

Optimising Industrial Water Use Through Advanced Technologies

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Agenda

01 Industrial Water Optimisation: From Necessity to Strategic Priority

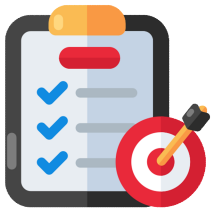
02 Key Drivers for Optimization

03 Optimisation through Process Design

04 L&T's inhouse Competency and R&D Initiatives

05 Optimisation Philosophy: AI-Driven & Predictive Water Management

06 Summary



Industrial Water Optimisation: From Necessity to Strategic Priority

Four pressures are converging on industrial water systems

WATER SECURITY

Freshwater availability can constrain capacity and expansion.

COST

Water, energy, chemicals, sludge and disposal create recurring OPEX.

COMPLIANCE

Variable influent and tighter discharge/reuse requirements demand robust treatment.

Adaptability

Stable water quality and availability directly support production / business continuity.

OPTIMISATION = Lower Freshwater Intake + Higher Reuse + Lower Discharge + Lower Lifecycle Cost

Design objective: maximise water productivity — not simply treatment capacity.

Illustrative Industrial Water Optimisation Roadmap

A phased approach reduces technical and commercial risk

PHASE 1

Diagnose

Water balance
Quality mapping
Energy baseline
Reuse targets

PHASE 2

Pilot

Bench/pilot advanced technologies
• validate chemistry
• confirm performance

PHASE 3

Integrate

ETP + membranes + reject management + automation + digital platform

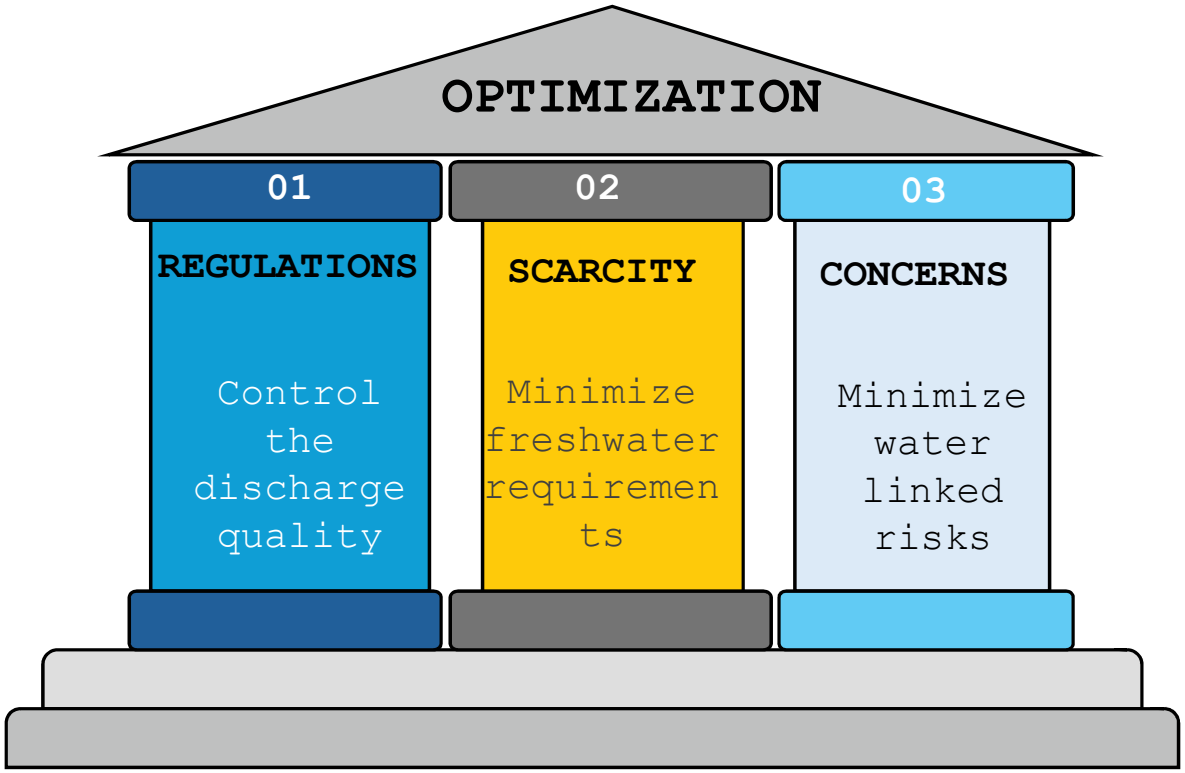
PHASE 4

Optimise

AI/digital twin
• predictive maintenance
• dynamic operating envelopes

KPIs: m^3 freshwater / unit product | % reuse | kWh/m^3 | ₹/m^3 | discharge volume | uptime

Key Drivers for Optimization



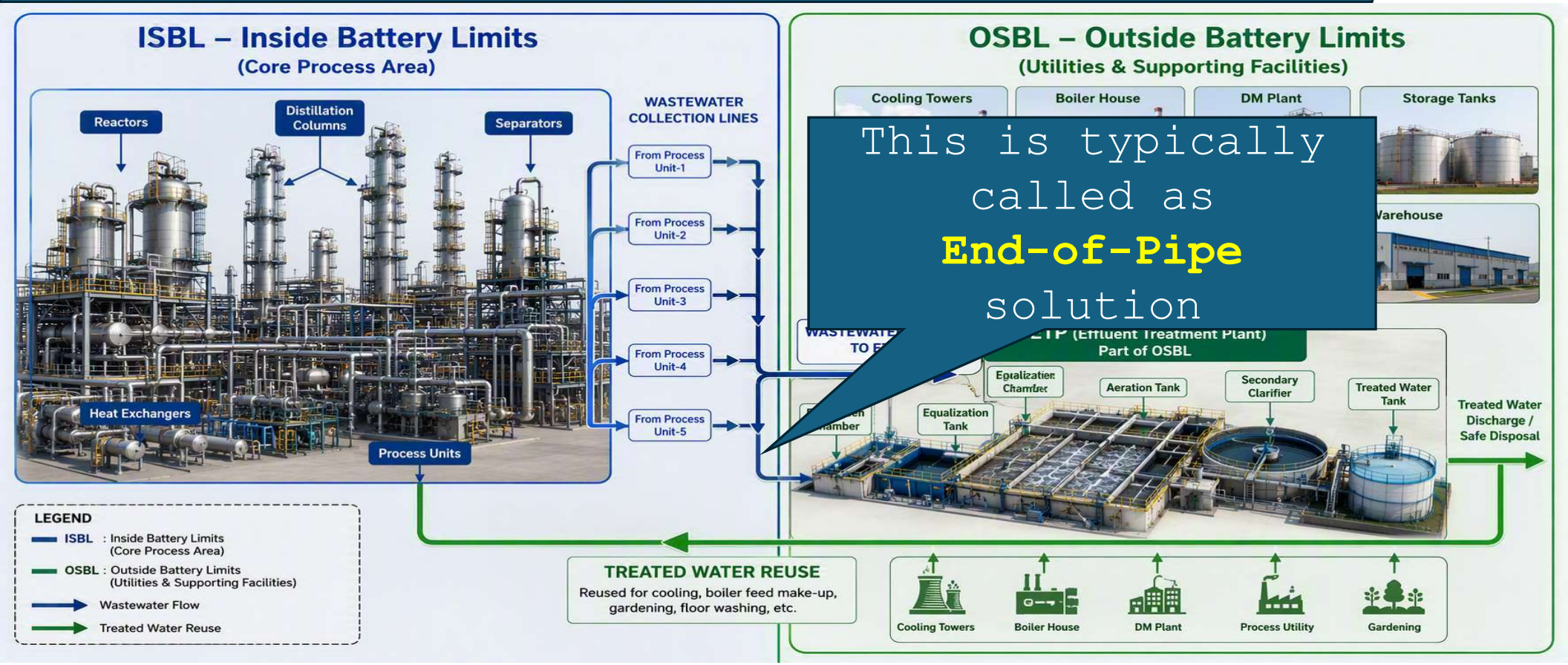
01 Treat
- **Process** the effluent
- **Monitor** the quality

02 Reuse
- Maximize **recycle**
- Adapt ZLD

03 Sustain
- **Condition** the feed
- **Recover** Value

Optimization becomes an essential step in Treat, Reuse and Sustain

Moving Beyond End-of-Pipe Thinking



A typical industrial setting : ETP is always away from the process

Conventional Design Limitations

REALITY



- ETPs often experience upsets and take operators by surprise
- Typically the ETPs designed for specific values of parameters specified in the tender
- The changes in the plant operations bring unexpected change in wastewater parameters
- Operational stability of an ETP depends finally on the skill levels of an operator

A well-designed ETP accommodates wastewater variability, ensuring operational calm and consistent performance.

Never design an ETP without knowing your Water

Necessary Correction in the current Design

MONTECARLO SIMULATION H

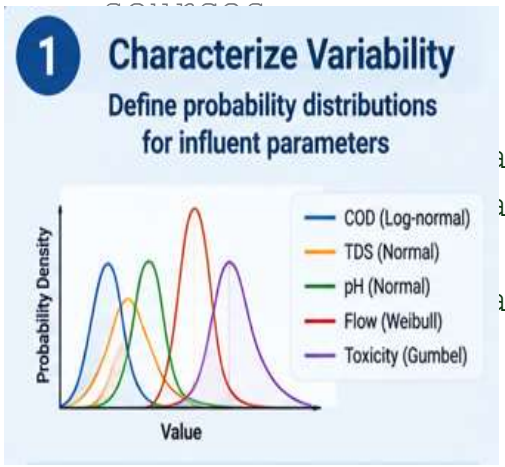


Wastewater from various



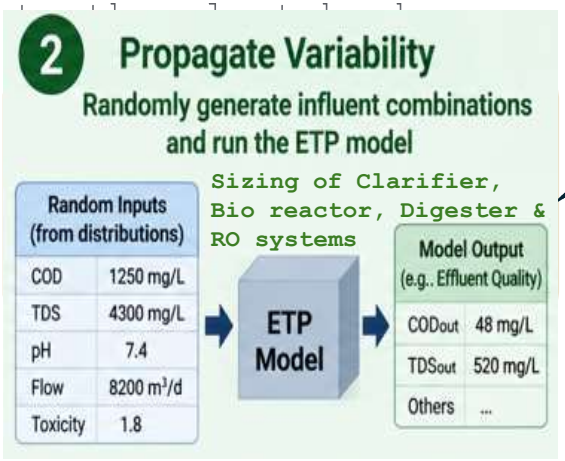
ETP treating the mixed water and recycling part

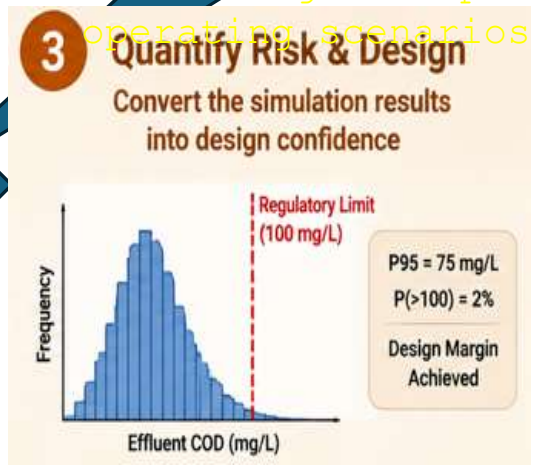
Montecarlo Simulation is a newer approach to optimize capacity and ensure quality amidst variation in feed quality by simulating multiple operating scenarios



alue

alue





INPUTS DESIGN OUTPUTS

From Variability to Confidence: Designing for Operational Calm

Better Operation by Knowing the Influent Be





Regular Approach

Composition

COD | BOD | TKN | TDS

TENDER DATA

Solution

Physical | Biological | Membrane

Process Designers Output

Erroneous process design leading to suboptimal performance

Required Approach

Organics

- Fingerprinting
- Mol. Wt. distribution
- Polarity, deg.of saturation

Inorganics

- Heavy metals (Zn,As,Cr)
- Highvalent ions
- 0 valent ions (Si, B)

Treatment philosophy based on specific pollutant

- Closer watch on the Influent
- Continuous monitoring of Process
- Operational philosophy based on sensed and estimated changes in Influent characteristics

Process insights and sensed information to give optimal output for design

L&T Water Technology Centre – Cutting Edge

A State-of-The-Art Research Centre for complete water research at Kancheepuram, Tamil Nadu



industrial effluent

Improve



Tank Fa

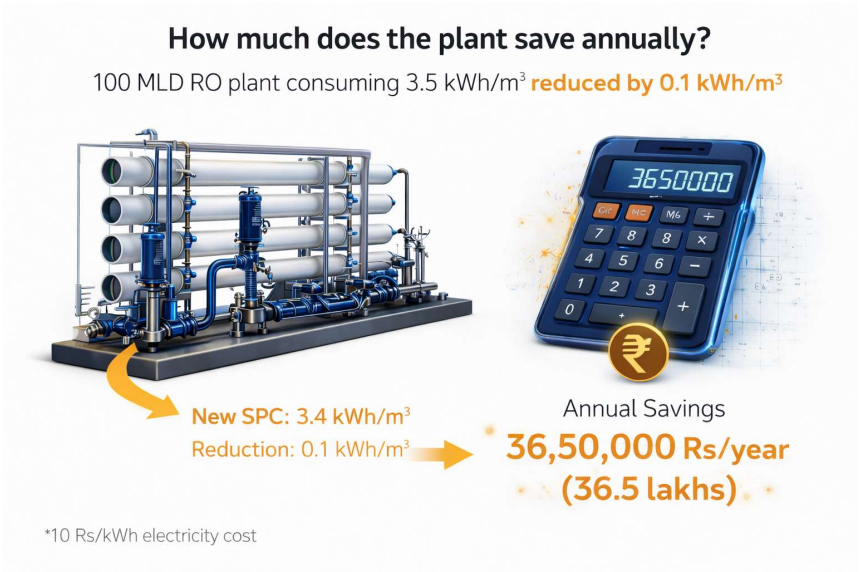
- Changes
  brings
  the desa
- More
  phenolic
  enter the
- Higher
  these parameters **disrupt**
  biological system suddenly, without any warnings
- Bringing ETP back to normalcy needs heavy efforts

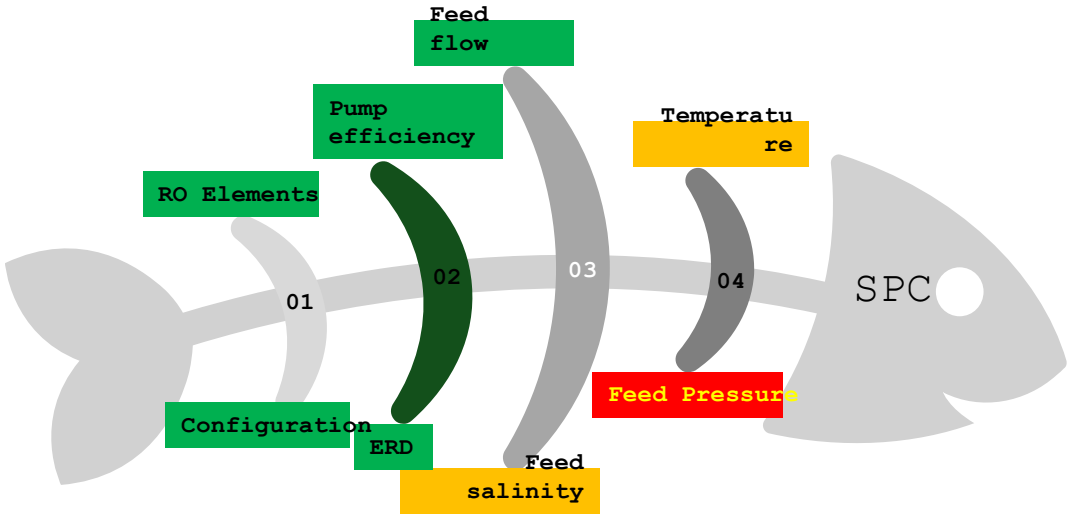


- **Protect:** Avoid shockloads on aerobic system thus protecting the entire integrated solution

Proactive Strategy Contd (Desalination)…

Specific Power Consumption (SPC) is one of the most critical parameter which significantly impacts economics of desal plant

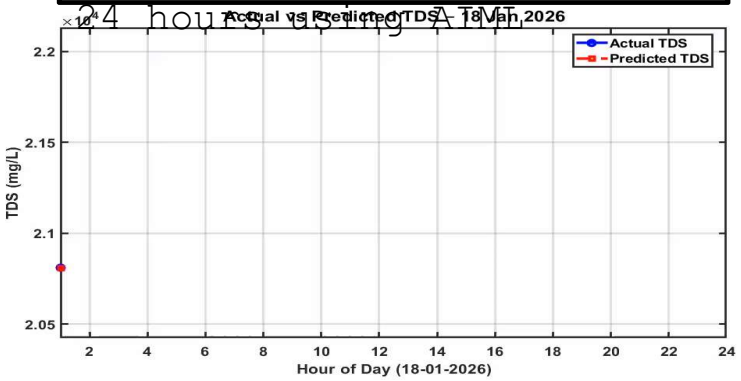


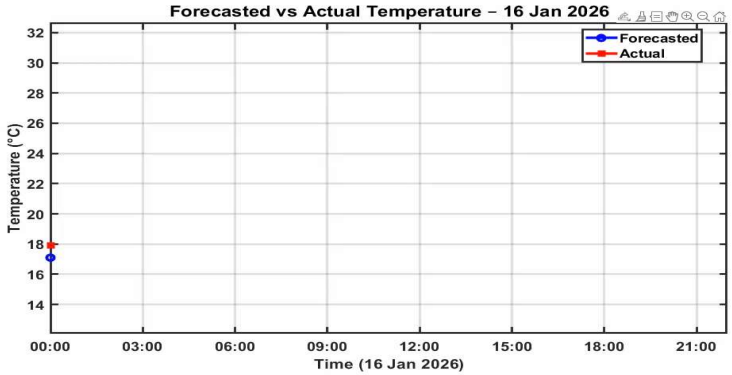


In desal, the temperature and feed salinity are the uncertainties which affect the SPC when certain volume of treated water needs to be produced in a day.

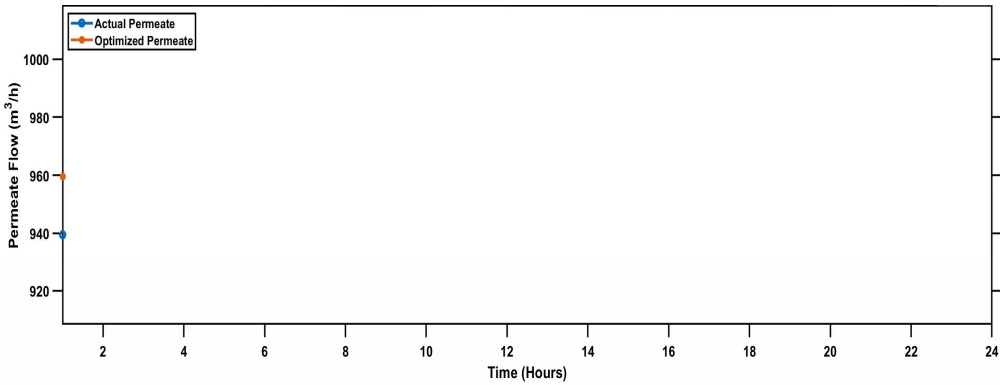
L&T WET's Solution: Optimal Predictive Cont

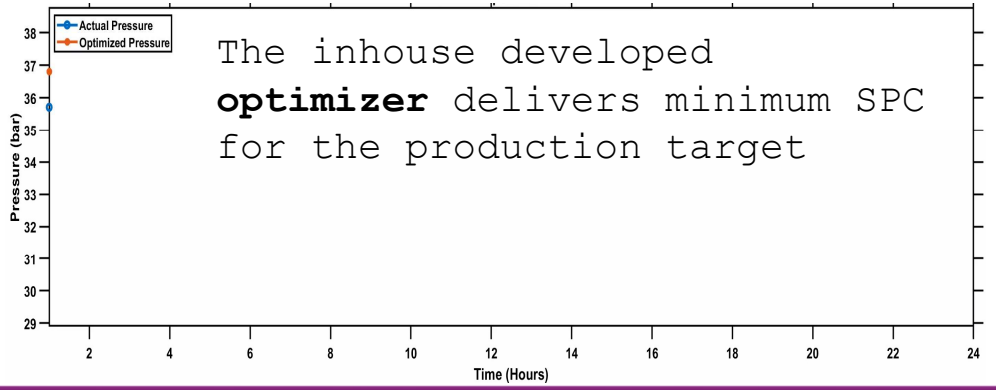
TDS and **Temperature** prediction over the next 24 hours using AIML





Reduction in SPC while processing the required volume of permeate





The inhouse developed **optimizer** delivers minimum SPC for the production target

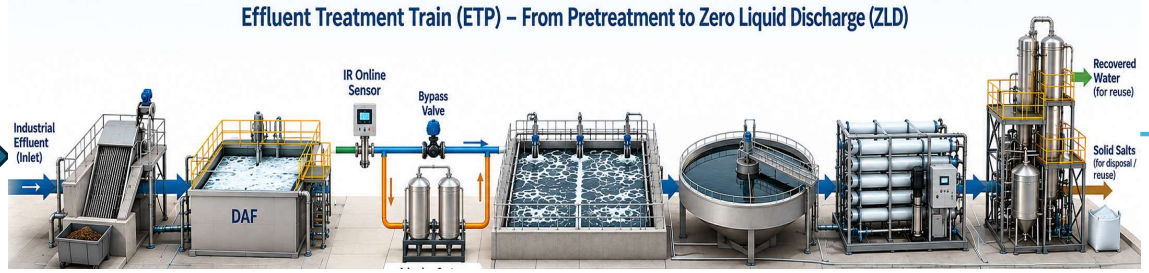
Uncertainty prediction helps in delivering optimal output

Moving Away from EoP Solution to Optimal Wa



Process Plant

ISBL



Screen DAF Biological process RO ZLD

EoP Solution

Recycle

- The above has been a traditional approach in industries for ages. Is this the most optimal solution?
- The EoP solution assumes water requirement for every process as an **independent demand** which violates the optimality

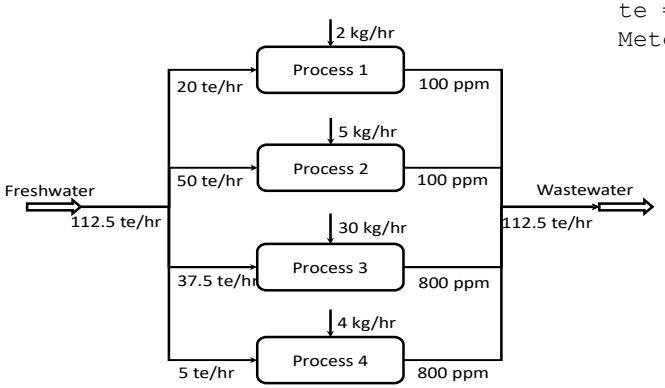
Newer approaches are emerging to optimize the overall water footprint

Water Minimization through Mathematical Pro

A contrived example representing an EoP solution

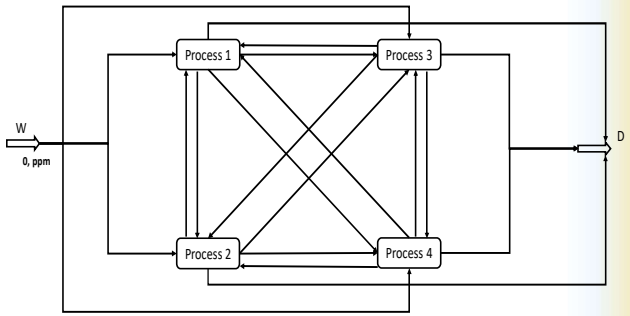
Process #	Contaminant load (e.g. COD), kg/hr	Max Inlet contaminant level, Cin, ppm	Max Outlet contaminant conc. Cout, ppm
1	2	5	100
2	5	50	100
3	30	50	800
4	4	400	800

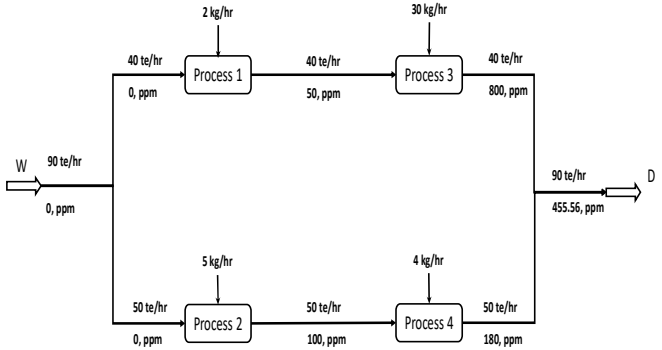
te = Cubic Meter



112.5 te/hr goes for the ETP for tre

- The MP assumes a superstructure (GAMS)
- It identifies optimal path under constraints to deliver best





Only 90 te/hr needs to be treated

*Grossman 2013

Digital technologies like MP are able to minimize the total water foot-print

Summary

The Future of Industrial Water Plant is Circular, Intelligent and Fit-for-Purpose

The opportunity is to turn water management from a treatment function into a business performance lever

CIRCULAR

Reduce → Reuse → Recycle → Recover

INTELLIGENT

Sense → Predict → Optimise → Verify

ADAPTABILITY

Secure water → Stable quality → Reliable production

The goal is not the most advanced technology.
It is the most efficient water system that meets quality, reliability and lifecycle-cost requirements.

Thank you