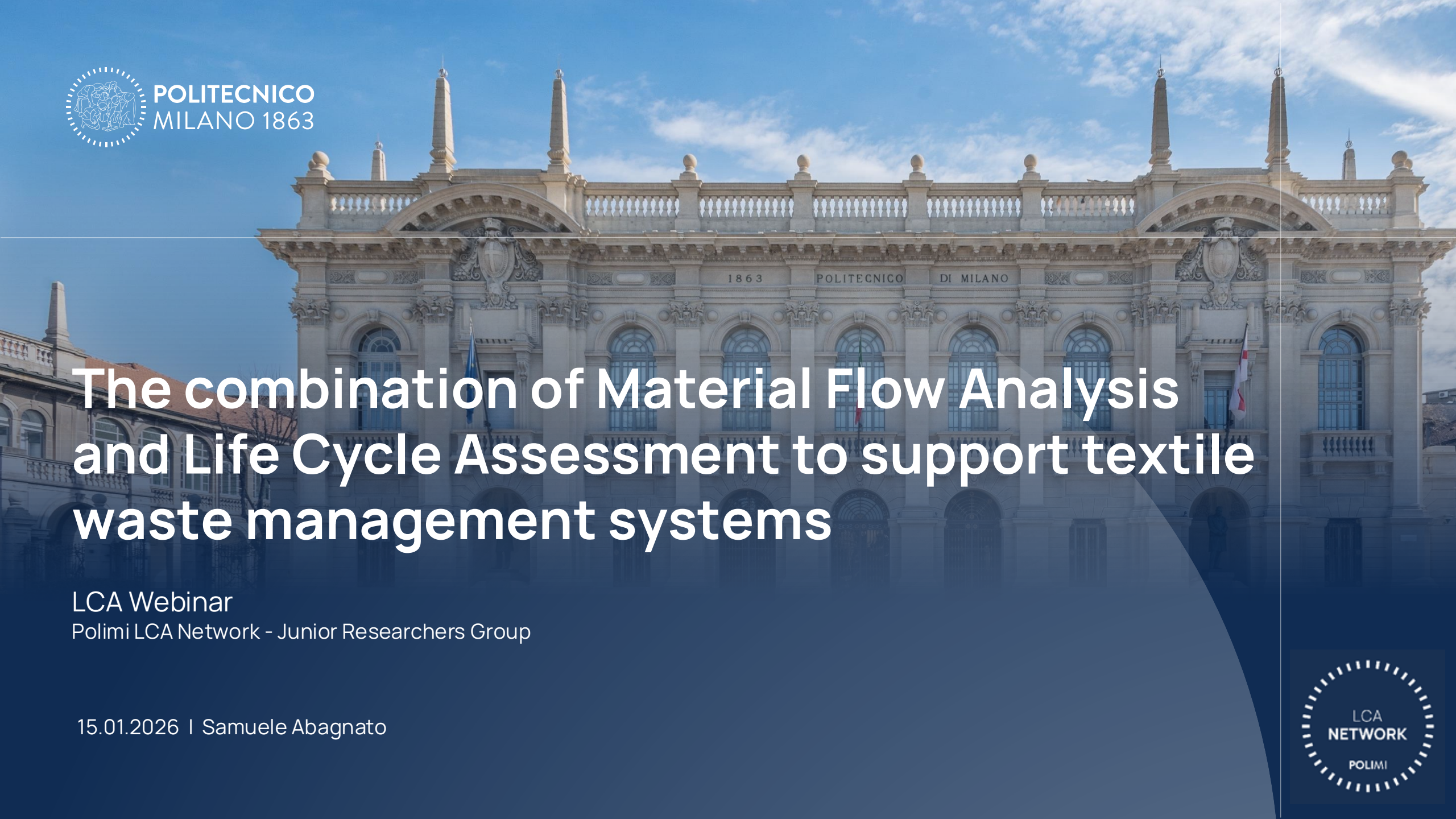

POLITECNICO MILANO 1863

The combination of Material Flow Analysis and Life Cycle Assessment to support textile waste management systems

LCA Webinar

Polimi LCA Network - Junior Researchers Group

15.01.2026 | Samuele Abagnato

LCA NETWORK POLIMI

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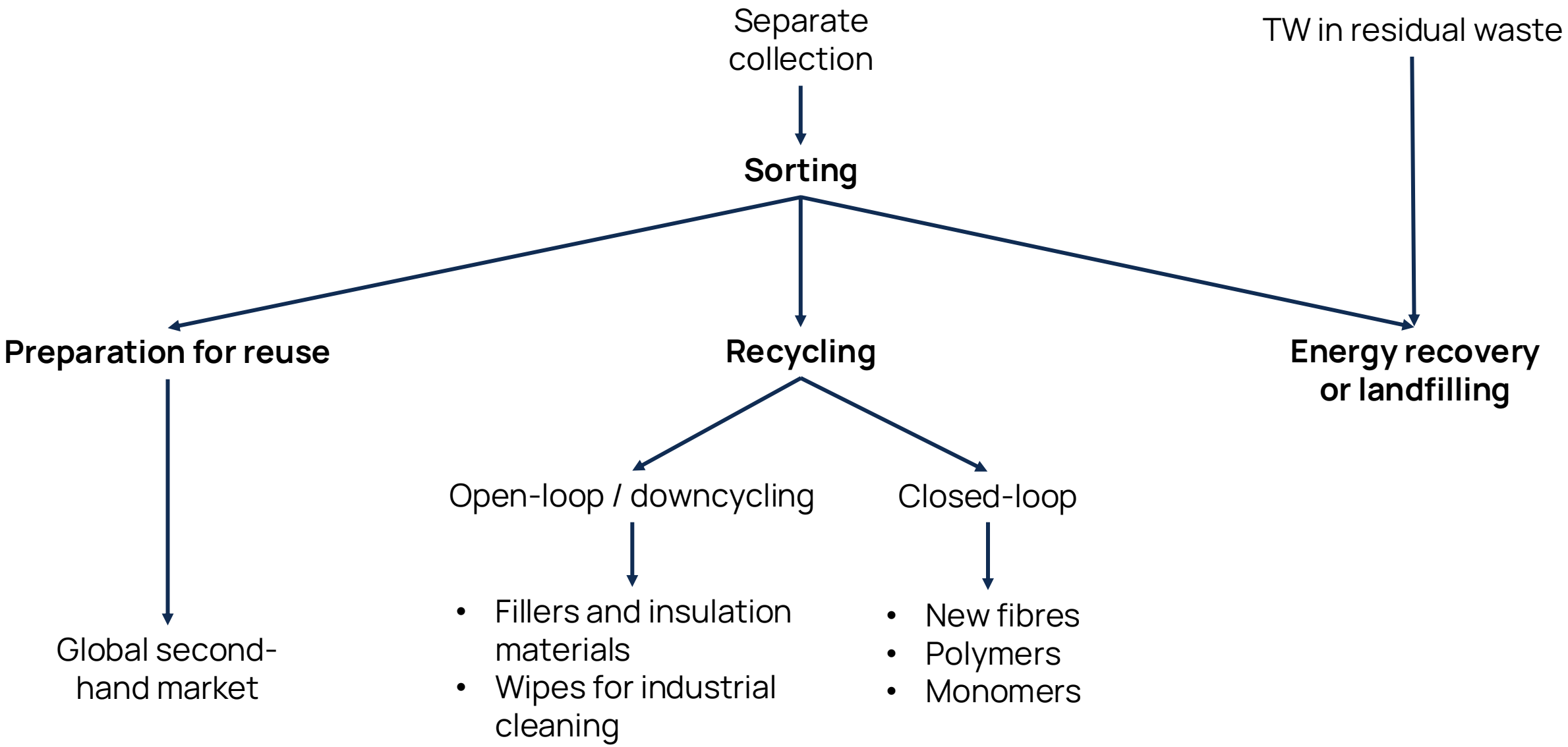
Textile waste management framework



Goal and Scope

- The goal of the study is to **assess the potential environmental impacts of the management of the post-consumer textile waste (PCTW) produced in Lombardy**.
- Functional unit: the management of **1 t of PCTW** generated in Lombardy.

Decision-making support

In the current context, is it better to **recycle textiles in Europe or to export them for reuse**?

How much would a **low-fossil energy mix** affect the impacts if the waste management system remained unchanged?

Will **new recycling technologies** be effective in the reduction of life cycle impacts?

How could an **integrated waste management system** be designed in the future?

Steps of the analysis: from waste composition to LCA impacts

Estimate **TW composition**

↓

Identification of **scenarios** that could support decision-making

↓

Material Flow Analysis for each scenario

↓

Life Cycle Inventory of each process involved in the different scenarios

↓

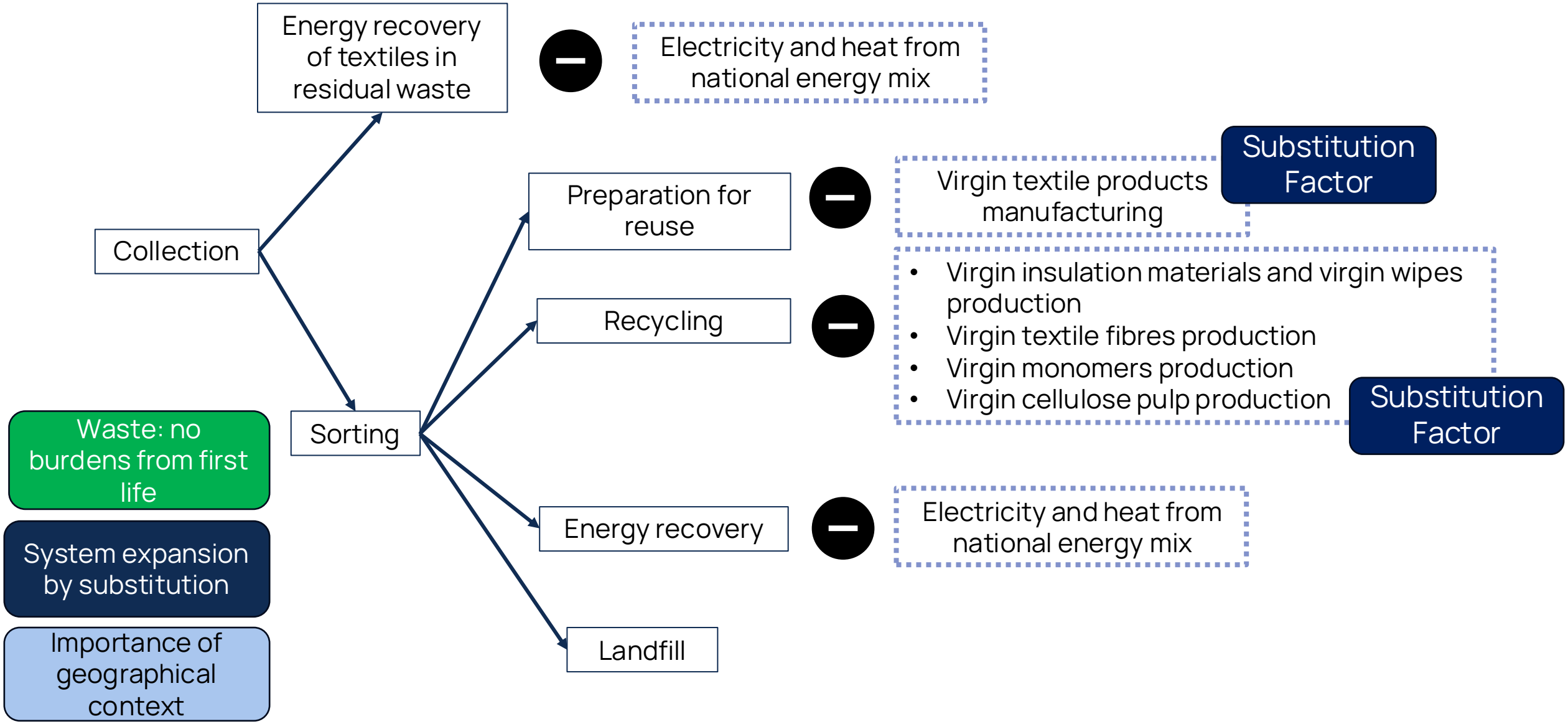
LCIA **results** (with interpretation and sensitivity analyses)

TW composition, MFA and LCIA results are linked one with each other

How to deal with decarbonisation effects?

How to deal with emerging technologies?

System boundaries and multifunctionality



Discussing MFA and LCA results

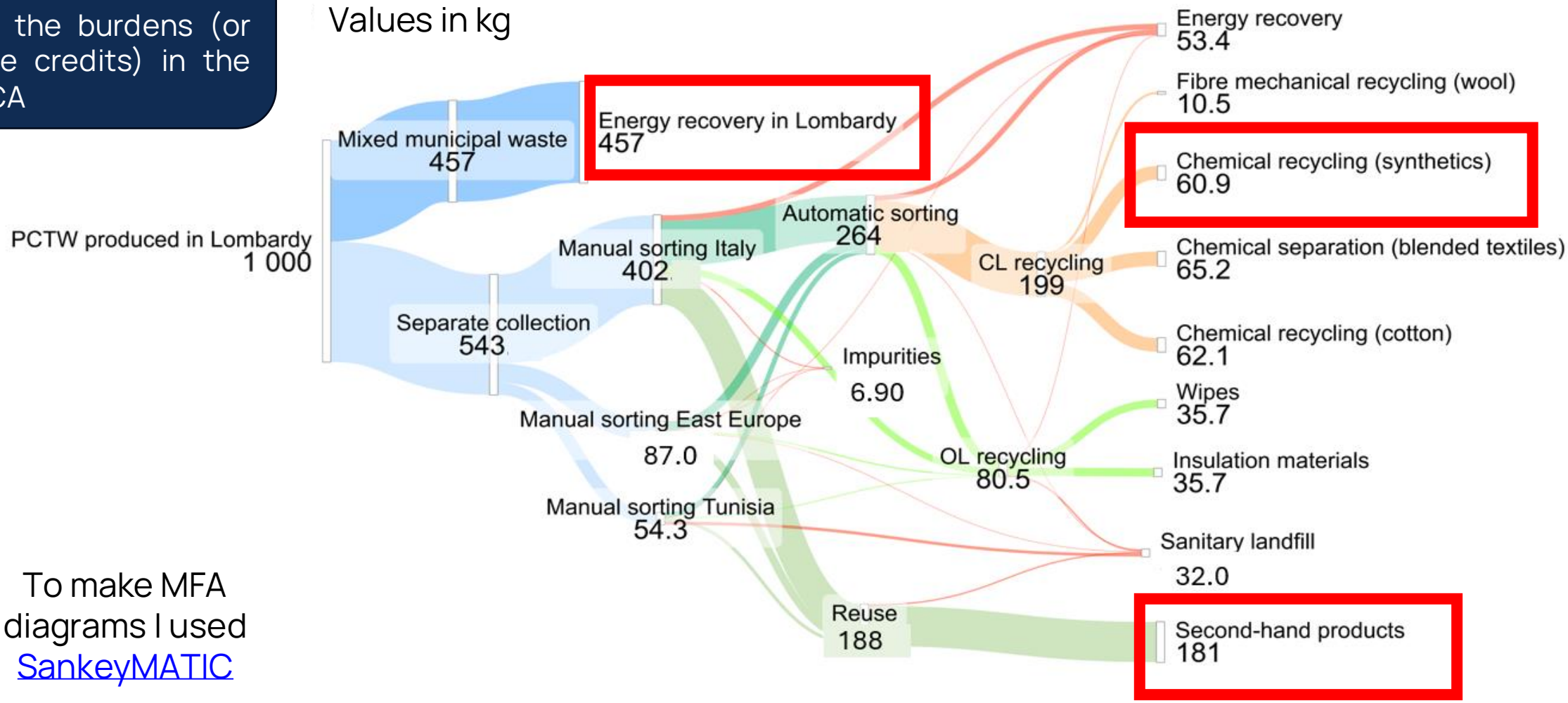
In this kind of studies, MFA and LCA results should be interpreted together, because:

1. A negligible flow in the MFA could contribute to most of the burdens (or the credits) in the LCA
2. A variation in MFA flows represents a different management system: LCA results can show if it is better to move the system toward a treatment option or another
3. MFA represent a realistic situation to support decision-making: we are not studying single-option scenarios but integrated systems. LCA translate these «flows picture» into potential environmental impacts.

Discussing MFA and LCA results

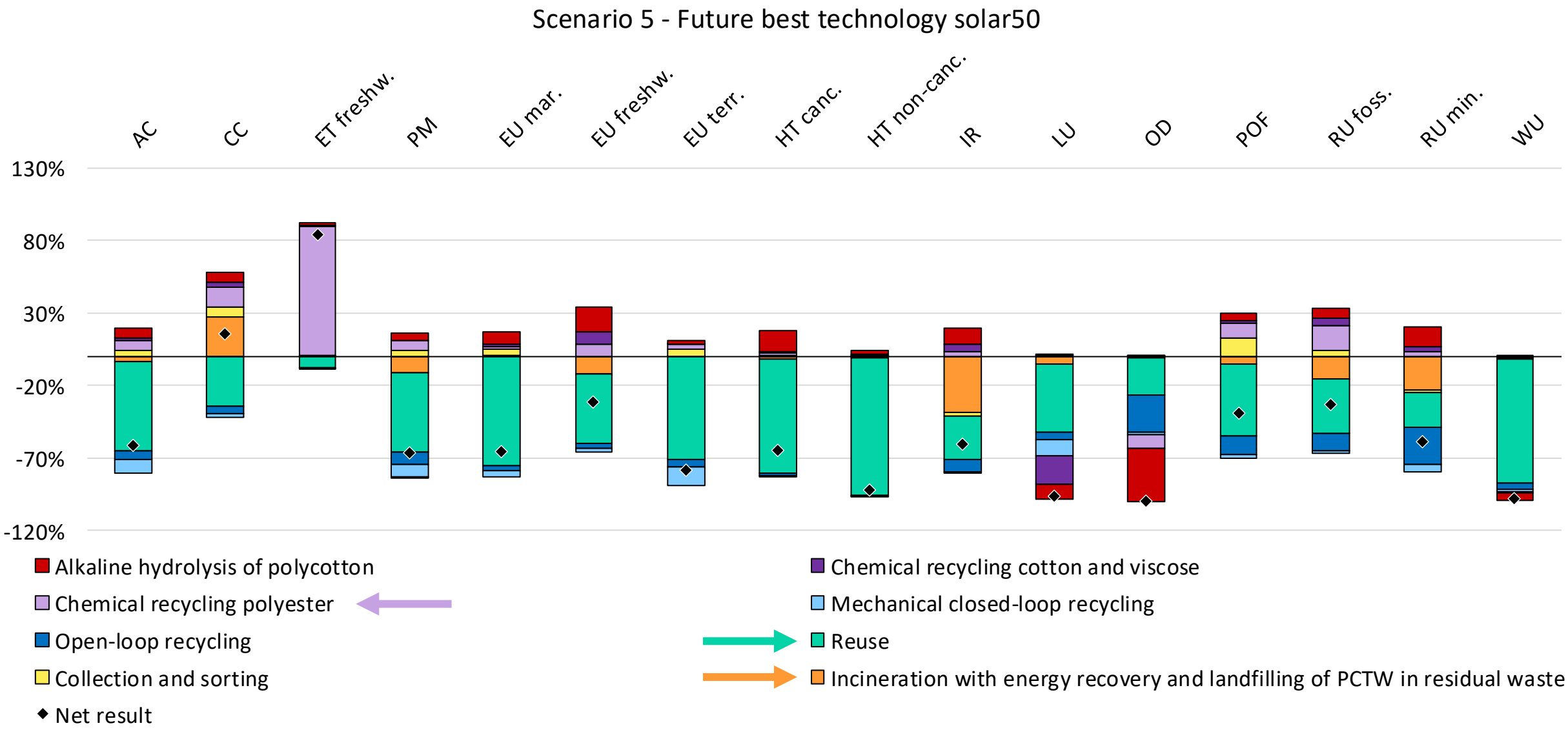
A negligible flow in the MFA could contribute to most of the burdens (or the credits) in the LCA

S5: future best technology solar50
Values in kg



To make MFA diagrams I used [SankeyMATIC]

Discussing MFA and LCA results



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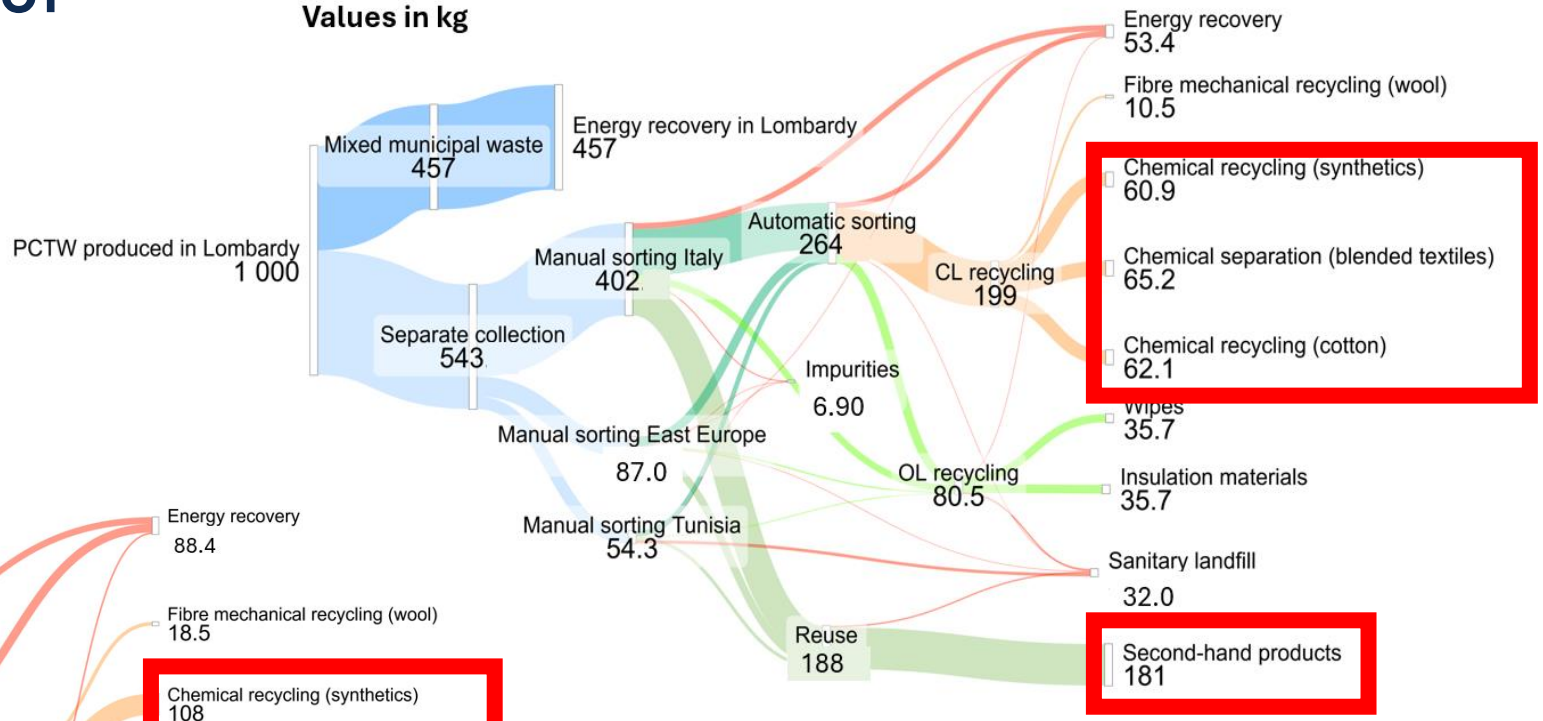
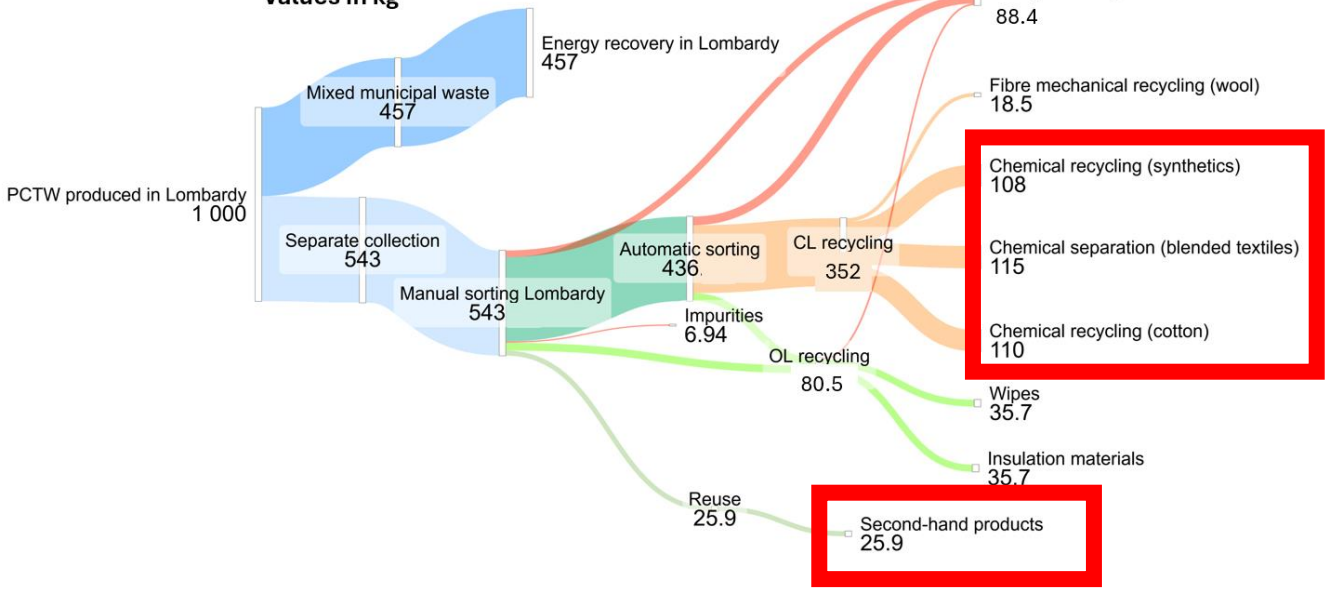
Effects of MFA variation of LCA results

A variation in MFA flows represents a different management system: LCA results can show if it is better to move the system toward a treatment option or another

S4 and S5: «future best technology» scenarios
Values in kg

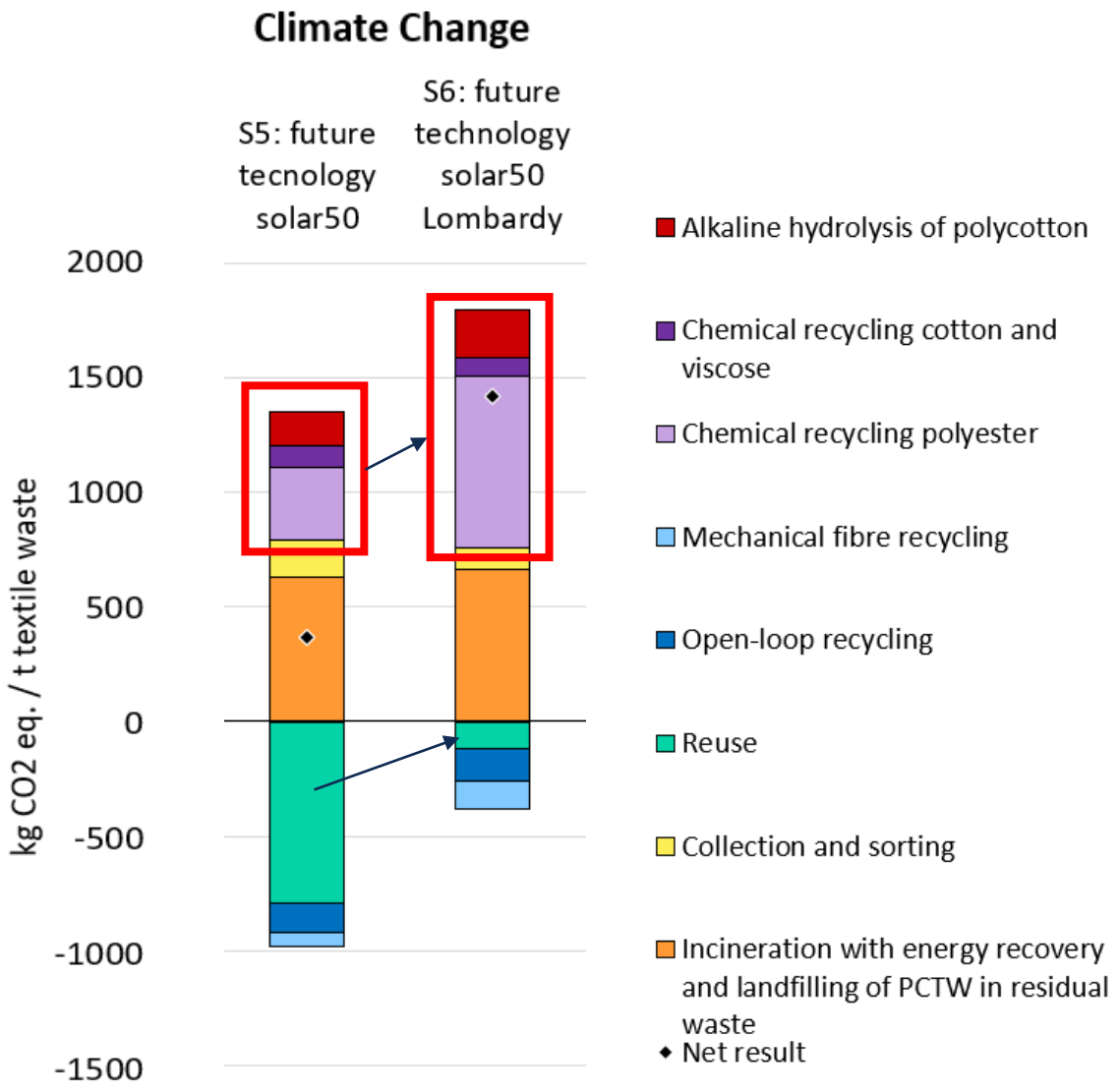


S6: «future best technology Lombardy» scenario
Values in kg



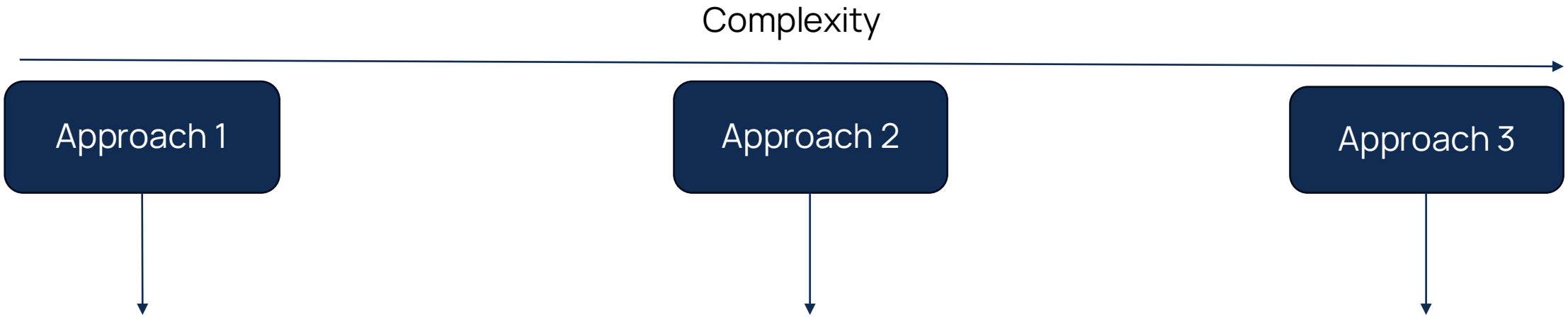
S6 includes a strong **reduction in the amount of waste to reuse** and an **increasing in the amount of textiles to chemical recycling**.
The separate collection rate, the sorting and recycling technologies and the energy mix is the same of S5.

Effects of MFA variation of LCA results



Climate Change impacts are more than doubled, due to the **reduction of reuse credits** and to the **higher burdens of chemical recycling** (due to higher amount of waste sent to chemical recycling).

Learning from experience: considering decarbonisation for future scenarios



Assume a certain % of renewable electricity in the future mix of the foreground system (also in avoided processes modelling)

Model your processes according to the energy mix in the IIASA database

Consistency with Shared Socioeconomic Pathways

Use PREMISE in Brightway or Activity Browser

- Consistency with Shared Socioeconomic Pathways
- Decarbonisation of the background system

Learning from experience: how to deal with emerging technologies

- Study carefully the technology characteristics. If you are not a specialist, talk with someone who really knows the **features and the bottlenecks of the technology**
- Look for **upscaling methodologies** to project LCI data from the lab to the industrial level, or contribute to create upscaling methodologies in your field
- Develop **sensitivity analyses** on the most important parameters and on the most uncertain aspects

Systematic review of scale-up methods for prospective life cycle assessment of emerging technologies

Merve Erakca [a,b,*], Manuel Baumann [a,c], Christoph Helbig [d], Marcel Weil [a,b]

From laboratory to industrial scale: a scale-up framework for chemical processes in life cycle assessment studies

Fabiano Piccinno [a, b], Roland Hischier [a], Stefan Seeger [b], Claudia Som [a, *]

In my case I found that the **de-dyeing stage before textile chemical recycling** was overlooked, but its impacts were relevant.

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