



# Sustainable textiles: From renewable carbon to fibres

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## Background

People have three elementary needs in order to stay alive: food, shelter and clothing. The way we dress ourselves needs to change drastically, as the textile industry ranks among the highest emitting and polluting industries in the world.

## Objective

Decarbonisation is applicable to the energy sector, but food, shelter and clothing consist of organic matter and will always be based on carbon. This study presents the options we have for the production of sustainable textiles from renewable carbon-sources and the challenges ahead.

## Introduction

An extremely wide range of techniques are applied to turn raw materials into garments (see figure 1).

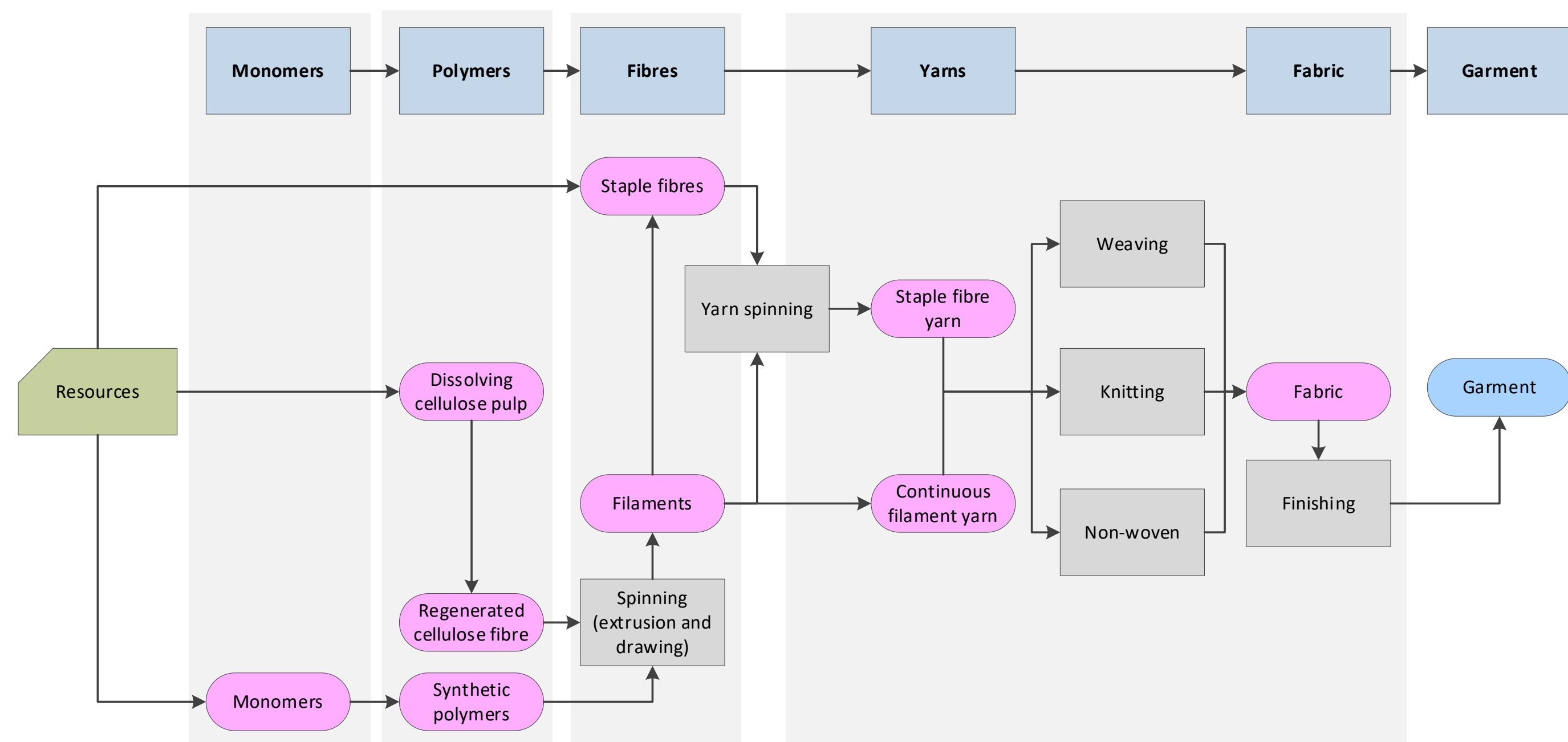


Figure 1. From resources to fibres, yarns, fabric and garments, a highly simplified scheme

Spinning, weaving and knitting are essential processes in textile production, but also new processes like 3D-printing are gaining attention. It is essential that new resources fit in this existing infrastructure of textile production.

## Carbon sources for conventional textile fibres

Fibre production in 2020 was 111 Mton [1]. As carbon source mainly fossil was used (65 wt%), the remainder was biomass (35 wt%) (figure 2).

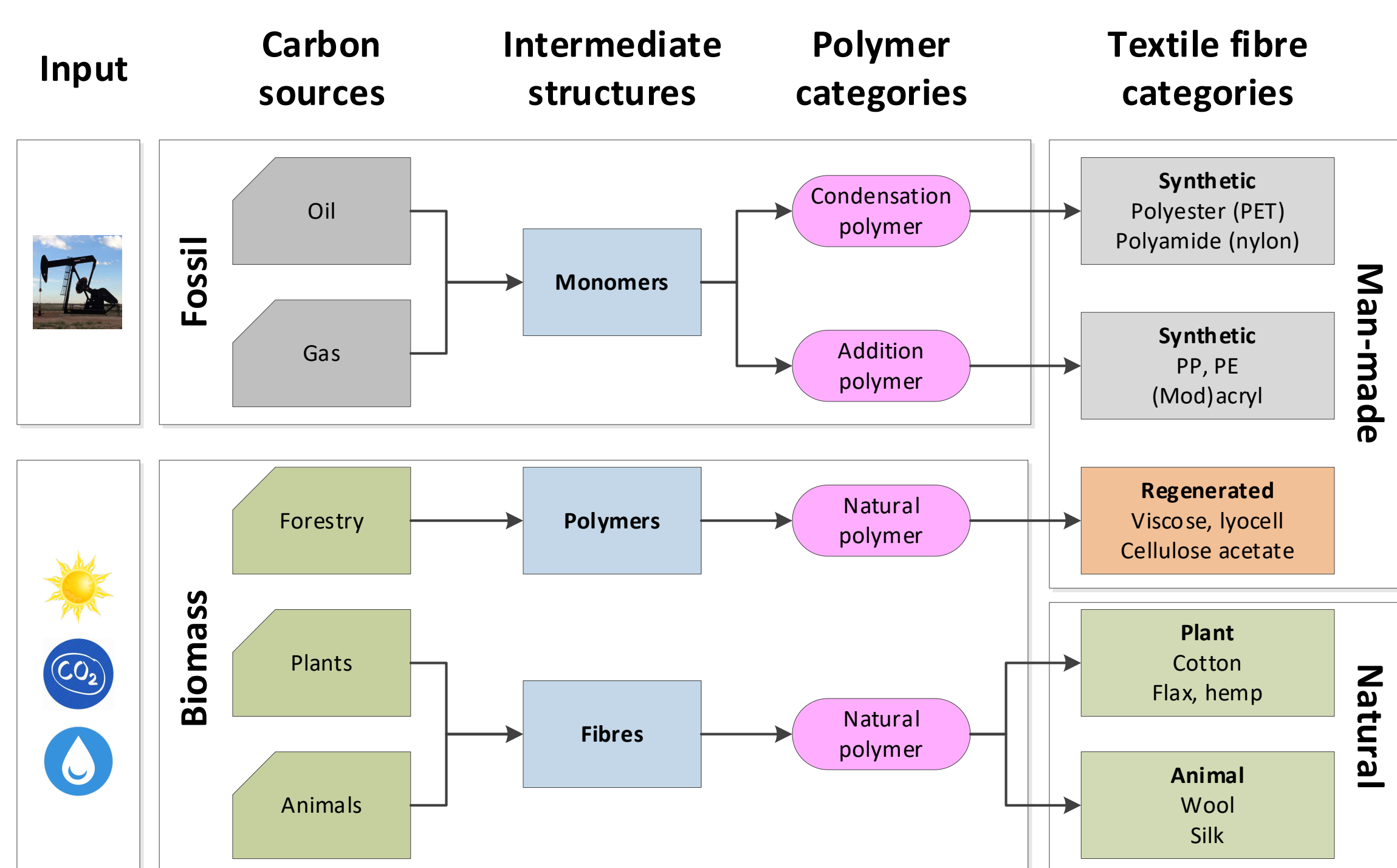


Figure 2. Conventional fibres: relation between carbon sources and textile fibres

## Carbon sources for sustainable textile fibres

For sustainable textiles we

- Reduce the use of (virgin) resources
- Phase out fossil resources
- Prevent the release of harmful microplastics (microfibres) to the atmosphere

As renewable carbon sources we have three options (see figure 3):

- Recycled content
- CO<sub>2</sub>
- Biomass

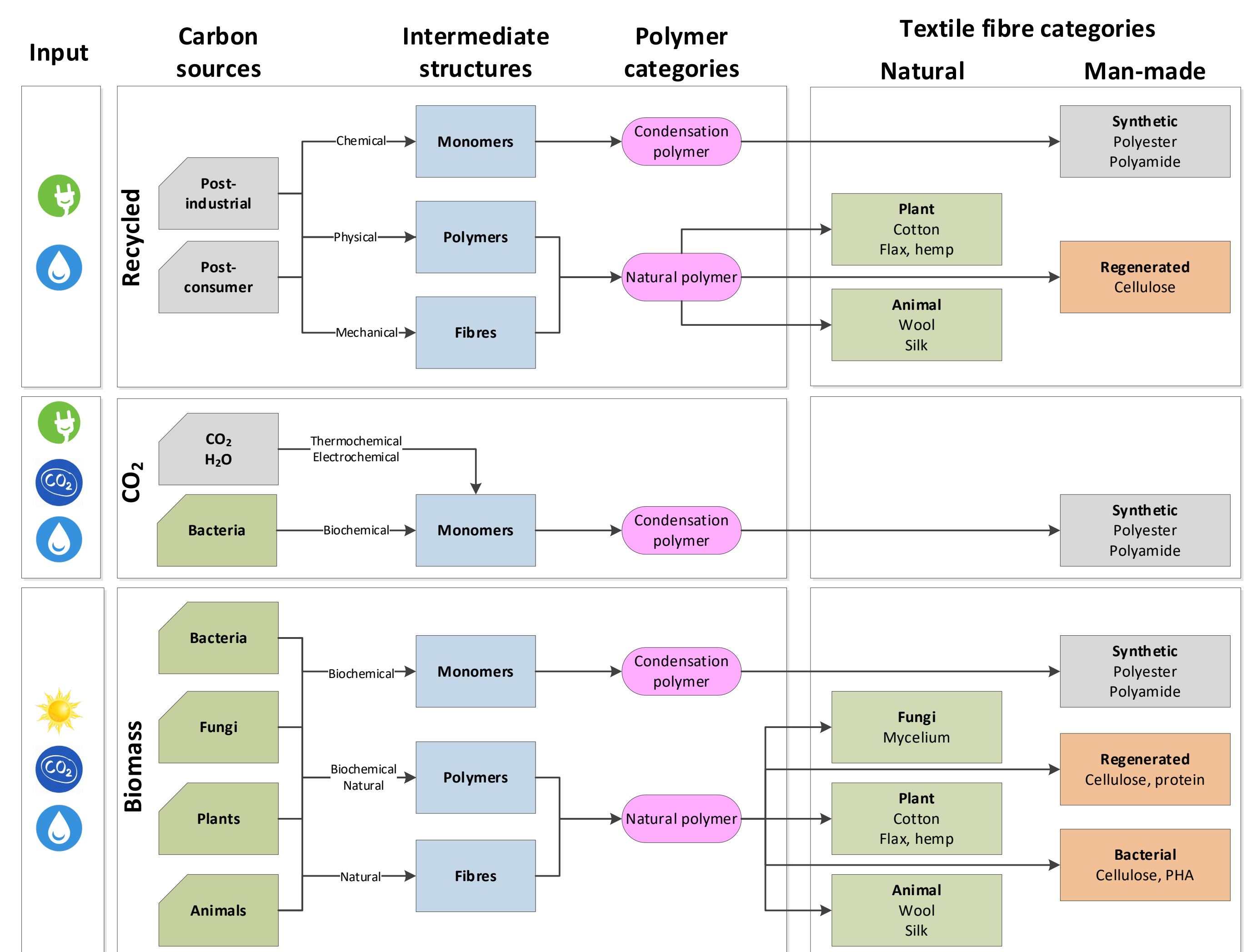


Figure 3. Sustainable fibres: relation between carbon sources and textile fibres

## Challenges ahead

- **Recycled content:** There are good recycling options for mono-material streams. Real challenge lies in blended textiles. Design for recycling needs to be implemented on large scale [2].
- **CO<sub>2</sub>:** "It is foreseeable that in 20-30 years the solar-driven conversion of CO<sub>2</sub> into chemicals, materials and fuels will come through" [3].
- **Biomass:** In the past, we had limited types of biomass as carbon source for textile (i.e. wool, silk, hemp, linen, cotton). For sustainable textiles, we have to broaden our scope and use also less familiar types.

## References

1. Textile Exchange, *Preferred Fiber and Materials Market Report 2020*. 2020, Textile Exchange.
2. Harmsen, P., M. Scheffer, and H. Bos, *Textiles for Circular Fashion: The Logic behind Recycling Options*. Sustainability, 2021. **13**(17): p. 9714.
3. Aresta, M., A. Dibenedetto, and A. Angelini, *Catalysis for the valorization of exhaust carbon: from CO<sub>2</sub> to chemicals, materials, and fuels*. Technological use of CO<sub>2</sub>. Chemical reviews, 2014. **114**(3): p. 1709-1742.

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