Technologie- und Förderzentrum
im Kompetenzzentrum
für Nachwachsende Rohstoffe

ExpRessBio-Methods

Ecological and economic assessment of product systems - system boundaries and calculation methods

Workshop on 23rd May 2017 in Brussels

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Outline

- The ExpRessBio-Project
  - Motivation
  - Objectives and challenges

- ExpRessBio-Method and elements of harmonization
  - System
  - Assumptions and definitions
  - Result presentation and documentation

- Conclusion and outcome

Motivation of the ExpRessBio-Project

- **Identification of site-specific optimization potential** for reducing greenhouse gas emissions of agricultural and forestry raw materials
- **Deriving recommendations** for action for the farmer and forester
  → **Default values,** e.g. specified by RED, **are not sufficient**
- A **specific knowledge about the source and amount** of GHG-emissions from raw material production, distribution and use is required
- Additionally the knowledge of the **economic impacts** is also necessary

Bundling of competences of evaluating agricultural and forestry raw materials in the "Expert group on resource management Bioenergy **– ExpRessBio"** in Bavaria

Challenges and objectives of ExpRessBio: Transparency and comparability of results

Challenge:

Despite of international standards, mostly non-comparable results because of different assumptions along the entire process chain

- → Definition of system boundaries
- → Choice of functional unit
- → Choice of data basis and quality
- → Method for dealing with co-products

Development of a **harmonized and transparent method to evaluate ecological and economic impacts** of product systems from **both** agricultural and forestry raw materials exemplified for Bavaria

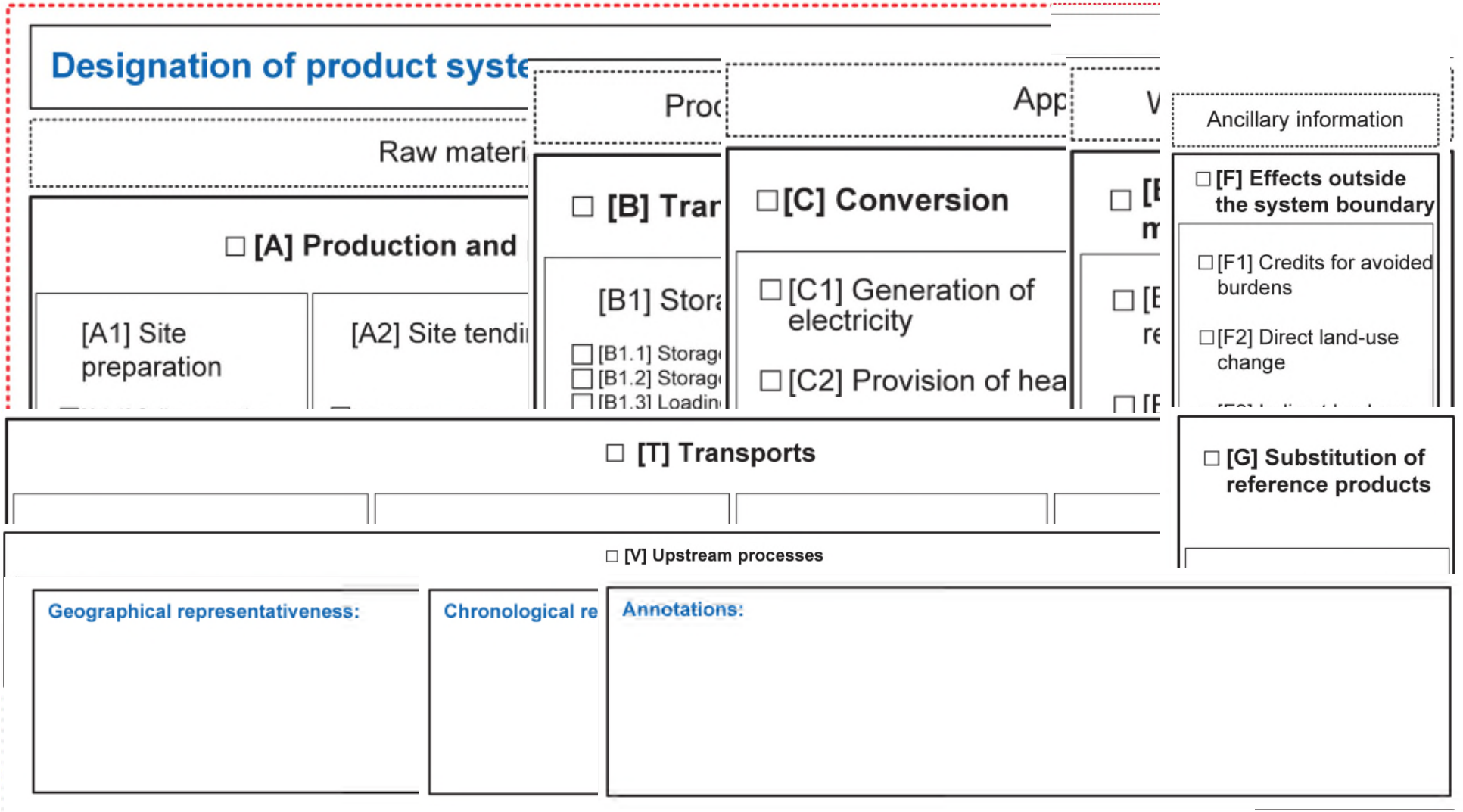
ExpRessBio-Method: Elements of harmonization

Analysing and assessment of ecological and economic impacts

H A R M O N I Z A T I O N

System	Assumptions & Definitions	Result presentation & Documentation
▪ System boundaries ▪ Cut-off criteria ▪ Completeness ▪ Transparency	▪ Data basis (site-specific) ▪ Emission factors ▪ Allocation ▪ Credits ▪ Reference value and functional unit ▪ Reference systems ▪ Physical and chemical parameters	▪ Impact assessment ▪ Diagrams and tables ▪ Database

System description of ExpRessBio-Methods



ExpRessBio-Method: Elements of harmonization

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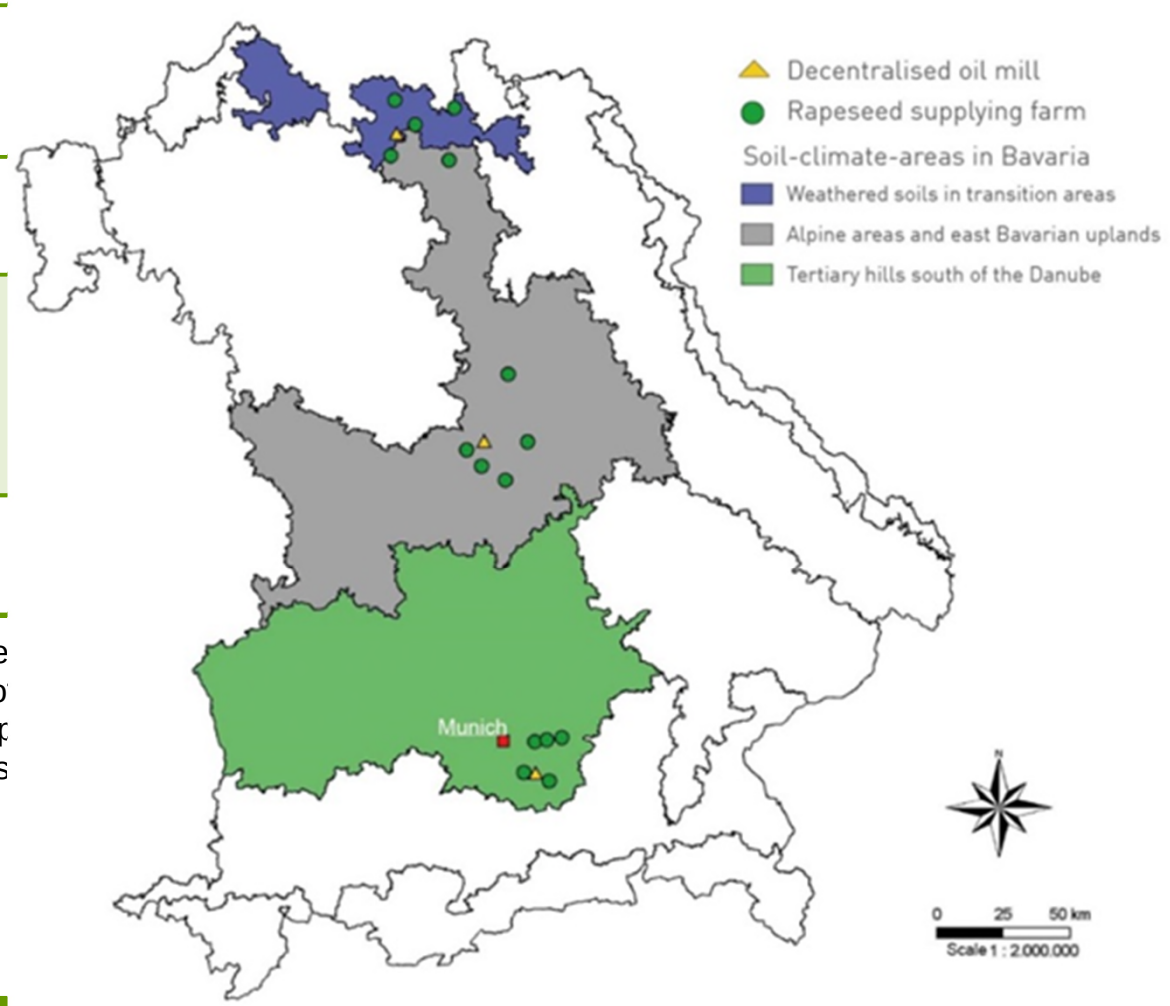
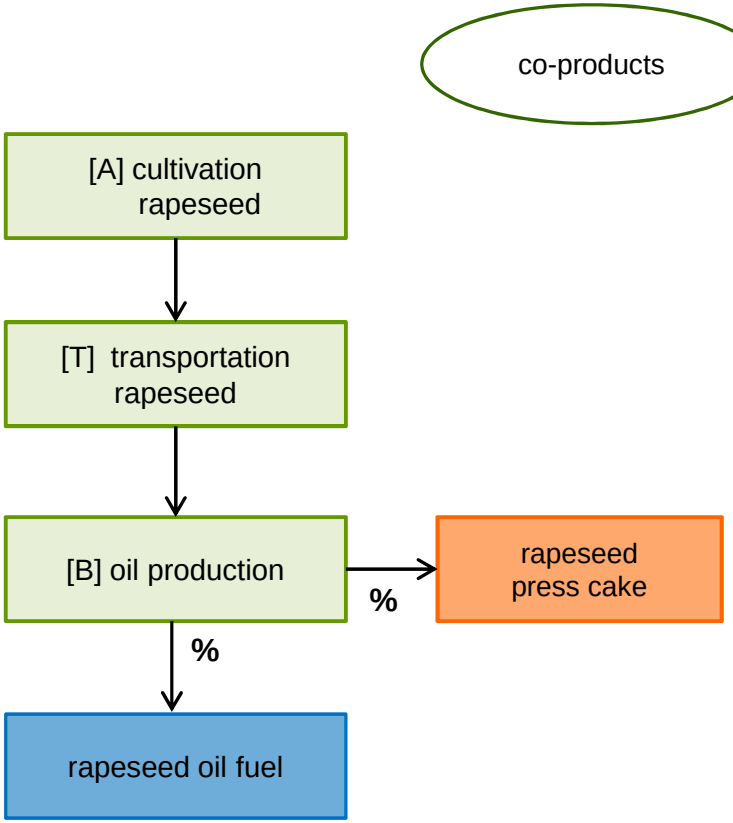


Soil-climate-areas in Bavaria

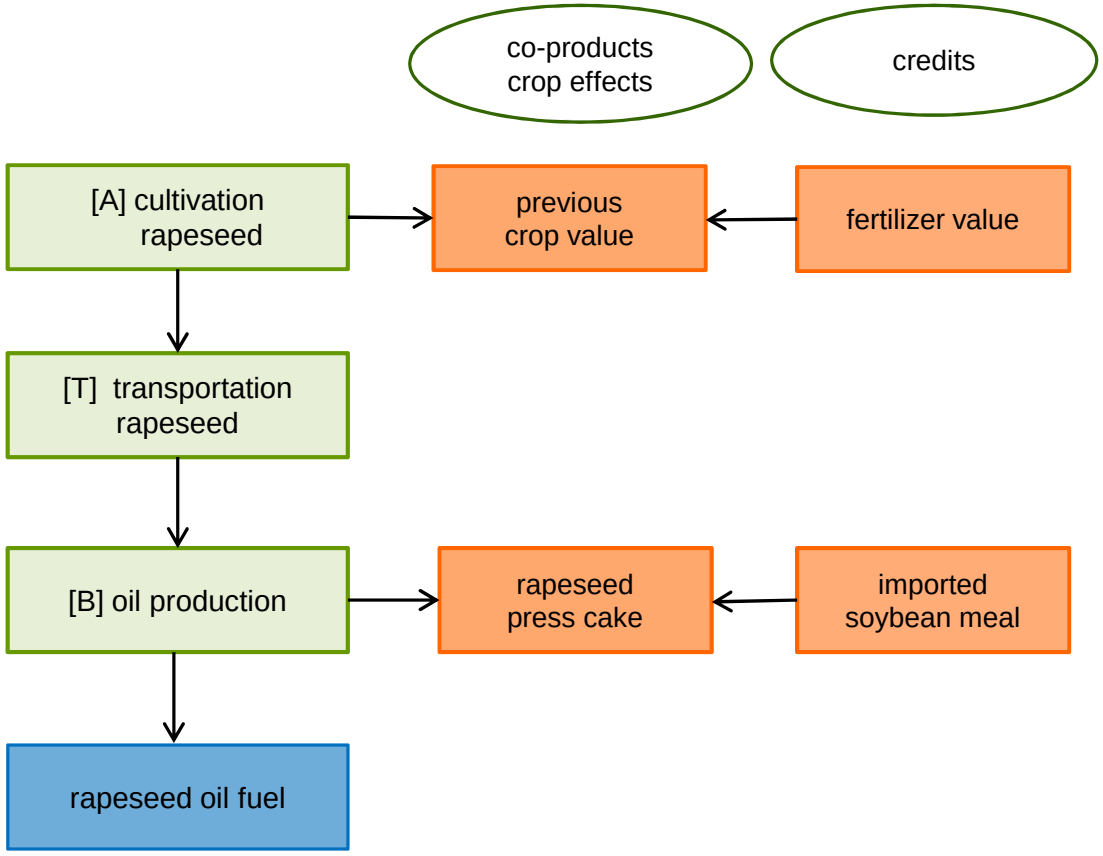
Evaluation of co-products

Allocation by calorific value



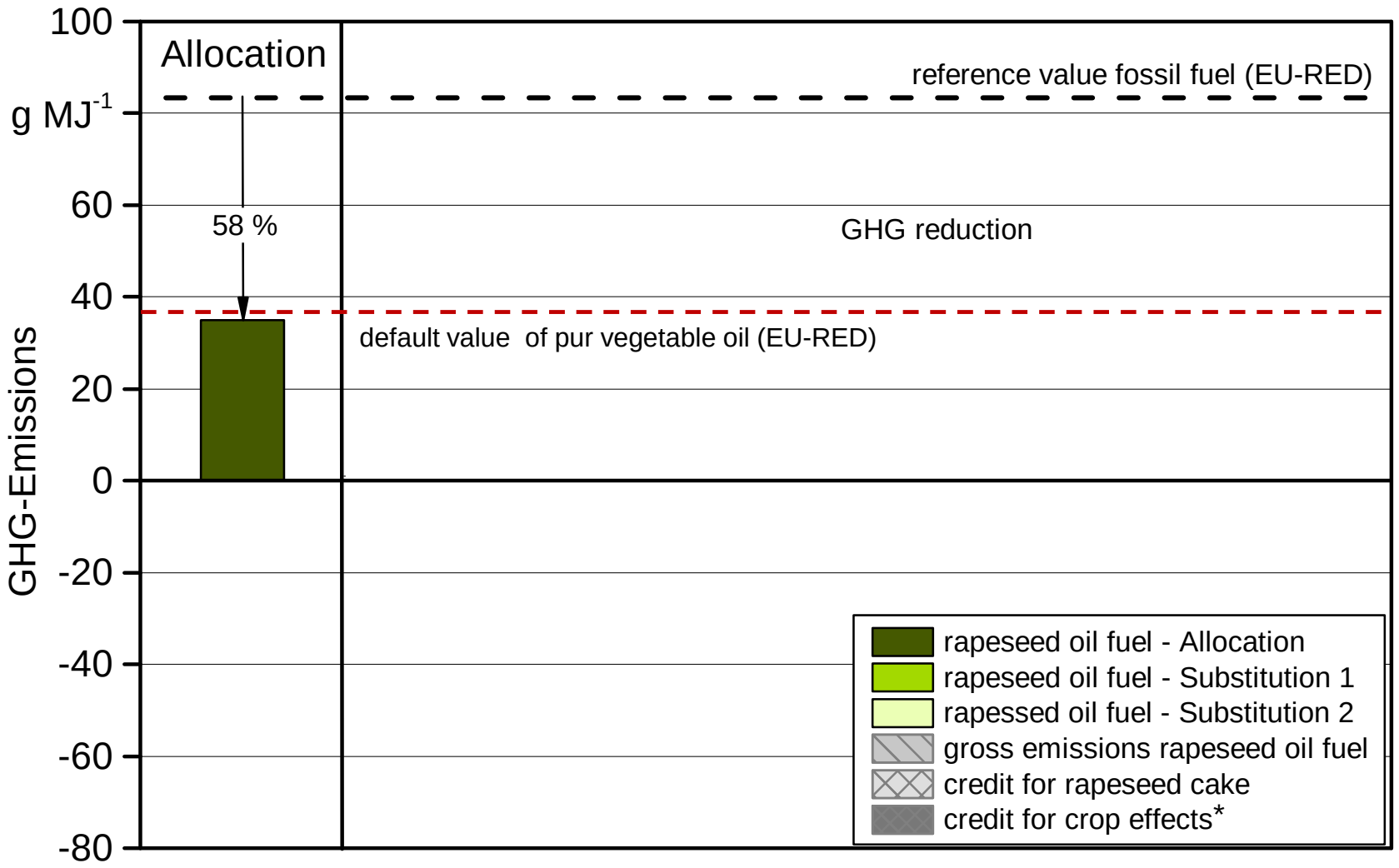
Percentage distribution of the emissions
Ratio of the energy output of the product (rapeseed oil) to the total energy output (rapeseed oil and rapeseed press cake)

Substitution and emission credits



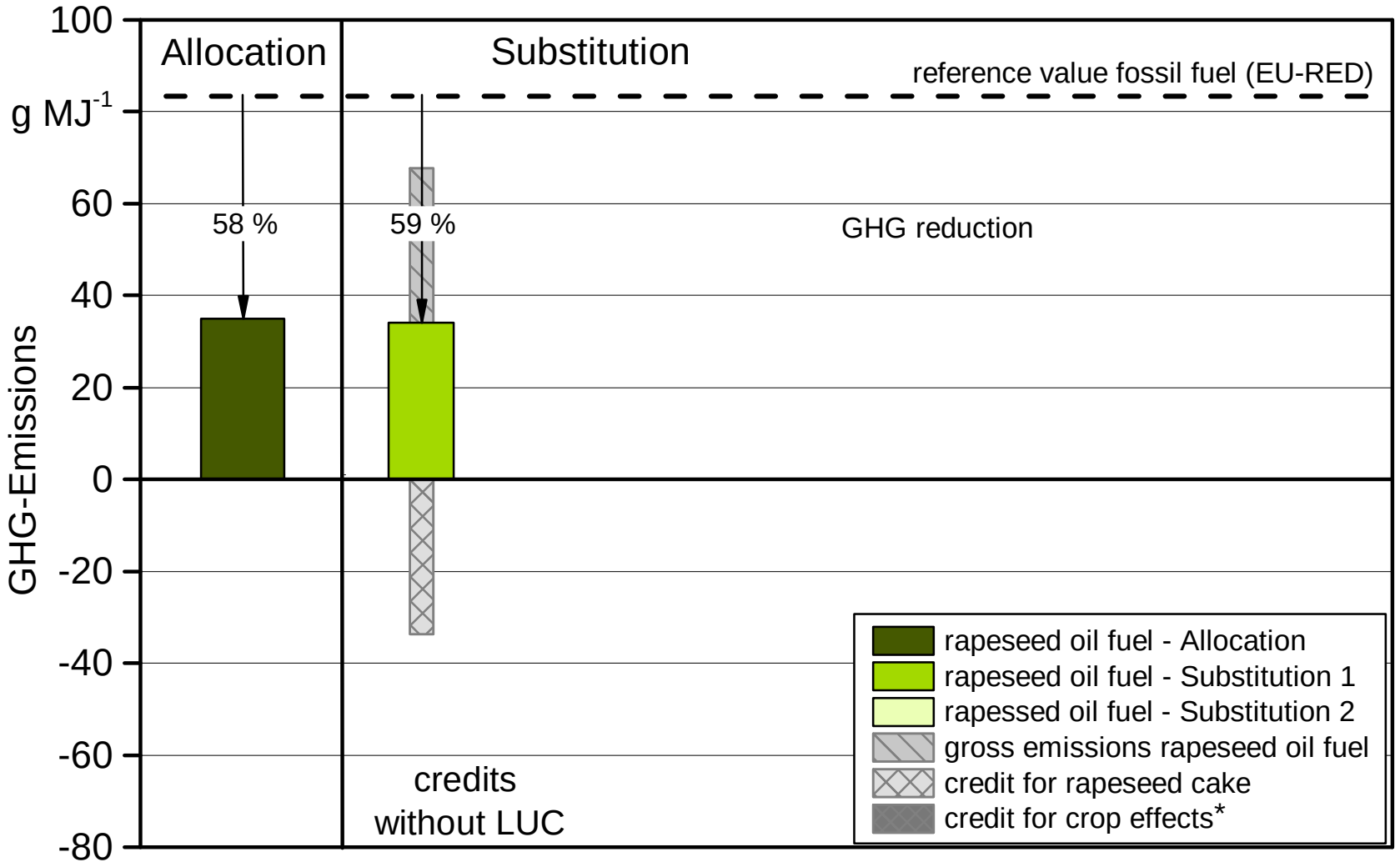
Credits
for the avoided burden of the reference product

GHG-emissions of decentralized rapeseed oil fuel from Bavaria: Comparison of allocation and substitution method



* Kage & Pahlmann (2013)

GHG-emissions of decentralized rapeseed oil fuel from Bavaria: Comparison of allocation and substitution method



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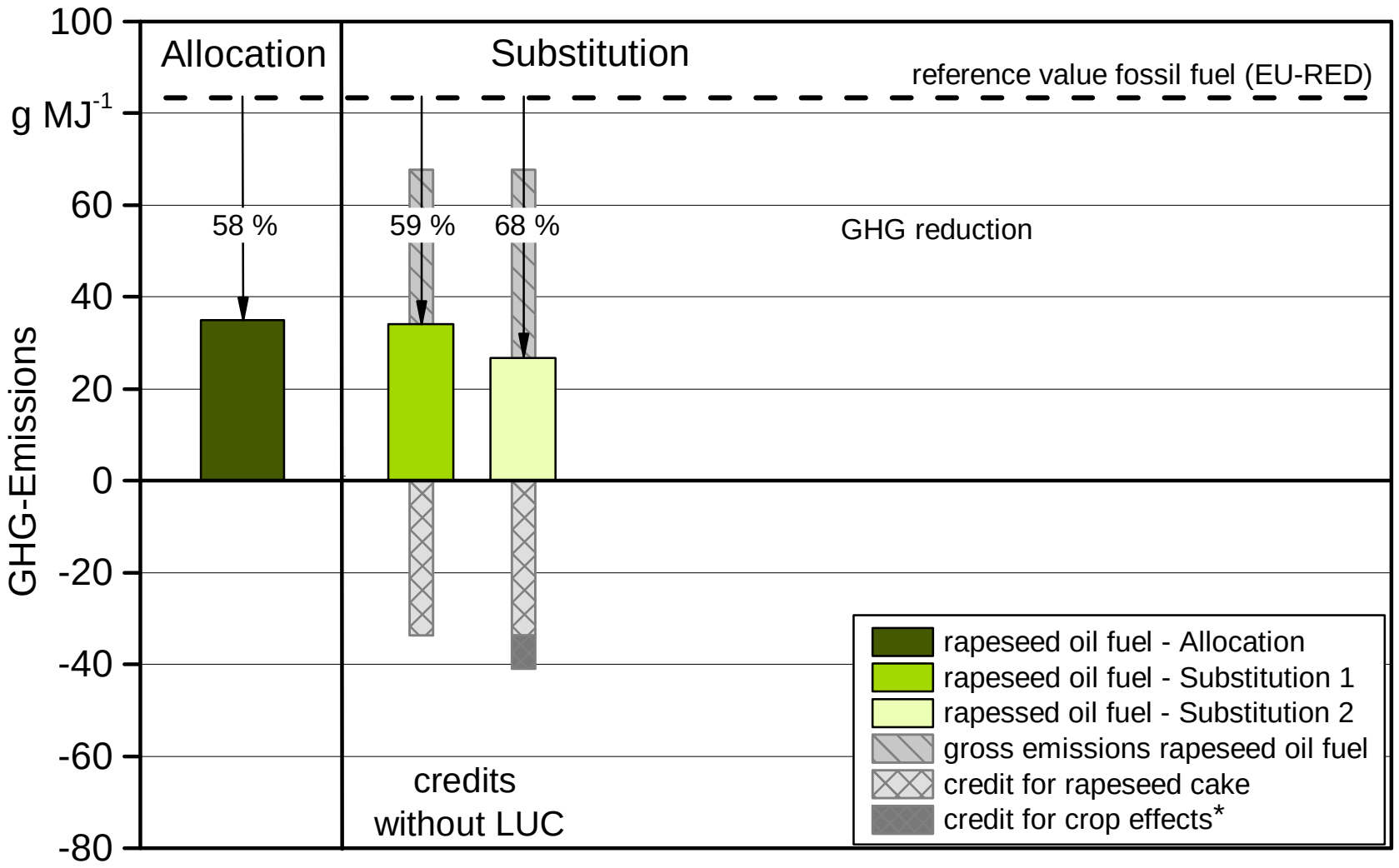

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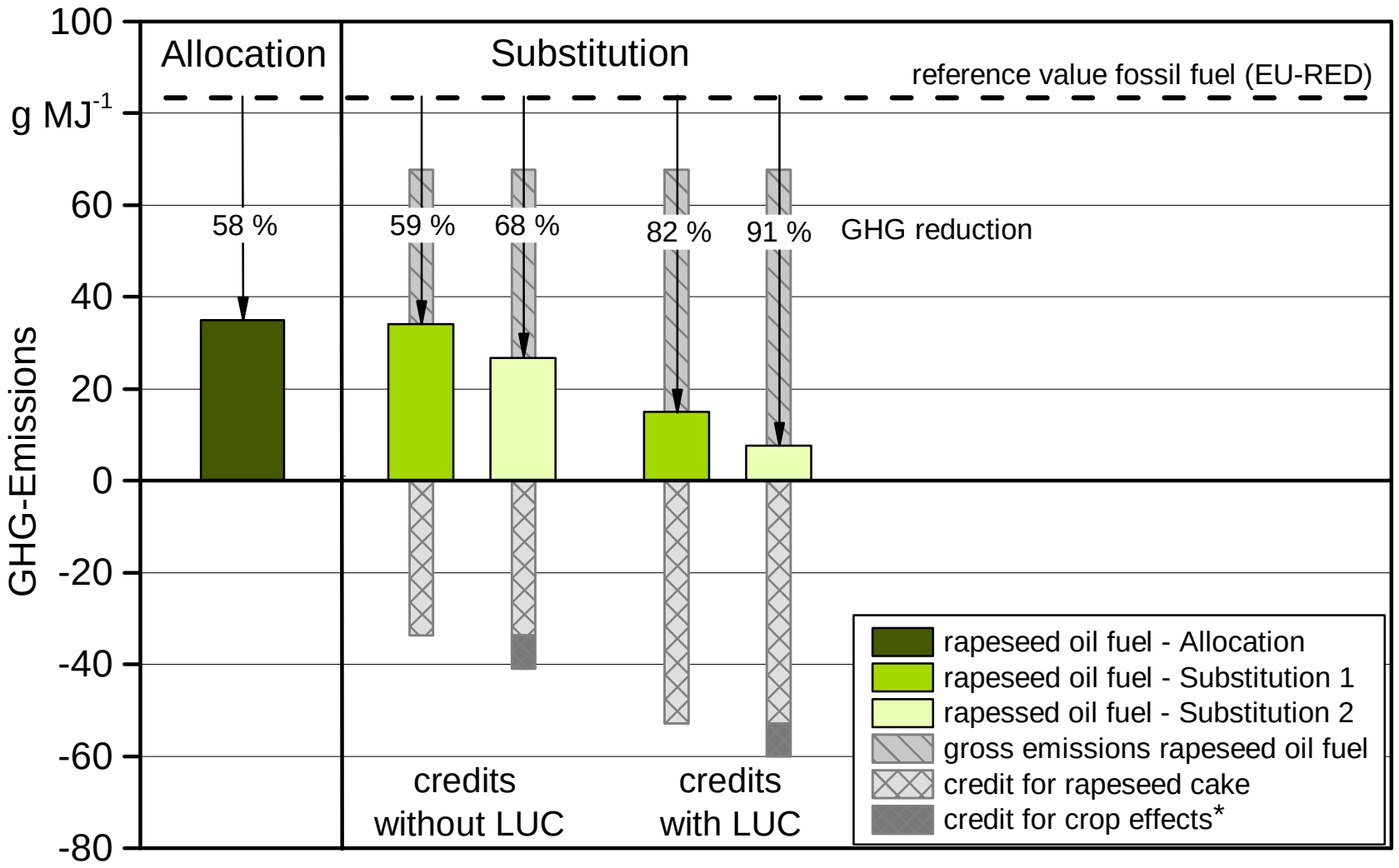


* Kage & Pahlmann (2013)

Extract of Directive 2009/28/EC (EU-RED)

(79) It is in the interests of the Community to encourage the development of multilateral and bilateral agreements and

(84) In order to avoid encouraging the cultivation of raw materials for biofuels and bioliquids in places where this would

(81) Co-products from the production and use of fuels should be taken into account in the calculation of greenhouse gas emissions. The substitution method is appropriate for the purposes of policy analysis, but not for the regulation of individual economic operators and individual consignments of transport fuels. In those cases the energy allocation method is the most appropriate method, as it is easy to apply, is predictable over time, minimises counter-productive incentives and produces results that are generally comparable with those produced by the substitution method. For the purposes of policy analysis the Commission should also, in its reporting, present results using the substitution method.

ExpRessBio-Method: Elements of harmonization

Analysing and assessment of ecological and economic impacts

H A R M O N I Z A T I O N

System	Assumptions & Definitions	Result presentation & Documentation
▪ System boundaries ▪ Cut-off criteria ▪ Completeness ▪ Transparency	▪ Data basis ▪ Emission factors ▪ Allocation ▪ Credits ▪ Reference value and functional unit ▪ Reference systems ▪ Physical and chemical parameters	▪ Impact assessment ▪ Diagrams and tables ▪ Database

Aggregated / disaggregated results

Process	CO_2–eq in g MJ^{-1}	CO_2–eq in %
[A] Production and provision of biomass	**23.7**	**92.5**
[A1] Site preparation	**1.0466**	**4.2**
[A1.1] Soil preparation		
[A1.1] Diesel consumption	*0.4596*	*1.8*
[V1] Use of machines and equipment	*0.0719*	*0.3*
[V4] Provision of diesel	*0.0744*	*0.3*
…	…	…
[A2] Site tending	**5.5753**	**21.7**
…		
[A2.3] Fertilizing		
[A1.1] Diesel consumption	*0.2528*	*1.1*
[V1] Use of machines and equipment	*0.2959*	*1.2*
[V4] Provision of diesel	*0.0459*	*0.2*
[V6] Provision of mineral fertilizer	*4.6733*	*18.2*
…		

Conclusion

- **Different assumptions hamper the comparability** of GHG-mitigation results
  - → system boundaries
  - → functional unit
  - → geographic and chronological representativeness
  - → choice of data basis
  - → the method for dealing with co-products

- Mean and **default values are unsuitable** to evaluate the optimization potential of GHG-mitigation options of the production and use of agricultural and forestry raw materials

Outcomes

The **harmonized ExpRessBio-Method enables** to

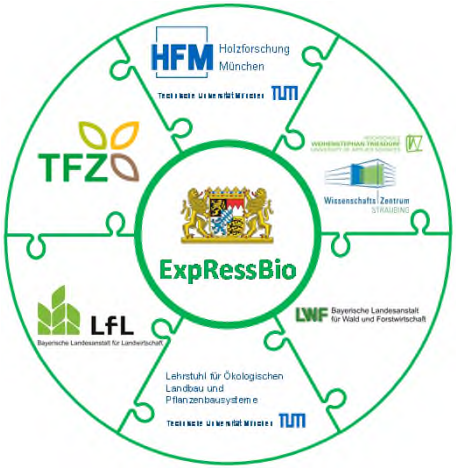
- describe the whole process chain, broken down into sub-processes, as well as all important information like functional unit, allocation method etc. in one fact sheet
- receive transparent and reproducible results
- link the results of ecological and economic evaluation to mitigation costs
- represent the results broken down into sub-processes for each impact category taken into account

Recommendations of the ExpRessBio-Project

- to **apply the ExpRessBio-Method** including the system description for transparency
- to use regional and farm specific input data to calculate GHG-mitigation **as basis for deriving recommendations for action for the farmer and forester**
- to **use additionally the substitution method** for evaluating co-products and implementation in legal requirements like RED
- to **evaluate crop rotation systems** for considering the previous crop effect

Further Information:
www.tfz.bayern.de

Thank you for your attention!



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Ernährung, Landwirtschaft und Forsten

Basis and quality of data

- Data requirements for calculating GHG-mitigation options of the production and use of agricultural and forestry raw materials

  → Representative, complete, consistence, transparent and exact (ISO 14040/44)

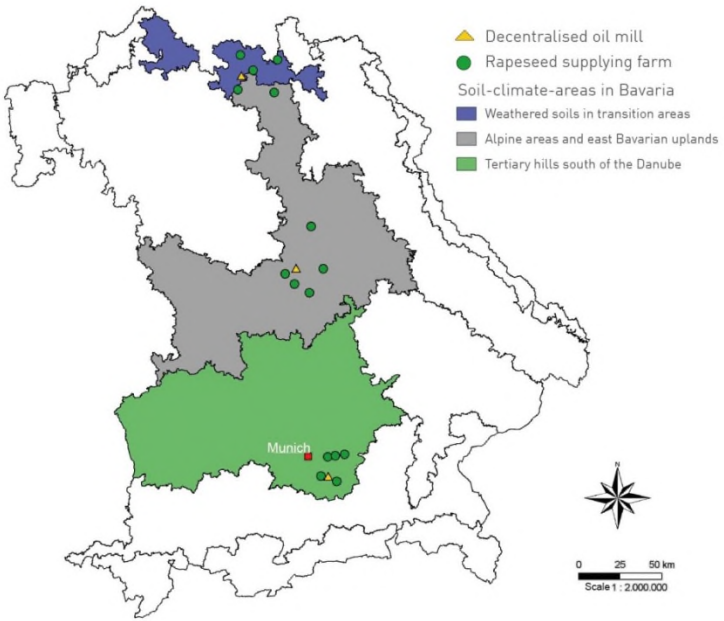
  → Avoidance of mean and default values by analyzing
  - agricultural field trials
  - trial farms
  - model regions

  → Consideration of special regarding times
  - one crop for one year
  - whole crop rotation including crop effects

- Reasons:

  → Results based on mean and default values are non-transferable to site-specific conditions

  → Soil and climate conditions have an influence on the results and thus, are highly important



Soil-climate-areas in Bavaria

Definitions for the substitution method

- The substitution of soy extraction meal imported, is based on the usable raw protein content (nXP)
  - Rapeseed cake of decentralized oil mills: 208[1] g nXP kg^{-1} DM
  - Soy extraction meal[1]: 319 g nXP kg^{-1} DM
  - → **In cattle feeding 1 kg soy extraction meal could be substituted by 1,53 kg rapeseed cake**

- Origin of substituted soy extraction meal respectively soybean in Germany
  - 50 % of soy extraction meal is imported to 95 % from South America
  - 50 % of soy extraction meal is produced in Germany from imported soybeans. These soy beans are to 55 % from North America and to 45 % from South America

[1]Preissinger et al. (2004)

Definitions for the substitution method

- Cultivation of soybeans in North and South America
  - **System boundary 1:** No consideration of land use change (LUC)
  - **System boundary 2:** Consideration of land use change in the cultivation of soybeans in South America caused by a significant increase of cultivation area (In Brazil: increase from 13.5 (2000) to 30 million ha (2014))[1]

    → **Proportional LUC in the amount of 8.4 % by Sutter[2]**

    Due to the applicable sustainability ordinance, no considering of LUC in the cultivation of rapeseed in Germany**

- Previous crop value of rapeseed cultivation based on field trials by Christian-Albrechts-Universität zu Kiel[3]

  → **Cultivation wheat after rapeseed compared to cultivation wheat after wheat**

[1] FAO (2016)
[2] Sutter (2006)
[3] Kage & Pahlmann (2013)

** LUC in the cultivation of rapeseed leads to five time less emissions compare to the cultivation of soy bean in South America

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