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HOW TO PRODUCE RECYCLED TEXTILE RAW MATERIAL AT REASONABLE PRICE?

THE EFFECT OF DIFFERENT TEXTILE COLLECTION AND PROCESSING PRACTICES ON PRICE

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Motivation for costs calculation (1/2)

- Currently, about 3% of municipal mixed waste consists of end-of-life textiles in Finland, and the share will increase, if nothing is done.
  - In general, textile material suits poorly for energy burning plants
- There is technology for end-of-life textile material recycling and companies, who are willing to use recycled textile.
- However, high logistics costs related to collecting, sorting and treating of end-of-life textile has prevented the use of recycled textile in production.
- Particular challenges of organizing these operations cost-effectively are:
  - small batches,
  - diversity of materials,
  - complicated sorting and treatment processes.

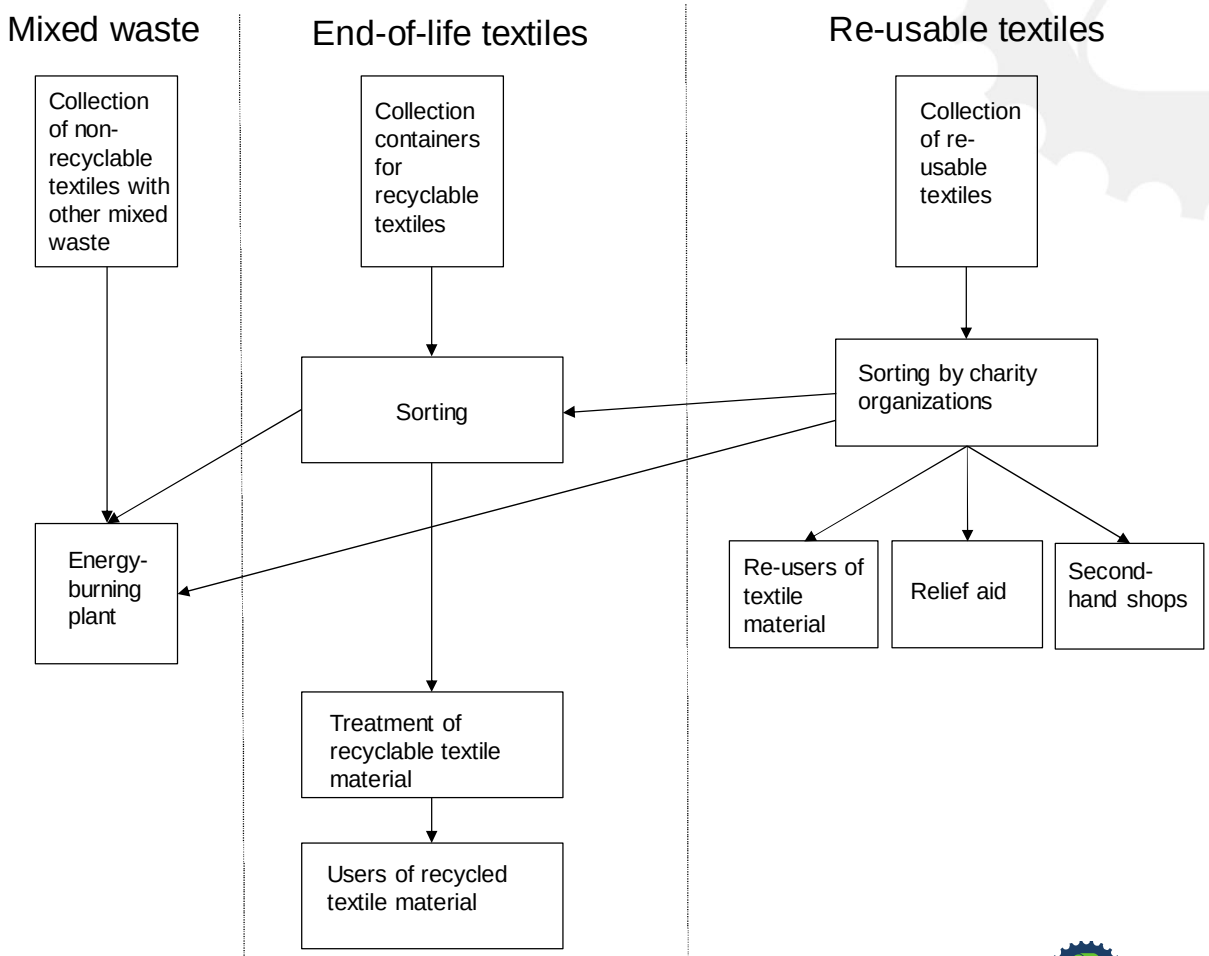
Motivation for costs calculation (1/2)

- Finding out economical alternatives to arrange reverse logistics of end-of-life textile enables the evolution of companies using recycled textile material in large-scale production.
- In addition, better knowledge about recycled textile material prices help companies to plan investments.

Research methods

- Literature review
  - Reports, pilot studies, articles, waste stastistics,...
- Qualitative methods
  - Visits
  - Interviews
  - Workshop
- Quantitative methods
  - Quantitative process model for costs calculations

Preliminary process chart for different types of end-of-life textiles



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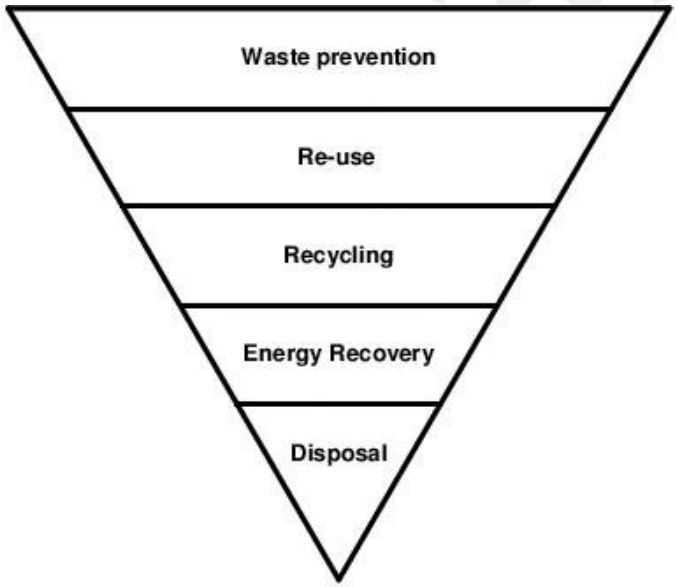
Different alternatives for end-of-life textile processes: Collection

- Waste hierarchy should be followed and aim is to minimize contamination of reusable material with other end-of-life textile:
  - Reusable textile material is collected separately by charity organizations,
  - Other end-of-life textile material is collected by regional household waste management organizations
- Together with LSJH, we estimated that suitable density in Southwest Finland could be around one textile collection places (collection containers) for each 10,000 inhabitant.



Different alternatives for end-of-life textile processes: Sorting

- Regional sorting in the facilities of local regional waste management organization
+ Risk of contamination of good textile material with spoiled material can be decreased
+ No need for transporting unsorted textiles
+ Sorted textile material is available locally

- Centralized sorting (e.g. in Southwest Finland)
+ Economies of scale benefits enables investments to automation
+ Bigger volumes of certain sorted textile material is available in one place (e.g. for treatments)

Different alternatives for end-of-life textile processes: Pre-sorting

- Consumers probably hand over reusable clothes for waste management organizations' end-of-life textile collection.
- The stakeholders for current textile collection pilots are interested to investigate the content of the collected textile material to find out, whether it makes sense to go through manually this material to separate reusable clothes before contamination happens in later process phases.
- Pre-sorting also helps to remove harmful content before they contaminate recyclable textile material.
- If the share of reusable textile material is high, the value of this material will cover the costs of pre-sorting

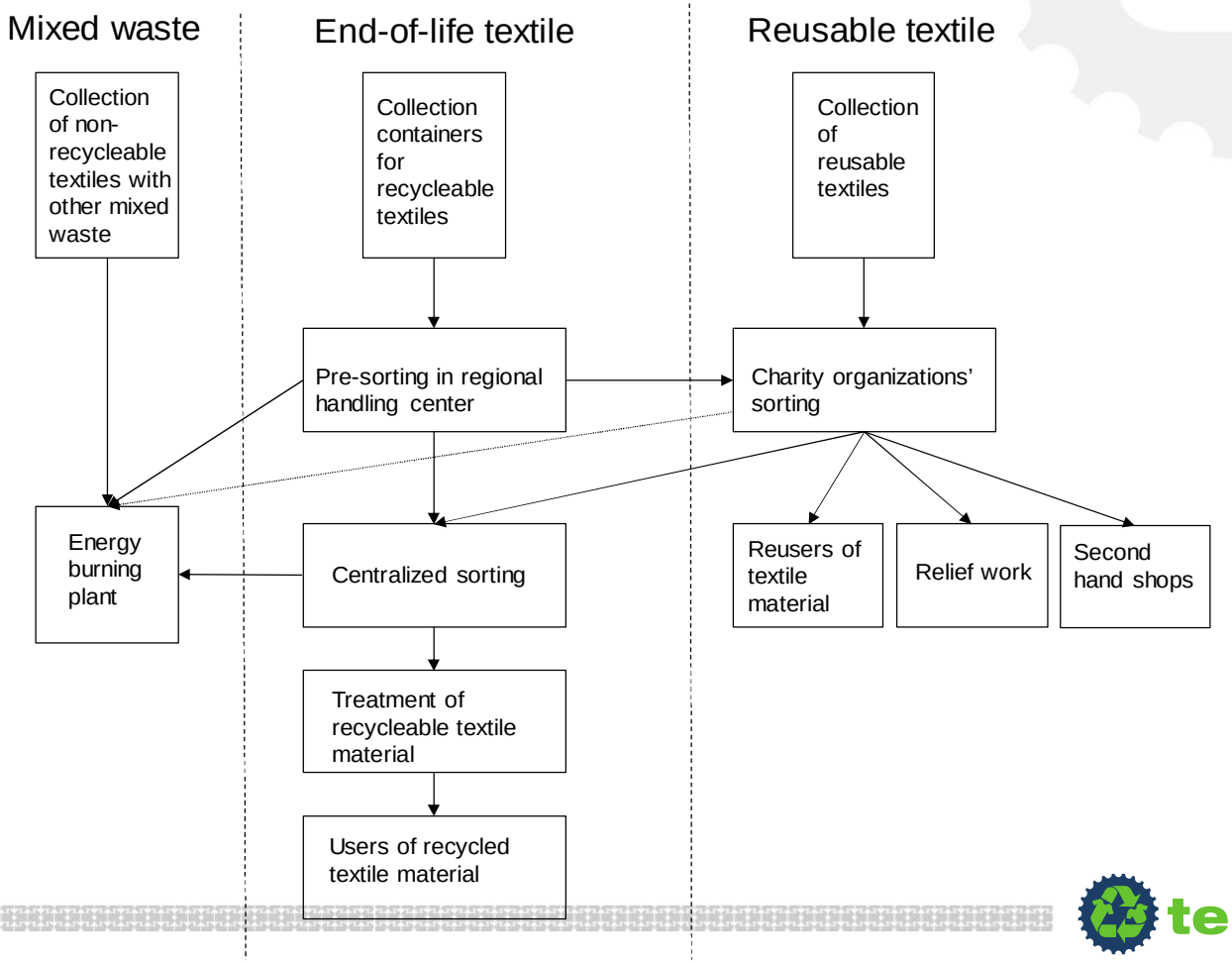
Treatment methods

- There are three possible handling methods for sorted textiles:
  - Mechanical
    - The material is sorted mechanically
    - Two phases: Ripping and teasing
  - Chemical
    - In chemical recycling, materials are dissolved in a way that its raw materials are returned to fibers and hence as usable textile raw material
    - Possible to use mixed material and to some extent dirty material
  - Thermal
    - The fibers are heated and they can be melt-spun again into fibers.
    - The fibers lose some of their features -> material is no more suitable for textiles

Other possible treatments

- Removing components, such as zips and buttons
- Washing
- Ozonizing
- Bleaching
- Steaming

Process chart for different types of end-of-life textiles



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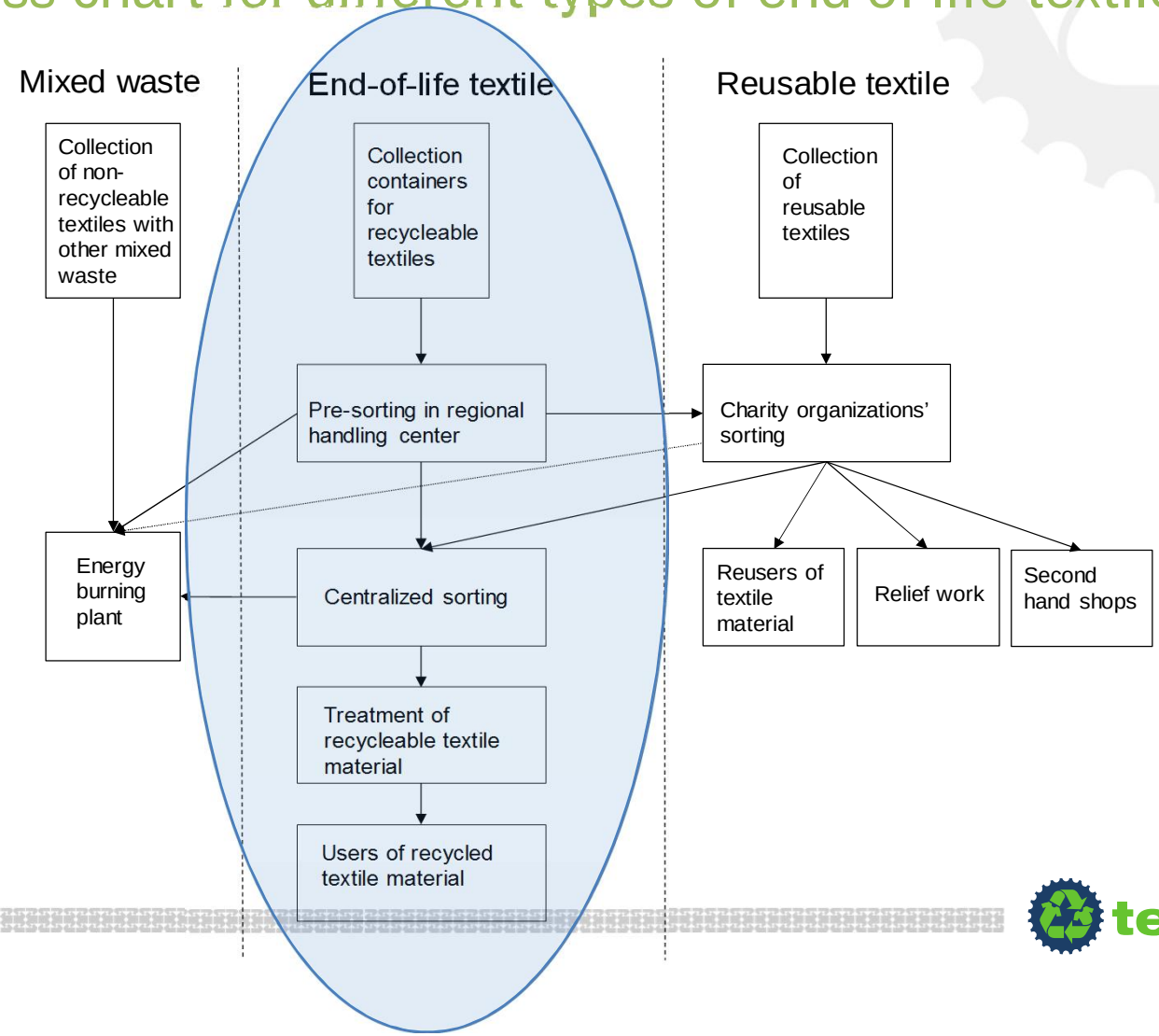
Process chart for different types of end-of-life textiles



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Cost estimations: Assumptions

- The amount of textile material that currently ends up as mixed waste in Finland is 8.5 kg
- Separate textile material collection will get 40% of this material (3.4 kg / inhabitant)
- Collected material is delivered first to local handling centres. The number of local hadling centres is estimated to be same as regional units in Finland (18).
- For investments, amortization time is 5 years, and interest rate is 5%.

Cost estimations without treatments

- Amount of recyclable textile material: ~16 million kilos
- Collection: 0.1 – 0.15 € / kg (of collected textile material)
- Costs of local handling cetres (18): ~0.05 € / kg
- Costs of pre-sorting: Minimal
- Costs of transports between local handling and centralized sorting: ~0.02 € / kg
- Costs of sorting:
  - 0.12 € /kg (automatic)
  - 0.18 € / kg (semi-automatic)
  - 0.3 € / kg (manual)

Cost estimations: treatments

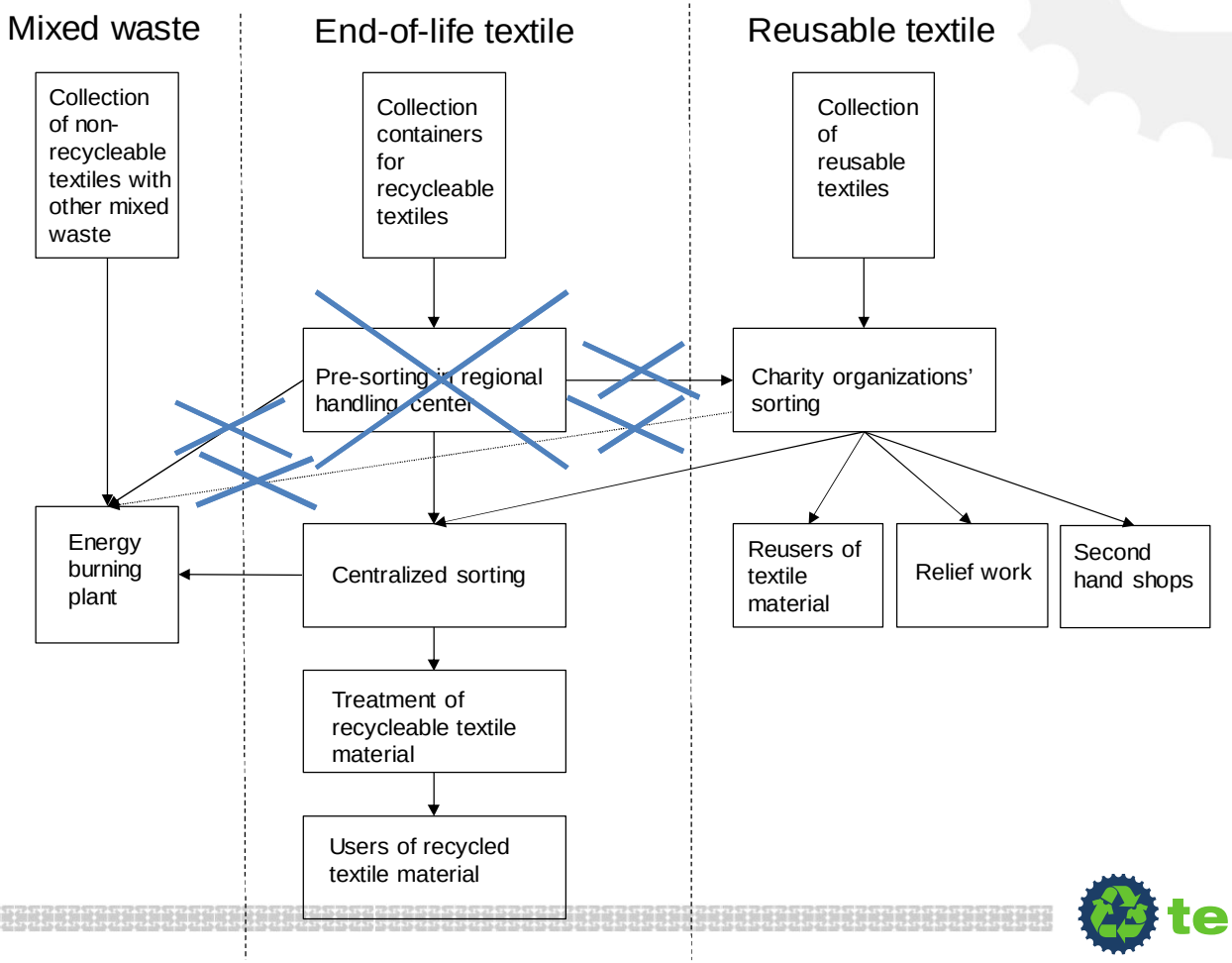
- Chemical treatment: 0.5 € - 1.0 €/ kg
- Mechanical treatment: 0.4 € - 0.8 € / kg
- Washing: ~2 € / kg ?
- Removing components: ~0.1 €/ kg

- The cost of chemical and mechanical treatments depend of the share of the usable material after the process.

Conclusions

- Based on the results of the study, it seems that it is possible to produce recycled textile raw material at a reasonable cost (1-2 €/kg) when the ecosystem is in use.
- The factors that help to keep the costs reasonable:
  - The availability of textile material is sufficient:
    - Consumers are willing to separate their end-of-life textiles and carry them to right place.
    - Cooperation between organizations that collect end-of-life textile: Charity organizations and shops deliver their excess clothes to material recycling
  - The share of harmful material remain small
  - Latest technologies are implemented.

Ideal process?



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THANK YOU FOR YOUR ATTENTION!

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