

Safe Reuse of Treated Water (SRTW): Industrial Business Models to Encourage Reuse

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Core Areas that MGC focusses on...



Water Resources Management

Waste Management

Climate Resilience

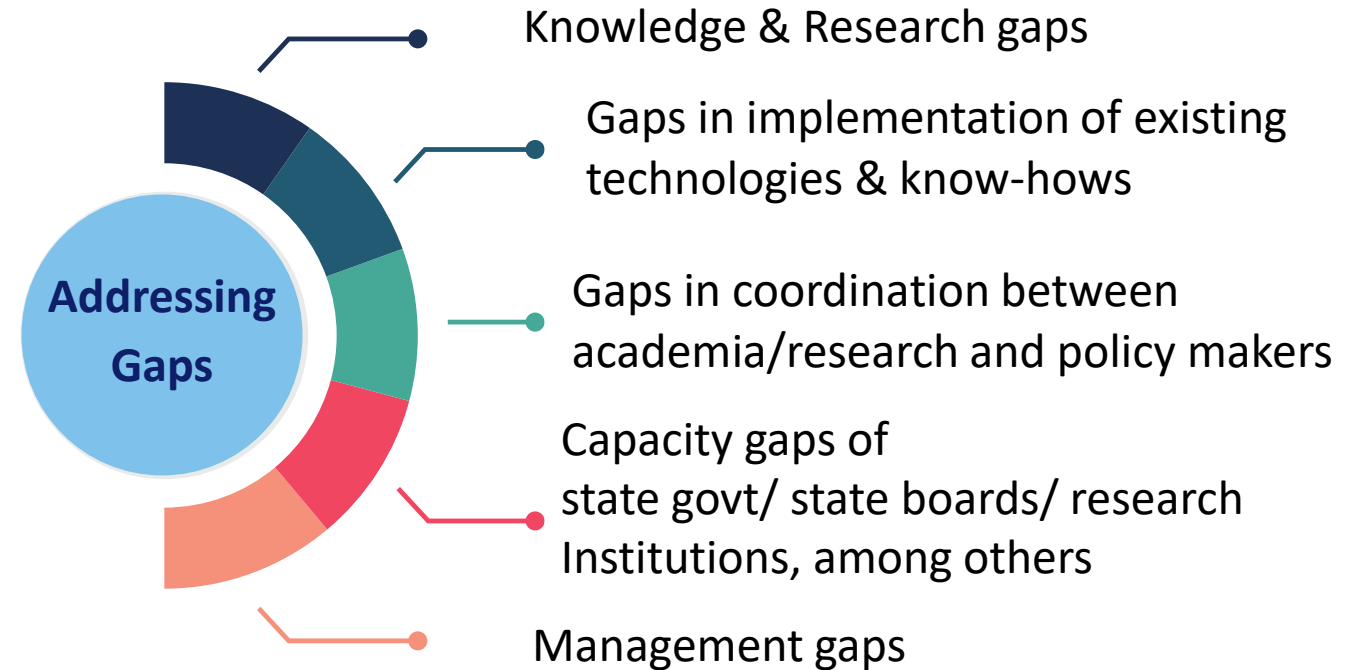


We are...

Knowledge creator

Knowledge customiser

Knowledge connector





About MGC

What

Knowledge Products in the niche area of expertise

SBM, JJM, AMRUT, LiFE Mission, Namami Gange

How

- Conduct **research** to fill in knowledge gaps
- **Engagement** with stakeholders to co-develop solutions
- **Advocate** for evidence based scientific solutions
- Build **capacity** of stakeholders

Approach

Science-informed policy recommendations

Impact



- **New Knowledge** created on CECs, MPs in River Basin scale
- **Two RBM plans** developed in India based on **customized knowledge solutions** given
- **National Framework** for SRTW developed
- SRTW for UP and UK under preparation
- **Leh City Sanitation Roadmap**
- **Hand Hygiene Roadmap for Odisha**

Adoption

- Solutions fed into **National and International policy documents** - India's NIP for Stockholm Convention; UN Plastic Pollution Treaty, PWM Amendment Rules, National Framework for SRTW, Business model for ULBs, Code of conduct for agri-plastics (FAO)
- Knowledge products adopted by various **Government and International bodies and other stakeholders**
- SRTW solution document for Panipat

About MGC

Impact of our work



Capacity Building & Training

- Policy Makers- 300+
- State Level Officials – 500+
- Local government officials-1500+
- Training Institutes- 20+
- Youth-15000+

Policy Advocacy

- Number of policy advocacy documents: 15
- Direct contribution: National Framework for SRTW, Solution Document for Panipat and Business compendium for SRTW.
- Expected to drive Circular Economy in Used water management; PWM

5
Suggestions taken
into account for
global Plastic treaty
UNEA 5.2

5
Policies at
International,
National and State
levels

7
Suggestions taken
into account for
national policy PWM
Amendment Rules

Outputs: Policies, Policy Briefs and Discussion Papers

DISCUSSION PAPER
ALIGNING INDIA'S SANITATION POLICIES WITH SUSTAINABLE DEVELOPMENT GOALS (SDGs)

Authors: Grijja K Bharat, Nathaniel B Dishar and Many...

POLICY BRIEF
Faecal Sludge Management in Urban India: Policies, Practices and Possibilities

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
Swachh Bharat Mission (Urban) Towards Clean India: A Policy Perspective

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

DISCUSSION PAPER
Perspective on a Water Resilience Policy for India

Authors: Neha Lakshman, Dr Grijja K Bharat & Dr S Sankar

DISCUSSION PAPER
Climate Resilience in Water Resource Management in India: A Conceptual Framework for Action

Authors: Neha Lakshman, Dr Grijja K Bharat & Dr S Sankar

ACTIONABLE HAND HYGIENE ROADMAP FOR ODISHA

Authors: Grijja K Bharat, Anand Turgur, Dr S Sankar

POLICY BRIEF
State of Urban Water and Sanitation in India

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
People, Planet, and Progress Beyond 2015

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
Monitoring of Community Signaling the Spread of COVID-19

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
Endocrine-disrupting chemicals in food and drinking water

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
Detecting SARS-CoV-2 in Wastewater: An Early Warning Signal for COVID-19

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

POLICY BRIEF
Safe Reuse of Treated Water in Panipat

Authors: Dr S Sankar, Anand Turgur, Dr Gajendra Bharat

Contents

National Framework on Safe Reuse of Treated Water (SRTW)

- Launch, Vision, Context, Outline, Objectives
- Reuse: sources and uses
- Expected outcomes
- Roles and Responsibilities, National Advisory Council on SRTW

Compendium on SRTW business models

SRTW Business Models for Industrial Reuse

- Business Model 1: Chennai, Tamil Nadu, India
- Business Model 2: Mathura, Uttar Pradesh, India
- Business Model 3: Delhi, India
- Business Model 4: Kalundborg, Zealand, Denmark



National Framework on Safe Reuse of Treated Water (SRTW)



The National Framework for Safe Reuse of Treated Wastewater was published by the National Mission for Clean Ganga (NMCG). It provides guidelines for the formulation of State reuse policy and intends to build appropriate market and economic models for the reuse of treated wastewater.



The National Framework on SRTW was launched in January 2023 by the National Mission for Clean Ganga (NMCG)

VISION: Widespread and safe reuse of treated used water in India that reduces the pressure on scarce freshwater resources, reduces pollution of the environment and risks to public health, and achieves socio-economic benefits by adopting a sustainable circular economy approach.

The Policy sets the context, priorities and direction for SRTW:

- Move India on a **pathway of mainstreaming SRTW** by 2022 by encouraging States to adopt the necessary enabling environment and actively promoting its implementation.
- View SRTW as part of the **wider water cycle** encouraging multiple cycles of use and reuse
- Contribute to the Government's **commitment to environmental sustainability** and achievement of SDG 6.3 on improving water quality through increased recycling and safe reuse.
- Define the **roles and responsibilities** of various government entities and agencies and of other key stakeholders such as industry and other parts of the private sector, local government, civil society organisations and citizens.
- Establish new **funding mechanisms** and support synergies among relevant Central Government programs such as AMRUT, NMCG, SMB and Jal Jeevan Mission.
- Support initiatives on **river basin planning** including the potential for SRTW within the catchment water cycle and clarify entitlements to water.

Sources of used water for reuse covered by the SRTW Policy

- Wastewater generated by households and commercial enterprises in both urban and rural settings
- Not industrial wastewater – that is covered under a separate CPCB initiative on Zero Liquid Discharge
- Special considerations are needed where industrial wastewater is mixed with municipal wastewater – prioritize separation

Potential areas of Reuse - *priorities to be defined by each State depending on prevailing demand and viability*

- industry (including industrial estates, power generation and railways)
- agriculture (including forestry and horticulture) and aquaculture
- municipal uses (e.g. landscaping, parks, toilet flushing, firefighting, ...) – not potable water
- environment, including discharge into surface water bodies and maintenance of wetlands and environmental flows
- aquifer recharge (subject to stringent controls)
- construction
- on-site use within STPs, including landscaping and cleaning of desludging vehicles

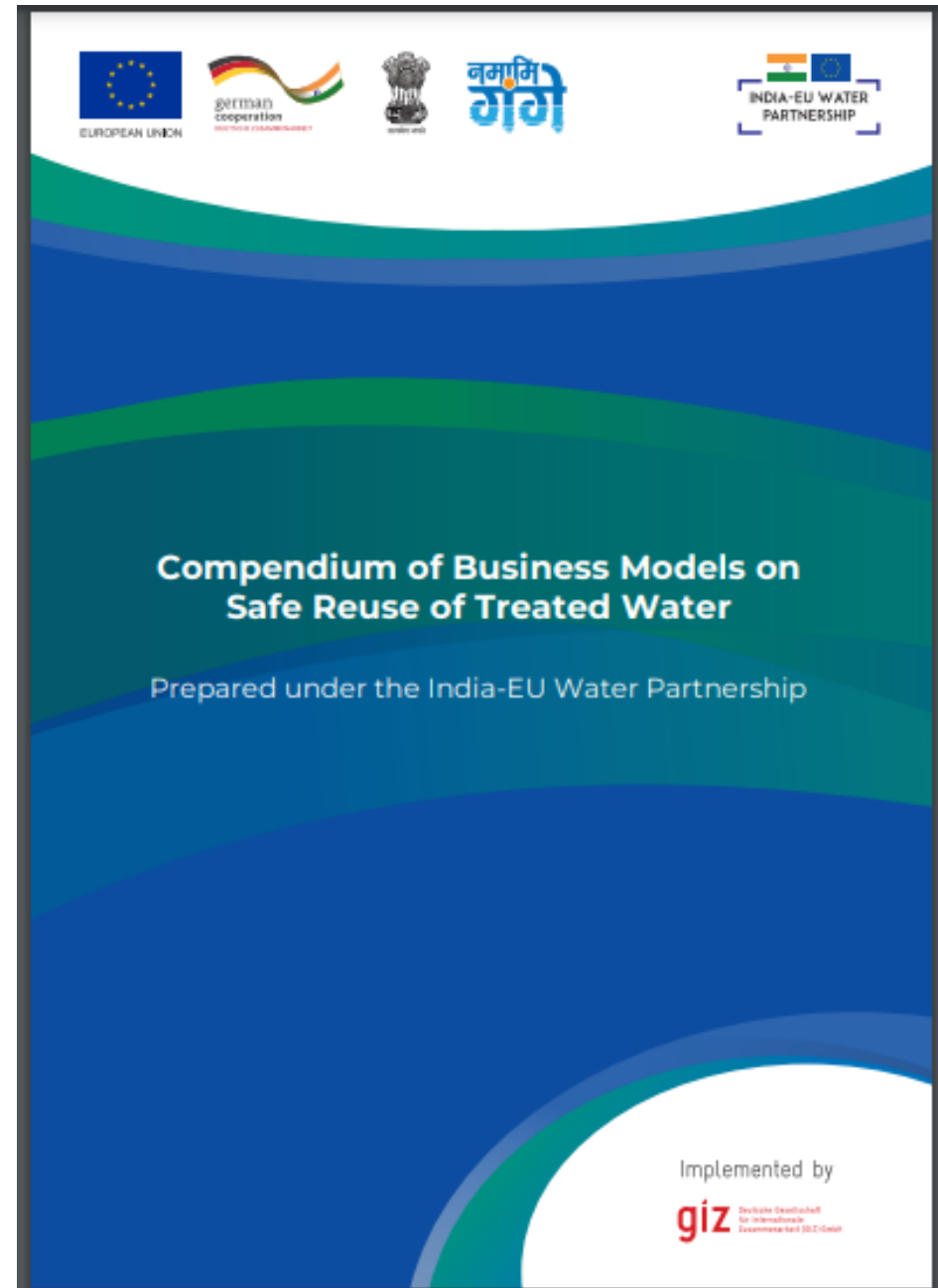
Where tertiary treatment is required, the costs will be covered by the end-user, e.g. for industrial re-use

The Policy is expected to yield significant benefits in terms of:

- **Water security** – replacing freshwater use by SRTW will reduce pressure on surface and groundwater resources
- **Health benefits** – due to reduced pollution of water bodies
- **Environmental benefits** – by reducing the contamination of surface water bodies and groundwater from pollution by human waste
- **Social benefits** – through improvements in productivity and wellbeing
- **Economic benefits** – by viewing waste as a resource and opening up a revenue stream to treat used water, reducing risk for food safety, and providing green jobs
- **Innovation and more efficient technology** – as research and development flourishes and benefits of scale are achieved
- **Increased capacity** in ULBs to implement SRTW projects including cross-sector collaboration
- **Reduced climate emissions** – resulting from reduced pumping of freshwater

Compendium on SRTW business models

- Serves as good practice documentation to support the National Framework on SRTW by identifying and assessing viable business models for SRTW.
- Includes 10 SRTW case studies from India and Europe



SRTW Business Models for Industrial Reuse

- **Business Model 1: Chennai:** Reuse of secondary & tertiary treated used water by petrochemical industries and State Industries Promotion Corporation Tamil Nadu (SIPCOT), Chennai
- **Business Model 2: Mathura:** Reuse of treated water from the sewage treatment plants of Mathura Refinery of Indian Oil Corporation Ltd. (IOCL)
- **Business Model 3: Delhi:** Integrated Wastewater Reuse System at Delhi International Airport Limited
- **Business Model 4: Kalundborg:** Business value chain and business model at Kalundborg Eco-Industrial Park, Denmark

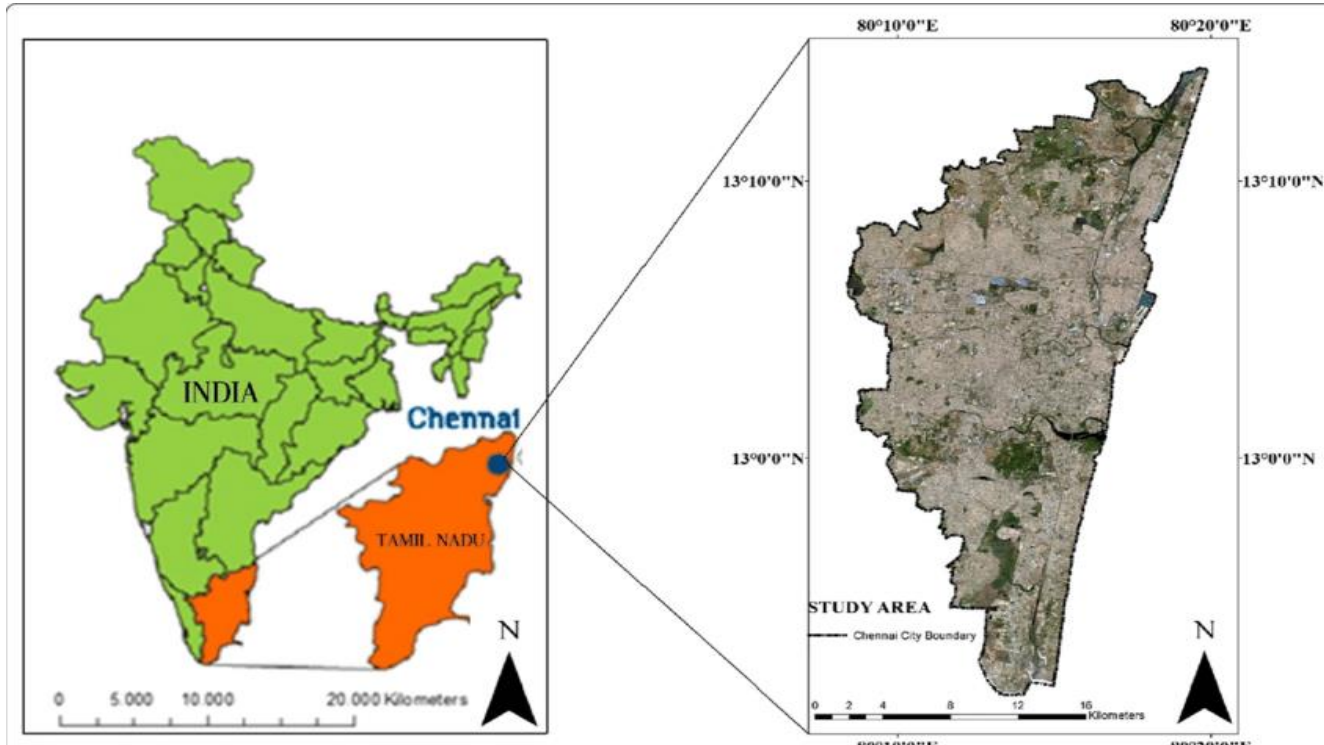




Business Model 1: Chennai

Reuse of secondary & tertiary treated used water by petrochemical industries and State Industries Promotion Corporation Tamil Nadu (SIPCOT), Chennai

City Context and Background



Location: Chennai, Tamil Nadu, India

Population Growth: 10.9 million (2020), 2.3% annual growth.

Water Scarcity:

- Day Zero in June 2019.
- Water supply reduced to 525 MLD against demand of 1,200 MLD.

Government Initiative:

Reuse of treated wastewater to reduce water stress.

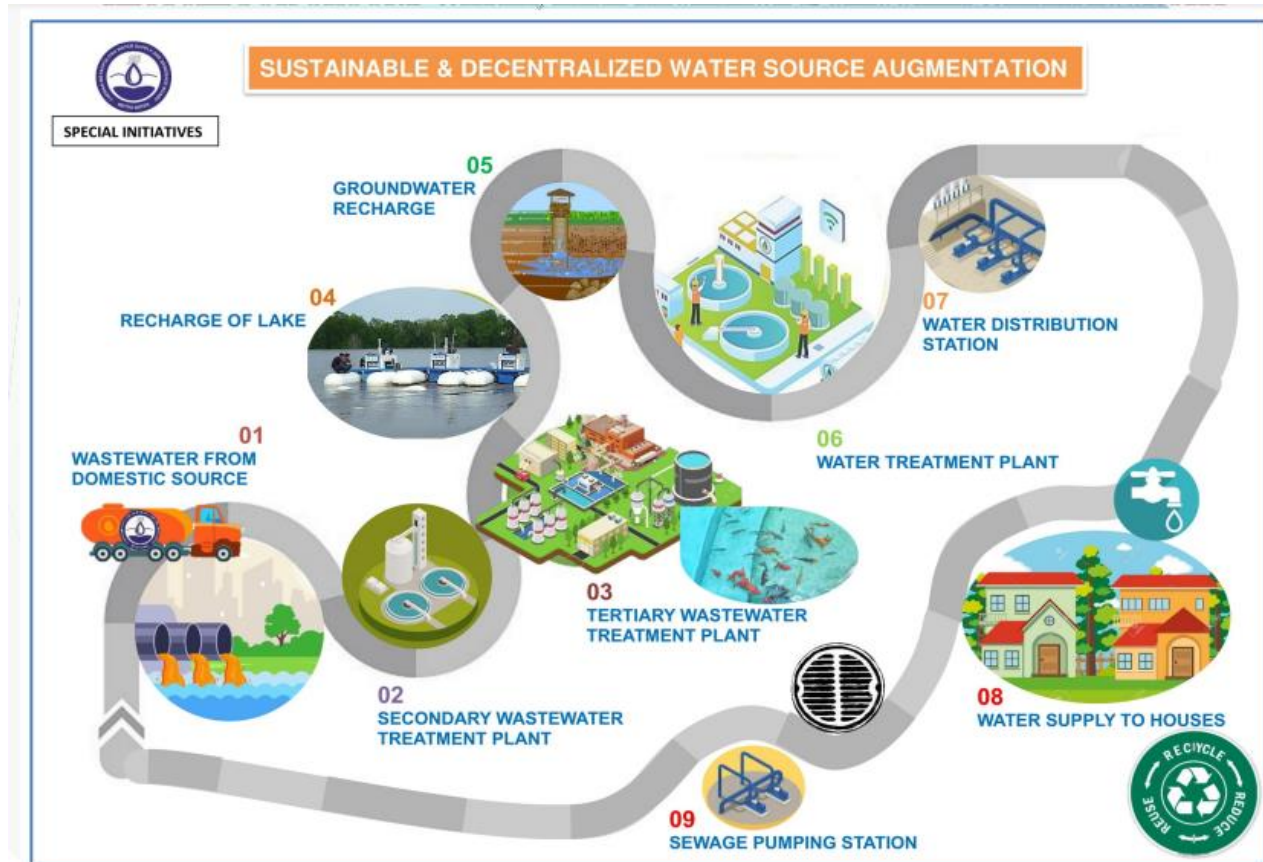


Water Reuse Models by CMWSSB:

- Secondary treated water for petrochemical industries (CPCL, MFL, MPL).
- Tertiary treated water for SIPCOT.

Usage Statistics:

- 10% of treated water reused (2020).
- 90 MLD of tertiary treated water reused for industrial purposes.



Sewage Treatment Capacity:

- 13 STPs, 745 MLD capacity.

TTRO Plants:

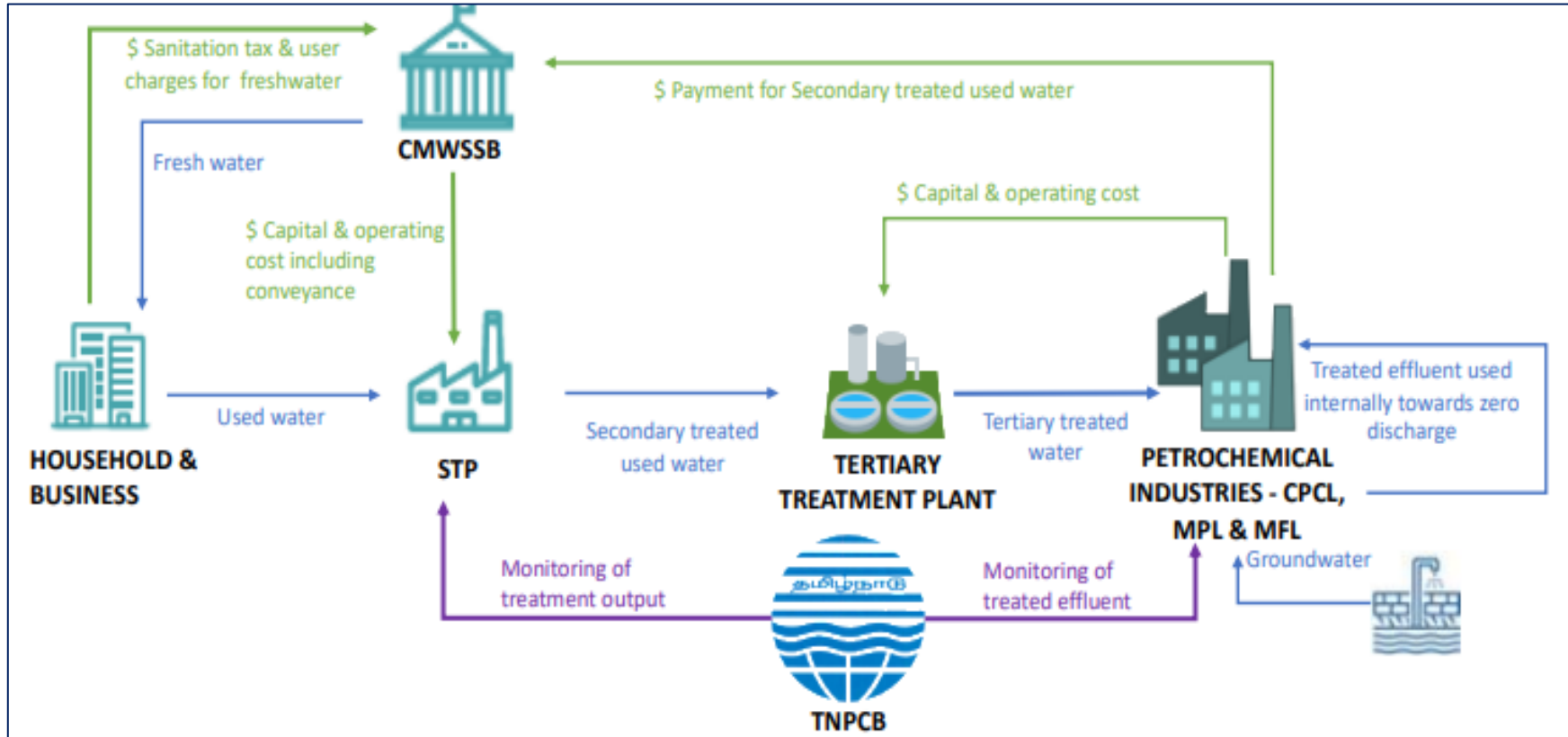
- 2 plants (Koyambedu, Kodungaiyur), each 45 MLD capacity.

Treatment Stages:

- **Primary:** Pre-chlorination, rapid sand filters.
- **Secondary:** Ultrafiltration.
- **Tertiary:** Reverse osmosis, ozonation.

Chennai Business Model

Business Models for Industrial Reuse



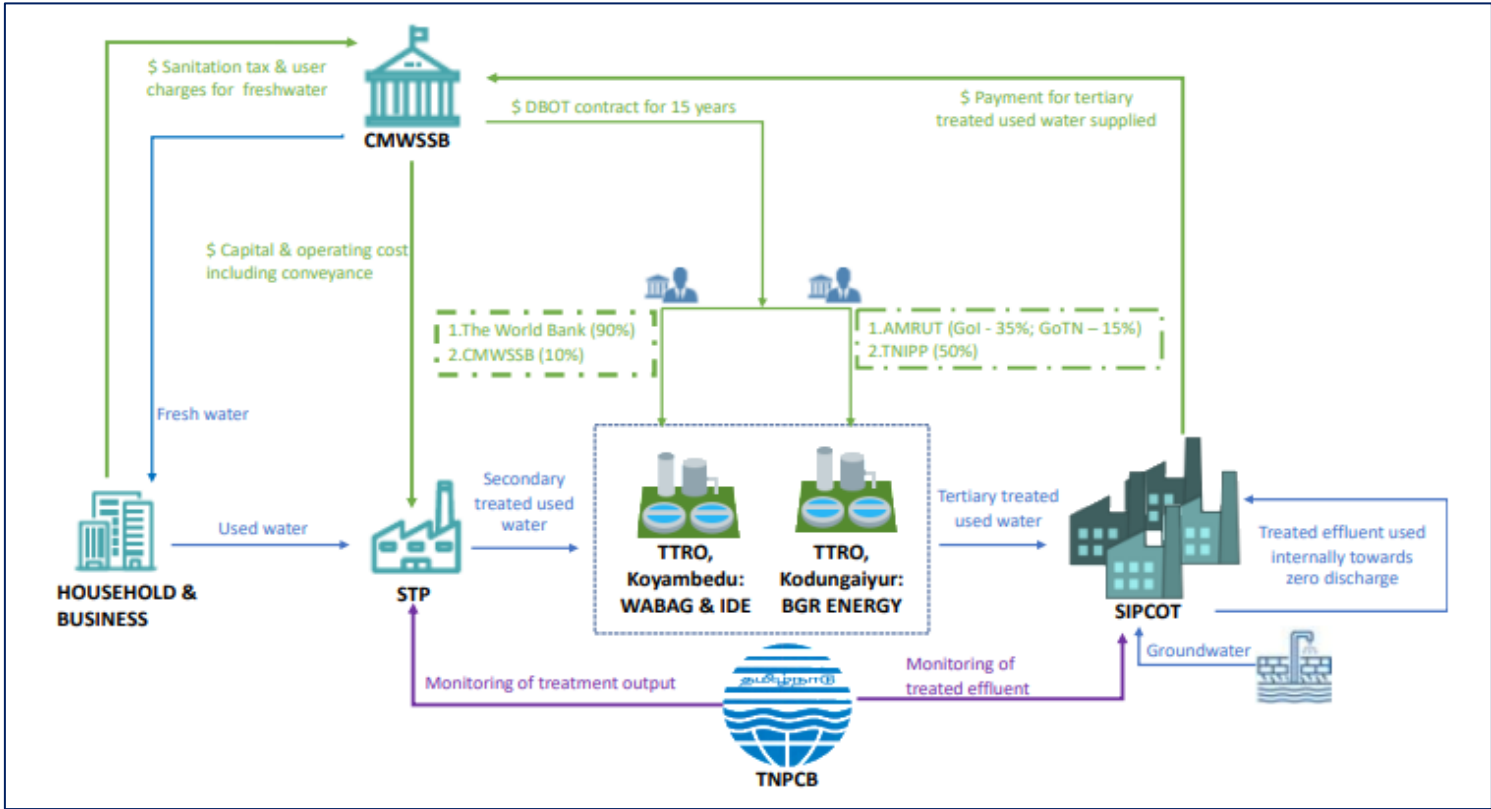
Chennai Business Model 1: Secondary treated water supplied to petrochemical industries

- Petrochemical industries (CPCL, MPL, MFL) invest in tertiary treatment and operations.

Chennai Business Model 1: Secondary treated water supplied to petrochemical industries

Chennai Business Model

Business Models for Industrial Reuse



Chennai Business Model 2: Tertiary treated water supplied to SIPCOT

- Sewage from households treated at STP
- CMWSSB transports secondary treated used water to TTP in Koyambedu and Kodungaiyur
- TTRo plants set up under Design-Build-Operate (DBO) contracts.
- CMWSSB provide tertiary treated water to SIPCOT.
- Key partners: M/s Wabang – IDE consortium (Koyambedu) & M/s. BGR Energy Systems Ltd (Kodungaiyur)

Chennai Business Model 2: Tertiary treated water supplied to SIPCOT

Funding and Financials



Model 1: Capital cost: Rs. 760 million (CPCL).

Annual operating cost: Rs. 378 million.

Water price: Rs. 20.25/m³.

Model 2: Koyambedu TTRO: Rs. 3.94 billion (World Bank, CMWSSB funding).

Kodungaiyur TTRO: Rs. 2.55 billion (AMRUT, TNIPP funding).

Water price: Rs. 130/m³.

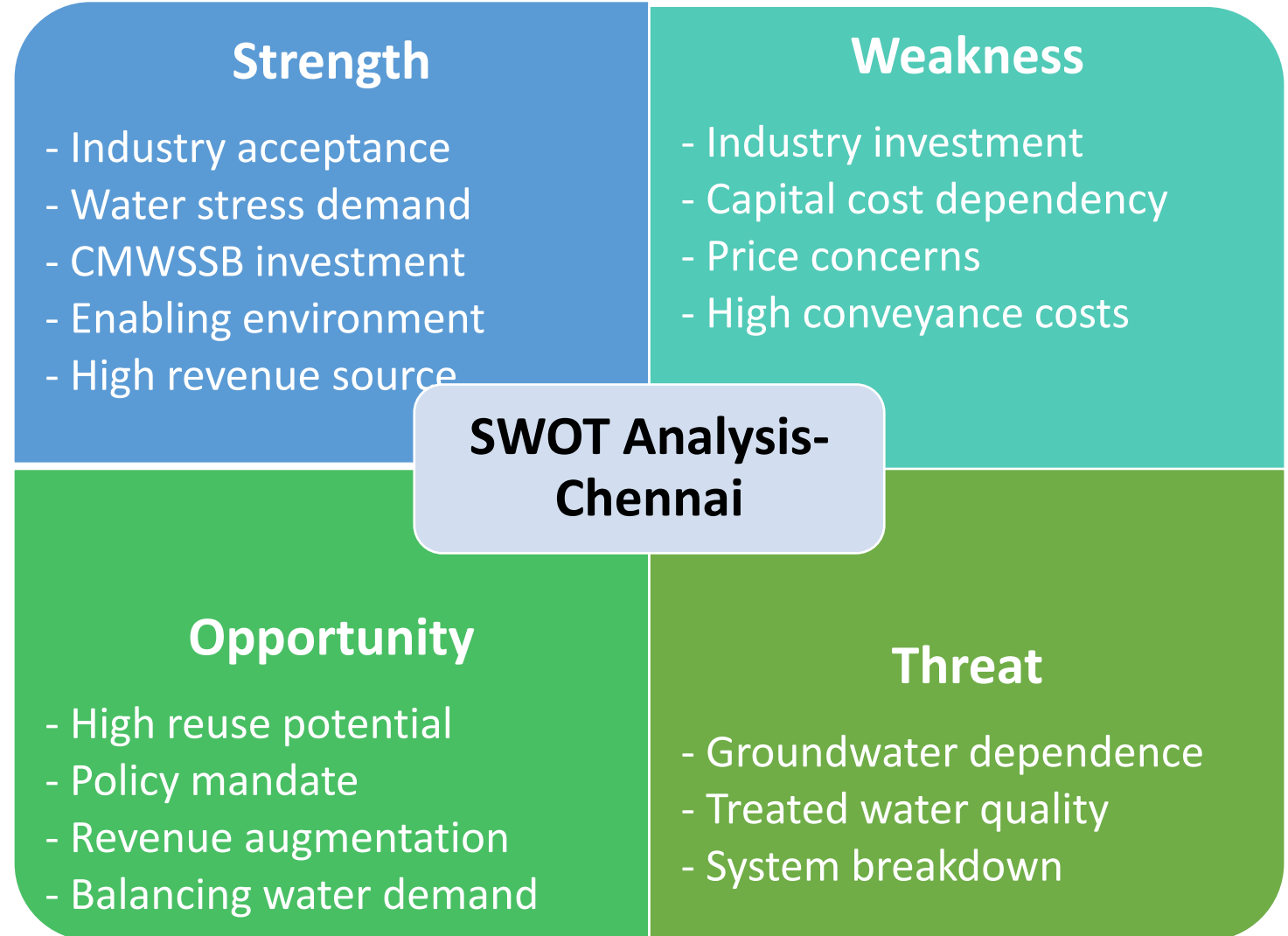
Benefits & Assessment

Environmental Benefits:

- Reduced freshwater demand, reduced groundwater depletion.
- Lower GHG emissions compared to desalination plants.

Future Goals:

- Increase STP capacity to 600 MLD by 2026, reuse 50% of treated water.





Business Model 2: Mathura

Reuse of treated water from the sewage treatment plants of Mathura Refinery of Indian Oil Corporation Ltd. (IOCL)

Overview & Project Goals

- **Location:** Mathura, Uttar Pradesh, India
- **Project:** IOCL Mathura Refinery wastewater reuse initiative
- **Population (2021):** 481,000
- **Treatment Capacity:** 20 MLD Tertiary Treatment Plant (TTP)

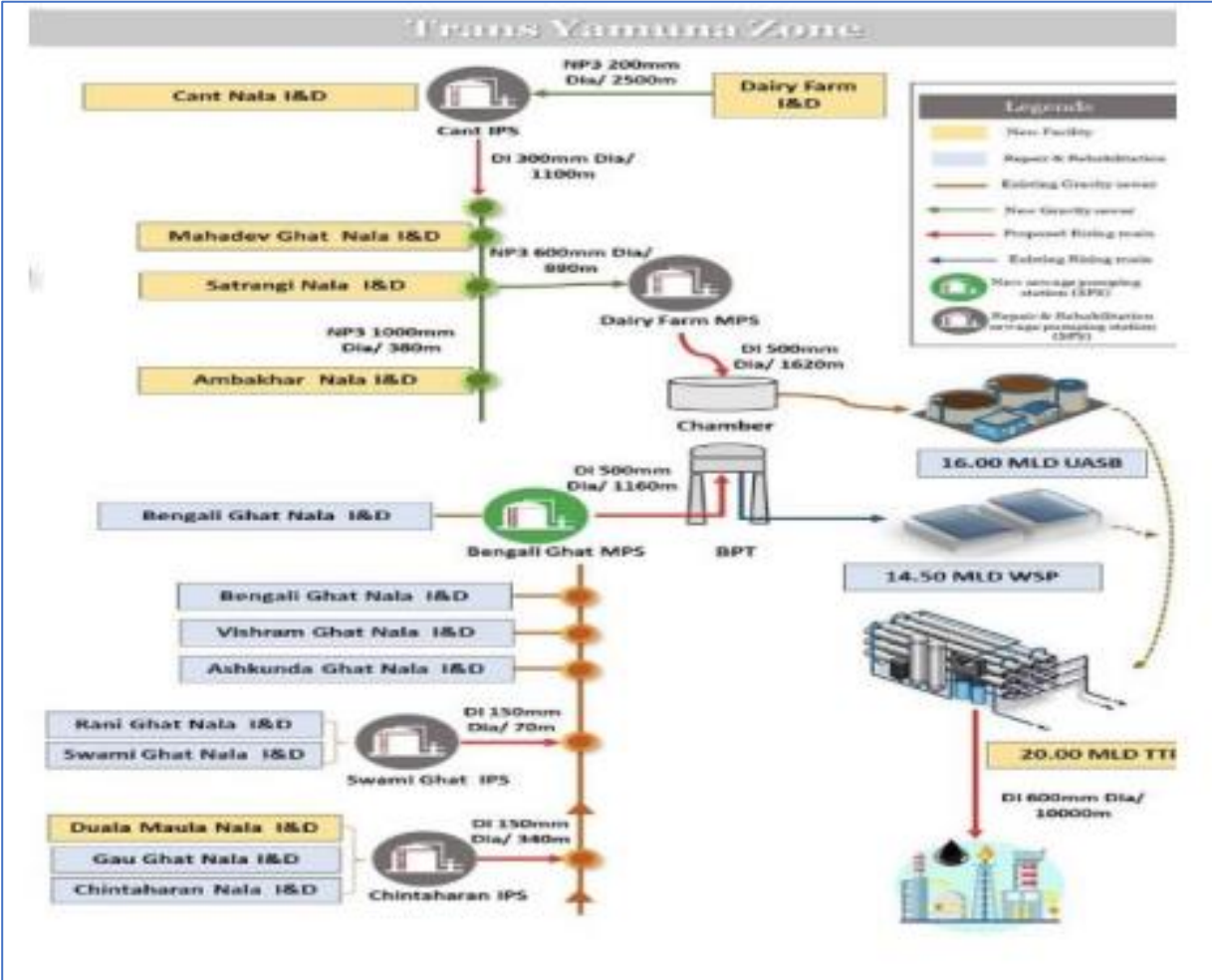
Project Goals

- Divert raw sewage from the Yamuna River to Sewage Treatment Plants (STPs).
- Treat sewage effluents for industrial reuse by IOCL.
- Employ international best practices for STP and TTP operations and maintenance.

Key Stakeholders

- NMCG
- UP Jal Nigam
- Indian Oil Corporation
- Ministry of Jal Shakti
- Ministry of Petroleum & Natural Gas
- Mathura-Vrindavan Development Authority
- Mathura-Vrindavan Nagar Nigam
- Mathura Wastewater Management Pvt. Ltd.
- Triveni Engineering & Industries Ltd. or Mahindra Consulting Engineers, Chennai

Infrastructure Details



- Components:**
- 20 MLD TTP at Lakshmi Nagar (RO technology).
 - 67.3 MLD total sewage treatment capacity through new and rehabilitated STPs.
 - 10.11 km pipeline for treated water disposal.
- Treatment Technology:**
- Coagulation, flocculation, disinfection (PAC, Sodium Hypochlorite).
 - Reverse Osmosis for advanced TDS removal.

Integrated Sewage Infrastructure Development of STP and Associated Infrastructure under HAM based PP mode at Mathura



Indian Oil signed agreement for reuse of treated water for Mathura Refinery

Source: <https://www.psuconnect.in/news/indianoil-signs-agreement-for-reuse-of-treated-water-for-mathura-refinery/16313>

Water Reuse:

- 70% treated wastewater recycled (402 m³/hr).
- Reduction in freshwater dependency by 2 crore liters/day.
- 7 STPs and 39% of total water reused from the Mathura WWTPs

Pollutant Treatment Methods:

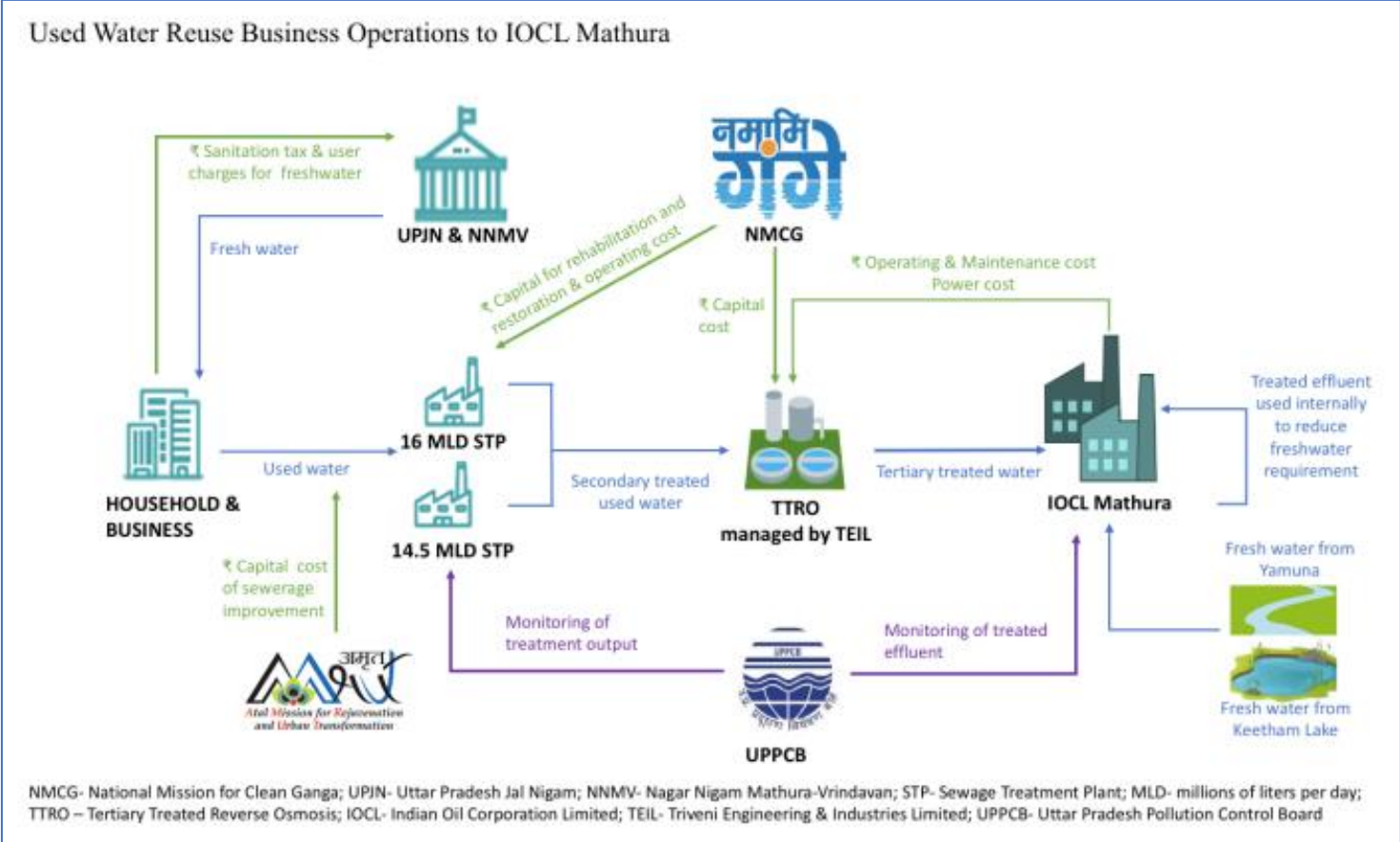
- Biological oxidation, sedimentation, disinfection, and RO systems.

Compliance:

- Meets CPCB discharge standards.

Mathura Business Model

Business Model Highlights



"One City-One Operator" Concept:

- Integrated management of STPs and TTPs.

Hybrid Annuity Model (HAM):

- Total cost: ₹437.95 crore.
- IOCL pays ₹8.70/kL for treated water.

Revenue Streams:

- Sale of tertiary treated water to IOCL.

Business value chain of Industrial reuse in IOCL Mathura

Funding & Financing



Total Cost: ₹460.45 crore under Namami Gange Programme.

Breakdown: ₹27,557.60 lakh for Mathura STP components.
₹16,237.47 lakh for Mathura TTRO – IOCL components.
₹2,250.40 lakh for additional project components.

Concession Agreement: Capital costs covered by NMCG.

IOCL responsible for operational and electricity expenses.

Impacts & Assessment

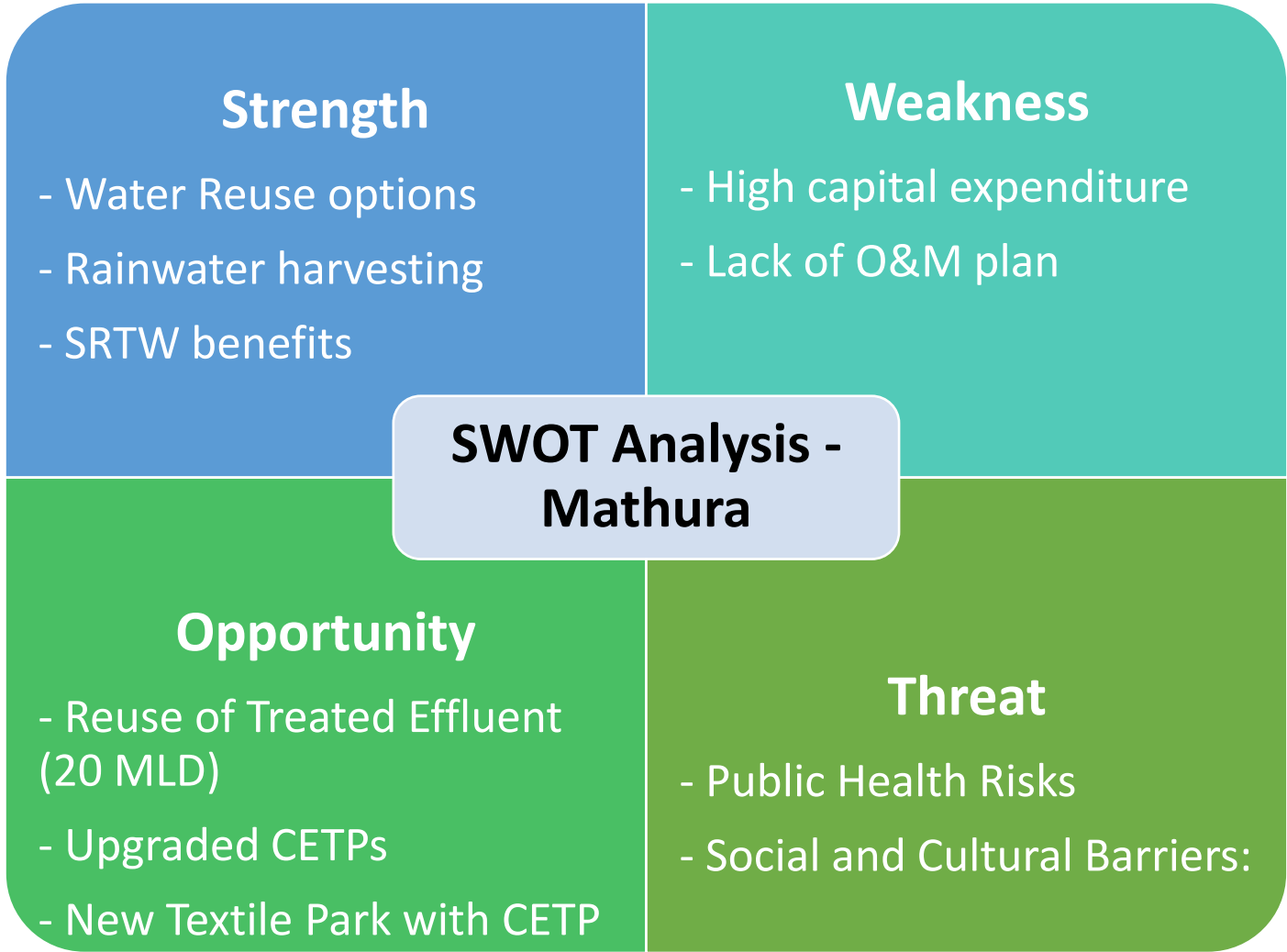
Environmental & Social Impacts

Benefits:

- Reduced dependency on freshwater from Yamuna River.
- Promotes circular economy through water reuse.
- Social acceptance and improved infrastructure investment.

Challenges:

- Operational complexities and water availability concerns.





Business Model 3: Delhi

Integrated Wastewater
Reuse System at Delhi
International Airport
Limited (DIAL)



City Context & Background

- **Location:** New Delhi, India
- **Population (2021):** 20 million
- **Water Scarcity:** 18% deficit in water supply.
- Delhi Jal Board (DJB) responsible for water production, distribution, and sewage management.

Objective:

- Promote sustainable water use through wastewater reuse for irrigation, HVAC, and toilet flushing.

Key Drivers:

- Water scarcity, environmental sustainability, biodiversity promotion, and cost savings.

Wastewater Treatment & Reuse Infrastructure



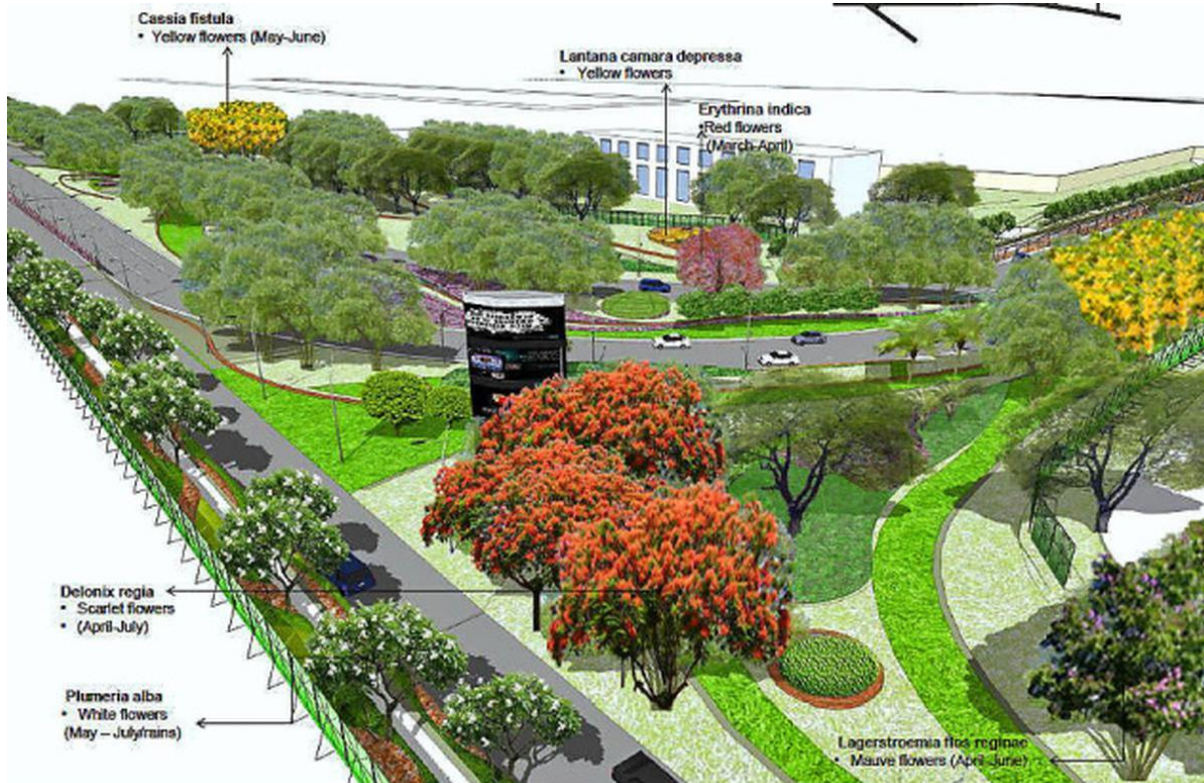
Sewage Treatment Plant (STP):

- Capacity: 16.6 MLD
- Treatment: Primary, secondary, tertiary with advanced filtration systems (UF & RO).
- Uses: Irrigation, HVAC, sanitation (flushing).

Efficient Systems:

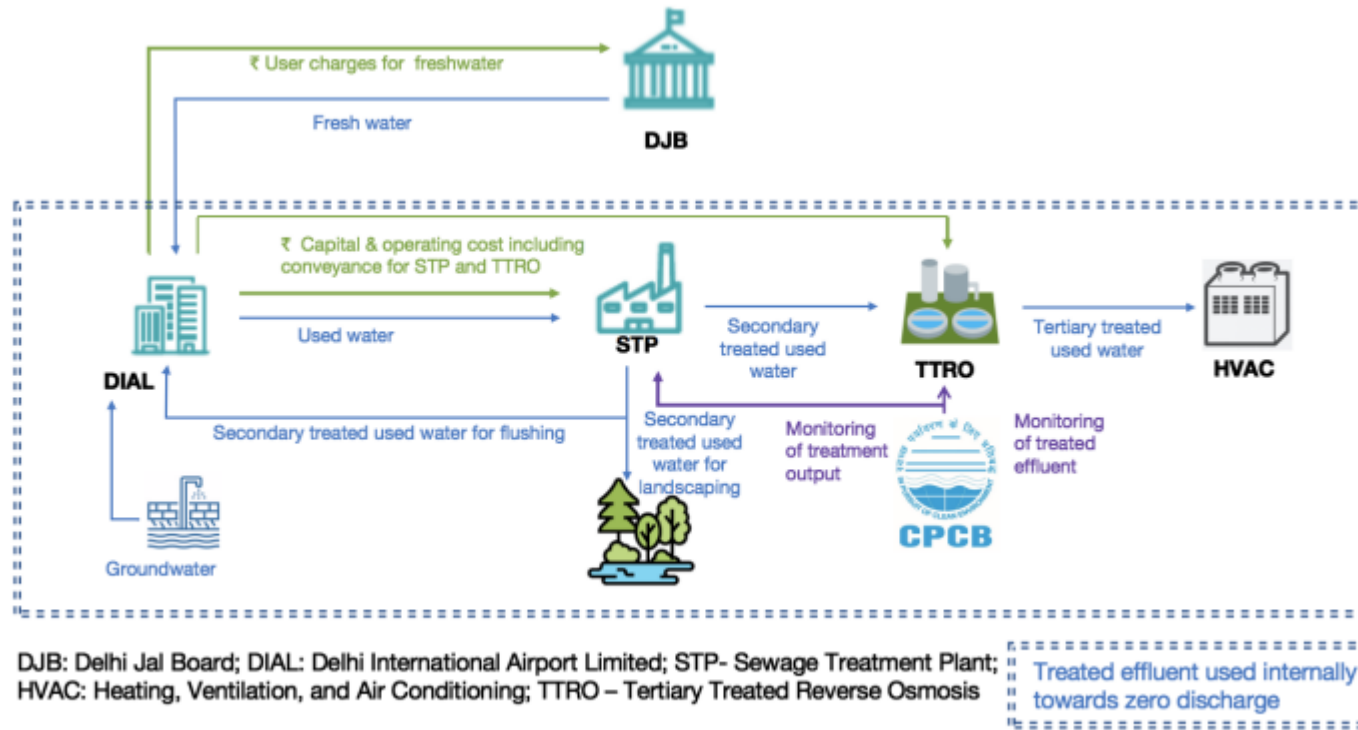
- Automated and energy-efficient infrastructure.
- Regular quality monitoring via MoEF&CC/NABL approved labs.

Landscaping & Irrigation



- **Area:** 120 acres of landscaping.
- **Trees Planted:** Over 19,000.
- **Water Source:** Entirely treated wastewater via drip irrigation.
- **Automatic Water Dispensing:** Optimizes water usage for irrigation.
- **Environmental Impact:** Conserves freshwater resources and reduces wastewater discharge.

Business Model & Key Partners



Key Partners:

- DJB
- DIAL
- Airports Authority of India (AAI)

Key Activities:

- Water treatment & conveyance for horticulture, flushing, and cooling.

Value Proposition:

- Water reuse reduces freshwater demand for non-potable uses

Economic Impact & Savings

- Water Savings: Saves INR 25 crores annually through treated water reuse.

Cost Breakdown

- CAPEX: 350 Crores
- OPEX: 419.667 lakhs per year

Water Treatment

- 7 MLD for potable water; treated water for non-potable uses.

Institutional Environment & Green Financing

Green Bond & Loan Principles:

- Financing through green bonds and loans to support eco-friendly initiatives.

DJB implements treated water reuse projects under the DJB Act of 1998.

Social and environmental costs and benefits



Social & Environmental costs

- High energy requirement to operate facility resulting in GHG (greenhouse gas) emissions

Social & Environmental benefits

- Conservation of Freshwater Resources
- Reduction of Wastewater Discharge to the environment
- Minimization of Environmental Impact
- Enhanced Resilience to Water Supply Challenges

Scalability & Analysis

Scalability & Replicability

Future Demand:

- Delhi's population expected to reach 29.1 million by 2031, increasing water demand.

Sustainable Urban Water Management:

- Integrated Urban Water Management (IUWM) and recycled treated water will reduce freshwater demand by 2041.





Business Model 4: Kalundborg

Business value chain
and business model at
Kalundborg Eco-
Industrial Park,
Denmark

Overview



- **Location:** Kalundborg, Zealand, Denmark
- **Population:** 16,211 (2016).
- **Focus:** Reuse of energy, material, and water flows.
- **Key outcome:** Optimization of wastewater treatment prices, efficiency, and effectiveness.
- **Evolution:** Developed into an advanced 'Industrial Symbiosis' over 20 years.
- **Eco-Industrial Park:**
 - ✓ Established in 1959 with Asnaes Power Station.
 - ✓ Links industries via shared energy and material flows.
 - ✓ Examples: Water reuse (700,000 m³/year), waste material exchanges, etc.

Wastewater Treatment and Water Reuse Infrastructure



Operator: Kalundborg Forsyning.

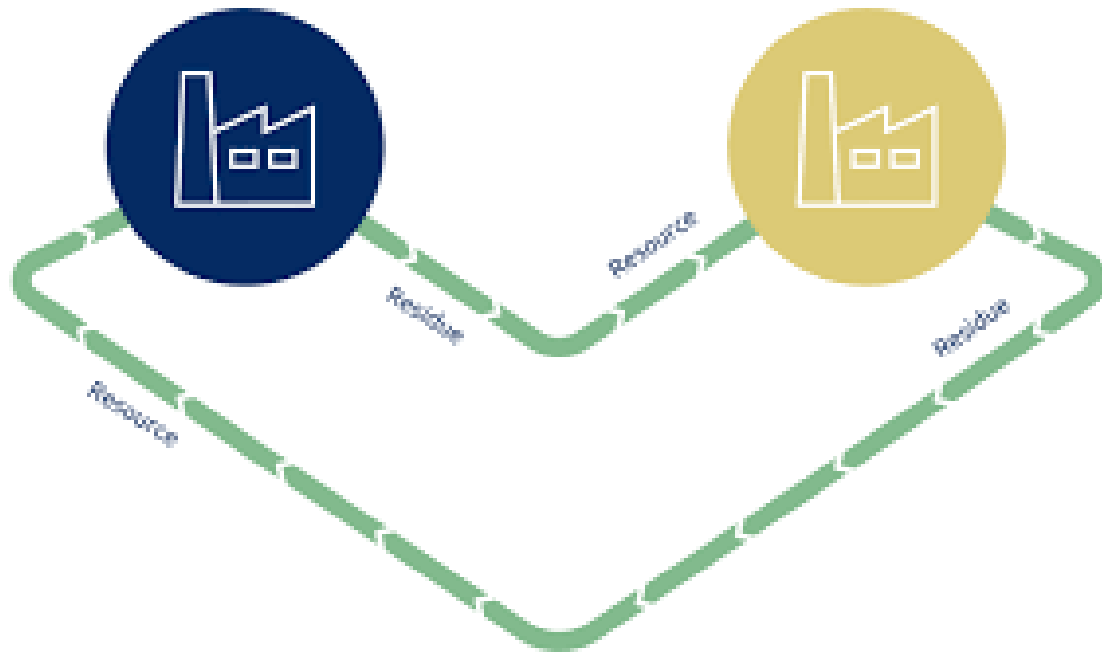
Capacity: 50,000 person equivalents.

Breakdown:

- 60% industrial wastewater.
- 40% municipal wastewater.

Advanced WWTP Features:

- Biogas plant for electricity and heat.
- Sludge reused as agricultural fertilizer.
- Tertiary treatment with ozonation and MBBR.



Water sector:

- Natural monopolies under Danish Water Sector Act.

Economic regulation:

- Revenue caps and efficiency benchmarks.
- Guidelines for cost recovery.

Climate adaptation funding:

- Wastewater companies contribute to dual-purpose projects (e.g., heavy rainfall systems).

Funding and Financing Model

Initial Investment: Tax-funded by the municipality.

Upgrades: Contributions by industries and municipalities.

Fee Structure:

- Water transport: €5.07/m³.
- Water treatment: €0.95/m³.

Special Fees:

- Rainwater treatment (municipality).
- High-pollution wastewater (polluting companies).

Social & Environmental costs and benefits:

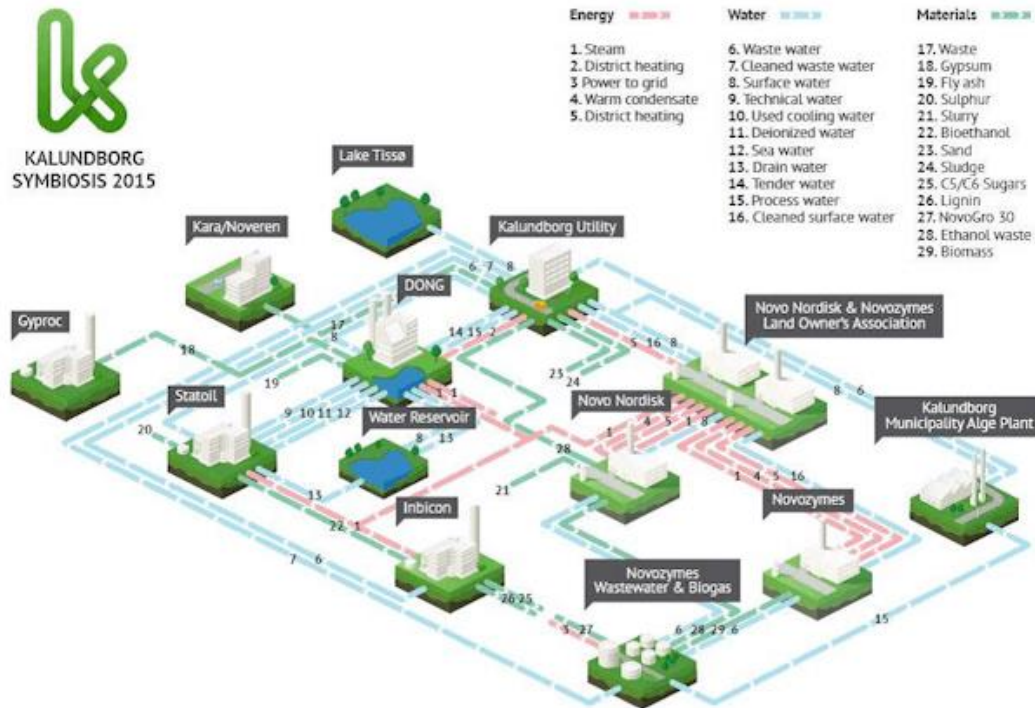
- **Costs:** High energy requirement to operate facility resulting in GHG (greenhouse gas) emissions
- **Benefits:** Reduced pressure on freshwater demand and groundwater depletion



Kalundborg
SYMBIOSIS

Kalundborg Business Model

Impacts, Scalability, and Replicability



Positive Impacts:

- Reduced waste generation and environmental footprint.
- Cost savings, efficiency, and competitiveness for industries.
- Job creation and economic growth.

Challenges in Scalability:

- Context-specific factors (industries, regulation, stakeholder commitment).
- High infrastructure and investment costs.
- Dependence on resource availability and partnerships.

Strength

- Resource sharing
- Minimizes waste and environmental footprint.
- Job creation
- Public health protection

Weakness

- Scalability Limitations

SWOT Analysis - Kalundborg

Opportunity

- Legal Frameworks
- Monopoly concerns

Threat

- Replicability challenges

Key Takeaways

- Kalundborg Symbiosis: A benchmark for circular economy and industrial symbiosis.
- Collaboration: Industries, municipalities, and regulatory alignment drive success.
- Lessons for replication: Context customization, resource availability, and long-term engagement.

Thanks!

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