



# The development of a fossil-free textile chain: the revival of plant-based dyes

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## To which domain did you submit your proposal?

Domain Textiles, Topic 4: CO<sub>2</sub> capture and utilization

## What are you exploring? With what objective?

The textile industry heavily relies on fossil resources; not only for their fibers but also for their auxiliaries such as dyes. Recycling of fibers and bio-based alternatives are gaining quite some attention, while auxiliaries lag behind. This is rather remarkable, as the environmental impact of these fossil-derived products is substantial.

In this project we will take one dye as an example and compare the technological, environmental and economic impact of production pathways for fossil-based versus its bio-based options. The results will be communicated to the textile industry and other stakeholders to enable fair comparisons, taking true pricing into account.

The ultimate goal is to create awareness of the problems associated with fossil-based dye production and stimulate the implementation of bio-based dyes (produced by plants and/or micro-organisms) in the textile industry.



In the 2022 Wildcard project "Dyes for textiles" the plant species *Indigofera tinctoria* was identified as one of the most promising crops to provide a high-value bio-based dye to be used in a fossil-free, circular textile chain. We will compare the fossil-based and bio-based pathways for the production of indigo to determine CO<sub>2</sub> capture potential and determine the most sustainable process and value chain.

## Why is this interesting scientifically?

Developing a fossil-free textile chain requires the integration of different disciplines, ranging from plant physiology and breeding to material chemistry and process technology. Usually, these fields of expertise develop and publish their knowledge separately. Analyzing production processes from different scientific perspectives will enable identification of critical steps and opportunities for improvement. For example: emission of harmful substances may be reduced by combining elements of different production pathways, or yield and quality of plant-based dyes may be improved through breeding or cultivation strategies.

## How is this relevant to the materials transition?

In this project the fossil-based and bio-based pathway for dye production will be compared based on their economic, environmental and societal impact. Doing so will show potential consequences of the transition towards the use of fossil-free (bio-based) dyes in the textile industry and identify the necessity, advantages and possible bottlenecks for realizing this transition.

## What are the key activities or steps?

**Activity 1: Workshop with researchers from different fields** such as protected cultivation, CO<sub>2</sub>, textile value chains, plant breeding and chemistry to develop cross-disciplinary understanding of the system.

**Activity 2: Comparison of fossil- and bio-based pathways** for producing the colorant indigo and determine CO<sub>2</sub> capture potential and the most sustainable process and value chain.

**Activity 3: Workshop with stakeholders** to discuss results of activity 2 and determine potential future steps.

**Activity 4: Dissemination** to the research community by presentations.

## What are key deliverables?

- Short document describing the project conceptual approach, workflow and communication strategy.
- Report describing the results of Activities 2 and 3.
- Presentations on the project (results) during community meetings.
- Long read article on the results of this project to be placed on the WUR webpage.

## On what issues would you like to get input from others?

- Knowledge on production pathways of dyes for the textile industry
- Methodologies for organizing workshops and brainstorm sessions with experts and/or stakeholders

