MultiHemp

Sustainability Implications of Hemp Value Chains

13th International Conference of the
European Industrial Hemp Association (EIHA)

Stephan Piotrowski, Martha Barth; nova-Institut GmbH
Wesseling, Germany, June 2nd, 2016

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Content

- Introduction to the FP7 project “MultiHemp”
- Database – Model assumptions
- Economic implications
- Ecological implications

MultiHemp

Multipurpose hemp for industrial bioproducts and biomass

Start: September 2012

End: February 2017

Total budget: 8 M€

EC contribution: 6 M€

Consortium:
22 Partners (13 SME) from 11 EU countries + China

FP7-Project number: 311849

www.multihemp.eu

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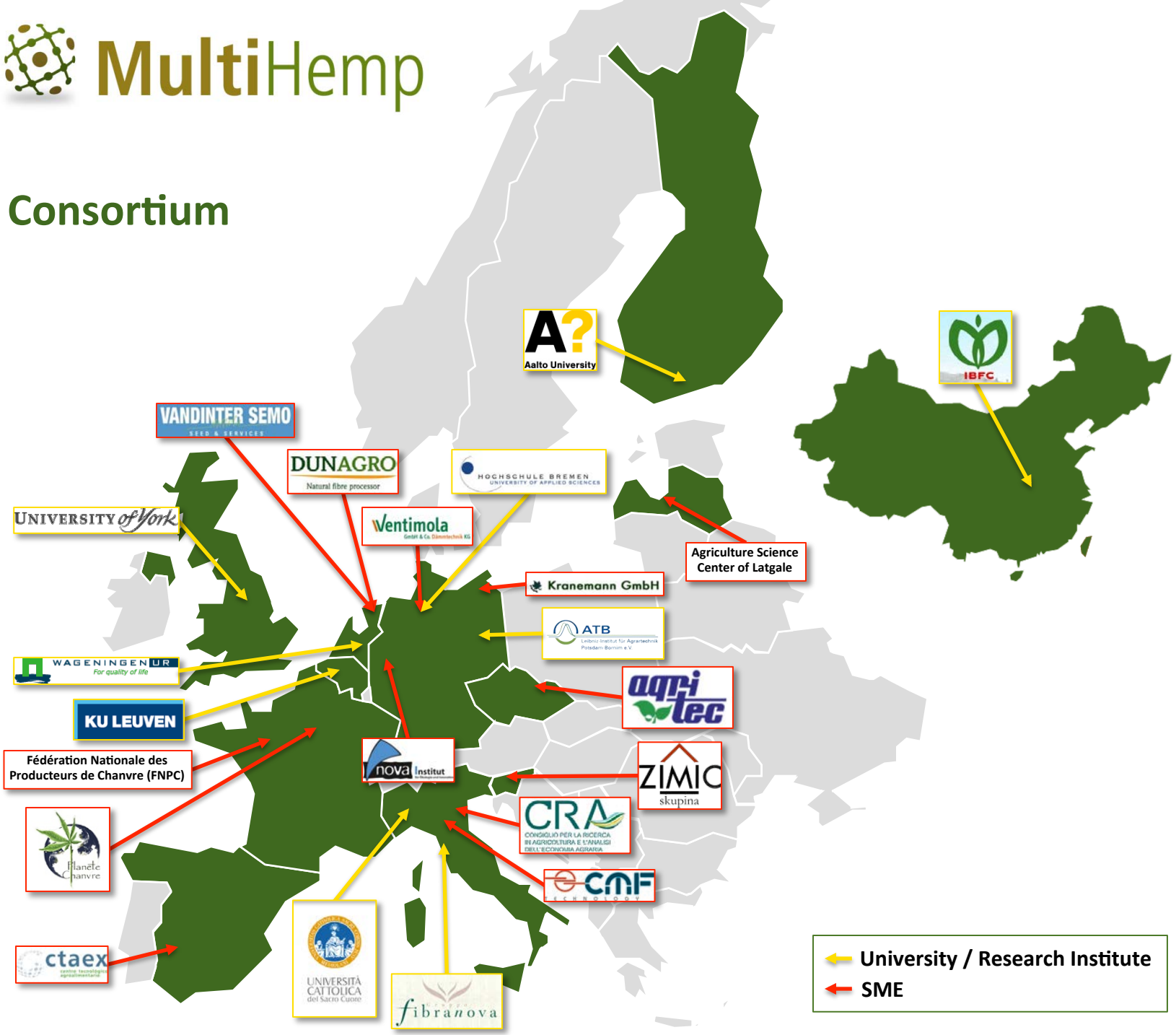
Consortium

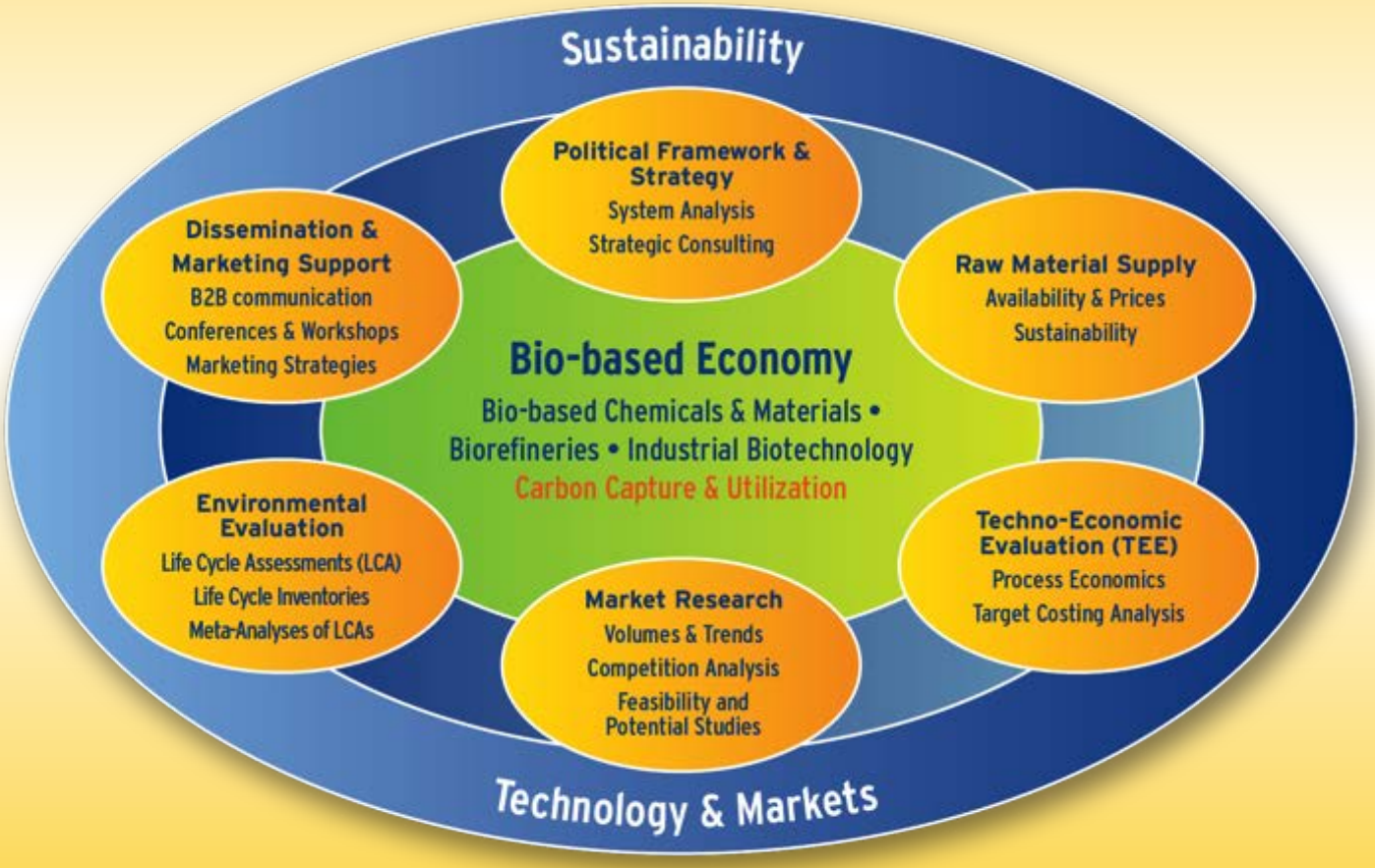


nova-Institut GmbH – SME

Founded in 1994 as a private and independent research institute
25 employees – interdisciplinary, international team

Revenue shares

- Research Projects
- Conferences & Dissemination
- Industrial & Political Consultancy



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Objective

Advance the scientific and technical research needed to consolidate and expand the market of hemp renewable materials

Specific objectives

- Understand the physiological and genetic basis of relevant hemp traits;
- Parameterisation and validation of a sophisticated crop model;
- Development of a high-throughput quality evaluation system;
- Genotypes with enhanced traits for diverse environments and use;
- Characterization of hemp varieties that are commercially available;
- Advances in agronomic practices;
- Design of a modular biorefinery, in which markets dictate the flow of raw material;
- **Integrated sustainability assessment with LCA & techno-economic evaluation;**
- Targeted dissemination and exploitation activities.

Hemp

A natural biorefinery

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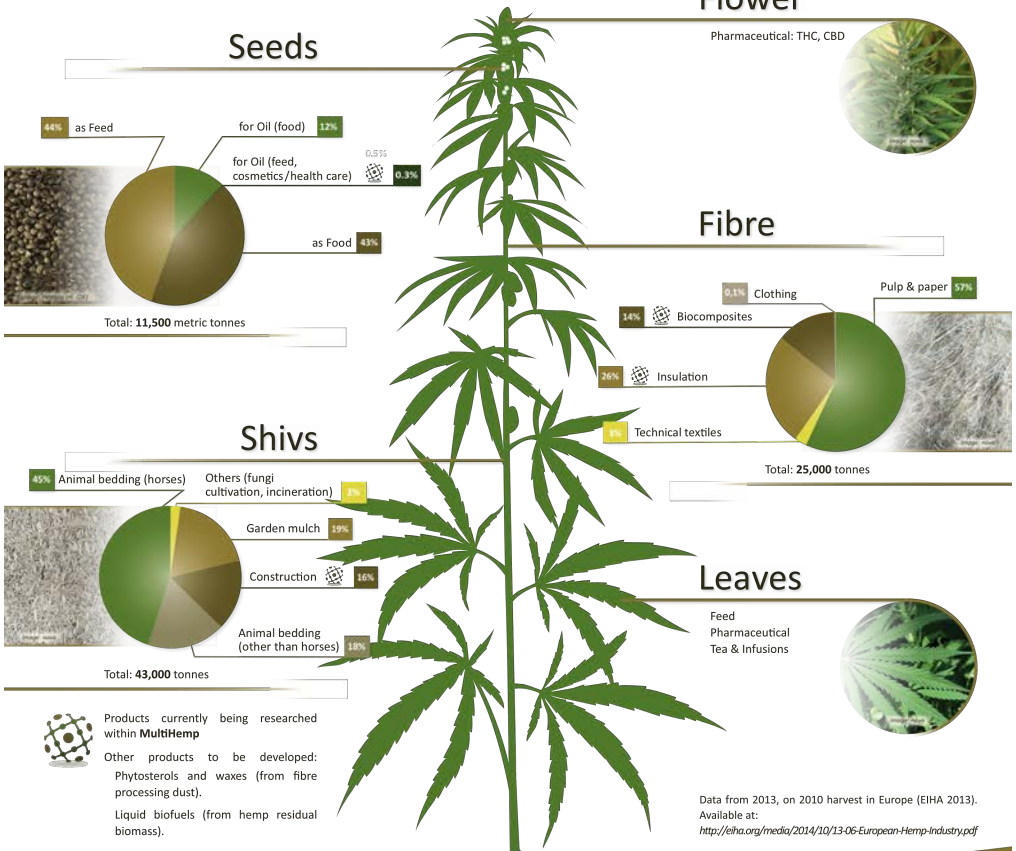

Products currently being researched within **MultiHemp**

Other products to be developed:

Phytosterols and waxes (from fibre processing dust).

Liquid biofuels (from hemp residual biomass).

Data from 2013, on 2010 harvest in Europe (EIHA 2013). Available at: *http://eiha.org/media/2014/10/13-06-European-Hemp-Industry.pdf*

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The MultiHemp project aims at developing hemp genotypes with enhanced traits suitable for diverse cultivation environments and to provide improved feedstock for a wide array of innovative end products generated within an integrated biorefinery. For more information, see **http://www.multihemp.eu.**

The MultiHemp project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No 311849.

Roots

Revitalise soil with nutrients.
Provide aeration of soils.

FIBRA

The main target of the FIBRA project is to link the research activities carried out in both the European Union and China on natural fibre crops, to provide a long term vision on future common research activities on fibre crops and to improve researchers' training opportunities. For more information, see **http://www.fibrafp7.net.**

The FIBRA project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 311965.

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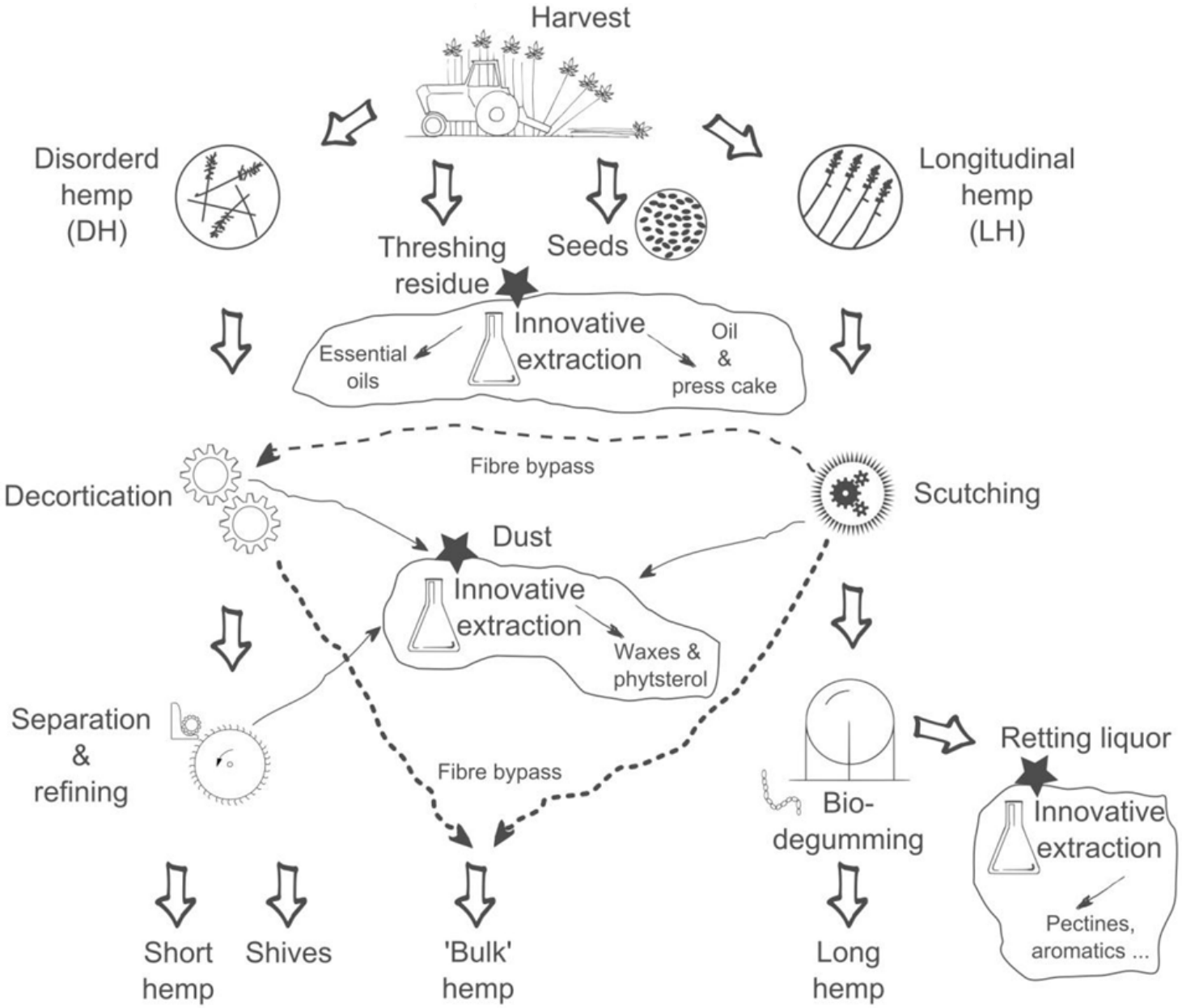
European Industrial Hemp Association

FIBRA

MultiHemp biorefinery concept



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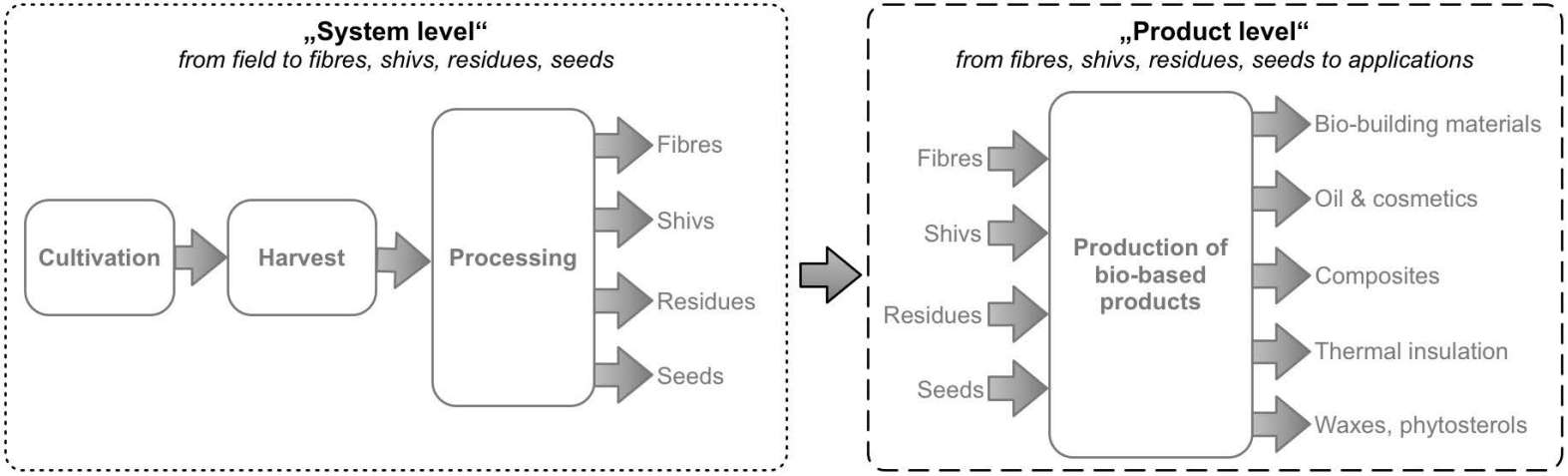
Database - Models



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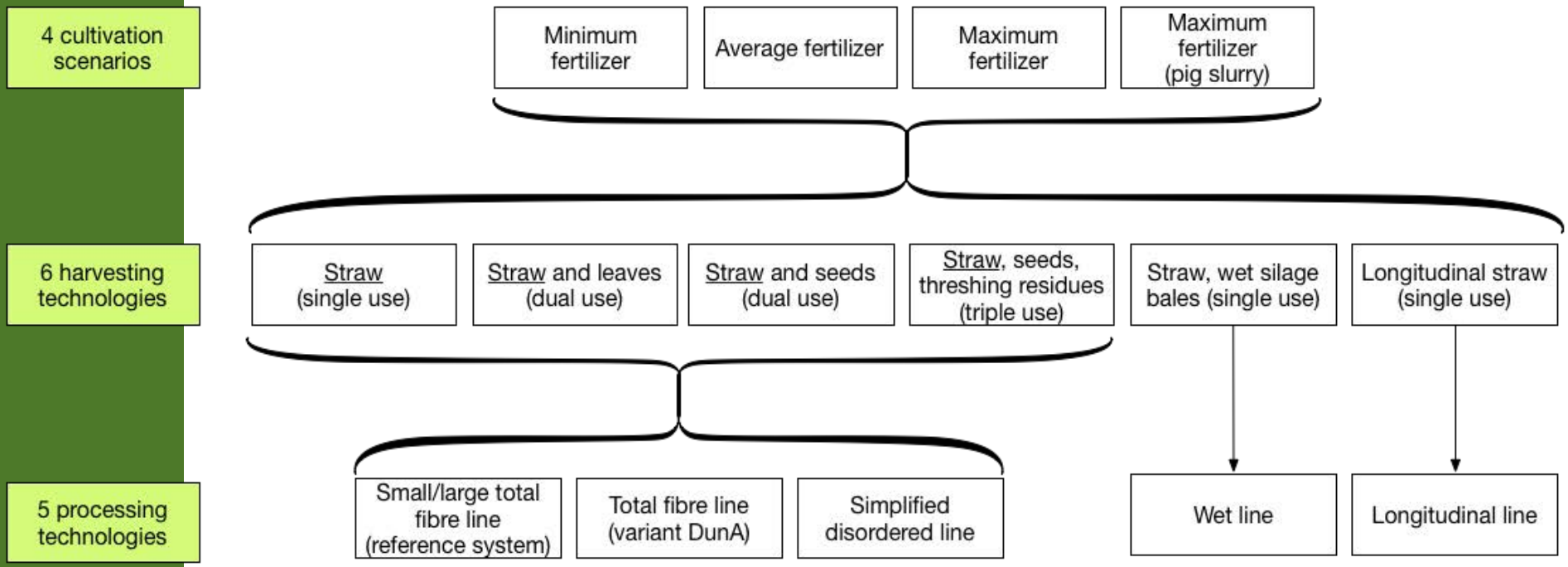

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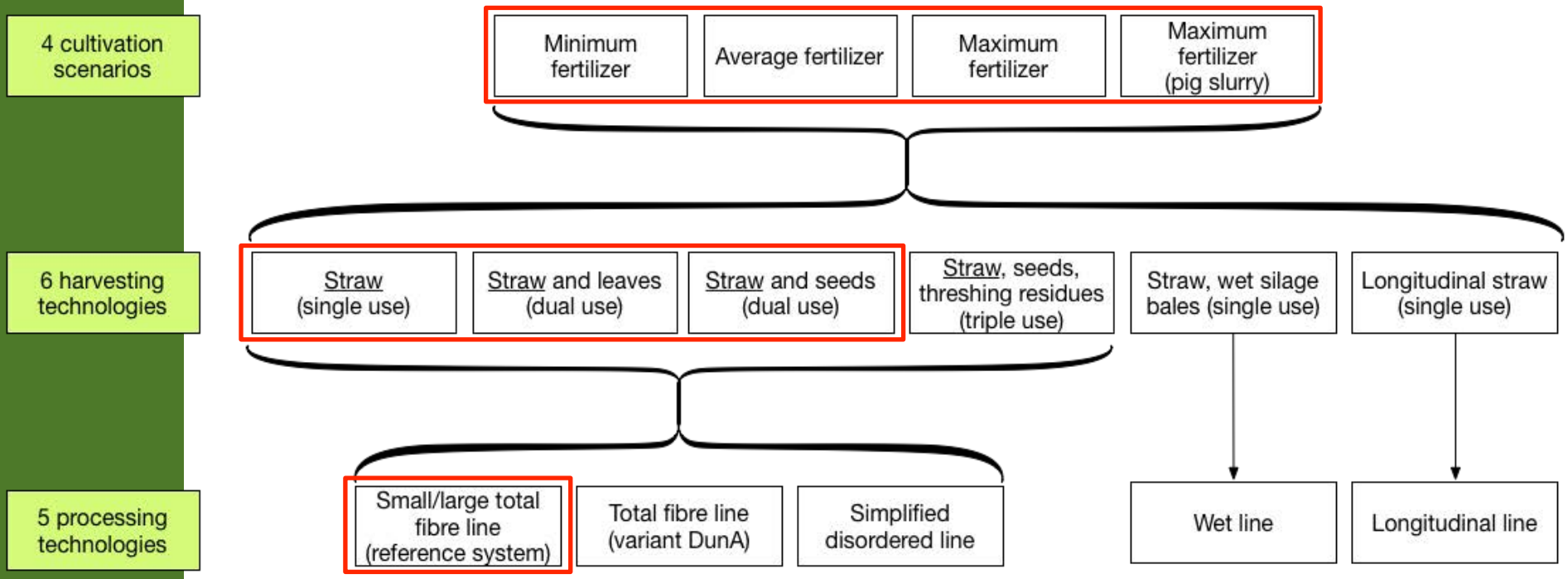
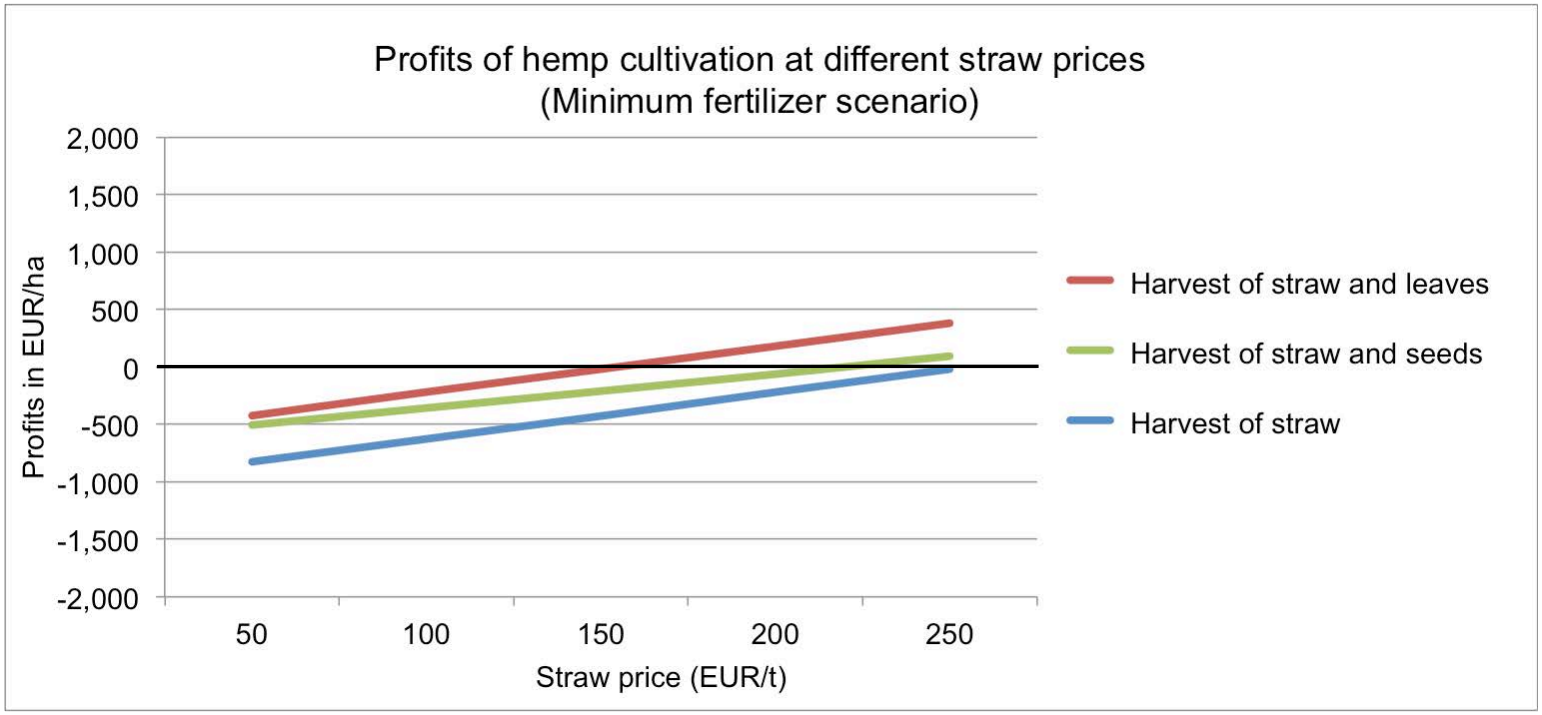


Economic implications

Preliminary results

- This figure shows the comparison of profits of the three harvesting systems at the four fertilizer/yield scenarios.
- As prices for the co-products, 400 EUR/t for leaves (assuming an actual valorisation of 10% of the yield of leaves) and 700 EUR/t for seeds were used.



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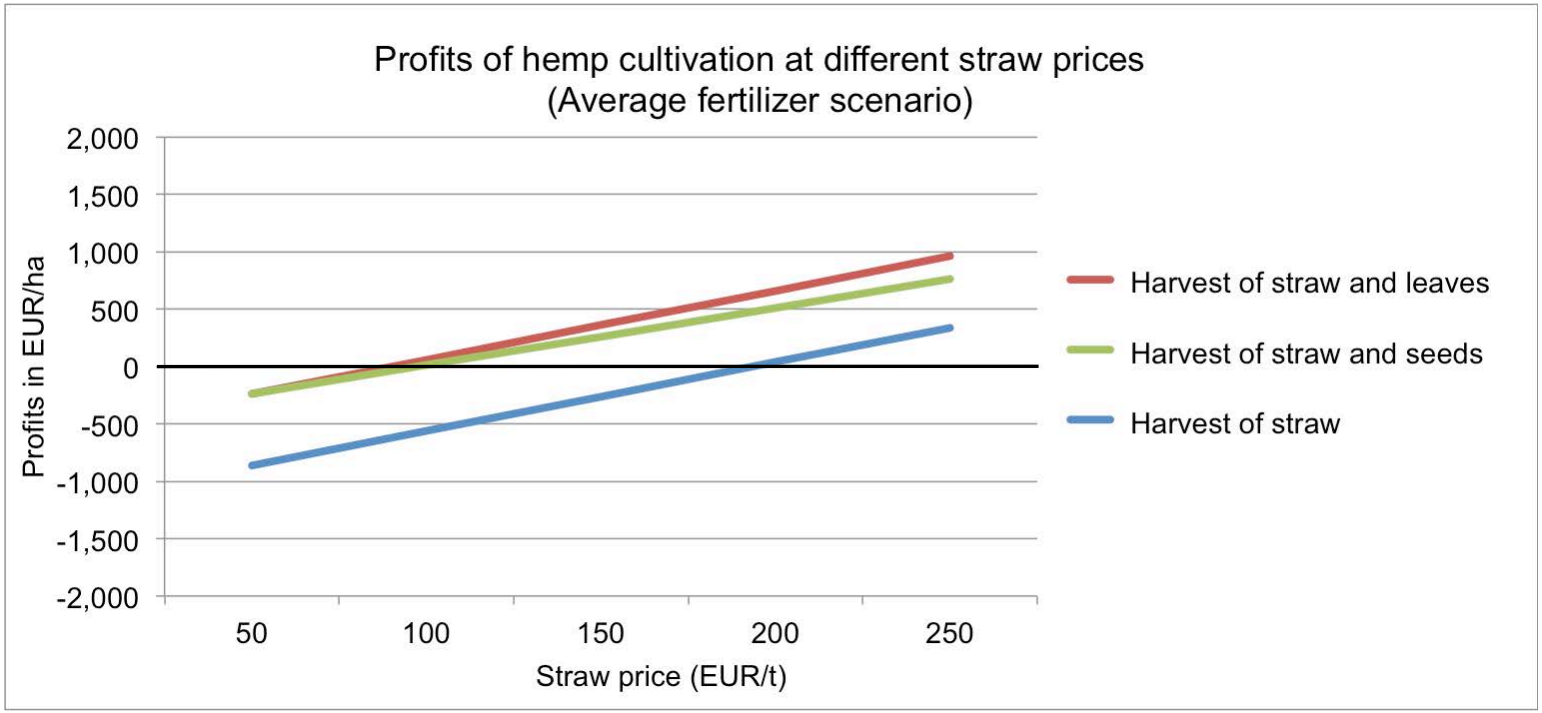

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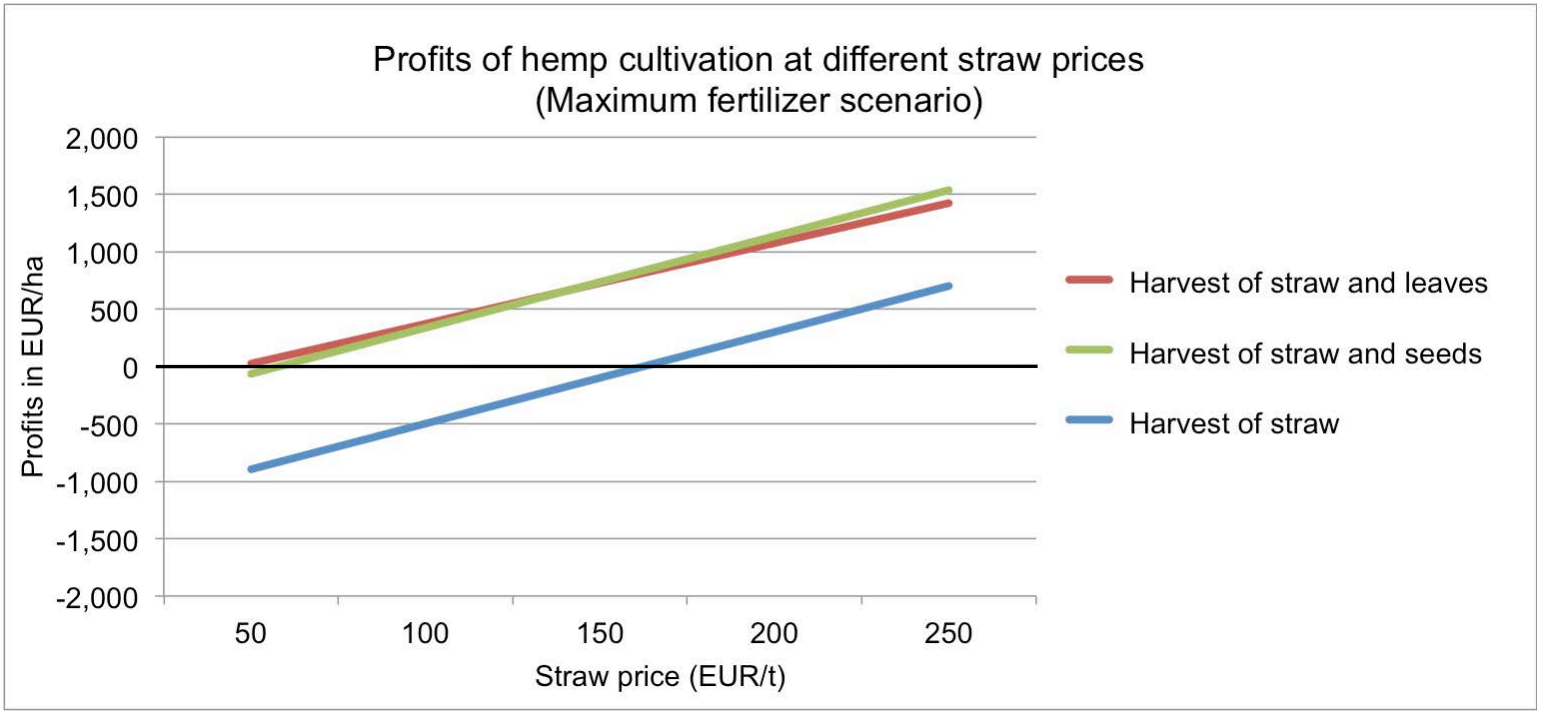

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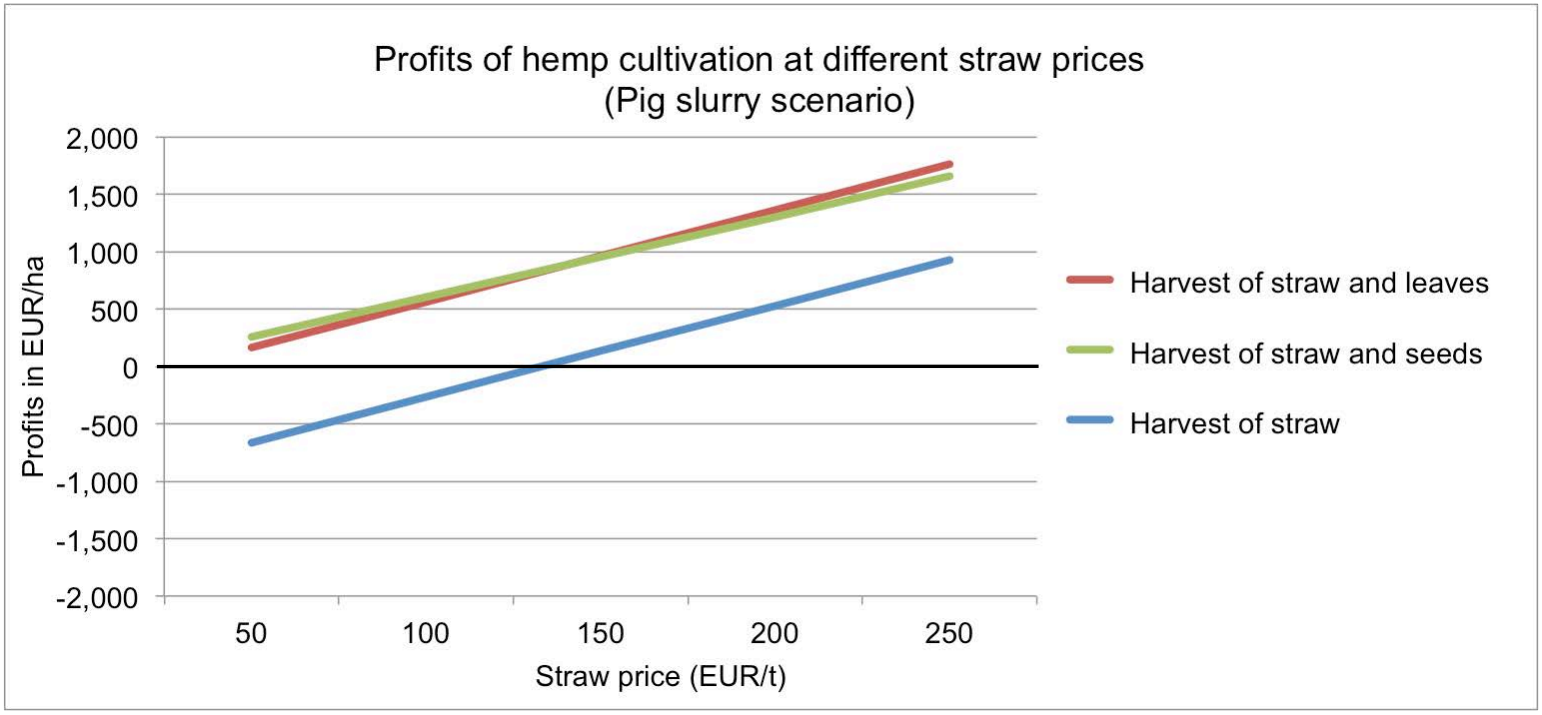

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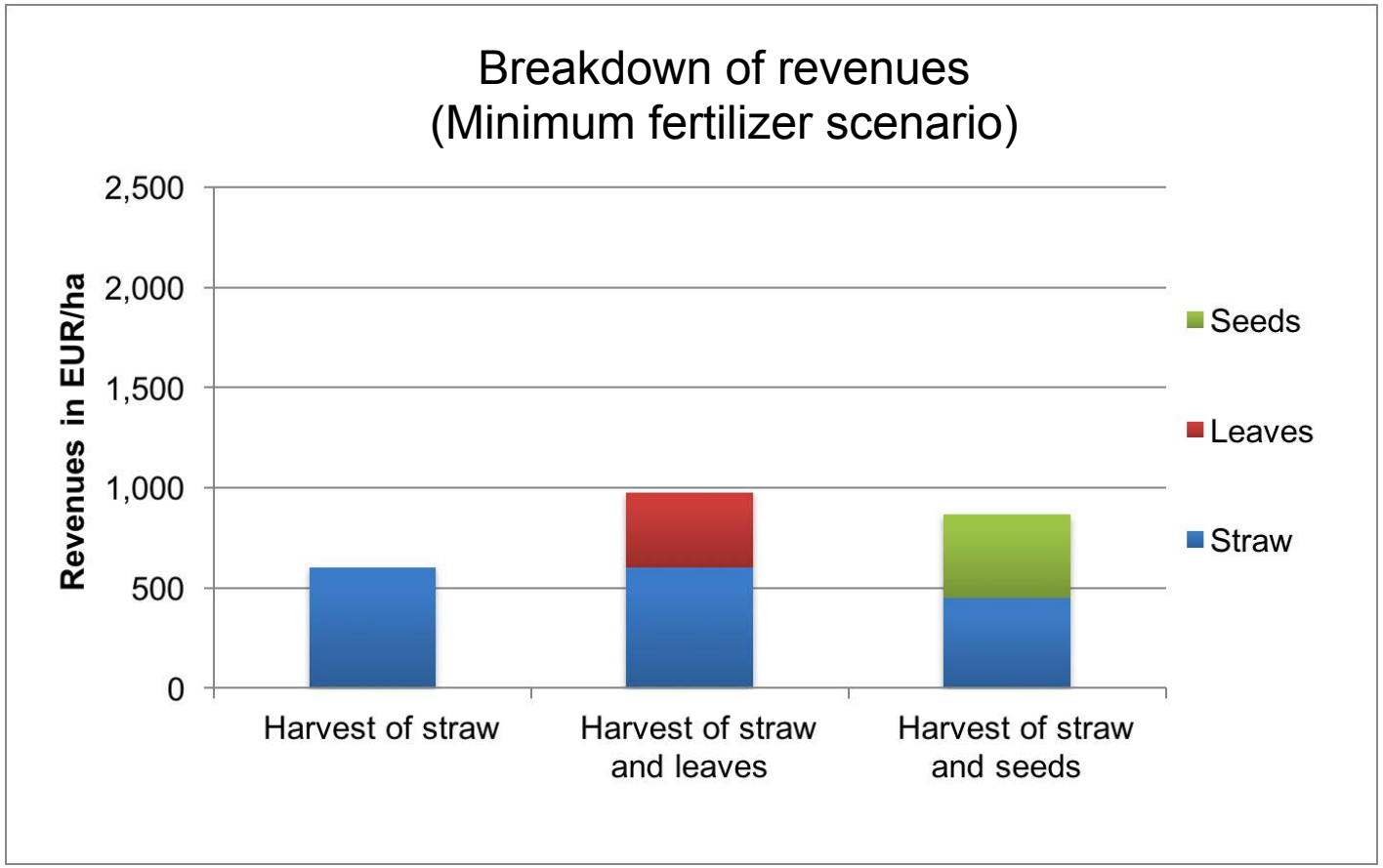

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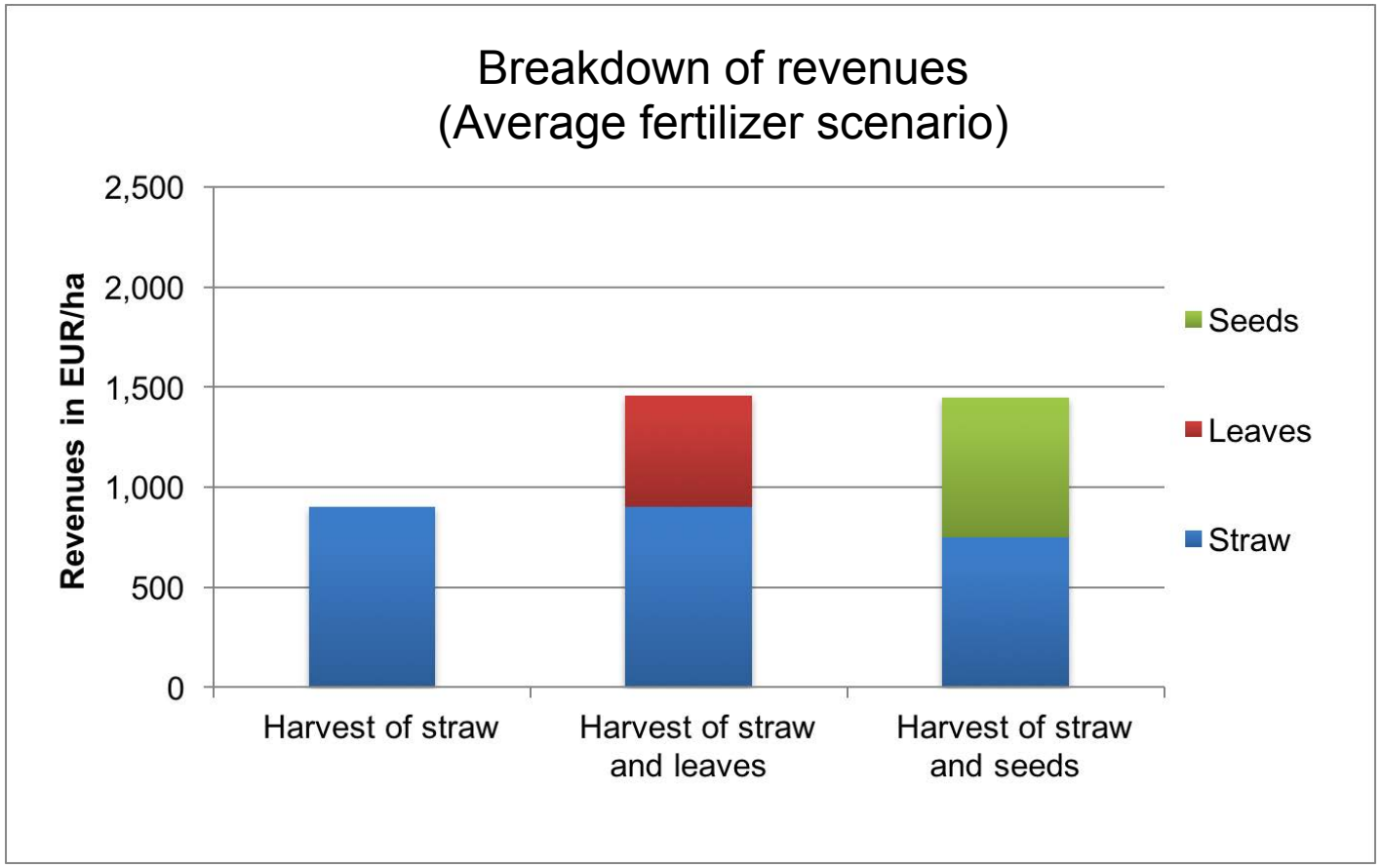

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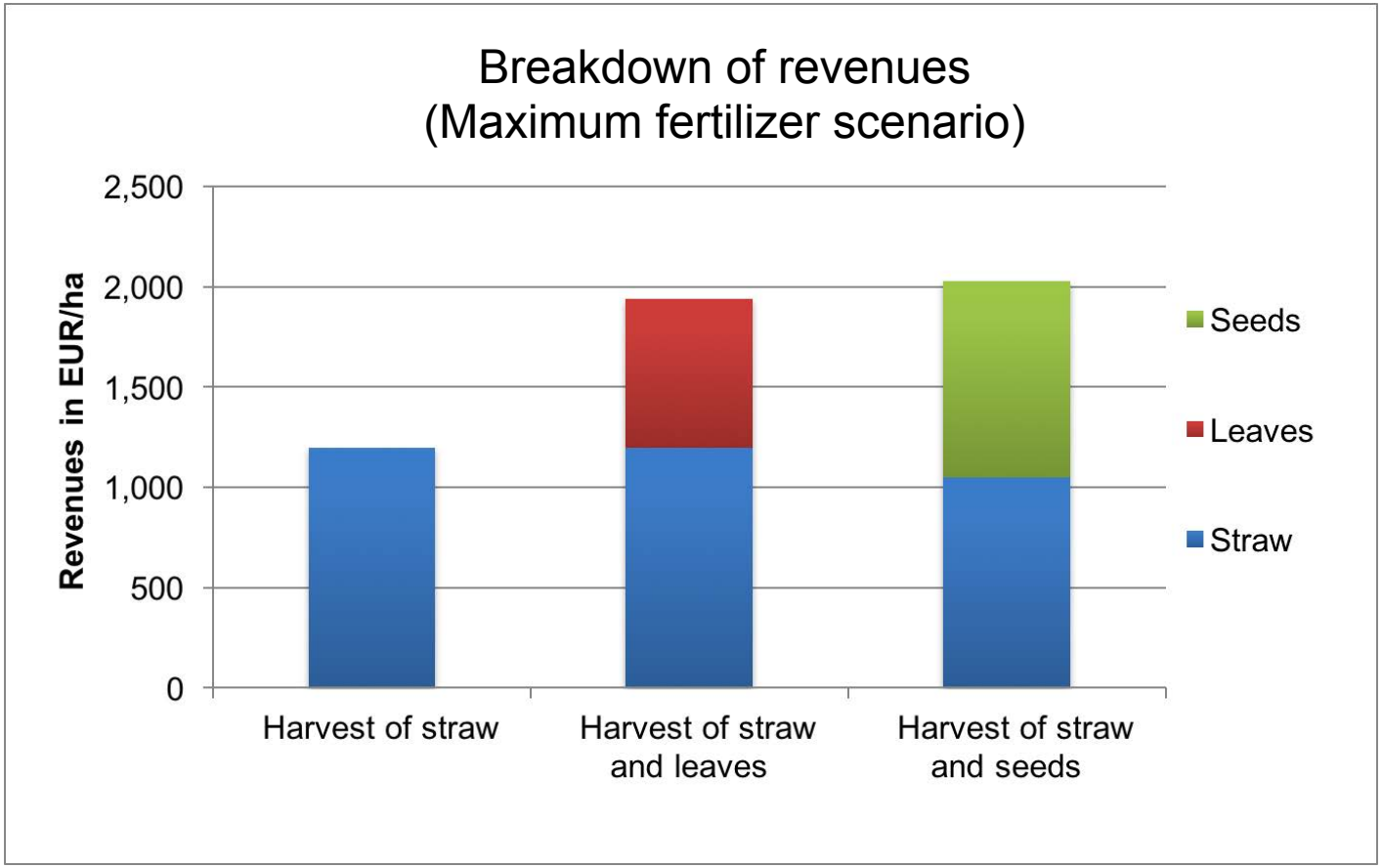
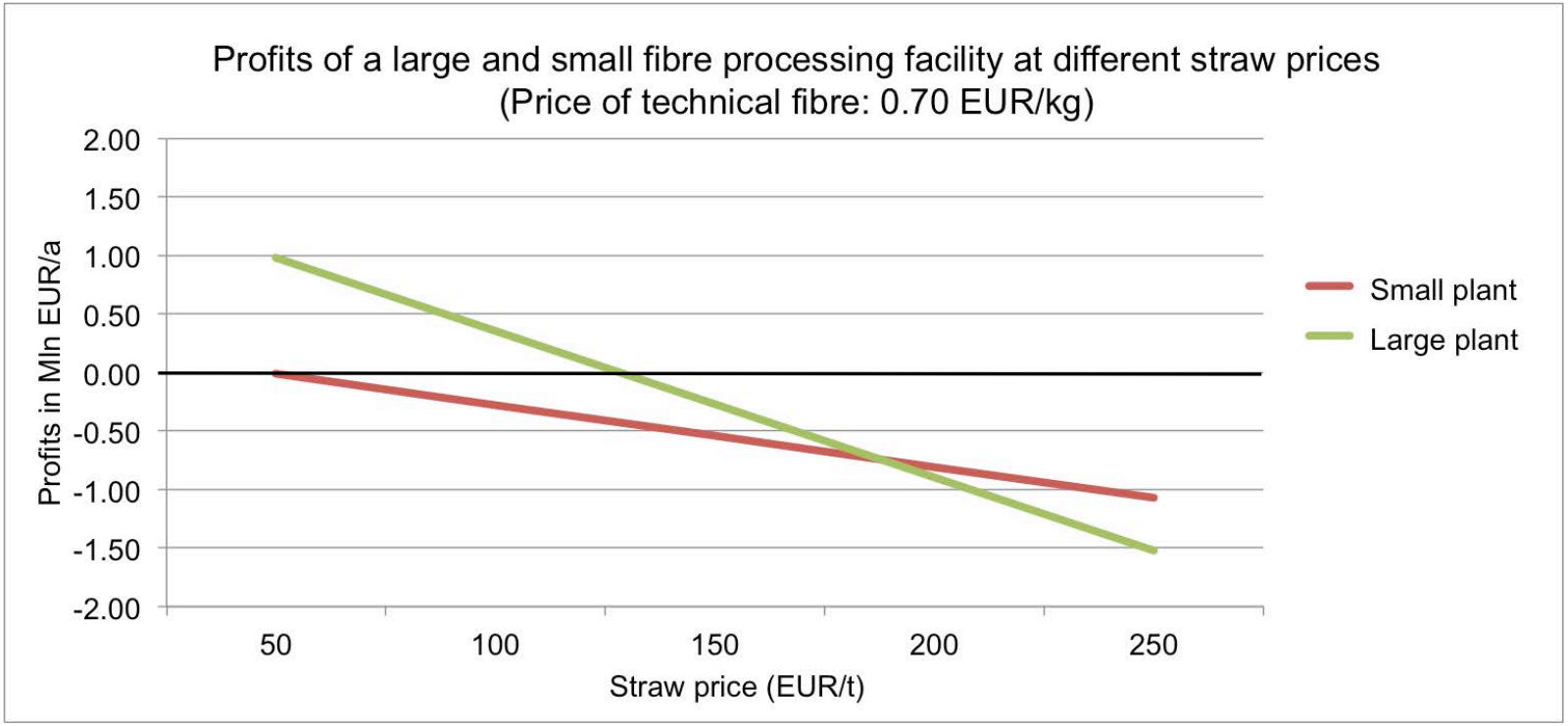


Preliminary results

- This figure shows the comparison of profits of a small (1.5 t/h) and large (4 t/h) total fibre line at different straw prices and prices for the technical fibre.



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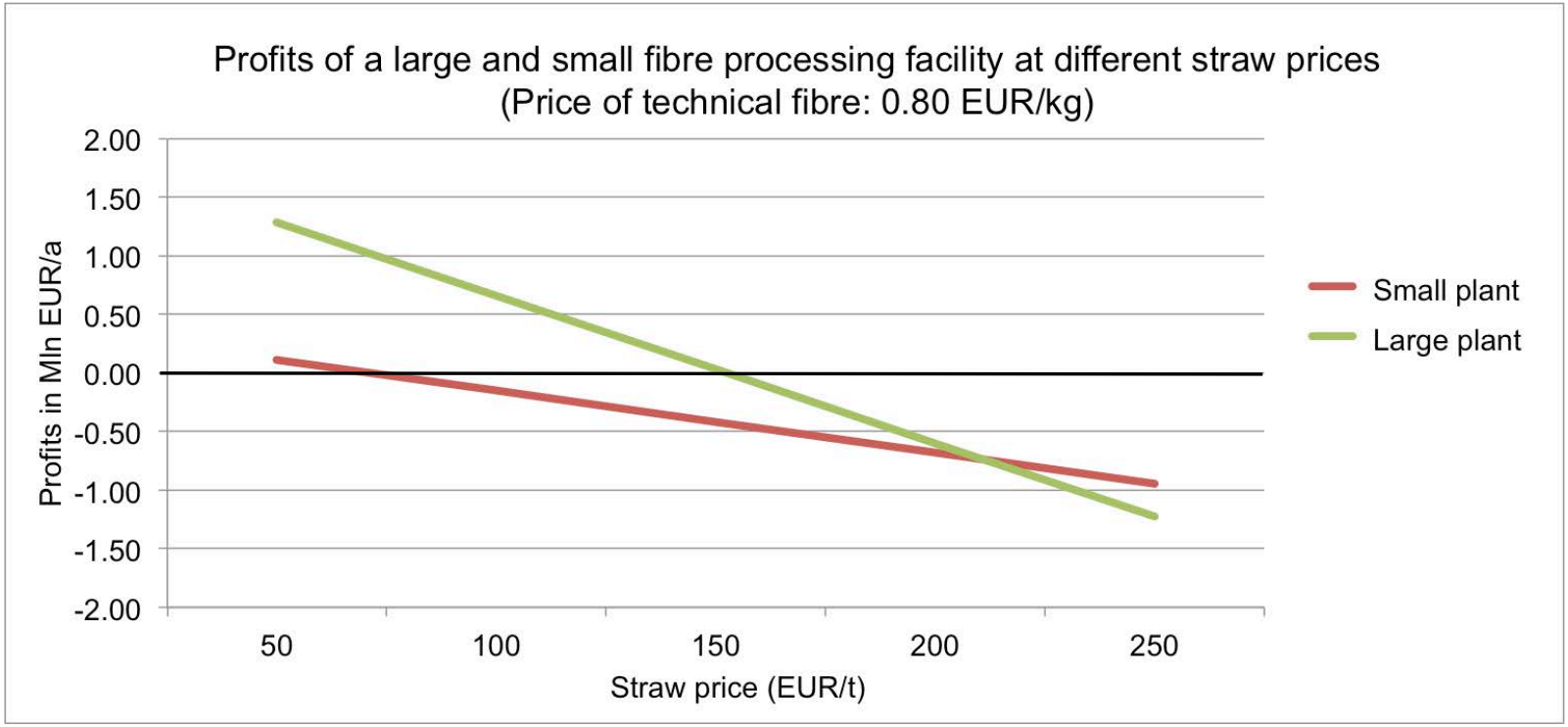

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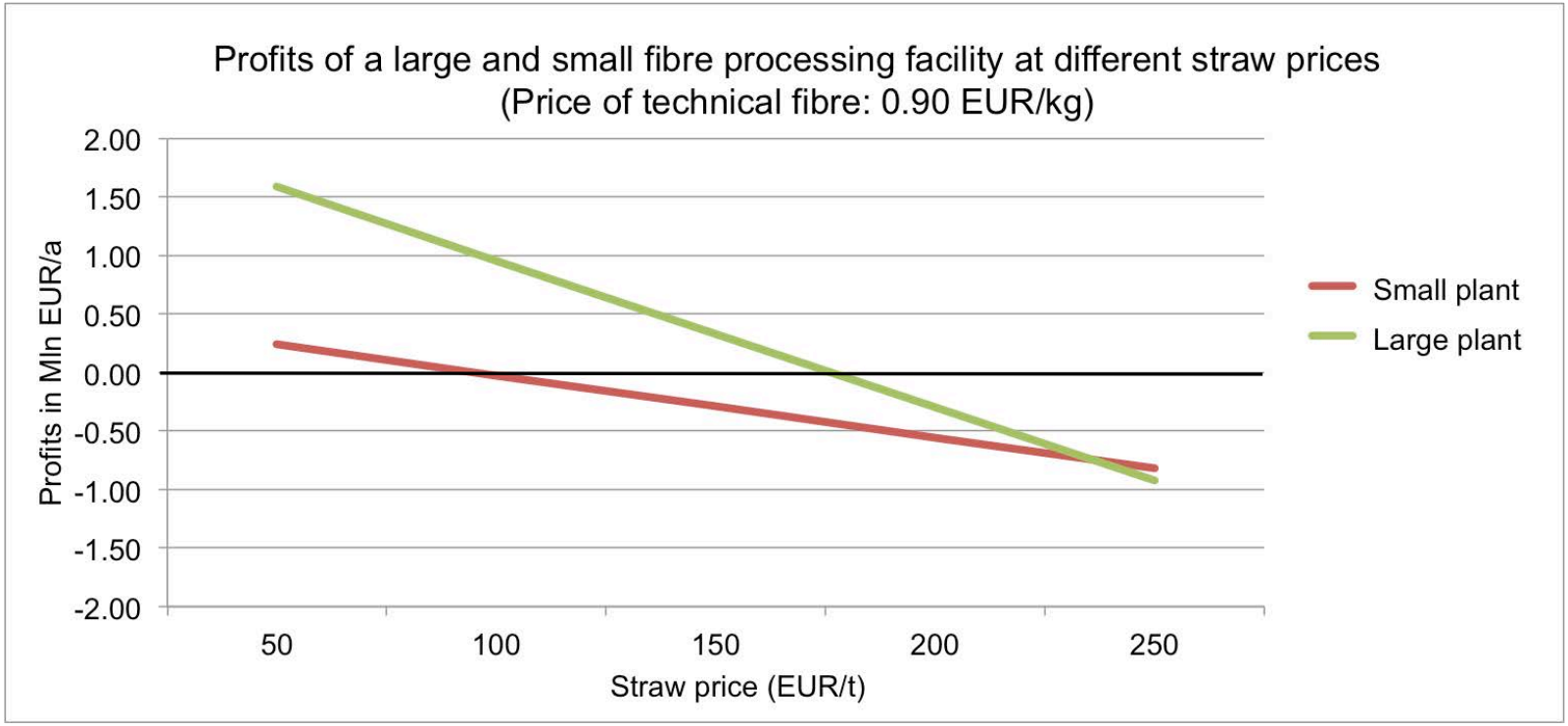

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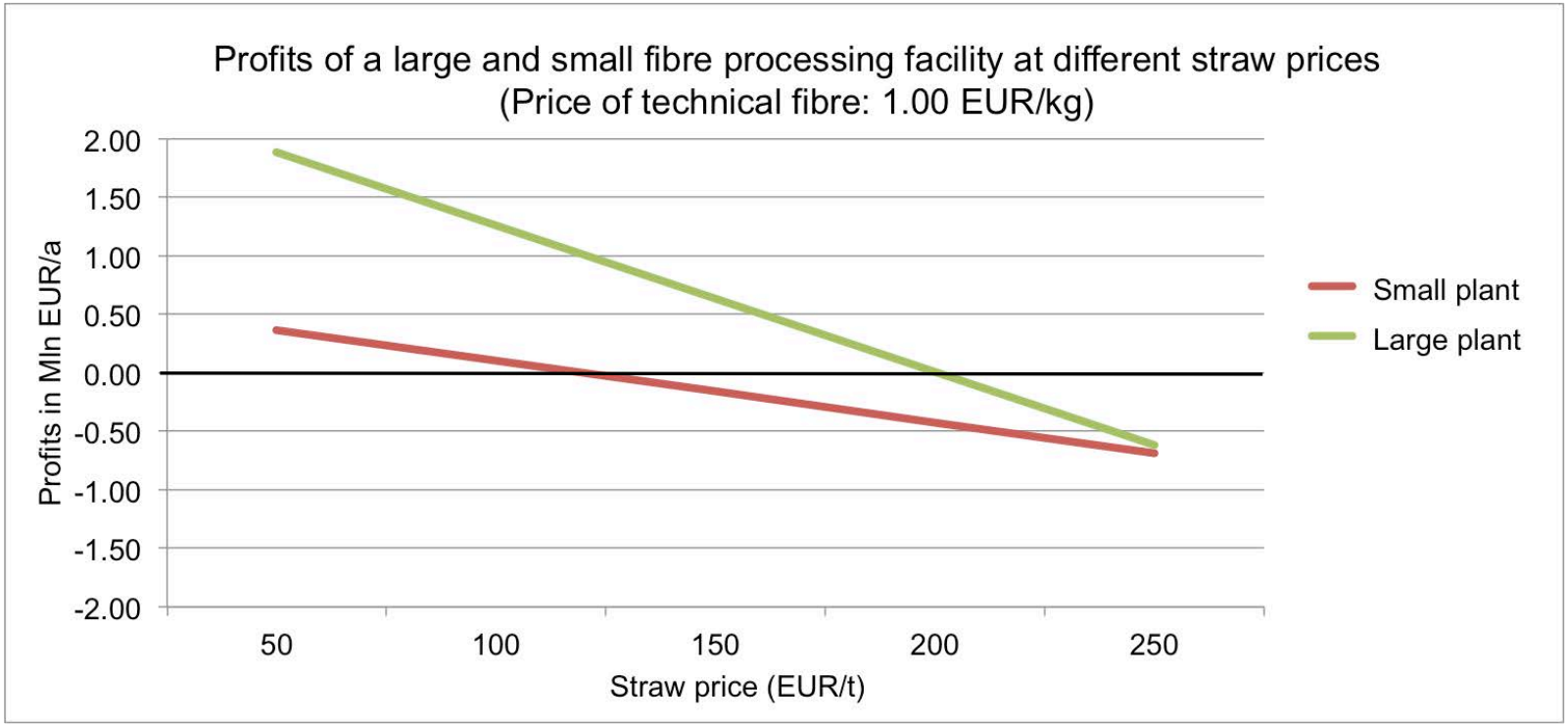

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Conclusions

- A dual use of either seeds or leaves significantly improves the economics of hemp cultivation.
- While both dual uses lead to similar results, the seed market is much more stable and predictable compared to the current market for leaves for CBD extraction.
- Larger fibre processing facilities are in general more profitable than smaller ones.
- Larger processing facilities are able to produce technical fibres at a competitive price of 0.80 EUR/kg (compared to prices for kenaf of about 1.30 EUR/kg and for flax of about 1 EUR/kg), given straw prices below 150 EUR/t.
- Such straw prices are likely to be achievable only in dual use systems.

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Ecological implications:

Global Warming of hemp based insulation material

(1) Objective, Scope and Approach

(2) Global Warming of hemp cultivation and processing

(3) Global Warming of hemp based insulation material

(4) Comparison with conventional counterparts

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(1) Objective, Scope and Approach

- Objective

  Global warming results from the hemp fibre processing and consequentially the usage of hemp fibres in thermal insulation

- Scope
  - Data acquisition (experimental data from partners, literature review, expert interviews)
  - Inventory and Impact Assessment for Global Warming
- Approach
  - “cradle-to-gate” approach for technical short fibres (hemp cultivation and processing)
  - “cradle-to-gate” approach for hemp fibre based thermal insulation

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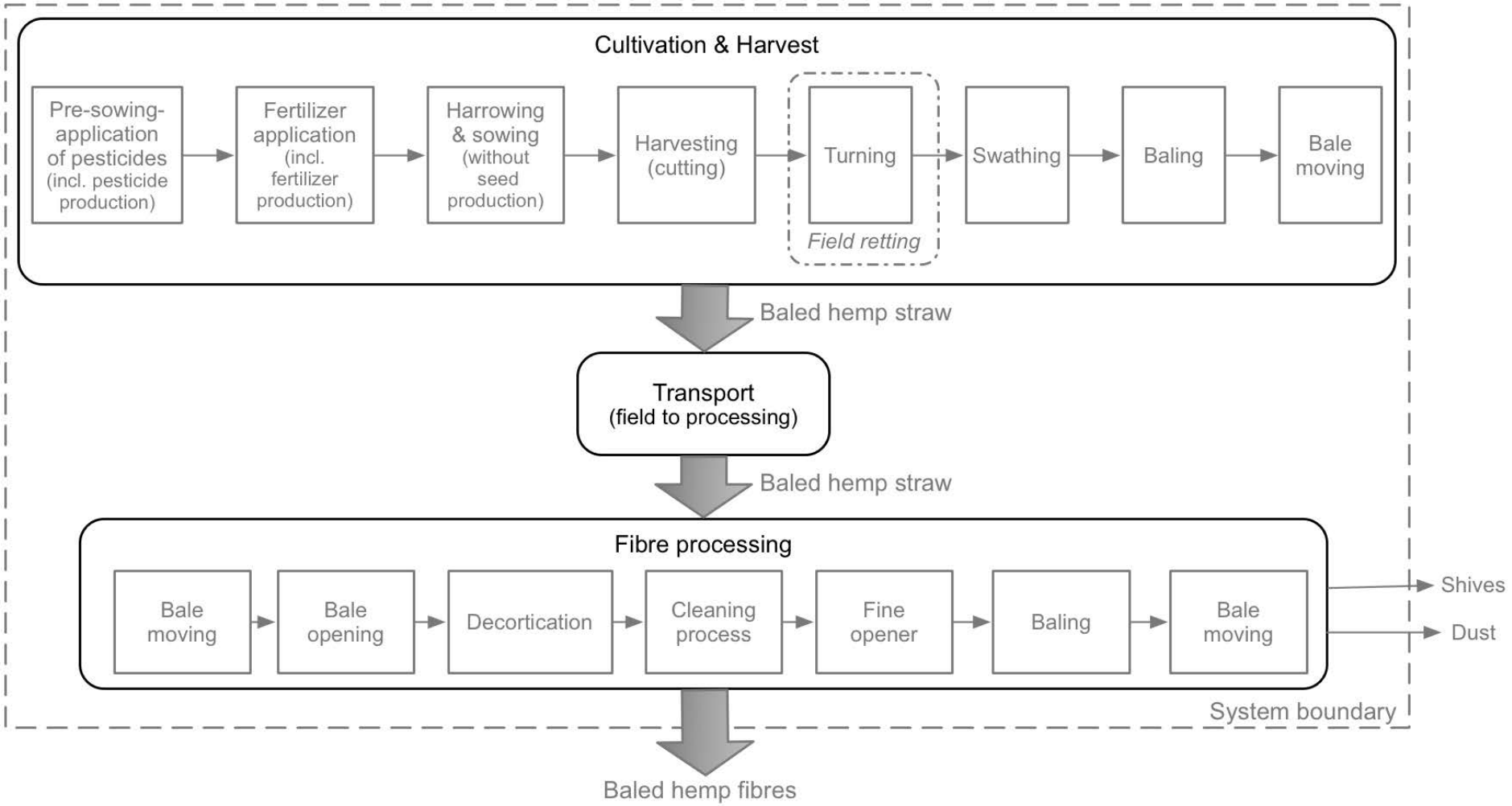
(2) Hemp cultivation and processing

"cradle-to-gate"



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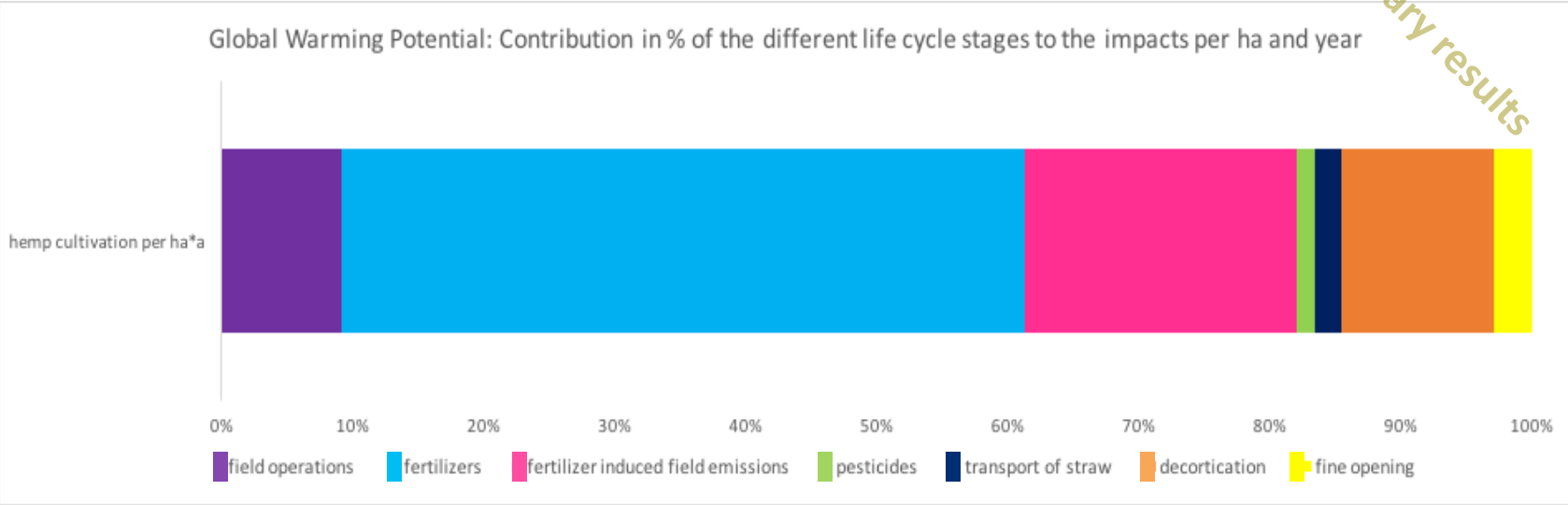
(2) Global Warming of hemp cultivation and processing

Results Global Warming “from field to fibre”

Preliminary results



Contribution in percent to the Global Warming per ha and year of hemp cultivation and hemp processing

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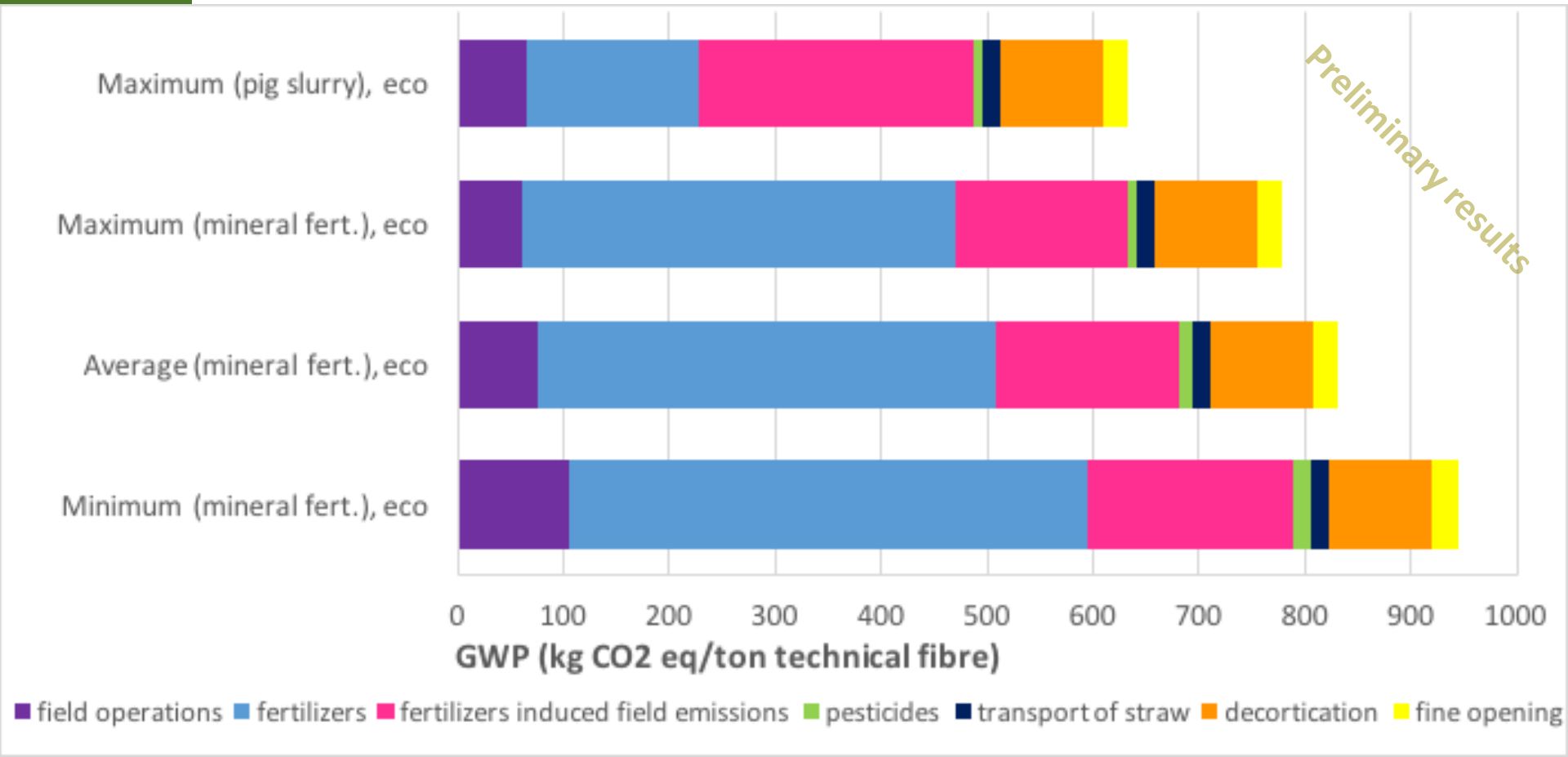
(2) Global Warming of hemp cultivation and processing

Impact of different fertilizer applications for the reference scenarios shown **per tonne of technical fibre for insulation material**



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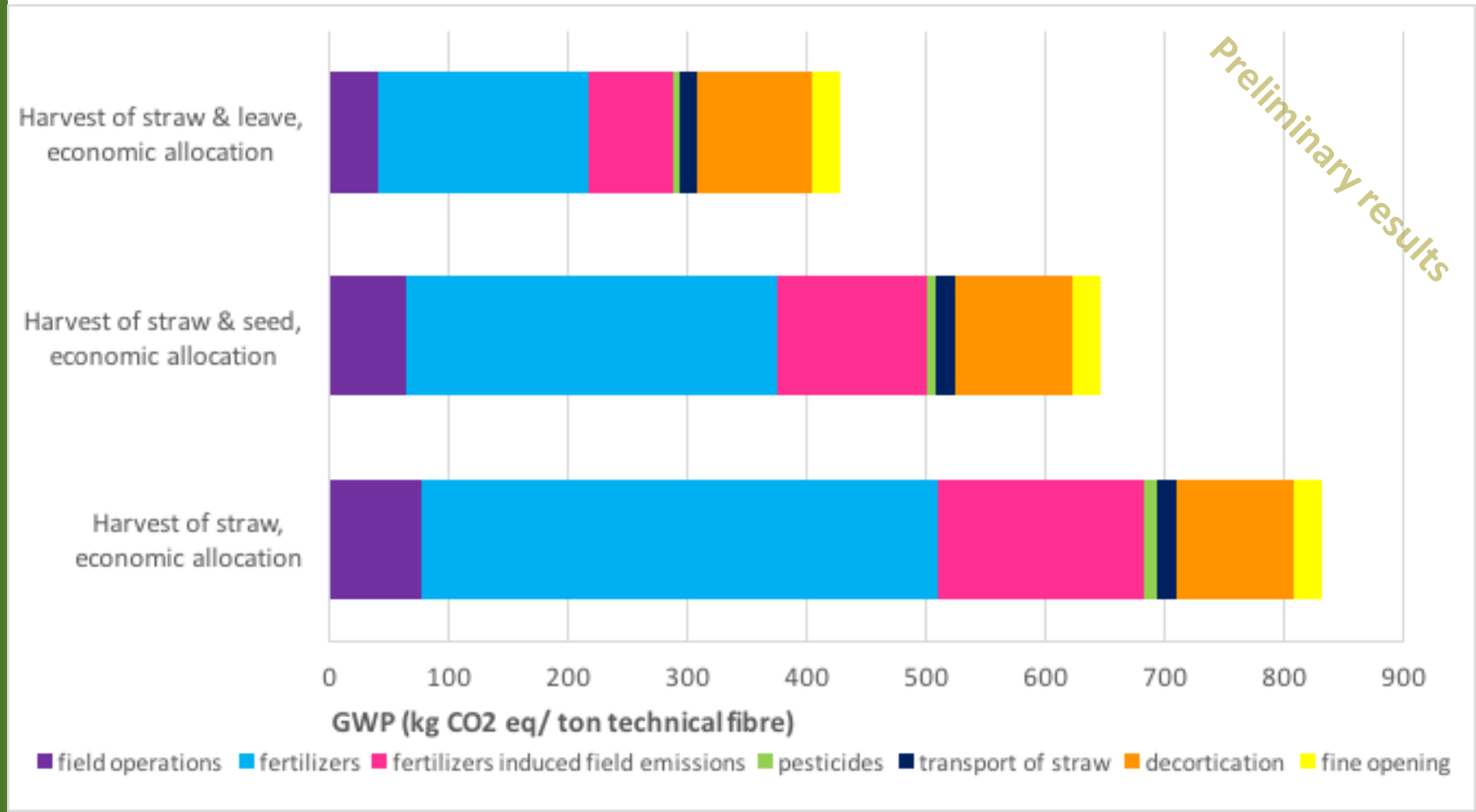
(2) Global Warming of hemp cultivation and processing

Impact of different harvesting scenarios
per tonne technical fibre (cultivation: average)



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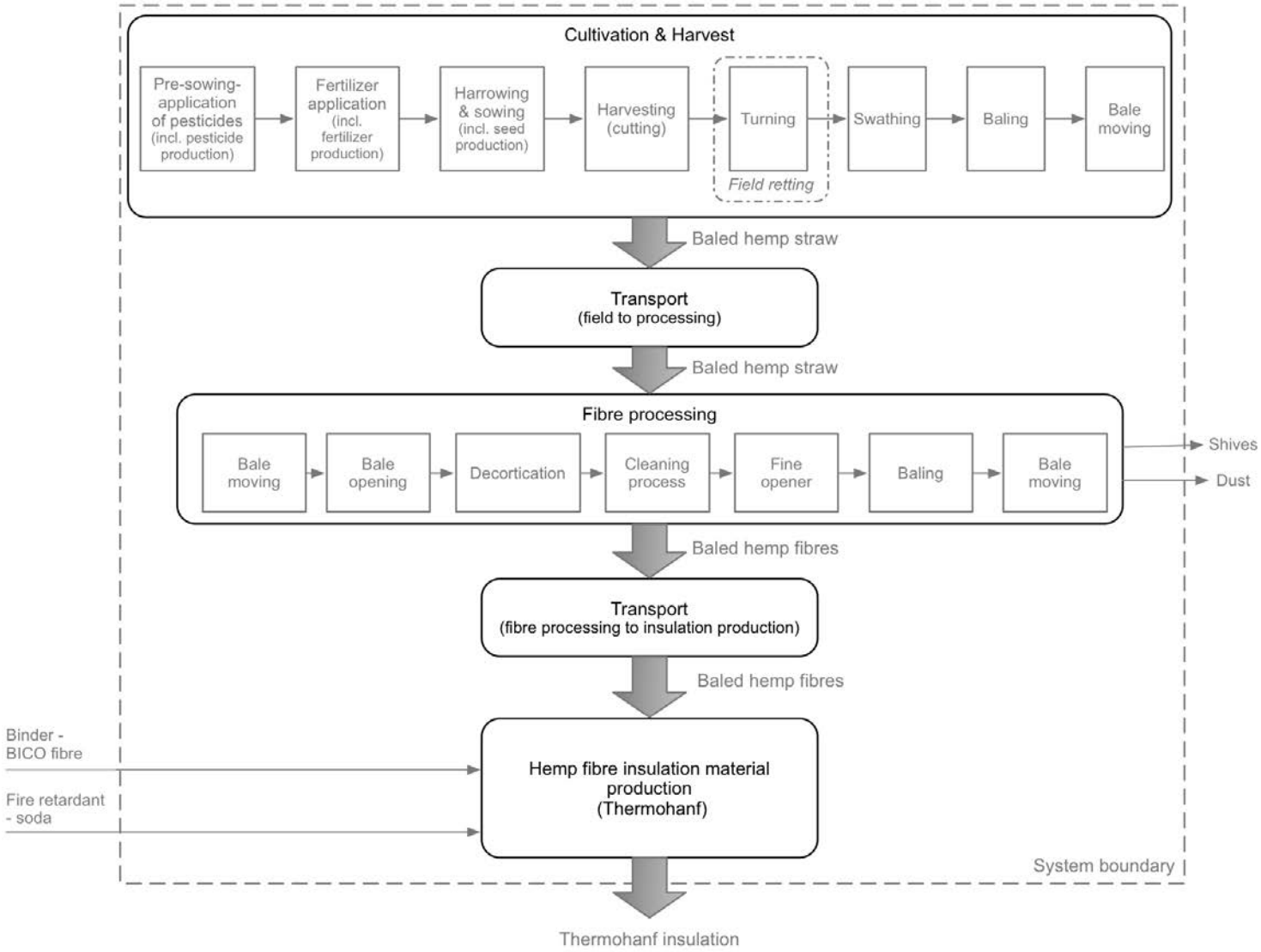
(3) Hemp based insulation material

"cradle-to-gate"



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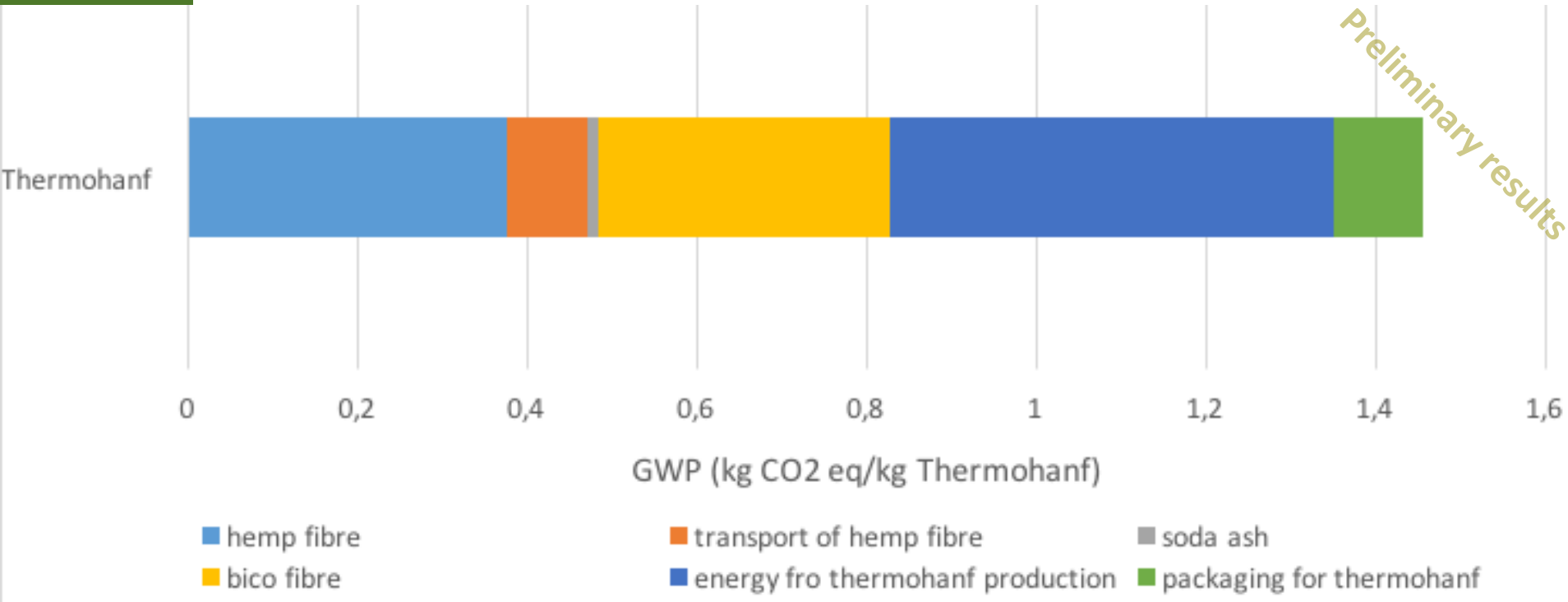
(3) Global Warming of hemp based insulation material

Results Global Warming "from field to Thermohanf"



(cultivation-harvesting-processing: average-reference)

3 important contributions to the Global Warming of Thermohanf

hemp-fibre-production | BICO fibre | energy for Thermohanf-production

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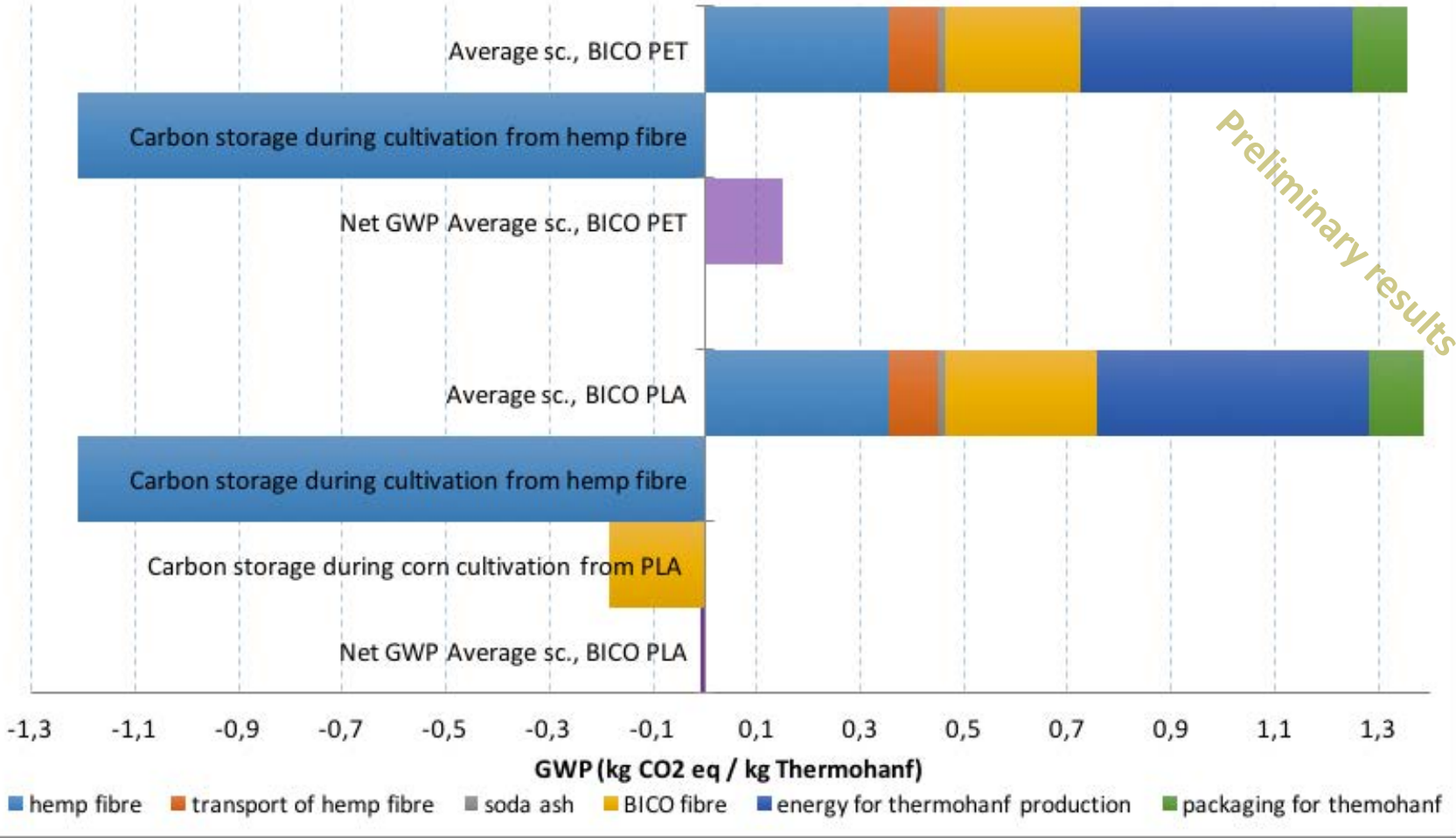
(3) Global Warming of hemp based insulation material

Global Warming per kg Thermohanf displaying the biogenic carbon storage and the resulting “net GWP”



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(3) Hemp based insulation material

Uncertainty Analysis

- Data in life cycle models have some uncertainty.
- To assess the **effect of data variability** on the GW of Thermohanf, an uncertainty analysis on the basis of Monte Carlo simulations is performed.

- **Monte Carlo simulation**:
  - relies on the repeated sampling of statistical distributions to produce results.
  - assesses how much influence uncertainty in the data has on the GW.
  - NOT assesses uncertainty regarding model choices, such as allocation methods, system boundaries, simplifications.
  - Is performed in SimaPro with 10.000 runs.
- The **variability in the data** has been obtained from **literature, experts and assumptions** and is assessed with a statistical distribution or a pedigree matrix approach.

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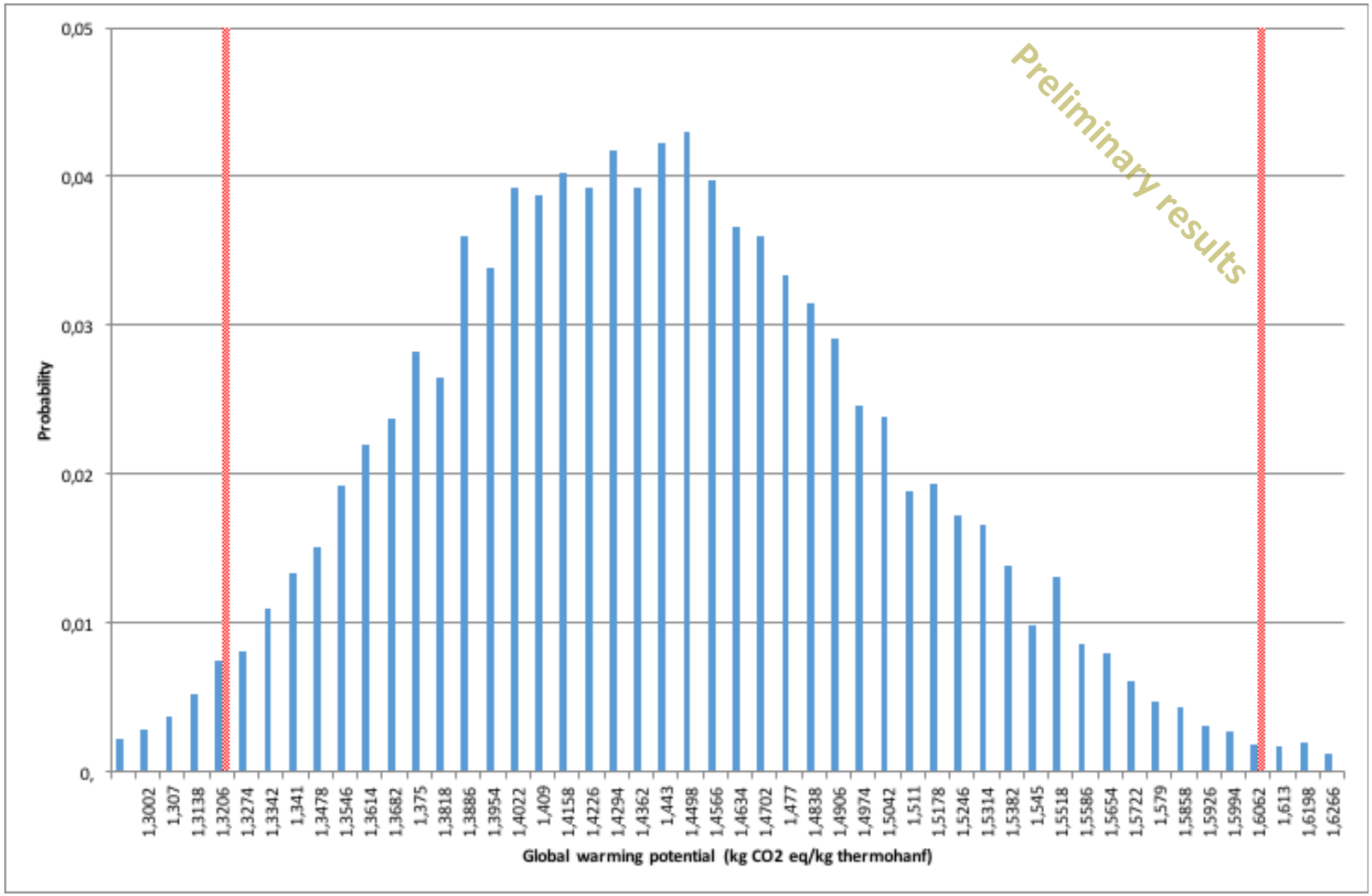
(3) Hemp based insulation material

Uncertainty Analysis



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(4) Comparison with conventional material

Functional unit: thermal resistance of 1 m^2*K/W

Conversion method

(1) Normalization of the provided impact data to 1 kg insulation material – e.g. 1.2 kg $CO_{2\ eq}$/kg insulation material

(2) Calculation of the amount of insulation material needed to achieve a thermal resistance of 1 m^2*K/W, using the below formula:

$$m = R * \lambda * \rho * A$$

m = mass of insulation material [kg]
R = thermal resistance = 1 m^2*K/W
λ = thermal conductivity [W/m*K]
ρ = density [kg/m^3]
A = area = 1 m^2

(3) Multiplication of the mass derived under (2) with the impact data per kg calculated under (1).

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(4) Comparison with conventional material

Input data for the comparison

Material	λ [W/(m*K)]	ρ [kg/m^3]	Global Warming [kg CO_2eq/kg material]
glass wool	0.035	22	2.37
rock wool	0.0385	54.5	1.34
expanded polystyrene (EPS)	0.032	15	4.42
extruded polystyrene (XPS)	0.035	35	3.74
polyurethane (PUR)	0.023	33.17	4.96
Thermohanf	0.04	37	1.32 – 1.61 Preliminary results

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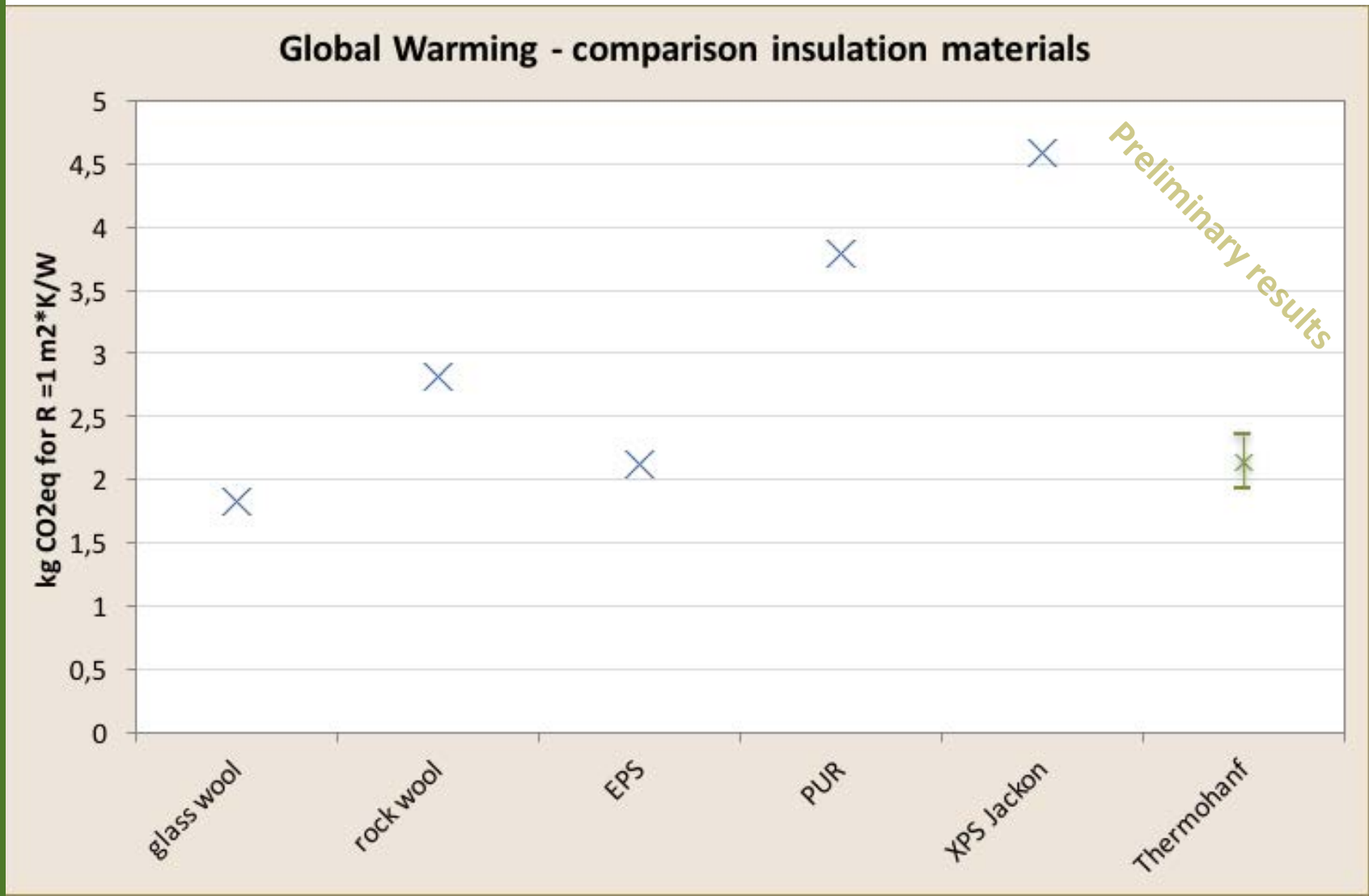
(4) Comparison with conventional material



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Acknowledgement

- Thanks to all MultiHemp partners who have provided data.
- Thanks to the TIM-project for providing us with data.

Thank you for your attention!

Dr. Sc. agr. Stephan Piotrowski
Economics & Resources
+49 (0) 2233 48 14 – 53
stephan.piotrowski@nova-institut.de

Dipl.-Ing. env. eng. Martha Barth
Life Cycle Assessment & Waste Management
+49 (0) 2233 48 14 – 60
martha.barth@nova-institut.de

nova

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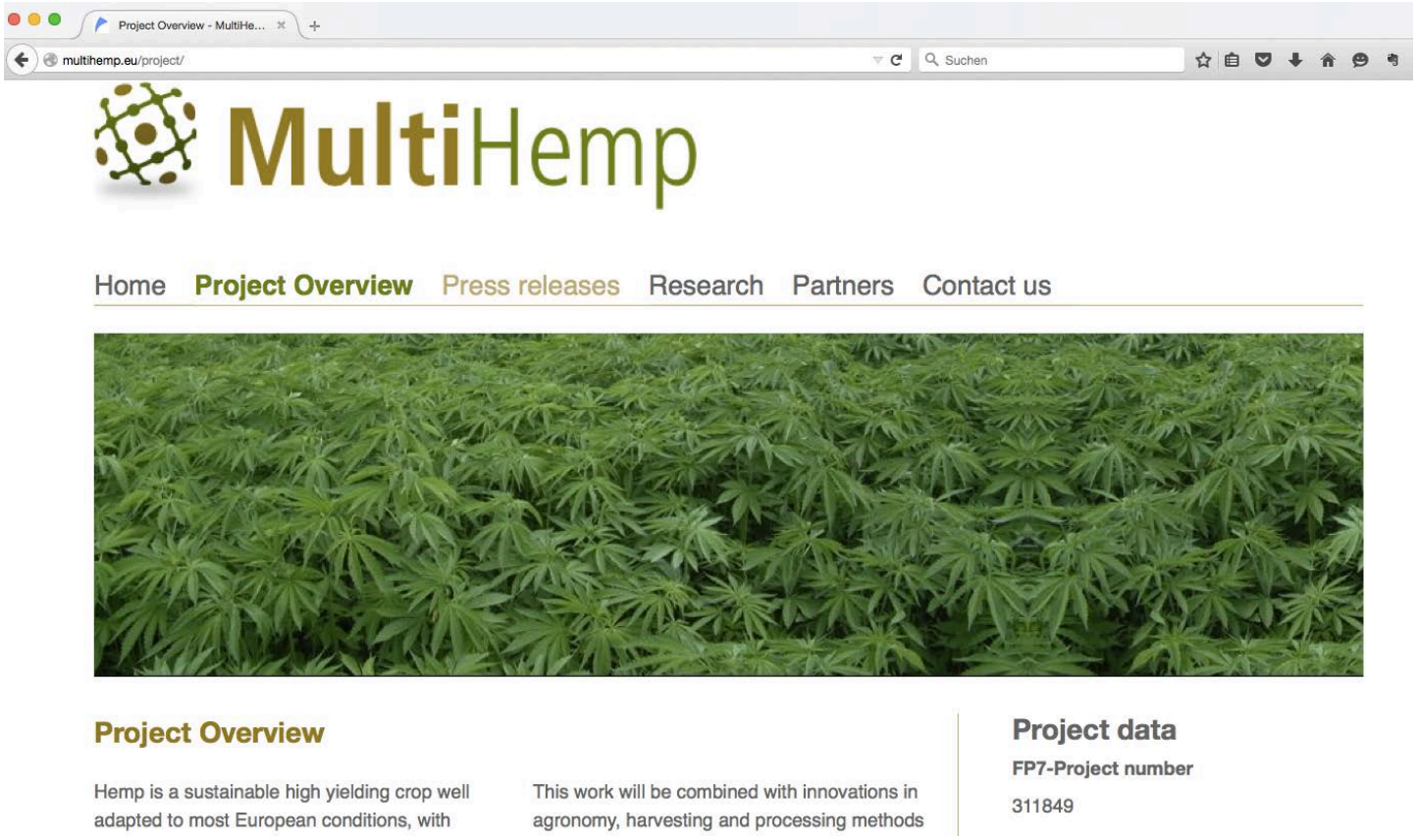
More information on: **www.multihemp.eu**



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