Carbon Footprint of Different Natural Fibres

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Overview

- Background & context
- Approach
- Results
- Discussion
- Outlook

MultiHemp

nova Institute for Ecology and Innovation

Carbon Footprint and Sustainability of Different Natural Fibres for Biocomposites and Insulation Material

Study providing data for the automotive and insulation industry

EU Project:

Multipurpose hemp for industrial bioproducts and biomass

In the frame of MultiHemp, the partners will use cutting-edge genomic approaches to **achieve rapid targeted improvements in hemp productivity and raw material quality for end-user requirements**, whilst also **advancing scientific understanding of gene-to-trait relationships** in this crop. This work will be combined with innovations in agronomy, harvesting and processing methods to generate sustainable products from improved varieties.

Project coordinator:

Dr. Stefano Amaducci (Università Cattolica del Sacro Cuore, Piacenza, Italy)

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www.multihemp.eu

22 Partners

- Kranemann GmbH www.kranemann.org
- Planète Chanvre SAS www.planetechanvre.com
- Hennepverwerkingsbedrijf Dun Agro B.V. www.dunagro.nl
- Montažna gradnja Tadej Zimic s.p. www.zimic.si
- Institute of Bast Fiber Crops (IBFC), Chinese Academy of Agricultural Sciences (CAAS) http://english.caas.net.cn
- C.M.F. Technology SPA www.cmftechnology.com
- Gruppo Fibranova SRL www.gruppofibranova.it
- Latgales Lauksaimniecības zinātnes centrs SIA http://org.daba.lv/LLZC/
  Fédération Nationale des Producteurs de Chanvre (FNPC)
- Asociación Empresarial de Investigación Centro Tecnológico Agroalimentario Extremadura (CTAEX) www.ctaex.com
- Vandijke Semo BV www.vandijkesemo.nl
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- nova-Institut GmbH www-nova-institut.de
- Hochschule Bremen www.hs-bremen.de
- Agritec, výzkum, šlechtění a služby, s.r.o. www.agritec.cz
- Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V. (ATB) www.atb-potsdam.de
- Ventimola GmbH & Co. Dämmtechnik KG www.ventimola.de
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- Università Cattolica del Sacro Cuore www.unicatt.it
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- KU Leuven www.kuleuven.be

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Multipurpose hemp for industrial bioproducts and biomass

Goal

- Development of an **integrated hemp-based biorefinery** in which improved feedstock is subject to efficient and modular processing steps
  - to provide fibre, oil, construction materials, fine chemicals and biofuels using all components of the harvested biomass
  - to generate new opportunities within the developing knowledge based bioeconomy

The economic and environmental implications of each innovation will be assessed so as to maximise economic return and increase sustainability.

→ **WP 7 - Economic / Environmental assessment** (WP-leader: nova)

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Background

- **Pre-study within the MultiHemp project (WP7)**
- **Usage of natural fibres**
  - in biocomposites, mainly for the automotive sector
  - as insulation material
- **The environmental impacts of different natural fibres are not easily compared.**

Objective and scope

- **Objective**
  - Compare the Carbon Footprint of the four most important natural fibres used in the automotive and insulation industry:

flax

Flax *(Linum usitatissimum L.)* (Source: nova 2015)

hemp

Hemp *(Cannabis sativa L.)* (Source: nova 2015)

jute

Jute field (Source: Subrata Gupta 2015)

kenaf

Kenaf (Hibiscus cannabinus L.) (Source: nova 2015)

- **Scope**
  - Data acquisition (literature review, expert interviews)
  - Inventory and Impact Assessment
  - Further sustainability aspects

Approach

- **Functional unit**
  - one tonne of technical fibre for the production of non-wovens

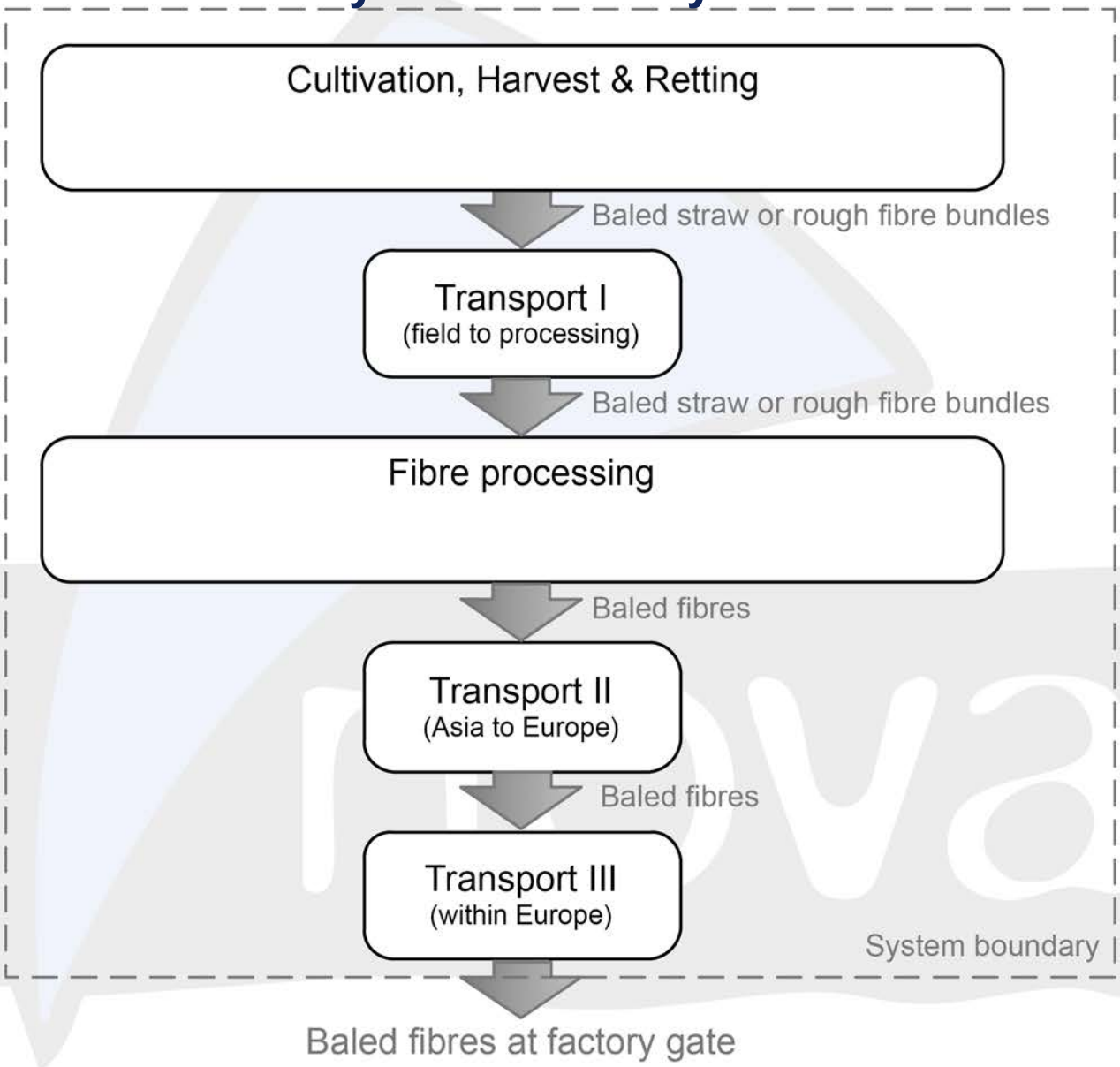
- **System boundaries**
  - “cradle-to-gate” approach
  - from the cultivation of natural fibres at farm level to the factory gate of the non-woven producer
  - Geographical coverage:

    Hemp and flax cultivation and production in Europe

    Jute and kenaf cultivation and production in India as well as the transportation from India to the European non-woven-producer

- **Allocation procedure**
  - Mass allocation

System boundary



Retting

- The traditional methods for separating bast fibres are by dew and water retting.
- **Retting (field and water retting) has not been investigated in any LCA-studies for natural fibres so far.**
- **Water retting:**
  - Consumes large amounts of water
  - Causes pollution of surface waters
  - Wastewater: Organic degradation products of decomposting plant tissues and accumulation of microbial biomass are not considered toxic, but the process causes oxygen depletion and foul smell emission
  - The practice of water retting could be a concern in terms of working conditions.

Impact category

- Global Warming Potential (GWP) expressed in **CO_2 equivalents** (CO_2-eq)
- The **characterisation factors** are based on the **default values by the IPCC 2013** „Climate Change 2013. The Physical Science Basis. Working Group I contribution to the Fifth Assessment Report of the IPCC“ – timeframe 100 years.

Life cycle inventory parameter	Characterisation factor
Carbon dioxide fossil	1
Nitrous oxide	265
Methane	28

Results

Greenhouse gas emissions per tonne fibre of

flax

Flax *(Linum usitatissimum L.)* (Source: nova 2015)

hemp

Hemp *(Cannabis sativa L.)* (Source: nova 2015)

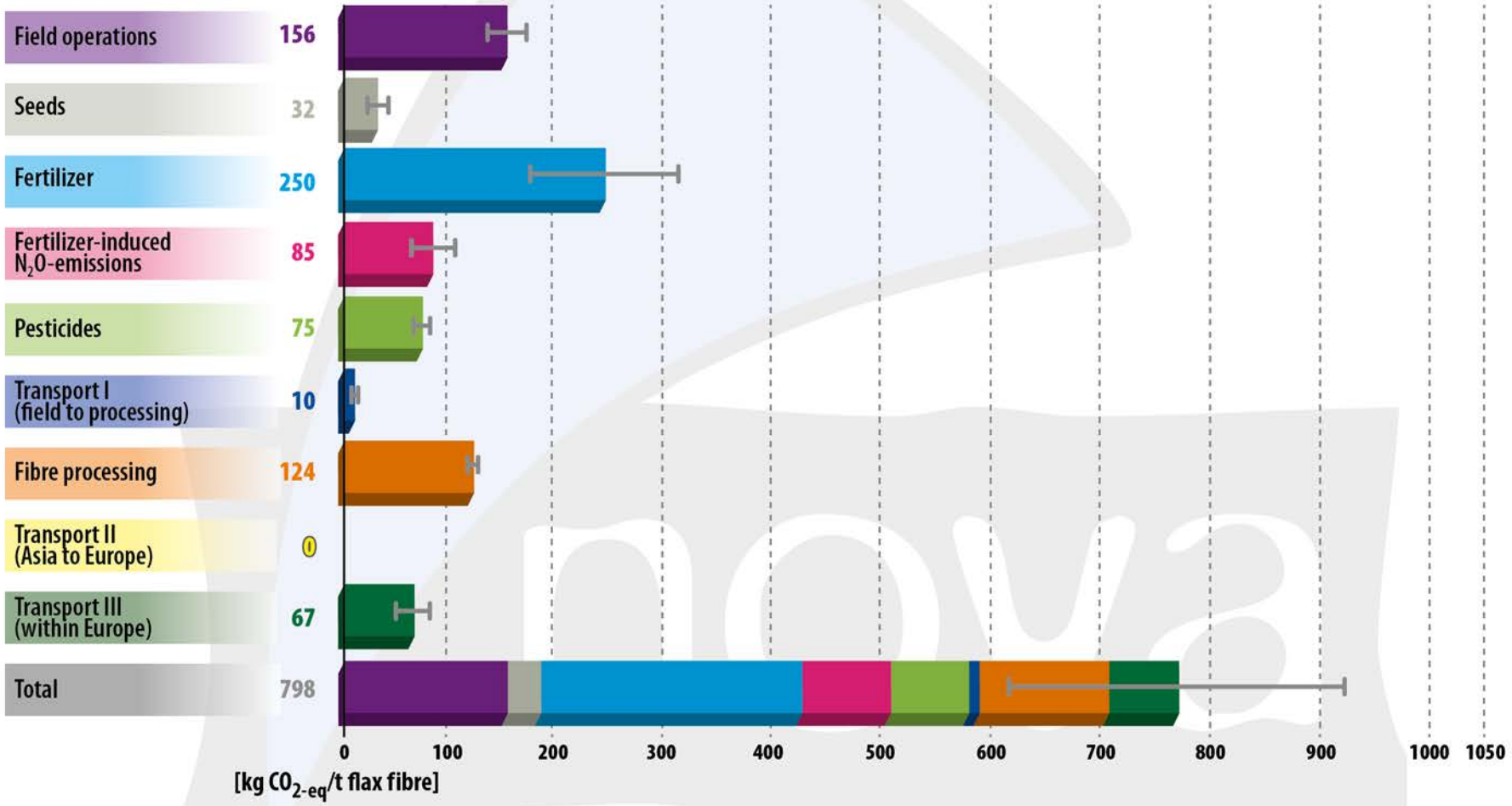
jute

Jute field (Source: Subrata Gupta 2015)

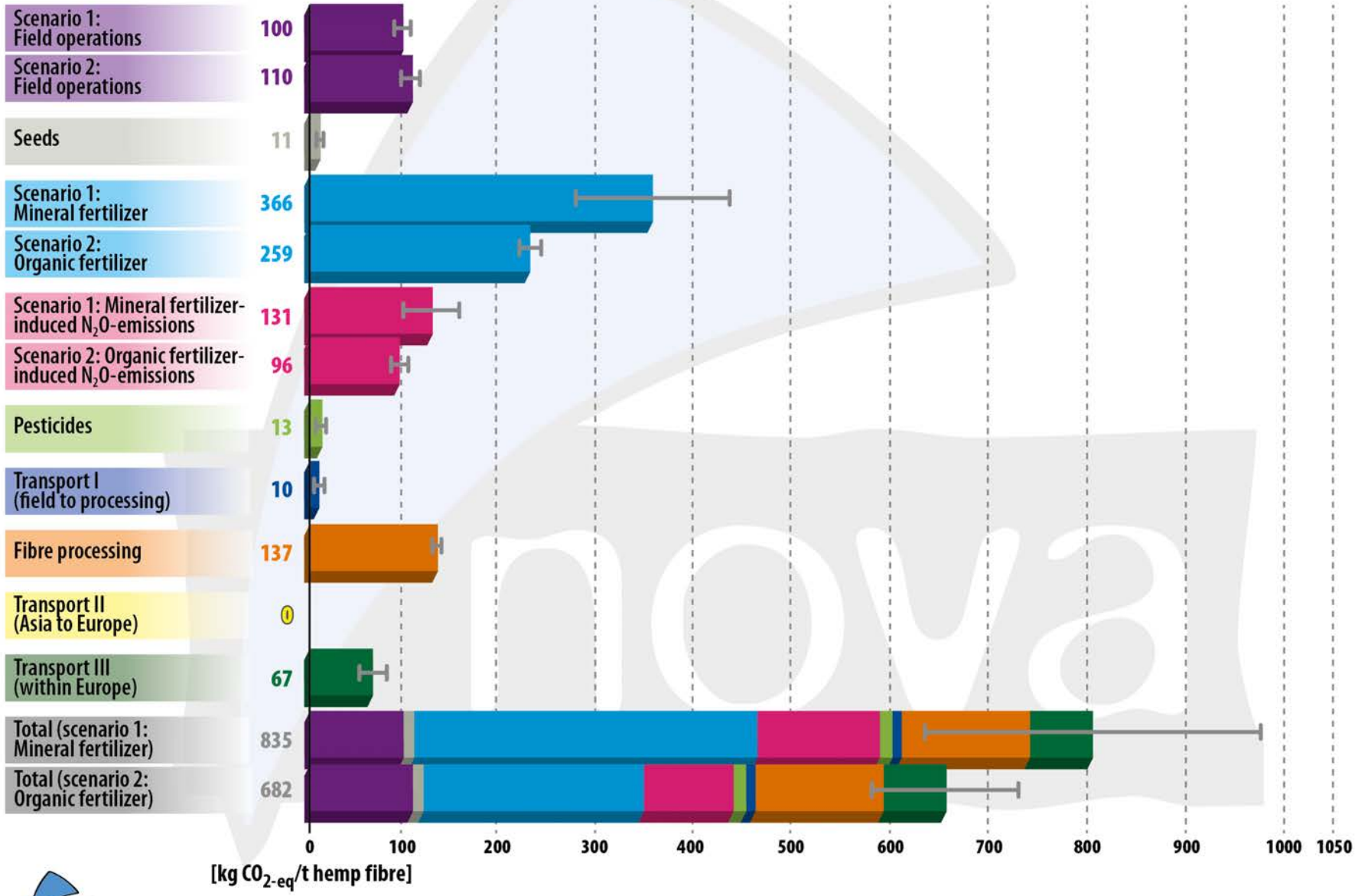
kenaf

Kenaf (Hibiscus cannabinus L.) (Source: nova 2015)

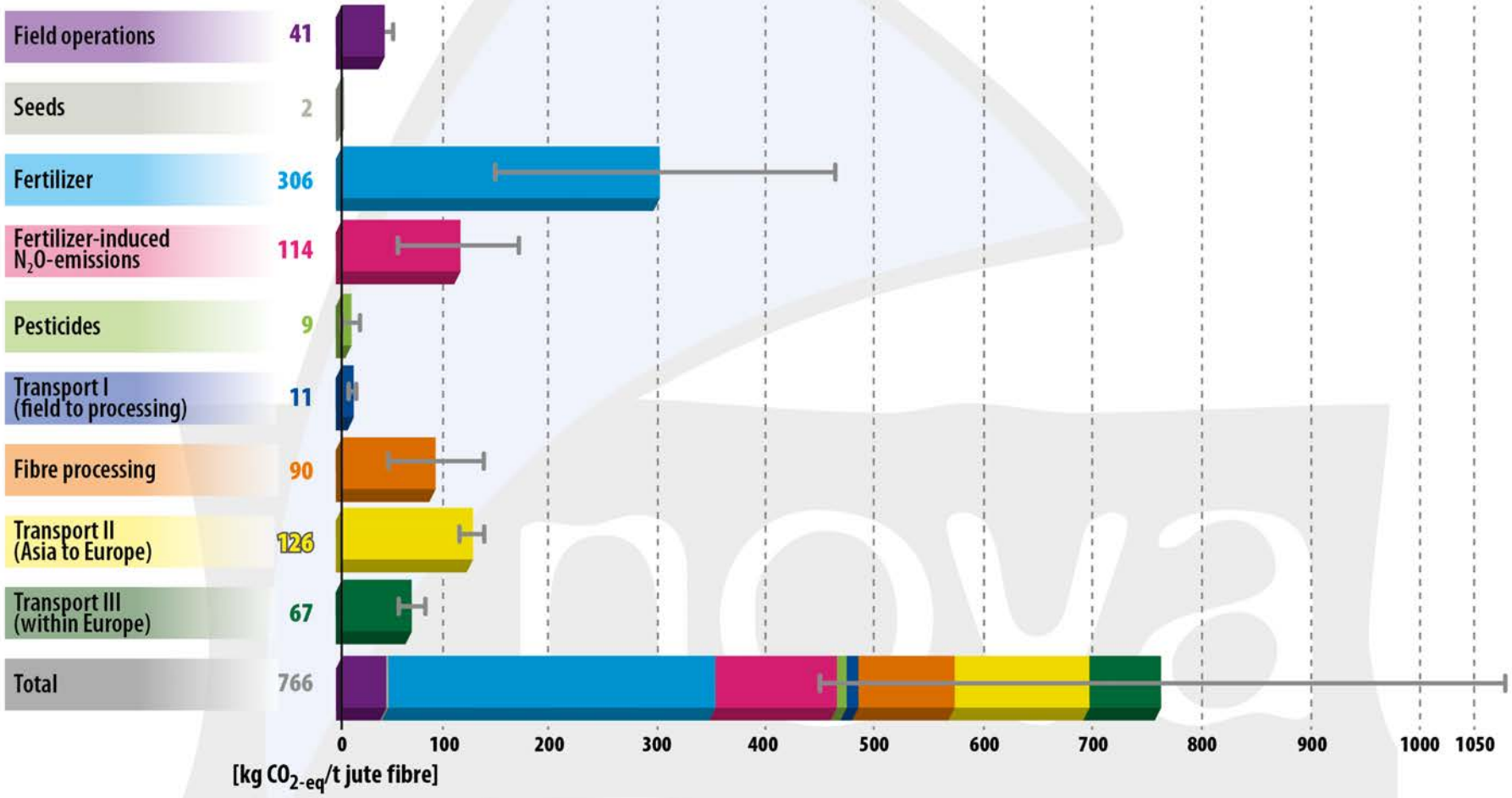
Greenhouse gas emissions per tonne flax fibre



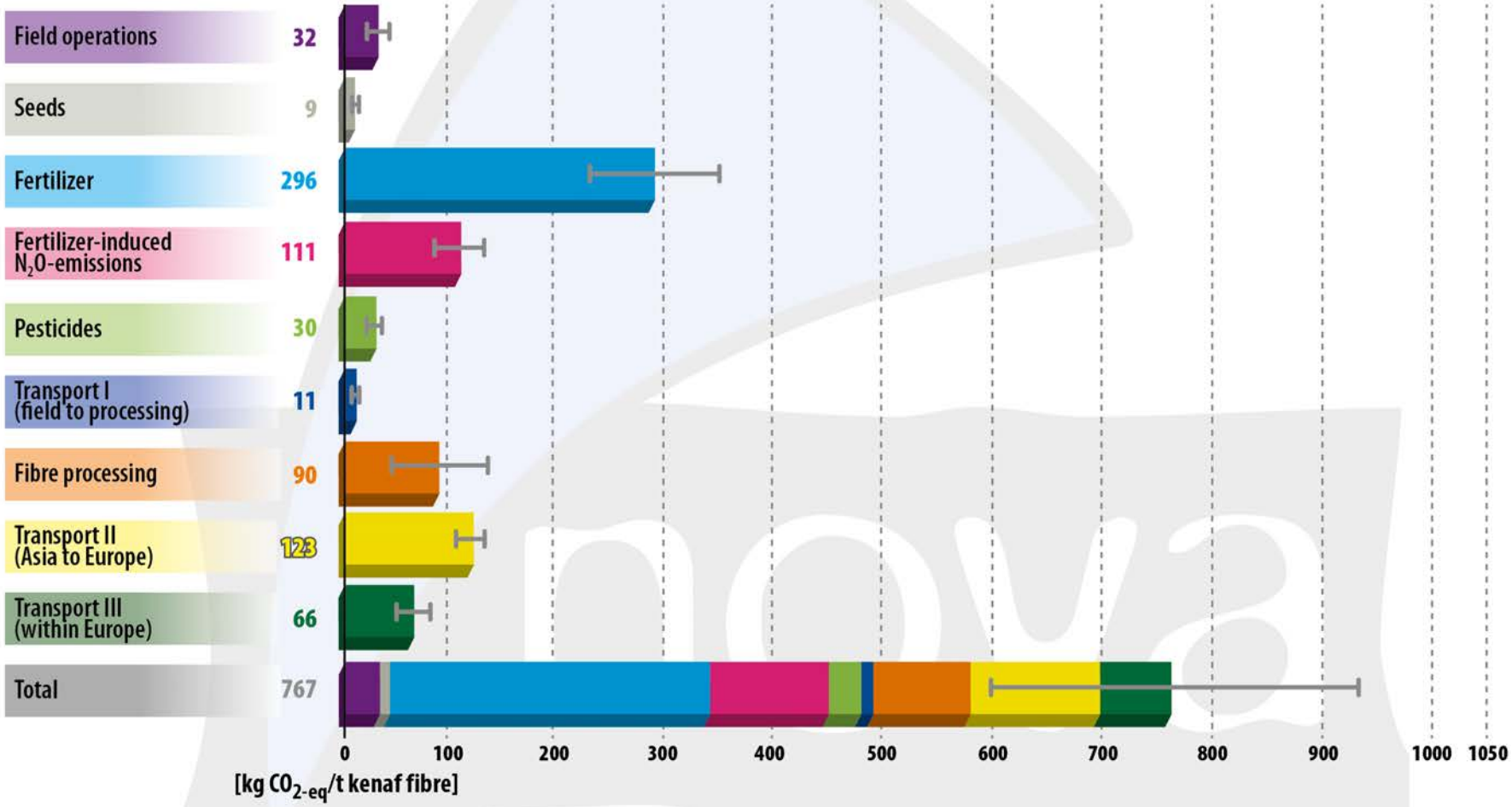
Greenhouse gas emissions per tonne hemp fibre



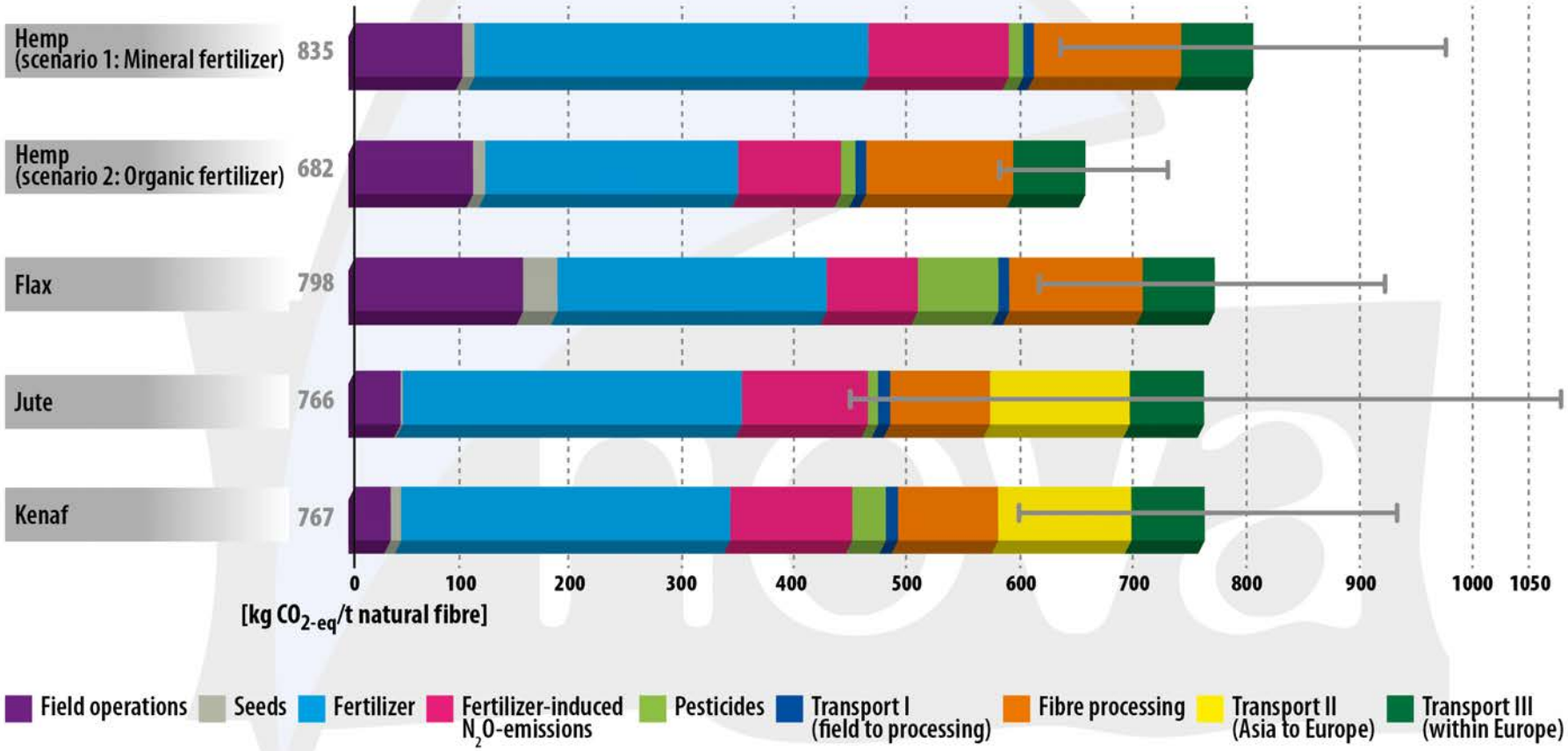
Greenhouse gas emissions per tonne jute fibre



Greenhouse gas emissions per tonne kenaf fibre



Comparison of the greenhouse gas emissions per tonne natural fibre



Discussion

Comparison with fossil based fibres

Greenhouse gas emissions

production of 1 tonne of continuous filament glass fibre products (CFGF):

average impact of 1.7 tonnes $CO_{2\text{-eq}}$ [PwC 2012]

production of 1 tonne of glass fibre:

average impact of 2.2 tonnes $CO_{2\text{-eq}}$ [Ecoinvent 3]

production of 1 tonne of natural fibres (e.g. flax, hemp, kenaf, jute; from cultivation to fibre factory exit gate, excluding transport to the customer):

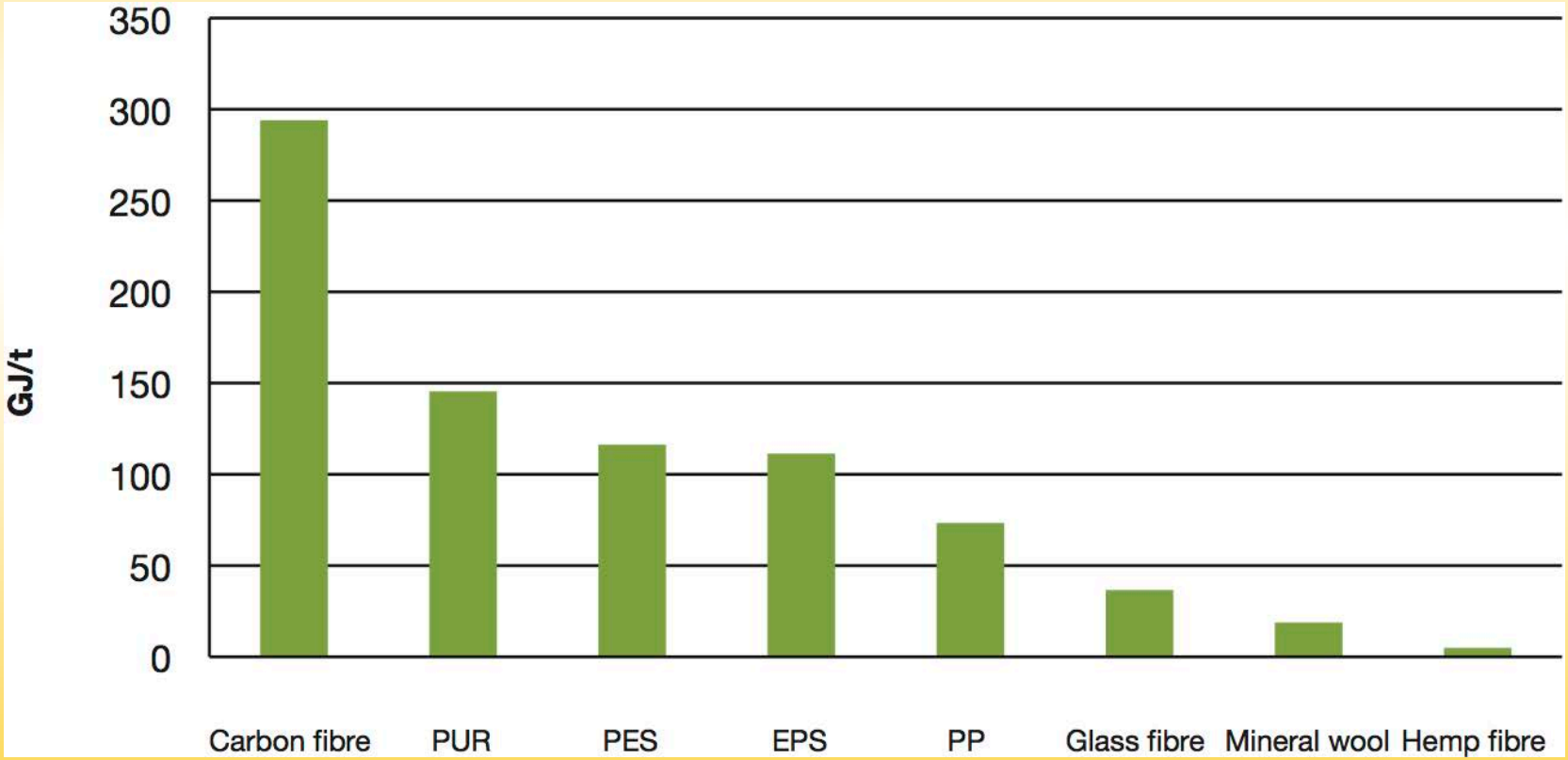
impact of 0.5–0.7 tonnes of $CO_{2\text{-eq}}$

→The impact on climate change from glass fibre production is approx. **three times higher** than the impact from natural fibre production.

Discussion

Comparison with fossil based fibres

Primary energy use of different materials



Further sustainability aspects of natural bast fibres

According to ISCC PLUS

Aspects for the biomass production:

① Not on land with high biodiversity value or high carbon stock

② Environmentally responsible way

③ Safe working conditions

④ Not violate human rights, labour rights or land rights

⑤ Compliance with all applicable regional and national laws and relevant international treaties

⑥ Good management practices

⑦ Greenhouse gas emissions

Outlook

- **Primary data collection**
  - from different locations, varieties, fertilizer use and various processes are collected right now within the European MultiHemp project for hemp as well as some specifics on kenaf

- **Retting**
  - experiments on field retting and water retting are planned within the MultiHemp project

Publication of the data

- available at

www.bio-based.eu/ecology

For further information on the MultiHemp project, please visit:

www.multihemp.eu

Thank you for your attention!

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