

# Chemical Reuse, Recovery and Recycling in Textile Factories

Promotion of Sustainability in the Textile and Garment Industry in Asia-FABRIC

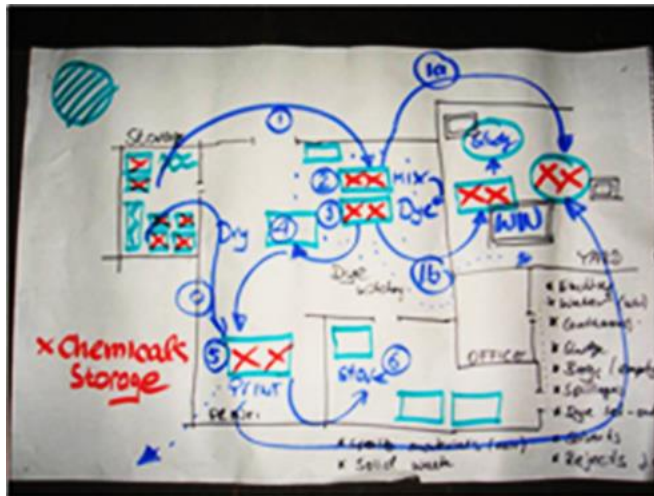
# 3. Material Flow Cost Accounting

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**Executive Director, Espire Consult**

**on behalf of GIZ FABRICS, adelphi consult GmbH and Espire Consult**

# In this session...



- **Understand purpose and concept of process flow mapping**
- **Familiarise with practical mapping tools**
  - Flow diagrams
  - Eco-mapping
  - Material Flow Cost Accounting
- **Exercise**
- **Plan your next steps**

# Purpose of process flow mapping

- To lay **ground work** for inventorying of chemicals and **establishing chemical management system framework** for promoting responsible usage and prevention of adverse impacts on environment, health and safety as well as losses
- To **support identification** and **documentation of hazard/risks** related to entire range of production processes, products, non-product outputs (NPO) activities under purview of your company

### **ZDHC CMS 2.1. - Systematically identify and document chemicals used and stored in your organisation**

- 2.1.2 Facility Plan and Walk Through; expected CMS deliverable:  
Factory plan depicting areas with chemical storage and usage.
- 2.1.3 Chemical Material Flow Diagrams
- 2.1.4.1.1 Accurate Chemical Inventory Using Mass Balance

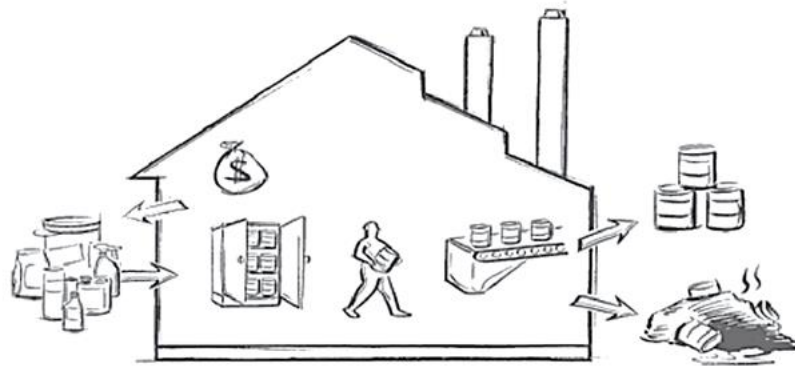
# Concept of process flow mapping

- Apply **systematic step-by-step approach** towards understanding process and chemical flows;
- Understand **where chemicals and chemical (containing) wastes are present and stored** within your site;
- Set boundaries regarding **external operations that your company can/should/wants to influence**
  - ✓ For example
  - ✓ Procurement of chemicals and products containing chemicals
  - ✓ Transport/shipment and delivery of products and chemicals to/from company as
  - ✓ Disposal of waste products (air emissions, solid waste, waste water)

# Mapping your processes and chemical flows

**Important: Set the boundaries of your system**

Procurement  
Delivery  
Reception/  
unloading  
Storage  
Packing/  
repacking  
Laboratory  
testing



Product warehouse  
Product Loading  
Product transport/  
shipment and  
distribution  
Product use and  
final disposal

Emission control  
Treatment and  
disposal of waste  
Other...

Internal transfer  
Formulation/Mixing  
Dosing  
Production

Internal waste  
collection and  
removal  
Maintenance

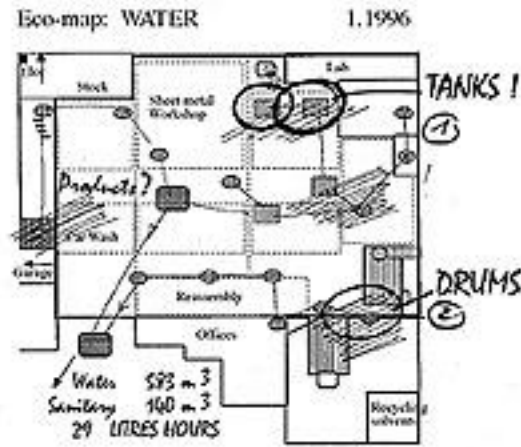
# Benefits of process flow mapping

- Gain general overview of production process
- Identify all relevant process steps, intermediary products, most important and/or critical materials
- Create basis for
  - ✓ systematically analysing of inputs and outputs (both desired products and NPOs/wastes)
  - ✓ visualizing quantities and costs (for mass balancing)
  - ✓ documenting hazards/risks and areas with chemicals and process of concern
- Localize optimization potentials and areas
- Improve process communication inside your company
- Establish reference for planning, monitoring and reporting



# Practical mapping tools

## Eco-mapping

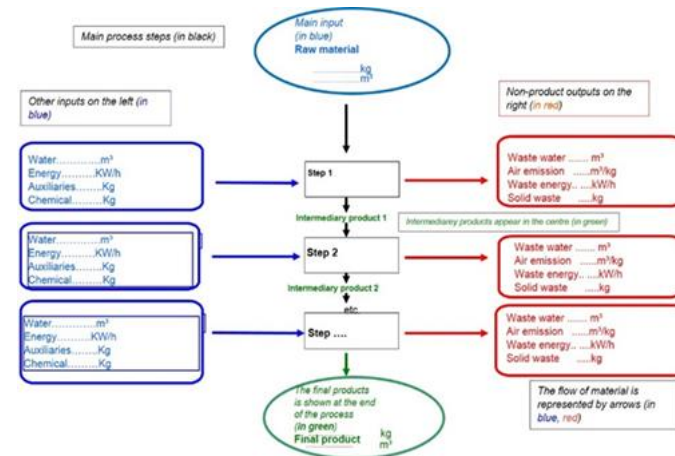


TO DO:

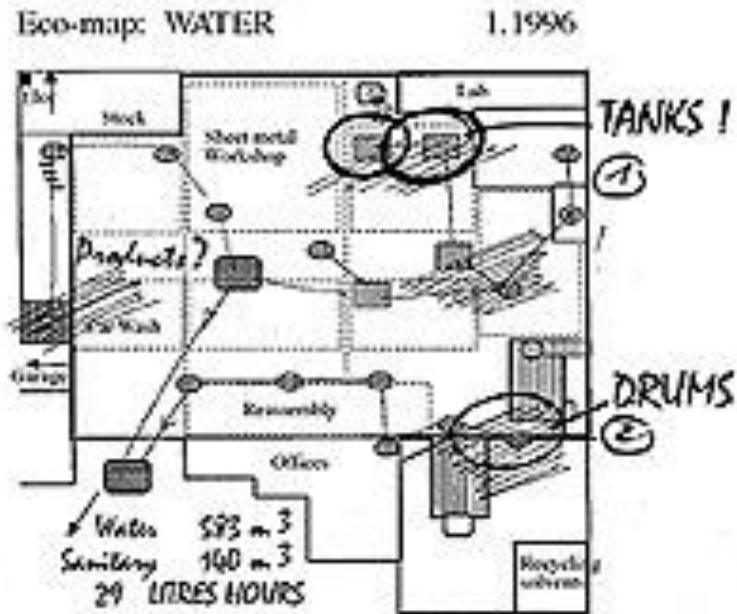
1. Pierre A.: Empty effluents tank  
Well sedimentation tank → 6.96
2. Emiso M.: Close drums  
Move hydraulic oil immediately!!

OK ✓

## Process flow diagram



# Eco-mapping



## TO DO:

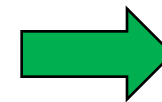
1. Pierre A.: Empty septic tank  
Well sedimentation tank → 6.96
2. Enrico M.: Close drums  
Move hydraulic oil immediately!!

OK ✓

- simple, practical tool for visualization of process flows
- good to use in resource efficiency, OSH and/or chemical management for
  - ✓ identifying and documenting the prevalent situation and issues
  - ✓ identifying and analysing common issues and priority
  - ✓ selecting and planning areas for improvement
  - ✓ monitoring progress of implementation
  - ✓ auditing and reporting

# How to proceed

- Use existing ground and floor plans to facilitate identification and visualization of environmental problems (“critical situations/ hot spots”) within a company
- **Consider using different maps to create a useful multi layer set of graphical information (e.g. for chemicals, water, energy, air, wastes)**
- **Prepare or verify during an initial company/site walk-through**
- **Collect and fill in additional information, using guiding questions and observations on site**



Involve staff and workers on-site in different processes or production areas

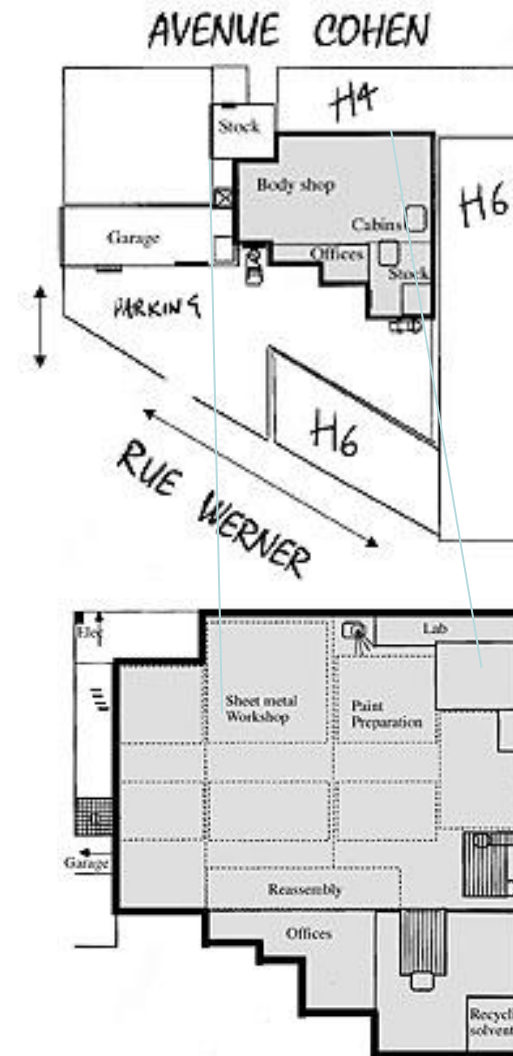
# How to proceed



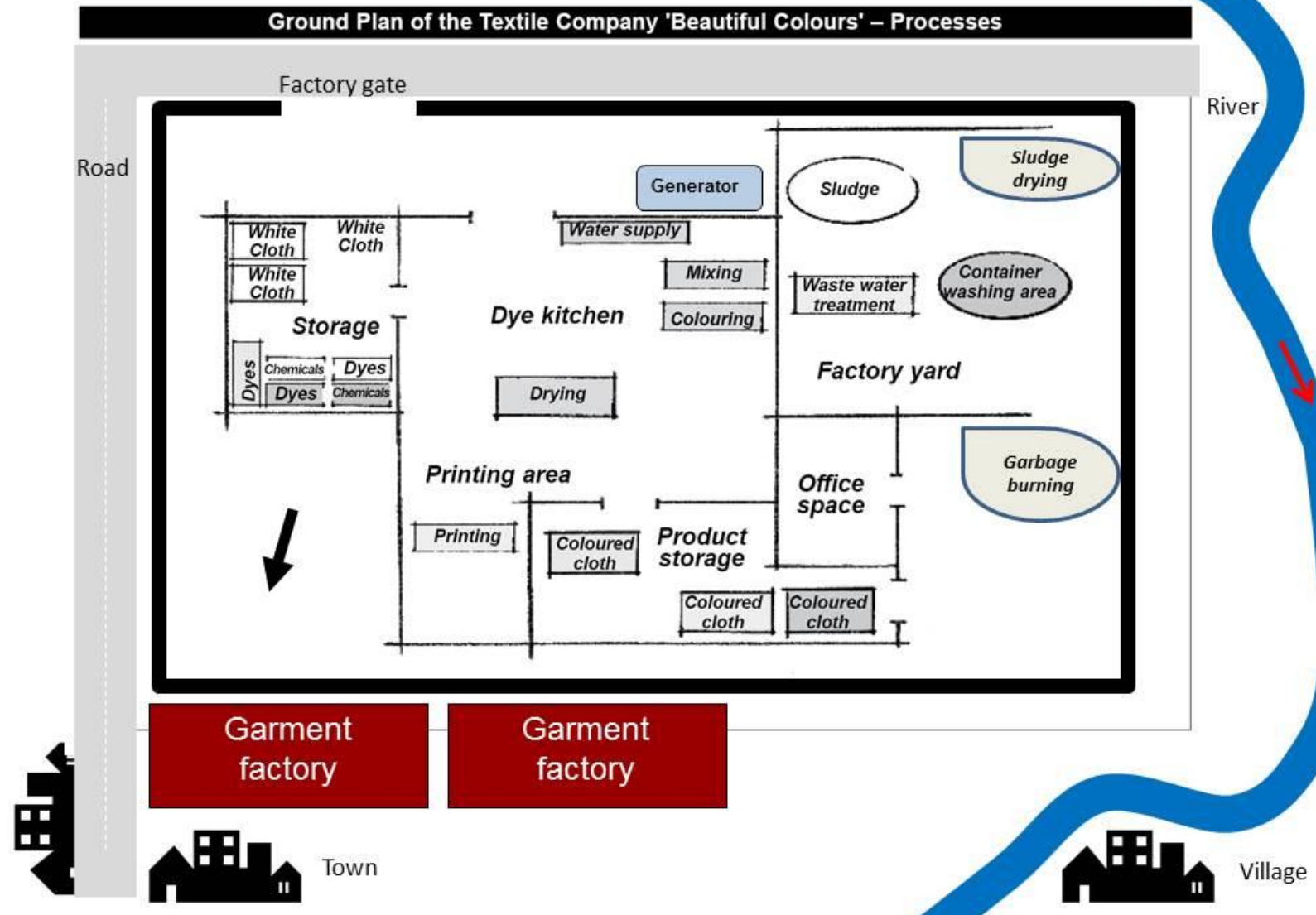
# Practical tips

## Also take into consideration general location of your company in the area

- ✓ Any water bodies around the compound?
- ✓ Housing areas? Schools?
- ✓ Neighbouring industries?
- ✓ Roads used by company
- ✓ Other...



# Example

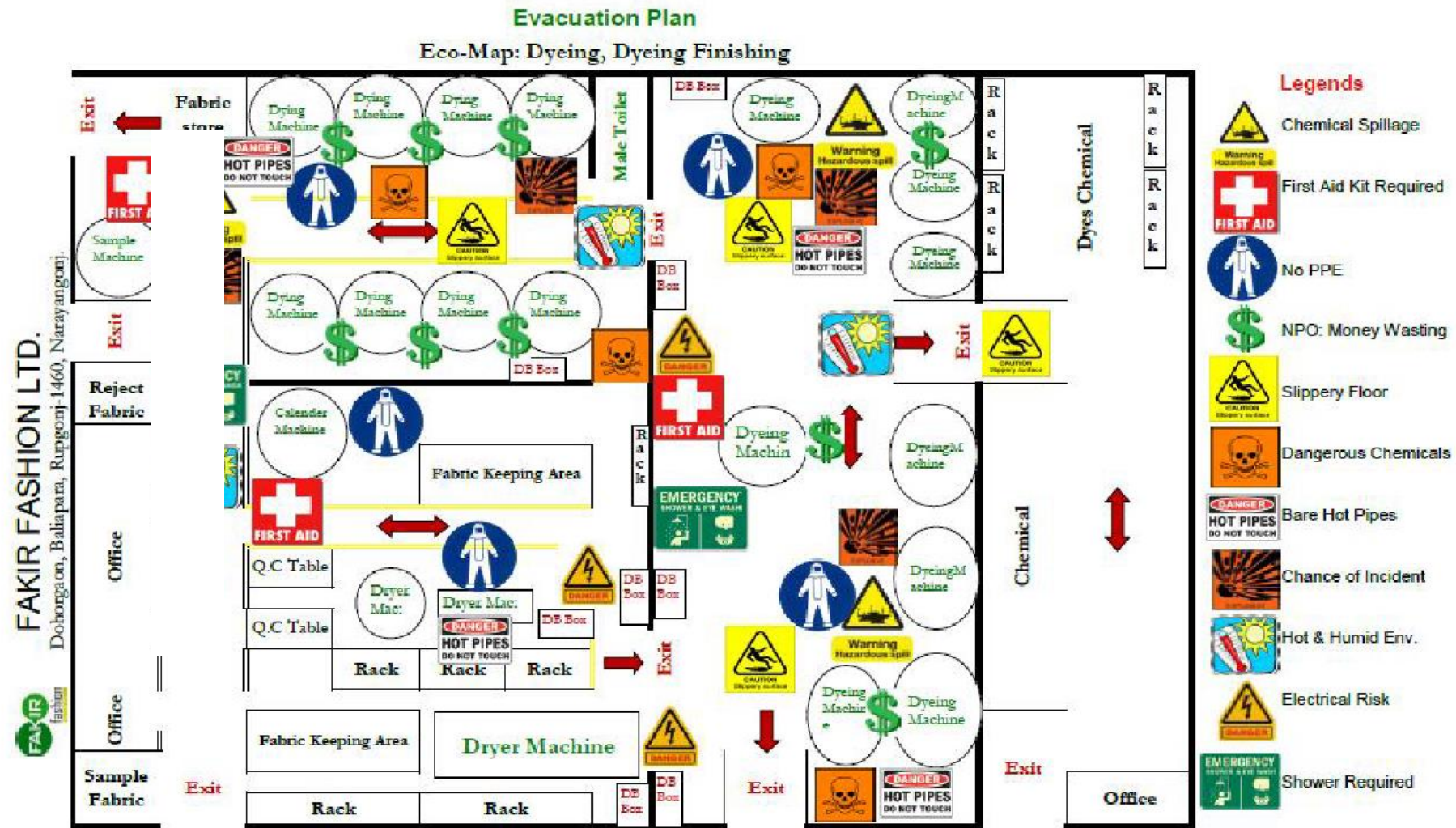


# Practical tips

- Decide and agree on your own standard symbols beforehand
- **Use** consistently in all maps
- **Indicate** gravity of observed “hotspots”
  - ✓ Hatched lines: small problem (area to be monitored, problem to be studied)
  - ✓ Circle: large problem (stop, corrective action)
  - ✓ The more serious the problem: the thicker or larger the circle or symbol



# Example: Textile unit, Narayanganj, Bangladesh

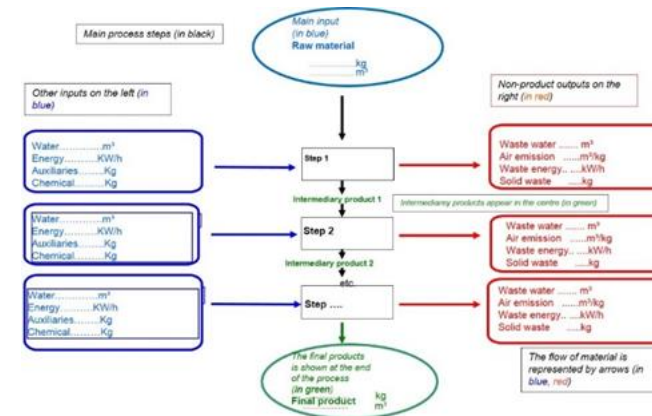
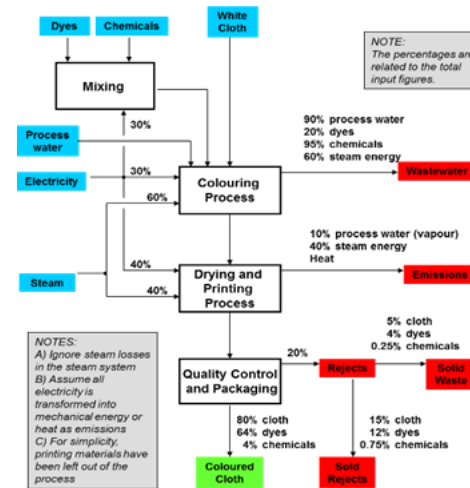




# Process flow diagrams

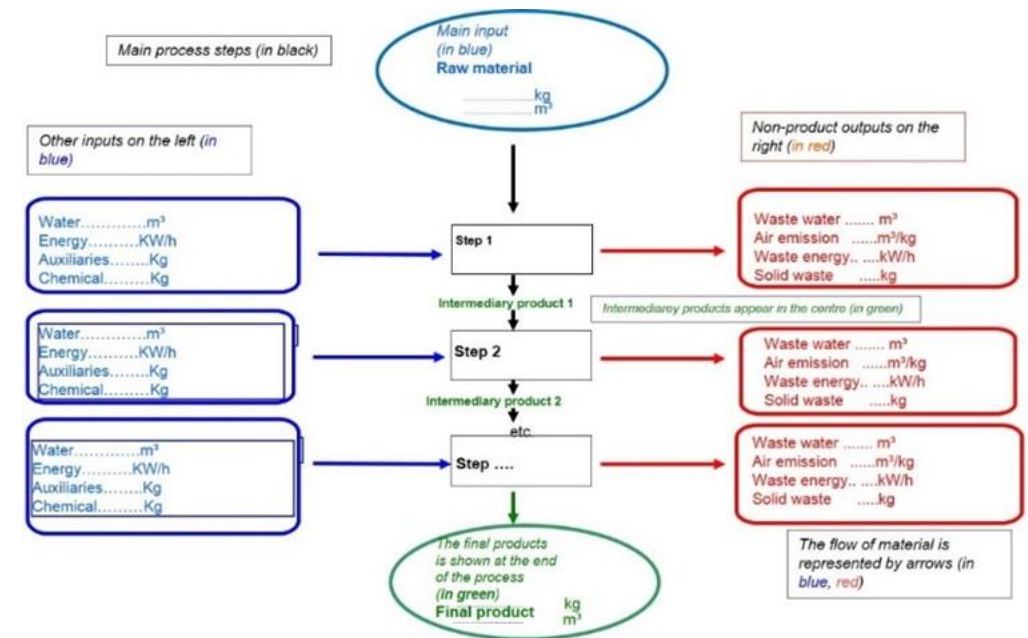
## Used to

- **Document...**
  - ✓ Processes/process steps
  - ✓ Interconnection between process steps
  - ✓ Process inputs
  - ✓ Intermediary and final products
  - ✓ Non-product outputs (NPOs)
- **prepare mass balance and/or cost analysis**
  - ✓ Indicate quantifies and/or value of inputs, outputs, non-product outputs

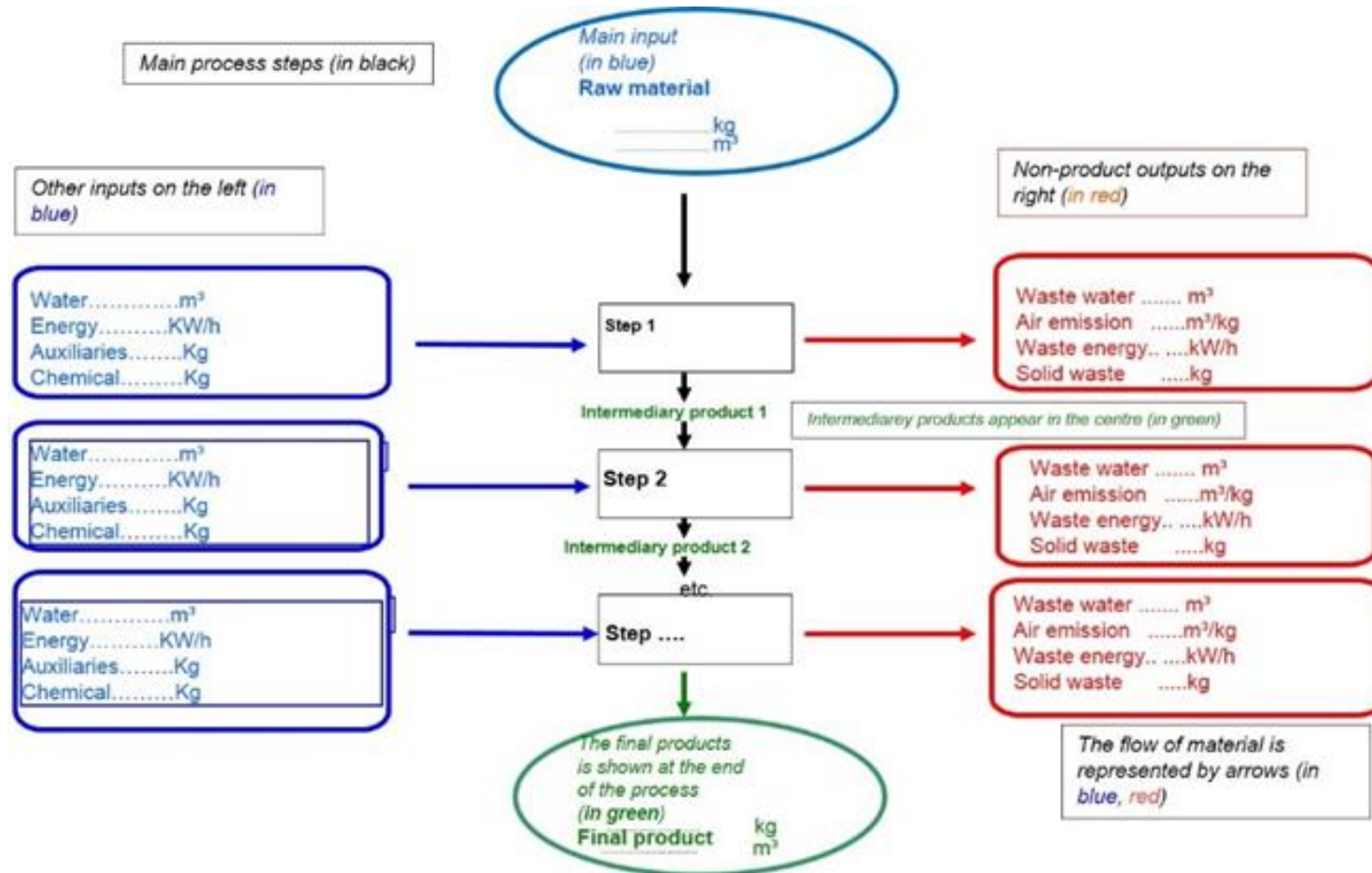


# Practical tips

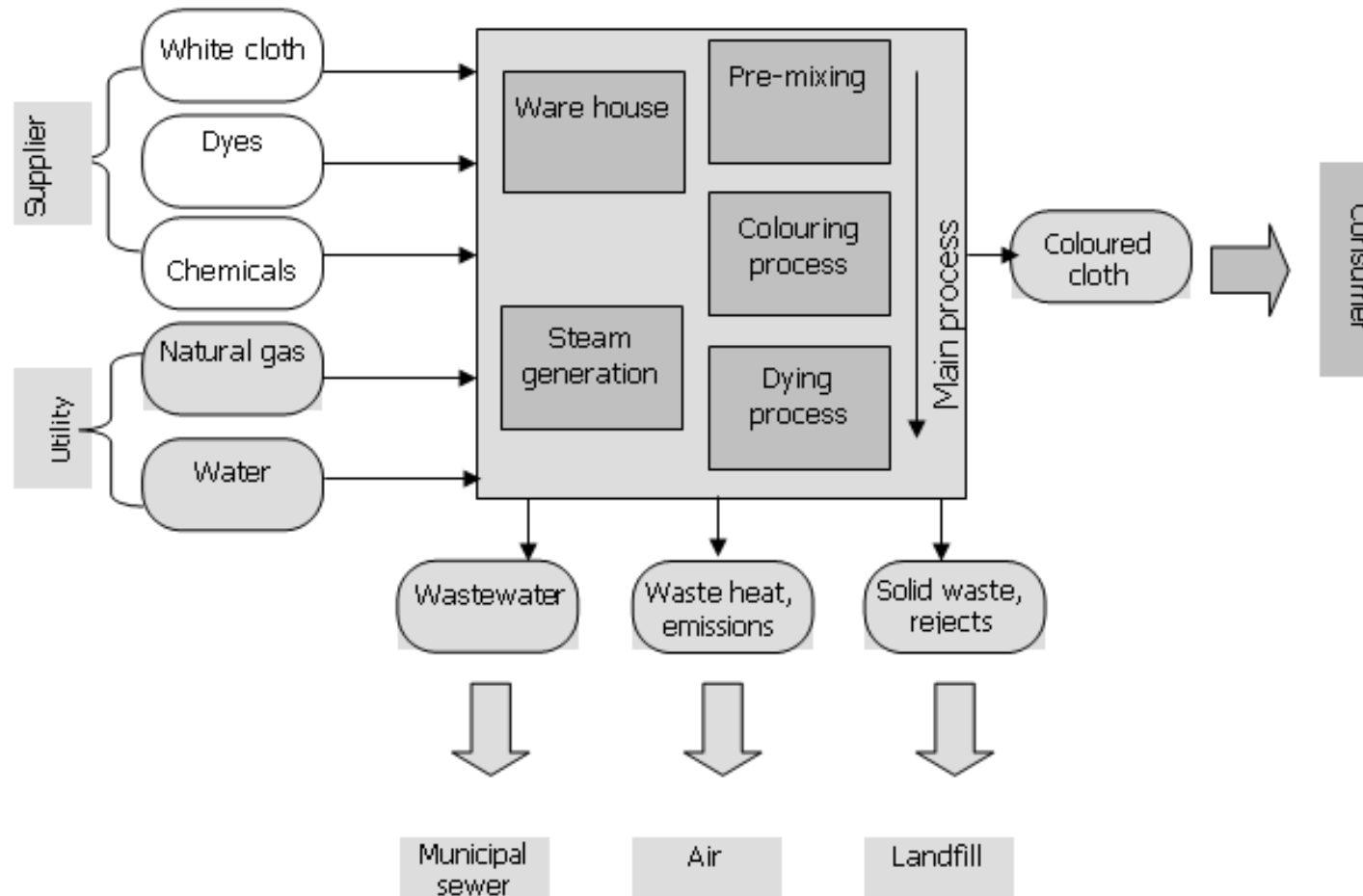
- Processes/process steps represented by squares
- Flows represented by arrows
- Inputs (raw materials, water, energy, chemicals) on one side
- Main input comes from above
- Intermediary products located below each process
- NPOs as output to right side
- Final product leaving process



# Practical tips

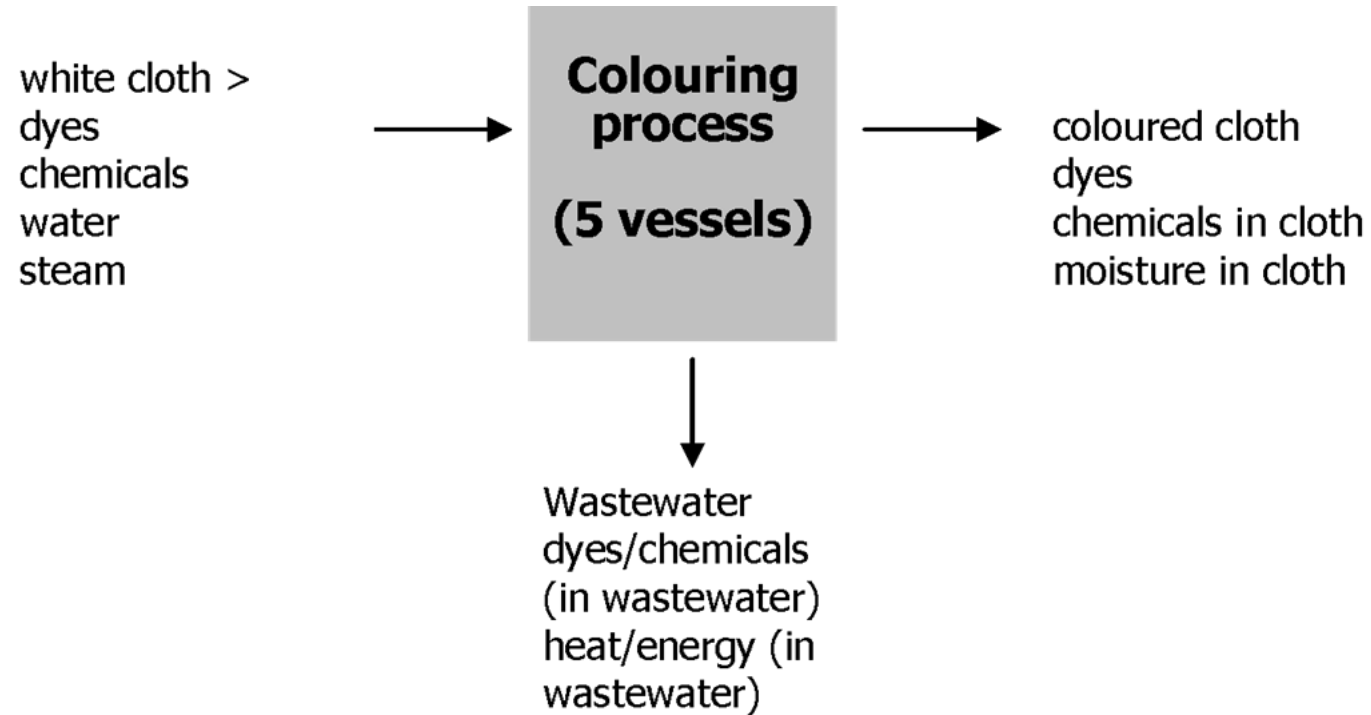


# First get an overview ...



Source: UNEP RP

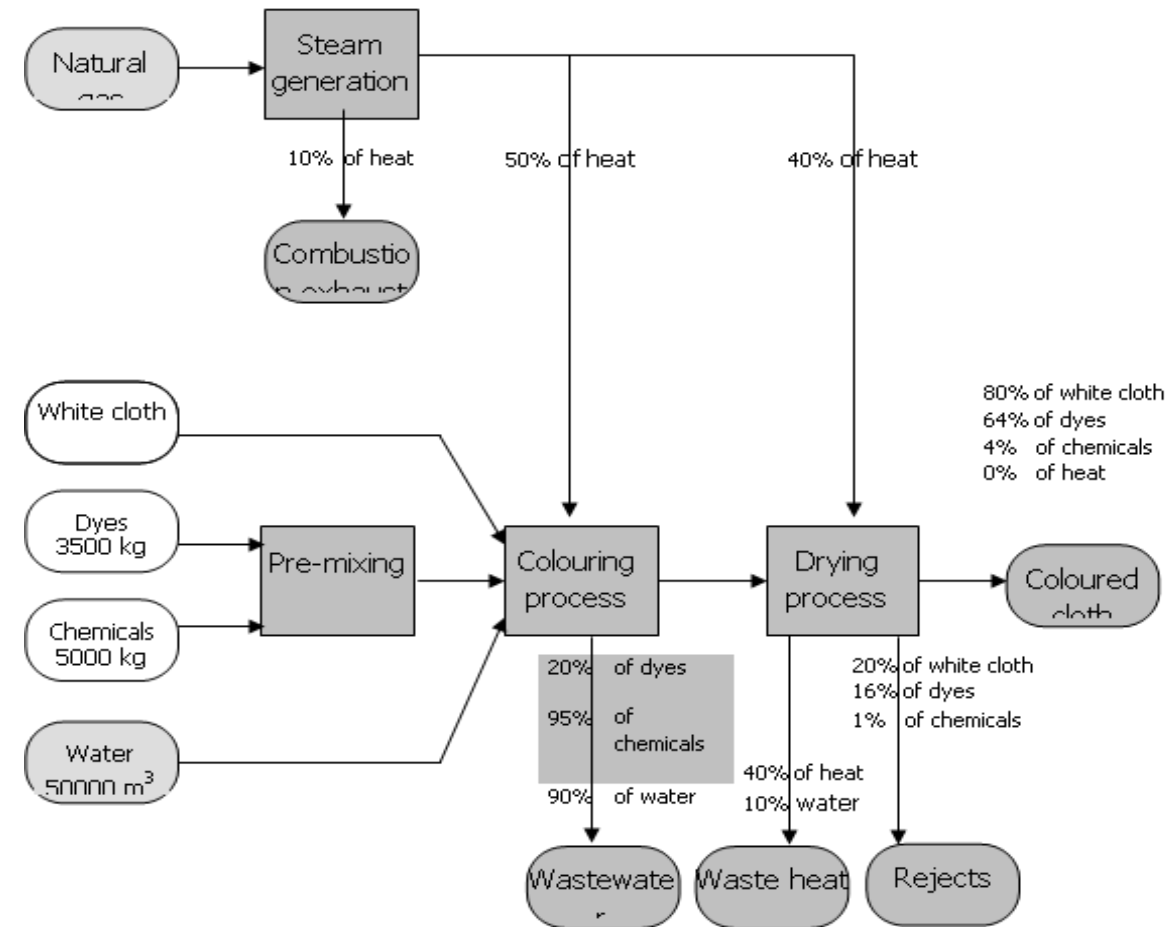
## ... then a blow up of major process steps...



Source: UNEP RP

# and finally allocate percentages and absolute quantities to flows...

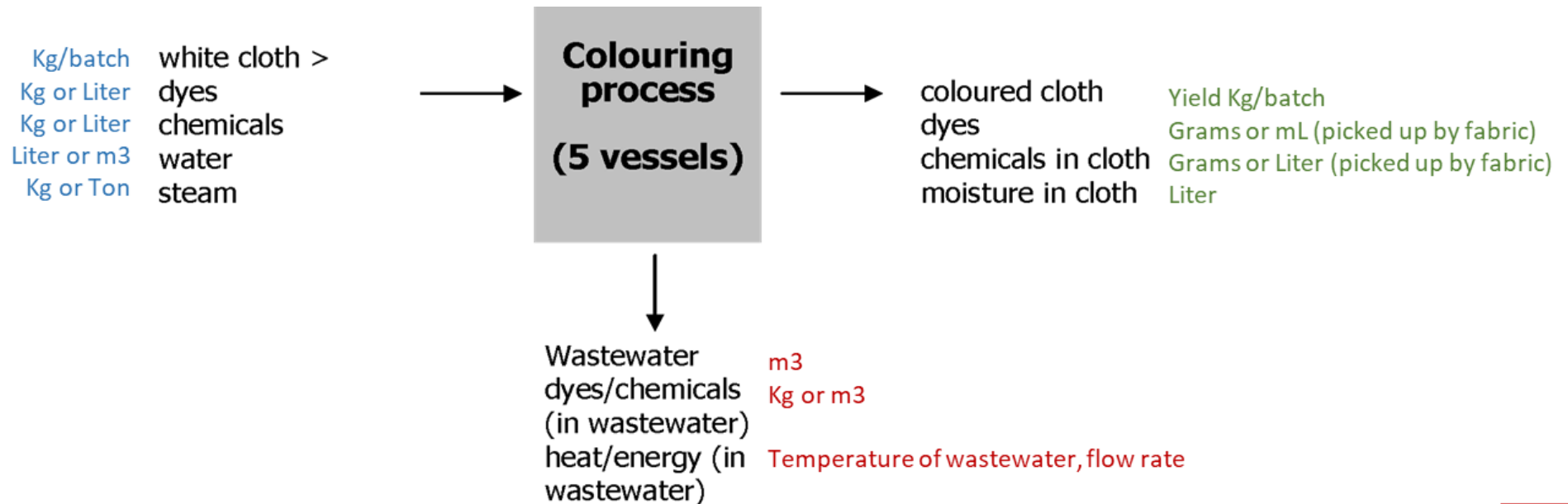
- Once the flow maps are ready, next important aspect is to quantify the flows
- Start by quantifying the input quantities, percentage / quantities used at each process and estimate / quantify wastes
- **MFCA measures the flow and stock of all materials in the manufacturing process in both monetary and physical terms (ISO 14051)**



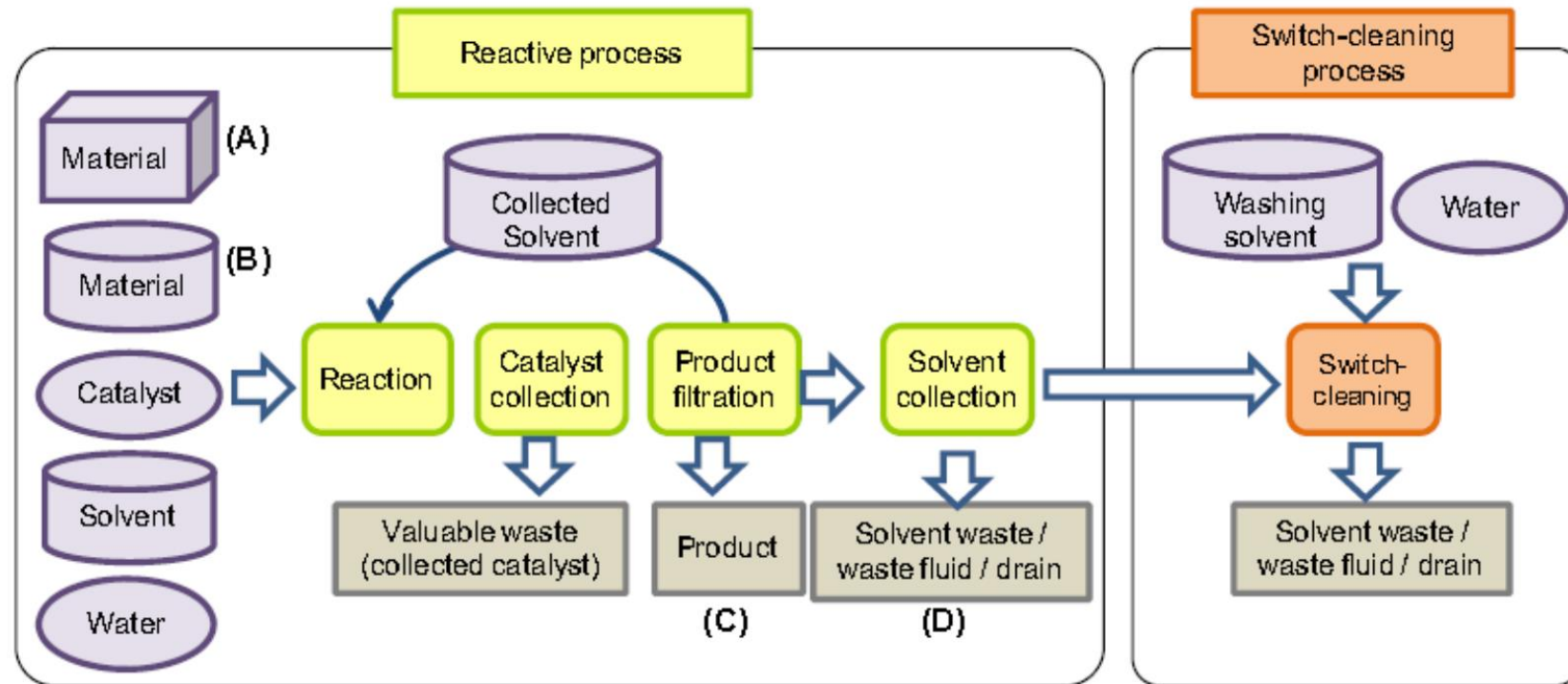
Source: UNEP RP

# Concept of Quantity Center

- Quantity center is a process or combination of processes whose all flows can be quantified



# MFCA Case for Facilities involving Chemical Reaction



Source: APO



# MFCA Case for Facilities involving Chemical Reaction

	Input	Quantity (kg)	Output	Category	Quantity (kg)
QC1 Reactive Process	Material (A)	780	Product C	Product	1,250
	Material (B)	650			
	Solvent (New)	1,200	Solvent Waste	Material Loss	500
	Collected Solvent	8,200	Collected Solvent	Material Loss	8,200
	Process Water	7,300	Wastewater	Material Loss	7,380
			Waste Solution	Material Loss	800
	Catalyst	20	Collected Catalyst	Valuable Waste	15
			Catalyst Residue	Material Loss	05
Total Input	18,150	Total Output		18,150	
QC2 Switch- Cleaning Process	Washing Solvent	900	Solvent Waste	Material Loss	1,700
	Process Water	1,300	Drainage	Material Loss	500
	Total Input	2,200	Total Output		2,200

Source: APO

# MFCA Case for Facilities involving Chemical Reaction

	Reactive Process					Switch Cleaning Process				
	Material Cost	Energy Cost	System Cost	Waste Management Cost	Total	Material Cost	Energy Cost	System Cost	Waste Management Cost	Total
Product	5,610	130	2,600	-	8,340	0	0	0	-	0
	54.2%	1.3%	25.1%	-	80.6	0%	0%	0%	-	0%
Material Loss	1,430	30	520	30	2,010	90	70	1350	40	1550
	13.8%	0.3%	5.0%	0.3%	19.4%	5.8%	4.5%	87.1%	2.6%	100%
Subtotal	7,040	160	3120	30	10,350	90	70	1,350	40	1550
	68%	1.5%	30.1%	0.3%	100%	5.8%	4.5%	87.1%	2.6%	100%

Source: APO

# Exercise – „Beautiful Colours“

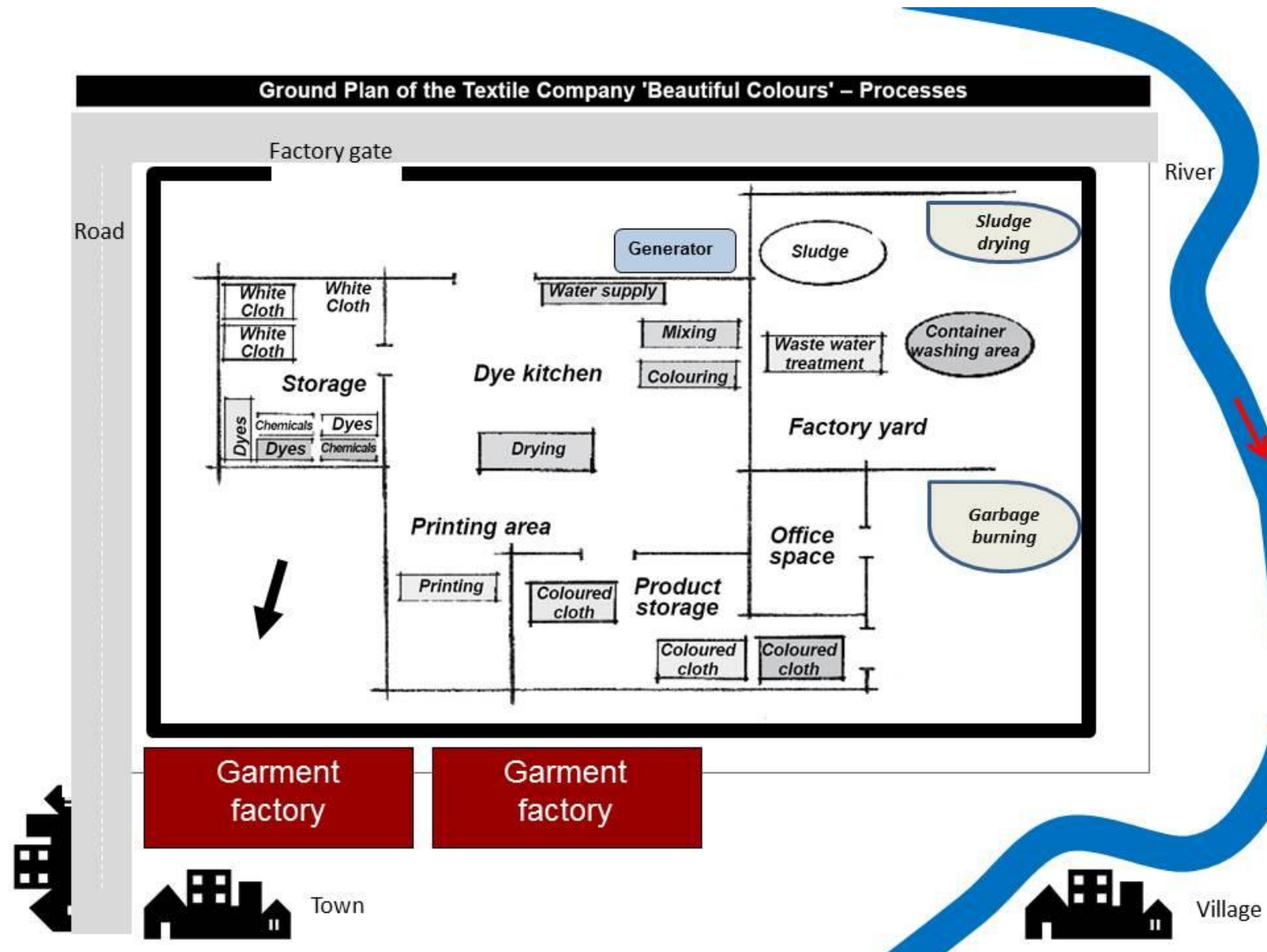
## Objective

- **To identify and map chemical flows and locations in a company`s operations**
  - ✓ using tools such as flow diagrams and eco-maps for visualisation and documentation

Welcome to **Beautiful Colours**  
Textile Company



# Exercise



## Exercise: Tasks in your group

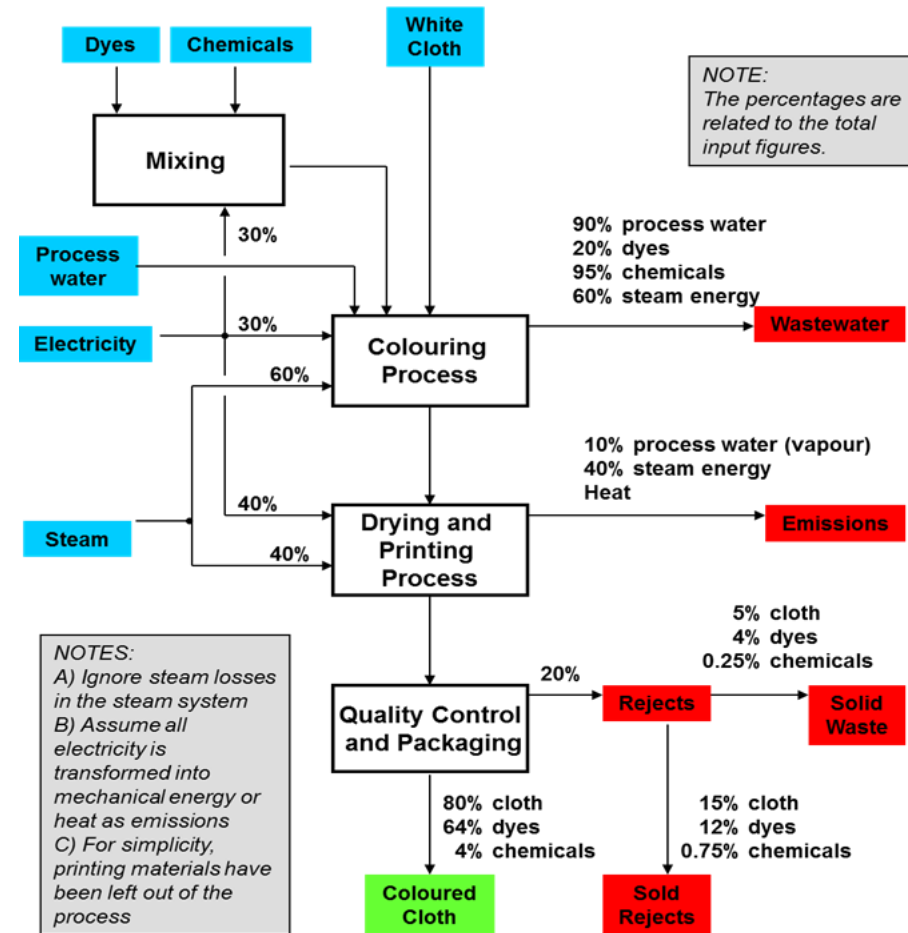
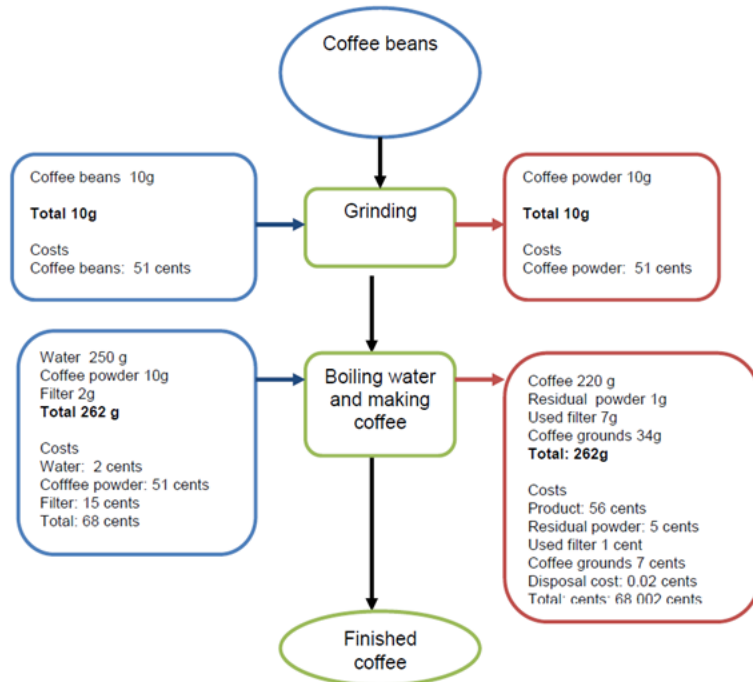
1. Identify the location and flows of chemicals and chemical (containing) waste in the company (flow chart and quantification)
2. Recognise and point out possible chemical hotspots (for example defined as areas which pose immediate risk to environment and health or loss of materials, might be seen critical by relevant authorities or buyers)
3. Identify opportunities of chemical reuse, recovery and recycling.
4. Present your findings in one eco-map

**Total time: 45 minutes**

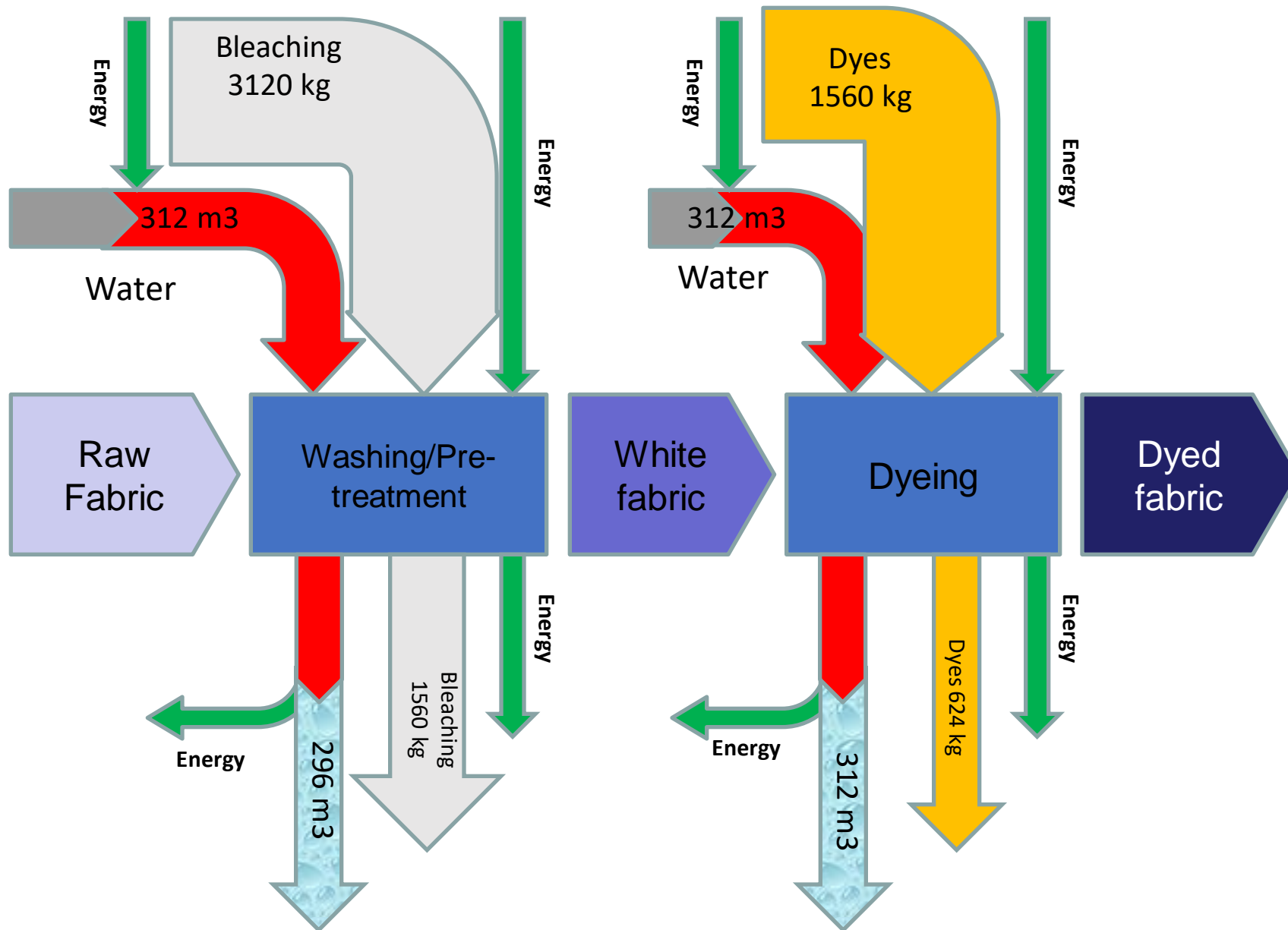
### For further consideration regarding NPOs

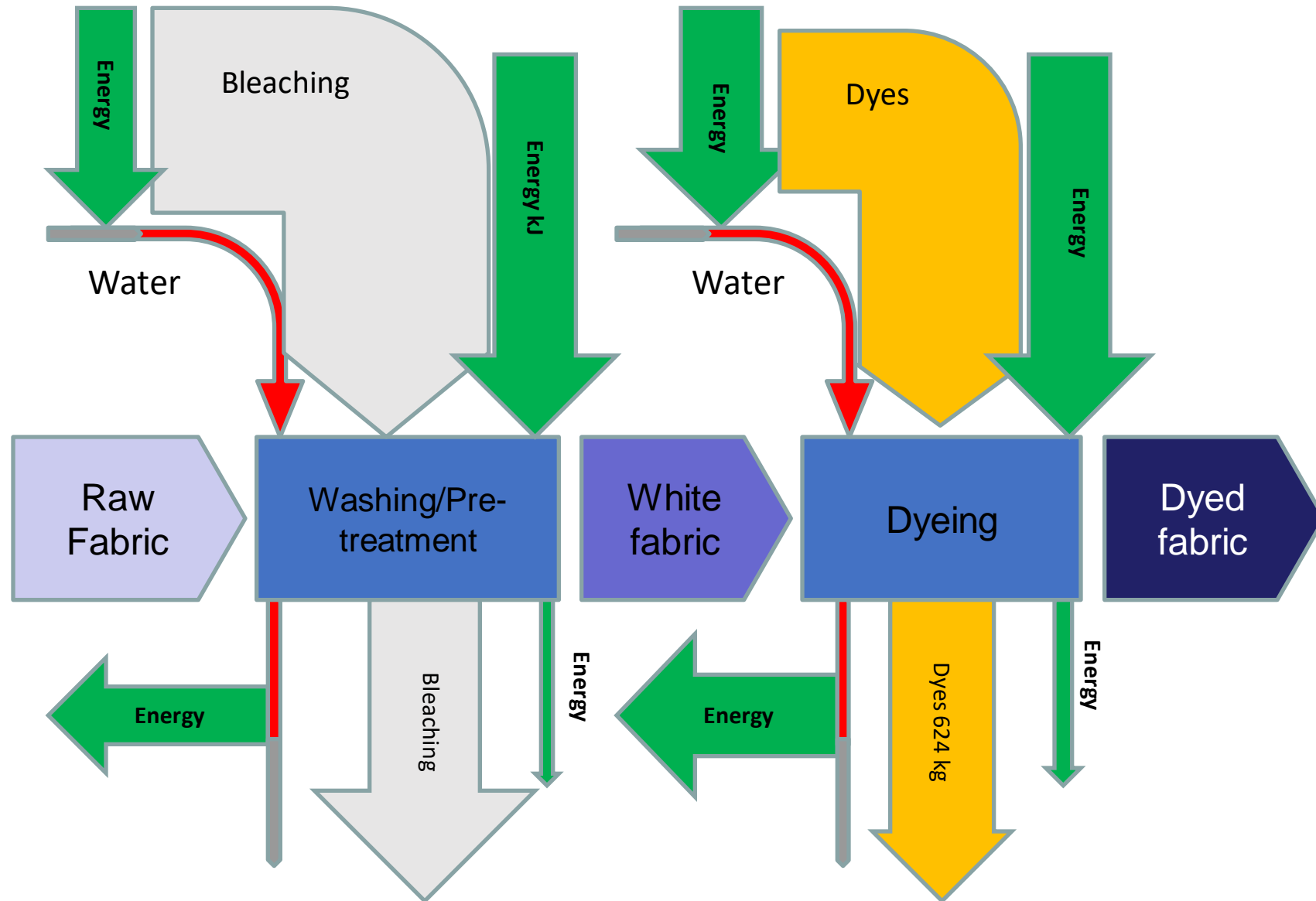
- Which inputs (raw materials, energy, water, chemicals, others) are used in production process?
- Which of these inputs do not end up in the final product (i.e. are Non-Product Output)?
- Who is directly or indirectly involved in the generation and handling of which of these NPOs?
- What are the potential environmental, safety & health and other impacts of these NPOs?
- Which possible costs are caused by the NPOs?
- Which information is required inside the company to assess the impacts and quantify the costs of NPOs?

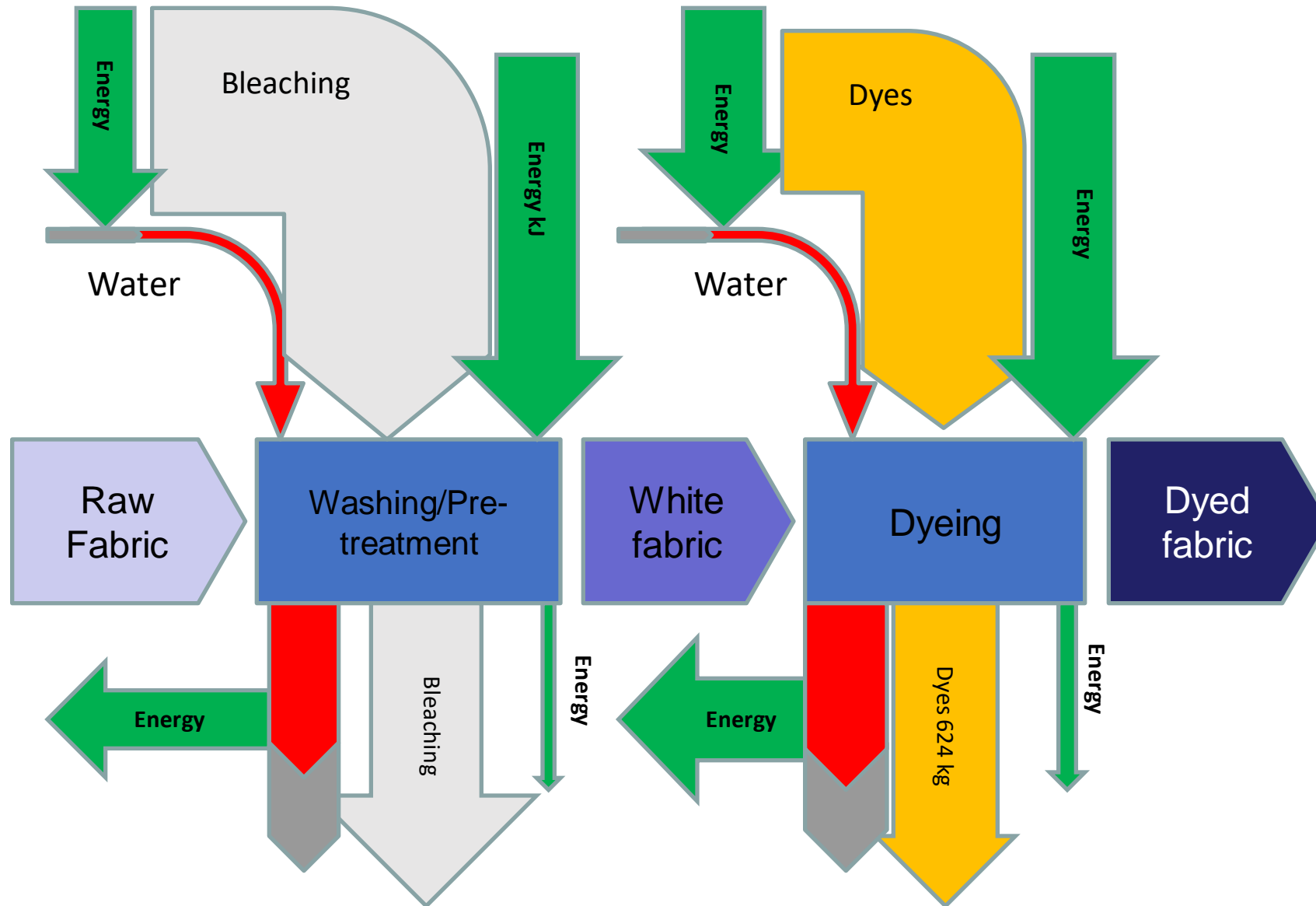
# Using your flowchart information











## Plan next steps

- **Conduct company/site walk-through**
  - ✓ Consider using ZDHC walk-through inspections sheet
- **Prepare eco-map(s)**
  - ✓ Involve your staff and workers on-site
- **Compile process flow diagram**
  - ✓ showing inputs, outputs, processes, process boundaries, products and non-product outputs



# For your further guidance...

**In your training materials, refer to...**

- **Eco-mapping handbook**
- **EMAS/EMS Easy handbook**



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