Industrial Water Supply
- Incentives for Conservation


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The Water Crisis

- Continuing growth, development and population increases in many areas are straining existing water supplies
- Local governments (and states) are competing for available water sources
- Indoor and outdoor water conservation is not widely practiced

Water Conservation
Why should We Do It?
(more reasons than a drought)

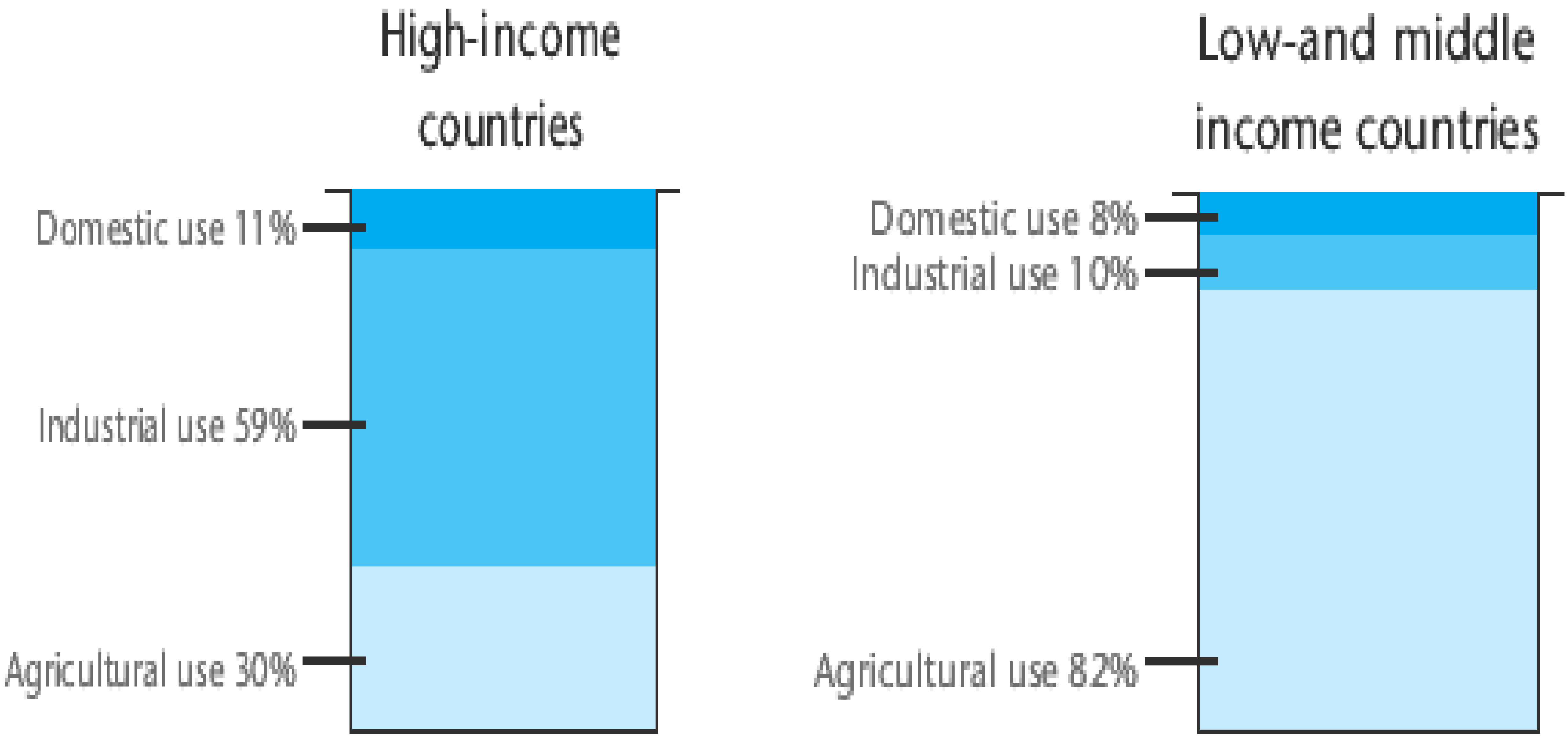
- Reduce personal water costs
- Minimize the need for local governments to fund expensive reservoir, water treatment plant and pipeline projects
- Help maintain sufficient water in streams, rivers and lakes for fishing, boating, swimming, protection of aquatic life and downstream users

Industrial Water Use

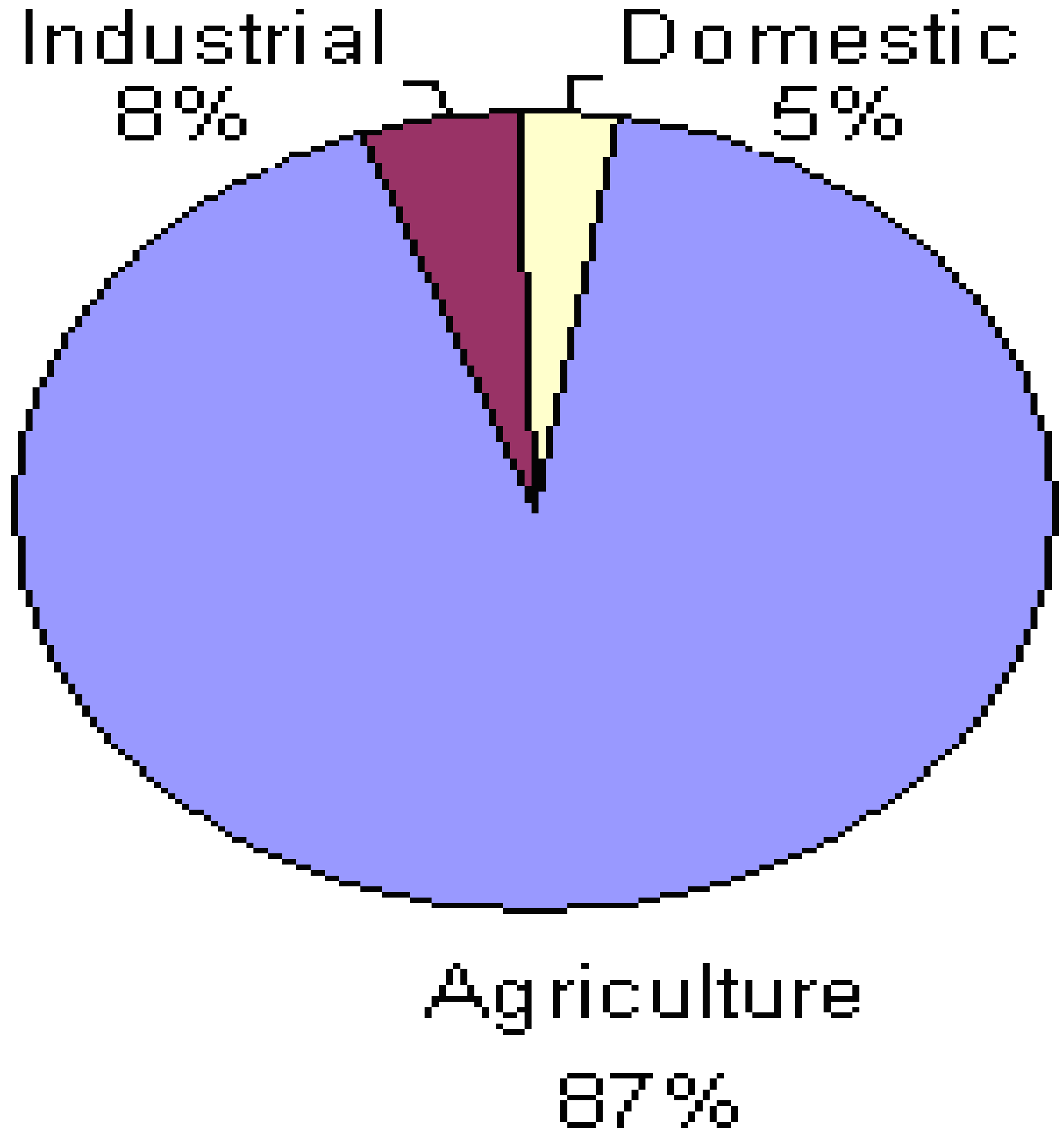
- Industrial water use is closely linked to the economy of a country

- As GDP increases, so will industrial water consumption

Global Industrial Water Use



India: National Water Use



Current scenario

- A basic necessity of industrial development is adequate availability of water.
- The Second Irrigation Commission in their report of 1972 recommended a provision of 50 b.cu.m. for industrial purpose for the country as a whole.
- However, a recent assessment indicates that requirement for industrial use during 2000 AD will be about 30 b.cu.m. while it will rise to 120 b.cu.m by 2025 AD
- Estimates by the Ministry of Water Resources (MoWR) indicate that water used for industry in India is around 7-8 per cent of the total freshwater withdrawal in the country. In the next two decades water consumption will triple current levels.

Current scenario

- The industrial sector is the second highest user of water after agriculture.
- India's annual fresh water withdrawals were about 500 billion cubic meters and the Indian industry consumed about 10 billion cubic meter of water as process water and 30 billion cubic meters as cooling water
- As per the World Bank studies, the water demand for industrial uses and energy production will grow at a rate of 4.2 percent /year, rising from 67 billion cubic meter in 1999 to 228 billion cubic meter by 2025. Therefore, according to World Bank the current industrial water use in India is about 13 per cent of the total fresh water withdrawal in the country.
- Cost of water supply varies widely and can be in the range of Rs. 0.09 to 50.0 per cubic meter.

Current scenario

- Although the industrial sector accounts for only 10% to 15% of the aggregate annual water demand in developing countries, water is a critical input for process and cooling requirements in a number of major industries.
- As documented in case studies from Nigeria and India, water shortages, unreliable supplies and high prices adversely affect the expansion of small and medium industries resulting in loss of employment opportunities for the poor.

Current scenario

- In a number of regions in India (Chennai, Hyderabad), China (Beijing, Tianjin), and Indonesia (Jakarta), and countries in the Middle-East, water supply and prices are emerging as one of the major constraints in growth of industries.
- Despite the overall apparent shortage of water, there are few incentives for efficient use of water in many parts of the world.
- Most countries have not developed instruments (either regulations or economic incentives) and related institutional structures for reallocating water between sectors, or for internalizing the externalities which arise when one user affects the quantity and quality of water available to another group

Constraints & Challenges

- Meeting this unprecedented demand for water with limited availability

- Besides water, there is substantial demand for land, power and other infrastructure

- Increased demand for potable water due to large scale employment by hi-tech / IT industries

What is Water Conservation?

Water conservation is defined as any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces the loss or waste of water, improves the efficiency of water use, increases recycling and reuse of water, or prevents the pollution of water (New Mexico Office of the State Engineer, 1997)

Ten Key Steps to Planning a Successful Water Conservation Program*

- Identify conservation goals
- Develop a water-use profile and forecast
- Evaluate planned facilities
- Identify and evaluate conservation measures
- Identify and assess conservation incentives

***From EPA Water Conservation Guidelines**

Ten Key Steps to Planning a Successful Water Conservation Program*

- Analyze benefits and costs
- Select conservation measures and incentives
- Prepare and implement the conservation plan
- Integrate conservation and supply plans, modify forecasts
- Monitor, evaluate and revise program as needed

***From EPA Water Conservation Guidelines**

Conservation programs should have a mix of *Incentives* and *Measures*

- ***Incentives:*** "carrots and sticks" that prompt users to want to save water and adopt a conservation measure
- ***Measures:*** Implementation of hardware and behavioral changes that result in water savings

Water Conservation Incentives

- ***Educational***

  -School education, television, bill stuffers, etc.

- ***Regulatory/Policy***

  -Water waste ordinance, retrofit on resale ordinance, etc.

- ***Financial***

  -Conservation rate structures, rebates, cost-sharing, etc.

What are the rewards ?

- Economic Stability and Growth
- Reduced Capital/Operational Cost for Water
- Enhanced Protection of the Environment
- Prolonged Life of Capital Facilities
- Community Pride

Challenges to Conservation

- Need to bring decision makers up to speed
- Inadequate financial and human resources
- Planning tasks are daunting
- Conservation not given equal weight as infrastructure supply projects
- Inadequate communications strategy

Creating Effective Incentives for Water Reuse and Recycling

- Reuse and recycling incentives have been more successful when implemented as an overlay to a coherent regulatory regime.
- Jurisdictions where water policy is overseen by a centralized water authority—e.g., Singapore, Israel, Tunisia—or delegated to specialized basin-level authorities—e.g., Florida—have been particularly successful at encouraging water reuse.
- Institutional organization, planning, and knowledge sharing in these jurisdictions has led to more effective regulatory development, which in turn creates greater demand for incentives.

Incentive measures can interrelate and complement one another

- A levy imposed on freshwater extraction can help limit demand, as can an exemption from the same measure for companies that reuse water for internal processes.
- The promulgation of updated standards for effluent use can link water treatment operators and industrial water users with new markets for their treated effluent
- Introduction of tax incentives can hasten technology investments that enable companies to meet the more stringent effluent standards.
- Water trading and privatization of water goods and services can help to create competitive markets for efficient water use and reuse, while regulatory mandates and quotas can drive competition and
- Establish benchmarks for measuring progress in water use goals.

Effective incentive structures in policy areas

- Water pricing and discharge fees
- Water trading
- Tax incentives
- Public-private partnerships and privatization

Tiered Water Rates and Rate Reduction Measures

- Tiered water rates, also known as increasing block tariffs (IBTs), are increasingly popular as an alternative to uniform volumetric tariffs, and as a means to encourage conservation
- Under adjusted IBTs, baseline water use can be set for small, medium and large commercial users and tiered rates only increase as a user moves above its baseline.
- IBTs have been credited with helping to halt growth in urban water demand in both Israel and Singapore.
- In the U.S., this approach is used in the state of Arizona, as well as the city of Tampa Bay and several cities in California

Tiered Water Rates and Rate Reduction Measures

- A traditional IBT clearly creates an incentive for large-scale users to reuse water in order to limit initial demand,
- It also limits the user's potential reuse applications because it requires reused water to be recycled internally in order to access the tariff's embedded incentive
- Rebates and rate reductions for water reuse can be used effectively in conjunction with both uniform volumetric tariffs and IBTs.

Tiered Water Rates and Rate Reduction Measures

- Water authorities have also had success with reducing rates for the use of recycled water. Singapore, for example, provides NEWater *at a lower rate than regular water and also does not apply its Water Conservation Tax (30 percent of tariff* charge for industrial users) or water treatment fees to the sale of NEWater.
- Importantly, any alternative rate structure to encourage water reuse should also be combined with an education and outreach program to ensure water users are aware of the lower rates available for conservation.

Market-Based Incentives for Reuse

Open Market

- Lower water costs due to reduced demand
- Profits from sale of reclaimed water

Baseline/Cap-and-Trade Markets

- Profits from sale of reduced demand/improved quality
- Offset demand through provision of reclaimed water to other users

Water Quality and Demand Trading

- Water quality trading programs allow firms with high pollution abatement costs to purchase pollution reductions from other firms or from non-point sources that have lower abatement costs.
- A 2008 WRI survey found that there are currently around 20 active water quality trading programs in the U.S., and around six active programs outside the U.S.
- Another 21 programs are under consideration or development around the world

Water Quality and Demand Trading

- In addition to individual permit limits, a watershed can also establish a cap and allocate allowed discharges under the cap based on historical discharge volumes.
- Allowed discharges decrease each year subject to a declining cap and credits can be traded among different point sources
- Water quality trading programs encourage higher levels of water treatment as facilities comply with discharge limits and also seek to capitalize on the incentives available for further reductions below those limits.
- This structure creates a clear incentive for water treatment and reuse in order to generate tradable credits.

Water Demand Trading

- Trading programs can be implemented with respect to a firm's initial water demand. This type of demand trading is already reported in several jurisdictions around the world.
- Physical and derivative water trading has now become fairly common among irrigators and various state and local authorities in Australia and takes place over-the-counter, as well as on trading platforms.
- The challenge inherent to using water markets to incentivize more efficient water use and reuse, as with any of the incentive instruments is how to balance potential water use benefits with the potential and social and economic impacts attributable to the same incentive structure.

Tax Financing and Public Grants

- Governments can provide incentives and financing for water reuse through tax measures. Tax credits and exemptions, as well as grants, can be used to improve the economics of an investment in water reuse, while tax assessments may be used to help finance public water reuse systems or infrastructure
- "Reclamation Tax Credit" might be extended to companies that reclaim water on a per litre basis.
- Such a credit could be offered at either the state or local level and might equal roughly the market value of one litre of either potable or reclaimed water
- Singapore has a tax credit equal to a percentage of fixed capital expenditure on projects or activities that reduce the consumption of potable water. This incentive is provided under the country's Economic Expansion Incentives (Relief from Income Tax) Act as part of an incentive "package" for a particular project.

Public-Private Partnerships

- Public private partnerships (PPPs) are also increasingly viewed as an effective means of stimulating investment in reuse infrastructure around the world.
- Tax-exempt private activity bonds (PABs) are one way of incentivizing private investment in new water reuse technologies.
- PABs are issued by, or on behalf of local governments and the proceeds of their sale are used to finance private projects, including water infrastructure projects.
- The bond-holder’s return comes directly from revenues from the financed project.

Framework for PPP

- Clarity in objectives of PPP
- Institutional restructuring to coincide with PPP initiatives
- Regulatory framework to be put in place
- Managing political risk, affordability and willingness to pay issues

Community Participation

Stakeholder Concerns

- Capacity building of government / public agencies
- Interest and capacity among private sector operators
- Building awareness for “pay for use” principle among consumers and communities within society
- Addressing financing issues of lenders and investors
- Ensuring adequacy of services at affordable rates to the urban poor

Way forward

- Development of innovative financing and security mechanisms enabling PPCP
- Enabling regulatory framework like TRAI etc. with representative from the User for:
  - Frame and regulate tariff – retail and bulk
  - Lay down, enforce and monitor minimum standards of service; model concession
  - Promote efficiency and competition
  - Adjudicate disputes / differences between local bodies, service provider and consumers
  - Formulate sustainable sectoral policy framework

Need for new approaches

- Moving from water supply mgt to demand mgt
- Conservation and intelligent use of conserved water
- Watershed management approaches
- Measuring and restoring instream flow
- Ground/surface water conjunctive management
- Intelligent use of storage
- Facilitating best use of scarce supplies
- Use of produced water, re-use of waste water
- Desalinization
- Rainwater harvesting

Summary

- Acute water shortage
- Industrial sector more at risk
- Huge funding requirements in water sector
- Infrastructure cost and prevailing low price of water make it unviable for private capital in domestic sector
- Cross-subsidisation in PPCP
- Need for a regulatory framework
- Need to involve "Unapproved Stakeholders". Official plans simply pretend that these people do not exist
- Look at water provision and sewage disposal and recycling in one go
- Water problems need local solutions like water harvesting and wastewater recycling

Industrial Water Supply
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Indian Context

Industrial Water Supply- Incentives for Conservation

1.0 Reduction in Water Consumption through Process Improvement and Recycle/ Reuse of Process Water:

1. Cleaner Technology:
    1. Introduction of counter current washing, looping, recycling and reuse of treated wastewater (resulted in reduction of water consumption of 50-60% in paper and textile industries)
    - Adoption of advance technologies such as continuous digestion, BSW, ODL, high speed paper machine in Pulp & Paper, continuous fermentation/ integrated evaporation in distilleries resulted in reduction of water consuption per unit of product)
2. Effective Water Management:
    - Benchmarking of Process Water Quality Requirement
    - Adoption of best practices such as use of wastewater from one loop to another loop with lesser quality requirement (resulted in ZLD in RCF based Kraft paper mills)

Industrial Water Supply- Incentives for Conservation

2.0 Advanced Effluent Treatment & Management System:

- Adding Tertiary treatment units to produce industrioal grade water from excess wastewater discharged from various processes within the industry
- Adoption of advance technologies such as Membrane Filtration, Concentration-incineration (resulted in recycling of 90% of wasetwater in the process)

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3.0 Regulatory/ Consent Management:

1 Effluent Discharge Standards:

- Concentration based Standards
- Load based Standards
- National Minimal Standards
- Location Specific Standards
- General Standards for Discharge
- Specific Standards- Industry, Operation or Process

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4.0 Polluters Pay Principle:

- Indiscriminate water uses in most of the industries
- Inadequate control on quantity of water used and wastewater discharged from industries
- Lack of pollution tax except for water cess
- Low water cess rates do not tempt industry for water conservation
- Lack of penalty on defaulters

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5.0 Financial Incentives:

1. Fiscal and Financial incentives to promote cleaner technology, process change and ETP upgradation,
2. Promoting cluster/ common facilities and providing financial assistance to common facilities like CETP/ TSDF

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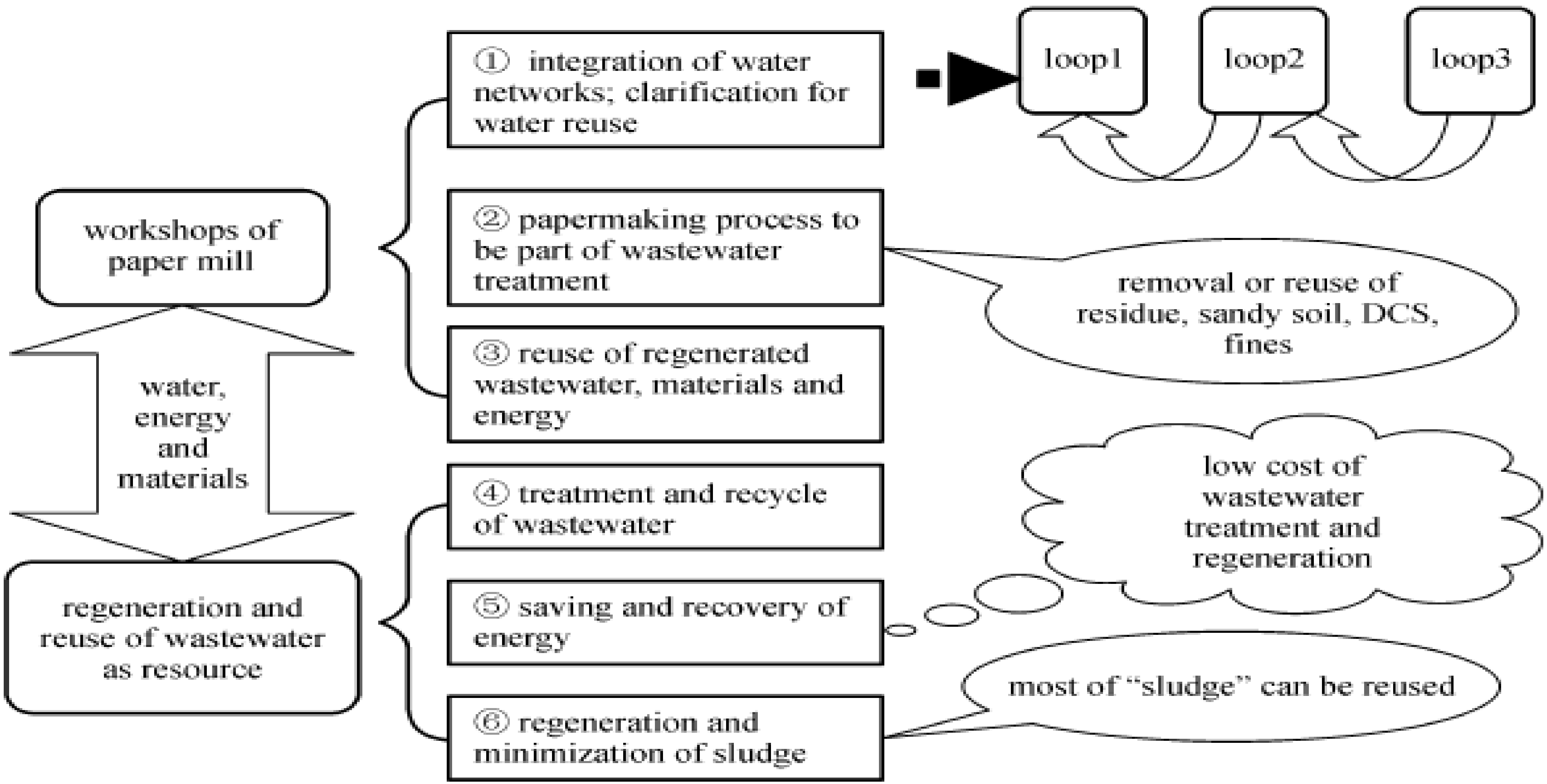
6. Zero Effluent Discharge: Indian Context

River Ganga has been given the status of a National River and the Government of India has constituted the National Ganga River Basin Authority (NGRBA) to ensure effective abatement of pollution and conservation of the river Ganga by adopting a river basin approach for comprehensive planning and management.

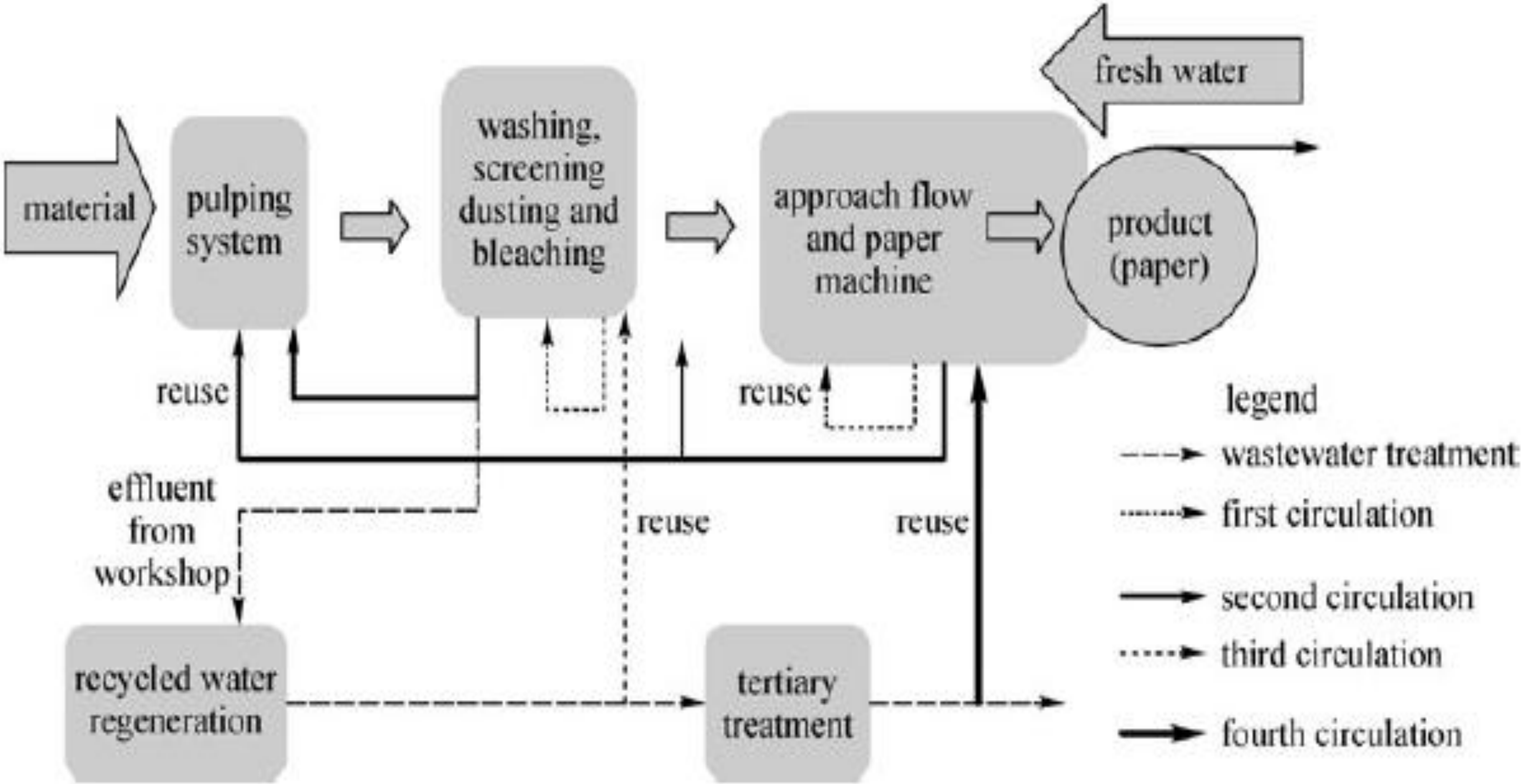
NGRBA has resolved that under "Mission Clean Ganga", no untreated municipal sewage or industrial effluents would be allowed to be discharged into Ganga by the year 2020.

Case Studies from Industries

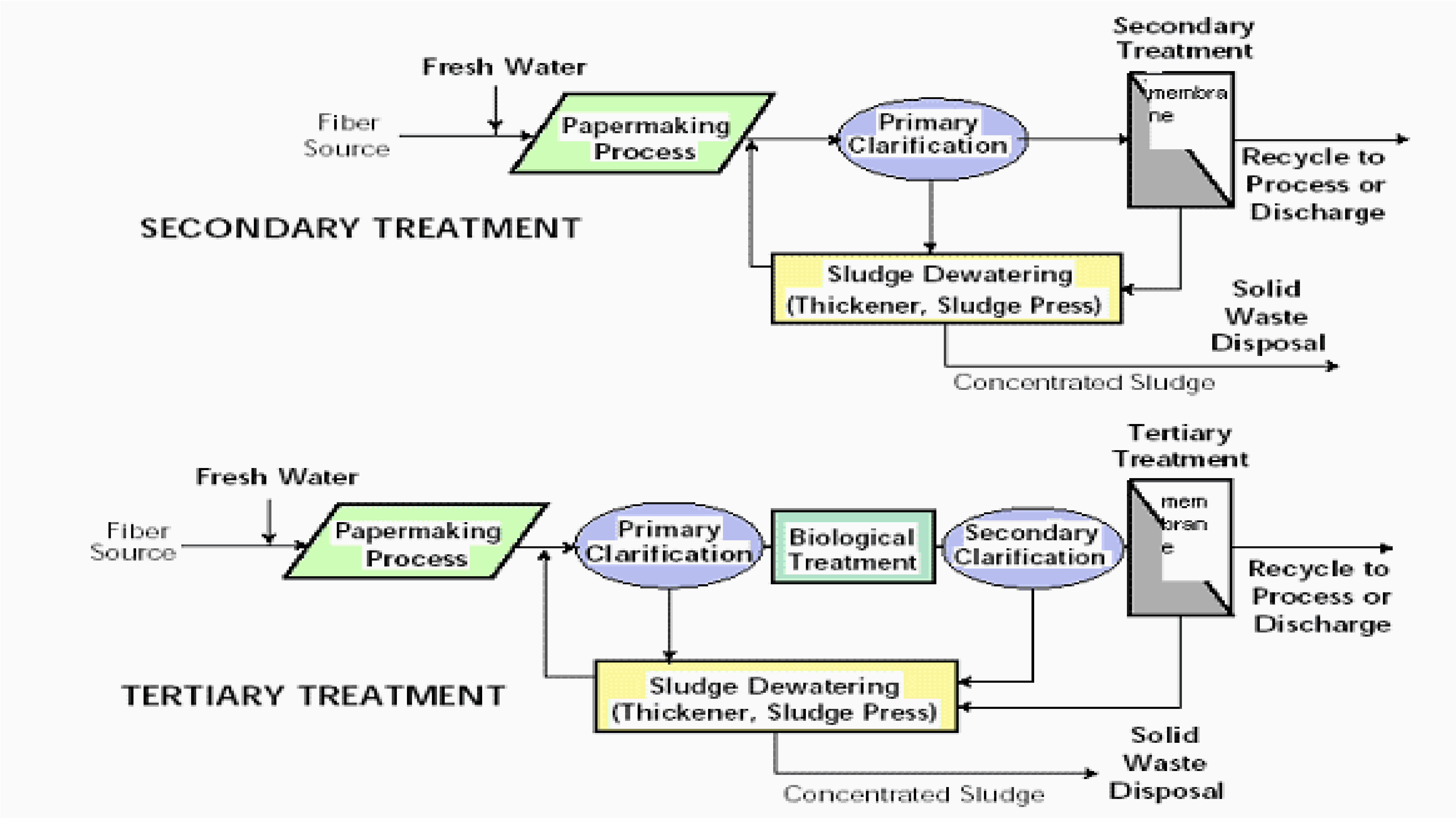
Typical Closed Water Loop: One process unit receives used water from other process units and, in turn, provides used water for the other process units since the requirements of water quality for each process unit are different.



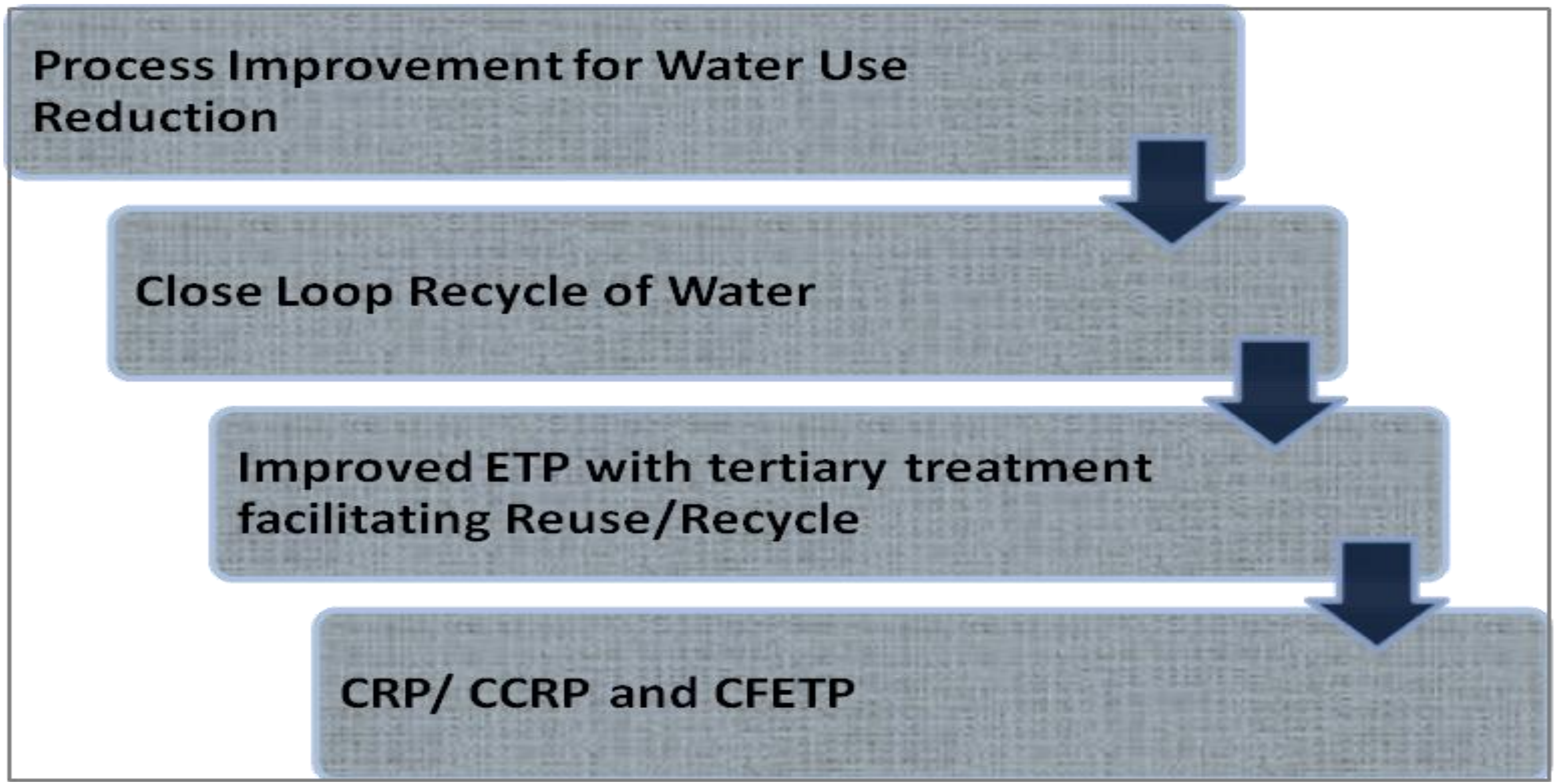
Typical Reuse/ Recycling System:



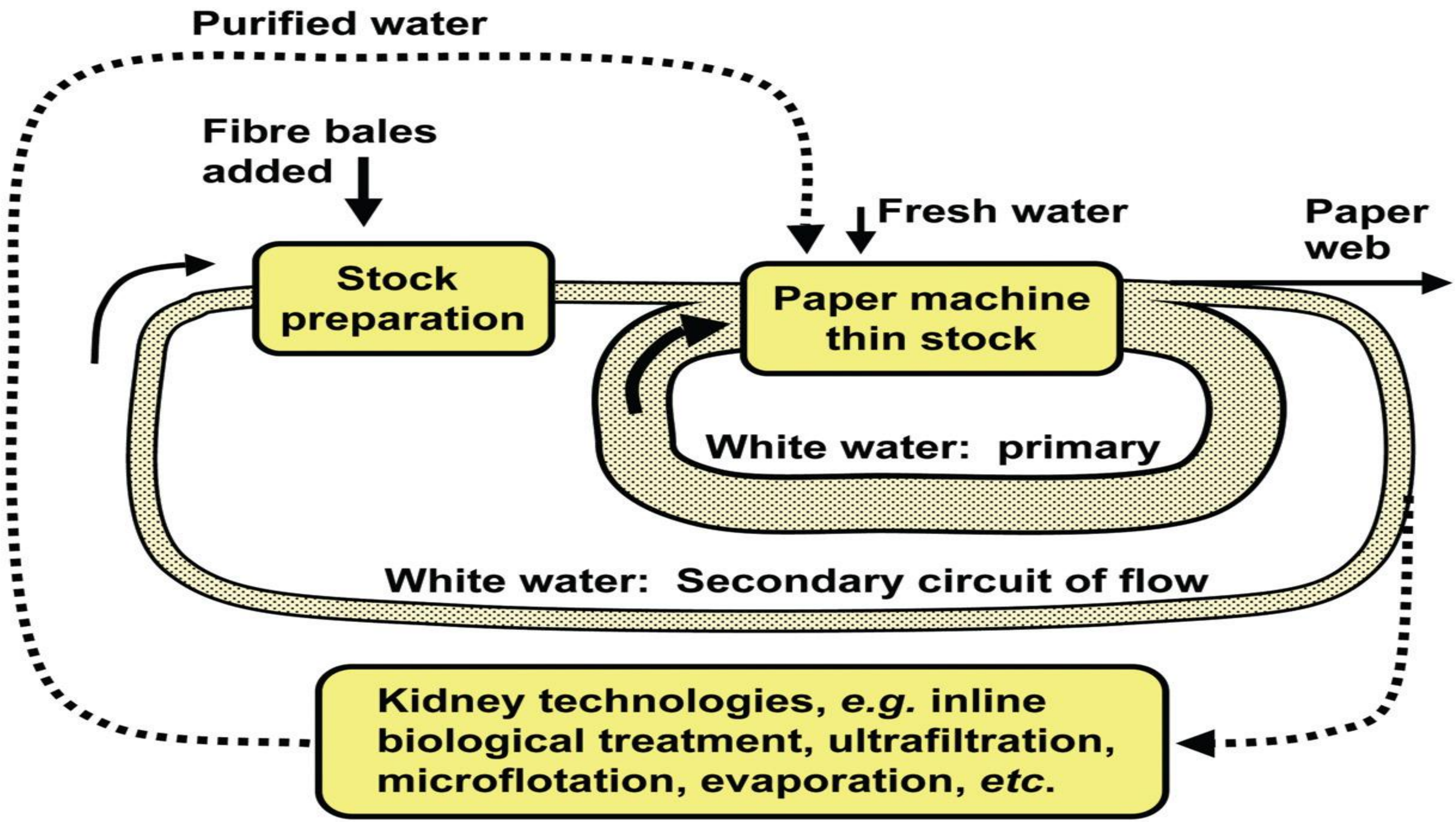
Typical Effluent Treatment Train



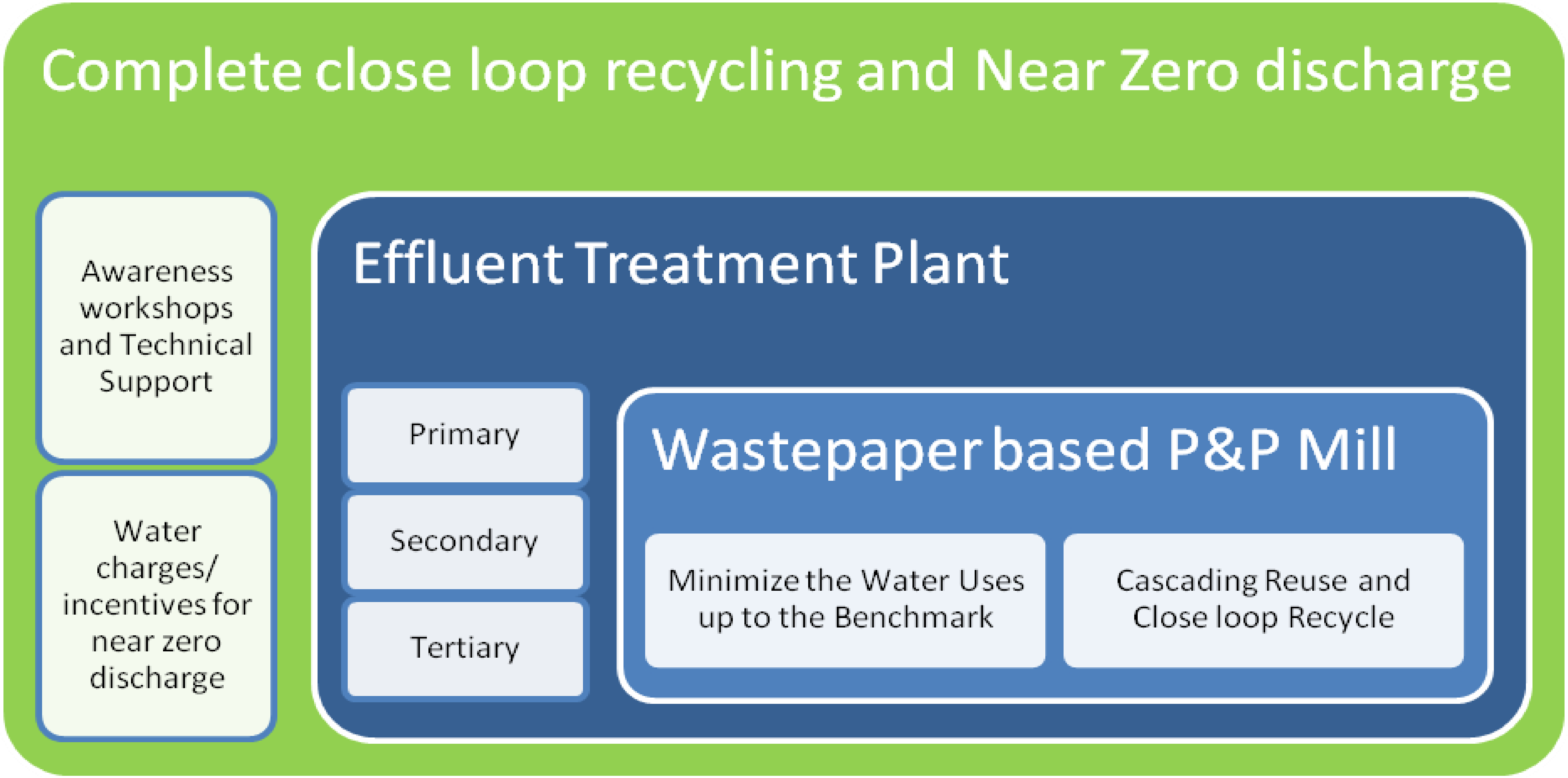
Integrated approach for ZLD in Pulp & Paper Mills



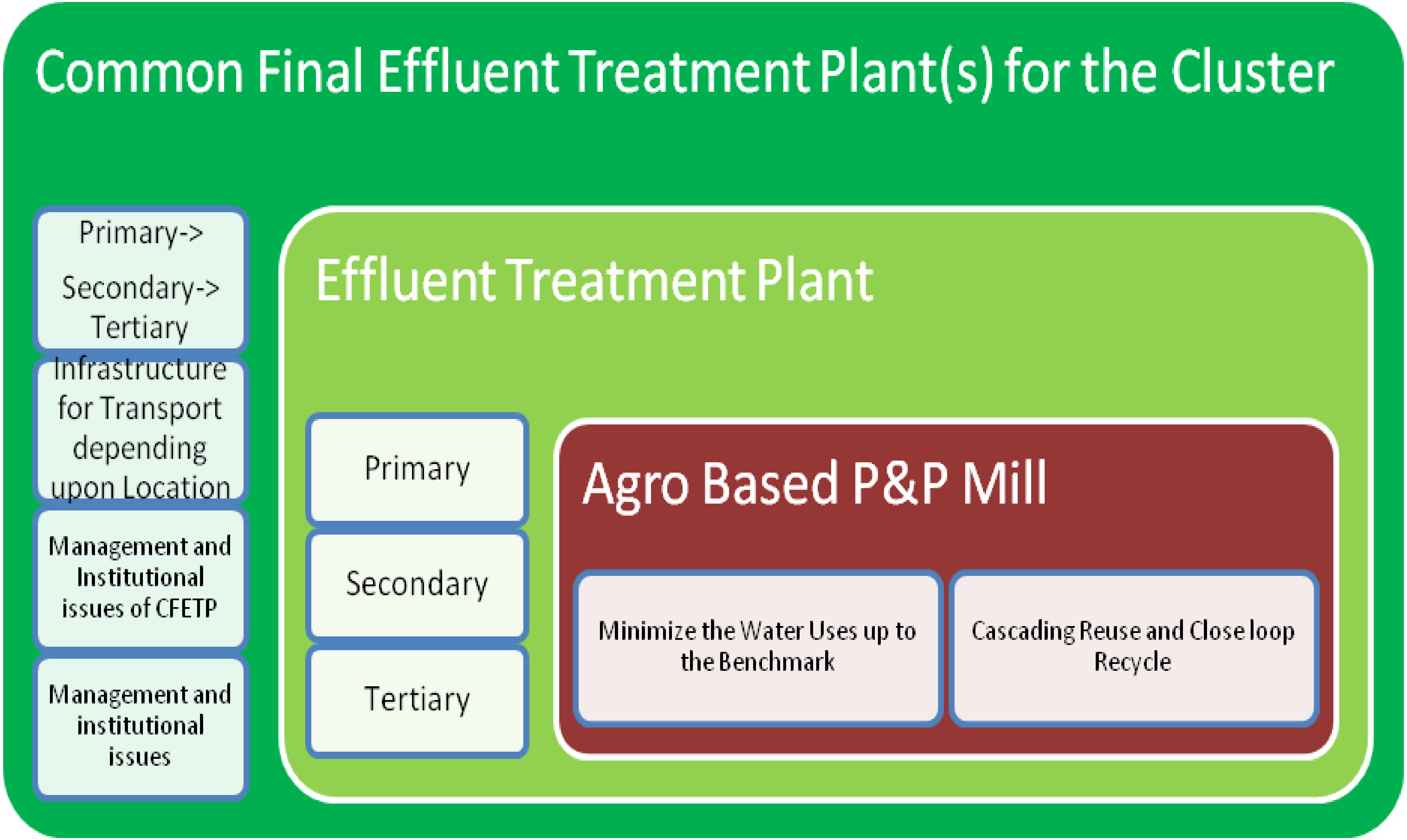
“Kidney” water purification system:



Proposed water management strategy for the wastepaper based pulp and paper Mills



Proposed water management strategy for the agro based pulp and paper mills



Integrated Approach for ZLD in Distilleries:

Spent Wash generated by molasses based distilleries @ 12 to 15 KL/KL of Rectified Spirit having high COD (80,000-1,20,000 mg/l), BOD (40,000- 60,000 mg/l), high Suspended Solid, inorganic solid, low pH, strong odour & dark brown colour.

Spent Wash generation depends on:

- Type of fermentation process (Batch or Continuous)
- Type of distillation process (Atmospheric or Multi-pressure)
- Distillation with reboiler or without reboiler
- Distillation with or without integrated evaporation system
- Stand alone evaporation system
- Alcohol concentration in fermented wash depends on molasses quality.
- Selection of yeast culture
- Spent wash recycle % (Depends on final alcohol quality)

Emerging technologies

- Reboiler/ Evaporation/ Concentration– Incineration system

- Co-processing in cement kilns/ furnaces of TPPs/ Steel Plants.

Treatment technologies for distillery spent wash

- Biomethanation followed by multi-effect evaporation followed by drying/ incineration/ co-processing.
- Biomethanation followed by reverse osmosis followed by drying/ incineration/ co-processing.
- Biomethanation followed by reverse osmosis followed by multiple effect evaporation followed by drying/ incineration/ co-processing.
- Concentration through RO/ MEE followed by drying/ incineration/ co-processing.

Wastewater Management in Tanneries:

Environmental Issues::

- High TDS concentration in tannery effluent due usage of salt for preservation of animal hides and skin.

- Salt preservation is the widely practiced method for preservation of hides/ skins throughout the world.

- In Indian practices, 50–60% (w/w) of common salt applied to preserve them.

- Typically some 50% of this amount of salt ends up in the tannery waste water as dissolved solids (TDS) leading to high levels of pollution in groundwater and rivers.

- Elimination of salt preservation means that the total salt freight of the wastewater to be reduced up to 60–70%.

Wastewater Management in Tanneries:

Innovative Technology: Lyophilization of hides and skins:

Removal of moisture content of the skin/hides and making it suitable for preservation in ambient atmosphere.

This method of preservation enables preservation of hides and skins for a period more than 15 days thereby reducing salinity (TDS) of the effluent substantially.

The quality of leather to be comparable with salted leather and is acceptable by the tannery industry.

Techno-economically viable option for combating the pollution problem of TDS in Tanneries, arising from the salt curing method.

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- Huge funding requirements in water sector
- Infrastructure cost and prevailing low price of water make it unviable for private capital in domestic sector
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- Need for a regulatory framework
- Need to involve "Unapproved Stakeholders". Official plans simply pretend that these people do not exist
- Look at water provision and sewage disposal and recycling in one go
- Water problems need local solutions like water harvesting and wastewater recycling

Cost of water supply varies widely and can be in the range of Rs. 0.09 to 50.0 per cubic meter.

Web resources

- www.usibc.com/sites/default/files/.../files/towardsanintegratedsolution.ppt
- ww.worldenergy.org/documents/11.151mex._city.ppt
- 12thplan.gov.in/.../20_Key%20Challenges%20for%2012th%20Plan%20-%20Initial%20CII%20Note.ppt
- www.kelman.com.br/ppt/DesigningEffectiveNationalIncentive.ppt
- www.sustainableplant.com/.../ge-says-better-incentives-needed-to-stimulate-water-reuse-and-recycling/
- www.gpem.uq.edu.au/docs/.../OzWater_Brisbane%20Waterpaper.pdf
- www.civil.iitm.ac.in/.../PPT_Discussion%20with%20WSP_21st%20Aug%2009_changed.ppt
- www.karunadu.gov.in/.../Presentation%20on%20Water%20Sector%20-%20Emerging%20Challenges.ppt
- www.ucowr.org/updates/pdf/V111_A7.pdf
- www.igidr.ac.in/~ashima/Water-iir-ashima-preprint.pdf
- www1.gadnr.org/sustain/files_ppt/wcw1-a.ppt