detailed audits** and access funding under the **2017 GR**, ensuring large-scale adoption.



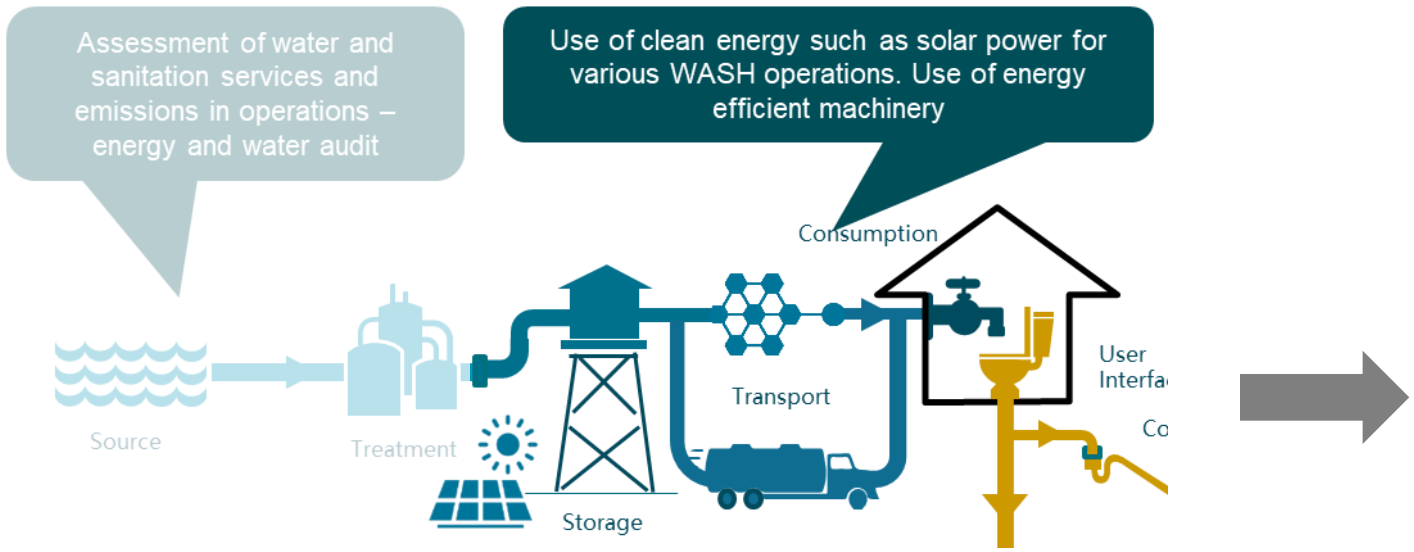


Energy Audit Guideline document



Simple energy audit excel tool

Energy Transition efforts broadly focused on energy audit and use of solar power for WASH operations



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Approach: Energy transition to 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

Satara FSTP – 30 Kw

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

Vita FSTP and Pumping stations – 30 Kw

Learnings : Proper maintenance and online monitoring are crucial to ensure efficiency of solar panels

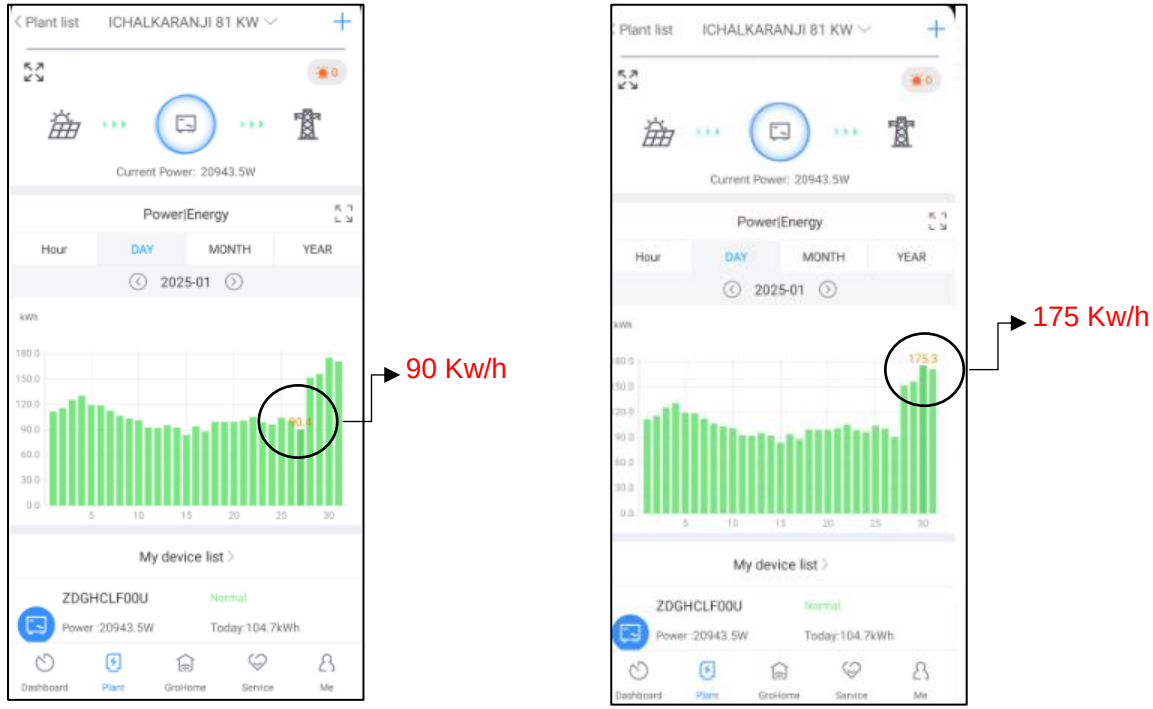
Online monitoring

- Net metering systems installed at each facility to measure electricity generation from solar panels.
- Online monitoring app provided for real-time tracking of system performance and efficiency.
- Enables continuous monitoring and optimization of energy usage by the cities.

Maintenance of solar panel

- **Regular Maintenance**: Solar panel efficiency is directly linked to proper upkeep.
- **Dust & Debris Impact**: Accumulation of dust, grit, and bird droppings reduces power generation.
- **Cleaning Accessibility**: Ensure panels are easy to reach for regular maintenance.
- **Water Supply**: A reliable water source is necessary for effective cleaning.

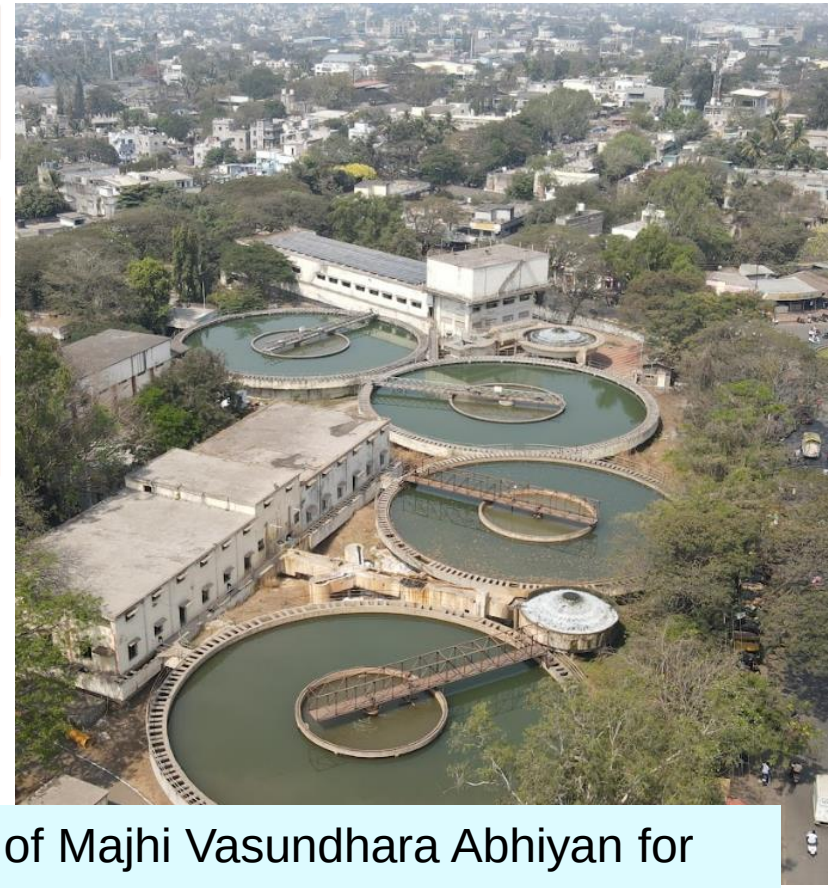
Formal SHG engagement for maintenance of the solar panels on all ULB WASH infrastructure is under progress. A model SHG contract has also been drafted for the same.



Innovative practices : Model tender for Public-Private Partnership (PPP) engagement for solar at WASH infrastructure facility.

The model **performance-based solar** PPP tender aims to establish a solar power plant at public infrastructure within a city. The city incurs **no upfront capital costs** and pays only for the electricity generated. Under this model, a private operator finances **both CAPEX and OPEX** while handling the design, installation, and operations & maintenance (O&M) for a period of 10 years or above or as decided by the city.

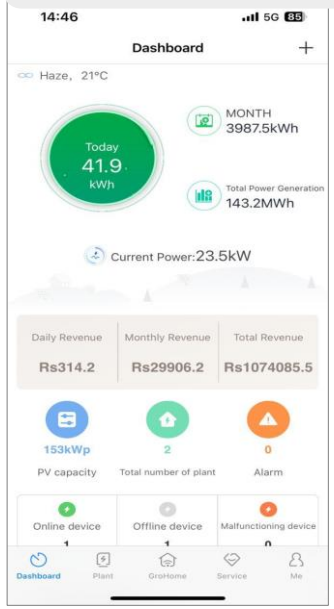
Financial Features	Operations and system Monitoring	Other clauses
No capital investment and formation of escrow account	Online monitoring systems to track performance of solar systems	Dispute Resolution
Payment based on performance of solar system	Minimum performance guarantee	Cost escalation
Payment security mechanisms	Operation and Maintenance and transfer with appropriate training	
Environment or sustainability objectives		

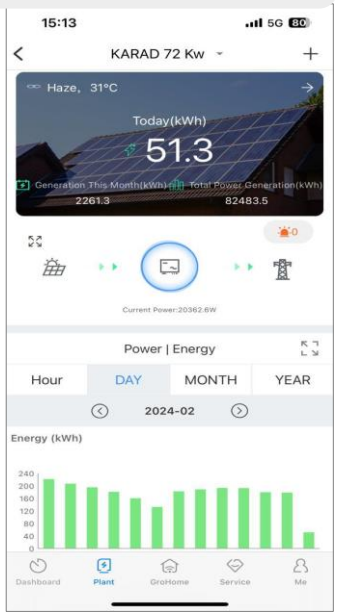


Scaleup : The model PPP solar tender has been submitted to the mission office of Majhi Vasundhara Abhiyan for statewide scaleup.

Scale up at city level : Energy transition through solar power led scaled up by cities

Online monitoring system





Through pilot efforts

IMC: 103 kW at WTP
Vita: 22 kW at Pumphouse and 8 kW at shed of FSTP
Karad: 72 kW at shed of SWM site

Total : 265 Kw

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

Clean energy generated till Feb 2025
337 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 cityside leveraged projects by ULB

IMC: 800 kW at WTP, auditorium and stadium
Vita: 10 kW at pumphouse.
Karad: 760 kW at STP and SWM site

Total : 1490 Kw

6 times

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

Scale up at State and National level: Scaling up practice and contributing the national goals

State level initiative

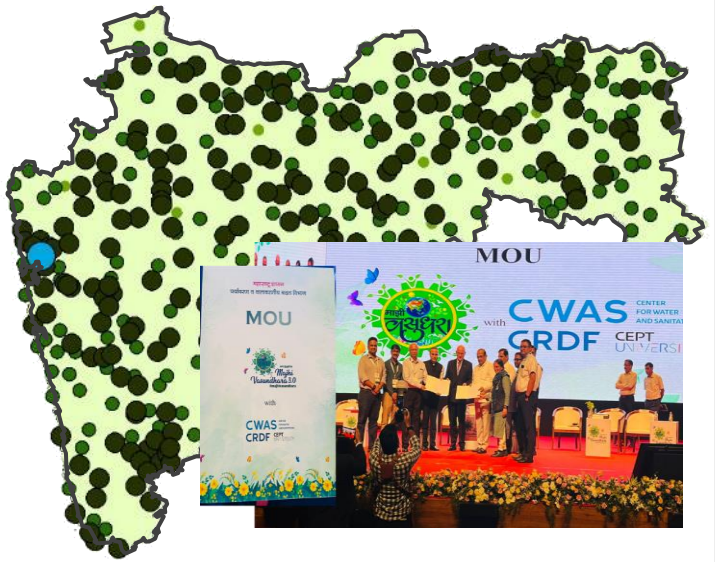
Majhi Vasundhara

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

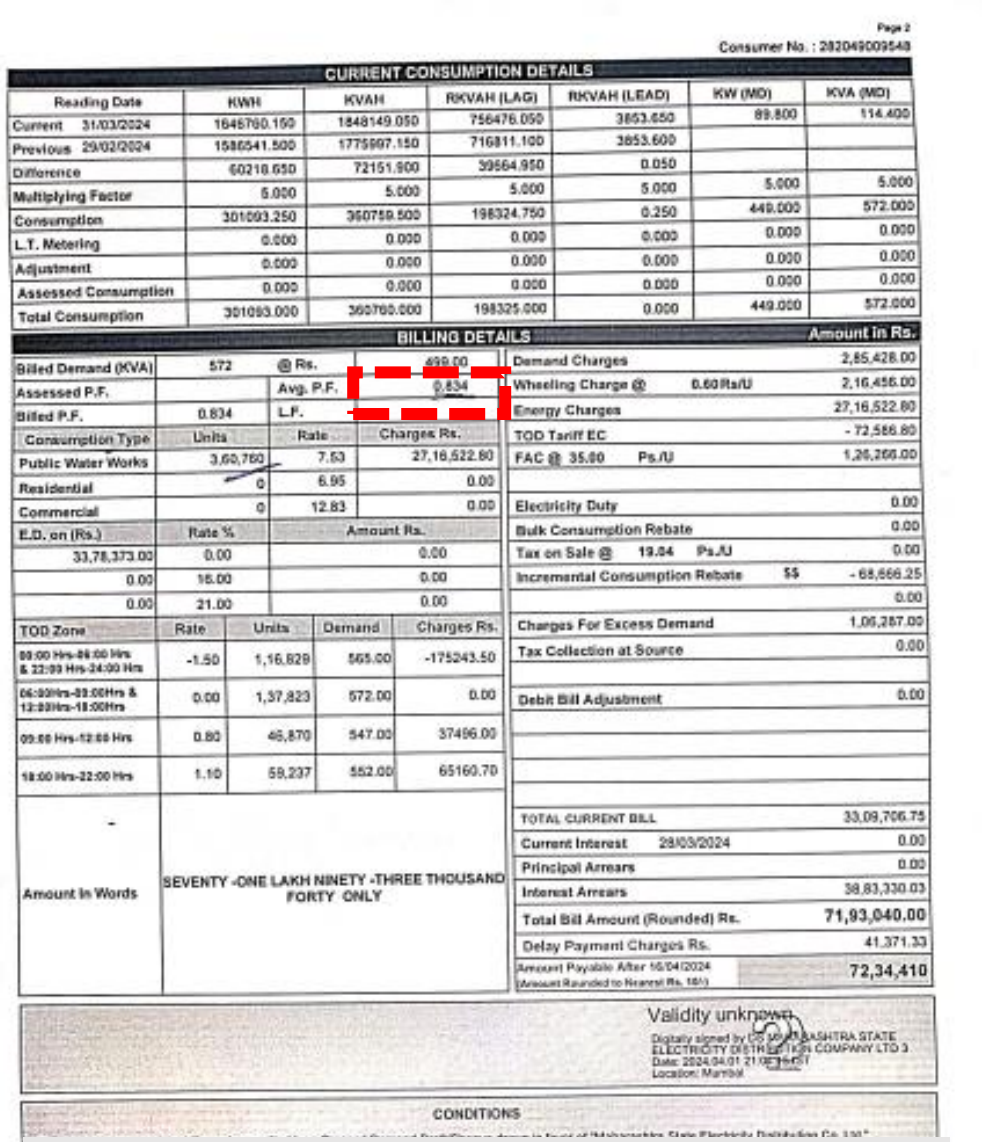
Source : https://majhivasundhara.in/en; https://mnre.gov.in/

Thank You

Global South Academic Conclave on WASH and Climate 2025

CWAS CENTER FOR WATER AND SANITATION
CRDF CEPT UNIVERSITY
CEPT UNIVERSITY FACULTY OF PLANNING
Gates Foundation
viega foundation

Vita Energy Bills



Page 2

Consumer No. : 282049009548

CURRENT CONSUMPTION DETAILS

Reading Date	KWH	KVAH	RKVAH (LAG)	RKVAH (LEAD)	KW (MD)	KVA (MD)
Current 31/03/2024	1846700.150	1848149.050	756476.050	3853.650	89.800	114.400
Previous 29/02/2024	1586541.500	1775997.150	716811.100	3853.600		
Difference	60218.650	72151.900	39664.950	0.050		
Multiplying Factor	5.000	5.000	5.000	5.000	5.000	5.000
Consumption	301093.250	360759.500	198324.750	0.250	449.000	572.000
L.T. Metering	0.000	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000	0.000	0.000	0.000
Assessed Consumption	0.000	0.000	0.000	0.000	0.000	0.000
Total Consumption	301093.000	360760.000	198325.000	0.000	449.000	572.000

BILLING DETAILS — Amount in Rs.

Billed Demand (KVA)	572	@ Rs.	499.00
Assessed P.F.		Avg. P.F.	0.834
Billed P.F.	0.834	L.F.	

Consumption Type	Units	Rate	Charges Rs.
Public Water Works	3,60,760	7.53	27,16,522.80
Residential	0	6.95	0.00
Commercial	0	12.83	0.00

E.D. on (Rs.)	Rate %	Amount Rs.
33,78,373.00	0.00	0.00
0.00	16.00	0.00
0.00	21.00	0.00

TOD Zone	Rate	Units	Demand	Charges Rs.
00:00 Hrs-06:00 Hrs & 22:00 Hrs-24:00 Hrs	-1.50	1,16,829	565.00	-175243.50
06:00Hrs-09:00Hrs & 12:00Hrs-18:00Hrs	0.00	1,37,823	572.00	0.00
09:00 Hrs-12:00 Hrs	0.80	46,870	547.00	37496.00
18:00 Hrs-22:00 Hrs	1.10	59,237	552.00	65160.70

Amount In Words	SEVENTY -ONE LAKH NINETY -THREE THOUSAND FORTY ONLY

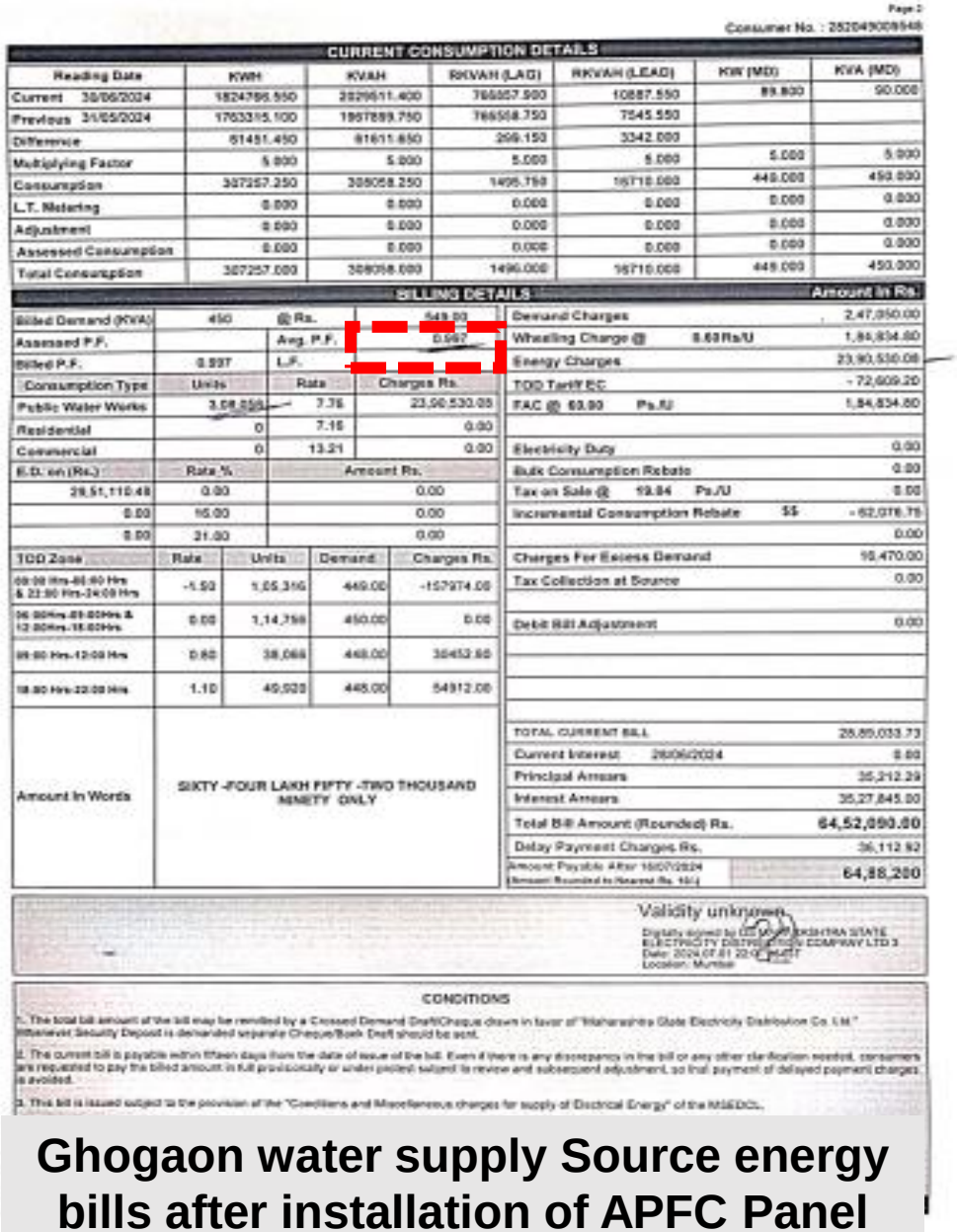
Demand Charges	2,85,428.00
Wheeling Charge @ 0.60Rs/U	2,16,456.00
Energy Charges	27,16,522.80
TOD Tariff EC	- 72,586.80
FAC @ 35.00 Ps./U	1,26,266.00
Electricity Duty	0.00
Bulk Consumption Rebate	0.00
Tax on Sale @ 19.04 Ps./U	0.00
Incremental Consumption Rebate $$	- 68,666.25
	0.00
Charges For Excess Demand	1,06,287.00
Tax Collection at Source	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	33,09,706.75
Current Interest 28/03/2024	0.00
Principal Arrears	0.00
Interest Arrears	38,83,330.03
Total Bill Amount (Rounded) Rs.	71,93,040.00
Delay Payment Charges Rs.	41,371.33
Amount Payable After 16/04/2024 (Amount Rounded to Nearest Rs. 10/-)	72,34,410

Validity unknown

Digitally signed by CO MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD 3
Date: 2024.04.01 21:06:28 IST
Location: Mumbai

CONDITIONS

Ghogaon water supply Source energy bills before installation of APFC Panel



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Current 30/06/2024	1824795.550	2329511.400	785857.900	10887.550	89.800	90.000
Previous 31/05/2024	1763315.100	1987889.750	769568.750	7545.550		
Difference	61481.450	61611.650	269.150	3342.000		
Multiplying Factor	5.000	5.000	5.000	5.000	5.000	5.000
Consumption	307257.250	308058.250	1495.750	16710.000	449.000	450.000
L.T. Metering	0.000	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000	0.000	0.000	0.000
Assessed Consumption	0.000	0.000	0.000	0.000	0.000	0.000
Total Consumption	307257.000	308058.000	1496.000	16710.000	449.000	450.000

BILLING DETAILS — Amount in Rs.

Billed Demand (KVA)	450	@ Rs.	649.00
Assessed P.F.		Avg. P.F.	0.997
Billed P.F.	0.997	L.F.	

Consumption Type	Units	Rate	Charges Rs.
Public Water Works	3,08,000	7.78	23,90,530.05
Residential	0	7.78	0.00
Commercial	0	13.21	0.00

E.D. on (Rs.)	Rate %	Amount Rs.
28,51,110.48	0.00	0.00
0.00	16.00	0.00
0.00	21.00	0.00

TOD Zone	Rate	Units	Demand	Charges Rs.
00:00 Hrs-06:00 Hrs & 22:00 Hrs-24:00 Hrs	-1.50	1,05,316	449.00	-157974.00
06:00Hrs-09:00Hrs & 12:00Hrs-18:00Hrs	0.00	1,14,756	450.00	0.00
09:00 Hrs-12:00 Hrs	0.80	38,068	448.00	30452.80
18:00 Hrs-22:00 Hrs	1.10	40,928	448.00	54912.00

Amount In Words	SIXTY -FOUR LAKH FIFTY -TWO THOUSAND NINETY ONLY

Demand Charges	2,47,950.00
Wheeling Charge @ 0.60Rs/U	1,94,834.60
Energy Charges	23,90,530.05
TOD Tariff EC	- 72,609.20
FAC @ 63.00 Ps./U	1,84,834.80
Electricity Duty	0.00
Bulk Consumption Rebate	0.00
Tax on Sale @ 19.04 Ps./U	0.00
Incremental Consumption Rebate $$	- 62,076.75
	0.00
Charges For Excess Demand	16,470.00
Tax Collection at Source	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	28,80,033.73
Current Interest 28/06/2024	0.00
Principal Arrears	35,212.29
Interest Arrears	35,27,845.00
Total Bill Amount (Rounded) Rs.	64,52,090.00
Delay Payment Charges Rs.	36,112.92
Amount Payable After 16/07/2024 (Amount Rounded to Nearest Rs. 10/-)	64,88,200

Validity unknown

Digitally signed by CO MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD 3
Date: 2024.07.01 22:04:27 IST
Location: Mumbai

CONDITIONS

Ghogaon water supply Source energy bills after installation of APFC Panel

- Power factor before installation of APFC Panel: **0.834**
- Power factor after installation of APFC Panel: **0.997**

Installation of APFC Panel

- In Vita, **APFC panels were installed at two locations** to enhance pump energy efficiency, resulting in **monthly savings of ₹14.05 lakh** for the municipal council. The total investment of **₹35 lakh** had a **payback period of just 2-3 months**.
- Instead of replacing pumps, **APFC panel installation was preferred** as it not only improves efficiency but also corrects the **power factor (PF)**. At one location, the PF improved from **0.834 to 0.997**, reducing **power factor penalty charges**.
- Previously, Vita council paid **₹1.06 lakh in excessive demand charges**, which has now reduced to **₹16,470** post-installation.
- Thus, **APFC panels offer a quick, cost-effective, and system-wide solution** for energy savings while eliminating penalties and optimizing power usage.