

water + chemicals + energy = effluent

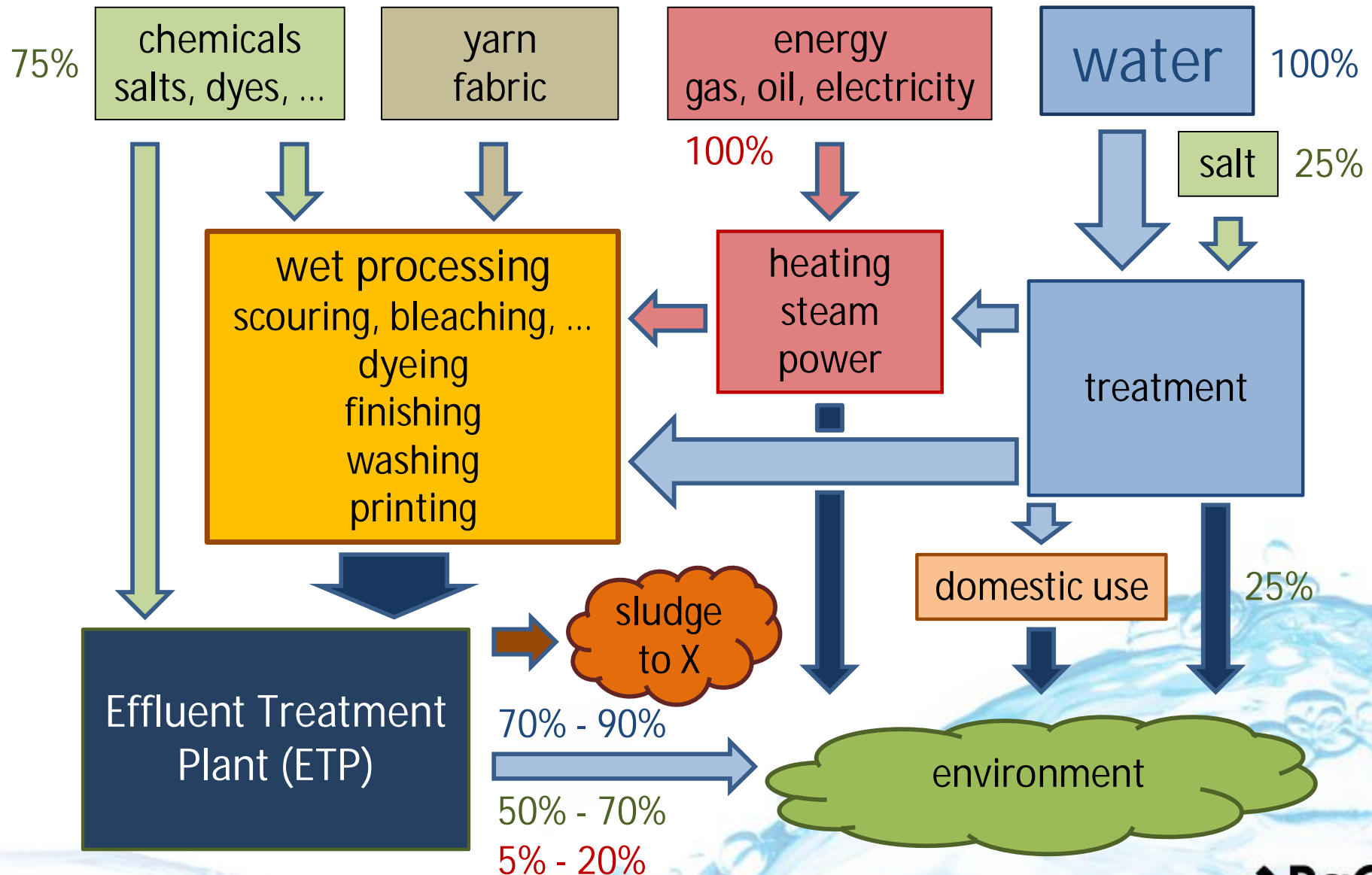


lessons &
opportunities

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Model Engineering

from 2012 - 2014 deep dive CPA in 19 BD Textile Industries

water + chemicals + energy = effluent



Key Performance Indicators (KPI's)

KPI's indicate resource consumption & emissions per kg fabric produced

KPI	impacts	unit	Dyeing & Finishing	Washing
water	ground water	liter/kg	88 - 421	105 - 154
energy	natural gas	kWh/kg	9.4 - 38.5	4.5 - 11.1
CDE	air & climate	kg/kg	1.9 - 7.5	0.8 - 2.3
COD	water quality	g/kg	4.7 - 41.6	5.2 - 15.3
TDS	water quality	g/kg	87 - 431	28 - 71
sludge°	environment	g/kg	12 - 179	16 - 68

CDE = Carbon Dioxide (CO₂) Equivalent (air emission - global warming)

COD = Chemical Oxygen Demand (organic pollution in ETP discharge)

TDS = Total Dissolved Solids (salinity in ETP discharge)

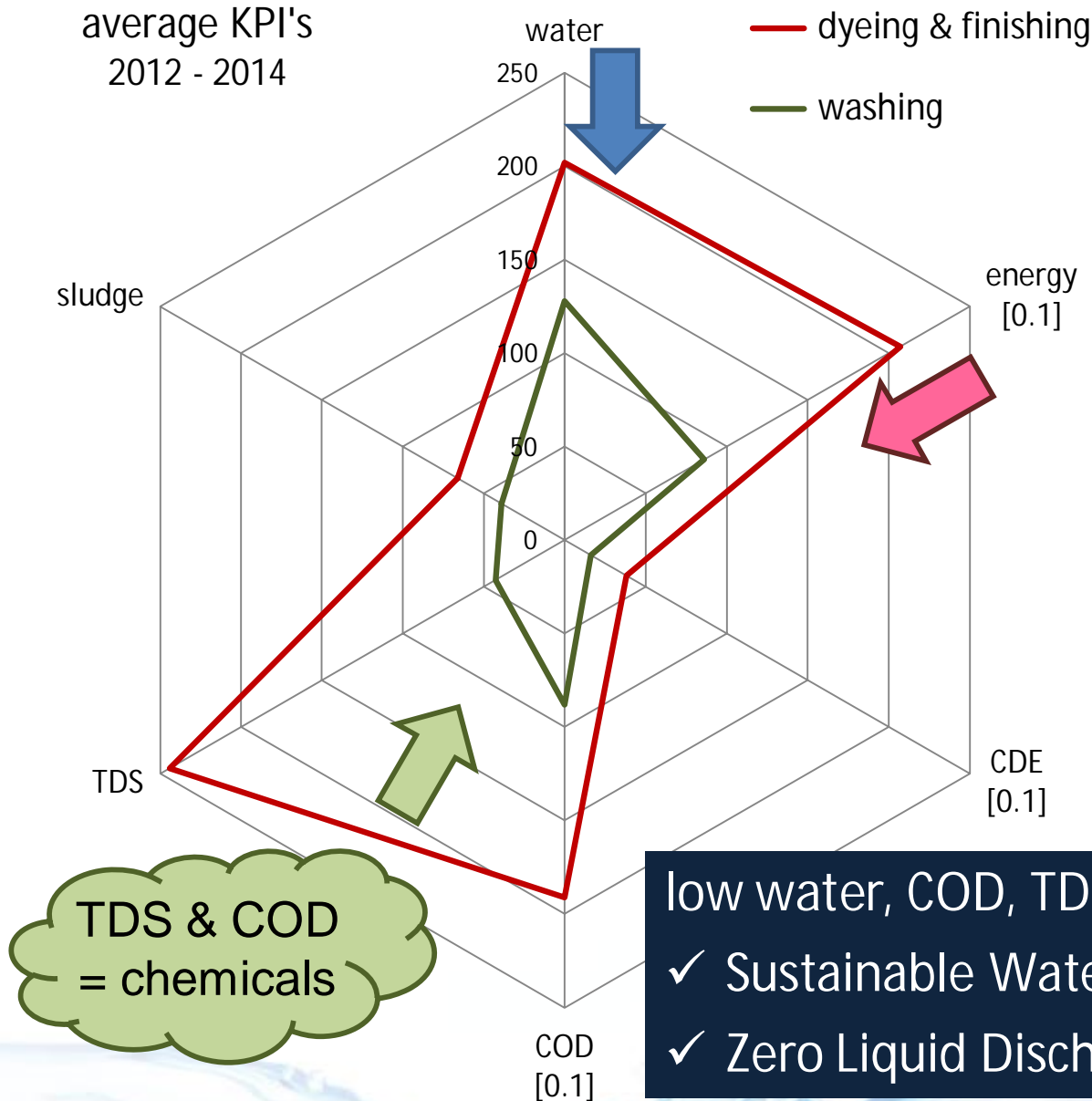
high KPI =
huge potential

resource	unit	unit cost	comment
water	BDT/m ³	10 - 30	from full biological to chemical effluent treatment
energy	BDT/kWh	0.5 - 7.0	from 100% natural gas to 100% diesel oil

°dry ETP waste sludge estimate per 1 g COD removed : 0.5 g biological, 1.5 g chemical

KPI's in a glance ... in real-time on your tablet

average KPI's
2012 - 2014



driving KPI's down to

- ✓ squeeze footprint,
- ✓ squeeze costs and
- ✓ boost sustainability

low water, COD, TDS KPI's enable

- ✓ Sustainable Water Reuse SWR and
- ✓ Zero Liquid Discharge ZLD

squeeze energy & climate impact

key recommendations to save up to 55% on energy costs & emissions* :

1. boost efficiency of fuel to steam * on top of savings in wet processing
 - tune, overhaul or replace inefficient steam boilers
 - add economizer ← or better condenser & oxygen trim
 - recycle maximum of steam condensate ←
 - maximize steam production efficiency in real-time
2. boost efficiency of fuel to electrical power & heat
 - tune, overhaul or replace inefficient generators
 - recover heat from exhaust as steam ← and engine as hot water
 - maximize electrical power production efficiency in real-time
3. move from steam to hot water
 - reuse hot cooling water (from dyeing, ...) for pre-heating ←
 - add free hot water from generator cooling, solar collectors, ...

already applied by champions in BD

squeeze water + salt for SWR & ZLD

key recommendations to save water & salt for SWR & efficient ZLD :

* on top of savings in wet processing

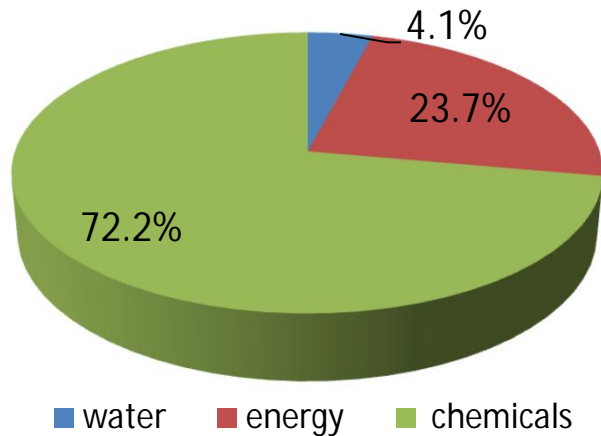
1. squeeze fresh water* and unload ETP (without bypass)
 - in WP : recycle clean water (last rinse, cooling water, ...) ←
 - in WTP : harvest rain water to use as free soft water ←
2. squeeze salt* and maximize SWR & minimize ZLD cost
 - in WP : recover clean brine after dyeing for next batch
 - in WTP : upgrade to zero salt water softening
 - in ETP : maximize bio-treatment ← , use CO₂ or organic acid
3. manage effluent & upgrade ETP
 - segregate effluent for optimal recovery: green, orange, red.
 - convert 'red' to 'orange' to 'green' to clean water for reuse.
 - apply advanced biological treatment ← on 'orange' mainstream.

SWR = Sustainable Water Reuse

ZLD = Zero Liquid Discharge

already applied by champions in BD

key results from the 19 deep CPA cases



cost & saving potential (BDT, USD)

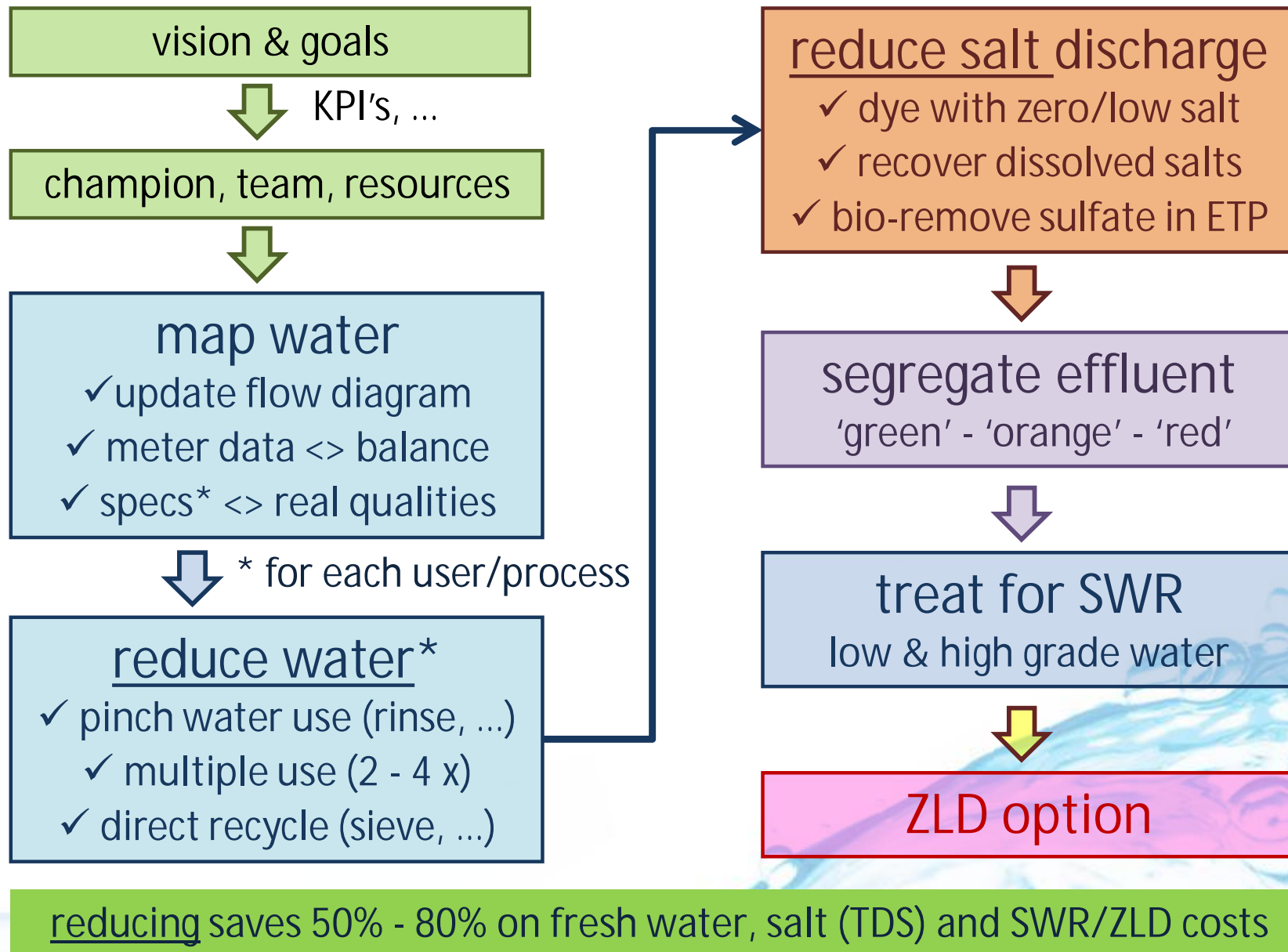
- **water** including ETP : very low
- **chemicals** : **huge** = direct + brine recycling
- **Zero Liquid Discharge (ZLD)** = game-changer

average saving potential*

- **water** : **9.6%**
- **energy** : **40.8%**

* on top of savings in wet processing

water + salt roadmap “reduce before reuse”



Reduce - SWR - ZLD comparison

criteria	Reduce	SWR	ZLD
water savings	50% - 80% fresh	90% effluent	9% effluent
energy [kWh/m ³]	< 0.1	1.0 - 1.5	200 - 300
capex [USD/MLD]	< 0.5 M	1.0 M - 1.3 M	2.5 M - 3.5 M
opex [USD/m ³]	< 0.1	0.3 - 0.5	4.0 - 7.0
ROI including ZLD	huge	high	medium-low
staff qualification	low-medium	medium-high	high
risks	low	medium	high

capex = capital expenditure, opex = operating expenditure, ROI = return on investment,
 1 USD = 80 BDT, M = million, MLD = million liter per day = 1000 m³/d.