PRODUCT ENVIRONMENTAL FOOTPRINT CATEGORY RULES

Mustard

Draft version 1.0
September 2018

Il presente documento include indicazioni metodologiche per la conduzione di uno studio LCA secondo quanto previsto dalla metodologia PEF (Product Environmental Footprint) per la valutazione dell'impronta ambientale di prodotto così come definita nella Raccomandazione 2013/179/UE della Commissione e, ove possibile, dalle Product Environmental Footprint Category Rules Guidance, Version 6.3, May 2018.

ll documento, sviluppato nell'ambito del progetto LIFE EFFIGE, è riferito al solo mercato Italiano ed è stato redatto in collaborazione con il Consorzio Agrituristico Mantovano "Verdi Terre d'Acqua". I suoi contenuti sono un contributo agli studi di settore, ma non sono vincolanti rispetto ad altre iniziative in corso o a venire".

This paper include methodological indication for the development of a LCA study according with the PEF (Product Environmental Footprint) methodology in order to evaluate the product environmental foortprint as defined in Recommendation 2013/179/UE of European Commission and, when possible, of *Product Environmental Footprint Category Rules Guidance, Version 6.3, May 2018.*

The paper, developed inside the LIFE Project EFFIGE is focused only on Italian market and it was written in co-operation with Consorzio Agrituristico Mantovano. The paper subjects are a contribution to the sectoral studies but are not binding in relation to other activities currently underway or forthcoming.

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1 Introduction

The present Product Environmental Footprint Category Rules (PEFCR) is developed within the Life EFFIGE Project, aimed to develop new tools for the implementation of PEF in small and medium-sized businesses, helping them to experiment innovative approaches and methods reduce their environmental footprint and making them more competitive on the current market.

The Product Environmental Footprint (PEF) Guide provides detailed and comprehensive technical guidance on how to conduct a PEF study. PEF studies may be used for a variety of purposes, including in-house management and participation in voluntary or mandatory programmes.

The compliance with the present PEFCR is optional for PEF in-house applications, whilst it is mandatory whenever the results of a PEF study or any of its content is intended to be communicated.

1.1 Terminology: shall, should and may

This PEFCR uses precise terminology to indicate the requirements, the recommendations and options that could be chosen when a PEF study is conducted.

- The term “shall” is used to indicate what is required in order for a PEF study to be in conformance with this PEFCR.
- The term “should” is used to indicate a recommendation rather than a requirement. Any deviation from a “should” requirement has to be justified when developing the PEF study and made transparent.
- The term “may” is used to indicate an option that is permissible. Whenever options are available, the PEF study shall include adequate argumentation to justify 2. General information about the PEFCR

This PEFCR is valid for products in scope sold in Italy.

The PEFCR is written in English.

This PEFCR has been prepared in conformance with the following documents:

- Product Environmental Footprint (PEF) Guide; Annex II to the Recommendation 2013/179/EU, 9 April 2013. Published in the official journal of the European Union Volume 56, 4 May 2013;

- "PEFCR Guidance version 6.3", excluding all that parts applicable only from products already covered by existing PEFCR. Deviations from the requirements of Guidance v.6.3 have been made based on older versions of the Guidance and expert judgment.

- ENVIFOOD - Food and Drink Protocol, version 1.0, November 20th 2013.

Moreover, given the similarity in the production process of mustard with the marmalades, it is useful get in consideration the PECR on these products, i.e. PCR CPC 21494 on "jams, fruit, jellies, marmalades, fruit or nuit puree and fruit or nuit paste", version 2.0 - 2011 and valid until May 2020. Relating to the agricultural production this PCR on the general PCR of CPC Group 013 "Fruits and Nuts", that is expired in August 2017.

The organisations listed in Table 1 were the Sectorial Technical Group (STG), which is responsible for the development of the PEFCRs for the mustard sector.

Table 1 List of the organizations in the STG

Name of the organization	Type of organization	Name of the members
Consorzio Agrituristico Mantovano	Consortium	Marco Boschetti
Comune di Mantova	Public	Arch. Giulia Moraschi
Provincia di Mantova	Public	
Andrini Marmellate	Industry	Andrea Petrò
Loghino Sei Piane	Farm	Samuele Carrara
Loghino Vittoria	Farm	Francesco Ferrari

2 PEFCR scope

2.1 Product classification

Mustard is the result of activities that are classified *Nomenclature Générale des Activités Économiques dans les Communautés Européennes*/Statistical classification of products by activity (NACE/CPA) Rev.2 under code **10.39** and, in particular:

- **10.39.22.30:** Citrus fruit jams, marmalades, jellies, purees or pastes, being cooked preparations (excluding homogenized preparations);

- **10.39.22.90:** Jams, marmalades, fruit jellies, fruit or nut purees and pastes, being cooked preparations (excluding of citrus fruit, homogenised preparations).

2.2 Representative product(s)

The RP is virtual products defined on the basis on Italian market share of the different kind of mustard recipes. Mustard is an old product with long history and the innovation in the industry are very small. Therefore no significant differences are in the production process.

Nevertheless there is a critical problem in the definition of the recipe for the functional unit, not only because of the wide range of different recipes, including different type of fruit and vegetable, but also because the composition of a single product sold in the market is never fix. Therefore, the representative product has been defined considering all the input of more than 85% of the total national market production (year 2017), weighted be each company market share. Functional unit and reference flow

The functional unit, as approved by the STG, is **1 Kg of Mustard at industry gates**.

Table 2 ***Key aspects of the FU***

What?	Mustard
How much?	1 kg of mustard mix
How long?	Until the expiry date

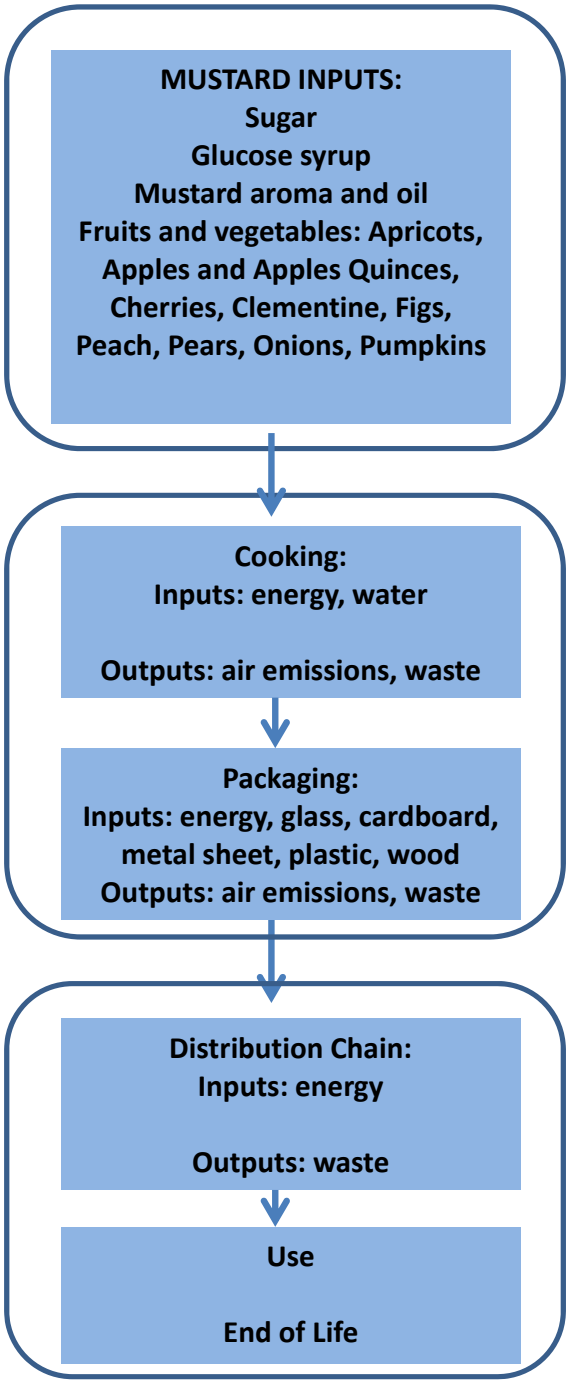
2.3 System boundary

The flow diagram of the entire process includes the following activities:

Table 3 Life cycle stages

Life cycle stage	*Short description of the processes included*
Inputs production – agricultural stage	Production and supply of inputs, including: - Sugar; - Glucose syrup; - mustard aroma or mustard natural oil; - Apricots; - Apples; - Apples Quinces;

Life cycle stage	*Short description of the processes included*
	- Clementine; - Cherries; - Figs; - Peach; - Pears; - Onions; - Pumpkins;
Production – cooking stage (candied fruit)	Melting of inputs in big pots heated with hot water. From the input side: - Energy sources (electricity, natural gas) - Water; From the output side; - Air emissions - Drainage Water - Waste
Production – mustard addition and packaging stage	Mustard Packaging. From the input side: - Electricity; - Glass - Metal sheet - Paper and cardboard - PVC; - Pallet wood; From the output side; - Air emissions; - Waste
Distribution Chain	Final product supply: storage and transportation. From the input side: - Electricity; - Fuel; From the output side: - Waste.
Use	Consumption: eat the product (without cooking)
End of Life	Circular Footprint Formula provided in chapter 4.7



Processes in Situation 1 are the processes run by the company applying the PEFCR. Processes in Situation 3 are the ones not run by the company applying the PEFCR and this company does not have access to (company-) specific information.

According to this PEFCR, the following processes may be excluded based on the cut-off rule:

- The production of buildings and equipment.

2.4 EF impact assessment

Each PEF study carried out in compliance with this PEFCR shall calculate the PEF-profile including all PEF impact categories listed in the table below (ILCD Method 2011 for characterisation, normalisation and weighting factors)

Impact category	Indicator	Unit	Recommended default LCIA method	Source of CFs	Robustness
Climate change	Radiative forcing as Global Warming Potential (GWP100)	kg $CO_{2\ eq}$	Baseline model of 100 years of the IPCC (based on IPCC 2013)	EC-JRC, 2017[1]	I
Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 $_{eq}$	Steady-state ODPs as in (WMO 1999)	EC-JRC, 2017	I
Human toxicity, cancer*	Comparative Toxic Unit for humans (CTU_h)	CTUh	USEtox model (Rosenbaum et al, 2008)	EC-JRC, 2017	III/interim
Human toxicity, non-cancer*	Comparative Toxic Unit for humans (CTU_h)	CTUh	USEtox model (Rosenbaum et al, 2008)	EC-JRC, 2017	III/interim
Particulate matter	Impact on human health	disease incidence	PM method recomended by UNEP (UNEP 2016)	EC-JRC, 2017	I
Ionising radiation, human health	Human exposure efficiency relative to U^{235}	kBq U^{235} $_{eq}$	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)	EC-JRC, 2017	II
Photochemical ozone formation,	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$	LOTOS-EUROS model (Van	EC-JRC,	II

[1] The complete list of the characterization factors (EC-JRC, 2017a) is available at the following link: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtm

Impact category	Indicator	Unit	Recommended default LCIA method	Source of CFs	Robustness
human health			Zelm et al, 2008) as implemented in ReCiPe 2008	2017	
Acidification	Accumulated Exceedance (AE)	mol $H+_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	EC-JRC, 2017	II
Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N_{eq}	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	EC-JRC, 2017	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P_{eq}	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	EC-JRC, 2017	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N_{eq}	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	EC-JRC, 2017	II
Ecotoxicity, freshwater*[2]	Comparative Toxic Unit for ecosystems (CTU_e)	CTUe	USEtox model, (Rosenbaum et al, 2008)	EC-JRC, 2017	III/interim
Land use	• Soil quality index • Biotic production • Erosion resistance • Mechanical filtration • Groundwater replenishment	• Dimensionless (pt) • kg biotic production • kg soil • m^3 water • m^3 groundwater	Soil quality index based on LANCA (Beck et al. 2010 and Bos et al. 2016)	EC-JRC, 2017	III
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 world $_{eq}$	Available WAter REmaining (AWARE) as recommended by UNEP, 2016	EC-JRC, 2017	III
Mineral, fossil and renewable resource depletion	Abiotic resource depletion (ADP ultimate reserves)	kg Sb_{eq}	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.		III

[2] Long-term emissions (occurring beyond 100 years) shall be excluded from the toxic impact categories. Toxicity emissions to this sub-compartment have a characterisation factor set to 0 in the EF LCIA (to ensure consistency). If included by the applicant in the LCI modelling, the sub-compartment 'unspecified (long-term)' shall be used

2.5 Limitations

The main limitation are the lack of data on the production of buildings and equipment. This is due also to the long history of the mustard production: in many firms the plants are mix of old and new tools and it is very difficult to make a model of the equipment with a similar differentiation. For example, there are craft production with big pots with more than eighty years and industrial production with production line with more than thirty years old. The same situation there is in the buildings, that in some firms are more than a century year old.

3 Most relevant impact categories, life cycle stages, processes and elementary flows

The most relevant impact categories for the product Mustard, in scope of this PEFCR, are the following:

- climate change
- particulate matter
- acidification
- marine eutrophication

For all relevant impact categories, the most relevant life cycle stages for product, in scope of this PEFCR, are the following:

- Production process;
- Mustard addition and packaging.

The most relevant processes for product Mustard in scope of this PEFCR are the following:

Table 1. List of the most relevant processes: mustard

Impact category	*Processes*
Climate change;	Natural gas – Cooking stage; Electricity – Cooking stage; Plastic – Packaging stage.
Particular matter	Plastic – Packaging stage; Glass – Packaging stage; Sugar - Input production – agricultural stage; Glucose syrup - Input production – agricultural stage; Electricity – Cooking stage; Natural gas – Cooking stage.
Acidification	Plastic – Packaging stage; Glass – Packaging stage; Biowaste treatment of composting; Natural gas – Cooking stage; Electricity – Cooking stage.
Marine eutrophication	Sugar beet - Input production – agricultural stage; Sugar production - Input production.

4 Life cycle inventory

4.1 List of mandatory company-specific data

The following processes shall be modelled using company specific data:

- Consumption and supply of inputs materials;
- Cooking;
- Mustard addition and Packaging;
- Distribution Chain
- Use (no mandatory data)
- End of Life

4.2 Mandatory data on consumption and supply of inputs materials life stage

Data collection requirements for mandatory process of Inputs Production life cycle stage: mustard

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node)*	*UUID*	*TiR*	*TeR*	*GR*	*P*	*DQR*	
Inputs:											
Yearly Apricots consumption	1 year average	ton/year	Apricot {IT}| apricot production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apricots per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apricots per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Cherries consumption	1 year average	Ton /year	Proxy from Peach {IT}| peach production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	

Yearly amount of transported Cherries per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Cherries per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Clementine consumption	1 year average	ton/year	Clementine, export quality, Souss, at orchard/MA U	Agribalyse	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Clementine per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Clementine per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Figs consumption	1 year average	Ton /year	Proxy from Apple {IT}| apple production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Figs per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	

Yearly amount of transported Figs per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Apples consumption	1 year average	ton/year	Apple {IT}| apple production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apples per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apples per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Apple Quinces consumption	1 year average	Ton /year	Proxy from Apple {IT}| apple production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apple Quinces per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Apple Quinces per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	

Yearly Peach consumption	1 year average	ton/year	Peach {IT}| peach production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Peach per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Peach per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Pears consumption	1 year average	Ton /year	Pear {BE}| pear production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Pears per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Pears per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Onions consumption	1 year average	ton/year	Onion, at farm/FR Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Onions per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	

Yearly amount of transported Onions per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Pumpkins consumption	1 year average	Ton /year	Proxy from Zucchini {GLO}| production | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Pumpkins per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Pumpkins per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Sugar consumption	1 year average	ton/year	Sugar, from sugar beet, from sugar production, at plant/IT Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported sugar per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported sugar per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Glucose	1 year average	Ton /year	Sugar, from sugarcane	Ecoinvent 3 +	n/a	n/a	n/a	n/a	n/a	n/a	

syrup consumption			{GLO}| market for | Alloc Rec, U + Enzyme, Alpha-amylase, Novozyme Liquozyme/kg/RER Copy	data from EU PEF pilot for beer							
Yearly amount of transported Glucose syrup per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Glucose syrup per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Mustard Aroma (Allyl Isothiocyanate) consumption	1 year average	ton/year	Proxy from Allyl chloride {GLO}| market for | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Mustard Aroma per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Mustard Aroma per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly	1 year average	Ton /year	Proxy from	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	

Mustard Essential Oil consumption			Allyl chloride {GLO}| market for | Alloc Rec, U								
Yearly amount of transported Mustard Essential Oil per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Mustard Essential Oil per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly Brown Sugar consumption	1 year average	ton/year	Sugar, from sugar cane, from sugar production, at plant/BR Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Brown Sugar per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported Brown Sugar per km travelled on ship	1 year average	Ton km / year	Transport, sea ship, 80000 DWT, 100%LF, long, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly water	1 year average	m^3/year	Tap water {Europe	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	

consumption			without Switzerland}| market for | Alloc Rec, U								

4.3 Mandatory data on production cooking life stage

Data collection requirements for mandatory process of Production Cooking life cycle stage: mustard – candied fruits

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	***Specific requirements (e.g. frequency, measurement standard, etc)***	***Unit of measure***	***Default dataset to be used***	***Dataset source (i.e. node)***	***UUID***	***TiR***	***TeR***	***GR***	***P***	***DQR***	
Inputs:											
Yearly electricity consumption for cooking	1 year average	kWh / year	Electricity, medium voltage {IT}| market for | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly natural gas consumption for cooking	1 year average	m^3 / year	Heat, district or industrial, natural gas {Europe without Switzerland}| heat production, natural gas, at boiler condensing modulating >100kW | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node)*	*UUID*	*TiR*	*TeR*	*GR*	*P*	*DQR*	
Yearly water consumption for cooking	1 year average	m^3 / year	Tap water {Europe without Switzerland}| tap water production, conventional treatment | APOS, U	Ecoinvent	n/a	n/a	n/a	n/a	n/a	n/a	
Outputs:											
Yearly packaging waste: paper and cardboard packaging (EWC 15.01.01)	1 year average	ton / year	Linerboard {RER}| production, kraftliner | Alloc Rec, U Linerboard {RER}| treatment of recovered paper to, testliner | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly plastic packaging (EWC 15.01.02)	1 year average	ton / year	Polypropylene, granulate {GLO}| market for | Alloc Rec, UGlass, secondary, at plant/		n/a	n/a	n/a	n/a	n/a	n/a	

4.4 Mandatory data on production packaging life stage

Data collection requirements for mandatory process of addition mustard aroma (or essential oil) and packaging life cycle stage: mustard

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node)*	*UUID*	*TiR*	*TeR*	*GR*	*P*	*DQR*	
Inputs:											
Yearly Aluminium foil consumption for packaging	1 year average	ton/year	Aluminium, primary, at plant – IT	Ecoinvent 3 + data from EU PEF pilot for beer	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported aluminium foil per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly plastic consumption for packaging	1 year average	Ton km / year	Polypropylene, granulate {GLO}| market for | Alloc Rec, UGlass, secondary, at plant/ Extrusion, plastic film {GLO}| market for | Alloc	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	

			Rec, U								
Yearly amount of transported plastic per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly cardboard consumption for packaging	1 year average	Ton / year	Linerboard {RER}| production, kraftliner | Alloc Rec, U Linerboard {RER}| treatment of recovered paper to, testliner | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported cardboard per km travelled on ship	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly glass consumption for packaging	1 year average	Ton / year	Glass, primary, at plant/ RER IT Glass, secondary, at plant/ RER IT	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	

glass per km travelled on ship											

4.5 Mandatory data on distribution chain life stage

Data collection requirements for mandatory process of Distribution Chain life cycle stage: mustard

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	***Specific requirements (e.g. frequency, measurement standard, etc)***	***Unit of measure***	***Default dataset to be used***	***Dataset source (i.e. node)***	***UUID***	***TiR***	***TeR***	***GR***	***P***	***DQR***	
Inputs:											
Yearly electricity consumption for storage	1 year average	kWh / year	Electricity, medium voltage {IT}| market for | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly amount of transported mustard per km travelled on lorry	1 year average	Ton km / year	Transport, truck >20t, EURO5, 80%LF, default/GLO Economic	Agri-footprint	n/a	n/a	n/a	n/a	n/a	n/a	
Outputs:											

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node)*	*UUID*	*TiR*	*TeR*	*GR*	*P*	*DQR*	
Yearly packaging waste: paper and cardboard packaging (EWC 15.01.01)	1 year average	ton / year	Linerboard {RER}| production, kraftliner | Alloc Rec, U Linerboard {RER}| treatment of recovered paper to, testliner | Alloc Rec, U	Ecoinvent 3	n/a	n/a	n/a	n/a	n/a	n/a	
Yearly plastic packaging (EWC 15.01.02)	1 year average	ton / year	Polypropylene, granulate {GLO}| market for | Alloc Rec, UGlass, secondary, at plant/		n/a	n/a	n/a	n/a	n/a	n/a	
Yearly packaging waste: metal sheet packaging (EWC 15.01.04)	1 year average	ton / year	Aluminium, primary, at plant – IT Aluminium can body, secondary, at plant/ RER - IT	Ecoinvent 3 + data from EU PEF pilot for beer	n/a	n/a	n/a	n/a	n/a	n/a	

4.6 Use stage

No mandatory data are recommended for mustard, since the product is ready to be eaten without any cooking phaset and the only waste is the packaging (data are collected in the packaging stage).

4.7 End of Life stage

On end of life of packaging materials, use the CFF formula indicated in PEF Guidance 6.3, with national average value on recycling rate, incineration rate and landfill rate.

PROCESS	KIND OF WASTE	CFF VALUE
Disposal, aluminium, 0% water, to municipal incineration/CH U (incl energy recovery)	Aluminium	9.8 %
Disposal, aluminium, 0% water, to sanitary landfill/CH U - PEF	Aluminium	18.2 %
Recycling aluminium (PEF) - CFF - IT	Aluminium	57.6 %
Disposal, packaging cardboard, 19.6% water, to municipal incineration/CH U (incl energy recovery) - CFF IT	Cardboard	9.45 %
Disposal, packaging cardboard, 19.6% water, to sanitary landfill/CH U - CFF	Cardboard	10.07 %
Recycling cardboard (PEF) - CFF IT	Cardboard	67.6 %
Disposal, glass, 0% water, to inert material landfill/CH U - PEF	Glass	24.05 %
Disposal, glass, 0% water, to municipal incineration/CH U (incl energy recovery)	Glass	12.95 %
Recycling glass (PEF) - PEF/Integrated formula - CFF IT	Glass	50.4 %
Disposal, packaging paper, 13.7% water, to municipal incineration/CH U - PEF (included energy recovery) - CFF IT	Packaging paper	9.45 %
Disposal, packaging paper, 13.7% water, to sanitary landfill/CH U - PEF	Packaging paper	17.55 %
Recycling packaging paper (PEF) - CFF IT	Packaging paper	58.4 %
Disposal, PE sealing sheet, 4% water, to municipal incineration/CH U - CFF IT	PE	25.2 %
Recycling PE (CFF)	PE	14 %
Waste polyethylene {Europe without Switzerland}| treatment of waste polyethylene, sanitary landfill | Alloc Rec, U - CFF - IT	PE	46.8 %
Disposal, polyethylene terephtalate, 0.2% water, to municipal incineration/CH U (incl energy recovery) - CFF IT	PET	24.15 %
Disposal, polyethylene terephtalate, 0.2% water, to sanitary landfill/CH U - PEF	PET	44.85 %
Recycling PET (PEF) - CFF IT	PET	15.5 %
Recycling PP (PEF) - CFF IT PROXY	PP	14 %
Waste polypropylene {CH}| treatment of, municipal incineration | Alloc Rec, U - CFF IT	PP	25.2 %
Waste polypropylene {CH}| treatment of, sanitary landfill | Alloc Rec, U - CFF IT	PP	46.8 %
Recycling PVC - CFF IT - Proxy	PVC	14 %
Waste polyvinylchloride {Europe without Switzerland}| treatment of waste polyvinylchloride, municipal incineration | Alloc Rec, U	PVC	25.2 %
Waste polyvinylchloride {Europe without Switzerland}| treatment of waste polyvinylchloride, sanitary landfill | Alloc Rec, U	PVC	46.8 %

irect elementary flows requirements

Direct elementary flow collection requirements - moustard

Emissions/resources	Elementary flow	Frequency of measurement
CO_2 to Air, from cooking	Carbon dioxide (from fossil and Carbon dioxide, land transformation)	Yearly emission
Methane, fossil to Air, from cooking	Methane (from fossil)	Yearly emission
Dust to air, from cooking	Particulates, < 2.5 um	Yearly emission
Sulphur dioxides to air, from coocking and packaging	Sulphur dioxides	Yearly emission
Nitrogen oxides to air, from cooking and packaging	Nitrogen oxides	Yearly emission
Ammonium ion on air from agricultural production on input and cooking	Ammonioum ion	Yearly emission

4.8 List of processes expected to run by the company

All processes expected to be run by the company, for which company-specific data are mandatory, are reported in chapters 4.2 – 4.5 List of mandatory company-specific data.

4.9 Data gaps

Unless primary data on input materials and consumables production of appropriate quality (as defined in the PEF Recommendation) are made available from producers, to assure an appropriate overall quality of the PEF study and the comparability of the results, default proxies reported in cap. 4.2 – 4.5. have to be used.

4.10 Data quality requirements

In the screening report there are two categories with poor data in mustard production:

- Freshwater ecotoxicity;
- Water resource depletion.

Freshwater ecotoxicity is not a relevant impact category; Water resource depletion is important but is in the agricultural stage of the life cycle, so out of the enterprise control.

For other data quality requirements, assessment and reporting, see. PEFCR Guidance 6.3, Section B.5.4

4.11 Data needs matrix (DNM)

For the evaluation of all processes required to model the product using the Data Needs Matrix, see PEFCR Guidance 6.3. Section B.5.5.

4.12 Allocation rules

In the Production Plant, data of consumption of energy (power and gas), water and some waste output (drained water and packaging) shall be allocated with respect to the total mass of materials that are processed in the Plant and measured at the production gate .

4.13 Which datasets to use?

The secondary datasets to be used by the applicant are those listed in this PEFCR, and are get from:

- Ecoinvent 3 (www.ecoinvent.org)
- Agri-footprint (www.agri-footprint.com)
- Agribalyse (www.ademe.fr/agribalyse-r).

Whenever a dataset needed to calculate the PEF-profile is not among those listed in this PEFCR, then the applicant shall choose between the following options (in hierarchical order):

- Use an EF-compliant dataset available on one of the EU nodes or available in a free or commercial source;
- Use another EF-compliant dataset considered to be a good proxy. In such case this information shall be included in the "limitation" section of the PEF report;
- Use an ILCD-entry level-compliant dataset. In such case this information shall be included in the "data gap" section of the PEF report.

4.14 Modelling of wastes and recycled content

For modelling of waste and recycled content the Circular Footprint Formula, as described in PEFCR Guidance 6.3, Section B.5.11, shall be applied.

5 Life cycle stages

5.1 Inputs production

Processes related to production inputs acquisition, for which company-specific data are mandatory, are reported in chapter 4.2, 4.3, 4.4 List of mandatory company-specific data.

5.2 Manufacturing and supply chain

Processes expected to be run by the company at manufacturing stage, for which company-specific data are mandatory, are reported in chapter 4.3,4.4, 4.5 List of mandatory company-specific data.

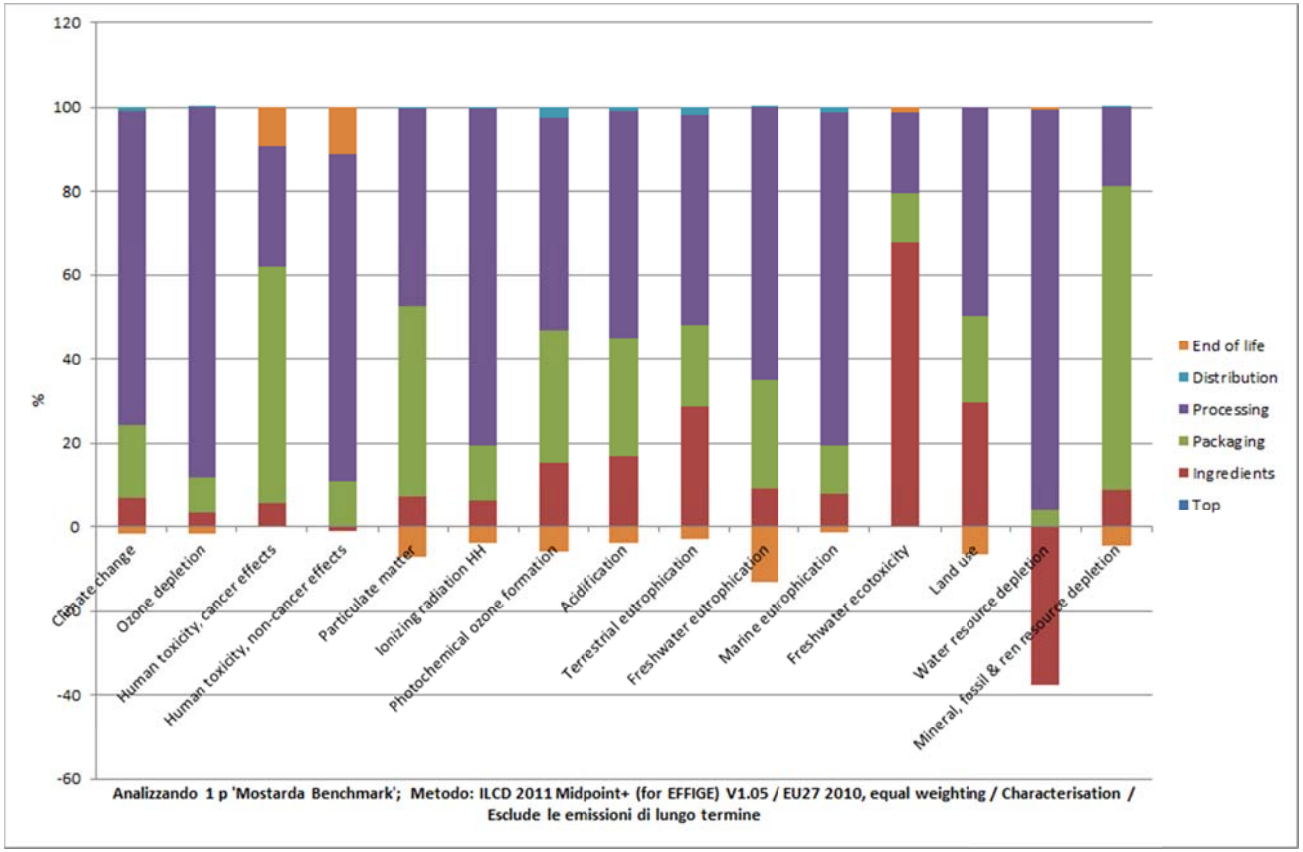
6 PEF results

6.1 Benchmark values

The following table reports the characterized, normalized and weighted LCIA results for 1 kg of mustard

Characterized results

Impact category	Unit	Total	Ingredients	Packaging	Processing	Distribution	End of life
Climate change	kg CO2 eq	3,92	0,27	0,69	3,00	0,03	- 0,07
Ozone depletion	kg CFC-11 eq	4,26E-07	1,42E-08	3,67E-08	3,82E-07	6,32E-11	-6,60E-09
Human toxicity, cancer effects	CTUh	1,09E-07	6,24E-09	6,15E-08	3,13E-08	2,33E-11	1,03E-08
Human toxicity, non-cancer effects	CTUh	9,33E-07	-9,10E-09	1,03E-07	7,32E-07	5,16E-10	1,07E-07
Particulate matter	kg PM2.5 eq	2,09E-03	1,57E-04	1,02E-03	1,07E-03	2,76E-06	-1,58E-04
Ionizing radiation HH	kBq U235 eq	9,95E-02	6,33E-03	1,37E-02	8,34E-02	7,69E-05	-4,07E-03
Photochemical ozone formation	kg NMVOC eq	8,25E-03	1,35E-03	2,74E-03	4,45E-03	2,09E-04	-4,95E-04
Acidification	molc H+ eq	1,77E-02	3,13E-03	5,20E-03	9,97E-03	1,66E-04	-7,26E-04
Terrestrial eutrophication	molc N eq	4,21E-02	1,24E-02	8,54E-03	2,16E-02	8,41E-04	-1,33E-03
Freshwater eutrophication	kg P eq	2,64E-04	2,74E-05	7,84E-05	1,98E-04	9,95E-08	-3,97E-05
Marine eutrophication	kg N eq	6,18E-03	4,87E-04	7,35E-04	4,96E-03	7,67E-05	-8,10E-05
Freshwater ecotoxicity	CTUe	11,84	8,05	1,38	2,25	0,01	0,14
Land use	kg C deficit	8,20	2,58	1,83	4,34	-	- 0,55
Water resource depletion	m3 water eq	1,93E-02	-1,15E-02	1,19E-03	2,94E-02	4,52E-07	1,78E-04
Mineral, fossil & ren resource depletion	kg Sb eq	1,92E-04	1,78E-05	1,46E-04	3,76E-05	7,26E-09	-8,84E-06


120
100
80
60
40
20
0
-40
-60
%
Climate change
Ozone depletion
Human toxicity, cancer effects
Human toxicity, non-cancer effects
Particulate matter
Ionizing radiation HH
Photochemical ozone formation
Acidification
Terrestrial eutrophication
Freshwater eutrophication
Marine eutrophication
Freshwater ecotoxicity
Land use
Water resource depletion
Mineral, fossil & ren resource depletion
End of life
Distribution
Processing
Packaging
Ingredients
Top
Analizzando 1 p 'Mostarda Benchmark'; Metodo: ILCD 2011 Midpoint+ (for EFFIGE) V1.05 / EU27 2010, equal weighting / Characterisation / Esclude le emissioni di lungo termine

Normalized results

Impact category	Total	Ingredients	Packaging	Processing	Distribution	End of life
Climate change	0,000431	3,00E-05	7,63E-05	0,00033	3,40E-06	-7,99E-06
Ozone depletion	1,97E-05	6,58E-07	1,70E-06	1,77E-05	2,92E-09	-3,05E-07
Human toxicity, cancer effects	0,002961	0,000169	0,001666	0,000847	6,31E-07	0,000278
Human toxicity, non-cancer effects	0,00175	-1,71E-05	0,000193	0,001373	9,67E-07	0,0002
Particulate matter	0,000549	4,13E-05	0,000268	0,000281	7,25E-07	-4,15E-05
Ionizing radiation HH	8,8E-05	5,60E-06	1,21E-05	7,38E-05	6,80E-08	-3,60E-06
Photochemical ozone formation	0,00026	4,25E-05	8,64E-05	0,00014	6,58E-06	-1,56E-05
Acidification	0,000374	6,60E-05	0,00011	0,00021	3,51E-06	-1,53E-05
Terrestrial eutrophication	0,000239	7,04E-05	4,85E-05	0,000123	4,78E-06	-7,54E-06
Freshwater eutrophication	0,000178	1,85E-05	5,30E-05	0,000134	6,73E-08	-2,68E-05
Marine eutrophication	0,000366	2,88E-05	4,35E-05	0,000294	4,54E-06	-4,79E-06
Freshwater ecotoxicity	0,001349	0,000917	0,000158	0,000257	1,50E-06	1,60E-05
Land use	0,00011	3,46E-05	2,46E-05	5,82E-05	0	-7,41E-06
Water resource depletion	2,37E-04	-0,00014	1,47E-05	0,000362	5,56E-09	2,19E-06
Mineral, fossil & ren resource depletion	0,001905	0,000176	0,001445	0,000372	7,19E-08	-8,75E-05

Weighted results

Impact category	Unit	Total	Ingredients	Packaging	Processing	Distribution	End of life
Totale	µPt	7,21E+02	9,61E+01	2,80E+02	3,25E+02	1,79E+00	1,85E+01
Climate change	µPt	2,88E+01	2,00E+00	5,09E+00	2,20E+01	2,27E-01	-5,33E-01
Ozone depletion	µPt	1,32E+00	4,39E-02	1,13E-01	1,18E+00	1,95E-04	-2,04E-02
Human toxicity, cancer effects	µPt	1,97E+02	1,13E+01	1,11E+02	5,65E+01	4,20E-02	1,85E+01
Human toxicity, non-cancer effects	µPt	1,17E+02	-1,14E+00	1,28E+01	9,15E+01	6,45E-02	1,34E+01
Particulate matter	µPt	3,66E+01	2,76E+00	1,79E+01	1,87E+01	4,83E-02	-2,76E+00
Ionizing radiation HH	µPt	5,87E+00	3,73E-01	8,08E-01	4,92E+00	4,54E-03	-2,40E-01
Photochemical ozone formation	µPt	1,73E+01	2,84E+00	5,76E+00	9,34E+00	4,39E-01	-1,04E+00
Acidification	µPt	2,49E+01	4,40E+00	7,31E+00	1,40E+01	2,34E-01	-1,02E+00
Terrestrial eutrophication	µPt	1,59E+01	4,69E+00	3,23E+00	8,19E+00	3,19E-01	-5,03E-01
Freshwater eutrophication	µPt	1,19E+01	1,23E+00	3,53E+00	8,90E+00	4,49E-03	-1,79E+00
Marine eutrophication	µPt	2,44E+01	1,92E+00	2,90E+00	1,96E+01	3,03E-01	-3,20E-01
Freshwater ecotoxicity	µPt	9,00E+01	6,12E+01	1,05E+01	1,71E+01	1,00E-01	1,06E+00
Land use	µPt	7,33E+00	2,30E+00	1,64E+00	3,88E+00	0,00E+00	-4,94E-01
Water resource depletion	µPt	1,58E+01	-9,46E+00	9,79E-01	2,41E+01	3,71E-04	1,46E-01
Mineral, fossil & ren resource depletion	µPt	1,27E+02	1,17E+01	9,63E+01	2,48E+01	4,79E-03	-5,83E+00

6.2 PEF profile

The applicant shall calculate the PEF profile of its product in compliance with all requirements included in this PEFCR. The following information shall be included in the PEF report:

- full life cycle inventory;
- characterised results in absolute values, for all impact categories (including toxicity; as a table);
- normalised and weighted result in absolute values, for all impact categories (including toxicity; as a table);
- the aggregated single score in absolute values.