Module 4: Analysing and documenting process and energy flows

Understanding the situation at hand

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

At the end of this module you will be able to…

- Analyse and document material and energy flows in your company
- Develop Energy Balance by quantities and costs of flow

Resources

- EMAS EASY
- Eco mapping Handbook

Content

- Understand purpose and concept of process flow mapping
- Familiarize with practical mapping tools
  - ✓ Flow diagrams
  - ✓ Eco-mapping
  - ✓ Sankey diagram
- Exercise
- Plan your next steps

Purpose of process flow mapping

- To lay ground-work for tracking energy sources and establishing energy management system framework for promoting responsible usage and prevention of adverse impacts on environment
- To support identification and documentation of energy losses related to entire range of production processes, products, non-product outputs (NPO) activities under purview of your company

References

Higg FEM Level-1 Question-1

- Track all energy sources

Concept of process flow mapping

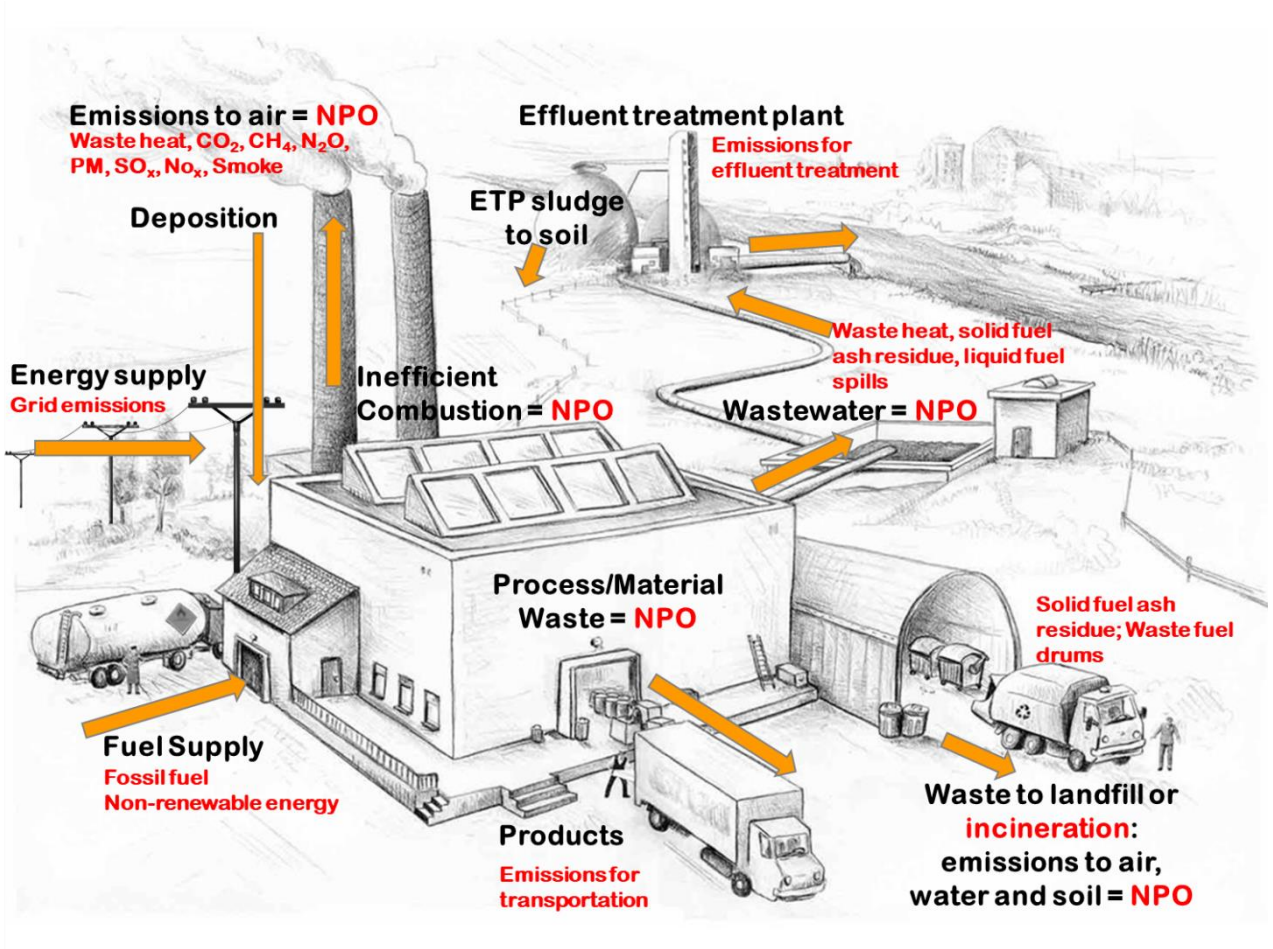
- Apply systematic step-by-step approach towards understanding process and energy flows;
- Understand which energy types are used and which are the energy users within your site;
- Set boundaries regarding external operations that your company can/should/wants to influence

For example

- Energy produced by sub-contractor within premise of the company
- GHG emissions related to solid waste incineration by 3rd party
  - ✓ this might be needed to qualify for Higg FEM Level-3 in Air Emissions to divert solid waste from incineration without energy recovery or landfill

Mapping your processes and energy flows

Important: Set the boundaries of your system



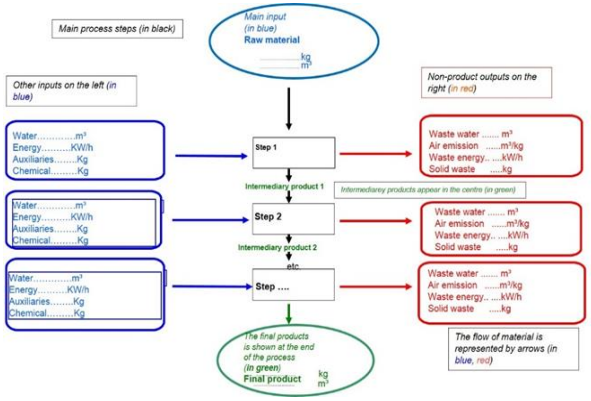
Benefits of process flow mapping

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

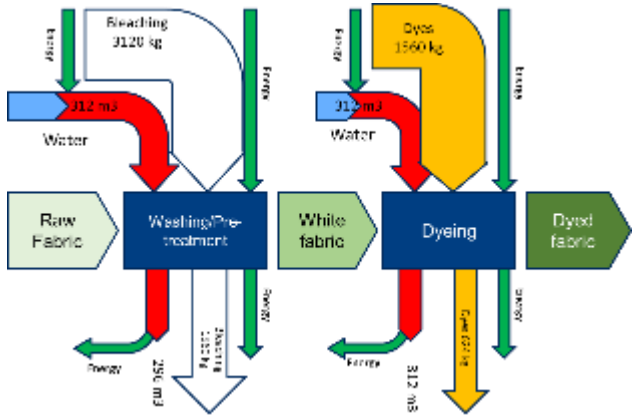
Practical mapping tools

Eco-mapping

Process flow diagram

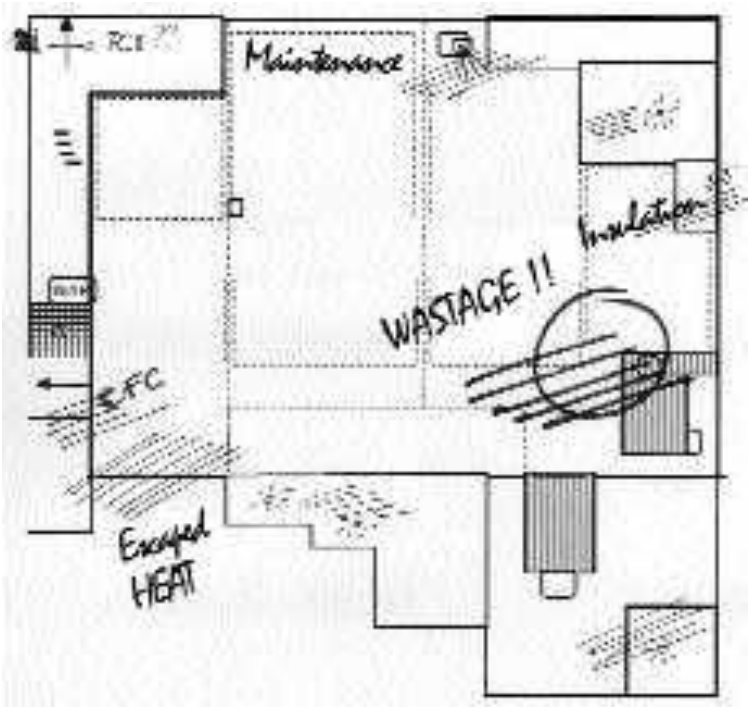


Sankey diagram



Eco-mapping

- simple, practical tool for visualization of process flows
- good to use in resource efficiency, energy efficiency, OSH etc. 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

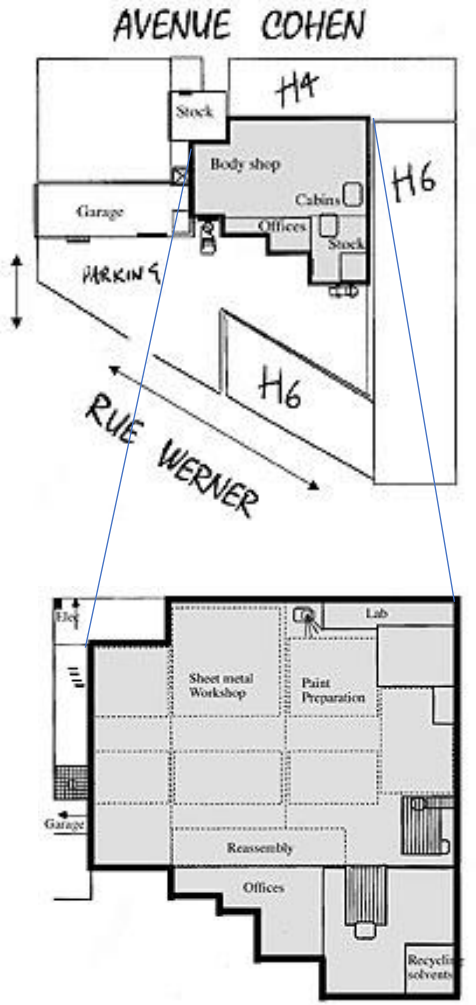
Involve staff and workers on-site in different processes or production areas

How to proceed

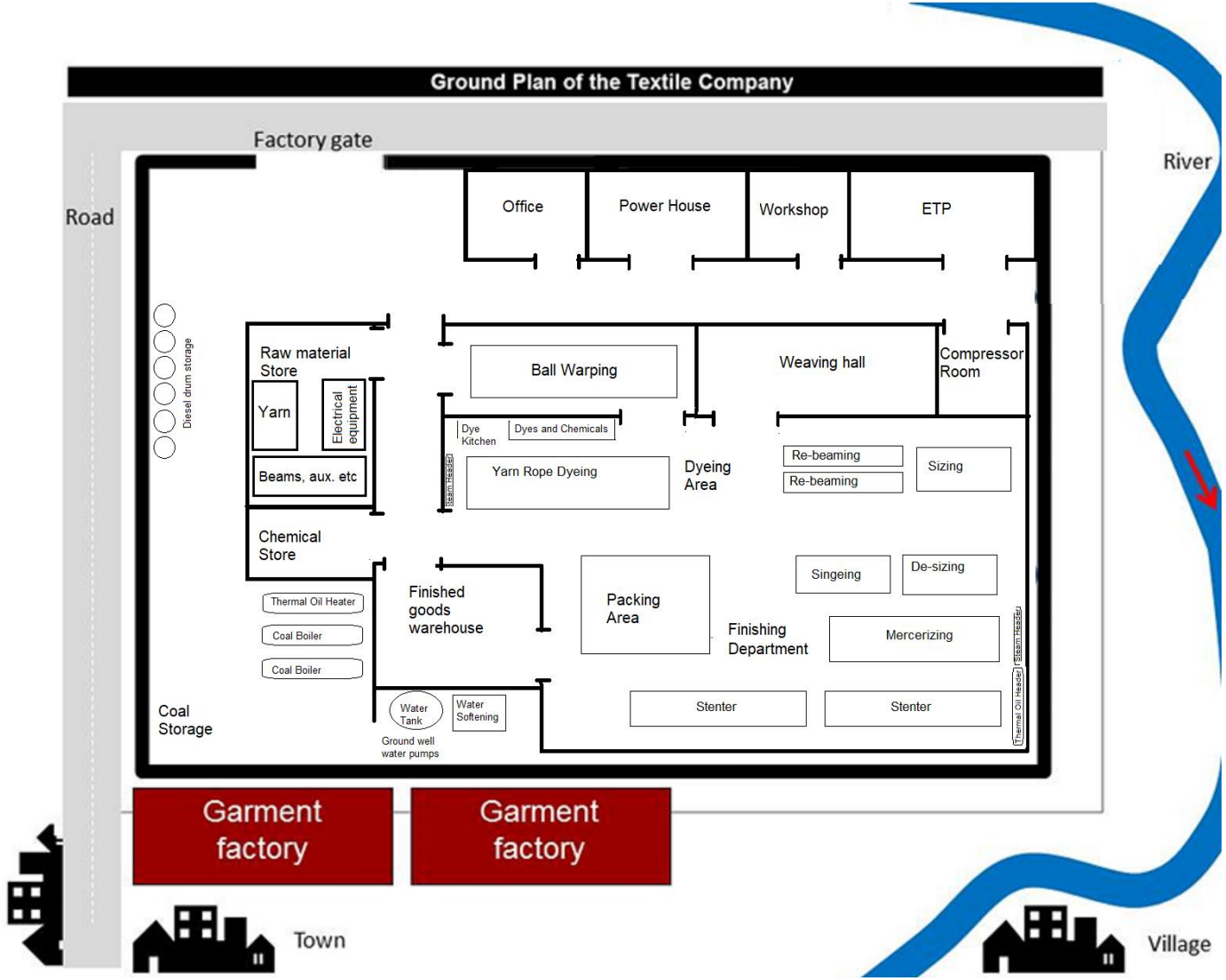
Practical tips

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…



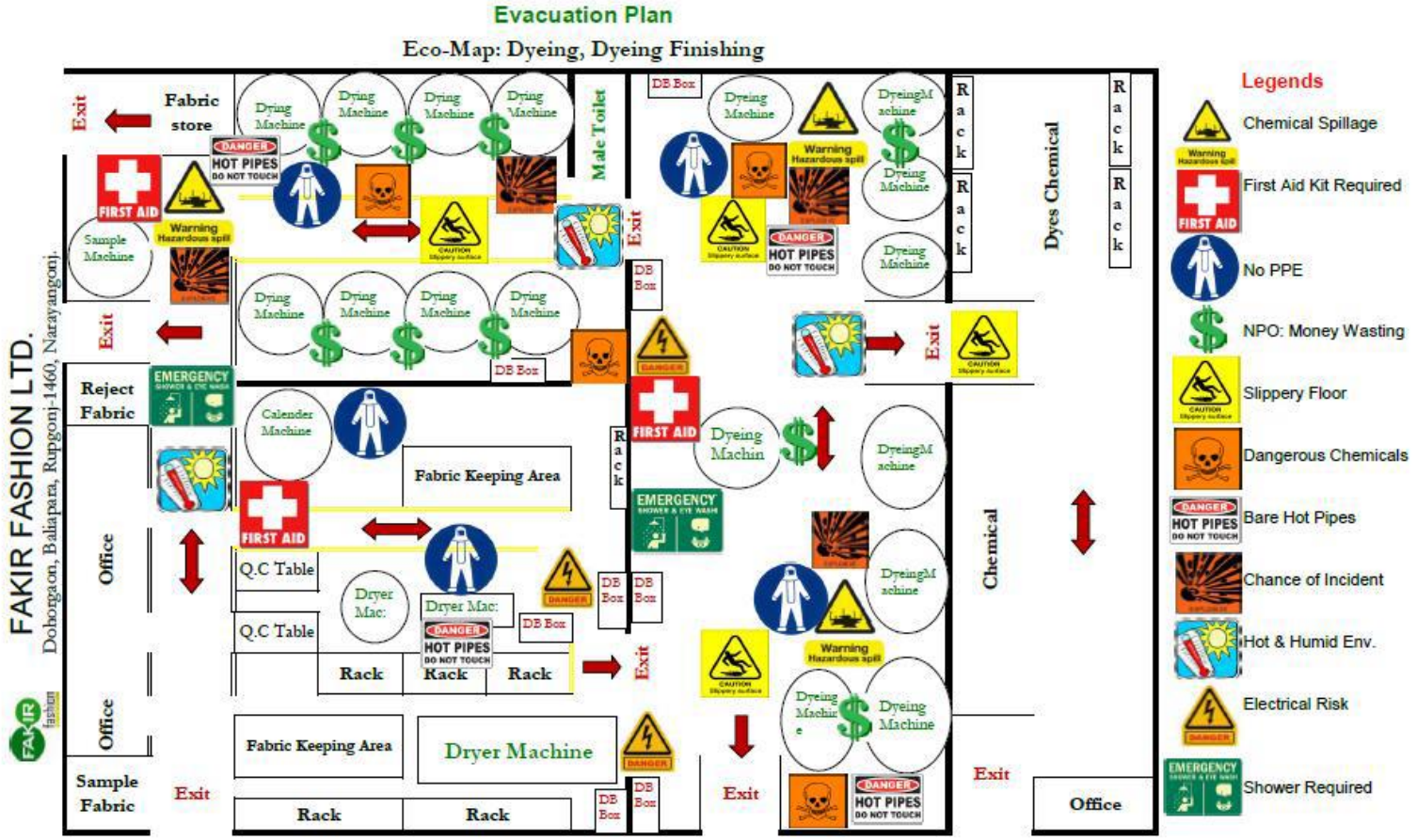
Example


Ground Plan of the Textile Company
Factory gate
Road
River
Office
Power House
Workshop
ETP
Diesel drum storage
Raw material Store
Yarn
Electrical equipment
Beams, aux. etc
Ball Warping
Weaving hall
Compressor Room
Dye Kitchen
Dyes and Chemicals
Yarn Rope Dyeing
Dyeing Area
Re-beaming
Re-beaming
Sizing
Chemical Store
Thermal Oil Heater
Coal Boiler
Coal Boiler
Finished goods warehouse
Packing Area
Singeing
De-sizing
Finishing Department
Mercerizing
Coal Storage
Water Tank
Water Softening
Ground well water pumps
Stenter
Stenter
Garment factory
Garment factory
Town
Village

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

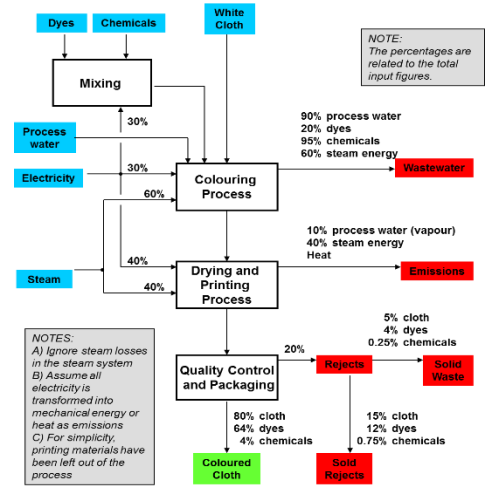
Example: Textile unit, Narayanganj, Bangladesh

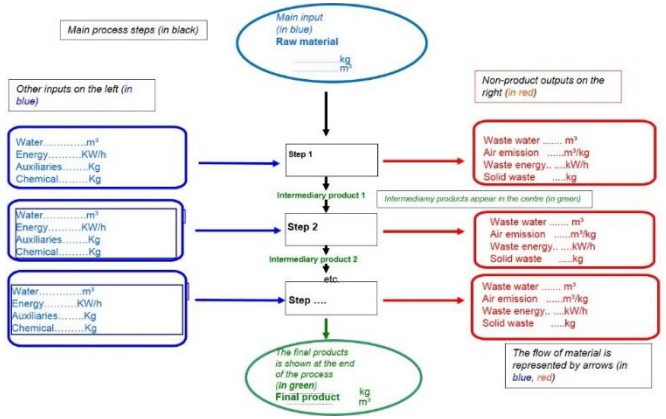


Process flow diagrams

Used to

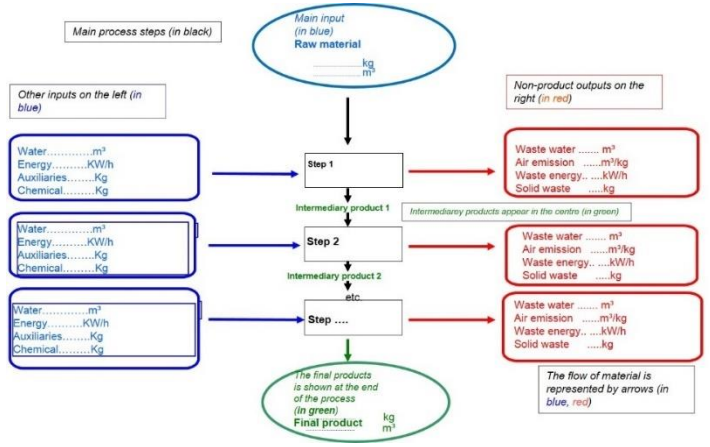
- Document…
  - ✓ Processes/process steps
  - ✓ Interconnection between process steps
  - ✓ Process inputs
  - ✓ Intermediary and final products
  - ✓ Non-product outputs (NPOs)
- prepare mass balance and/or cost analysis
  - ✓ Indicate quantifies and/or value of inputs, outputs, non-product outputs



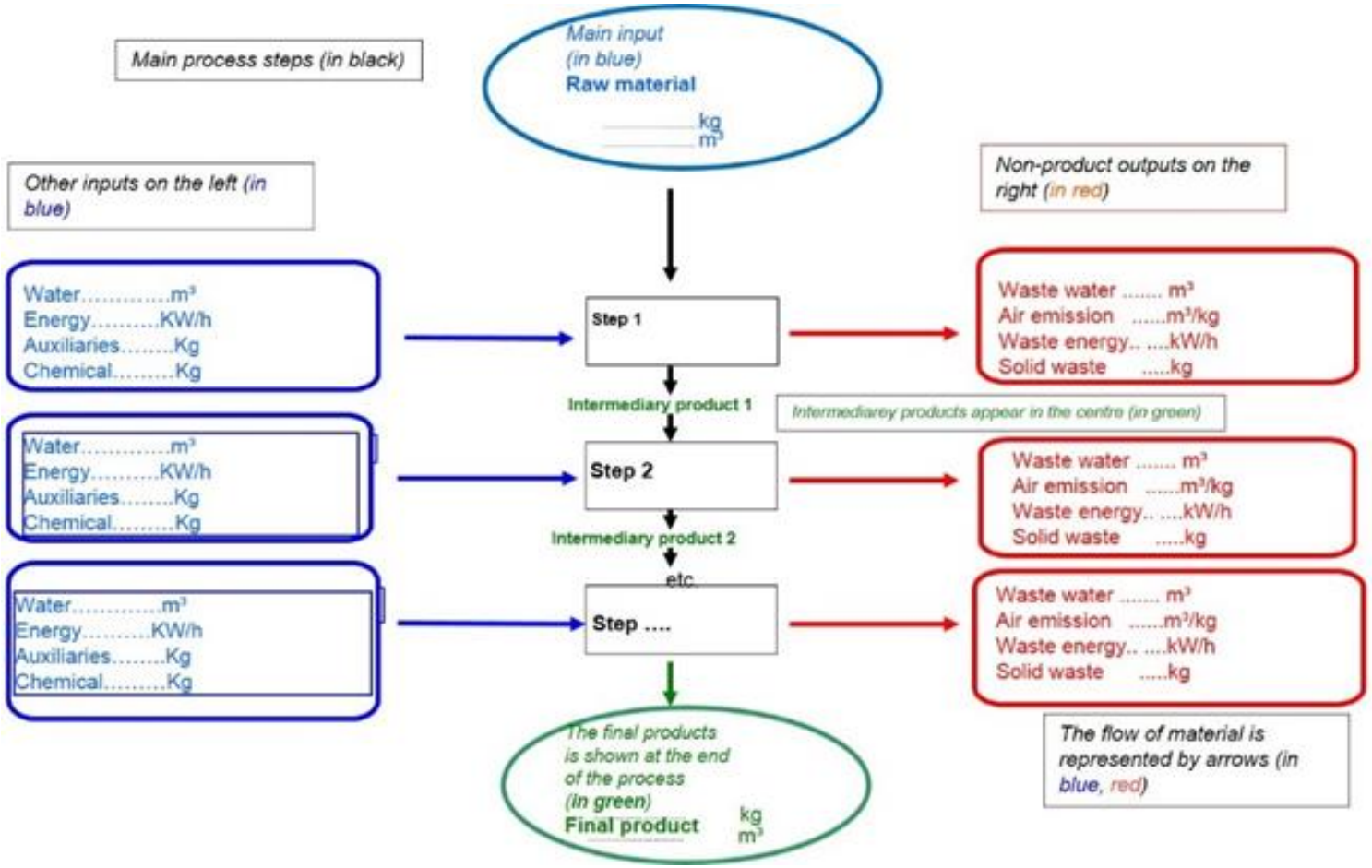


Practical tips

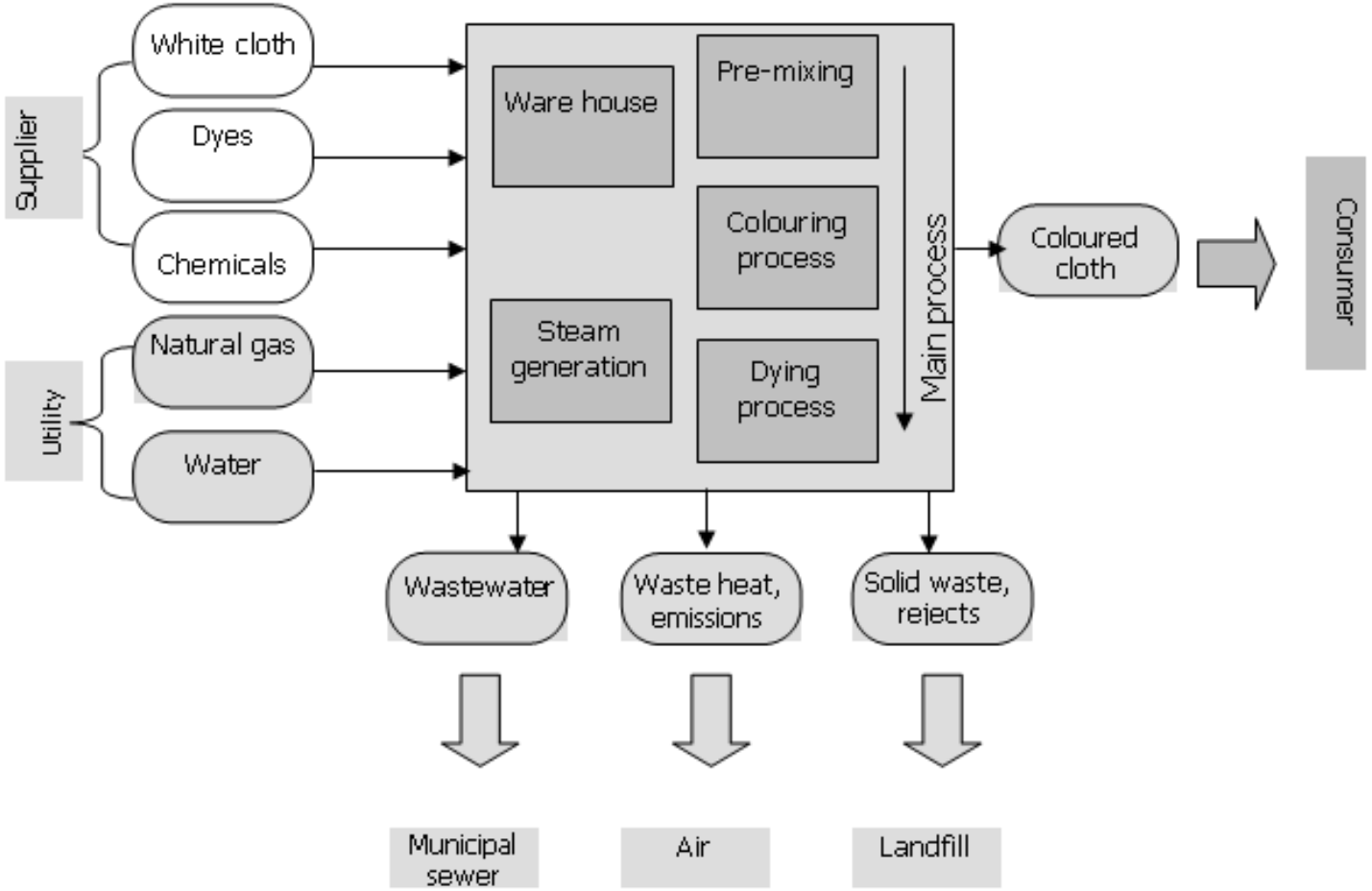
- Processes/process steps represented by squares
- Flows represented by arrows
- Inputs (raw materials, water, energy, chemicals) on one side
- Main input comes from above
- Intermediary products located below each process
- NPOs as output to right side
- Final product leaving process



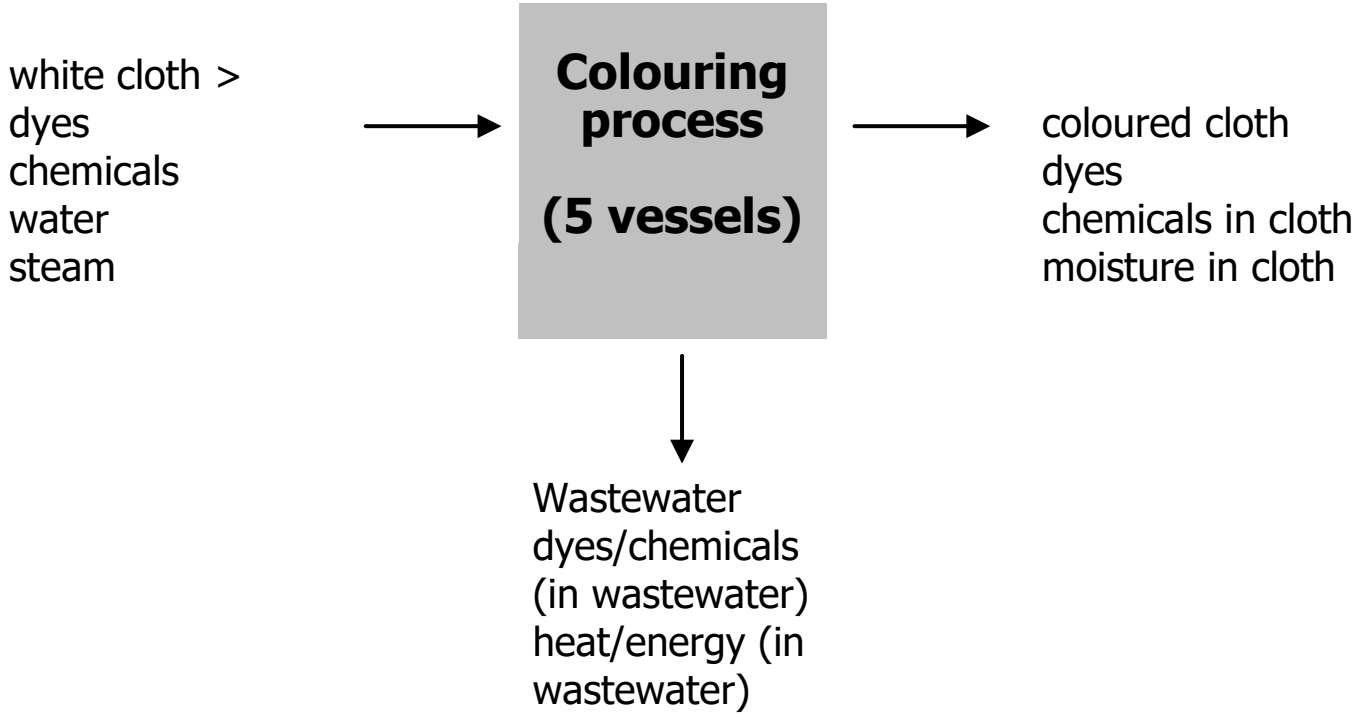
Practical tips



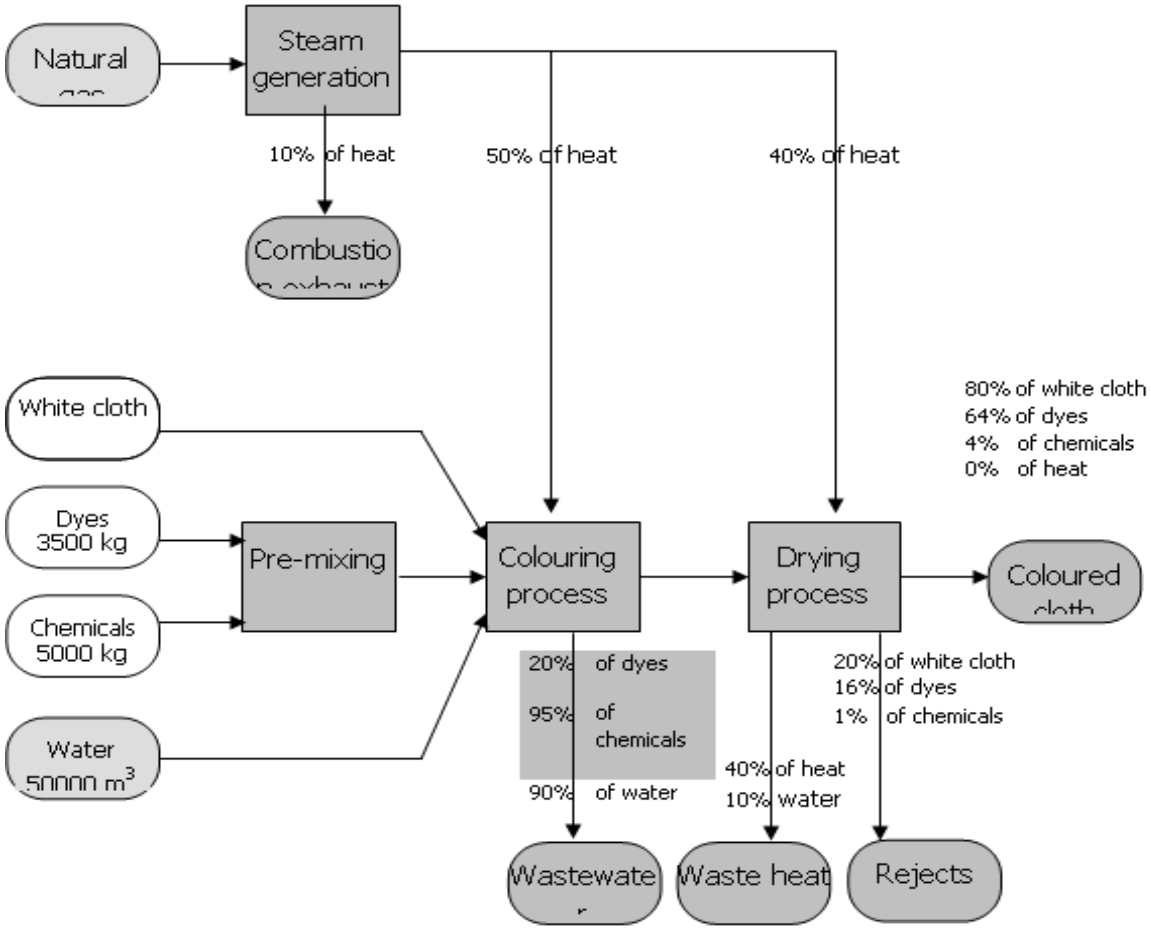
First get an overview ...



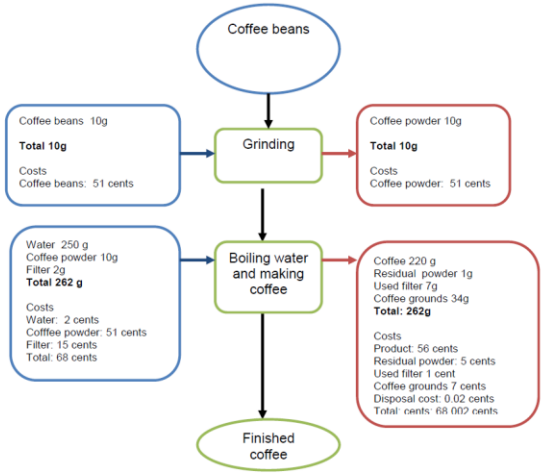
… then a blow up of major process steps...

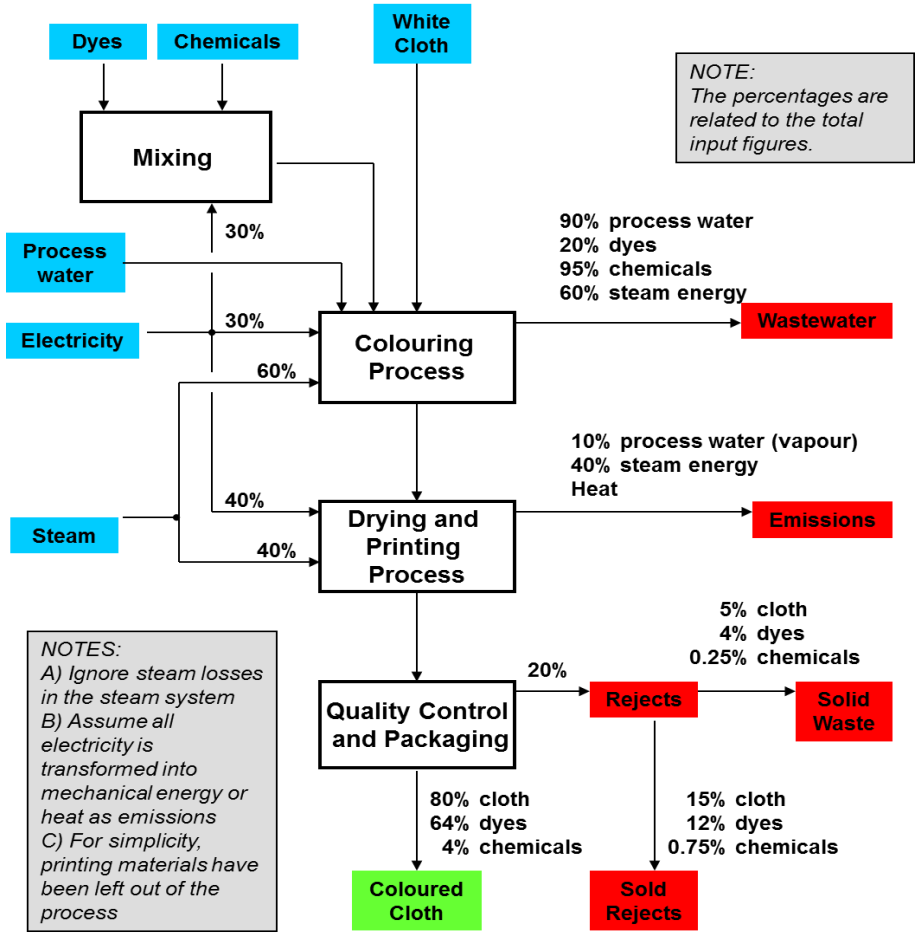


… and finally allocate percentages and absolute quantities to flows...

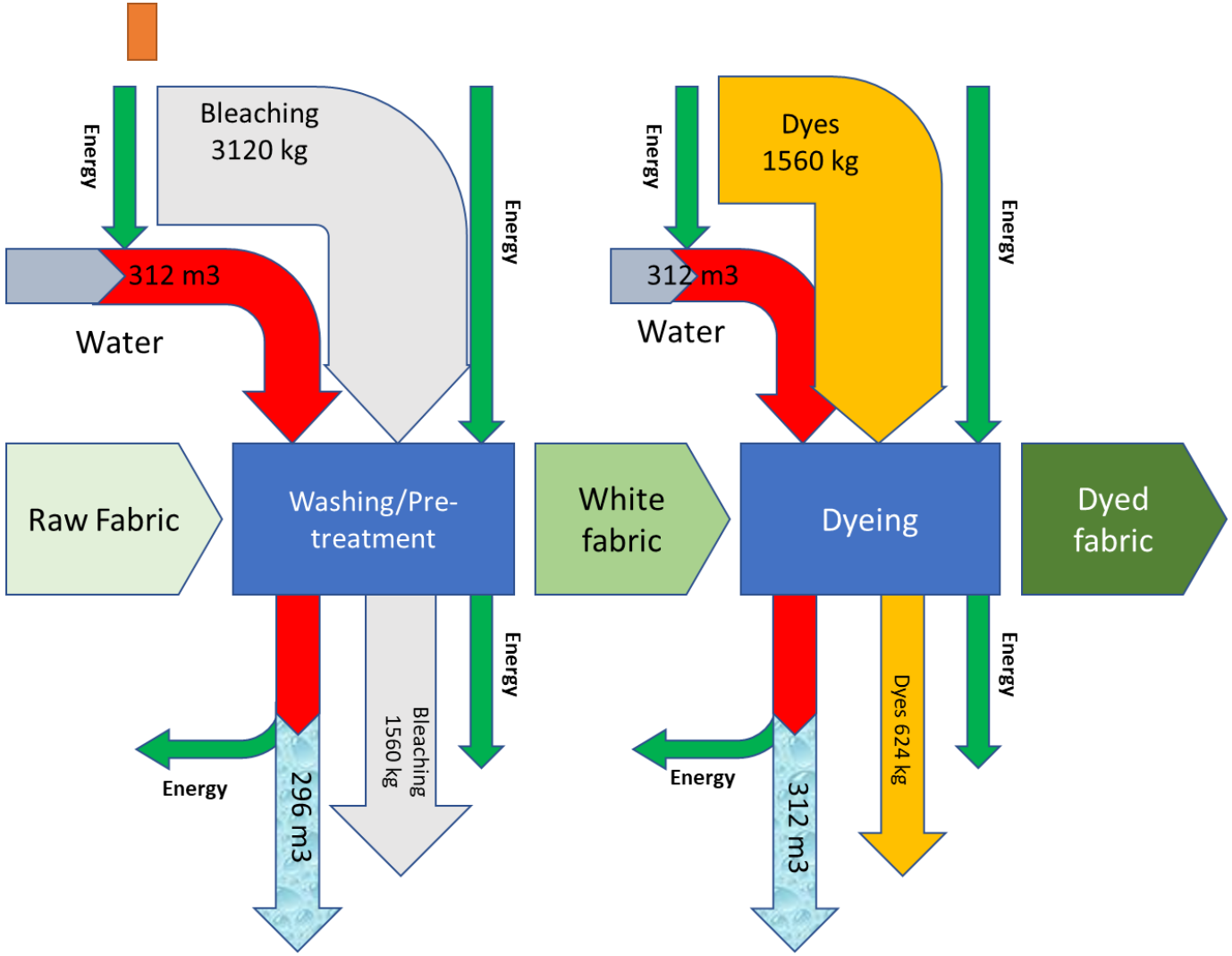


Using your flowchart information

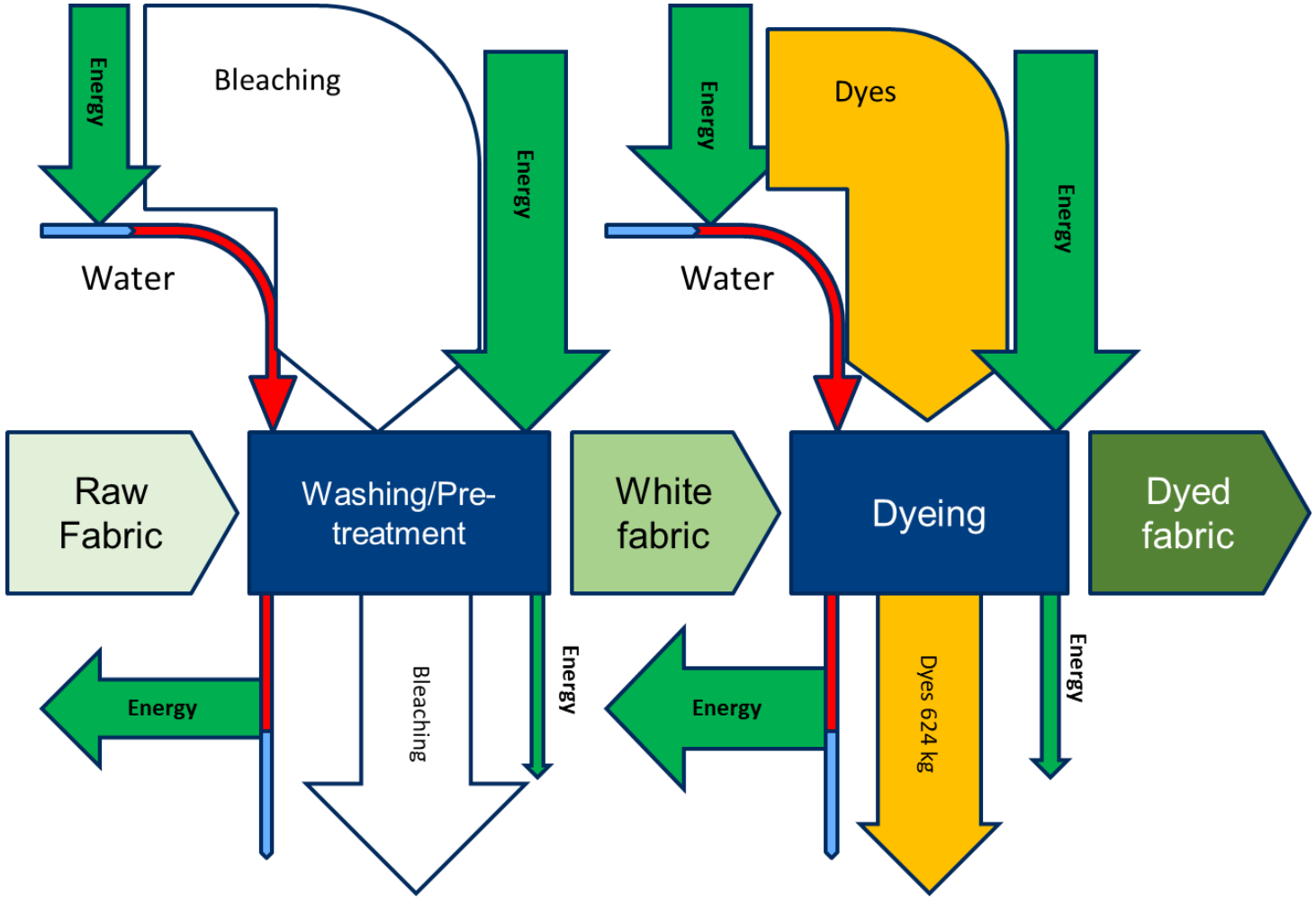




Input/Output flow – Sankey Diagram, by quantities



Input/Output flow – Sankey Diagram, by quantities

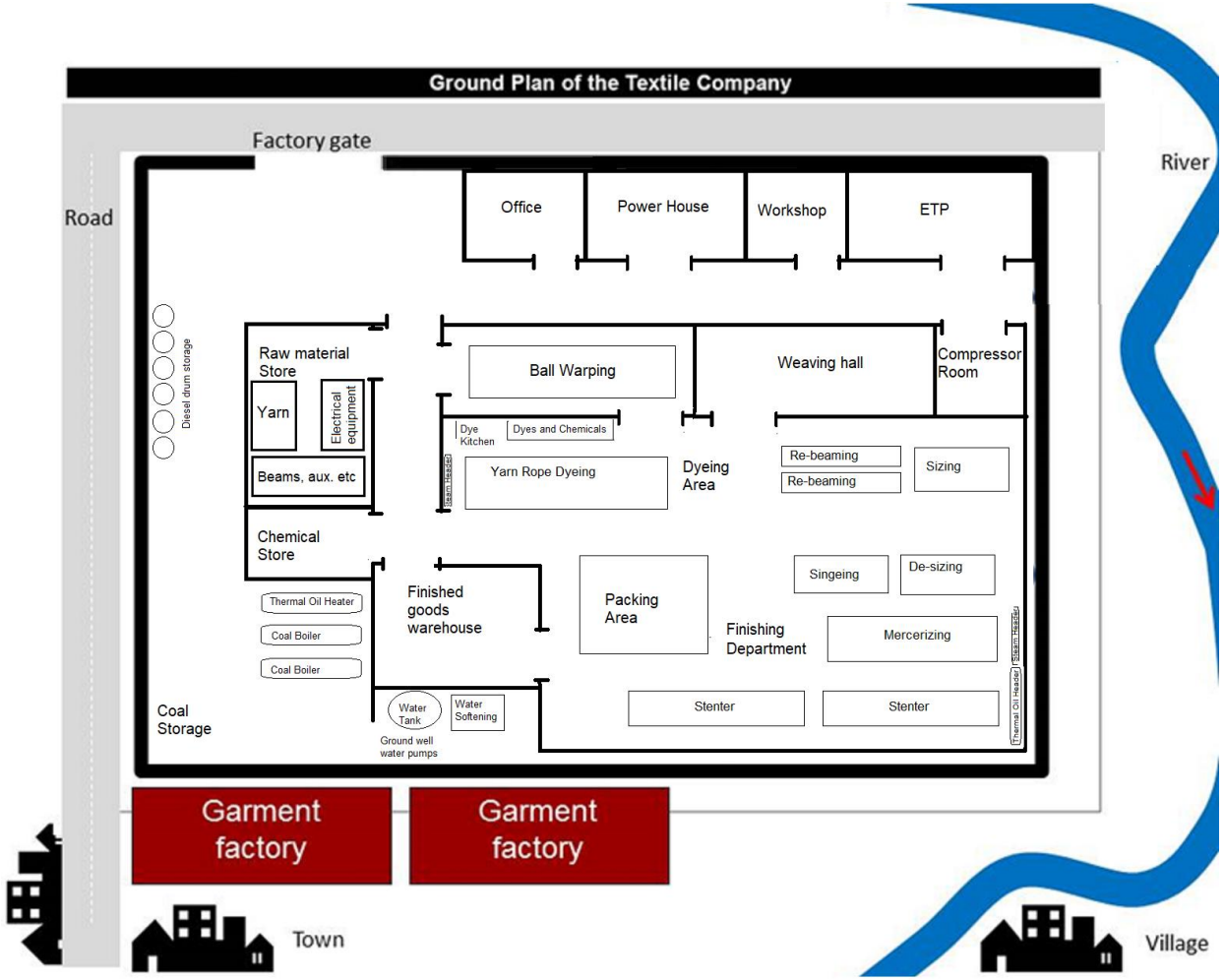


Exercise – „The Textile Company“

Objective

- To identify and map energy flows in a company`s operations
  - ✓ using tools such as flow diagrams and eco-maps for visualization and documentation

Exercise (layout of Textile Company)



Exercise

Tasks in your group

1. Document the process & energy flow
2. Point out possible NPOs and energy hotspots in an Eco-map (defined as areas which represent energy losses or immediate risk to environment)
3. Identify the internal key stake holders and decide who should be involved into the company`s energy management team
4. What changes would you make to your on-site assessment plan?
5. Point out areas where you need in depth analysis
6. Present your findings in plenary

Total time 90 minutes

Exercise-optional

For further consideration regarding NPOs

- Which inputs (raw materials, energy, water, 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?

Key takeaways

- Documenting the energy flows including all inputs, process, and outputs (and wastes), helps in identifying non product outputs along the whole factory.
- Assigning quantities and costs to the energy and material flows allows to develop an energy balance which becomes basis for identification of significant energy uses and costs
- Process and energy mapping must be conducted on the production floor involving all relevant staffs and workers. This also helps in raising awareness in the organization on critical energy aspects
- Process / Eco maps and Energy Balance can be used for further planning and monitoring of energy performance as well

Plan Next steps

- **Conduct company/site walk-through**

- **Prepare eco-map(s)**
  - Involve your staff and workers on-site
- **Compile process and energy flow diagram**
  - showing inputs, outputs, processes, process boundaries, products and non-product outputs
- **Develop sankey diagram**
  - Display energy balance by quantities and costs of flow

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn

Friedrich-Ebert-Allee 32 + 36
53113 Bonn, Germany
T +49 228 44 60 - 0
F +49 228 44 60 - 17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Germany
T +49 61 96 79 - 0
F +49 61 96 79 - 11 15

E info@giz.de
I www.giz.de

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH