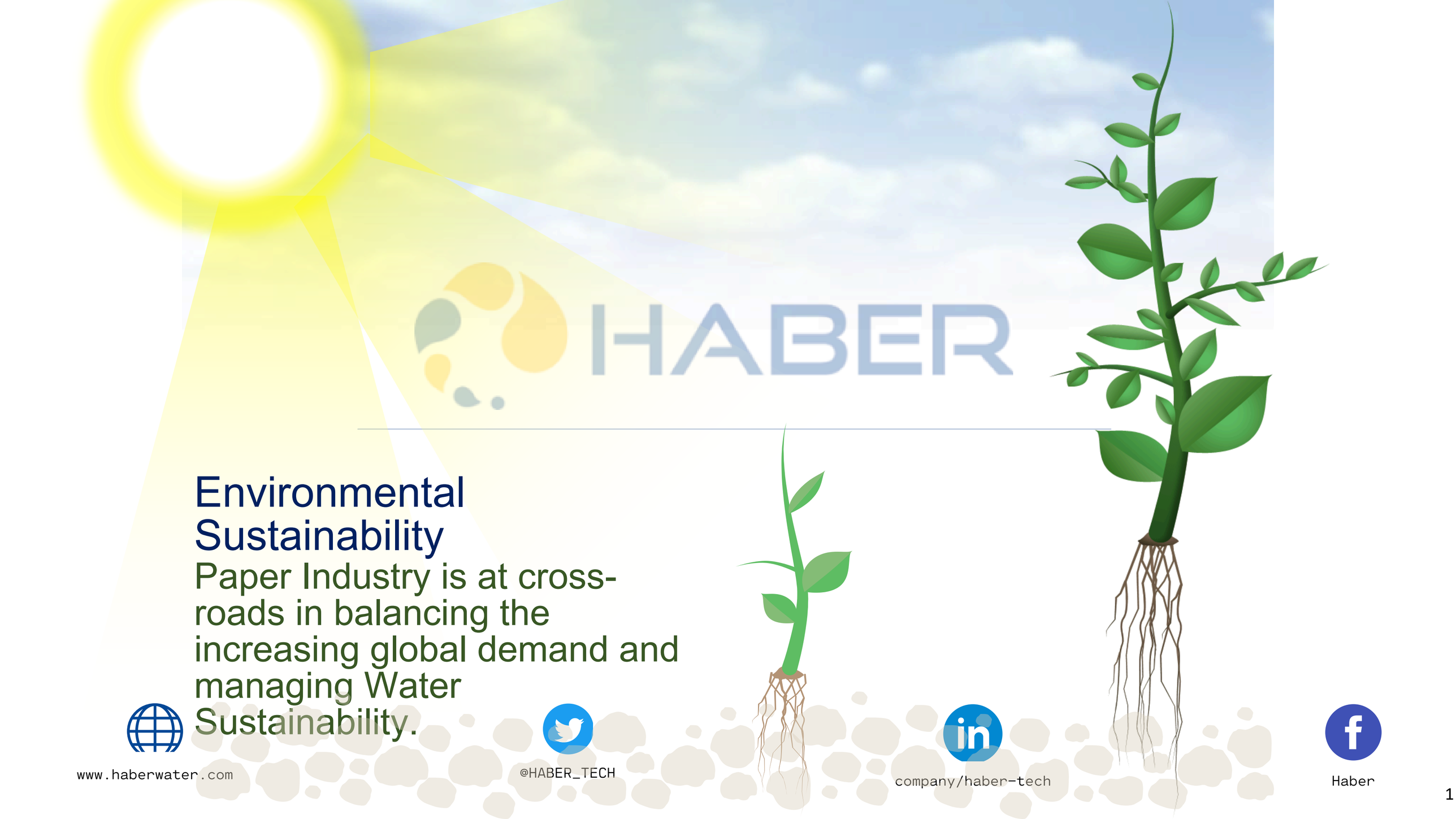


Environmental Sustainability

Paper Industry is at cross-roads in balancing the increasing global demand and managing Water Sustainability.

Scope of this presentation, exemptions

Sec 0. preamble

Topic of this presentation

CO2 Emissions

Biodiversity Loss

Renewable Energy

Consumption of green products

Air Pollution

Climate Change

People

Solid Waste Management

Energy Efficiency

Some Common Themes

Deforestation

Water Pollution

Innovation

Preserving natural resources

Understanding the current situation, what needs to be done, and time limits

Sec 1. ground realities & compulsions

Sec 1 content source : "Benchmarking Industrial Water Use Efficiency in India" – [Feb 2024] - *The Energy and Resources Institute (TERI), India, with support from the National Water Mission (NWM), Ministry of Jal Shakti, Government of India.*

Factual Scenario

Amongst the water-intensive industries, thermal power plants are the highest consumer of water, followed by ***pulp & paper,*** *textiles, and iron & steel industries.*

Existing challenges or inefficiencies in water management practices, such as over-extraction, pollution, or lack of wastewater treatment, further exacerbate the situation.

In consonance with the pace of industrial development, and with about 8% of the total water withdrawal, the industrial water demand in India has been on the rise and is expected to increase many folds from 56 BCM in 2010 to 151 BCM by 2050 (CWC, 2014).

It is estimated that without water efficiency improvements, global water demand will exceed available supplies by 40% by the year 2030 (2030 Water Resources Group, 2009; UNEP, 2014).

The Water consumers

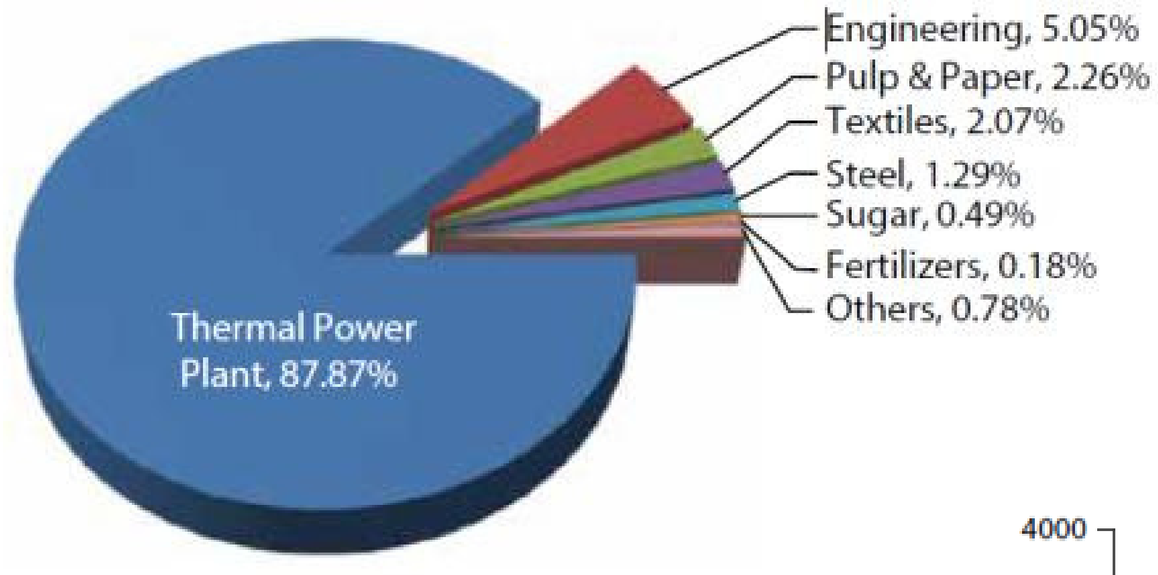


Figure 1a. Water consumption in Indian industries

What is not measured is the distribution data over land mass. The era of small mills distributed across near-urban and rural areas is changing to large consumers in concentrated locations

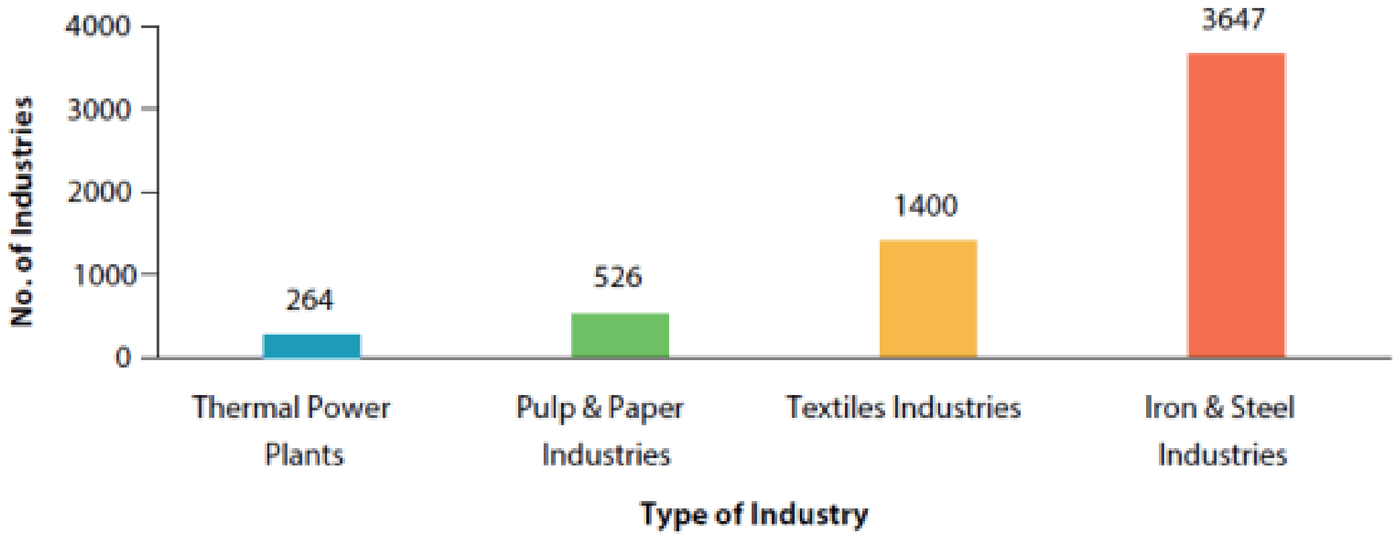
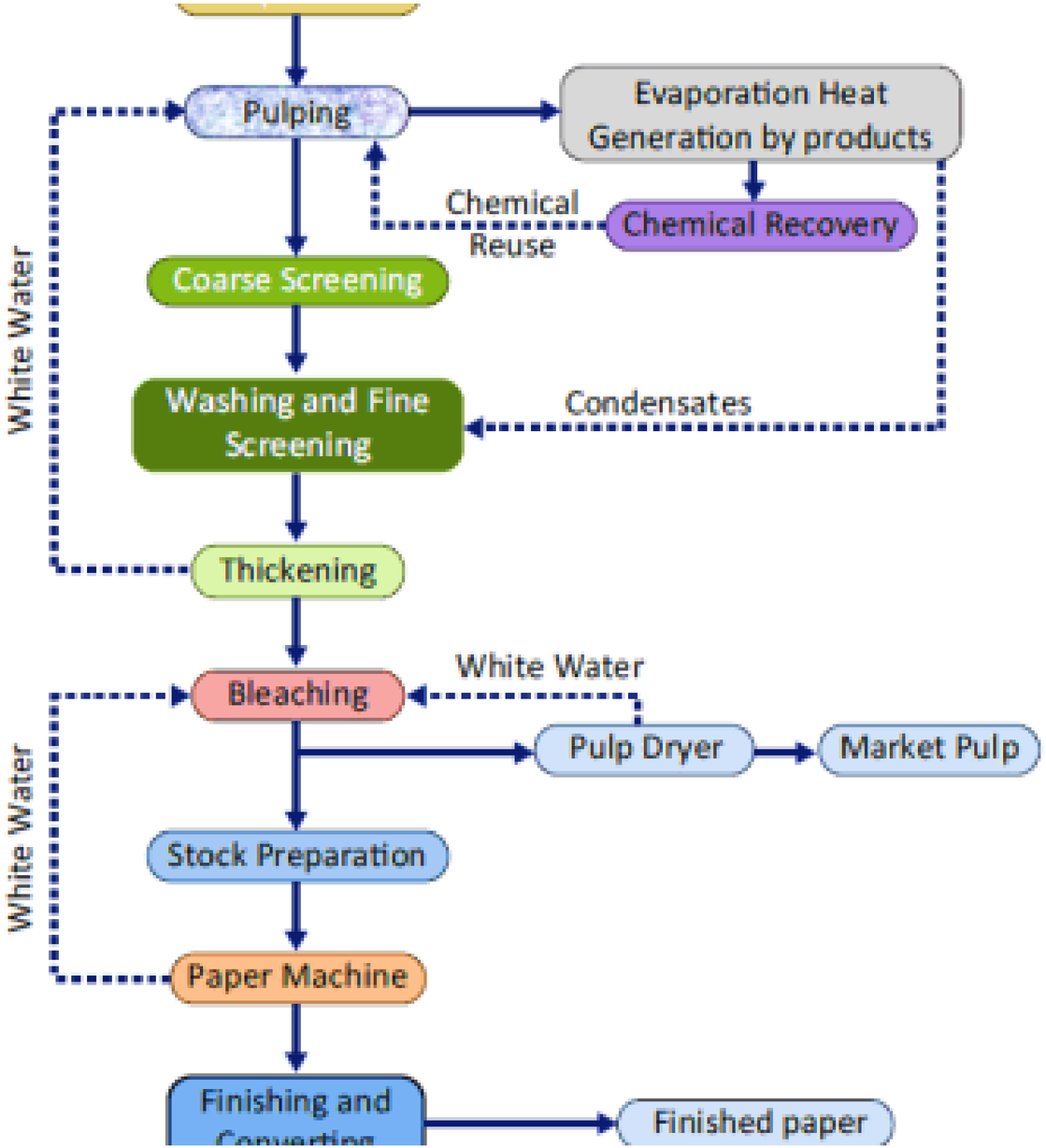


Figure 1b. Water intensive industries in India[3]

Pulp & Paper Industry



Integrated Mills, considerably higher, 30 to 33 m^3/MT (14,014 m3/day to 44,318 m3/day)

Recycled Fibre (RCF) based Mills 9.9 to 13 m^3/MT (between 1,770 m3/day to 9,959 m3/day)

At present, 73% of the paper is produced from the RCF based mills while only 18% production is from wood based mills and remaining 9% is from agro based mills.

Major Actions

Short term interventions:
Reduction of nozzle size in Paper Machine and reusing at least 50% of the wastewater being discharged from the mill

Long term interventions:
Reclamation of processed water (Save all Clarification System and Poly Disc Filtration System) along with approaching ZLD

End Goals

		Short-term interventions	**Long-term interventions**
Pulp & Paper Integrated Mills	**30.5 – 33.0**	**29.2 – 32.2**	**13.0 – 14.5**
RCF based Mills	**9.9 – 13.0**	**7.1 – 9.9**	**4.0 – 7.8**

Forthcoming Policy Recommendations

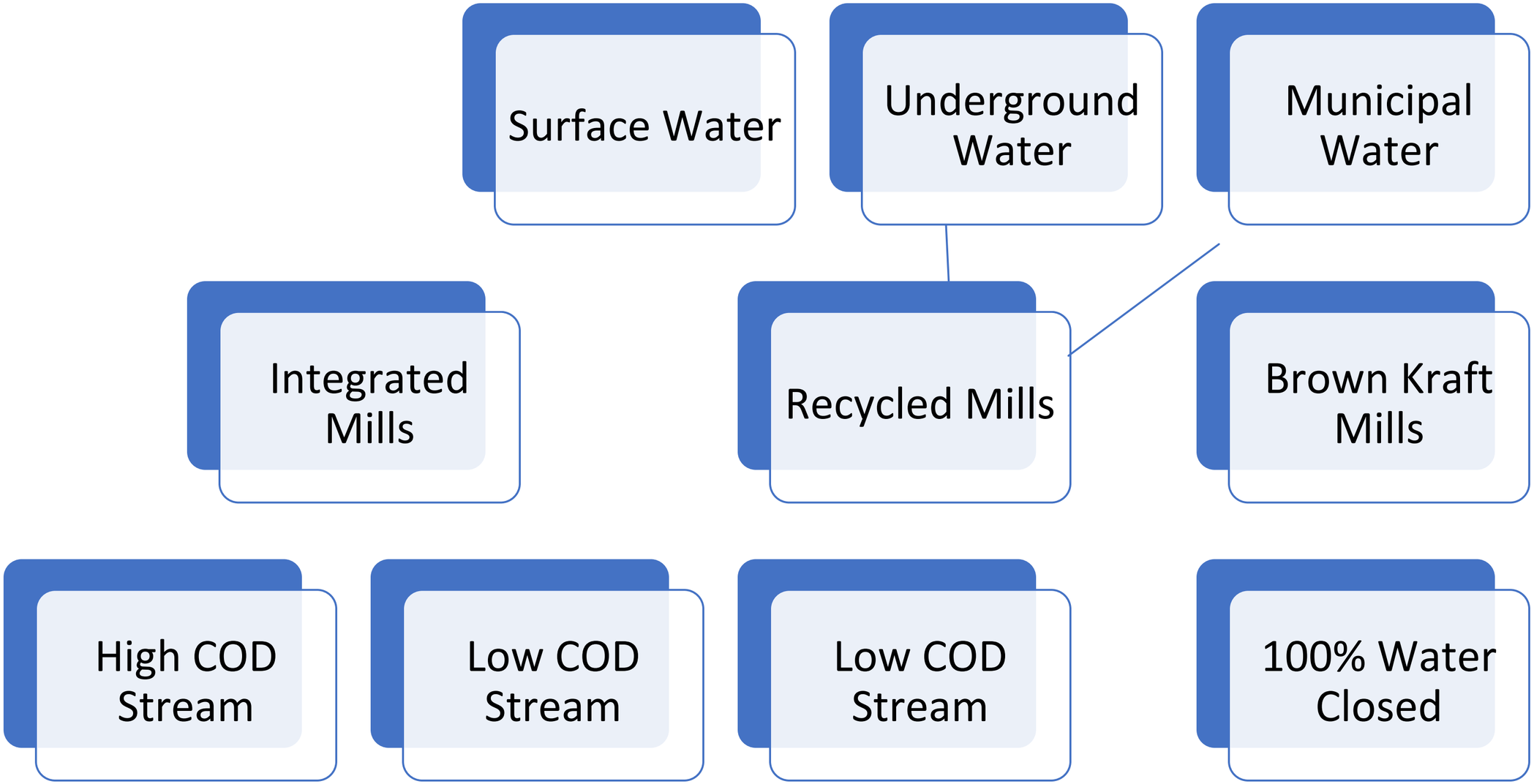
- Setting up of Water Use Benchmarks for Ind
- BWUE to be given a legal status
- Mandatory Water Audits from Third-Party A
- Information Management and Public Data S
- Industrial site approvals to be based on the c

- National Water Framework Bill 2016 >> sh basis
- Draft Water Policy 2020 >> O&M costs shou service fees
- Water Regulatory Authority by State to fix r
- Incentive mechanism by such WRA to those

Understanding origin and nature of different type of effluents

Sec 2. basics (effluent types in p&P)

Sources & Type of Effluent



Sources & Type of Effluent

Effluent is generated in three different mechanisms:

1. By chemical reactions and leaching in Pulp Mills where compounds are dissolved in water, as in Pulping & Bleaching in Integrated Plants signified by high TDS and COD.
2. By addition of suspended/coagulated matter in water as in Paper Machine systems, usually signified by high TSS and Turbidity
3. By Increase in concentration due to evaporation of water, as in Utility Systems / Heat Exchangers usually signified by scaling or corrosion tendencies.

Transition of Water to Waste Water

- Water is a universal solvent!
- Water finds its own balance – property wise!
- When water evaporates, its constituents don't!
- Significance of Treating Raw Water Vs Process / Waste Water

Types of discharge with key parameters

Discharge
pH, T, TSS, BOD, COD

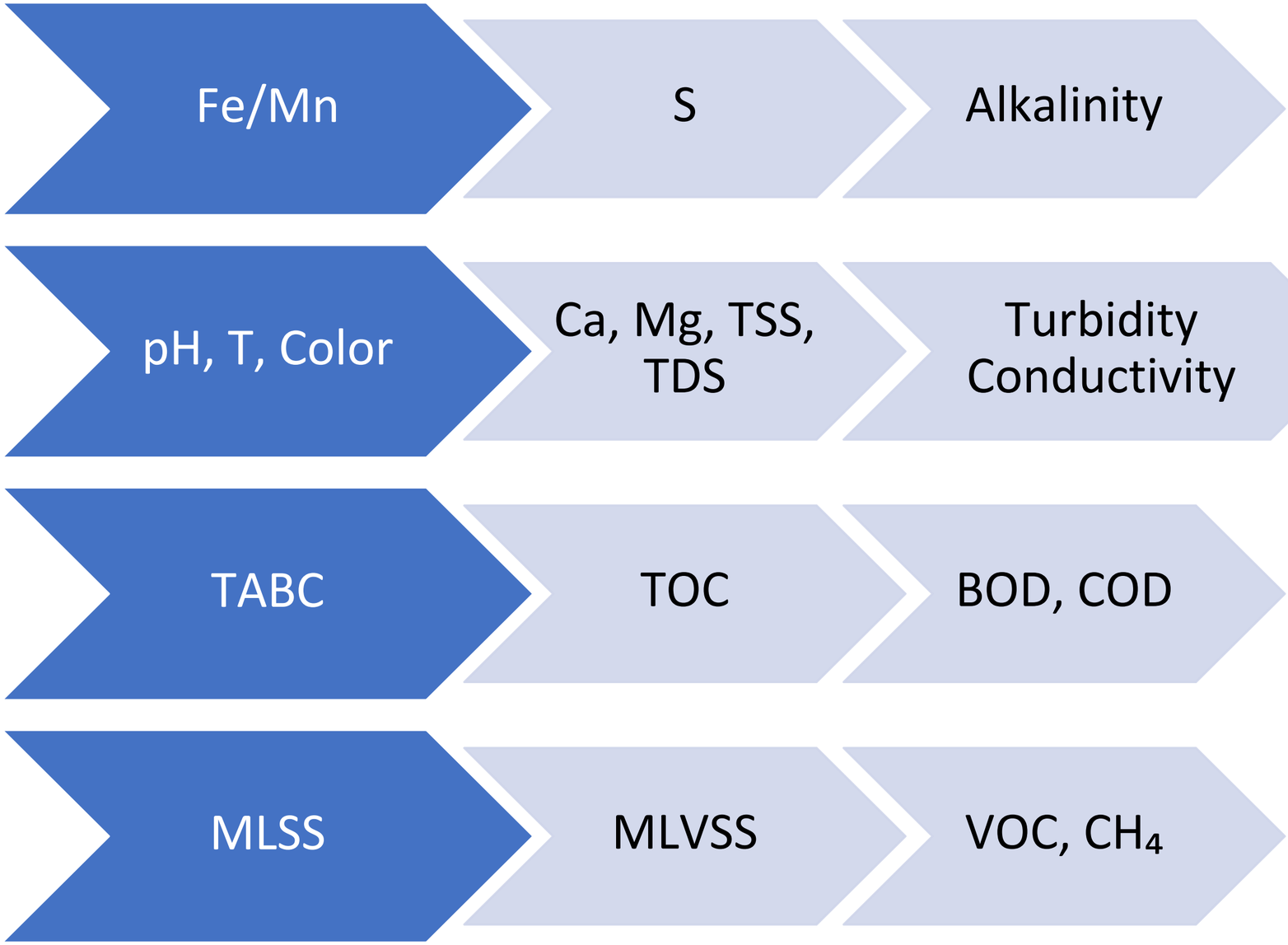
River
pH, T, TSS, BOD, COD

Farming
*TSS, NTU, COLOR

CETP
Q, TDS

Closed
VOC, CH_4

Describing Water within P&P Ind.



Special factors that may influence color, deposits or process in some way.

The physical properties that can provide a visual picture of the waste water

Biological properties that can be impacted by water closure as well as productivity / quality

Specific to Effluent Treatment Plant, its capacities and capabilities.

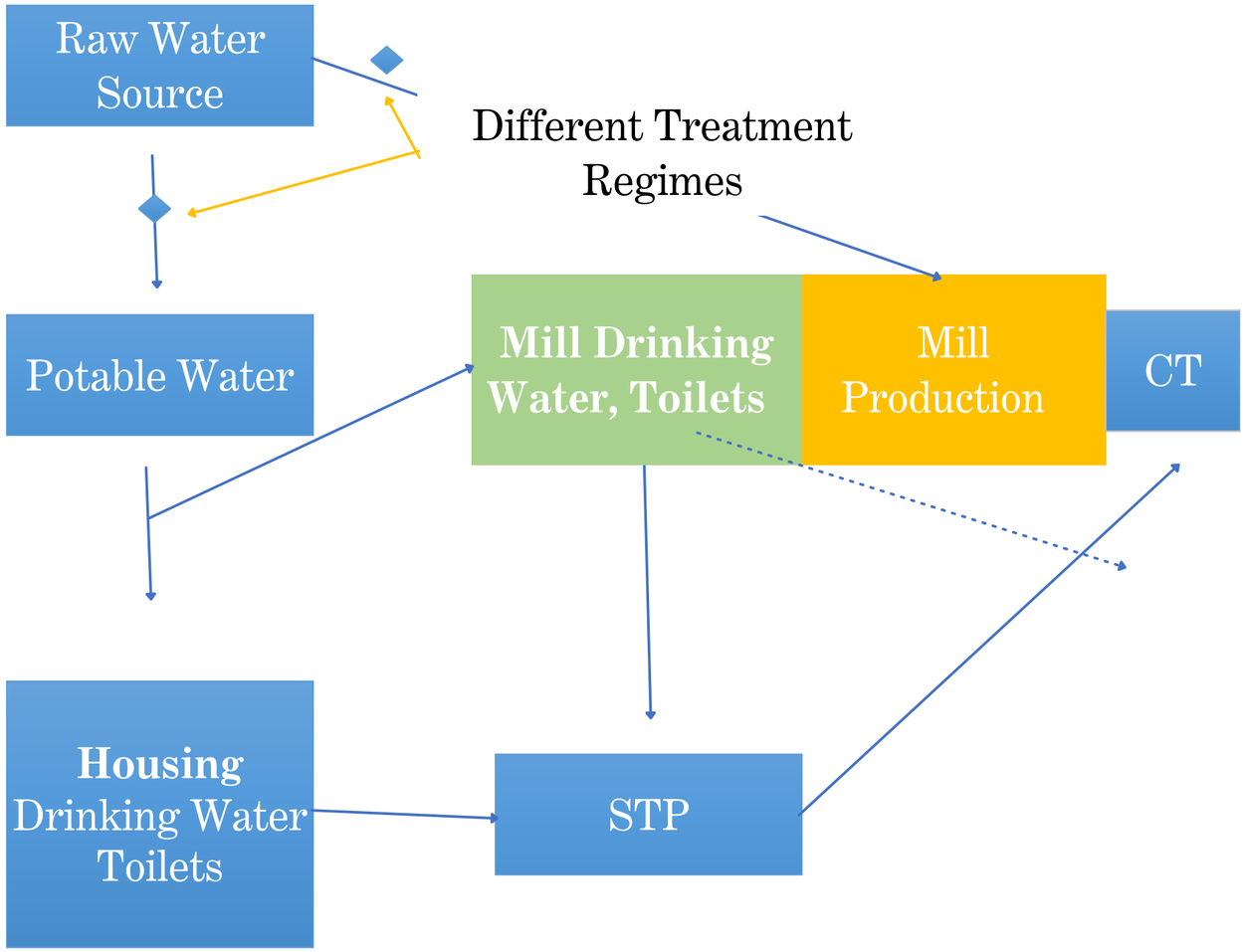
Common issues related to Water

Scaling	Reject components
Corrosion	Acquire / Transfer components
Odour	Release volatile gaseous components generally classified as Volatile Fatty Acids (VFA) or Products of Methanization.
Color	Presence of color inducing ions, addition of colors, Impact of Light on its components
Chemical reactions	Effectiveness of process chemicals and their interactions
Taste	Impact of components sensitive to human tongue

Effective steps to treating different process waters, reduce specific consumption

Sec 3. treatment methodologies

Significance of Treating Raw Water for Potable & Mill use



- In most mills there is no separation of Raw water for Potable and Mill use.
- Treating raw water is the comparatively easier, economical and requires different treatment regime than Process water especially in terms of biological aspects.
- If this is not available, compromise has to be taken with mill water treatment, which affects the end result.

Treatment Methodologies

Effluent is generated in three different mechanisms:

1. By chemical reactions and leaching in Pulp Mills where compounds are dissolved in water, as in Pulping & Bleaching in Integrated Plants signified by high TDS and COD.
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4

It would be much easier to treat water in the same way that it is added and there are technologies available for the same. First step in Sustainability is in reducing the utilization of water for a particular process (specific water consumption). The reduction in specific water consumption must be stretched to the extent of reducing water consumption of a particular process to the extent of retaining past achieved productivity and quality.

Reduce – Re-Use – Recycle

REDUCE is to make Process optimization to Avoid Spillages, Overflows, Reduce unwanted dilutions, Review Specific Consumption or handling higher consistencies where possible, etc.,
No amount is insignificant when it comes to "Reduce"

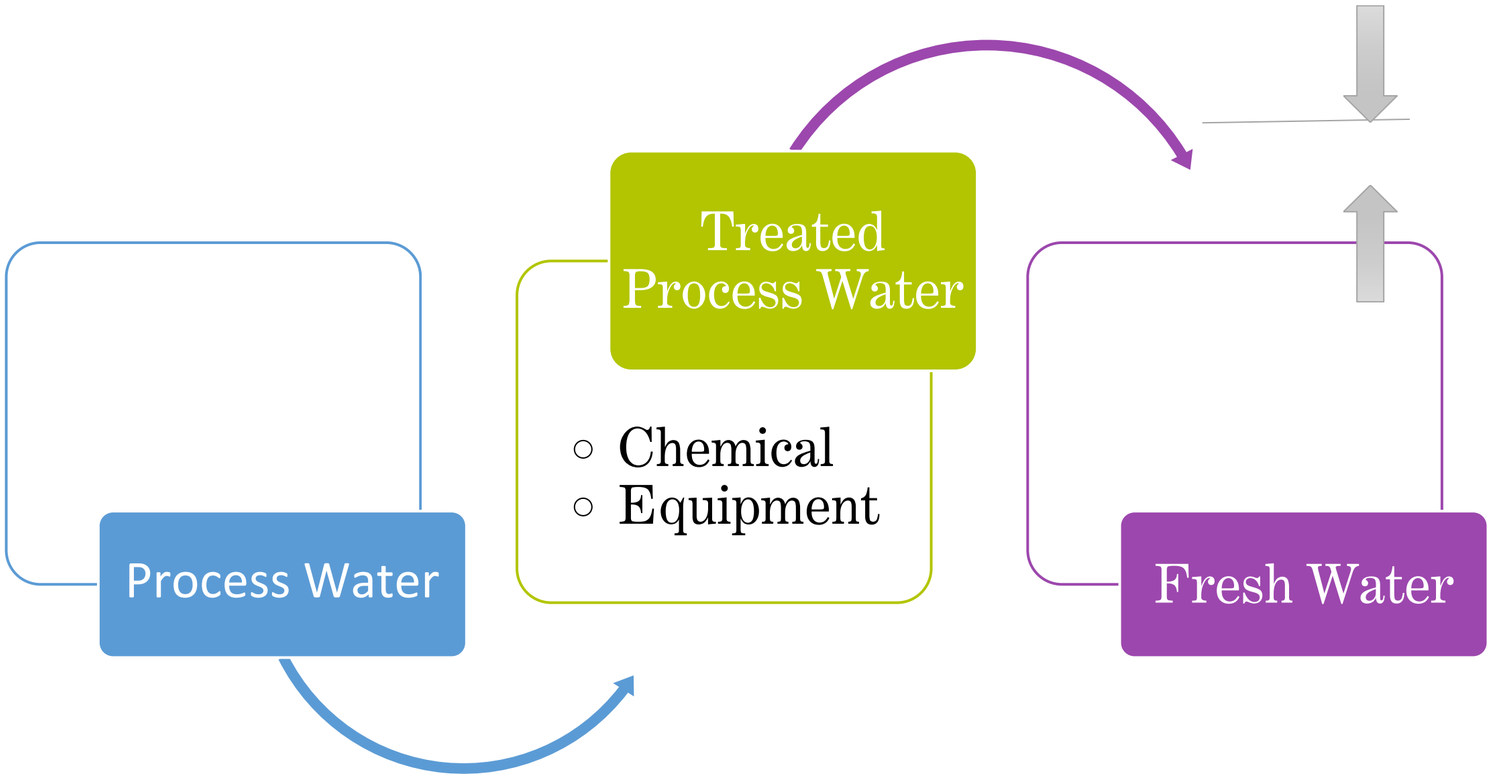
α

REUSE is to use existing process water to replace current fresh water applications. The common misnomer here is the wrong understanding that the existing process water as such is used to replace fresh water. This will create problems in water-associated problems such as scaling, corrosion or productivity or quality losses. This is done only after all "Reduce" options are exhausted
In order to maintain the chemical integrity of the process, this should be a short loop solution.

Reduce – Re-Use – Recycle

RECYCLE is the final option to remove contaminants at ionic level. This would be and should be the last option after exhausting REDUCE and REUSE cycles. Again traditional thinking is to use Recycle options at the final discharge quality water and re-use it back in mill. This method, considering the huge quantity of water used in P&P Industry, would not be financially viable most times.
It is better to apply this at a loop level as indicated above, ie., source water from Point A and use it in Point B while treating it in between. This is done only after all “Reduce” & “Re-use” options are exhausted

Common Misconception in Re-Use – Recycle



The common misconception in Re-use (ie., the use of water / clarified water in place of fresh water) is to only Quantify it.

However, this is not a sustainable method. It should be Qualitatively treated to be “as close” to fresh water parameters

The approach may classify as Re-Use or Recycle depending on the methodology employed

Zero Liquid Discharge [ZLD]

- **Discharge**
- **100% Water-Closed.** No-Discharge does exist
- “Zero “**Liquid-Discharge**”
- **Solid Discharge**

Steps to ZLD

Key Components of ZLD

UF
- Pre-treatment
- Capex, Replacement Membranes

RO-1
- Capex
- Replacement Membrane

RO-n
- Sea Water Membranes
- O&M

MEE
- Steam
- CIP / MOC / Maintenance

ATFD
- Steam
- Alternate – Crystallizer / MOC / Capex

Effective steps to achieve sustainability

Sec 4. PATH TO SUSTAINABILITY

Definition of Sustainability

Environmental sustainability, at its core, is about **responsible resource management and ecological balance** to meet current needs without compromising the ability of future generations to do the same.
It's about ensuring the long-term health of the planet and its ability to support life. This involves considering various factors, including

climate change,
resource depletion,
biodiversity loss, and
waste management

while also **balancing,**

social, economic, and environmental considerations.

Source: Google

Path to better Sustainability

Vision

- Where do you want to be in 5 years from now ?
- Motivation ? – what does it mean to you ?

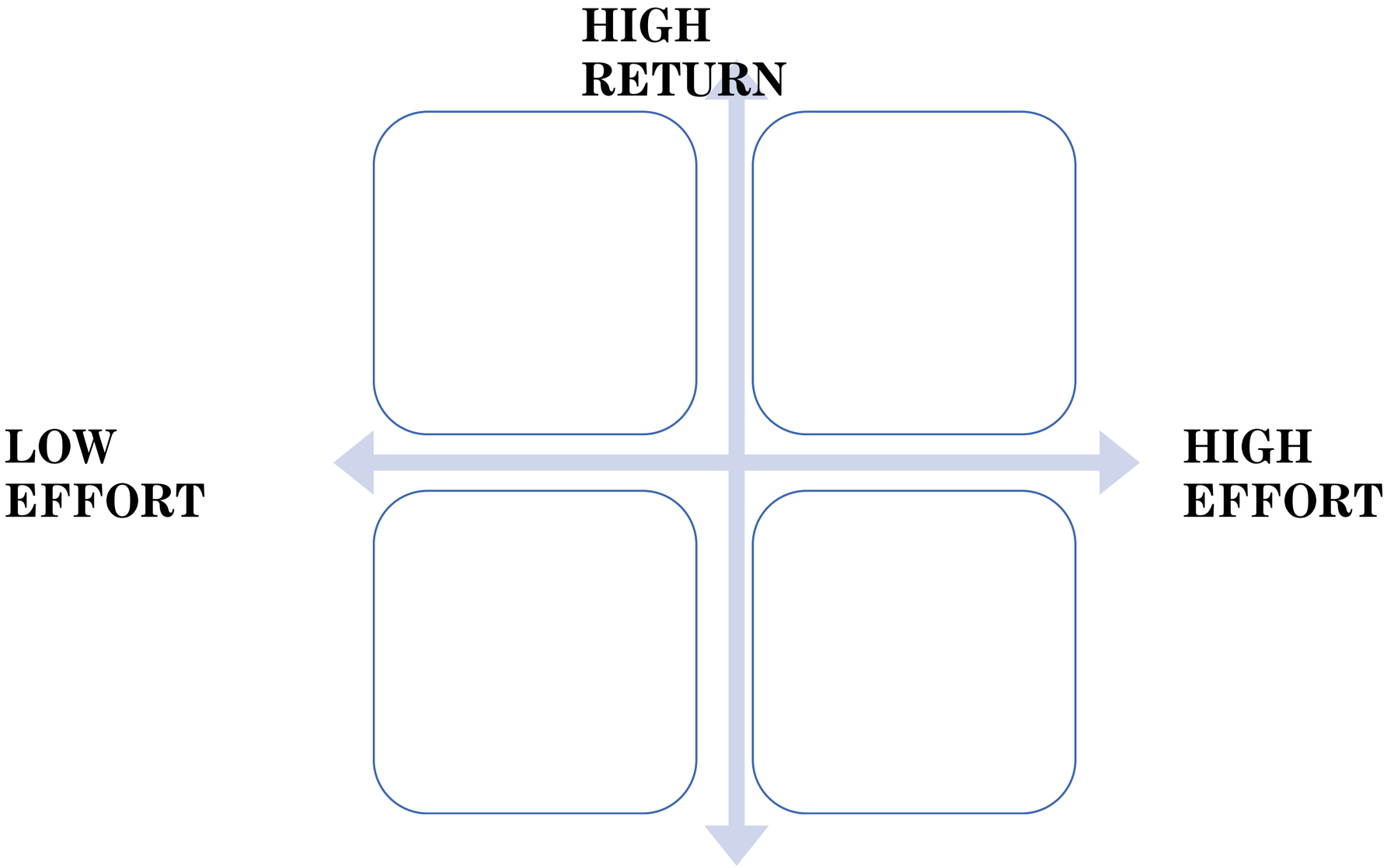
Mission

- Breakdown of your Vision into tangible action and time
- What steps you would take to achieve your Vision in next 5 years ?

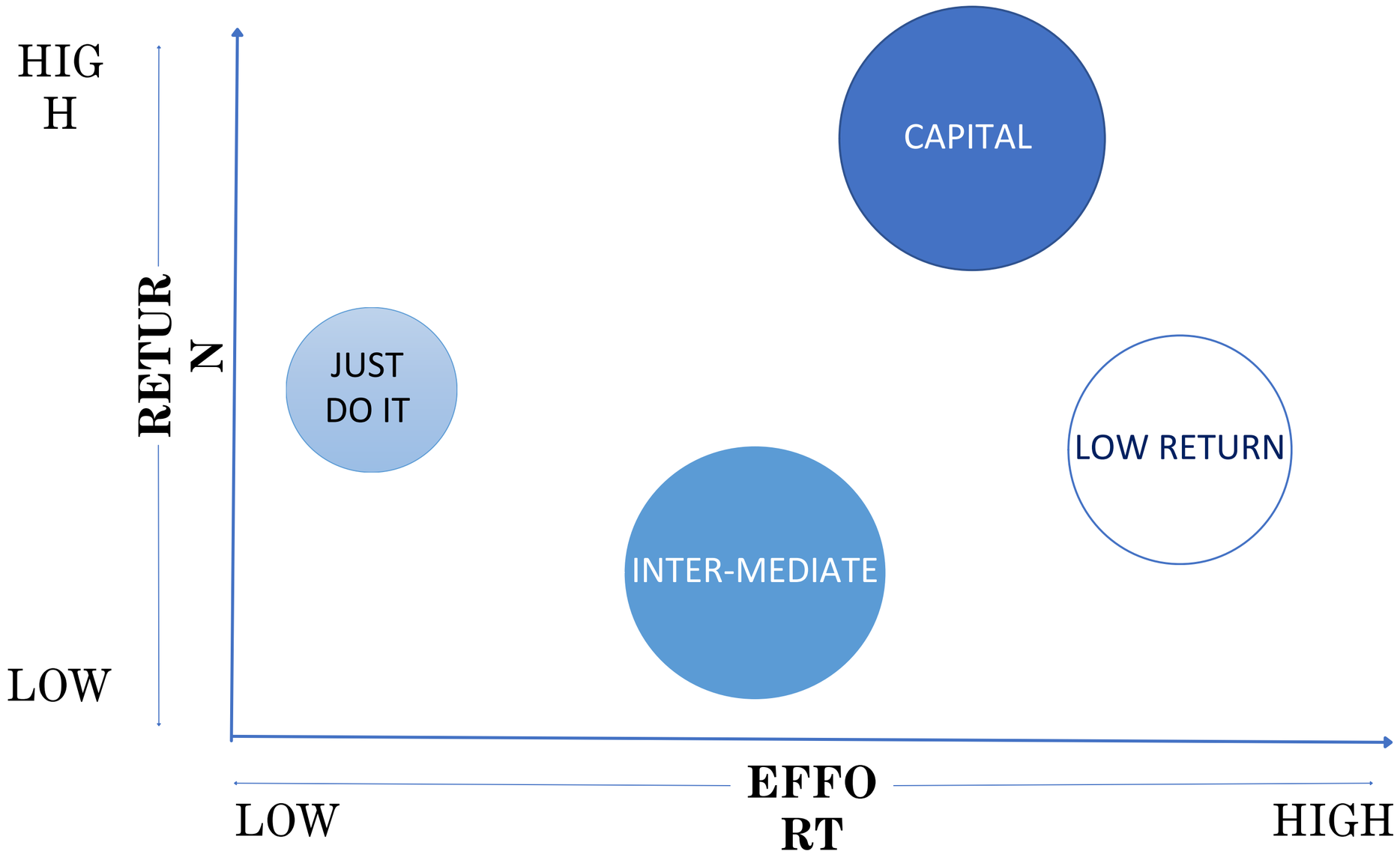
Goals

- Have your prioritized your Do'ables ?
- Short term periodic assessment of progress made

Planning to achieve your vision



Planning to achieve your vision



Key to Sustainability - Measurement

Major step towards Water Sustainability is to measure it.

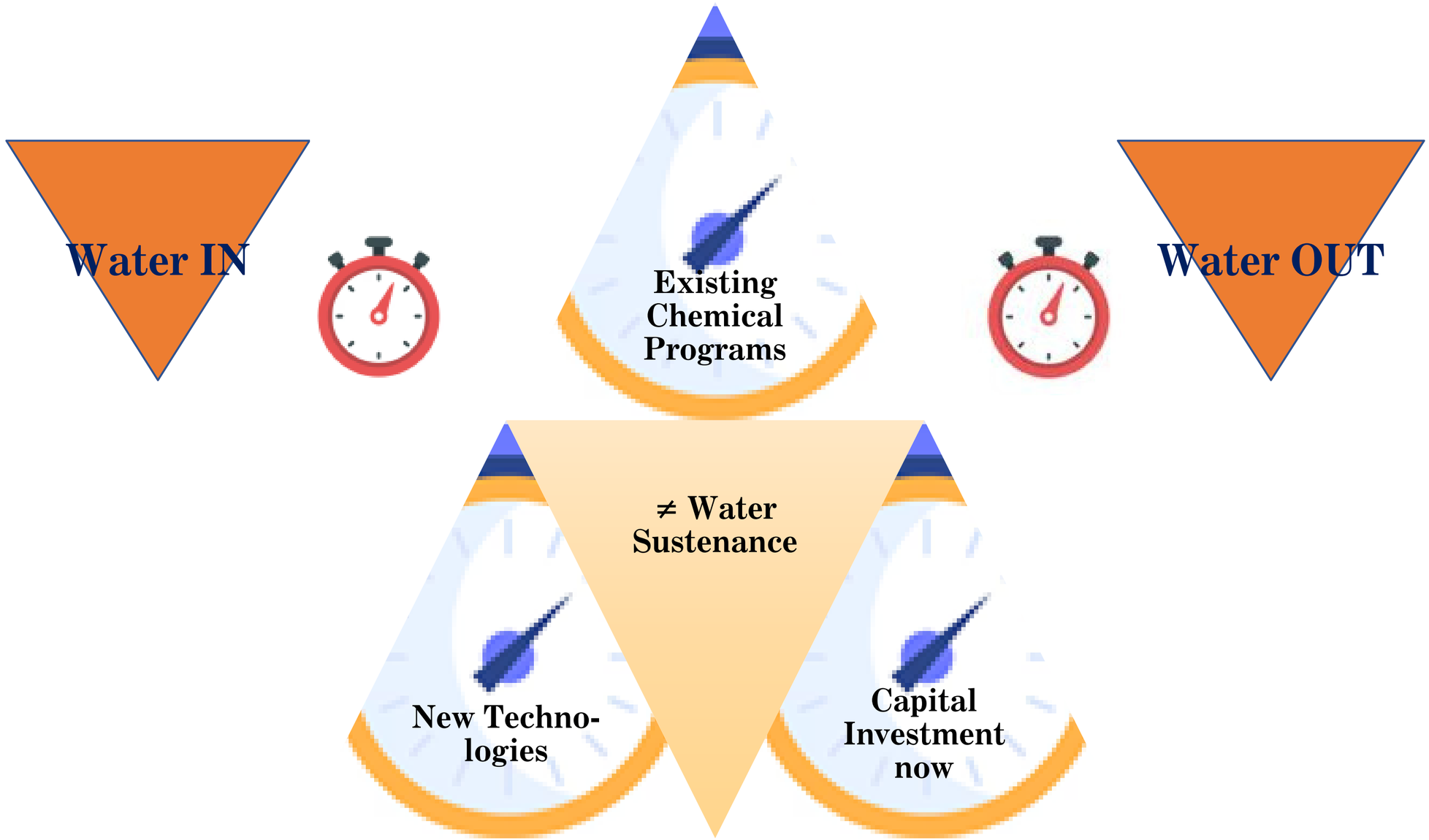
Lack of measurements leads to:

- Assumptions
- Mistakes
- Chemical or Mechanical inefficiencies
- Inability to create an accurate water balance

The probable reasons could be the expense related to it especially for large flows or pipelines. However, there are inexpensive options today which can be imaginatively used to achieve our goals.

Final Mill Sustainability = ∑ Sectional Sustainability

Roadblocks


Water IN
Existing Chemical Programs
Water OUT
≠ Water Sustenance
New Techno-logies
Capital Investment now

Audits

Final mill water mapping = ∑ Sectional water mapping

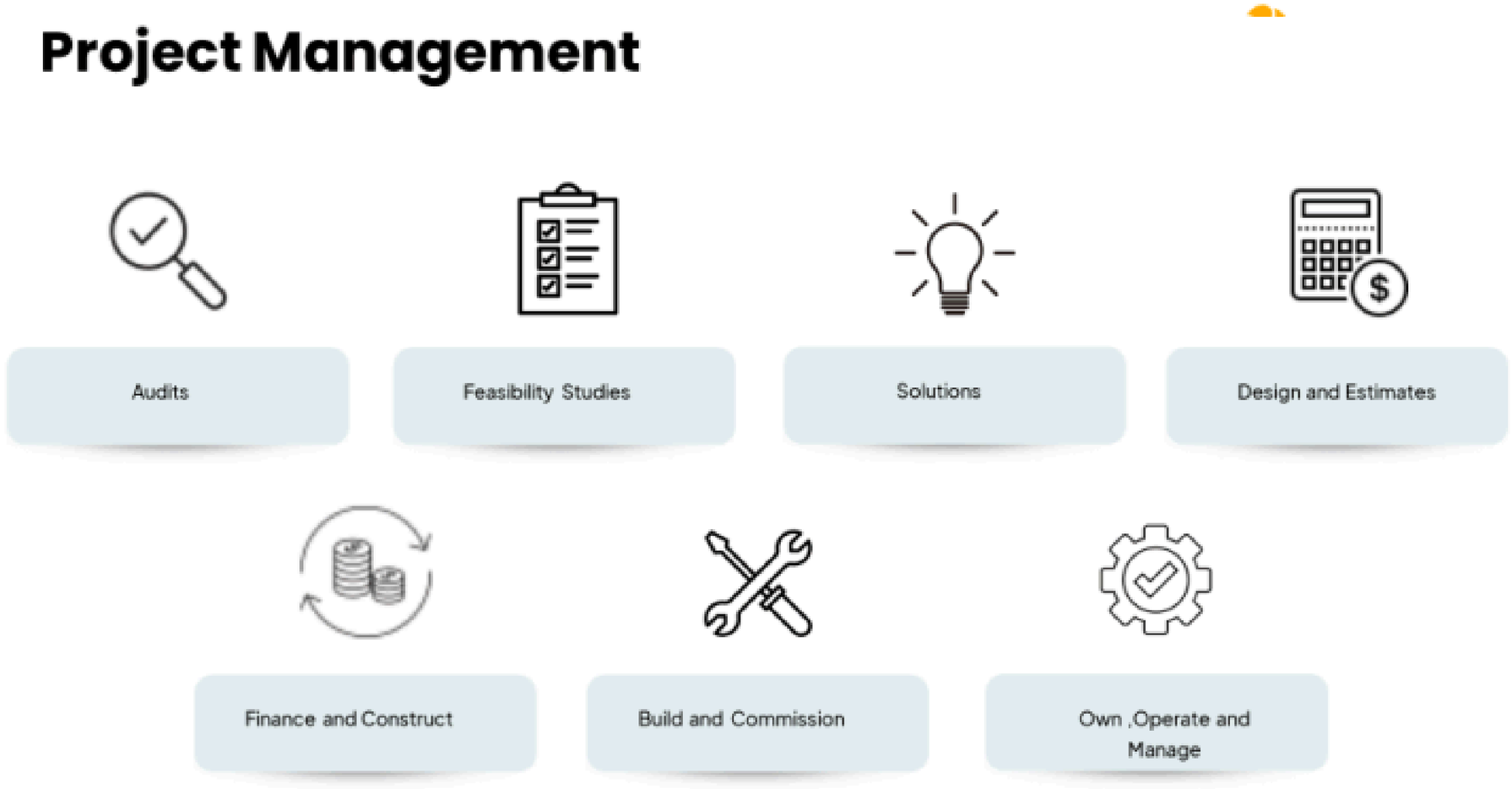
Rules

1. Mill-wide Audit (MWA) favourable to assess cross-sectional usage
2. All Entry and Exit points must be quantified
3. An extended [Quality] PFD can also be done
4. Larger data must be relied upon as against instantaneous
5. All entries must be balanced (No mystery inputs or losses)
6. Opportunities and Challenges must be drawn

Rules

1. Sectional improvements must include on-site lab trials for preliminary assessment
2. Extended off-site testing where required
3. Opportunities must be quantifiable and ROI template drawn
4. Develop Current and Proposed Water Mapping – again quantified
5. Conclusions must align and fact-check with Vision, Mission and Goals
6. Agree on path forward
7. Sequencing Implementation

From Audit to Implementation



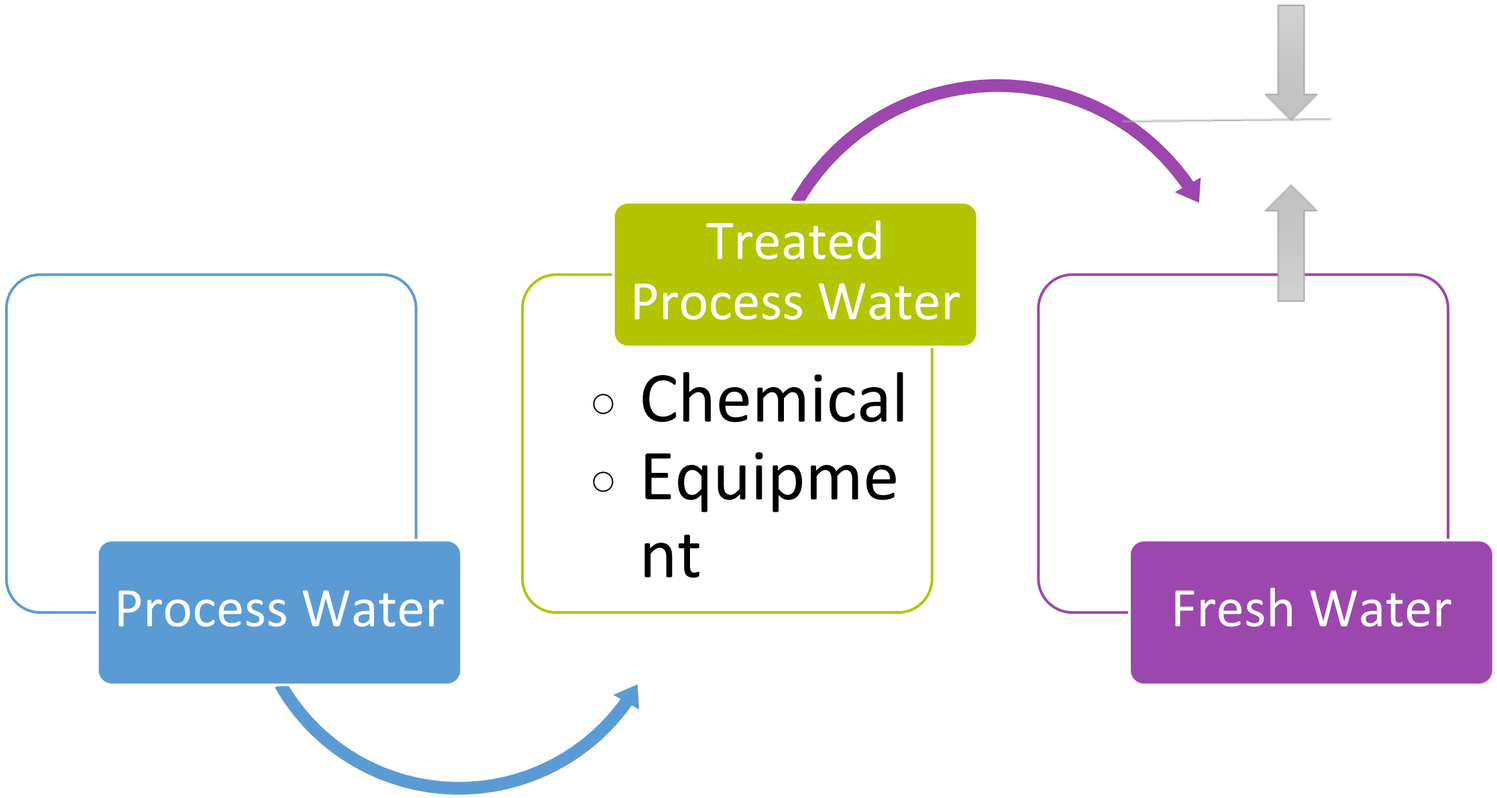
There needs to be a change in the mindset regime, as we will be progressing to a higher Cycle-of-concentration (COC) and higher TDS cycles and still need to achieve our target and productivity goals.

Maximizing Efficiency

Each Individual water treatment unit must operate at peak efficiency

- Krofta
- DAF
- Sedicell
- Disc Filters
- Pressure Filters
- Sand Filters
- Clarifiers
- Heat Exchangers
- Cooling Towers

Major areas of fresh water consumption



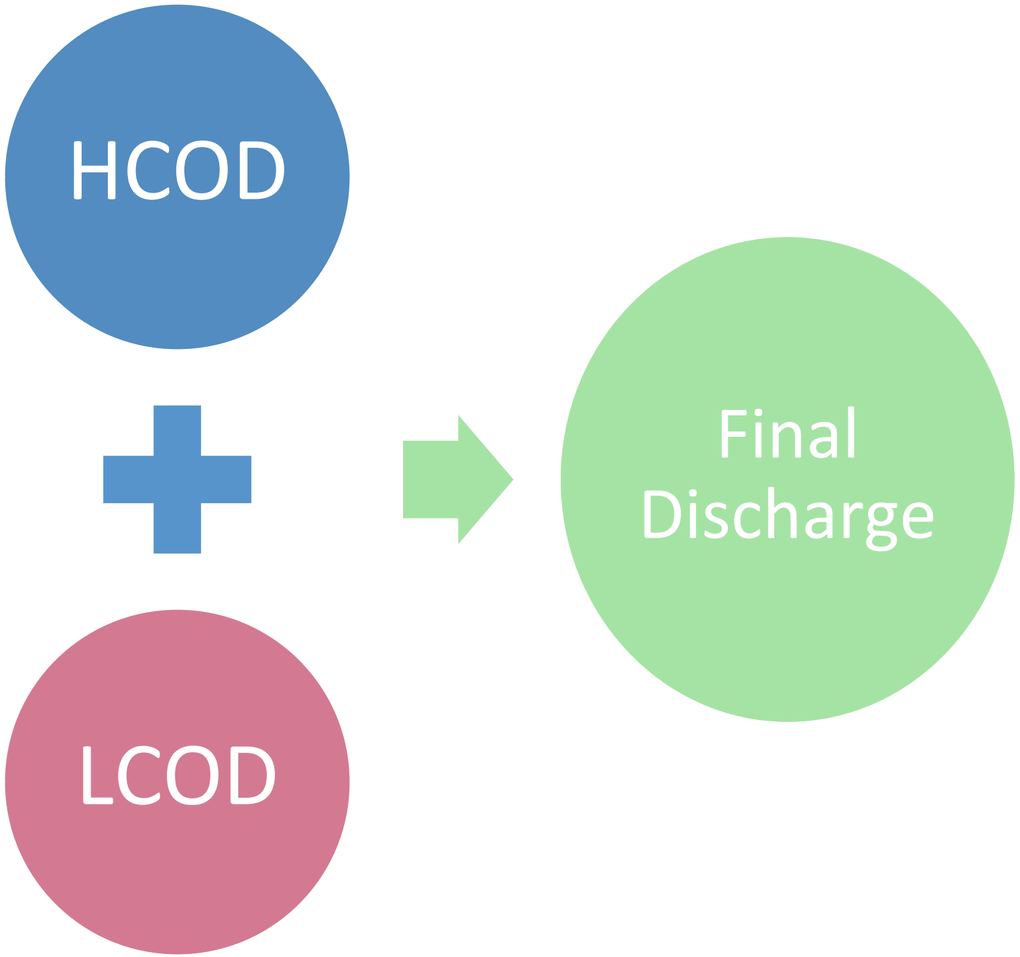
Paper Machine Clarified Water being used in Pulp Mill
Must be treated for TSS and Colloidal solids to the max

Major Fresh Water consumers

Paper m/c showers
Chemical additive plants
Some ancillaries

Recycling Process water for above use is an opportunity

Selective recycling of short loops

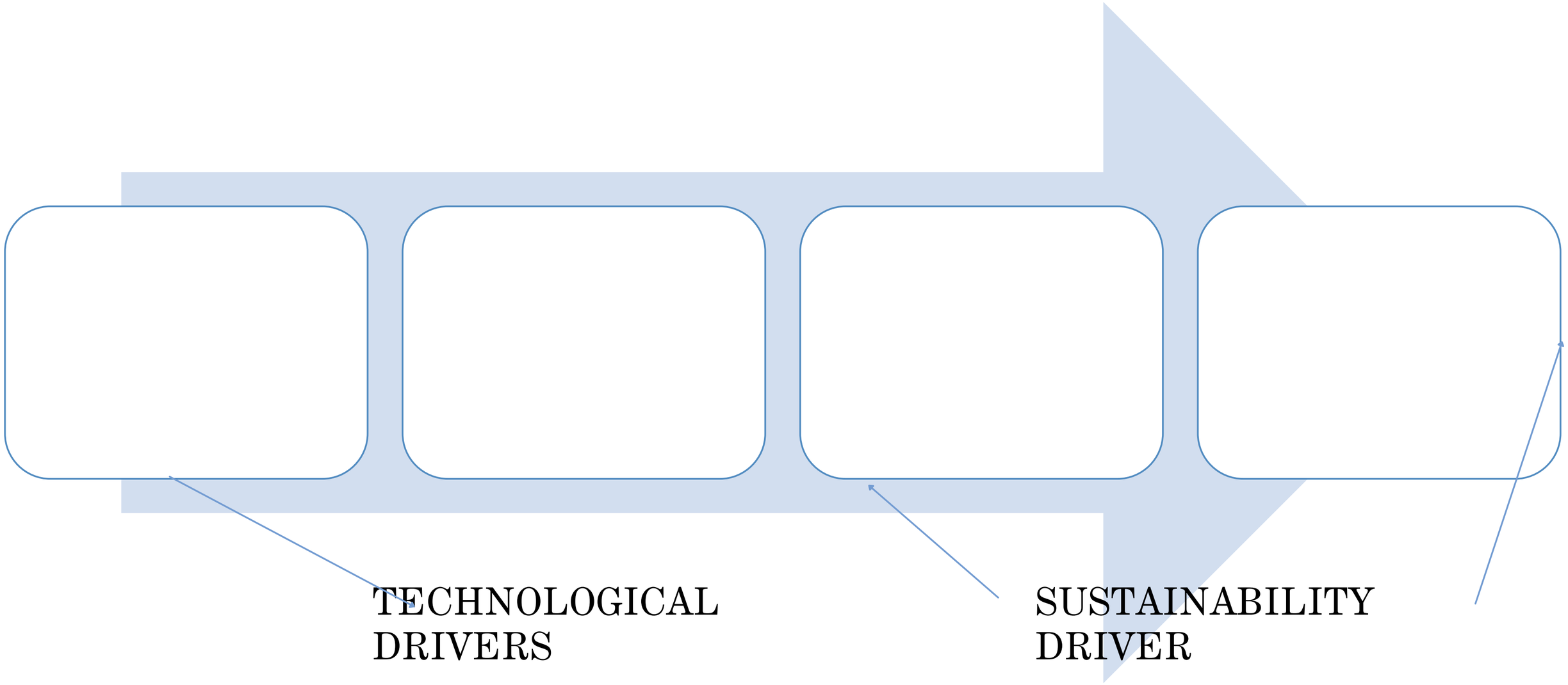


The Pulp Mill effluent and Paper Machine effluents are mixed either before or after the Pri. and Sec. treatment.
in many mills the Low COD stream acts as a dampener for transgressions in High COD stream. (Ref. section “Adopting New Frontiers in Technology”)
The Low COD stream lends itself to recycling at lower conversion costs. This must be used for several closed short loops
In effect, the overall inflow to the ETP will reduce and will provide more opportunities to treat this in a different way.

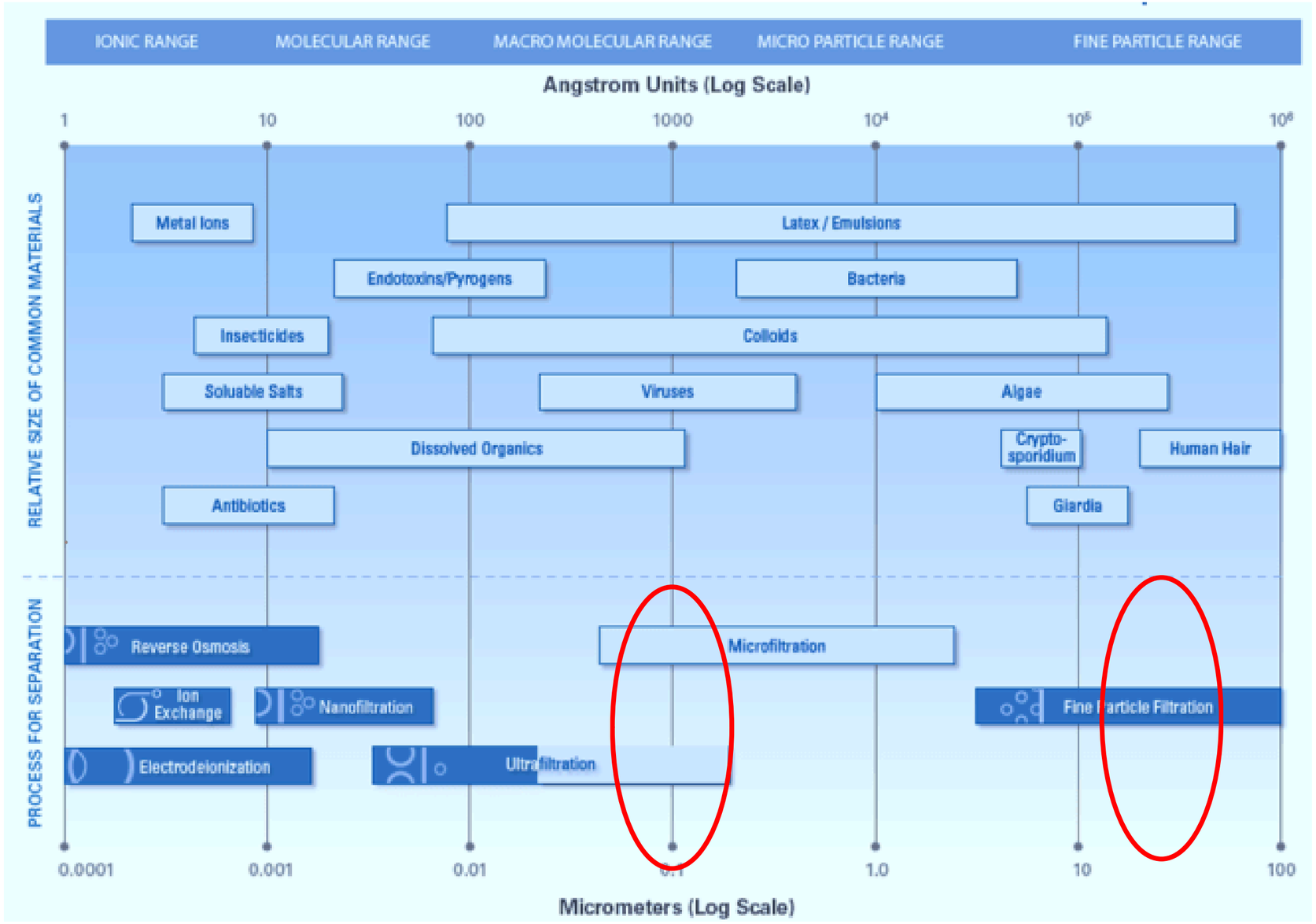
Out-stepping the technological status-quo and seeking new solutions

Sec 5. breaking the barrier

Shifting the technology barrier



Ultrafiltration [UF] concept



Disc Filter

Why can't we use it back in place of Fresh Water applications?

- Showers
  - Showers use many nozzles for creating a jet spray to cover the entire width. These are classified as Low pressure and High pressure showers. Nozzle diameters vary from 1.2 – 1.5 mm for Low pressure and, 0.7 - 1.0 mm in High pressure.

FISHTAIL

TIP SPRAY

FANJET

FLAT SPRAY

NEEDLE

Streaks, Felt damage, Marks and Runnability!

Typical UF used in water treatment

Temperature – PES / PVDF – Limit – 35^{0} C.

Most paper making systems in India operate at 45 – 47^{0} C

TSS slippage or variation

Continuous reject removal

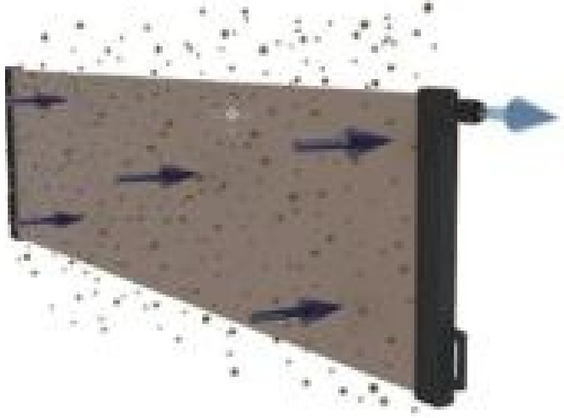
Feed Pressure – Power consumption

Expansion is difficult

Haber UF

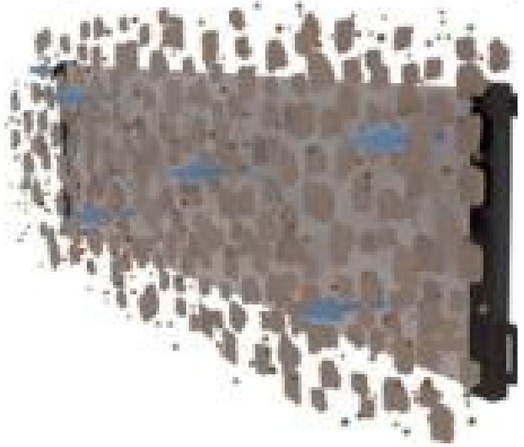
OUT-TO-IN FILTRATION

ramic plate with filter active layer on the
e of the membrane. Suspended solids
d on the membrane surface and forming
yer while clean water is passing through
ne body and is collected at both end caps.



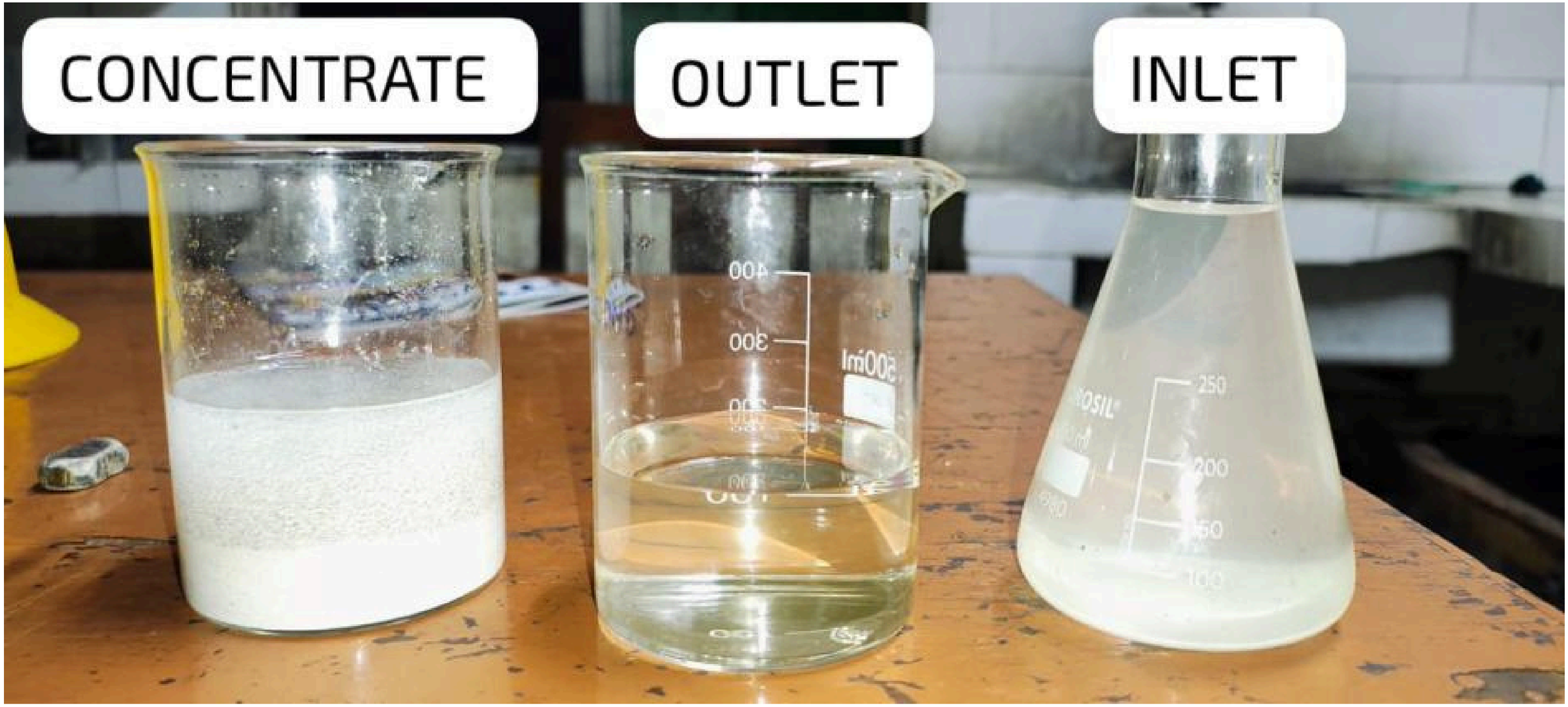
IN-TO-OUT BACKWASH

Reversed flow direction to filtratio
small amount of filtered water is
backwash the membrane. Within se
formed cake layer comes off in
Air-scouring can enhance the cake la

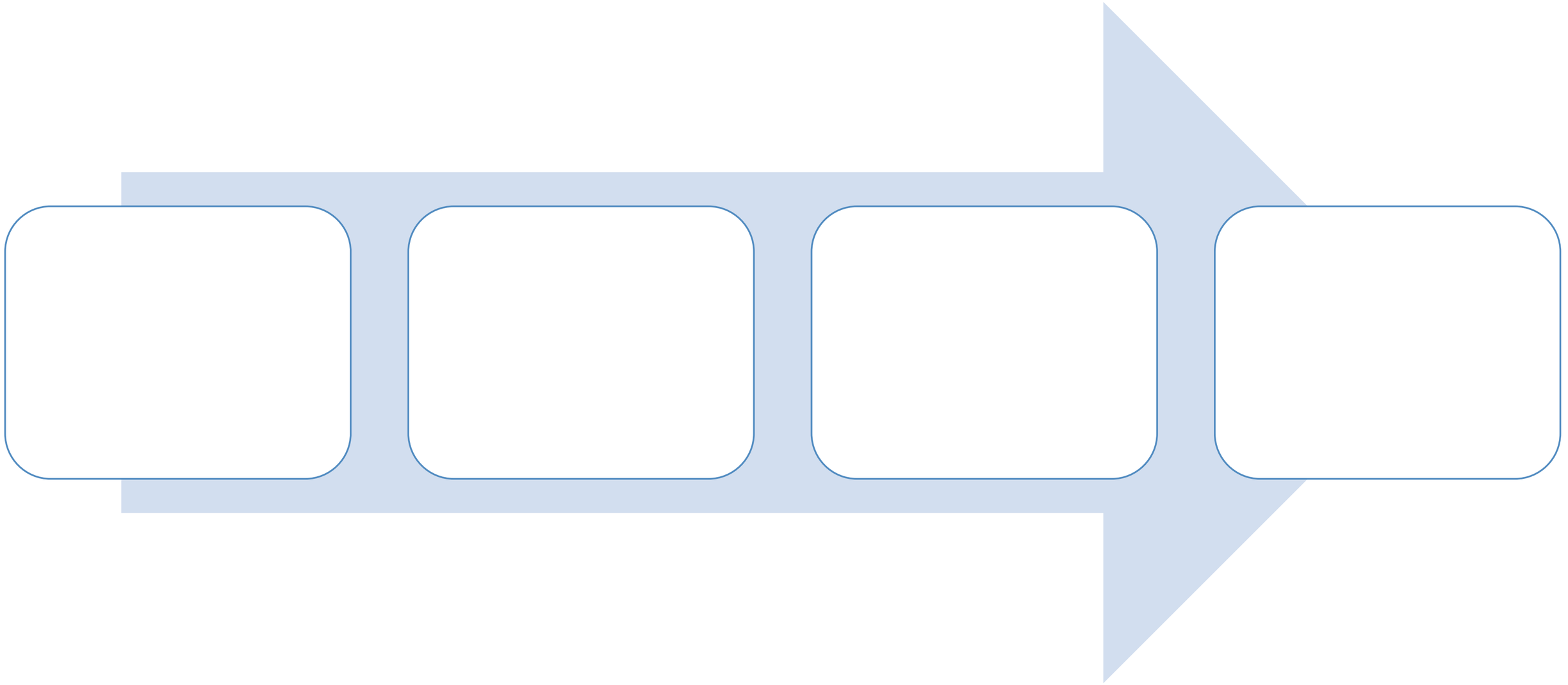


Typical UF results

Typical UF results

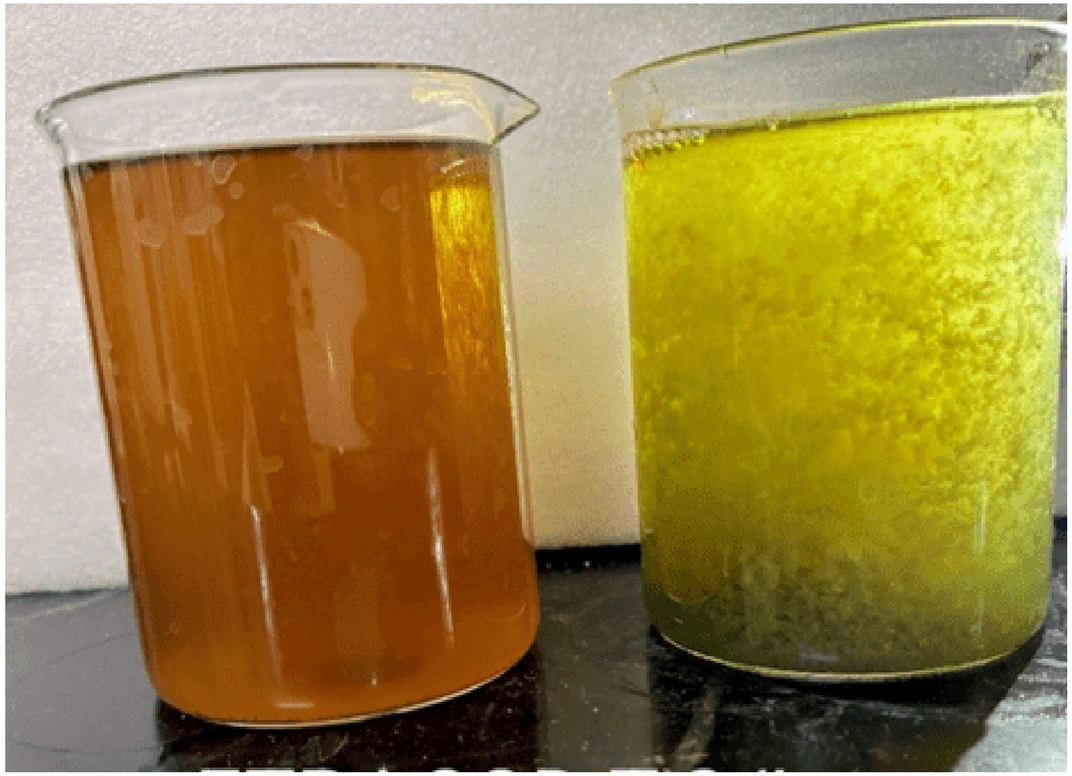


A different story in Brown Kraft Paper Mills



Typical UF results

Adopting new frontiers in technology



Electro-coagulation of EOP Filtrate	ETP HCOD effluent by Electro-coagulation	Electro-coagulation followed by Ultrafiltration

Electro-coagulation Pilot Plant

Value Addition

Fresh Water Saving
+++

COD Reduction
+++

Eff. Treatment Cost
+++

Chemical Performance
++

Sustainability Index
+

Sustainability

Process

Conductivity Reduction
+

TSS Reduction
++

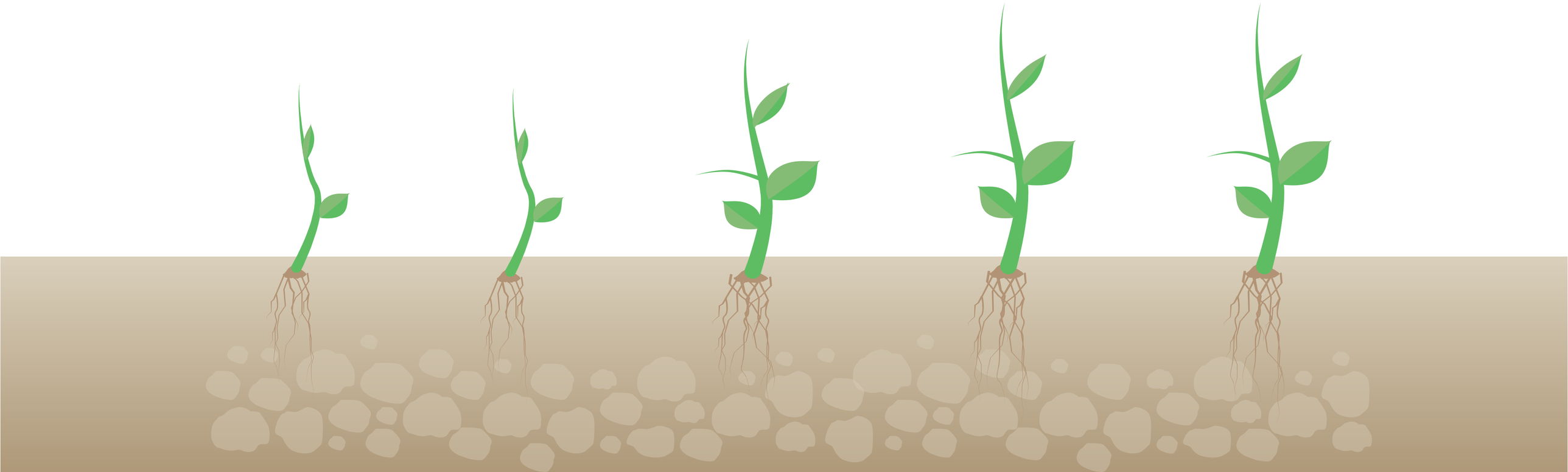
Turbidity Reduction
++++

DCS Reduction
++

Cat. Demand Reduction
++++

Conclusion

- Water Sustainability is no more an option but a necessity looming large on the operational efficiency and profitability of the mill. [SEC 1. SLIDE 11]
- In some cases, it can supersede the presence of mill over providing job opportunities or revenue that it can generate to the larger social cause. [SEC 1. SLIDE 11]
- Early induction into this exercise would help ratifying the right process and achieve cost optimization. [SEC 4 SLIDE 35]



THANK YOU!