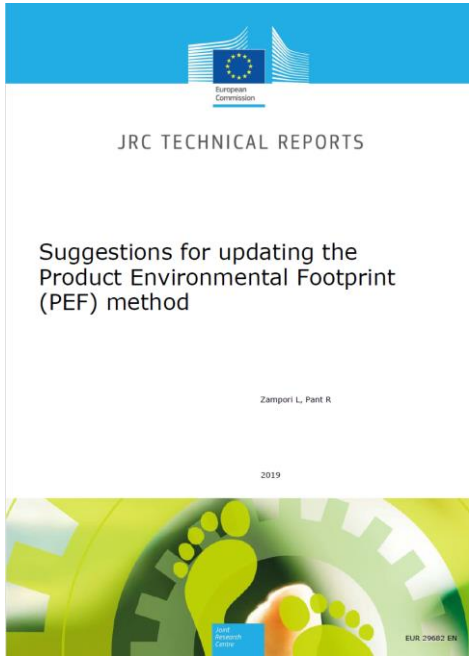
Guide to “Product Environmental Footprint of grass protein concentrate”

Product Environmental Footprint (PEF): Developed by the Joint Research Center of the European Commission to transparently assess the environmental impacts of products and services throughout their life cycle, decrease the environmental impacts, and strengthen the European markets for green products. The overarching purpose of PEF information is to enable to reduce the environmental impacts through the whole supply chain activities (from extraction of raw materials, through production and use and to final waste management).

Product Environmental Footprint Category Rules (PEFCR): Product category-specific, life cycle-based rules that complement general methodological guidance for PEF studies by providing further specifications at the level of a specific product category. PEFCRs help to shift the focus of the PEF study toward those aspects and parameters that matter the most, and hence contribute to increased relevance, reproducibility and consistency of the results by reducing costs versus a study based on the comprehensive requirements of the PEF method.

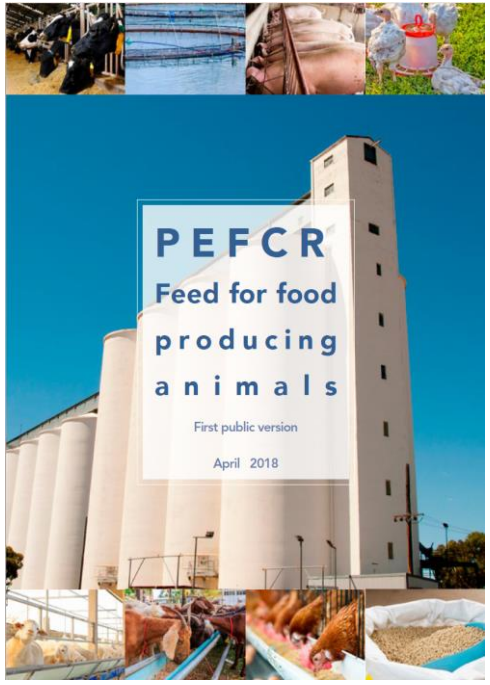


The rules provided in the PEF method enable to conduct PEF studies that are more reproducible, comparable and verifiable, compared to existing alternative approaches.

https://eplca.jrc.ec.europa.eu/permalink/PEF_method.pdf

Grass protein concentrate (GPC): This guide briefly describes the PEF and the steps in the PEF calculation. Grass protein concentrate (GPC) is used as an example to summarize how a PEF study can be implemented. GPC is a feed-grade protein with 90% dry weight and 47% crude protein, extracted from clover-grass, and can partly or fully replace soybean meal in compound feeds. It can be produced locally in Denmark and decrease the import of soybean and soybean meal from abroad and increase Denmark’s self-sufficiency in feed protein.

Comparability is only possible if the results are based on the same Product Environmental Footprint Category Rules (PEFCR).



https://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_Feed_Feb%202020.pdf

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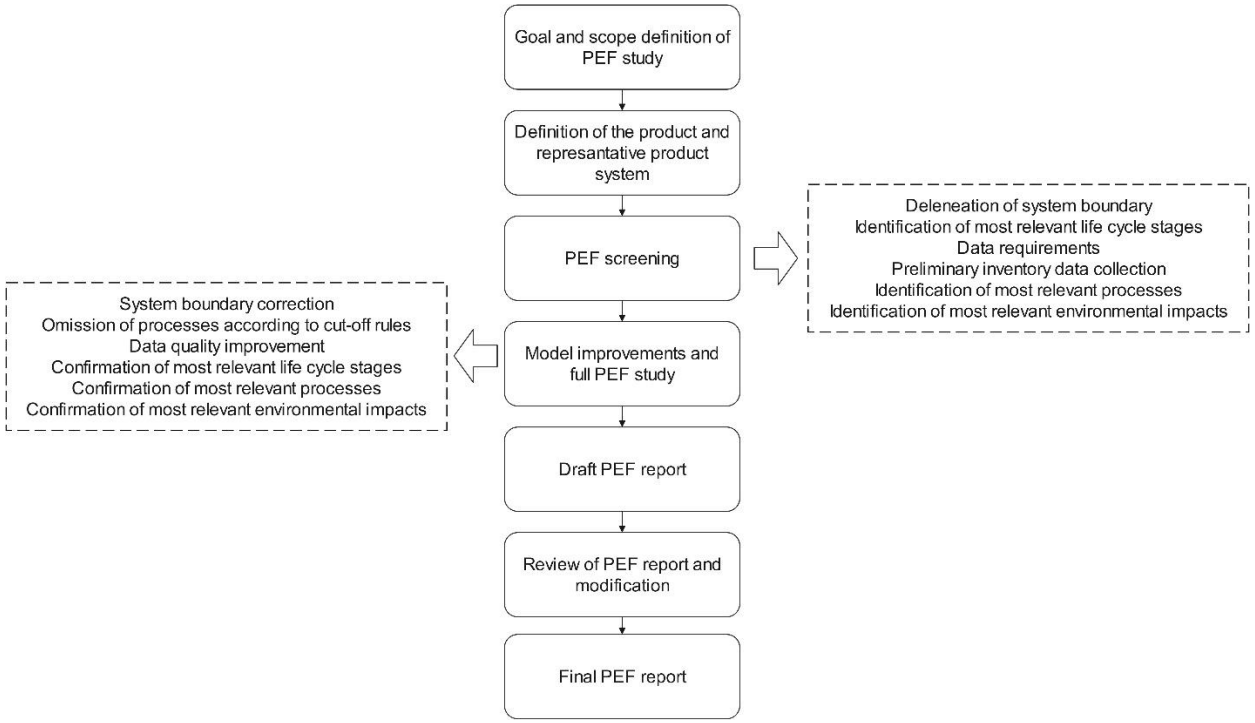
How to do PEF for Grass Protein Concentrate?

PEFCR requirement: The first step is to carefully read and follow the instructions detailed in the latest draft of PEFCR Feed for food-producing animals. Find the latest draft on the European Commission website at
https://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR_en.htm



Overview of step-to-step guide on how to implement a PEF study

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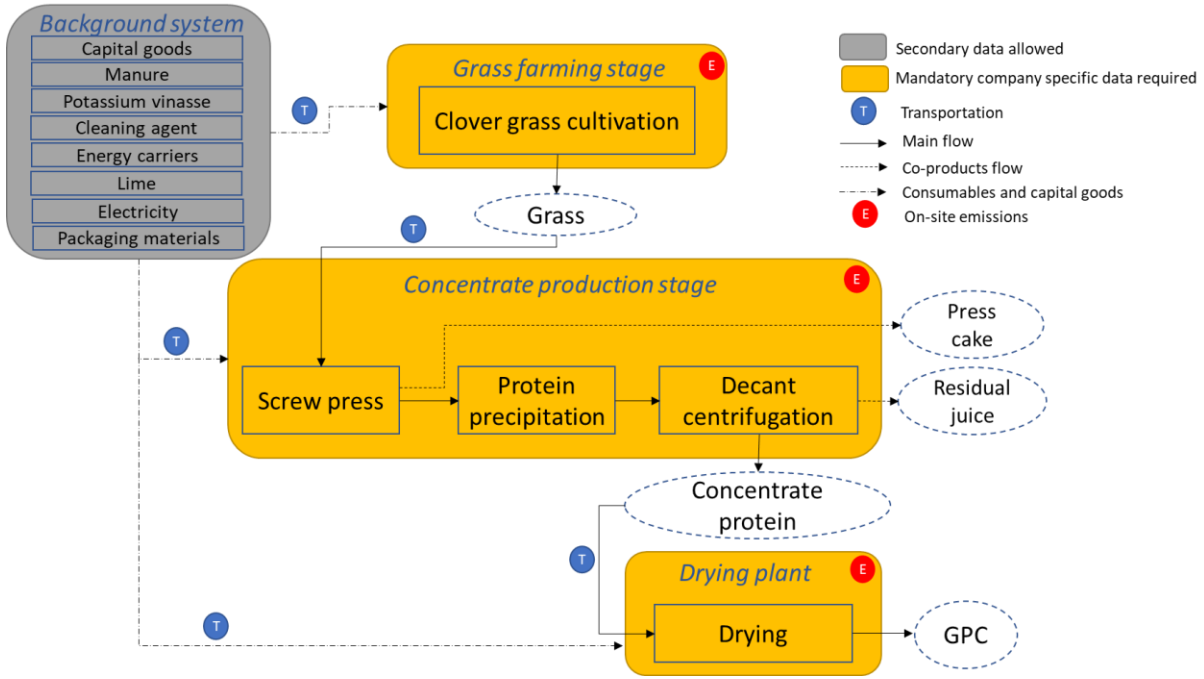
Scope of the PEF

Functional Unit (FU): The functional unit needs to be clearly defined. FU defines the qualitative and quantitative aspects of the function(s) and/or service(s) provided by the product being evaluated. The functional unit definition answers the questions "what?", "how much?", "how well?", and "for how long?"

Reference flow: A reference flow needs to be defined to which the inputs and outputs flow to be scaled. Life cycle inventory and life cycle impact assessment results are then shown per reference flow. Reference flow can be one tonne of grass protein concentrate.

System boundary: The system boundary defines which parts of the product life cycle and which associated life cycle stages and processes belong to the analyzed system (i.e., are required for carrying out its function as defined by the functional unit), except for those processes excluded based on the cut-off rule.
The system boundary shall be defined following a general supply-chain logic, including all stages from raw material acquisition and pre-processing, production of the main product, product distribution and storage, use stage and end of life treatment of the product (if appropriate).

Life cycle stage	Short description of the processes included
Organic grass cultivation	The cultivation of clover-grass is the first life cycle stage. The cultivation of organic grass requires the input of manure and biogas slurry as well as energy carriers, water, auxiliary materials and may involve land transformation. The full life cycle of the production of these products, including transport and depreciation of capital goods, is in the scope of PEF of GPC study.
Inbound transportation	The delivery of harvested grass to the biorefinery plant is part of the life cycle of GPC.
Production of GPC	GPC production is the core of PEF study where the delivered grass is processed to the final product and leaves two important co-products namely press cake and brown juice.
Outbound transportation	The transportation of intermediate protein concentrate to the drying facility as well as transportation of co-products are included in the scope of this study.
Processing of coproducts	The processing of the coproducts was excluded from the scope because of using economic allocation at the biorefinery gate.



System boundary for the assessment of organic protein concentrate from clover grass, including indication of the processes for which company-specific data are mandatory

Life Cycle Inventory

An inventory of all material, energy and waste inputs and outputs and emissions into air, water and soil for the product supply chain shall be compiled as a basis for modelling the PEF. This is called the life cycle inventory.

There are two types of inventory data:

1. Company-specific data (also called activity data): it refers to directly measured or collected data representative of activities at a specific facility or set of facilities.
2. Secondary dataset: refers to data not from specific process within the supply-chain of the company performing the PEF study. This refers to data that is not directly collected, measured, or estimated by the company, but sourced from a third-party life-cycle-inventory database or other sources.

Data Need Matrix (DNM): DNM shall be used to evaluate all processes required to model the product in scope on their data requirements. It indicates for which processes company-specific data or secondary data shall or may be used, depending on the level of influence the company has on the process.

		Data requirements
Situation 1: process run by the company	Option 1	Provide company-specific data (both activity data and direct emissions) and create a company-specific dataset.
Situation 2: process not run by the company but with access to company-specific information	Option 1	Provide company-specific data and create a company-specific dataset.
	Option 2	Use a secondary dataset that is Environmental Footprint (EF)-compliant and apply company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain-specific EF-compliant datasets.
Situation 3: process not run by the company and without access to company-specific information	Option 1	Use an EF-compliant secondary data set in aggregated form.

Use Data Need Matrix to decide if company-specific data or a secondary dataset is needed to implement a PEF study.

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Handling Multifunctional process

In the actual PEF-study the biorefining of clover-grass goes into three output flows: fiber, brown juice, and grass protein concentrate. This is referred to as a multifunctional process and the PEF results have to be allocated to the three output flows. The PEFCR Feed for Food-Producing Animals has suggested using a hierarchical approach as described in the LEAP Guideline: 'Environmental performance of animal feeds supply chains (pages 36-43), FAO 2015, available at http://www.fao.org/partnerships/leap/publications/en/'. Following the guidelines and considering that GPC is an intermediate product and should be used as an ingredient for compound feed production, using economic allocation at the biorefinery life cycle stage is suggested. Accordingly, the environmental burdens can be allocated to three flows according to the product's economic value. Since economic allocation was used in this PEF study, the final application of coproducts, including biogas production, does not need to be included in the system boundary and the scope of PEF GPC.

PEF secondary datasets

To perform the PEF study, the data from foreground systems (e.g., electricity consumption) needs to be linked to the background processes where energy carriers, chemicals, materials, etc., are produced. PEF studies shall use PEF secondary datasets for the background processes. PEF secondary datasets refers to general data not coming from a specific process within the supply-chain of the company performing a PEF study. Secondary datasets must be approved in the PEFCR system. A list of approved databases with secondary data are available on EU website at: https://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR_en.htm.

Where to find PEF secondary datasets

The secondary data to be used when implementing PEFCRs and OEFSRs are available on EU website at: https://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR_en.htm

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Each PEF study carried out in compliance with this PEFCR shall calculate the PEF profile including all PEF impact categories listed in the Table

Impact category	Indicator	Unit
Acidification	Accumulated Exceedance (AE)	mol H+ eq
Climate change (Total)	Radiative forcing as Global Warming Potential (GWP100)	kg CO_2 eq
Climate change-Biogenic (methane)		kg CO_2 eq
Climate change-fossil		kg CO_2 eq
Climate change-Land use and land use change		kg CO_2 eq
Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 eq
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems (CTUe)	CTUe
Eutrophication marine	Fraction of nutrients reaching marine end compartment (N)	kg N eq
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P eq
Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N eq
Human toxicity, cancer	Comparative Toxic Unit for humans (CTUh)	CTUh
Human toxicity, non-cancer		CTUh
Ionizing radiation, human health	Human exposure efficiency relative to U235	kBq U^{235} eq
Land use	· Soil quality index · Biotic production · Erosion resistance · Mechanical filtration · Groundwater replenishment	· Dimensionless (pt) · kg biotic production · kg soil · m3 water · m3 groundwater
Particulate Matter	Impact on human health	disease incidence
Photochemical ozone formation - human health	Tropospheric ozone concentration increase	kg NMVOC eq
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP-fossil)	MJ
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb eq
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 world eq

Environmental Footprint (EF) impact assessment

Once the Life Cycle Inventory (LCI) has been compiled, the EF impact assessment shall be undertaken to calculate the environmental performance of the GPC, using all the EF impact categories and models. EF impact assessment includes four steps: classification, characterization, normalization and weighting. Results of a PEF study shall be calculated and reported in the PEF report as characterized, normalized, and weighted results for each EF impact category and as a single overall score based on the weighting factors provided.

Global normalization and weighting factors for environmental footprint

Impact category	Normalization factor	Weighting factor
Acidification	55.5	0.0664
Climate change (Total)	7760.0	0.2219
Climate change-Biogenic (methane)		
Climate change-fossil		
Climate change-Land use and land use change		
Ozone depletion	0.0234	0.0675
Ecotoxicity, freshwater	11800.0	
Eutrophication marine	28.3	0.0312
Eutrophication, freshwater	2.55	0.0295
Eutrophication, terrestrial	177.0	0.0391
Human toxicity, cancer	3.85E-5	
Human toxicity, non-cancer	4.75E-4	
Ionizing radiation, human health	4220.0	0.0537
Land use	1330000.0	0.0842
Particulate Matter	6.37E-4	0.0954
Photochemical ozone formation - human health	40.6	0.051
Resource use, fossils	65300.0	0.0892
Resource use, minerals and metals	0.0579	0.0808
Water use	11500.0	0.0903

Normalization and weighting of EF

EF impact assessment shall be complemented with normalization and weighting. Normalization is the step in which the life cycle impact assessment results are divided by normalization factors to calculate and compare the magnitude of their contributions to the EF impact categories relative to a reference unit.
Weighting is a mandatory step in PEF studies and supports the interpretation and communication of the analysis results. In this step, normalized results are multiplied by a set of weighting factors (in %) which reflect the perceived relative importance of the life cycle impact categories considered.

What should be reported?

The report shall include as a minimum:

- Characterized results of all EF impact categories shall be calculated and reported as absolute values in the PEF report. The sub-categories “climate change-fossil”, “climate change-biogenic” and “climate change-land use and land use change” shall be reported separately if they show a contribution of more than 5% each to the total score of climate change);
- Normalized and weighted results as absolute values;
- Weighted results as single score;
- Results of the use stage for final products shall be reported separately

Græs-Prof

This guide is made in the project Græs-Prof. This is a 4-year GUDP project with 13 partners to obtain the concrete knowledge and technical solutions that farmers and grass protein plants need to be able to produce grass protein economically and sustainably.

Contact information

For further information or help, you can contact us at SDU LCE at bekh@igt.sdu.dk and morb@igt.sdu.dk or at ICOEL at eikf@icoel.dk

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