जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION

Bureau of Water Use Efficiency
Ministry of Jal Shakti

National Water Mission
Ministry of Jal Shakti

Compendium on Best Practices

on Water Use Efficiency by Industries

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C R Paatil

सत्यमेव जयते

जल शक्ति मंत्री
भारत सरकार
Minister of Jal Shakti
Government of India

Message

Water is one of the most valuable natural resources sustaining life, ecosystems, and economic development. In India, where growing population, rapid urbanization, and expanding industrial activities are increasing the demand for water, its conservation and efficient management have become critical national priorities. With limited freshwater resources available to support a large and dynamic economy, improving water-use efficiency and promoting responsible water management practices across sectors particularly in industry - has become the need of the hour.

The industrial sector plays a vital role in India's economic growth, manufacturing capability, and employment generation. However, many industrial processes depend heavily on water for operations such as cooling, processing, cleaning, and energy production. As industrial activity continues to expand, it is essential that industries adopt strategies that minimize freshwater consumption while maximizing productivity.

Encouragingly, several industries across the country have already demonstrated that the adoption of modern water-saving technologies and improved operational practices can lead to substantial reductions in water consumption. Technologies such as advanced cooling systems, zero liquid discharge (ZLD) systems, membrane filtration, reverse osmosis, wastewater treatment and reuse, automated monitoring systems, and process water recycling have proven highly effective in optimizing water use within industrial facilities.

The practices presented in this compendium demonstrate that water conservation is not only an environmental responsibility but also an opportunity for industries to improve operational efficiency, reduce costs, and strengthen long-term resilience. Many of these interventions are scalable, replicable, and adaptable to diverse industrial conditions across the country.

I am optimistic that the compendium will emerge as a reference source to the policy makers, industrialist and many more who aspire to contribute towards water conservation efforts for the well-being of the nation.

C R PAATIL

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वी. सोमण्णा
V. Somanna

सत्यमेव जयते

केंद्र रೈಲ್ವೆ ಮತ್ತು ಜಲ ಶಕ್ತಿ
ರಾಜ್ಯ ಖಾತೆ ಸಚಿವರು
ಭಾರತ ಸರ್ಕಾರ
रेल एवं जल शक्ति राज्य मंत्री
भारत सरकार
Minister of State of
Railways and Jal Shakti
Government of India

Foreword

Water is an indispensable natural resource that supports human well-being, economic productivity, and ecological balance. In a rapidly developing country like India, the availability and sustainable management of water resources have become critical to maintaining the momentum of growth and development.

Over the decades, per capita water availability has declined considerably, highlighting the urgent need to manage water more efficiently and sustainably. In this scenario, improving water-use efficiency and minimizing the reliance on freshwater sources have become essential national priorities.

India has already taken important steps toward strengthening water governance through initiatives under the National Water Mission. A key objective of the Mission is to enhance water-use efficiency across sectors. Within this framework, the promotion of efficient water use practices in industries is particularly significant, as it offers substantial potential for conserving water and reducing operational costs.

This compendium presents valuable insights into innovative approaches that have resulted in measurable improvements in water-use efficiency. It compiles successful case studies and practical experiences from various industrial sectors, as provided by the respective industry associations.

I believe that this compendium will serve as a useful reference for industry leaders, policymakers, and practitioners seeking to implement effective water management solutions. The practices highlighted here can be replicated or adapted according to local conditions, thereby enabling industries across the country to adopt efficient and sustainable water-use strategies.

(V. Somanna)

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Dr. Raj Bhushan Choudhary

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भारत सरकार
नई दिल्ली-110001
MINISTER OF STATE FOR JAL SHAKTI
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FOREWORD

Water sustains life, powers industry, and underpins the prosperity of nations. For a country like India - home to nearly 18 percent of the world's population but endowed with only about 4 percent of global freshwater resources - the responsible management of water is both a necessity and a strategic priority. As India continues its journey toward becoming a global economic powerhouse and realizing the vision of *Viksit Bharat by 2047*, ensuring efficient and responsible use of water across all sectors is of paramount importance.

Increasing urbanization, climate variability and competing sectoral demands are further intensifying pressure on available freshwater resources. In this context, enhancing water-use efficiency and promoting responsible water management across industries is not merely desirable - it is the call of the hour.

The industrial sector is a key engine of economic growth, employment generation, and technological progress. At the same time, it accounts for a substantial share of freshwater withdrawals for manufacturing processes, cooling, cleaning and other operational needs. Improving water-use efficiency in industrial operations therefore presents a major opportunity to reduce freshwater consumption while maintaining productivity and competitiveness.

In particular, it seeks to encourage industries to adopt efficient water management strategies that reduce wastage, increase recycling and reuse and enhance overall operational efficiency.

As India moves forward on its path of sustainable development, the role of industries in conserving and managing water resources responsibly will be pivotal. This compendium serves not only as a repository of knowledge but also as a catalyst for collective action - encouraging industries to adopt efficient practices.

I hope the best practices depicted in this compendium encourage everyone to think innovatively towards sustainable water use efficiency practices in India. By embracing the principles of water use efficiency we can ensure that every drop of water is valued and utilized judiciously.

(Dr. Raj Bhushan Choudhary)

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जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION

Message

Water is the foundation of life and a vital driver of economic growth, social well-being, and environmental sustainability. In India, rapid industrialization and urban expansion have significantly increased pressure on limited water resources, making efficient and responsible water use a national priority.

Across industrial sector, rising water demand underscores the urgent need for water-efficient technologies, process optimization, reuse and recycling practices, and data-driven decision-making to secure India's water future.

Water conservation is at the core of the **National Water Mission**, with one of its key objectives being the improvement of water-use efficiency by at least **20 percent**. This goal is particularly important for the industrial sector, which plays a crucial role in national development while also accounting for significant freshwater consumption.

In this context, **Bureau of Water Use Efficiency (BWUE)** under the **National Water Mission** promotes sustainable water management through water use efficiency improvement, and equitable use across sectors. As industrial operations expand and supply chains become more complex, efficient water management has become not only an environmental responsibility but also a strategic business necessity enhancing resilience, reducing costs, and supporting long-term sustainability.

Against this backdrop, the efforts of the Bureau of Water Use Efficiency in compiling this *Compendium of Best Practices on Water Use Efficiency*, based on inputs provided by industry associations, are both timely and significant.This publication serves as a practical guide for industries and other stakeholders, supporting water audits, promoting efficient water-use practices, and enabling the implementation of targeted, high-impact interventions. It reflects a strong commitment to innovation, continuous improvement, and the sharing of actionable knowledge adaptable across diverse industrial sectors.

By adopting best practices in water-use efficiency and integrating them into industrial operations, we can collectively build a future where every drop of water is valued, responsibly managed, and conserved for generations to come- honoring water as the life-giving resource it truly is. The interventions discussed can be replicated under Indian conditions or can be customized to suit the local present conditions to attain best outcomes.

(V. L. Kantha Rao)

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जल शक्ति मंत्रालय/MINISTRY OF JAL SHAKTI
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
DEPTT. OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
राष्ट्रीय जल मिशन/NATIONAL WATER MISSION

Message

Efficient management of water resources has emerged as a critical requirement for sustaining industrial growth in India. With increasing water stress, regulatory expectations, and the need for operational resilience, industries are required to adopt systematic approaches to optimize water use while maintaining productivity and competitiveness. Under the Prime Minister's vision of "Viksit Bharat 2047", a water-secure India would ensure, sustainable groundwater management, and industrial water-use efficiency through reuse and recycling.

To support this effort, the **Bureau of Water Use Efficiency (BWUE)** under the **National Water Mission** has compiled this **"Compendium on Best Practices on Water Use Efficiency by Industries"**, based on inputs received from industry associations. This Compendium shares proven industrial practices such as water-saving measures, efficient technologies, and water reuse/recycling. These interventions help reduce water use, lower costs, and improve efficiency while protecting the environment. The practices included here represent diverse industrial sectors and geographical contexts, offering practical insights for industries at different stages of water management maturity.

This document is intended for industrial stakeholders, policymakers, water professionals, auditors, technology providers, and researchers seeking to improve water-use efficiency in industrial operations.

I congratulate all the industries, Industry Associations and other stakeholders for their efforts in adopting innovative water-use efficiency measures and appreciate the contributions of the team involved in compiling this Compendium. It is hoped that this publication will serve as a valuable resource for practitioners, policymakers, and industry leaders, and will inspire further action toward water conservation, efficiency, and sustainable industrial development.

Archana Varma

(Archana Varma)

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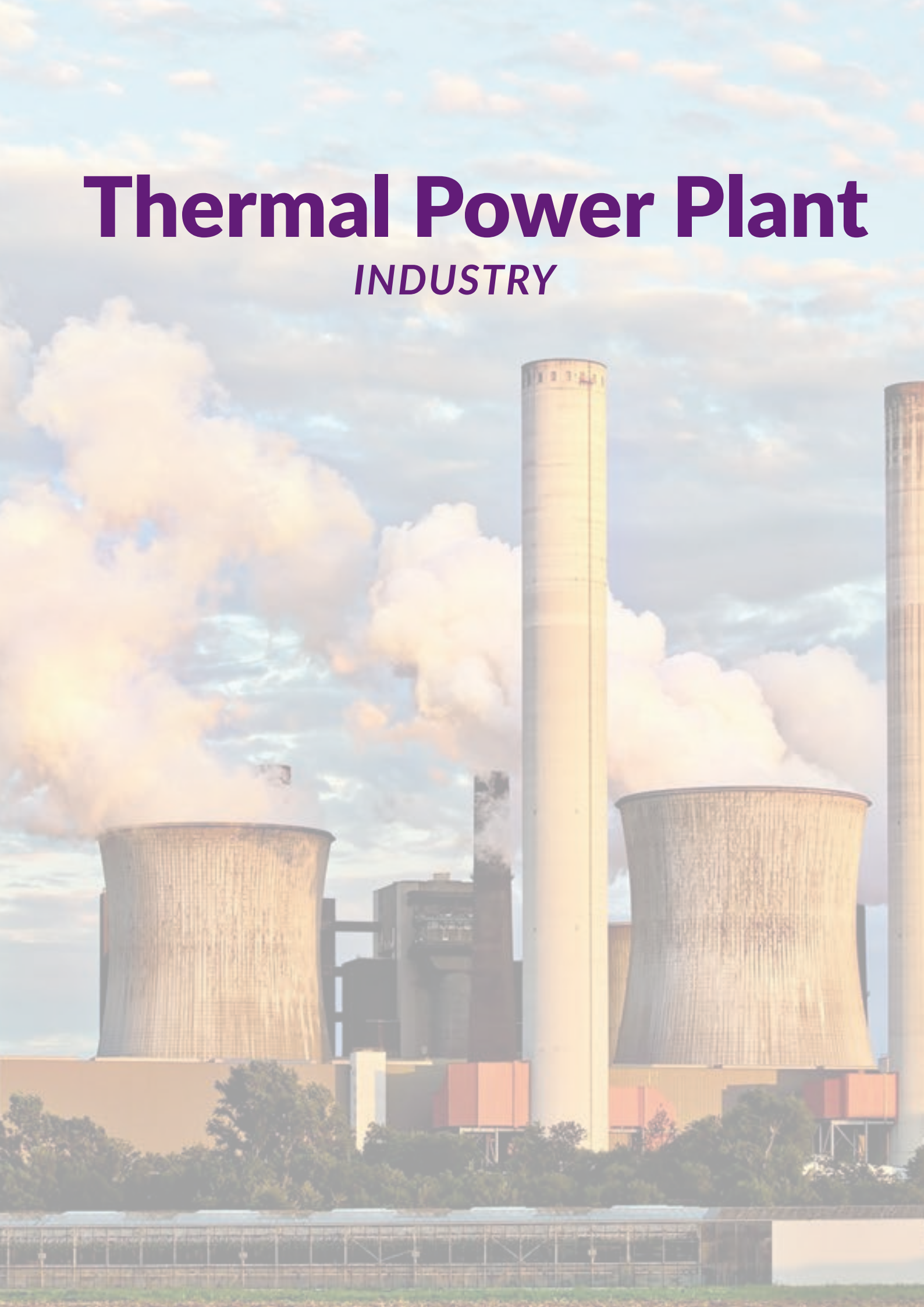
INDUSTRY



Tata Power, Jojobera

Sector: Power (Infrastructure)

CPCB Category:Red

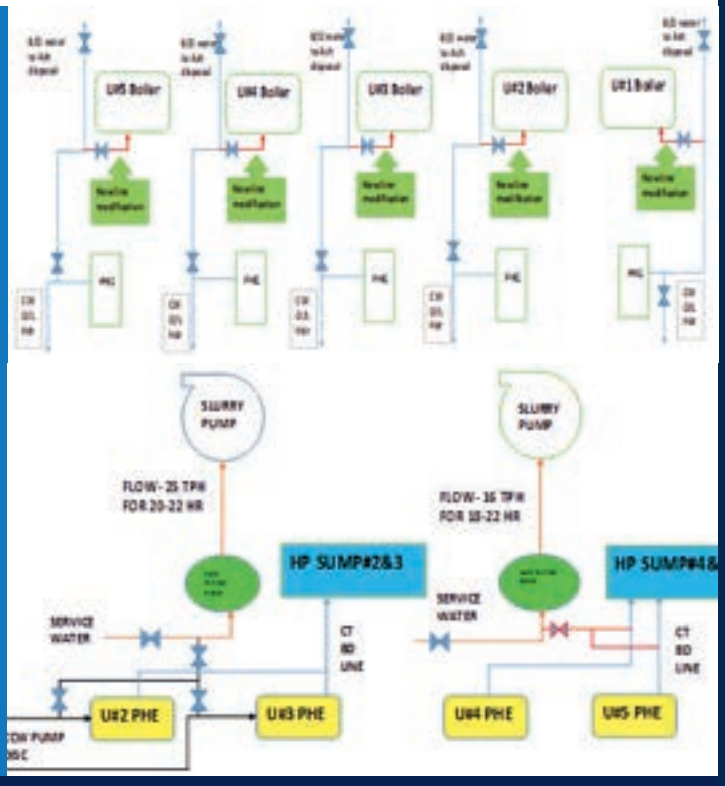
Location: Jojobera, Jamshedpur, Jharkhand

Objective

Tata Power, Jojobera power plants minimize environmental impact by reducing freshwater consumption through various projects, reusing cooling tower waste water in process, and recycling rain water in Rain Water Harvesting projects.

Nature of Intervention

- Industrial Water Reuse & Infrastructure Optimization
- Cooling T ower Water Reuse for Efficiency
- Industrial Water Recycling & Process Optimization
- Reducing Freshwater Dependence through Water Reuse



Best Practices Implemented:

A. Cooling tower Blowdown water utilization in Boiler seal trough make up and seal water pump

- **Implementation Period**: 2023
- **Intervention Type:** Reduce Reuse Recycle

Description:
Boiler seal trough make-up water was earlier connected to the service water header, resulting in raw water consumption of 55–60 TPH. At Jojobera Ash Plant, cooling tower blowdown water from the PHE outlet was available for ash disposal. A new line was laid from this blowdown line to the seal trough make-up line, and the service water valve was closed. This modification saved 55–60 TPH of fresh water.

Similarly, the seal water pump suction line for the ash slurry pump was earlier connected to the raw/service water header with a consumption of 40 TPH. A new line was connected from the cooling tower blowdown line (PHE outlet) to the seal water pump suction header. After closing the service water valve, this change resulted in an additional saving of 40 TPH fresh water.

- **Benefits**: 90 TPH fresh water
- **Water Saved:** 90 TPH (approx.) fresh water
- **Applicability:** Can be implemented same type of plant
- **Replicability Potential:** High

B. Entire Fire hydrant line brought overground from underground

- **Implementation Period**: 2024
- **Intervention Type:** Reduce Reuse Recycle

Description:
Jojobera Power Plant fire hydrant lines were laid mostly in underground since inception. But later on leakage was developed in the due course of time and which was very time taking job to identify and attend the leakage. We have decided and implemented to bring entire line to overground. So that leakage identification and attending will be easy.

- **Benefits**: 65 TPH fresh water
- **Water Saved:** 65 TPH
- **Applicability:** Across all thermal power plant
- **Replicability Potential:** High

Key Takeaway:

At Tata Power Jojobera, raw water consumption has reached benchmark levels in its category through continuous annual improvements. Additionally, under CSR initiatives, rainwater harvesting ponds of various sizes have been developed to recharge groundwater. The plant aims to become water neutral by 2030.

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DCM Shri Ram Limited

Sector: Thermal Power Plant

CPCB Category: Red

Location: Kota, Rajasthan

Objective

To maximize use of non-conventional water sources, recycle effluent streams, and achieve near-zero discharge while maintaining operational reliability.

Nature of Intervention

- Reduced raw water dependency
- Near-zero discharge through ZLD
- Improved effluent quality and process water substitution

Best Practices Implemented:

A. Rainwater Harvesting and Utilization

- **Intervention Type:** Rainwater harvesting & reuse

Description:
A rainwater harvesting system with a storage pond capacity of 4.5 lakh m^3 has been installed. The pond typically fills during monsoon, and excess water is released through controlled channel gates. The harvested rainwater quality is good, with conductivity ranging between 500–700 µS/cm.
In FY 2024–25, a system was commissioned to recycle 1.5 lakh m^3 of harvested rainwater for plant operations, reducing reliance on raw water sources.

- **Water Saved/Reused:** 1.5 lakh m^3 per annum
- **Applicability:** Water-scarce regions, large industrial sites with monsoon rainfall.
- **Replicability Potential:** High

B. Utilization of Treated Wastewater in Fire Hydrant & Auxiliary Systems

- **Implementation Period:** ?
- **Intervention Type:** Effluent reuse

Description:
Effluent from the power plant is utilized in the fire hydrant network, and subsequently reused for dust suppression, floor washing, and sprinkler systems. This closed-loop reuse significantly reduces freshwater demand and improves operational sustainability.

- **Applicability:** Thermal power plants and large industrial facilities with water-intensive auxiliary systems.
- **Replicability Potential:** High

Water Harvesting Pond at Kota Complex (4.5 Lac Cubic Meter)

Key Takeaway:

DCM Shri Ram demonstrates an integrated water conservation approach by combining rainwater harvesting, effluent reuse, and ZLD-based recycling—enabling significant water savings in a water-stressed region while achieving near-zero discharge

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Muzaffarpur Thermal Power Station, Kanti

Sector: Thermal Power Plant

CPCB Category: Red

Location: Kanti, Muzaffarpur, Bihar

Objective

To maximize use of non-conventional water sources, recycle effluent streams, and achieve near-zero discharge while maintaining operational reliability.

Nature of Intervention

- Water Use Efficiency through 3R Strategy & Process Innovation
- Sustainable Water Management through Reduce–Reuse–Recycle Interventions
- Integrated Water Conservation Measures in Power Generation

Best Practices Implemented:

A. A Multidimensional approach towards water sustainability

MTPS has adopted systematic & structured approach such as formation of Performance Optimization group for periodic survey of water consumed in various processes and optimization thereof. Capacity Building through learning, Training, awareness programmes, technical documentation etc. , Developing In-House Engineering Capabilities for undertaking initiatives towards water sustainability, digital initiatives & transparency measures have been undertaken such as display of water flows in various processes, real-time water monitoring dashboard, reporting of water consumption, conducting Third party water audits, reporting of water related data to appropriate & statutoryauthorities and voluntary/ mandatory disclosures such as CEO Water Mandate & IR/SAR reporting.

- **Implementation Period:** 2018
- **Intervention Type:** 3Rs principal and ZLD

Description:

MTPS has taken several initiatives in adoption of upgraded technologies for energy conservation and water conservation. Post commercialization of expansion units, specific water consumption has shown a reducing pattern and since FY 2019-20, it has been continuously maintaining below normative value of 3.5 L/KWH

MTPS team has adopted systematic & structured approaches for enhanced water use efficiency and has been proactive in taking up the planned interventions as & when recommendations of process modifications/ new initiatives have been suggested in system.

- **Water Saved/Reused:** 4.13 (m^3 per unit of production) Specific water consumption

Key Takeaway:

Over the past 5 years, substantial water savings have been achieved through several measures & adoption of upgraded technologies. Though they have reached below their normative Specific water consumption of 3.5 L/KWH, they aim at aligning themselves with NTPCs brighter plan 2032 and attain sp. Water consumption below 3.0 L/Kwh.

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Tata Steel Meramandali Captive Power Plant

Sector: Captive Power Plant

CPCB Category: Red

Location: Angul, Odisha

Objective

To reduce freshwater dependency and optimize water usage in power generation operations by maximizing reuse of treated effluent, improving cooling tower efficiency, and enhancing wastewater treatment and surface runoff utilization.

Nature of Intervention

- Treated effluent and sewage water reuse
- Cooling tower efficiency enhancement through higher COC
- Wastewater recovery and surface runoff management

Best Practices Implemented:

A. Replacement of Fresh Water with Treated Effluent / Sewage Water

- **Implementation Period**: 2023–24
- **Intervention Type:** Treated wastewater reuse in auxiliary systems

Description:
Freshwater usage was replaced with treated effluent and sewage water across multiple applications, including ash conditioning systems and dust suppression. A Sewage Treatment Plant (STP) of 1,000 m³/day capacity was installed to treat domestic wastewater, which is now reused for greenbelt development and dust control, thereby significantly reducing freshwater demand.

- **Annual Water Saved:** 72,000 m³
- **Applicability:** Power plants and industrial units with sewage and effluent reuse potential.
- **Replicability Potential:** Moderate

B. Optimization of Cooling Tower Blowdown through COC Enhancement

- **Implementation Period**: 2023–24
- **Intervention Type:** Cooling tower water efficiency improvement

Description:
Raw water consumption was optimized by reducing continuous blowdown from Unit-03 Cooling Tower basin. The Cycle of Concentration (COC) was increased and maintained at 8, exceeding the design requirement of 5, leading to reduced blowdown volumes and improved cooling tower water efficiency.

- **Annual Water Saved:** 401,600 m³
- **Applicability:** Thermal power plants and cooling-intensive industries.
- **Replicability Potential:** High

Key Takeaway:

Tata Steel Meramandali Captive Power Plant demonstrates that strategic wastewater reuse, optimization of cooling tower operations, and comprehensive effluent treatment can significantly reduce freshwater consumption in power generation while ensuring regulatory compliance and operational efficiency.

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Textile

INDUSTRY

Welspun Group

Sector: Textile

CPCB Category: Red

Location: Anjar, Gujarat

Objective

Welspun has established a 30 MLD Sewage Treatment Plant at its Anjar facility to utilize treated sewage water for textile manufacturing operations, thereby eliminating dependence on freshwater and moving towards zero freshwater consumption in the production process.

Nature of Intervention

- Treated Sewage Water for Industrial Use
- Wastewater Recycling in Textile Manufacturing
- Municipal Sewage Reuse for Sustainable Industry
- Public–Private Model for Industrial Water Reuse

Best Practices Implemented:

A. Sewage treatment plant

- **Implementation Period**: 2024
- **Intervention Type:** Establishment of 30MLD Sewage treatment plant

Description:

Welspun Living collects, transports and treats public sewage at its Sewage treatment Plant and uses the treated water for its operational purposes. Reduces water intensity/kg of processed goods; minimizes the environmental impact caused by the release of untreated municipal sewage into the sea; makes freshwater available to multiple stakeholders; "Zero fresh water" use for Welspun's manufacturing operations at Anjar. Advanced treatment technologies, such as Membrane Bio-Reactor (MBR) and Reverse Osmosis (RO) systems, ensuring high-quality treated water that meets the standards for industrial and agricultural use.

- **Annual Water Saved:** 7 billion litres of sewage water recycled annually.
- **Applicability:** Global
- **Replicability Potential:** High

Key Takeaway:

Welspun Living achieved – "Zero fresh water" use for its manufacturing operation at Anjar, benefitting multiple stakeholders – nearby communities, local farmers and small industries – making freshwater available to them for their consumption. The initiative, in addition, minimizes the environmental impact caused by the release of untreated municipal sewage into the sea.

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Pal Fashions Private Limited

Sector: Textile

CPCB Category: Red

Location: Tarapur Village

Objective

Key objectives of the project is to achieve water positivity by enhancing the region's capacity to harvest and store rainwater.

Nature of Intervention

- Rainwater Harvesting & Groundwater Recharge Initiative
- Ecosystem Restoration & Groundwater Recharge
- Integrated Water & Community Development Model
- Sustainable Water Storage & Ecological Restoration

Best Practices Implemented:

A. Improving the groundwater quantum

- **Implementation Period**: 2022
- **Intervention Type:** This project aims to improve groundwater quality and enhance agricultural cultivation in the vicinity of reclaimed Khar lands.

Description:
By creating a large catchment area, Shri Krishna Sarovar will serve as a critical reservoir that collects seasonal rainfall, helping to reduce dependency on external water sources and mitigating water scarcity in the region.

- **Annual Water Saved:** 3 lakh m^3 per annum/liter per unit produced/other benchmark
- **Applicability:** 393 Acres
- **Replicability Potential:** Medium to High

Before Intervention

After Intervention

Key Takeaway:

The Shri Krishna Sarovar project is not just a water body restoration initiative but a holistic effort toward ecological revival and community development. It aims to create a sustainable freshwater ecosystem that benefits both the environment and nearby communities.
The project will also support the local agricultural economy by providing a reliable irrigation source, especially during dry seasons, helping farmers improve crop yields and livelihoods. Additionally, the Sarovar will be developed as a biodiverse ecosystem with a sacred forest around its perimeter, featuring native trees that promote biodiversity and ecological balance.

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Grasim Industries Limited

Sector: Textile

CPCB Category: Red

Location: Vilayat, Bharuch, Gujarat

Objective

To reduce its water intensity by 50% by 2027 from baseline of FY16. The focus is on improving water availability and consuming natural resources responsibly.

Nature of Intervention

- Water Intensity Reduction through Sustainable and Innovative Practices in Viscose Staple Fibre Industry
- Water Audits/Process Optimization/Reuse & Recycling/Zero Liquid Discharge (ZLD)/Others

Best Practices Implemented:

A. 4R Principal

R1 – Reduce:

Lower water consumption through advanced technologies and efficient processes. Key initiatives include real-time digital monitoring of water use, optimization of product washing cycles, adoption of self-cleaning filters, reuse of process liquids for filter washing, and installation of air-cooled condensers to minimize evaporation losses.

R2 – Reuse:

Reuse water across processes through circular technologies. Initiatives include using low-TDS streams for filter washing, reusing RO reject water for quenching tail gases, utilizing effluent streams in processes like desulfurization, eliminating fresh water in filter backwash, and removing once-through fibre washing.

R3 – Recycle:

Recycle wastewater using advanced membrane technologies. This includes installing RO systems on low-TDS and treated effluent streams to recycle water back into processes and implementing stage-wise recycling of vacuum pump and mechanical seal water to reduce overall water footprint.

R4 – Regenerate:

Regenerate water through rainwater harvesting and storage systems. Measures include collecting rainwater from building rooftops, recycling stormwater from coal storage areas, and exploring technologies to recover water from cooling tower mist and create additional natural ponds for water storage.

Water Saved:30 Specific water consumption, (m3 per unit of production) in 2022-23

Filter backwash water elimination

RO installed on treated effluent and other process streams

Key Takeaway:

Birla Cellulose has established a global benchmark for lowest water intensity in viscose manufacturing. Another breakthrough that Vilayat site has achieved is that it meets the ZDHC MMCF responsible viscose production standards

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Indo Count Industries Limited

Sector: Textile

CPCB Category: Red

Location: Kolhapur , Maharasthra

Objective

Reduction of freshwater consumption by reusing the Softflow hot water.

Nature of Intervention

- Process-Based Water Reuse & Resource Efficiency
- Energy-Efficient Water Reuse Practice
- Sustainable Process Water Optimization
- Industrial Water Conservation & Efficiency

Best Practices Implemented:

A. Improving the groundwater quantum

- **Implementation Period**: 2025-26
- **Intervention Type:** Water Use Efficiency Improvement

Description:

To collect hot water from Soft Flow machines in SS tanks and reuse it in Soft Flow and Jigger operations, reducing effluent discharge while improving efficiency and sustainability.

Benefits:

- **Energy Conservation -** Efficient Water Utilization
- **Reuses soft flow cooling water** instead of sending it directly to effluent treatment, reducing wastage.
- **Enhanced Process Reliability**
- **Captures hot water at 55–60 °C**, minimizing the need to reheat water for operations.
- **Promotes eco-friendly practices** by lowering effluent load and reducing environmental impact.
- **Designed setup allows hot water** to be effectively used in both Soft Flow and Jigger machines, improving production efficiency.
- **Resource efficiency,** sustainability, and cost-effectiveness while strengthening operational performance.

Water Saved: 72000 m³ per annum
Applicability: Soft flow machines
Replicability Potential: Medium

Key Takeaway:

The project at Indo Count Industries Ltd effectively reuses hot water from Soft Flow machines, reducing effluent discharge and conserving energy. By capturing water at 55–60 °C, the need for reheating is minimized, improving process reliability and sustainability. With an investment of INR 22.1 Lacs, annual savings of INR 98 Lacs and ROI in 3 months, it ensures eco-friendly, scalable efficiency.

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Steel

INDUSTRY

JSW Steel Limited (Vijayanagar)

Sector: Steel Manufacturing

CPCB Category: Orange

Location: Vijayanagar, Karnataka

Objective

To enhance water efficiency and minimize freshwater intake by implementing advanced membrane-based treatment systems and Zero Liquid Discharge (ZLD) initiatives in industrial operations.

Nature of Intervention

- High-efficiency process water recycling
- Implementation of Zero Liquid Discharge systems
- Reduction in freshwater intake through reuse of treated effluent

Best Practices Implemented:

A. SRP RO System for Process Water Recycling

- **Implementation Period**: 2023
- **Intervention Type:** Process water recycling through reverse osmosis

Description:
An SRP Reverse Osmosis (RO) system was installed to recover and reuse treated process water. The system enables high-volume recycling of wastewater, significantly reducing freshwater withdrawal and improving overall water use efficiency within the plant.

- **Water Saved:** 2,800,000 m^3
- **Applicability:** Large industrial units with significant process wastewater generation.
- **Replicability Potential:** High

B. CO–5 ZLD System – Phase I

- **Implementation Period**: 2024
- **Intervention Type:** Zero Liquid Discharge (ZLD) and high-recovery water management

Description:
Phase I of the CO–5 ZLD project was implemented to maximize water recovery and eliminate liquid effluent discharge. The system enhances reuse of treated effluent across plant operations, contributing to sustainable water management and regulatory compliance.

- **Water Saved:** 875,000 m^3
- **Applicability:** Water-intensive industries aiming for ZLD compliance.
- **Replicability Potential:** High

Key Takeaway:

JSW Steel Limited (Vijayanagar) showcases how large-scale industrial water conservation—through advanced RO-based recycling systems and phased ZLD implementation—can substantially reduce freshwater dependency while ensuring environmental compliance and operational sustainability.

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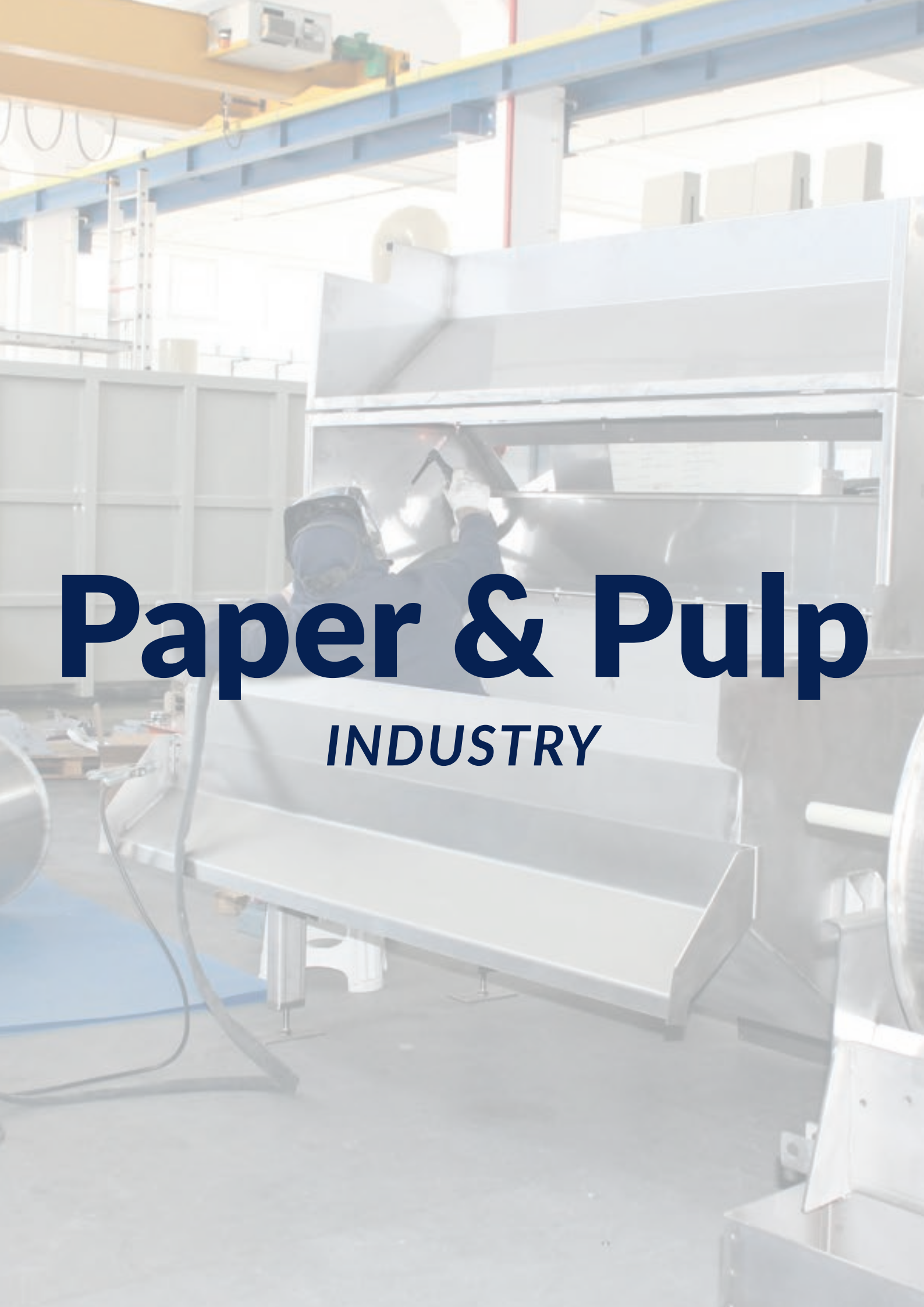

Paper & Pulp

INDUSTRY

Banknote Paper Mill India Private Limited

Sector: Paper & Pulp

CPCB Category: Red

Location: Mysuru, Karnataka

Objective

To enhance water recycling, reduce freshwater consumption, reduce effluent generation and increase rain water harvesting.

Nature of Intervention

- Improved reliability of ZLD operations
- Optimised MEE performance through reduced TDS loading

Best Practices Implemented:

A. Installation of Reverse osmosis plant of 65m3/hr Capacity

- **Implementation Period**: 2022-23
- **Intervention Type:** Effective recycling of Effluent and reduction in TDS of the recycled water

Description:

A Reverse Osmosis (RO) plant of 65 m³/hr capacity was installed and commissioned to recycle treated effluent. The project focused on reducing total dissolved solids (TDS) in the system, thereby lowering the operational load on the Multiple Effect Evaporator (MEE).Earlier Softener plant was installed for recycling of the treated effluent where about 1500kg of was being used for regeneration process thereby the MEE was being operated continuously to remove theTDS from the ZLD plant. Thus, by installing the RO plant and eliminating the softener, usage of the Salt, TDS in the recycled water reduced and the operation of MEE has been reduced considerably

- **Water Recycled:** 4,20,000 m3 per annum
- **Applicability:** All type of industries which generate Effluent
- **Replicability Potential:** Medium to High

B. Ultra-Filtration (UF) System for Rainwater Reuse

- **Implementation Period:** 2022-23
- **Intervention Type:** Effective utilisation of Resources (Treat Harvested Rain, runoff, seepage water)

Description:

An additional 70 m³/hr Ultra-Filtration (UF) plant was installed to treat runoff, seepage, rain water collected through a culvert. This UF unit acts as standby unit also. The treated water is reused directly in the process. The system also serves as a standby to the existing UF plant, improving system redundancy and water availability.

- **Water Reused:** Rainwater recovered and reused after UF treatment.
- **Applicability:** Industries with effluent generation and rainwater harvesting infrastructure.
- **Replicability Potential:** Medium to High

Key Takeaway:

Through strategic installation and process optimisation and adapting state of art technologies, Bank Note Paper Mill India Private Limited demonstrates how water-intensive industries can significantly enhance recycling, reduce treatment loads, and strengthen zero-liquid-discharge performance.

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Tyre Manufacturing

INDUSTRY

Balkrishna Industries Limited

Sector: Tyre Manufacturing

CPCB Category: Red

Location: Bhuj, Kutch District, Gujarat

Objective

To achieve systematic reduction of evaporative water losses and progressive elimination of process water use through technology-driven interventions, while maintaining operational reliability.

Nature of Intervention

- Utility system optimization
- Process efficiency improvement
- Water-free technology adoption

Best Practices Implemented:

A. Hybrid Curing Cooling System

- **Implementation Period**: 2022–23
- **Intervention Type:** Evaporation loss reduction

Description:
A dry air-cooling system was introduced to pre-cool curing water from approximately 80°C to 40°C before it enters the wet cooling stage. This significantly reduces evaporation losses associated with conventional wet cooling systems.

- **Water Saved:** 62,800 m³ per annum
- **Applicability:** Cooling-intensive industrial processes, particularly curing and thermal applications.
- **Replicability Potential:** High

B. Cooling Tower Blowdown Optimization

- **Implementation Period**: 2023–24
- **Intervention Type:** ·Water efficiency and reuse

Description:
Side-stream filtration systems were installed to control suspended solids in cooling water. This enabled improved cycles of concentration and reduced the frequency of cooling tower blowdown.

- **Water Saved:** 40,850 m³ per annum
- **Applicability:** Industrial cooling towers across manufacturing sectors.
- **Replicability Potential:** High

Side Stream Filter In Cooling Tower Water Circuit

Key Takeaway:

By combining immediate utility efficiency measures with long-term process innovation, Balkrishna Industries Limited demonstrates a holistic and scalable approach to industrial water stewardship, particularly suited for water-scarce regions.

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Apollo Tyres Limited

Sector: Tyre Manufacturing

CPCB Category: Red

Location: Oragadam, Sriperumbudur, Tamil Nadu

Objective

To improve cooling water efficiency, reduce freshwater intake, and maximize effluent and sewage recycling through automation and advanced water treatment technologies.

Nature of Intervention

- Cooling tower water efficiency
- Automation of utility water systems
- Enhanced effluent and sewage recycling

Best Practices Implemented:

A. 3D TRASAR-Based Cooling Tower Optimization

- **Implementation Period**: October 2024
- **Intervention Type:** Cooling tower automation and blowdown optimization

Description:
A 3D TRASAR system was installed for real-time monitoring of cooling tower water quality parameters such as pH, TDS, and ORP. The system was integrated with an automatic blowdown mechanism and synchronized chemical dosing. As part of this intervention, the cooling tower circulation water TDS set point was increased from 1,800 ppm to 2,200 ppm, enabling reduced blowdown without compromising system safety.

- **Water Saved:** 7,040 m³ per annum
- **Applicability:** HVAC and compressor cooling towers in industrial facilities.
- **Replicability Potential:** High

Auto blowdown system Installation & synchronization with 3D TRASAR

B. Level-Based Automatic Make-Up Water System

- **Implementation Period**: March 2025
- **Intervention Type:** Prevention of water losses through automation

Description:
Manual and ball-float-based make-up water systems for the Banbury cooling towers were replaced with a level-based automatic make-up water control system. This eliminated overflows caused by float failures and human error. The intervention resulted in consistent control of make-up water, with daily savings realized through elimination of overflow losses.

- **Water Saved:** 3,168 m³ per annum
- **Applicability:** Cooling towers and utility water systems
- **Replicability Potential:** High

Key Takeaway:

Through targeted automation of cooling systems and enhanced effluent recycling, Apollo Tyres Limited demonstrates how large-scale tyre manufacturing facilities can achieve measurable water savings while strengthening operational reliability.

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JK Tyres Limited (Kankroli)

Sector: Tyre Manufacturing

CPCB Category: Orange

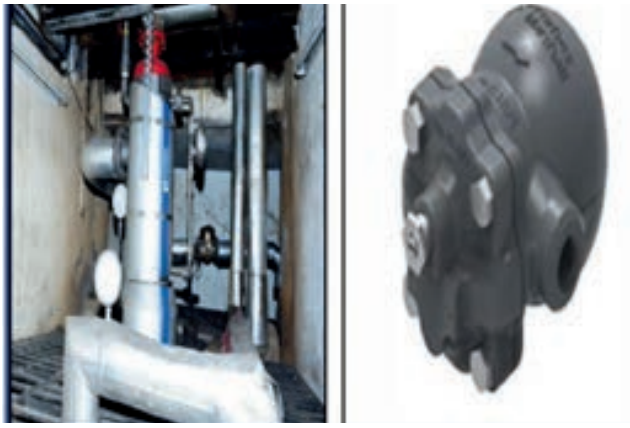
Location: Kankroli, Rajasthan

Objective

To improve water efficiency and reduce freshwater demand through rainwater harvesting, sanitation upgrades, and process water recovery initiatives in tyre manufacturing operations.

Nature of Intervention

- Enhanced rainwater harvesting and storage
- Reduction of water loss in sanitation systems
- Improved condensate recovery and reduced DM water consumption



Best Practices Implemented:

A. Enhanced Rainwater Collection through Drain Re-routing & Tank Rehabilitation

- **Implementation Period**: 2024
- **Intervention Type:** Rainwater harvesting and storage enhancement

Description:
Rainwater collection capacity was increased by rerouting and re-layout of land surface drains. An old, unused ETP tank was rehabilitated and repurposed into a fresh rainwater collection tank, thereby improving rainwater capture and storage.

- **Water Saved:** 7,500 m^3
- **Applicability:** Industrial facilities with existing unused tanks and drainage infrastructure.
- **Replicability Potential:** High

B. Jet Pump Installation for Condensate Recovery (Phase I)

- **Implementation Period**: 2024
- **Intervention Type:** Process water recovery and boiler efficiency

Description:
A jet pump was installed to increase condensate recovery, reducing the requirement for DM water in the boiler. This reduces freshwater demand and improves boiler water balance.

- **Water Saved:** 5,000 m^3
- **Applicability:** Industrial boilers with condensate recovery potential
- **Replicability Potential:** High (Phase II deployment planned for remaining units)

Key Takeaway:

JK Tyre & Industries Ltd. (Kankroli) demonstrates that integrated water conservation measures—combining rainwater harvesting enhancement, sanitation infrastructure upgrades, and condensate recovery—can significantly reduce freshwater dependency in tyre manufacturing.

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Food & Beverage

INDUSTRY

Bisleri Private Limited

Sector: Packaged Drinking Water

CPCB Category: White

Location: Valsad, Gujarat and Leh, Ladakh

Objective

The initiative aims to conserve rainwater and support groundwater recharge in topographically challenging terrains, ensure year-round availability of water, and enhance agricultural productivity, thereby improving the livelihoods of farmer families.

Nature of Intervention

- Community-led restoration of check dams
- Technical site assessments
- Rainwater harvesting and groundwater recharge

Best Practices Implemented:

A. Restoration of Check Dams

- **Implementation Period**: FY 2024-25, FY 2025-26 (till Jan 2026)
- **Intervention Type:** Check Dam Restoration

Description:
The initiative follows a community-driven approach to improve water availability and farmer livelihoods. Despite high annual rainfall (254 cm), the undulating terrain of Kaprada and Dharampur causes rapid runoff, leading to water scarcity by March and seasonal migration due to declining farm productivity. To address this, damaged check dams are identified through village demand and field assessments. The implementing team, Jashoda Narrottam Public Charity Trust (JNPCT), conducts site surveys, technical evaluations, and multiple community meetings to assess feasibility, benefits, and community participation. Projects proceed only when villagers commit to contributing labour and maintaining the restored structures.

- **Annual Water Saved:** 4,088 million litres of rainwater harvested.
- **Applicability:** Essential in Valsad's hilly blocks (Dharampur, Kaprada) to harvest water, slowing high-velocity runoff on slopes, preventing the loss of fertile topsoil and recharging groundwater, thereby reviving nearby borewells and open wells used for irrigation.
- **Replicability Potential:** Highly replicable across any hilly or forest region in India (like the Western Ghats) where rain is plenty, but water doesn't stay in the ground.

Key Takeaway:

Restoring traditional water infrastructure enables both regions to overcome seasonal scarcity by bridging the water availability with agricultural demand. While Valsad captures monsoon runoff to recharge groundwater and Ladakh captures glacial melt for immediate irrigation, both projects use community-led management to turn wasted water into a secure livelihood, building long-term climate resilience in topographically challenging terrains.

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Hindustan Coca-Cola Beverages Limited (Atmakuru)

Sector: FMCG – Beverage

CPCB Category: Red

Location: Atmakuru, Andhra Pradesh

Objective

To reduce freshwater consumption and enhance water-use efficiency in beverage manufacturing through optimized process modifications, improved membrane treatment performance, and reduced cleaning water consumption.

Nature of Intervention

- Process optimization and equipment modification
- Membrane treatment enhancement
- Reduced cleaning water consumption

Best Practices Implemented:

A. Reduction of Final Rinse Nozzle Size in Bottle Washer

- **Implementation Period**: 2024
- **Intervention Type:** Process optimization for water saving

Description:
The final rinse nozzle size in the new bottle washer was reduced from 2 mm to 1.5 mm, reducing the volume of rinse water per cycle without compromising cleaning effectiveness.

- **Annual Water Saved:** 6,300 m^3
- **Applicability:** ·: Beverage bottling lines with high rinse water usage.
- **Replicability Potential:** High

B. Increasing UF Capacity by 20%

- **Implementation Period:** 2023
- **Intervention Type:** Membrane treatment optimization

Description:
UF capacity was increased by 20% by adding two additional modules. This improved the efficiency and throughput of the UF system, reducing dependence on freshwater by enhancing treated water availability.

- **Annual Water Saved:** 8,500 m^3
- **Applicability:** ·Beverage plants with UF/RO tertiary treatment systems.
- **Replicability Potential:** Medium to High

C. Reduction of Final Rinse Nozzle Size in Bottle Washer

- **Implementation Period**: 2024
- **Intervention Type:** Cleaning optimization

Description:
The Cleaning-In-Place (CIP) frequency in ASSP-1 was extended from 72 hours to 96 hours, reducing the number of CIP cycles and thus saving water and chemicals.

- **Annual Water Saved:** 600 m^3
- **Applicability:** Beverage plants with CIP systems.
- **Replicability Potential:** High (for ASSP lines)

Key Takeaway:

Hindustan Coca-Cola Beverages Limited (Atmakuru) demonstrates that even small process optimizations such as nozzle size reduction, membrane capacity expansion, and CIP frequency adjustment can collectively lead to significant water savings and improved operational efficiency in beverage manufacturing.

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Varun Beverages Limited (Begusarai)

Sector: Beverage Manufacturing

CPCB Category: Red

Location: Begusarai, Bihar

Objective

To achieve high water-use efficiency and reduce groundwater dependency by implementing advanced water recovery, closed-loop reuse systems, and innovative RO optimization technologies across beverage manufacturing operations

Nature of Intervention

- Multi-source water recovery and reuse
- Closed-loop process water systems
- High-efficiency RO optimization and reject minimization
- Reduction in chemical and freshwater dependency

Best Practices Implemented:

A. Multi-Source Recovery Initiative – Backwash, Rinse & ETP RO Water Reutilization

- **Implementation Period**: 2022
- **Intervention Type:** Process water recovery and internal reuse

Description:
Earlier, backwash and rinse water from filtration units was discarded due to elevated turbidity, resulting in avoidable water loss. A dedicated Backwash Recovery Tank along with a Pressure Sand Filter (PSF) was installed to treat this water to acceptable process-grade quality. The treated water is now stored in underground tanks and reused in process utilities, enhancing internal water circularity.

- **Annual Water Saved:** 45,600 m^3
- **Replicability Potential:** Very High

B.Closed-Loop Bottle Washer Water Recovery System

- **Implementation Period:** 2022
- **Intervention Type:** Reuse in bottle washing operations

Description:
Soft water from bottle washers was previously drained due to high temperature, elevated pH, and residual impurities. A closed-loop recovery system was introduced comprising a Plate Heat Exchanger (PHE) for temperature reduction, followed by PSF, ACF, WAC softener, degasser system, and final disinfection. This enabled reuse of treated water in the bottle washer.

- **Reuse Efficiency Achieved:** Up to 60%
- **Annual Water Saved:** 8,640 m^3
- **Replicability Potential:** High

Key Takeaway:

Varun Beverages Limited (Begusarai) exemplifies next-generation water stewardship in the beverage sector by integrating closed-loop reuse, advanced RO science, and smart utility optimization achieving high recovery rates, reduced groundwater extraction, and long-term sustainability.

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Varun Beverages Limited (Sandila)

Sector: Beverage Manufacturing

CPCB Category: Orange

Location: Sandila, Uttar Pradesh

Objective

To minimize freshwater withdrawal and achieve industry-leading water-use efficiency by implementing extensive recycle–reuse initiatives, RO optimization technologies, CIP water reduction strategies, and zero-leakage practices across beverage manufacturing operations.

Nature of Intervention

- Extensive recycle and reuse across process and utilities
- Advanced RO recovery enhancement
- CIP water optimization and breakthrough rinsing technologies
- Elimination of softener-related water losses

Best Practices Implemented:

A. Extensive Process Water Recovery & Reuse Across Utilities

- **Implementation Period**: 2023–24
- **Intervention Type:** Multi-point process water recovery

Description:
Multiple low-cost, high-impact recovery systems were implemented, including PSF & ACF backwash recovery, RO sensor flow chamber water recovery, homogenizer piston cooling water reuse, pump seal water recovery, steam condensate recovery, and Aquafina RO flushing water reuse. These interventions collectively reduced avoidable drain losses and enhanced internal water circulation.

- **Annual Water Saved:** 1,05,000 m³
- **Applicability:** Beverage plants with RO systems and multiple utility streams
- **Replicability Potential:** Very High

B. RO Recovery Enhancement through CO_2 Injection

- **Implementation Period:** 2023
- **Intervention Type:** Advanced RO feed conditioning

Description:
CO_2 injection was introduced in five RO systems to reduce scaling tendency and improve membrane performance. This intervention increased RO recovery from ~82% to ~90%, extended membrane life, and significantly reduced RO reject volumes. Following successful trials, CO_2 dosing was automated across all primary RO systems

- **Annual Water Saved:** 12,500 m³
- **Additional Benefits:**
  - 5% increase in permeate recovery
  - Improved membrane life and reduced CIP frequency
- **Replicability Potential:** High

Key Takeaway:

Varun Beverages Limited, Sandila demonstrates that sustained, multi-point water conservation combining advanced RO science, smart CIP optimization, and rigorous operational discipline can deliver industry-leading water-use efficiency even at very high production capacities

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FMCG

INDUSTRY

ITC Limited (Saharanpur)

Sector: FMCG

CPCB Category: Red

Location: Saharanpur, Uttar Pradesh

Objective

To improve water-use efficiency and reduce freshwater consumption by implementing process modifications, adopting air-cooled systems, enhancing rainwater harvesting, and upgrading cooling infrastructure.

Nature of Intervention

- Cooling system optimization and waterless cooling technologies
- Rainwater harvesting and treatment
- Reduction of water losses through pipeline upgrades

Best Practices Implemented:

A. Adiabatic Cooling Tower for SMD Compressor

- **Implementation Period**: 2024–25
- **Intervention Type:** Cooling water optimization

Description:
An adiabatic cooling tower was installed for the SMD compressor to reduce water consumption in the HVAC cooling system. This technology enhances cooling efficiency while reducing dependency on fresh water.

- **Annual Water Saved:** 1,560 m^3
- **Applicability:** HVAC cooling systems in industrial facilities.
- **Replicability Potential:** High

B. Air-Cooled Compressor for Encapsulated Flavour Area

- **Implementation Period:** 2024–25
- **Intervention Type:** Waterless cooling system

Description:
An air-cooled compressor was installed for the encapsulated flavour area to replace water-cooled compressor systems, reducing water use for cooling.

- **Annual Water Saved:** 1,600 m^3
- **Applicability:** Compressor systems in HVAC and process areas
- **Replicability Potential:** High

Key Takeaway:

ITC Saharanpur demonstrates that a combination of cooling system upgrades, adoption of air-cooled equipment, and rainwater harvesting can significantly improve water sustainability in FMCG manufacturing operations

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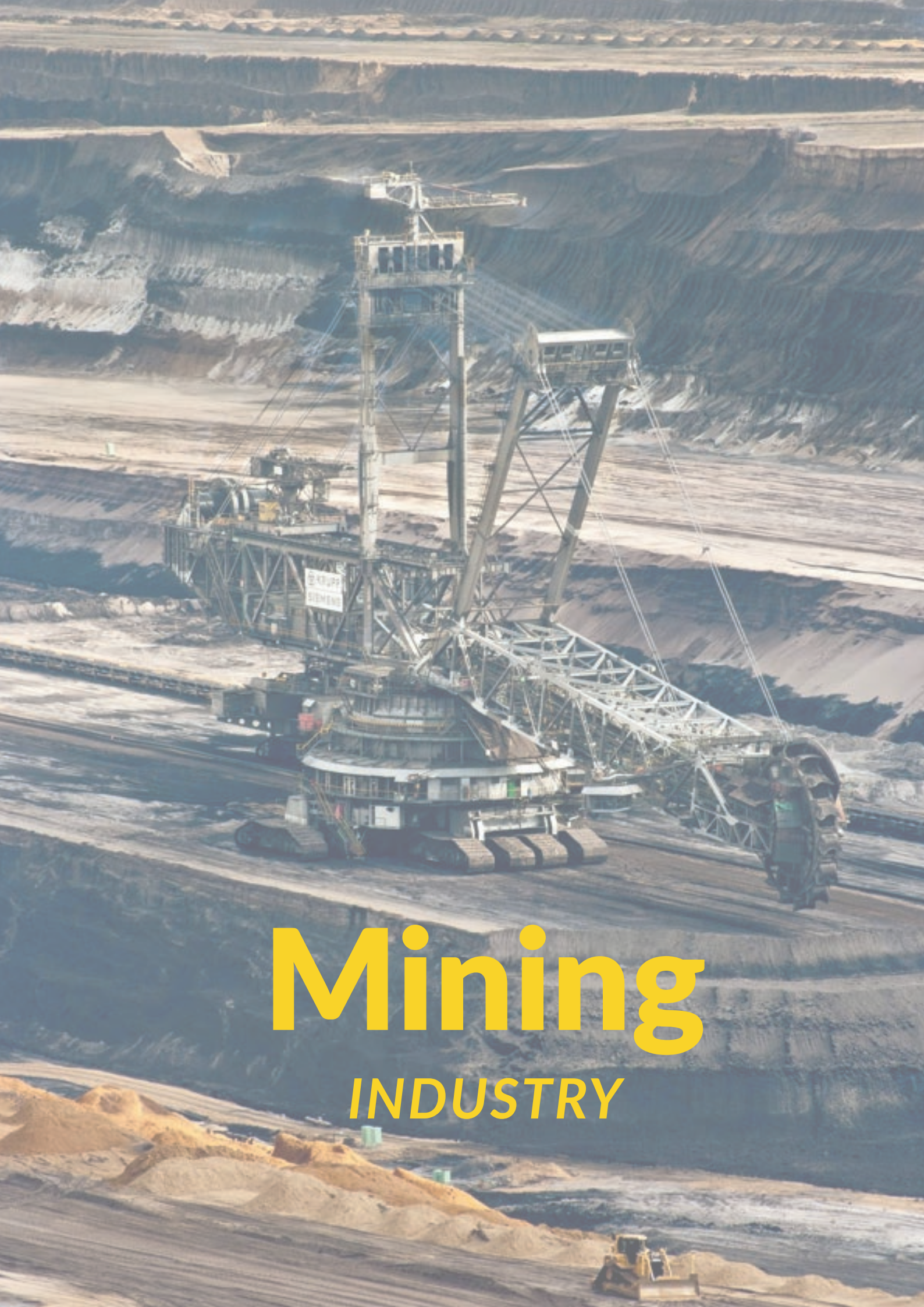


Mining

INDUSTRY

Hindalco Industries Limited (Sambalpur)

Sector: Mining **-** Aluminium

CPCB Category: Red

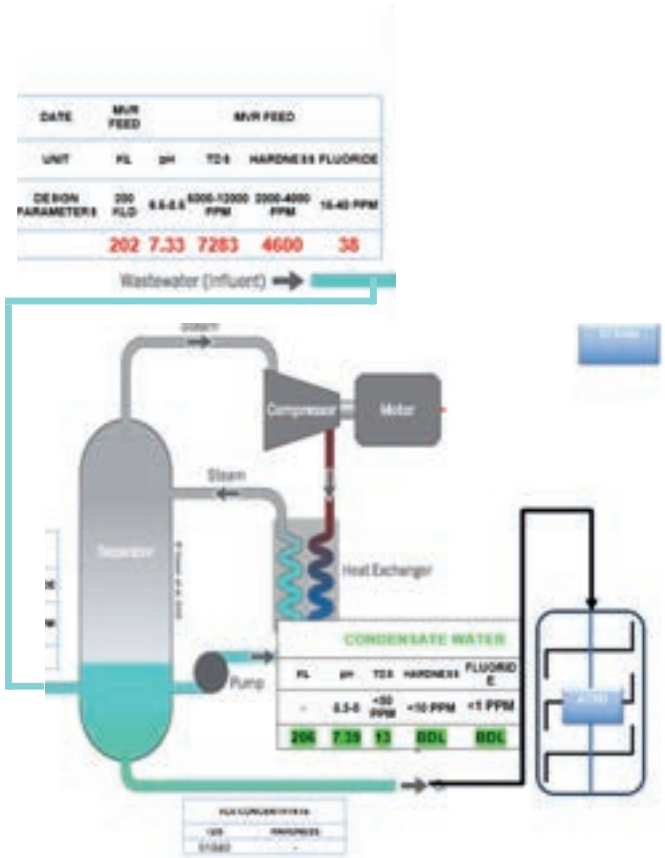
Location: Sambalpur, Odisha

Objective

To improve water efficiency and reduce freshwater consumption through advanced water recovery technologies and water storage solutions, ensuring sustainable operations in aluminium smelting and allied processes.

Nature of Intervention

- Water recovery through advanced evaporation technology
- Storage and reuse of process water and runoff
- Reduced freshwater withdrawal and improved water balance



Best Practices Implemented:

A. Multiple-Effect Vapor Recompression (MVR) Project

- **Implementation Period**: 2024
- **Intervention Type:** Water recovery and energy-efficient evaporation

Description:
An MVR (Mechanical Vapor Recompression) project was implemented to recover and reuse water from process streams. The technology enhances water recovery while reducing energy consumption compared to conventional evaporation systems.

- **Annual Water Saved:** 73,000 m3 per annum
- **Applicability:** Water-intensive industries with evaporative concentration needs.
- **Replicability Potential:** Medium

B. Water Lagoon

- **Implementation Period:** 2024
- **Intervention Type:** Water storage and reuse

Description:
A Water Lagoon was constructed to capture and store process water and runoff. The stored water is reused for various plant applications, improving water availability and reducing freshwater withdrawal.

- **Annual Water Saved:** 45,000 m^3
- **Applicability:** Industries with significant process water and stormwater generation.
- **Replicability Potential:** High

Key Takeaway:

Hindalco's Aditya Aluminium demonstrates that integrating advanced water recovery systems like MVR and developing water storage infrastructure such as lagoons can significantly reduce freshwater consumption and enhance water sustainability in aluminium smelting operations.

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Hindalco Industries Limited (Hirakud)

Sector: Mining - Aluminium Smelter Plant & Captive Power Plant

CPCB: Category Red

Location: Hirakud, Sambalpur, Odisha

Objective

To enhance water recovery and recycling across smelter and captive power operations by implementing advanced treatment systems, improving raw water utilization, and minimizing freshwater consumption through Zero Liquid Discharge (ZLD) practices.

Nature of Intervention

- Raw water recovery through pretreatment and sedimentation
- Large-scale RO-based reuse for cooling makeup
- RO reject recovery via MVRE-based ZLD
- Recovery of sludge water and restoration of storage basins

Best Practices Implemented:

A. Tube Settler Plant (50 m³/hr)

- **Implementation Period**: 2024
- **Intervention Type:** Effluent pre-treatment for reuse

Description:
Effluent water from coal yard, railway siding, and ash silo contains high suspended solids. The water is collected in a raw water collection tank (1200 m³) and treated in a Tube Settler plant (50 m³/hr). The treated water is then sent to the RO plant ETP for further treatment and subsequently used as cooling tower makeup water.

- **Annual Water Saved:** 50,000 m3 per annum
- **Replicability Potential:** High

B. New RO Plant (190 m³/hr)

- **Implementation Period:** 2025
- **Intervention Type:** Effluent treatment and water reuse

Description:
Effluent generated from 5 cooling towers, DM plant, and boilers is treated in a new RO plant (190 m³/hr). Treated water is used as makeup water in cooling towers 4 & 5, significantly reducing freshwater intake.

- **Annual Water Saved:** 12,26,400 m³
- **Replicability Potential:** High

Key Takeaway:

Hindalco Industries Limited,Hirakud demonstrates that integrated water recovery, recycling, and ZLD strategies combining tube settlers, RO systems, reject recovery, and basin restoration can substantially reduce freshwater demand and strengthen sustainable water management in aluminium smelting and power operations.

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Hindalco Industries Limited (Dahej)

Sector: Mining - Non-Ferrous Metals – Copper Smelter

CPCB Category: Red

Location: Dahej, Gujarat

Objective

To significantly reduce freshwater consumption and improve water sustainability through integrated water reuse, recycling, and Zero Liquid Discharge (ZLD) practices in a large copper smelter complex.

Nature of Intervention

- Integrated reuse of domestic and industrial wastewater
- Recycling of process water and cooling blowdown
- ZLD-based tertiary treatment for maximum recovery
- Significant reduction in freshwater withdrawal

Best Practices Implemented:

A. Reuse of STP Treated Water

- **Implementation Period**: 2016
- **Intervention Type:** Domestic wastewater recycling

Description:
Treated sewage water from the STP is reused for various plant utilities, reducing freshwater withdrawal and promoting circular water use.

- **Annual Water Saved:** 182,500 m^3
- **Applicability:** Industrial complexes with large domestic wastewater generation
- **Replicability Potential:** High

B. ETP RO Plant Started

- **Implementation Period:** 2017
- **Intervention Type:** Effluent treatment and reuse

Description:
Effluent Treatment Plant (ETP) Reverse Osmosis (RO) plant was commissioned to treat and recycle industrial effluent. Treated water is reused within the plant, reducing reliance on fresh water and supporting ZLD operations.

- **Annual Water Saved:** 936,000 m^3
- **Applicability:** Water-intensive industrial plants with effluent streams.
- **Replicability Potential:** High

Key Takeaway:

Hindalco Birla Copper demonstrates that a combination of STP reuse, RO-based effluent recycling, process water reuse, and ZLD implementation can substantially reduce freshwater demand and enhance sustainable water management in non-ferrous metal smelting operations

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Renewable Energy

INDUSTRY

Clean Max Enviro Energy Solutions Private Limited

Sector: Renewable Energy (Wind-Solar Hybrid)

CPCB Category: White

Location: Davanagere, Karnataka

Objective

Ensures that site recharges as much groundwater as it consumes annually, thereby regenerating local groundwater and supporting the regional water ecosystem. Used primarily for Solar module cleaning (5,17,709 modules) with other O&M activities, including biodiversity park.

Nature of Intervention

- Rainwater Harvesting & Groundwater Recharge
- Site-Specific Water Management Design
- Water Monitoring & Governance
- Sustainable & Replicable Water Model

Best Practices Implemented:

A. Large-Scale Groundwater Recharge Infrastructure

- 16 recharge ponds and 12 recharge pits constructed
- Designed based on hydrogeological and infiltration studies
- Total recharge measured: 1,05,53,091 L

B. Zero Surface Runoff Design

- Site layout leveraged undulating topography
- Drainage channels and perimeter bunds were constructed
- Natural sandy loam soil enhanced infiltration, reducing runoff to near zero

C. Water Monitoring & Governance

- 12 flow meters installed for accurate water measurement
- Continuous monitoring supports water footprint tracking and operational optimization

Daily water extraction monitored through flow meter by operations team

Key Takeaway:

The Jagalur project demonstrates that renewable energy projects can achieve water neutrality through strategic rainwater harvesting, demand-side water optimisation, and site-specific design. Integrated planning and robust monitoring are critical for success, while independent third-party verification strengthens credibility and supports ESG reporting. The initiative serves as a replicable model for water-stressed regions and large-scale renewable infrastructure.

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Fertilizer

INDUSTRY

Yara Fertilizers Private Limited (Babrala)

Sector: Fertilizer – Urea Manufacturing

CPCB Category: Red

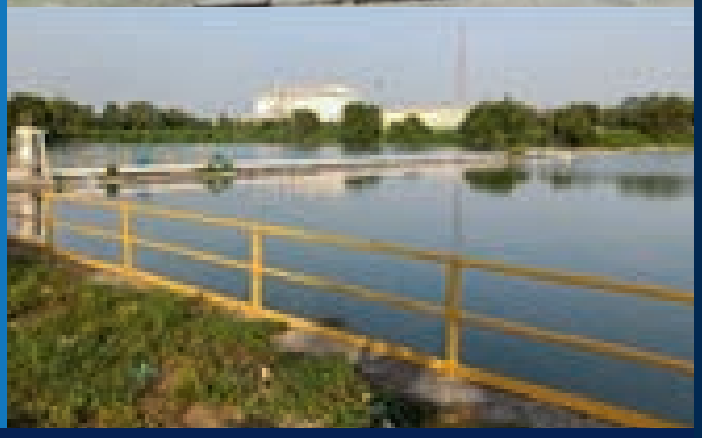
Location: Babrala, Uttar Pradesh

Objective

To significantly reduce freshwater withdrawal and improve water-use efficiency in urea manufacturing by strengthening water measurement, maximizing reuse of treated effluent, harnessing stormwater and rainwater, improving domestic water efficiency, and supporting water conservation in surrounding communities.

Nature of Intervention

- Accurate water measurement and governance
- Sewage and industrial effluent reuse
- Large-scale stormwater and rainwater harvesting
- Domestic water efficiency improvements
- Community-level water conservation and recharge



Best Practices Implemented:

A. Accurate Water Accounting through Flow Meter Upgradation

- **Implementation Period**: 2021
- **Intervention Type:** Water monitoring and management

Description:
All borewell discharge and drinking/process water flow meters were upgraded from orifice-type to magnetic flow meters to improve reliability and measurement accuracy. This strengthened water auditing, loss identification, and informed decision-making for conservation initiatives.

- **Annual Water Saving:** 100 KLD
- **Applicability:** Large industrial units with multiple water abstraction points
- **Replicability Potential:** High

B. Rainwater Harvesting & Reuse

- **Implementation Period:** 2022 -23
- **Intervention Type:** Stormwater harvesting and reuse

Description:
Infrastructure was developed to capture and utilize stormwater from the plant catchment area. On average, about 1,250 m^3/day of stormwater is collected and utilized, reducing dependence on groundwater.

- **Annual Water Saving:** 1,250 KLD
- **Completion:** November 2022 & December 2023
- **Replicability Potential:** High

Rainwater Treatment Plant

Rooftop Rainwater Treatment

Key Takeaway:

Yara Fertilizers Private Limited (Babrala) demonstrates that a holistic water stewardship approach—integrating industrial reuse, rainwater and stormwater harvesting, efficient sanitation systems, and community engagement—can substantially reduce freshwater dependency in large-scale fertilizer manufacturing."

To know more, contact :
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Indian Farmers Fertilizer Cooperative Limited, Aonla

Sector: Fertilizer

Location: Bareilly, Uttar Pradesh

Objective

Objective of the water audit should be to accurately quantify water consumption, measure and monitor water usage and its quality for different activities and processes, spot water leakage/loss areas and identify water saving opportunities through optimizing water use, recycling, process interventions, technological improvements, and adoption of best practices.

Nature of Intervention

- Water reuse by capturing and treating filter backwash water for reuse in DM Plant and Condensate Polishing Unit.
- Process optimization approach involving settling tanks and PSF treatment.

Best Practices Implemented:

A. Reutilization of FPS FilterBackwash Water in DM Plant

- **Implementation Period**: 2024
- **Intervention Type:** Reusing

Description:
Approximately 80 KLD of FPS Filters backwashwater is sent to ETP. This quantity of Water can be use after PSF treatment.

Benefits:
Installing one settling tank of 100 KL which can be used to store and settle the dust of the backwash water. Settled water after treatment through PSF can be transferred back to the 75 KL Raw water storage tank of DM Plant.Considering a small amount of settlingloss (20%), approximately 65 KLD i:e 23,725 KL/Year of ground water can be saved.

- **Water Saved:** 65 m^3 per annum
- **Applicability:** In all Industry whereDM plant is available.

A. Reutilization of FPS FilterBackwash Water in DM Plant

- **Implementation Period**: 2024
- **Intervention Type:** Reusing

Description:
Approximately 80 KLD of FPS Filters backwashwater is sent to ETP. This quantity of Water can be use after PSF treatment.

Benefits:
Installing one settling tank of 200 KL or small size (whichever can be installed as per available size) which can be used to store and settle the dust of the backwash water. Settled water after treatment through PSF can be transferred back to the 750 KL condensate water storage tank of CPU. Considering a small amount of settling loss (20%), approximately 145 KLD i:e 52,925KL/Year of condensate water can be saved.

Water Saved: 145 m^3 per annum
Applicability: In all Industry where Condensate Polishing Unit is available.

Construction of Surface Rainwater Storage Ponds in plant premises progress

Key Takeaway:

Reutilizing FPS filter backwash water through settling and PSF treatment enables industries to recycle water that would otherwise be discharged, significantly reducing freshwater and groundwater consumption while promoting efficient and sustainable water management.

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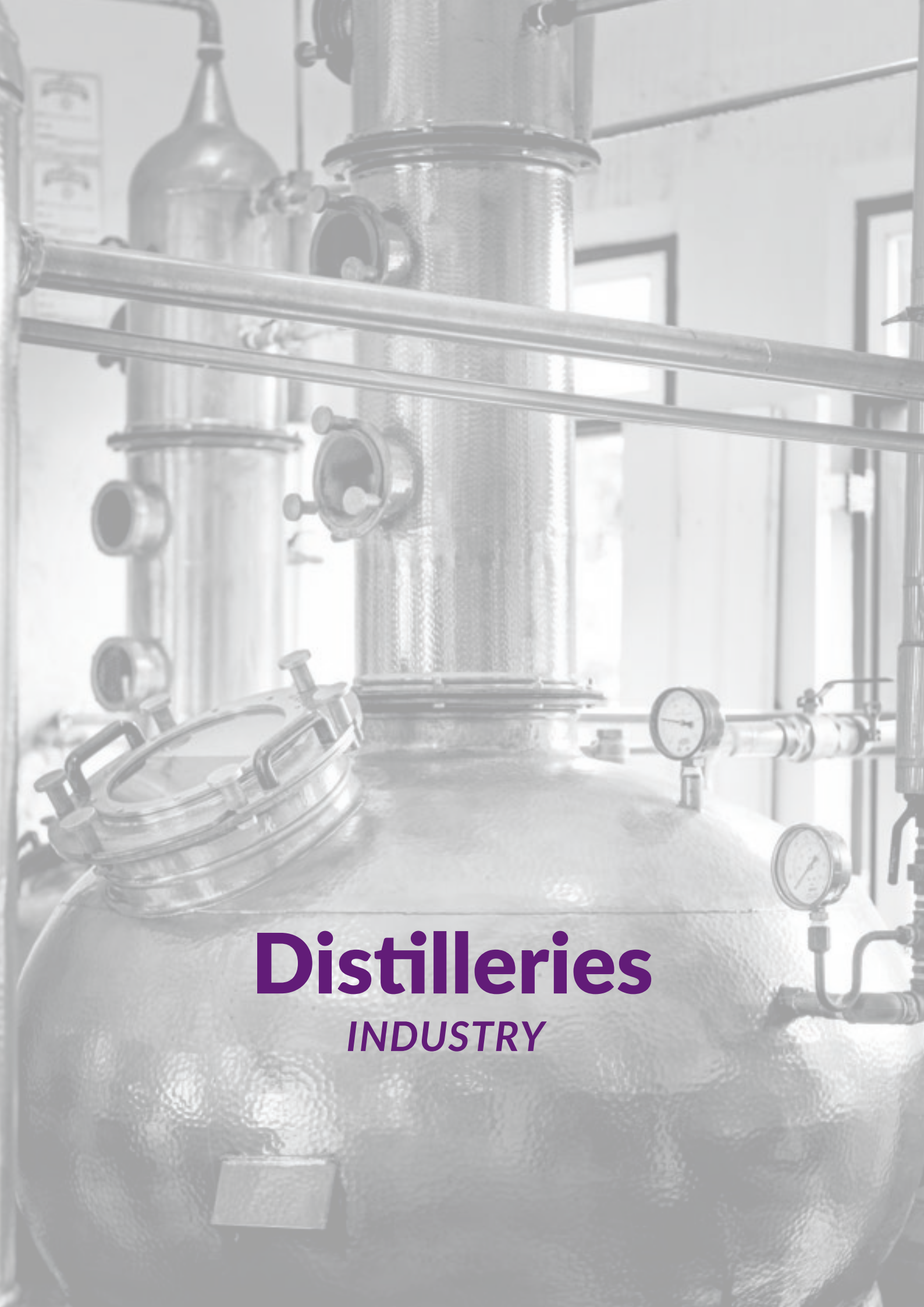


Distilleries

INDUSTRY

Premier Green Innovations Private Limited

Sector: Distillery

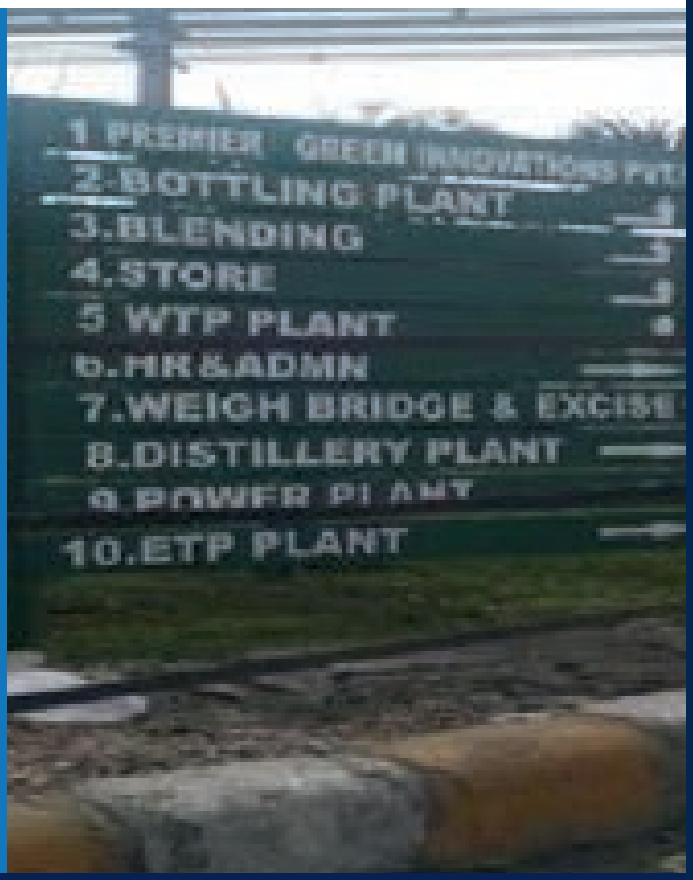
Location: Kangra, Himachal Pradesh

Objective

Objective of the water audit should be to accurately quantify water consumption, measure and monitor water usage and its quality for different activities and processes, spot water leakage/loss areas and identify water saving opportunities through optimizing water use, recycling, process interventions, technological improvements, and adoption of best practices.

Nature of Intervention

- Boiler Condensate Recovery
- Boiler System Optimization for Water Savings
- Steam System Efficiency & Water Conservation
- Condensate Recovery for Industrial Efficiency



Best Practices Implemented:

A. Condensate Recovery in Boiler Area

- **Implementation Period**: 2025
- **Intervention Type:** Process Improvement

Description:
Currently, steam is utilized across various processes, with a condensate recovery rate of 65%. The boiler make-up water requirement stands at 94.2 KLD. Discussions with the plant team have identified an opportunity to enhance condensate recovery up to 85%, which can lead to significant water and energy savings.

Benefits:
To enhance condensate recovery efficiency, it is recommended to implement the following measures:

1. Arrest Trap Leakages – Regularly inspect and repair steam traps to prevent loss of condensate and ensure optimal recovery.

2. Fix Valve Passing Issues – Identify and address any valve passing problems that may lead to steam or condensate wastage.

3. Reduce Blowdown Quantity – Optimize the blowdown process by monitoring water quality and minimizing unnecessary losses while maintaining system efficiency. By implementing these actions, condensate recovery can be significantly improved, leading to reduced water consumption, lower energy costs, and enhanced overall system performance.

Water Saved: 7000 m^3 per annum
Applicability: In all Industry where Boiler is used as thermal utility.

Key Takeaway:

Improving condensate recovery from the current 65% to 85% presents a significant opportunity to reduce boiler make-up water demand and enhance overall process efficiency. By addressing steam trap leakages, fixing valve passing issues, and optimizing blowdown operations, the plant can achieve substantial water and energy savings, lower operational costs, and improve the sustainability and performance of the steam system.

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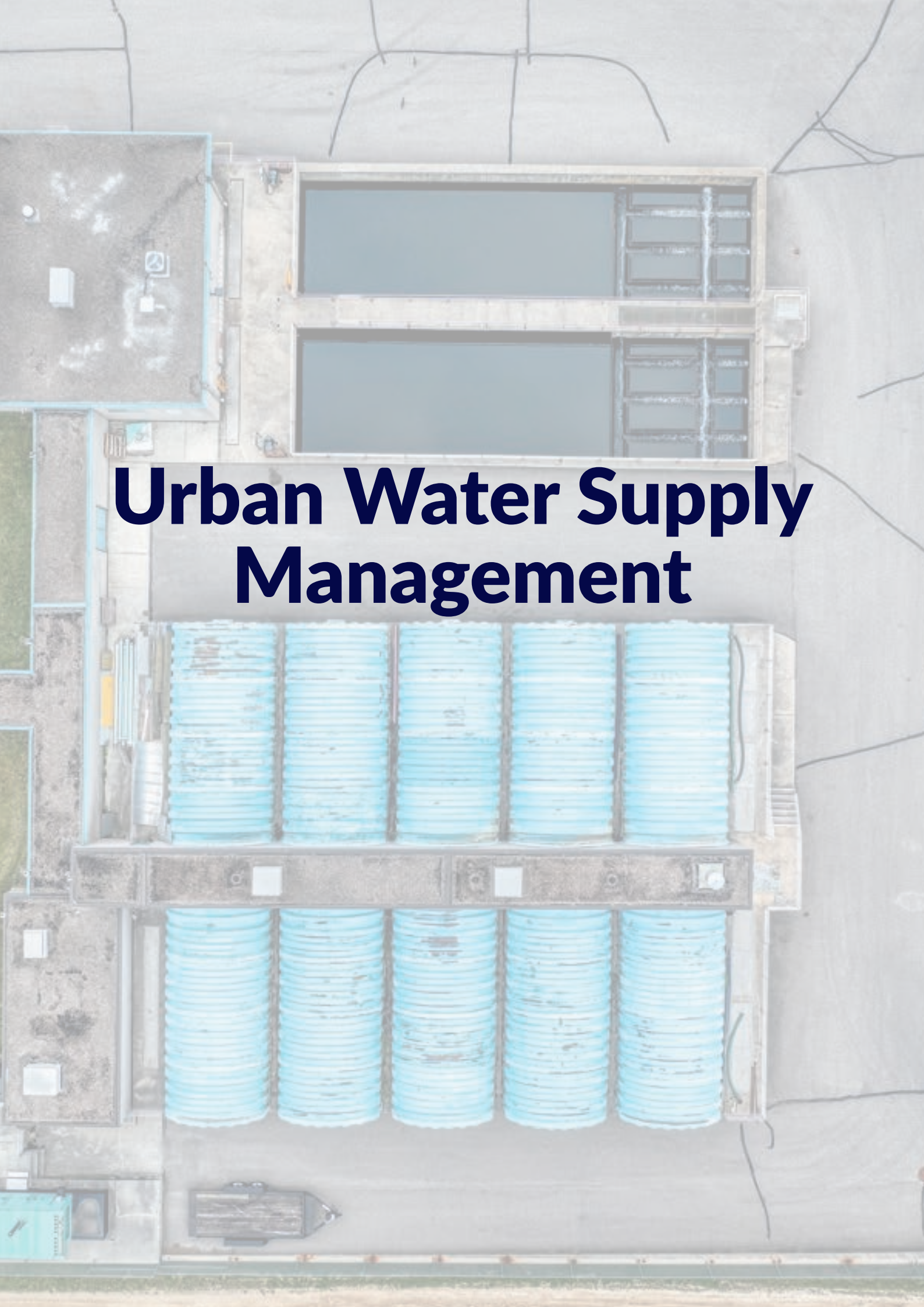


Urban Water Supply Management

BWSSB, Bengaluru by Pump Academy Private Limited.

Sector: Urban Water Supply Infrastructure

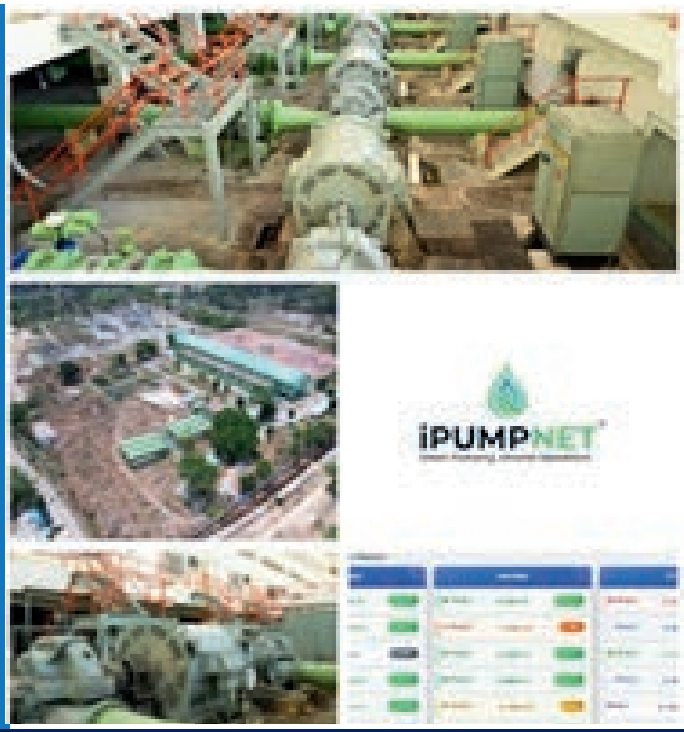
Location: Cauvery Water Supply Scheme (Stages I, II, III & Stage IV – Phase I), Karnataka, India

Objective

To optimize the operational efficiency of large-scale municipal pumping infrastructure through continuous performance monitoring, reduction of specific energy consumption per cubic meter pumped, early fault detection, and data-driven process optimization thereby improving reliability, energy efficiency, and lifecycle performance without reducing supply capacity.

Nature of Intervention

- AI and IoT-driven process optimization
- Operational efficiency improvement
- Predictive maintenance and condition monitoring



Best Practices Implemented:

A. Energy Performance Gap Identification & Optimization

- **Implementation Period**: 2024 - 2025
- **Intervention Type:** Process Optimization

Description:
IIoT and AI-driven monitoring was deployed across a 600 MLD multi-stage water pumping system to continuously measure flow, head, power consumption, vibration, and electrical parameters. A baseline study identified actual field efficiency at 74% versus achievable efficiency of 89%, revealing a 15% system-level performance gap.

Benefits:
- Quantified 15% efficiency gap
- Identified 68 million kWh annual avoidable energy consumption
- Enabled data-driven modernization strategy
- Improved asset-level and system-level transparency

Performance Benchmark:
- 15% efficiency improvement potential identified (74% → 89%) 68 million kWh annual energy optimization opportunity

Operational Context:
High-capacity, multi-stage municipal bulk water transmission systems

Scalability: High – replicable across legacy pumping infrastructure nationwide

Key Takeaway:

AI-enabled continuous process optimization transforms legacy pumping infrastructure from reactive operation to performance-governed systems, improving energy-water efficiency, operational stability, and long-term sustainability without reducing supply capacity.

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List of Abbreviations

- BCM: Billion Cubic Metre
- BOD: Biochemical Oxygen Demand
- BWUE: Bureau of Water Use Efficiency
- CAPEX: Capital Expenditure
- CGWB: Central Ground Water Board
- COD: Chemical Oxygen Demand
- CPCB: Central Pollution Control Board
- ETP: Effluent Treatment Plant
- FY: Financial Year
- HVAC: Heating, Ventilation, and Air Conditioning
- LPCD: Litres Per Capita per Day
- MEE: Multiple Effect Evaporator
- MoJS: Ministry of Jal Shakti
- NTU: Nephelometric Turbidity Unit
- OPEX: Operational Expenditure
- ORP: Oxidation-Reduction Potential
- pH: Potential of Hydrogen
- PPM: Parts Per Million
- RO: Reverse Osmosis
- SAR: Sodium Adsorption Ratio
- STP: Sewage Treatment Plant
- TDS: Total Dissolved Solids
- TSS: Total Suspended Solids
- ZLD: Zero Liquid Discharge
- TPH: Tons Per Hour
- PHE: Plate Heat Exchanger
- GCV: Gross Calorific Value

Disclaimer

This document has been prepared as a "Compendium on Best Practices on Water Use Efficiency by Industries" across the country. Every effort has been made to ensure the accuracy and reliability of the data and information included herein. However, the Ministry of Jal Shakti assumes no legal responsibility for the correctness of the information provided, the interpretations made, or any consequences resulting from the use of this material. The data and information presented in this Compendium have been certified by the respective Industry Associations engaged in the water sector. The Ministry of Jal Shakti does not claim ownership or copyright over any images included in the Compendium.


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