Footprint Category Rules Red Meat

Version 1.0

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July 2019

Technical Secretariat for the Red Meat Pilot

Foreword

The European Livestock and Meat Trades Union (UECBV) has developed this document with the aim of creating a comprehensive and harmonised scientific methodology that can be used by the industry stakeholders to calculate the product environmental footprint of red meat and to determine the impact of the red meat supply chain.

The Footprint Category Rules for Red Meat (FCR RED MEAT) will allow individual companies, in the red meat sector, to assess their environmental hot-spots associated with their supply chain and to compare environmental performance within species (pork vs. pork, beef vs. beef, lamb vs. lamb)

Following the LCA principles of products comparability, this guide shall not be used for any other purpose.

FCR RED MEAT is the result of an intensive development process, guided by the Single Market for Green Products Initiative organized by the European Commission (EC) during the Product Environmental Footprint Category Rules (PECR) pilot phase. However, this document was finalized independently by UECBV. During the development of this FCR RED MEAT two public consultations were carried out using a number of different stakeholders.

The consultations were carried out through the DG ENVI Wiki platform, to which more than 250 stakeholders, including LCA-practitioners, public authorities, NGO´s and industry stakeholders, had access.

The participating stakeholders included also:

- ADEME - French Environment and Energy Management Agency – Public sector
- DG ENVI – European Commission – Public sector
- Du Pont - Packaging Materials and Packaging Solutions – Private sector
- ENEA (IT) - Italian National Agency for new technologies, energy and sustainable economic development – Public sector
- EFFPRA – European Renderers Organisation – Private Sector
- FEDIAF – European Petfood industry – Private sector
- FEFAC – European Feed Industry- Private sector
- Nordic Environmental Footprint (NEF) – Public sector/Academy
- Soltub ltd. (Hungary) – Consultancy - Private sector
- Thinkstep – Consultancy – Private sector

The UECBV Red Meat FCR guidelines have also been peer reviewed, to ensure that they are robust and consistent, in compliance with PEFCR guidance document v 5.2 with the exception of three methodological choices: allocation at slaughterhouse, functional unit and handling of manure. The

two reviewers were chosen on the basis of their environmental, livestock and agricultural backgrounds and experience:

- Dr. - Stewart Ledgard (AgResearch - New Zealand – FAO Livestock Environmental Assessment and Performance contributor on small ruminant and large ruminant guidelines)

- PhD – Mirko Miselic (Force Technology – Denmark – Expert in environmental assessment, and mitigation, of waste handling, water distribution, industrial productions, and pollution of different environmental compartments (water, soil and air).

We hope that this document will provide a comprehensive guidance and a reference tool, when carrying out a Life Cycle Assessment within the meat sector.

Due to the complexity of the different livestock farming systems, the TS will explore further the issue of representative sampling.

UECBV welcomes contributions to improve the usability and the precision of this tool from LCA practitioners and experts in agricultural and livestock sciences.

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Abbreviations and Units

COD	= Chemical Oxygen demand
CF(s)	= Characterization factor(s)
CMWG	= Cow model working group
DE	= Digestible Energy
DM	= Dry matter content
DQA	= Data Quality Assessment
DQS	= Data Quality Score
EF	= Environmental Footprint
ELCD	= European reference Life Cycle Database
EPD	= Environmental Product Declaration
EOL	= End of Life Modelling
FCR	= Footprint category rules
Feed Pilot	= PEF pilot feed for food producing animals
FEFAC	= European Feed Manufacturers Federation
GE	= Gross Energy
GHG	= Greenhouse Gases
GWP	= Global Warming Potentials
Ha	= Hectare
HH	= Human health (used in ionizing radiation HH)
HSCW	= Hot slaughtered carcase weight
IDF	= International Dairy Federation
ILCD	= International Reference Life Cycle Data System
IPCC	= Intergovernmental Panel on Climate Change
ISO	= International Organization for Standardization
kWh	= kilowatt hour
LCA	= Life Cycle Assessment
LCI	= Life Cycle Inventory
LCIA	= Life Cycle Impact Assessment
LHV	= Lower Heating Value (or net calorific value)
LUC	= Land Use Change
LW	= Live weight
NACE	= Statistical classification of economic activities in the European Community
NPK	= Nitrogen (N), Phosphorus (P) and Potassium (K)
OEF	= Organisation Environmental Footprint
PCR	= Product Category Rules
PEF	= Product Environmental Footprint
PEFCR	= Product Environmental Footprint Category Rules
RER	= Region Europe
ReCiPe	= Impact assessment method
RP	= Representative Product
SC	= Steering Committee
TS	= Technical Secretariat
TS feed	= Technical Secretariat of the pilot feed for food producing animals
TS meat	= Technical Secretariat of the pilot for Red Meat
UECBV	= European Livestock and Meat Trading Union

Definitions

These paragraphs describe the whole animal and refer to definitions used in the slaughterhouse.

PROCESSES

Downstream processes: All processes and activities that happen after the core process and use the outputs of the core processes.

Upstream processes: All processes that happen before the core process, and lead to supply of inputs for the core process (from cradle-to-gate).

PRODUCTS, CO-PRODUCTS, BY-PRODUCTS AND WASTE

FRESH MEAT

The fresh meat product category includes **fresh meat and edible offal products either chilled or frozen**. Throughout the document, the term "fresh meat" is used to refer to both fresh meat and offal.

Fresh meat: According to CE/853/2004 the edible parts of the animal that has not undergone any preserving process other than chilling, freezing or quick-freezing, including that is vacuum-wrapped or wrapped in a controlled atmosphere, including the offal

Offal (or offals):

The term offal refers to the edible parts of the animal that are harvested in the slaughterhouse prior to the carcase being weighed. Usually the terms red and white offal are used. There are differences though based on geography and the different animal species in relation to how the term is used. In this FCR RED MEAT red offal is understood to include, but not limited to, tongue, throat, head, pluck (including aorta, heart, oesophagus, trachea and lungs) liver, diaphraghm, kidneys, intestine, cheek meat and tail, while white offal includes, but not limited to, the brains, sweetmeats, marrow and testicles. When used for human consumption, offal should be considered generally as fresh meat. If not used for human consumption, offal will be reclassified under the Reg. (CE) 1069/2011. Please look at the table below reported for further clarification.

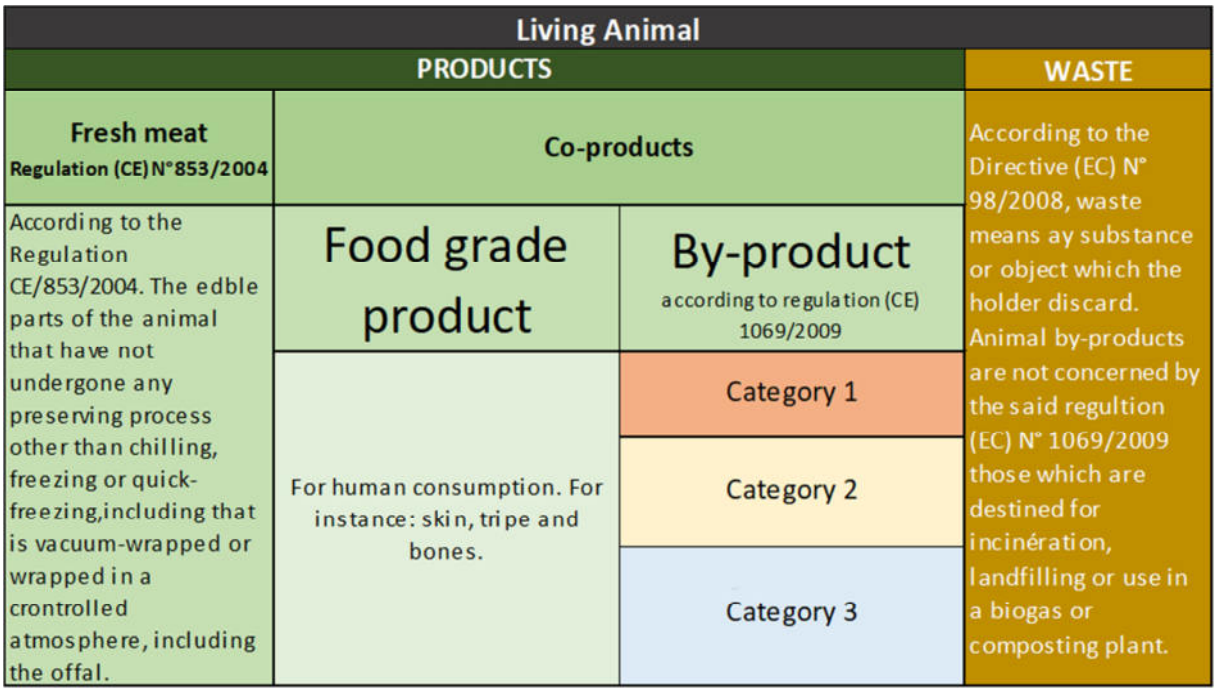


Figure D-1-1 - How to deal with waste and products

Co-products: Part of the animal that is not carcase meat, including food grade products and animal by-products.

Food grade product: Co-product intended for human consumption after further processing. For instance: skin and bones for gelatine, processed stomachs (tripe), hooves and casings.

Animal by-products: ABPs are animal carcasses, parts of animals, or other materials which come from animals but are not intended for humans to eat. They can either be destroyed or can be used to make pet-food, compost, biogas or other products depending on which category they are.

In this Footprint Category Rules (FCR) RED MEAT Animal by-products shall be understood to be by-products which are regulated under Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009. These are health rules concerning by-products of animal origin and derived products which are not intended for human consumption. The regulation sets end points in the manufacturing chain for processed and packaged pet food, biodiesel, tanned hides and skins and other by-products.

The regulation enables that all parts of the animal can be by-products including products normally intended for human consumption if a decision has been taken to downgrade them (i.e aesthetic or expiration date reasons).

Category 1, category 2 and category 3: terms which are used in the aforementioned animal by-product regulation – the categories describe products with different risk profiles and the regulation prescribes how by-products with these profiles must to be handled and the limitations for trade.

CLASSIFICATION OF ANIMAL BY-PRODUCTS

Category 1 material

Category 1 material comprises the following animal by-products:

- all body parts body, including hides and skins, of animals suspected of being infected by a transmissible spongiform encephalopathy (TSE) or in which the presence of a TSE has been confirmed, animals killed in the context of TSE eradication measures, experimental animals, wild animals suspected of being infected with a communicable disease;
- specified risk material as tissues likely to carry an infectious agent;
- products derived from animals that have absorbed prohibited substances or substances containing products dangerous for the environment;
- all animal material collected when treating wastewater from category 1 processing plants and other premises in which specified risk material is removed;
- international catering waste from vehicles operating internationally e.g cruise ships, airplanes etc.;
- mixtures of category 1 with category 2 and/or category 3 material.

Intermediate handling and storage of category 1 material must take place in approved intermediate establishments of the same category. Collected, transported and identified without delay, this material shall be:

- directly disposed of as waste by incineration in an approved incineration plant;
- processed in an approved plant by a specific method, in which case the resulting material shall be marked and finally disposed of as waste by incineration or co-incineration;
- with the exclusion of material coming from carcases of animals infected (or suspected of being infected) with a TSE, processed by a specific method in an approved plant, in which case the resultant material shall be marked and finally disposed of as waste by means of burial in an approved landfill;
- in the case of catering waste, disposed of by burial in a landfill.

Category 2 material

Category 2 material comprises the following animal by-products:

- manure and digestive tract content;
- all animal materials other than those belonging to category 1 collected when treating wastewater from slaughterhouses;
- products of animal origin containing residues of veterinary drugs and contaminants in concentrations exceeding the Community limits;
- products of animal origin, other than category 1 material, that are imported from third countries and fail to comply with the Community veterinary requirements;
- animals other than category 1 that have not been slaughtered for human consumption;
- mixtures of category 2 and category 3 material.

Except in the case of manure, the intermediate handling and storage of category 2 material must take place in approved intermediate establishments of the same category or can be downgraded to a category 1 plant. Collected, transported and identified without delay, this material shall be:

- directly disposed of as waste by incineration in an approved incineration plant;

- processed in an approved plant by a specific method, in which case the resultant material shall be marked and finally disposed of as waste;
- made into organic fertilisers/soil improvers, after processing and marking with GTH[1];
- composted or anaerobic digestion after processing by pressure sterilisation and marking with GTH (milk, milk products, eggs, egg products, digestive tract content, manure do not need processing, providing no risk of spreading serious transmissible disease);
- in the case of manure, digestive tract content, milk and colostrum not presenting any risk of spreading a communicable disease, either a) used without processing as raw material in a biogas or composting plant or treated in a technical plant, or b) applied to land;
- used in a technical plant to produce game trophies;
- used for manufacture of certain cosmetic products, medical devices and safe industrial or technical uses.

Category 3 material

Category 3 material comprises the following animal by-products:

- parts of slaughtered animals which are fit for human consumption but are not intended for human consumption for commercial reasons;
- parts of slaughtered animals which are rejected as unfit for human consumption but are not affected by any sign of a communicable disease;
- hides and skins, hooves and horns, pig bristles and feathers originating from animals that are slaughtered in a slaughterhouse and were declared fit for human consumption after undergoing an ante mortem inspection;
- blood obtained from animals declared fit for human consumption after undergoing an ante mortem inspection, other than ruminants slaughtered in a slaughterhouse;
- animal by-products derived from the production of products intended for human consumption, including degreased bones and greaves;
- former foodstuffs of animal origin, other than catering waste, which are no longer intended for human consumption for commercial reasons or due to problems of manufacturing or packaging defects;
- raw milk originating from animals that do not show any signs of a communicable disease;
- shells of eggs originating from animals that do not show any signs of a communicable disease;
- blood, hides and skins, hooves, feathers, wool, horns, hair and fur originating from healthy animals;
- catering waste other than category 1;
- mechanically recovered meat from bovine and ovine bones.

Intermediate handling and storage of category 3 material must take place in approved intermediate establishments of the same category. Collected, transported and identified without delay, this material shall be:

[1] Glyceroltriheptanoate (**GTH**) is a **marker** for animal by-products belonging to category 1 and 2, which are defined in the EU animal by-products

- directly disposed of as waste by incineration in an approved incineration plant;
- used as raw material in feed and pet food plants;
- processed by a specific method in an approved processing, technical, biogas or composting plant;
- composted or processed in a biogas plant in the case of category 3 catering waste;.

Waste: According to the Directive (EC) N° 98/2008, waste means any substance or object which the holder discards or intends or required to discard. As explained in the table above reported, animal by-products are not included, except according to the regulation (EC) N° 1069/2009 those which are destined for incineration, landfilling or use in a biogas or composting plant.

PACKAGING

Intermediate packaging: Packaging that is employed in the intermediate storage of products, but is not used as packaging in retail.

Retail packaging: Packaging in which the product is presented to the final consumer, for example, plastic meat trays in supermarkets. This may include primary packaging, directly in contact with the packed product and secondary packaging, packaging that is put around one or more primary packed products.

MARKETS

In the livestock and meat industry “markets” is used to refer to more than just the consumer market. It is regularly used as a collective noun to cover all outlets to where meat, co-products and animal by-products are sold. Therefore the collective noun markets includes retailers, wholesalers, exporters, renderers, tanneries, pet-food factories, mink farms, chemical and pharmaceutical plants, AD plants, biodiesel and even farms that buy semi-digested stomach contents for fertiliser.

1 Introduction

The scope of this FCR RED MEAT is to assess and compare meat as described in section 4.3 (The product category thus includes **fresh meat, fresh food grade products and edible offal products either chilled or frozen** being sold to the retailer, secondary process and food service excluding goats, horses or other equines). The FCR RED MEAT does not provide guidance for a complete sustainability assessment.

The FCR RED MEAT is compliant with the EC guidance document v5.2 except for the functional unit and the allocation at slaughterhouse level.

The FCR RED MEAT supports the following purposes:

1) PEF studies of a red meat product for either internal or external communication but without species comparison
2) PEF studies of a red meat product including a comparison either between alternatives (e.g. sourcing, production systems) or over time (e.g. trend monitoring) within the same species.

1.1 Technical Secretariat

The Technical Secretariat of the Red Meat Pilot consisted during the drafting of this FCR RED MEAT of the following members:

- ABP Food Group, John Durkan
- AHDB Beef and Lamb, Martin Palmer/Christine Walsh
- Beef + Lamb New Zealand Ltd, Ben O'Brien
- Blonk Consultants, Hans Blonk
- Bord BIA, Jim O'Toole/Padraig Brennan
- Célene, Christophe Lapasin
- COV - Dutch Meat Association, Richard de Mooij
- Danske Slagterier S.A., Peter Petersen/Sune Jin Christensen
- Danish Crown Group, Charlotte Thy
- Dawn Meats, David O'Flynn/Charlie Coakley/Richard Clinton
- Dunbia Ltd., Alison Harvey
- FEFAC, Nicolas Martin
- Meat & Livestock Australia, Joshua Anderson
- VanDrie Group, Jacques de Groot
- UECBV, Angelantonio D'Amario

1.2 Consultation and stakeholders

The Technical Secretariat of the FCR RED MEAT has on several occasions invited relevant stakeholders to participate in the FCR (previously PEFCR) development. The relevant stakeholders for the FCR development include representatives from retail, farm and trade associations, compound feed producers, consumers, government representatives, non-governmental organizations (NGOs), public agencies and independent parties and certification bodies.

This FCR RED MEAT has gone through an extended formal consultation. Annex VI – Consultation and stakeholders, describes the consultation process and the related activities followed for this FCR RED MEAT. Twenty-one activities are listed of which the first sixteen were carried out in the context of

the development of the meat PEFCR pilot. The last five activities were performed by the TS independently from the PEFCR pilot for the completion of the FCR RED MEAT.

1.3 Date of publication and expiration

Version number: 1.0
Date of publication/revision: July 2019
Date to review: 31 December 2022

1.4 Geographic region

The FCR RED MEAT is valid for all red meat producers and traders and the supply chains that provide these operations for the EU markets.

1.5 Language(s) of PEFCR

This FCR RED MEAT has been written in English. It is not foreseen at this stage to make this document available in other languages. Should this FCR RED MEAT be translated, the English version supersedes translated versions in case of conflicts.

2 Methodological inputs and compliance

This FCR RED MEAT has been developed according to the requirements of the PEF Guide (Annex II to Recommendation (2013/179/EU) and the Product Environmental Footprint Pilot Guidance (version 5.2). The FCR RED MEAT is compliant with the EC guidance document v5.2 except for the functional unit, the allocation at slaughterhouse level and the handling of manure.

3 Review and background information

3.1 Review process

The critical review is essential to ensure that the FCR RED MEAT:

- is consistent with the guidance provided in the PEF Guide and the PEFCR guidance (version 5.2), excluding the agreed deviations on functional unit, allocation at slaughterhouse level and the handling of manure;
- Complements the PEF guide requirements with additional requirements specific to the peculiarities of the life cycle of red meat products.

The Red Meat TS invited two independent reviewers for the peer review of the FCR RED MEAT:

Dr. Stewart Ledgard - Principal Scientist with Agresearch and an Adjunct Professor of the Life Cycle Management Centre at Massey University in New Zealand.
PhD Mirko Miseljic – Environmental Civil Engineer with FORCE Technology.

The review provided some essential remarks to get the FCR RED MEAT more aligned with the allocation principles on farm used in the LEAP guidelines and on the sampling procedures for data collection. These, plus many of the more detailed comments were processed. The review panel concluded that the document is compliant with the PEFCR guidance (version 5.2, excluding the agreed exceptions) and LEAP guidelines where applicable and conclude that FCR RED MEAT defines the additional requirements for beef, pork and sheep meat.

Please refer to Annex VII – Review Statement for the full review statement issued for this FCR RED MEAT.

3.2 Reasoning for development of FCR RED MEAT

The project's proponents initiated the creation of a tool able to drive improvement in environmental performance of red meat companies and the red meat supply chain. The meat sector has for the first time been directly dedicated to defining a fair, harmonised and reliable basis for assessing performance across the full life cycle of its product. There were no PCR-like documents of sufficient quality for the livestock-meat sector to be in accordance with the PEF guidelines. The FCR RED MEAT has not been developed to act as a barrier to different red meat categories but to rather improve the environmental performance of the sector and the farming stages.

3.3 Conformance with the PEFCR Guidance

This FCR RED MEAT has been developed in compliance with the "Guidance for the implementation of the EU PEF during the Environmental Footprint (EF) pilot phase – Version 5.2" except for the functional unit, the allocation at slaughterhouse level and the handling of manure.

4 FCR RED MEAT scope

4.1 Unit of analysis (functional unit)

The unit of analysis is: 1 tonne of red meat product as described in section 4.3 from a specific animal species, as sold to the retailer, secondary processor and or food service. The weight of packaging is not included in the 1 tonne but in scope of the analysis.

4.2 Representative product(s)

There are three representative products each based on a virtual EU average meat product:

1. 1 tonne of fresh ***beef*** including inedible animal parts (such as bone).
2. 1 tonne of fresh ***pork*** including inedible animal parts (such as bone).
3. 1 tonne of fresh ***sheep meat*** (or meat of ovine animals) including inedible animal parts (such as bone).

4.3 Product classification (NACE/CPA)

The FCR RED MEAT concerns the following CPA/NACE codes:

C.10.1 - Processing and preserving of meat and production of meat products
C.10.11 - Processing and preserving of meat
10.11.11 Meat of bovine animals, fresh or chilled
10.11.12 Meat of swine, fresh or chilled
10.11.13 Meat of sheep, fresh or chilled
10.11.20 Edible offal of bovine animals, swine, sheep
10.11.31 Meat of bovine animals, frozen
10.11.32 Meat of swine, frozen
10.11.33 Meat of sheep, frozen
10.11.39-Edible offal, fresh, chilled or frozen

The product category thus includes **fresh meat and edible offal products either chilled or frozen** as sold to the retailer, secondary processor and or food service.

For the rest of the document the product group will be referred to as **“fresh meat”**.

Meat of bovine animals (beef) includes animals from beef cattle, dairy culled cows and dairy calves. This FCR RED MEAT includes veal. There is no specific NACE for the veal; it has the same NACE code as beef. However, the Single CMO Regulation laid down marketing standards for veal that are based on the age.

A definition for veal (marketing standards) is provided by the common organization market regulation (EU) n°1308/2013 of the European Parliament and of the Council (the Single CMO Regulation), in the annex VIII, part I: Meat of bovine animals aged less than 12 months.

Definition : “For the purposes of this Part of this Annex, "meat means all carcases, meat on the bone or boned, and offal, whether or not cut, intended for human consumption, obtained from bovine animals aged less than 12 months, presented fresh, frozen or deep-frozen, whether or not wrapped or packed…..”

"A) Category V: bovine animals aged less than eight months. Category identification letter: V. "

"Sales description for the meat of bovine animals aged less than 12 months shall only be marketed in the Member States under the following sales description(s) laid down for each Member State" (e.g. United Kingdom: Veal).

Sheep meat includes meat from lambs, hoggets, ewes and rams.

4.4 Purposes of LCA assessment of meat supported by this FCR RED MEAT

This FCR RED MEAT can be used for the following purposes:

1) FCR studies of a single meat product without comparison
   a) for internal use
   b) for external use
2) FCR studies that include a
   a) *comparison between alternatives:* such as alternative farming systems, logistics, slaughtering practices, packaging types and consumption practices provided this comparison occur within the same red meat category
   b) *comparison in time:* monitoring trends/progress in environmental impact of meat products related to measures aimed at reducing environmental impact provided this comparison occurs within the same red meat category

4.5 System boundaries – life-cycle stages and processes

The system boundaries are described in Figure 4-1. The Figure consists of three main blocks:

1. Purple: The cores process "the slaughterhouse", consisting of slaughtering, cutting, packing and storage of meat products (assumed to be under the control of the FCR operator).
2. Orange: upstream production, consisting of the different farming phases and feed production phases, including production, distribution and use of all inputs in this stage.
3. Green: the storage, B2B and delivery stage.

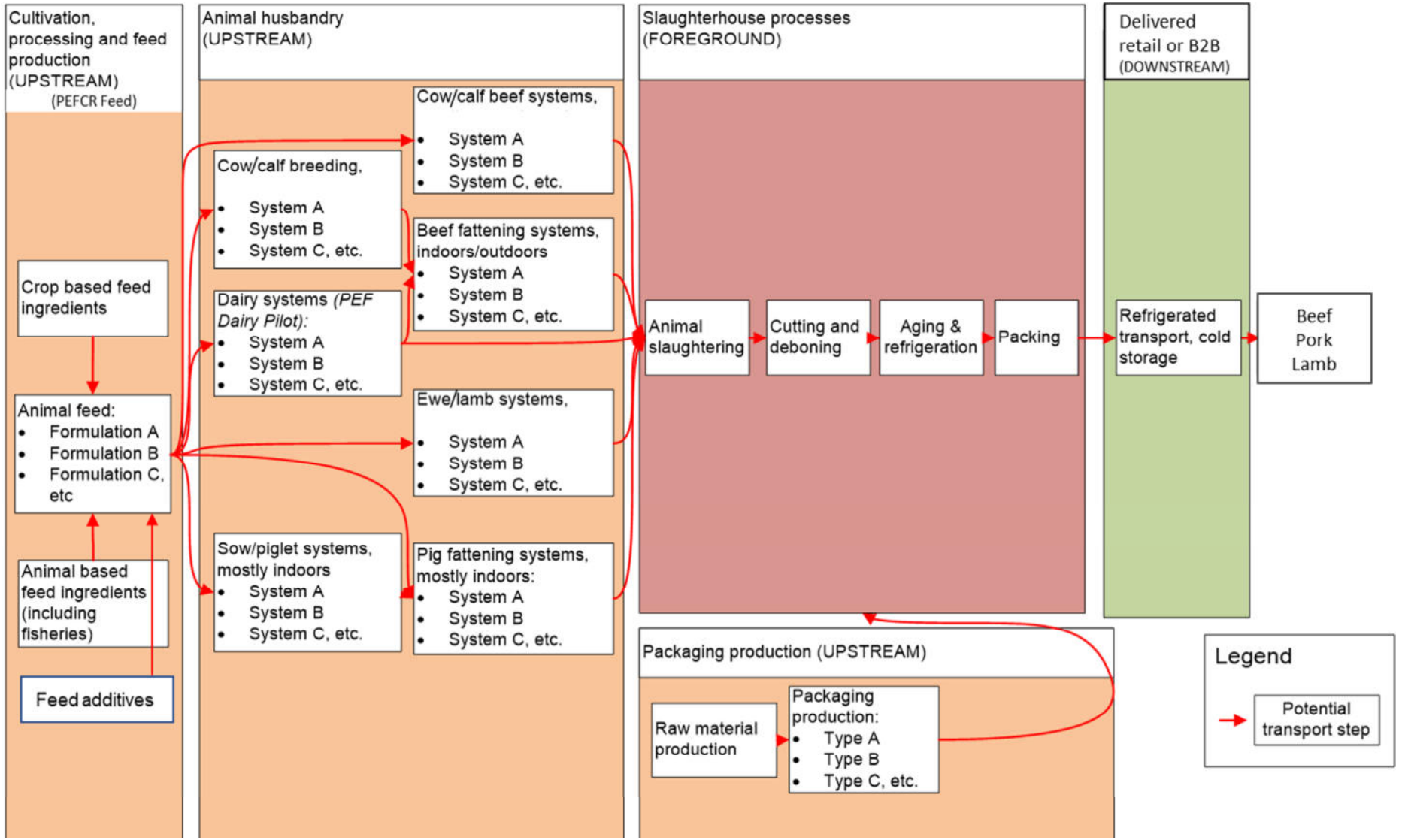
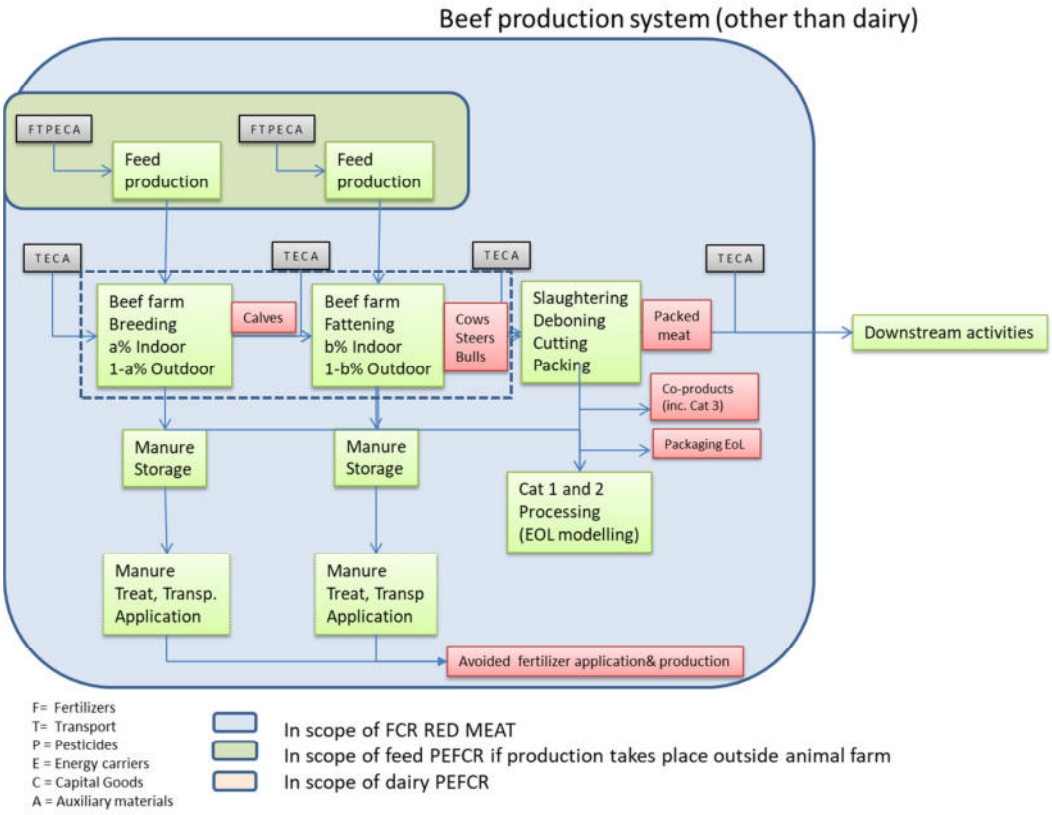


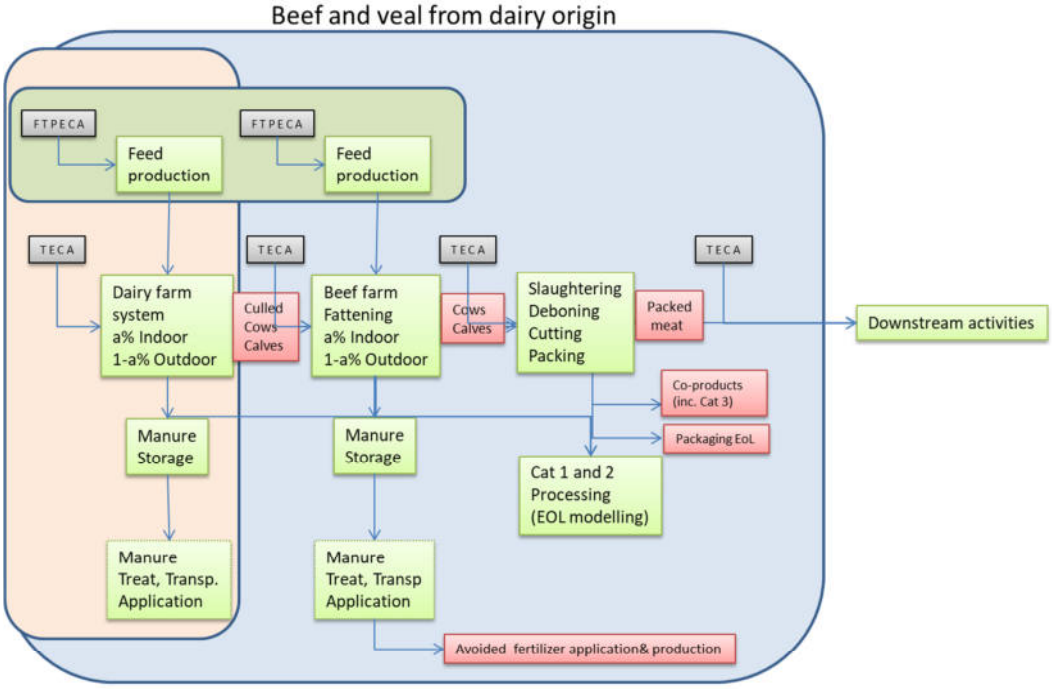
Figure 4-1 System boundaries for the lifecycle of fresh meat.

4.5.1 Interrelation of the lifecycle system boundaries with other pilots and generic PEF model approaches

The lifecycle system boundaries of fresh meat are related to other PEFCRs and generic modelling requirements formulated in the PEF pilot. This is illustrated for the beef from culled cow lifecycle, beef and veal from dairy, pork production system and sheep production system.



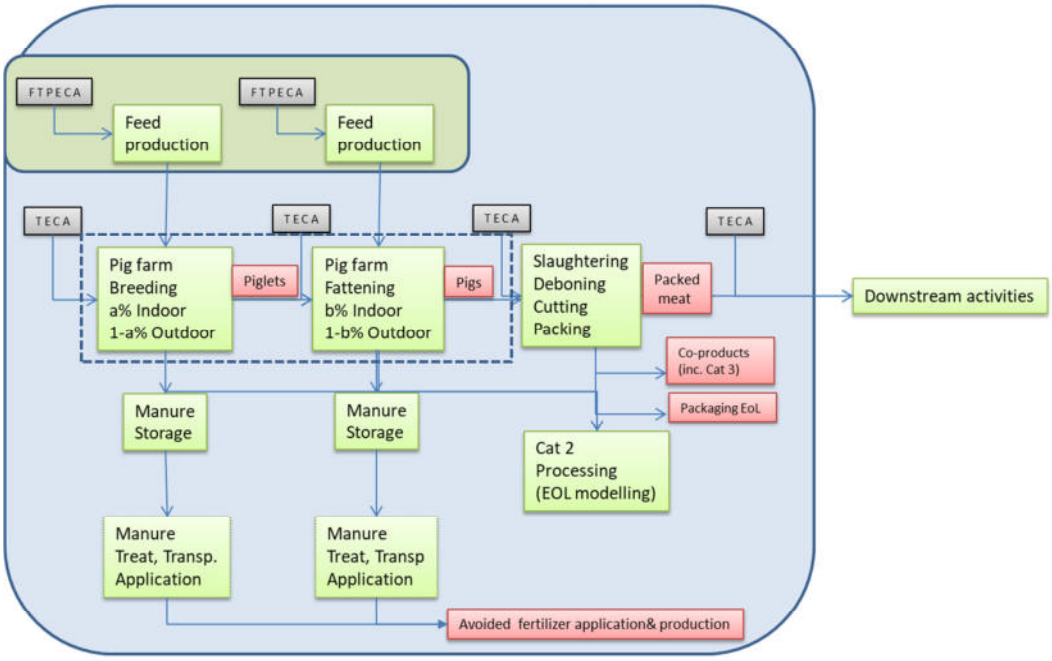
Beef and veal from dairy origin



F= Fertilizers
T= Transport
P = Pesticides
E = Energy carriers
C = Capital Goods
A = Auxiliary materials

In scope of FCR RED MEAT
In scope of feed PEFCR if production takes place outside animal farm
In scope of dairy PEFCR

Pork production system



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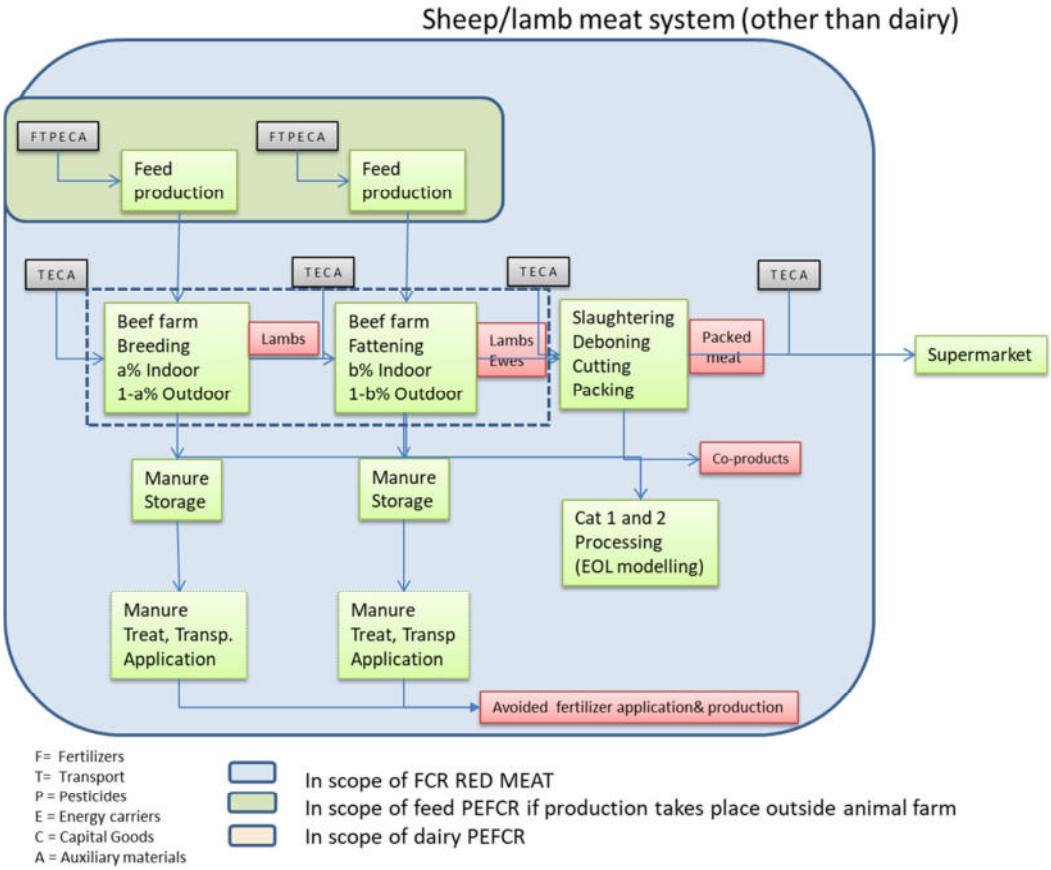


Figure 4-2 Overlap between FCR RED MEAT and PEFCRs - The different colours call to the figures of the different guidelines.
*Note: For pork production systems, cat 2 is downgraded to cat 1 in member states where there is no cat 2 rendering.

The system boundaries for the farm phase include all necessary inputs and elementary flows to breed, raise and fatten animals to the point that they can be delivered to the slaughterhouse. Breeding for animals specifically held for meat production is covered by this FCR RED MEAT. The environmental impact of dairy beef animals is determined by the lifecycle modelling requirements of the dairy PEFCR due to the manner in which the footprint is allocated between the two systems (beef and milk).

4.5.2 Breakdown of lifecycle stages

The following breakdown of lifecycle stages shall be used for the LCI and LCA:

1. Slaughtering, Cutting and Packing (including transport of live animals to slaughterhouse)
2. Upstream production of living animals
   - 2.1 Digestion of feed, housing and manure storage
   - 2.2 Feed production at animal farm (including manure application of own farm animals)
   - 2.3 Feed production and provision outside animal farm
   - 2.4 Manure application and substituted processes

4.6 Selection of the FCR RED MEAT impact categories indicators

All environmental impacts as being addressed in the PEF guide (PEF guidance document 5.2) shall be calculated in a LCA study, see Table 4-1.

Table 4-1: Impact categories to be quantified. The Robustness according to ILCD Quality classification is listed in the column ILCD Quality.
The column ILCD Quality provides the robustness according to ILCD Quality classification

	ILCD Quality	Impact category	Indicator	Unit	Recommended default LCIA method	Source of CFs
High robustness	I	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-11eq	Steady-state ODPs 1999 as in WMO assessment	EC-JRC, 2012
	I	Particulate matter/Respiratory inorganics	Intake fraction for fine particles	kg PM2.5-eq/kg	Humbert (2009)[2]	EC-JRC, 2012
Medium robustness	II	Photochemical ozone formation	Tropospheric ozone concentration increase	kg NMVOCeq	LOTOS-EUROS (Van Zelm et al, 2008) as applied in ReCiPe	EC-JRC, 2012
	II	Ionizing radiation, human health	Human exposure efficiency relative to U^{235}	kBq U^{235}	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)	EC-JRC, 2012
	II	Acidification	Accumulated Exceedance (AE)	mol H+ eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	EC-JRC, 2012
	II	Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	EC-JRC, 2012
	II	Eutrophication, aquatic	Fraction of nutrients reaching freshwater end compartment (P) or marine end compartment (N)	fresh water: kg P equivalent marine: kg N equivalent	EUTREND model (Struijs et al, 2009b) as implemented in ReCiPe	EC-JRC, 2012
	II	Resource use, mineral and metals.	Abiotic resource depletion (ADP ultimate reserves)	kg Sb-eq	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.	CFs from CML-IA method v. 4.8 (2016).
	II	Resource use, energy carriers	Abiotic resource depletion – fossil fuels (ADP-fossil)	MJ	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002	CML-IA method v. 4.8 (2016)

[1] Forthcoming document on the update of the recommended Impact Assessment methods for the EF; drafts have been presented at EF TAB meetings and been submitted to a consultation.
[2] This recommendation will be revised once a UNEP/SETAC recommendation and related characterization factors for this impact category have been made public, which is intended for the beginning of 2017.

	ILCD Quality	Impact category	Indicator	Unit	Recommended default LCIA method	Source of CFs
Low robustness	II / III	Human toxicity, cancer effects	Comparative Toxic Unit for humans (CTU_h)	CTUh	USEtox model (Rosenbaum et al, 2008)	EC-JRC, 2012
	II / III	Human toxicity, non-cancer effects	Comparative Toxic Unit for humans (CTU_h)	CTUh	USEtox model (Rosenbaum et al, 2008)	EC-JRC, 2012
	II / III	Ecotoxicity (freshwater)	Comparative Toxic Unit for ecosystems (CTU_e)	CTUe	USEtox model, (Rosenbaum et al, 2008)	EC-JRC, 2012
	III	Land use	• Soil quality index[3] • Biotic production • Erosion resistance • Mechanical filtration • Groundwater replenishment	• dimensionless • kg biotic production/(m^2*a)[4] • kg soil/(m^2*a) • m^3 water/(m^2*a) • m3 groundwater/ (m2*a)	• Soil quality index based on LANCA • LANCABeck et al. 2010)	EC-JRC, 2017[5] Bos et al. 2016 Bos et al. 2016 Bos et al. 2016 Bos et al. 2016
	II Not available	Water scarcity	User deprivation potential (deprivation-weighted water consumption)	m^3 world eq. deprived	Available WAter REmaining (AWARE) Boulay et al., 2016	WULCA 2016

[3] This index is the result of the aggregation, performed by JRC, of the 4 indicators provided by LANCA model as indicators for land use

[4] This refers to occupation. In case of transformation the LANCA indicators are without the year (a)

[5] Forthcoming document on the update of the recommended Impact Assessment methods and factors for the EF

4.7 Additional environmental information

Biodiversity and carbon sequestration in grassland are important issues for animal farming. An assessment of biodiversity and/or carbon sequestration may be part of a PEF study as additional information becomes available. However, since the science in these areas is still evolving, no specific methodology can be imposed. Therefore, if additional environmental information on biodiversity or carbon sequestration is added to the communication of the results of the FCR study, the applied methodologies shall be reported. Results shall always be reported without carbon sequestration and additionally may be reported with carbon sequestration in order that the impact can be easily understood.

4.7.1 Biodiversity

It is possible to include an assessment on biodiversity impacts as additional information. The methodology in this field is still evolving. The methods below are recommended to be considered, however using another method to assess biodiversity is also allowed. If an assessment on biodiversity impact is included in the PEF study, the used methodology shall be reported.

1. Recipe score (hierarchy perspective Recipe method 1.08) for biodiversity (Goedkoop et al., 2009), applicable for entire lifecycle and aggregating several midpoint indicators.
2. Improved biodiversity score according to Knudsen et al 2017, applicable for all land occupation in the lifecycle.

4.7.2 Carbon sequestration and loss

Carbon sequestration in grasslands can potentially have a significant positive contribution for reducing climate change impact. Therefore, PEF studies where meat is sourced from grass-based animal farming systems could include the amount of carbon sequestered in grass land as additional information. To make a full assessment of the carbon balance, the assessment should be extended to cover other types of feed production so that where there may be carbon loss in soils, associated with feed production and associated land use change, it must also be considered.

The method used to calculate the carbon sequestration shall be reported and scientifically published.

4.8 Assumptions/limitations of the FCR RED MEAT

The FCR RED MEAT does not provide guidance for a complete sustainability assessment. Issues that are not covered in the FCR RED MEAT include social and economic aspects, and animal health and welfare.

This FCR RED MEAT is not sufficient to fully evaluate the environmental impact of changes in meat products and its packaging that affect the lifecycle in the “use” stage. This is due to the definition of the functional unit in relation to meat and not in relation to the actual consumed meat, taking specific quality and nutritional aspects of consumption into account. However, LCA studies which aim to be PEF compliant but have the goal to study differences that affect environmental performance at the consumer stage can build upon the FCR RED MEAT for red meat for the lifecycle as figure 4-1. Any effects of measures in the products, the co-products and by-products, part of the supply chain, after the slaughterhouse level, could be built on this PEFCR.

5 Resource use and emission profile

5.1 Definition of foreground and background data in relation to contribution and access

This FCR RED MEAT is based on the outcomes of the screening study (TS Red meat FCR, 2019).The screening study generated insight into the main causes (due to emissions and resource use) of the environmental impact of the red meat lifecycle. The hot spot analysis and the sensitivity assessments of the three meat types result in rather consistent conclusions of the most relevant processes and elementary flows while the studied animal types (pork, beef and lamb) and production systems (intensive, extensive, EU production and import from New Zealand) differ considerably.

For all animals the life cycle stages **feed production (both on and off farm)** and **enteric fermentation**, **housing** and **manure management** are the most relevant. The environmental impacts at **the slaughterhouse** do not represent a major contributor to environmental impacts as such. However, allocation at the slaughterhouse is very important since it defines the amount of upstream environmental impact of the feed production and housing phase in the LCA. .

Consumer actions in the **use phase**, related to storage and preparation of meat cause some environmental impact but are not very important from a total lifecycle perspective of meat. Losses in the "use" phase can be important but are outside the scope of this FCR RED MEAT and so not directly linked to the functional unit (1 tonne of red meat).

Most of the determining emissions and resource use of the red meat lifecycle happen at processes (mainly feed production and animal farming) in the supply chain that are outside the influence of most slaughterhouses. However due to their relevancy, high quality (for a large part primary) data shall be used. In these situations primary and secondary data shall be used and what level of data quality shall be achieved is further defined in section 5.4.2.

The processes associated with the slaughterhouse are within the scope of influence of the slaughterhouse and are considered as foreground processes for which it is ***mandatory*** to collect primary data. This includes; operations in the slaughterhouse, cutting and the packing activities and use of packaging materials. Therefore, the PEF operator should have specific knowledge of, and shall collect primary data of:

1. Breakdown of the living animal to red meat and edible organs versus other co/by-products
2. Activity data of the slaughterhouse including use of energy carriers and potential on-site energy production, animals, packaging and auxiliary materials and allocation factors.
3. Transport activity data related to procurement of animals and use of packaging material.

In addition, the transport of animals to the slaughterhouse and transport of products from slaughterhouse to retail may also be owned or managed by the slaughterhouse. In that case primary data shall also be collected for this transport.

Other processes, such as the production of feed ingredients and off-site generation of energy are considered ***background*** processes for which in cases primary and in some cases secondary data can be used. The remainder of this chapter describes the data collection procedure, when the use of secondary data is allowed and the data quality requirements for primary and secondary data.

5.2 Data access and use of primary or secondary data and data quality requirements

This chapter is structured around the processes of collecting data from the perspective of the fresh meat producer. Firstly, collect the data from slaughtering, cutting and packing operations together with the information from where the data came. Secondly identify all the markets to where the meat is sold. Thirdly collect the supply chain data entire most importantly the types of animal farming systems. Table 5-1 gives an overview of the processes of the cradle to gate feed lifecycle for which primary and/or secondary data needs to be collected. Table 5-1 is the result of implementing the data needs matrix (PEF Guidance Document version 5.2) for the operator with access to slaughterhouse data which are essential to conduct a PEF study.

Without primary activity data on slaughtering, cutting and (consumer/B2B) packing a study compliant to this FCR RED MEAT is not possible. High quality data at farm level is also required to have a compliant PEF, otherwise a FCR RED MEAT is not possible. The data quality required at farm level is defined later (section 5.4)

Table 5-1: Overview of the data that shall be used, and related sections in this FCR RED MEAT. The DQR applies irrespective of the access to primary data[2].

	Process	Access to primary Data	No access to primary data	Data quality rating (DQR)
Processes completely or partially run by FCR operator	1. Slaughtering, cutting and packing use	→ ***section 5.3.1***	No PEF possible	DQR < or =1.6
	2. Inbound transport to slaughterhouse	Primary data on fuel use or on transport means and distance → ***section 5.3.4***	Explain estimate of transport distance and connect to secondary data. → ***section 5.3.4***	DQR < or = 4
	3. Outbound transport from slaughterhouse to retail	Primary data on fuel use or on transport means and distance → ***section 5.3.5***	Explain estimate of transport distance and connect to secondary data → ***section 5.3.5***	DQR < or = 4
Processes not run by FCR operator but relevant for results	4. Animal farming	Supplier specific data derived according to the requirements in this FCR RED MEAT → ***section 5.4***	Apply secondary data according to decision tree → ***section 5.4***	DQR < or = 1.6
	5. Feed	Supplier specific data derived according to the requirements in this FCR RED MEAT → ***section 5.4***	Secondary data based on national statistics → ***section 5.4***	DQR < or = 3
DQR = Data Quality Rating; scores can vary from 1 to 5. 1 = very good and 5 = very poor				

[2] The DQR is a semi-quantitative assessment of the quality of data based on representativeness and precision. The most relevant processes driving the environmental profile of a product, shall be assessed by using data with higher quality (lower DQR) compared to the less relevant processes, allowing to focus the attention in data collection where it really matters.

5.3 Data collection of slaughtering, cutting and packing

5.3.1 Constructing the slaughtering, cutting and packing operation process

Slaughtering, cutting and packing of a fresh meat product can occur in an integrated operation or can be split into different operations at different locations.

If slaughtering, cutting and packing are co-located as in one integrated factory all processes in the factory that are related to the specific product under study shall be included. Processes related to further processing of other meat products or co-products shall be excluded if possible. If this is not possible overall data of the factory (including all processes) may be used.

If slaughtering, cutting and packing are located in separate premises the inputs and outputs of the separate factories shall be determined on the basis of a mass balance that relates the inputs and outputs in the right proportion. Inclusion of additional processing of co-product per process step shall be excluded if possible. Transport shall be included.

The specific method of collecting data and system definition shall be reported.

All packaging production data shall be collected from the EC PEF database.

5.3.2 Definition of slaughtered animals

The type of animal(s), the average age and live weight used for the product under study shall be reported. The region where the living animals come from shall also be reported. In case of multiple regions, the breakdown of volume of origins shall be recorded. The farming systems that supply the slaughterhouse shall be qualified in terms that describe the applied technologies, management or breeds.

If no direct measurement of live weight of incoming living animals in the slaughterhouse data is available, live weight shall be determined on the basis of the method that is commonly used in the country of production and that is applicable for the animal type being under study. In Annex IV, some example conversion calculations from carcase weight to live weight are shown.

5.3.3 Slaughterhouse activity data of processing

5.3.3.1 Breakdown of living animal for allocation

The slaughterhouse which valorises the bulk of the slaughtered animal for food or feeding purposes has a limited contribution to the overall environmental impact. However, market allocation at the slaughterhouse is key for the overall environmental impact. The basic rule is mass allocation based on 'weight as is' for all co-products except for the products which are classified as waste or by-products category 1 and by-products category 2 to be rendered. The additional and avoided emission of these excepted products are accounted for. A further motivation of the choice for mass allocation can be found in Annex VII.

BOX 2. The slaughtering business

The slaughterhouse industry is characterised by the fact that it is unable to choose what raw materials to procure and make products from. The raw materials are live animals and the slaughterhouse has to find ways to utilise and identify the best outlets for all parts of the animal, including gut content and intestines. A slaughterhouse can thus be compared with a disassembly line where the slaughtered animals can become many different cuts, fats and other fractions. The carcases are cut in many different ways with the

consequence that parts like fat and bones could be either part of the product or could be products in their own right sold to a variety of markets. Usually muscle meat and some offal is sold for human consumption but many of the other products will be sold to different markets depending on the actual economic market value. The destination could change weekly. Animal by-products such as tripes, heart, hooves, liver, some offals, sheep skins, fat, rind and blood are examples of the products where the destination of the sales and prices can vary significantly depending on global market demand and economics. This makes it difficult to make an allocation key based on fixed fractions.
The slaughterhouses typically try to minimise waste production. The slaughterhouse will often have accurate data on the weights of the fractions/products being produced in the slaughterhouse. They tend to apply an allowance for water evaporated from the products during the slaughtering process. This data is usually used in production planning. Each facility will have detailed information with regard to the types of products produced and sold to each market and product specifications which enables the final purpose e.g human food, pet food to be established .

Allocation at slaughterhouse shall be based on mass[3].To conduct the allocation at the slaughterhouse to the main product "red meat" and the other co-products and wastes a breakdown shall be made in the following fractions of product groups:

1. ***Products used for human consumption (HC***): every product the slaughterhouse sells for the purpose of human consumption, this could be muscle meat, offal e.g. tongue, tail cheek meat, machine separated meat (MSM pork only), fat, but also food grade co-products, liver, tripe, hooves, bones or hides (being sold for gelatin manufacture) casings, rind, blood and other parts of the animal which could fall into this category
2. ***Hides and skins, sold to leather industry (HS)***: Hides and skins not being consumed but going for tanneries
3. ***Products for animal feed applications, such as pet food or feed for fur animals (AF):*** Products being sold with the purpose of consumption by animals, either pets or fur animals. This can include lungs, liver, blood and other parts
4. ***Products sold to pharma industry (PH):*** Examples are heparin from membranes in the intestines, collagen and blood and gall to the chemical sector.
5. ***Products sold for rendering (R):*** Products unfit for consumption by humans due to health regulation, category 1 and 2. Also category 3 if that hasn't been sold for feeding purposes.
6. ***Products sold for biogas production (BG***): Usually gut and stomach content, if not going directly as such to farms as soil improver, but also other fractions sold for digestion, i.e. fat and blood

Data shall be collected on the basis of average results from the slaughterhouse over at least the 3 most recent years and shall be specific for the animals under study as defined in 1.2.1. If this time period cannot be met due to, for instance, recent changes in the slaughterhouse operation or restarting the operation after maintenance or the plant being a new build a shorter time period is acceptable (but never less than 1 year). It is important that if the time period is less than 3 years, the longest possible time period shall be used and a rationale shall be included to explain why it is less than 3 years. Shortened time periods will not be permitted for existing premises even where practices or infrastructures has changed unless the factory has been closed for a year or more.

[3] Biophysical allocation when available for all animal species will be the most reliable approach according to the ISO 14040 "Environmental management — Life cycle assessment — Principles and framework".

Table 5-2 shows how different animal parts must be classified into the aforementioned product groups (the included figures are meant by way of an example). Allocation will then be applied on these product groups. The percentages should align to what has actually occurred in the slaughterhouse under study (i.e. based on actual sales data). For example, if livers are sold as edible offal to consumers, are sold for further processing for human consumption and a part is sold to pet food manufacturers, this animal part should be split over these different product groups for allocation at the slaughterhouse.

Table 5-2: Classification of animal parts into product groups. Matrix for allocation*.

Raw material groups →	Sold to →								
	Volume (kg)	Human food	Feed (pets)	Feed (fur)	Rendering	Pharma	Biogas	Leather	Total
	1. Muscle meat	64.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0%	64.0%
	2. Bones	11.4%	0.0%	0.2%	1.6%	0.0%	0.0%	0%	13.2%
	3. Lard, Fat and Rind	5.2%	0.6%	0.1%	0.0%	0.0%	0.6%	0%	6.5%
	4. Blood	1.2%	1.0%	1.1%	0.0%	0.0%	0.0%	0%	3.3%
	5. By-products (Liver, Kidney, Heart)	1.1%	1.1%	0.4%	0.0%	0.0%	0.0%	0%	2.6%
	6. By products (Lungs, others)	1.1%	1.0%	0.6%	0.4%	0.0%	0.0%	0%	3.1 3%
	7. Casings	0.1%	0.6%	0.5%	0.1%	0.2%	0.4%	0%	1.9%
	8. Waste (Cat I+II ABP)	0.0%	0.0%	0.3%	5.1%	0.0%	0.0%	0%	5.4%
	Total	84.1%	4.3%	3.2%	7.2%	0.2%	1.0%	0%	

*These figures are for illustration purposes and should be calculated for each new FCR RED MEAT.

5.3.3.2 Energy and material flows of slaughtering, cutting and packing

Primary activity data for slaughtering, cutting and packing shall be collected on the basis of average inputs (Table 5-3) for a minimum of the most recent 3 years unless the plant has been operating for a shorter period. The relevant activities for calculating the environmental performance of the slaughterhouse are listed in Table 5-3. The data shall be recorded according to the format in Table 5-3. In the fourth column, the method of measurement shall be explained. This includes the sources of information and any conversion of information and related assumptions.

Table 5-3: Collection of activity data for slaughtering, cutting and packing.

Activity data	Unit	Quantity	Source and method of measurement	Data set to be used
Inputs				
Living animal	Kg Live weight and head			Primary data or secondary data (see section 5.4.1)
Electricity use *	kWh			Data from European Commission (EC) energy and transport dataset for representative country or specific mix according to requirements in guidance document 6.0
Gas use for CHP*	MJ LHV			Data from EC energy and transport dataset
Gas use for boiler				Data from EC energy and transport dataset
Heat use	MJ LHV			Data from EC energy and transport dataset
Other energy inputs for CHP	MJ LHV (specify type)			Data from EC energy and transport dataset
Other energy inputs for boiler	MJ LHV (specify type)			Data from EC energy and transport dataset
Water use	m^3 (specify type)			Secondary data from EC secondary datasets, if not available ELCD data
Packaging use Intermediate and retail	kg (specify type)			Secondary data from EC secondary datasets, if not available ELCD (European lifecycle dataset) data
Detergents	kg / l as purchased (specify type)			Secondary data from EC secondary datasets, if not available ELCD data
Other, when relevant (>5% of overall slaughterhouse impacts)	kg / l as purchased			Secondary data from EC secondary datasets, if not available ELCD data
Intermediate transport**				Data from EC energy and transport dataset
Outputs				
Wastewater	m^3 (at minimum COD)			Secondary data from EC secondary datasets, if not available ELCD data
Material for digester	Kg and MJ LHV			Primary or secondary data
Biogas from digester	M3 and MJ LHV			Primary or secondary data
Electricity from CHP	Kwh			Primary or secondary data
Waste packaging	Kg			Primary or secondary data
Biomass for fertilizer and soil improvement	Kg			Primary or secondary data

** Energy use data focuses exclusively in the energy use related to slaughtering, cutting and packing operations, i.e. no energy use for offices needs to be included.*

*** The source of the activity data mentioned in Table 5-3 can be one production site with an integrated operation or several production sites when for instance the cutting and/or packing is done at another site. In this case intermediate transport shall be included according to the requirements for outbound transport 5.3.5.*

5.3.3.3 DQR (Data quality requirement) slaughtering, cutting and packing

The DQR of slaughtering, cutting and packing shall not be higher than 1.6 (Table 5-4).

Table 5-4: DQR table for slaughtering, cutting and packing. NO PEF means that no PEF study is possible when the DQR falls in a lower category.

Quality level	Quality rating	P	TiR	TeR	GeR
Very good	1	Measured/Calculated and externally verified	Data cover the time period in the scope of the study and refer to the most recent annual administration period	The technology(ies) is/are specific for the product(s) in scope and based on measurements	The data concern the specific slaughter and cutting operations in scope of study (either on a single location or if multiple locations on the basis of weighted average). (Location specific measurements need to be available)
Good	2	Measured/Calculated and internally verified, plausibility checked by reviewer	Data cover the time period in the scope of the study and refer to the previous annual administration period	The technology(ies) is/are specific for the product(s) in scope based on assigning overall energy and materials use of the total plant	The data concern the average slaughter and cutting operations in scope of study based on unweighted averages
Fair	3	No PEF	No PEF	No PEF	No PEF
Poor	4	No PEF	No PEF	No PEF	No PEF
Very poor	5	No PEF	No PEF	No PEF	No PEF

The data quality score for slaughtering, cutting and packing DQR is:

$$\mathrm{DQRscp} = \frac{TiR + TeR + GeR + P}{4}$$

TeR: Technological-Representativeness
TiR: Time-Representativeness
GeR: Geographical-Representativeness
P: Precision/uncertainty

The DQR of slaughtering, cutting and packing is a function of the DQR of the EC secondary dataset for transport and energy and the DQR of the activity data. The highest DQR score of both shall be taken. So, if DQR of the slaughtering process = 1.4 and of secondary energy data = 1.5, the DQR score =1.5. Secondary datasets of the European Commission can be accessible further to EC approval.

5.3.4 Inbound transport

Slaughterhouses shall collect the following information of logistics from their suppliers:

- The production locations of the living animals and the distances to the slaughterhouse
- The production location of the provider of packaging materials and other auxiliary materials
- The average transport scenario of these living animals.

Transport activity data shall be collected on transport distance, transport vehicles, load fractions, type of use. With this information transport inventories can be selected in the PEF compliant secondary database provided by the EC.

The next step is to fill in Table 5-5 using the parameterized transport datasets which are available in the EC datasets on transport. If no data are available on the lorry type or distance the default values in column 2 shall be used.
Secondary datasets of the European Commission can be accessible further to EC approval.

Table 5-5: Data collection for animal transport per vehicle type

Activity data	Unit	(defaults)	Source and method of measurement (if relevant)
Vehicle type share %	[-]		
• **Load Capacity**	Tonne	28-32	
• **Technology**	EURO-class		
• **Pay load**	Tonne	25	
• **Distance per trip**	Km		
• **Load fraction**	%	80%	
• **Utilisation rates**	%	50%	
• **Share biofuel**	%	0%	

Vehicle type: The EC dataset on transport and energy provides parametrized processes for the following lorry types (load capacity): <7.5 tonne; 7.5-12 tonne; 12-14 tonne; 14-20 tonne; 20-26 tonne; 28-32 tonne; >32 tonne.

With this information the LCI results of inbound transport shall be calculated.

The DQR is calculated on the basis of Table 5-6.

Table 5-6: Data quality rating system for transport (inbound and outbound)

Quality level	**Quality rating**	**P**	**TiR**	**TeR**	**GeR**
Very good	1	Measured/Calculated and externally verified	Data cover the time period in the scope of the study as defined in Table 5.3 and refer to the most recent	The transport modes is/are specific for the product(s) in scope and based on measurements	The data concern transport scenarios specific for the products in scope.

			annual administration period		
Good	2	Measured/Calculated and internally verified, plausibility checked by reviewer	Data cover the time period in the scope of the study as defined in Table 5.3 and refer to the previous annual administration period	The transport modes (ies) is/are average for the slaughter operation in scope and based on measurements	The data concern transport scenarios specific for the products in scope based on averages for the slaughter operation
Fair	3	Measured/calculated/literature and plausibility not checked by reviewer OR Qualified estimate based on calculations plausibility checked by reviewer	The data refers to maximum three annual administration periods with respect to the EF report publication date	Based on qualified estimates	Based on qualified estimates
Poor	4	No PEF	No PEF	No PEF	No PEF
Very poor	5	No PEF	No PEF	No PEF	No PEF

If no primary information is available on transport modes (lorry types), the lorry types shall be estimated based on qualitative information or the default lorry type shall be used. This estimate shall be reported with the justification as to why it is better than the default value. The technological representativeness (TeR) of the involved transport processes shall be increased by +1.

If no primary information is available for the transport distances, the transport distances shall be estimated based on the providers that supply the slaughterhouse or the default distances may be used. An estimate shall be reported with the justification as to why it is better than the default value. The geographical representativeness (GeR) of the transport process shall be increased by +1.

The data quality score for inbound transport DQRi is:

$$\mathrm{DQRi} = \frac{TiR + TeR + GeR + P}{4}$$

TeR: Technological-Representativeness
TiR: Time-Representativeness
GeR: Geographical-Representativeness
P: Precision/uncertainty

The TeR and GR shall be adjusted when some primary information is unavailable. The overall DQRi shall be the average (per impact category based on relative contributions) of all inbound transport processes involved.

5.3.5 Outbound transport

Slaughterhouses shall collect the following logistics information from outbound transport:

- The location of the retail or B2B organisation and its distance to the slaughterhouse
- The average transport scenario of the sold product.

Transport activity data shall be collected on transport distance, transport vehicles, load fractions, utilisation rate and share of biofuel use. With this information transport inventories can be selected in the PEF compliant secondary database provided by the EC.

Table 5-7: Data collection for outbound transport per vehicle type

Activity data	Unit	(defaults)	Source and method of measurement (if relevant)
Vehicle type share %	[-]		
• **Load Capacity**	Tonne	28-32	
• **Technology**	EURO-class		
• **Pay load**	Tonne	25	
• **Distance per trip**	Km		
• **Load fraction**	%	80%	
• **Utilisation rates**	%	50%	
• **Share biofuel**	%	0%	

If no primary information is available on transport modes, the transport mode shall be estimated based on qualitative information. This estimate shall be reported. The technological representativeness (TeR) of the involved transport processes shall be increased by +1.

If no primary information is available for the transport distances, the transport distances shall be estimated based on the markets that supply the slaughterhouse. This estimate shall be reported. The geographical representativeness (GR) of the transport process shall be increased by +1.

The data quality score for outbound transport DQRo is:

$$\mathrm{DQRo} = \frac{TiR + TeR + GeR + P}{4}$$

TeR: Technological-Representativeness GR: Geographical-Representativeness
TiR: Time-Representativeness
P: Precision/uncertainty

The TeR and GeR shall be adjusted when some primary information is unavailable. The overall DQRo shall be the average (per impact category based on relative contributions) of all outbound transport processes involved.

5.4 Data collection of animal farming

5.4.1 Data sources

Four types of data sources can be used for deriving or collecting LCI data for animal farming, in sequence of preference:

1. Animal farm activity data available from the specific farms supplying the living animals
2. Animal farm activity data available from national or regional databases representative of the farms that provide living animals
3. Animal farm LCI data available in EU food database representative of country of origin
4. Animal farm LCI data available in EU dataset on continent or global level

In case of data sources 1 and 2 the activity data shall be modelled according to guidance in section 5.4.2 . The sources 1 and 2 shall contain and provide the following information at a minimum:

- Average annual herd composition and time division indoors and outdoors- relevant for the emission factors to be used (see section 5.4.2.2)
- Annual feed intake by feed source: grazing, roughage, wet and dry feeds (see sections 5.4.2.3)
- Annual live weight gain and a balance of mass, N and P. (see section 0)

If the data sources 1 or 2 have generated LCI datasets for their farm data according to the requirements of this FCR RED MEAT they shall be considered as identical to source 1 and 2, and thus preferable over 3 and 4.

The data quality and maximum share of allowable data from a source can be found in the decision tree in Figure 5-1.

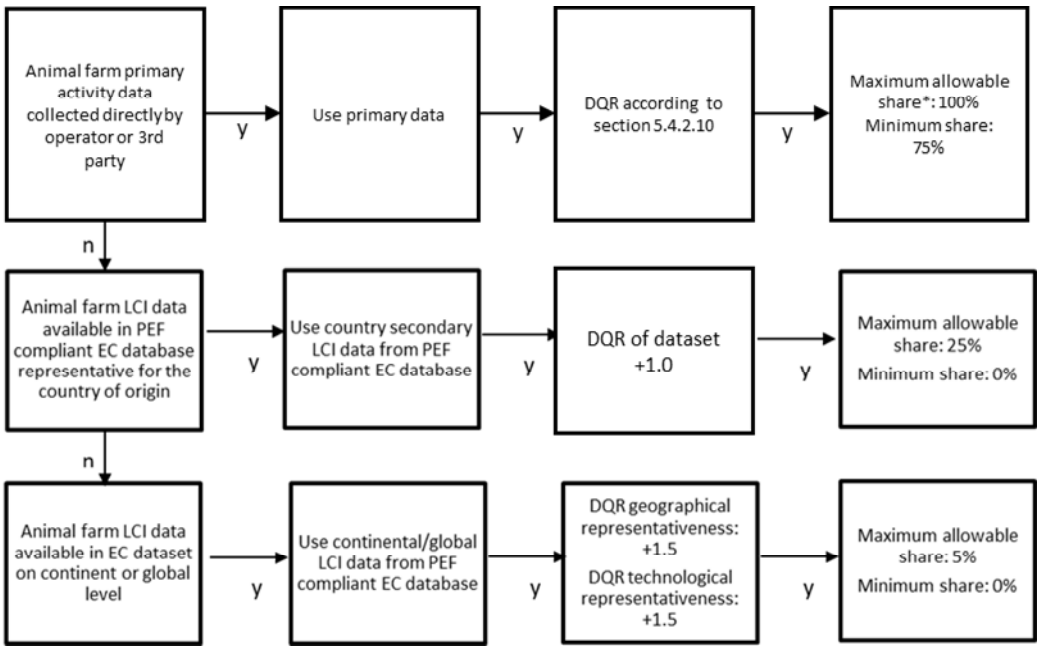


Figure 5-1: Data to be used and maximum share of allowable data per source. *the shares refer to the share of environmental impacts due to emissions on the farm.

Notes to Figure 5-1:

1. Animal farm primary activity data can be collected by operator or third party. Data collection shall be in compliance with the data collection requirements of the FCR RED MEAT methodology and data collection shall be based on a sufficiently large sample of farms..]

2. A minimum 75% of the farming impacts (i.e. impacts in 2.1 "Digestion of feed, housing and manure storage") shall be based on primary data (either directly surveyed or collected by a third party).

3. The EC dataset refers to the PEF compliant data that was tendered by the European Commission during the PEF pilot phase. This data is not restricted to just European data but can also include data for countries or regions outside EU.

The rules on minimum and maximum allowable shares shall be determined when the life cycle impact assessment is complete, and reported. Violating these conditions means that a FCR study according to this FCR RED MEAT is not possible.

5.4.2 Modelling guidance for primary data collection and collecting data from regional or national databases

5.4.2.1 Movement of animals through farm systems

The following sections give guidance on how to collect primary data per farm system. An animal can move through several farm systems. All these systems shall be accounted for in the proportion of live days at these systems.

5.4.2.2 Average herd composition

The average herd (or flock) composition and the breakdown of time spent indoor and outdoor shall be reported in accordance to the appropriate emission modelling for the specific country or region in scope. This should be done for every animal type present on the farm, in the format of Table 5-8. Animal types in this case refers to the age classification and sex of the animal (e.g. calf, female, <1 year).

Table 5-8: Herd composition

	Average amount of animals present	Days indoors	Days outdoors
Animal type 1			
Animal type 2			
Animal type 3			
…			
Animal type X			

5.4.2.3 Feed intake and feed composition

The total feed intake and feed composition shall be recorded for: grazing, roughage, wet and dry feed products. The feed composition(s) shall be representative of the farming system, country and time period under study. The feed composition information shall include the following information (Table 5-9).

Table 5-9: Data collection for feed.

	Feed ingredients	Dry matter content	Energy content	Digestible energy fraction	Fossil carbon content	Biogenic carbon content	N-content	P-content	Zn-content	Cu-content
Grazing (estimate of quantity of grass consumed)										
Roughage such as fed grass, silage, maize, hay, etc.										
Wet co-products, such as spent grain, distiller's grain, etc.										
Dry single feeds such as soybean meal, wheat										
Compound feeds (with a breakdown to feed ingredients)										
Supplemented additives										
Total feed										

The lifecycle information for purchased feed products shall be based on either a feed PEF report or a declaration which provides life cycle impact data of feed and the nutritional analysis data, or LCI data generated according to the feed PEFCR requirements (e.g. from the EC database). If no information is collected from feed suppliers, estimates shall be made and recorded on the basis of national statistical information on representative feed composition based on the agreed scope (year, animal type (including growing stage)) and nutritional data. These estimates are penalized in the data quality rating system (Table 5-1). The LCI of growing crops at animal farm (for own feed production) shall be quantified and recorded according to the requirements for crop cultivation of the feed PEFCR.

5.4.2.4 Mass and N, P balance of animals at farm (intake, retention and excretion)

The following mass balances shall be calculated for the animal systems for the relevant time period in the scope of the study and depending on the system boundaries and the purpose of the study. Users are free to choose the units as long as they are consistent.

Table 5-10: Mass balances to be calculated.

	Intake		Retention				Excretion
	Input of animals	**Input of feed**	**Output of all Living animals**	**Output of all dead animals**	**Output of animal products (wool/milk)**	**Stock changes (0 in a steady state)**	**Manure**
Mass weight as is							
Mass dm							
N, P, Zn, Cu							

The phosphorous, zinc and copper balances are especially relevant when the animal farming system includes grazing or manure application on crops (and thus P, Zn, Cu related emissions).

The nitrogen excretion shall always be calculated based on the following formula.

$$N_{excretion} = N_{feed} - N_{retention}$$

where $N_{retention}$ is the sum of outputs in living and dead animals and stock changes.

The nitrogen content of feed (N_{feed}) shall be requested from feed suppliers or if not available, sourced from published statistics representative of the feed composition in a specific country. The nitrogen content retained in animals ($N_{retention}$) shall be collected for the specific animals under study. These figures are often published in national statistics, or scientific literature.

The excretion values for P, Zn and Cu shall be calculated if manure is applied on own farm during grazing or at growing crops or when the application of manure is outside the farm (see section 5.4.2.5).

Table 5-11 gives retention values for nitrogen (N), phosphorous (P), copper (Cu) and Zinc (Zn). Copper and Zinc retention values were not available at this stage for Cattle and Lamb. For these animals it is assumed in this FCR RED MEAT that all intake of Cu and Zn is excreted.

Table 5-11: Overview of N, P,K, Cu and Zn contents for living pigs , cattle and lamb (Jongbloed & Kemme, 2006), (Van Bruggen 2014).

Animal		N	P	Cu	Zn
	Kg Live weight	g/kg	g/kg	mg/kg	mg/kg
Pigs					
Born piglet	1.3	18.7	6.2	1	16
Piglet before weaning	2.8	23.1	5.4	1	16
Piglet after weaning	12	24.2	5.2	1	16
Starter of 25 kg	25	24.8	5.3	2	16
Pig halfway	60	24.8	5.4	1	16
Pig before slaughtering	115	25.0	5.4	1	16
Sow	250	25.0	5.4	1	16
Boar	325	25.0	5.4	1	16
Cattle					
Veal at birth/starter	44	29.4	8.0		
Veal blanc	225	27.3	5.9		
Veal rose	330	26.4	6.8		
Cattle bull	450	28.5	7.5		
Cattle bull	600-700	27.0	7.4		
Suckling cow	650	22.5	7.4		
Sheep					
Mutton	75	25.0	7.4		
Lamb	42	26.2	5.2		

5.4.2.5 Emission calculation of housing and manure system

When calculating the emissions from housing and manure systems on a per animal and species basis, it is important to determine the number of days per year that an animal stays in a particular housing type. Firstly data shall be collected on the number of animals, the animal type, the housing type and the number of days spent on that unit as well as the fraction of manure storage and manure type. Secondly using the above data calculate the emissions using either the 'preferred' or 'alternative' options as presented on Table 5.12. If insufficient data is available the 'fallback' option shall be used however, in this case the TeR DQR must be increased by 1.

Table 5-12 Emissions and modelling requirements.

Emission	Preferred Option	Alternative option	Fallback option
Methane, biogenic, enteric fermentation	IPCC, vol4, chapt10, Tier 2	Country specific Tier 3 method (EFs) used in national monitoring	NO
Methane, biogenic, manure management	IPCC, vol4, chapt10, Tier 2	Country specific Tier 3 method (EFs) used in national monitoring	NO
Particulates , < 10 um	EMEP/EEA air pollution emission inventory guidebook 2013. Technical report No 12/2013. 3.B Manure management. Section 3.3.3 Tier 2	Country specific Tier 3 method (EFs) used in national monitoring, policy or legislation	Tier 1 Emission factors, DQR penalty of +1 for TeR
Dinitrogen monoxide direct from housing and manure management	IPCC, vol4, chapt10 Tier 2 method	Country specific Tier 3 method (EFs) used in national monitoring, policy or legislation	Tier 1 Emission factors, DQR penalty of +1 for TeR
Dinitrogen monoxide indirect from housing manure management	IPCC, vol4, chapt10 Tier 2 method t	Country specific Tier 3 method (EFs) used in national monitoring, policy	Tier 1 Emission factors, DQR penalty of +1 for TeR

		or legislation	
Ammonia from housing and manure storage	EMEP/EEA air pollution emission inventory guidebook 2013. Technical report No 12/2013. 3.B Manure management. Section 3 Methods. Tier 2	Country specific method used (EFs) in national monitoring, policy or legislation in accordance to EMEP/EEA	Tier 1 Emission factors, DQR penalty of +1 for TeR
NMVOC , non-methane volatile organic compounds, unspecified origin	EMEP/EEA air pollution emission inventory guidebook 2013. Technical report No 12/2013. 3.B Manure management. Section 3.3.2 Algorithm for NMVOC, page 24-26.	Country specific method used (EFs) in national monitoring, policy or legislation in accordance to EMEP/EEA	Tier 1 Emission factors, DQR penalty of +1 for TeR
Nitric oxide emissions	EMEP/EEA air pollution emission inventory guidebook 2013. Technical report No 12/2013. 3.B Manure management. Section 3.3.1 Algorithm for ammonia and nitric oxide, page 18-24.	Country specific method used (EFs) in national monitoring, policy or legislation in accordance to EMEP/EEA	Tier 1 Emission factors, DQR penalty of +1 for TeR

Ammonia emissions can be calculated according to EMEP/EEA emissions inventory guidebook 2013 by using the default total available nitrogen (TAN) values unless more specific country information is available.

Table 5-13: Default TAN values and an example of more specific TAN values for a country.

Livestock category	Default TAN proportion of N excretion (EMEP/EEA emissions inventory guidebook 2013)	Example of specific TAN proportion of N excretion as used in the Netherlands for ammonia emission monitoring
Dairy cows	0.6	0.66
Other dairy cattle	0.6	0.59-0.7 depending on animal category
Beef cattle	0.6	0.54- 0.68 depending on animal category
Fattening pigs	0.7	0.68
Sows and piglets	0.7	0.65

The applied emission modelling methods and assumptions shall be recorded and reported.

5.4.2.6 Energy and material flows at farm

The following animal farm activity data shall be reported and connected to background data provided by the EC. The data source shall also be reported.

Table 5-14: Activity data for animal farm related to energy and material use

Activity data	Unit	Quantity
Inputs		
Living animal(s)	kg Live weight and numbers	
Electricity use	kWh	
Gas use	M3 and MJ LHV	
Heat use	MJ LHV	

Other energy inputs for boiler	MJ LHV (specify type)	
Water use	m^3 (specify type)	
Bedding materials	kg (specify type)	

5.4.2.7 Manure (co-) digesting

Production of energy on the basis of biomass residuals from the farm or the slaughterhouse will be modelled on the basis of avoided energy production (electricity, fuel or heat) following the recommendations of the PEF guidance document v 5.2 on avoided electricity production.

5.4.2.8 Allocation at farm level

For the animal farm systems, the LEAP guidelines regarding allocation shall be followed. These are summarised in Table 5-15. Please refer to the specific LEAP guidelines for detailed guidance.
When feed is produced at farm, the allocations rules of the feed PEFCR shall be applied.

Table 5-15: Allocation of animals on farm.

Animal type	Allocation	Source for more specific guidance
Beef Enterprise	Use biophysical allocation according to energy requirements for animal physiological functions of growth, milk production, reproduction, activity and maintenance.	Environmental performance of large ruminant supply chains (FAO LEAP, 2016a)
Pigs / sows	Use biophysical allocation based on the proportion of total energy requirements for growth and piglet production.	Environmental performance of pig supply chains (FAO LEAP, 2016b)
Sheep	Use biophysical allocation according to energy or protein requirements for animal physiological functions of growth, fibre production, milk production, reproduction and maintenance	(FAO LEAP, 2015) Greenhouse gas emissions and fossil energy demand from small ruminant supply chains

For manure that leaves the animal farm the system boundaries are extended to include manure use at arable farming and avoided N and P fertilizer production and application:

To calculate the replacement of N and P fertilizer by manure application outside the animal farm system the following steps shall be undertaken:

- Determine the type of fertilizer that would have normally been used by the farmer in a situation without manure. Default is CAN for nitrogen and (TSP) triple superphosphate for phosphate.

- Determine the replacement rate; to define the level of replacement the differences in efficiency of manure as a nutrient source and artificial fertilizer needs to be accounted for. If no data is collected the default replacement rate is 50% for nitrogen and phosphate based on the tested N and P content in the manure.
- Include a 100% of the transport, potential manure treatment and in-field manure application
- Use the 50% default position for the replacement rate for the production, transport and application of fertilizer when calculating the replacement rate.

5.4.2.9 DQR of Feed

Feed production at farm shall be modelled according to the Feed PEFCR.

The first step is to define the total feed ration and composition of the feed ration in types of feed ingredients, see Table 5-9. The next step is to determine the accuracy of the feed ration and then combine this with the DQR of the primary and secondary data of feed production to set the total DQR of feed.

The DQR of feed shall be less than or equal to 3.

If the feed composition is modelled by the PEF operator based on information of the feed composition and LCIs from PEF compliant databases, the data quality score for feed use and production is:

$$DQRf = AFC*a + DQRlci*b$$

AFC: Accuracy feed composition data

DQRlci: Data Quality Rating LCIs used to model feed production

Where

a = 0.3, b = 0.7,

5.4.2.10 DQR animal farm (without feed)

The DQR of the animal farm (minus feed) shall be lower than 2.4 based on the following DQR system. The DQR system is listed in Table 5-16.

Table 5-16: DQR animal farm. NO PEF = No PEF study is possible with this DQR score

Quality level	Quality rating	C	TiR	P	TeR	GR
Very good	1	All data points as mentioned in sections 0 to 5.4.2.9 are included	Data cover the exact time period in the scope of the study	≤ 10%	The technology(ies) is/are specific for the farm(s) in scope and all data points are calculated for	The data cover the specific production region(s) in scope of study on the basis of a weighted share

					this technology	
Good	2	All data points necessary to calculate N, P, C , Zn and Copper related emissions are included but no energy and materials use data	Data partially cover the time period in the scope of the study	10% to 20%	The technology(ies) is/are specific for the farm(s) in scope and but some minor flows are based on average data	The data cover the specific production region(s) in scope of study but unweighted
Fair	3	All data points necessary to calculate N, C , related emissions are included but no energy and materials use data	Collected data is within the 2 most recent years with respect to the time period in the scope of the study	20% to 30%	Modelled farming technologies are similar to the farms under study	The data partially cover the region of production
Poor	4	NO PEF possible	Collected data is within the 4 most recent years with respect to the time period in the scope of the study	30% to 50%	NO PEF	NO PEF
Very poor	5	NO PEF possible	Collected data is within the 6 most recent years with respect to the time period in the scope of the study	> 50%	NO PEF	NO PEF

$$\mathrm{DQRaf} = \frac{C + TiR + TeR + GR + P}{5}$$

TeR: Technological-Representativeness GR: Geographical-Representativeness

TiR: Time-Representativeness

P: Precision/uncertainty C = Completeness

5.5 Calculating overall data quality scores

If all data quality scores per process fulfill the minimum requirements, an overall score shall be calculated per environmental impact by applying the following formula.

The overall data quality score $DQRtotal_i$ is calculated per environmental impact on the basis of the following formula:

$$DQRtotal_i = \sum DQRscp * a_{pi} + \sum DQRo * b_{pi} + \sum DQRi * c_{pi} + \sum DQRf * d_{pi} + \sum DQRaf * e_{pi}$$

Where:

- $a_{pi}, b_{pi}, c_{pi}, d_{pi}, e_{pi}$ = The relative contribution of process p to impact i in the respective life cycle stages.
- DQRscp = DQR slaughtering cutting and packing,
- DQRo= DQR outbound transport(s);
- DQRi = DQR of inbound transport(s);
- DQRf = DQR of feed data;
- DQRaf =DQR animal farm data;

And $\sum_p a_{pi} + \sum_p b_{pi} + \sum_p c_{pi} + \sum_p d_{pi} + \sum_p e_{pi} = 1$

The overall data quality score (DQRtotal) can then be calculated by calculating the average of the scores per impact category. In this calculation it is assumed that the data quality score of secondary databases for energy production and transport processes does not negatively affect any of the DQRs calculated according to this FCR RED MEAT. The DQR overall values and the breakdown to the 5 calculated DQRs shall be reported per impact category and averaged to determine the overall DQR. The minimum data quality requirements per life cycle stage are listed in Table 5-17.

Table 5-17: Data quality scores.

	DQR Total	DQRscp Slaughtering, cutting and packing	DQRo Outbound transport	DQR1 Inbound transport	DQRf Feed	DQRaf Animal farm
Required minimum level	**≤ 2.5**	**≤ 1.6**	**≤ 3**	**≤ 3**	**≤ 3**	**≤ 1.6**

6 Benchmark and classes of environmental performance

Description of the representative products:

There are three representative products each based on a virtual EU average meat product:

1. 1 tonne of ***beef*** including inedible animal parts (such as bone).
2. 1 tonne of ***pork*** including inedible animal parts (such as bone).
3. 1 tonne of ***sheep meat*** including inedible animal parts (such as bone).

For the currently available benchmark results calculated in the screening study (TS Red meat FCR, 2019) these averages are derived as follows:

The representative product **Beef** is an average where 55% of the carcase weight comes from EU dairy enterprises and 45% of Beef enterprises. The beef from dairy farming data are based on the PEF compliant dairy process in Agri-footprint 2.0. The data for beef cattle farming originate from the screening and are based on French farming systems as being defined in the Agribalyse v1.2 database.

The representative product **pork** is an average EU pig farming system modelled in the screening study. The representative product **sheep meat** is an average sheep meat farming system modelled in the screening study on the basis of three important producing countries for the EU consumption: UK, Spain and New Zealand.

A further description of the representative product and modelling assumptions can be found in the screening report.

6.1 Results per impact category of the benchmarks prior to normalization

The results shown below are based on the screening study prior to normalization and normalized (TS Red meat FCR, 2019).

Table 6-1: Results prior to normalization for each impact category **for 1 tonne of pork sold to retailers or food service or manufacturing (total and per life cycle stage).**

Impact category	Unit	Total	Sow-piglet system	Feed sow-piglet system	Fattening pig system	Feed fattening pigs	Slaughterhouse	Packaging
Climate change	kg CO2 eq	4.19E+03	2.50E+02	7.37E+02	6.80E+02	2.21E+03	2.37E+02	7.32E+01
Climate change_exLUC	kg CO2 eq	3.01E+03	2.50E+02	4.15E+02	6.80E+02	1.35E+03	2.37E+02	7.32E+01
Ozone depletion	kg CFC-11 eq	4.40E-05	2.12E-06	9.31E-06	5.39E-07	2.55E-05	4.93E-06	1.61E-06
Human toxicity, non-cancer effects	CTUh	1.52E-03	-8.12E-08	3.40E-04	-1.39E-06	1.18E-03	-3.47E-06	6.45E-06
Human toxicity, cancer effects	CTUh	4.99E-05	-8.66E-08	1.09E-05	-5.55E-07	3.70E-05	-3.57E-07	3.03E-06
Particulate matter	kg PM2.5 eq	2.74E+00	3.92E-01	1.61E-01	1.59E+00	5.58E-01	5.31E-03	3.52E-02
Ionizing radiation HH	kBq U235 eq	6.36E+01	2.69E+00	1.12E+01	5.95E-01	3.09E+01	5.52E+00	1.27E+01
Ionizing radiation E (interim)	CTUe	1.14E-03	2.68E-05	2.89E-04	6.98E-06	7.19E-04	5.71E-05	3.93E-05
Photochemical ozone formation	kg NMVOC eq	5.69E+00	1.29E-01	1.12E+00	3.29E-01	3.51E+00	3.48E-01	2.51E-01
Acidification	molc H+ eq	1.15E+02	1.72E+01	5.92E+00	7.02E+01	2.11E+01	3.79E-01	3.12E-01
Terrestrial eutrophication	molc N eq	5.09E+02	7.68E+01	2.53E+01	3.14E+02	9.11E+01	1.38E+00	5.78E-01
Freshwater eutrophication	kg P eq	1.17E+00	-1.40E-03	2.22E-01	2.08E-01	7.43E-01	-1.45E-02	1.73E-02
Marine eutrophication	kg N eq	3.32E+01	5.52E-01	5.30E+00	8.30E+00	1.88E+01	1.68E-01	5.81E-02
Freshwater ecotoxicity	CTUe	1.22E+04	-7.67E+00	2.82E+03	-3.19E+01	9.31E+03	-8.24E+01	2.37E+02
Land use	kg C deficit	5.13E+04	-1.27E+00	1.19E+04	-5.06E+00	3.93E+04	-1.20E+01	1.11E+02
Water resource depletion	m3 water eq	9.67E+00	3.87E-01	2.06E+00	1.35E+00	5.07E+00	6.52E-02	7.45E-01
Mineral, fossil & ren resource depletion	kg Sb eq	1.19E-01	1.16E-04	3.57E-02	-8.79E-05	8.31E-02	1.66E-04	2.68E-04

Table 6-2: Results prior to normalization for each impact category for 1 tonne of beef sold to retailers or food service or manufacturing (total and per life cycle stage).

Impact category	Unit	Total	Emissions stable suckler cow system	Enteric fermentation suckler cow system	Suckler cow system	Transport FR-IT (to fattening)	Emissions stable fattening system	Enteric fermentation fattening system	Fattening system	Slaughterhouse	Packaging
Climate change	kg CO2 eq	3.25E+04	2.70E+03	1.21E+04	7.54E+03	6.47E+02	1.74E+03	4.45E+03	3.38E+03	-1.17E+02	7.32E+01
Climate change exLUC	kg CO2 eq	3.17E+04	2.70E+03	1.21E+04	7.14E+03	6.47E+02	1.74E+03	4.45E+03	2.99E+03	-1.17E+02	7.32E+01
Ozone depletion	kg CFC-11 eq	6.12E-04	0.00E+00	0.00E+00	3.83E-04	1.32E-06	0.00E+00	0.00E+00	2.21E-04	4.40E-06	1.61E-06
Human toxicity, non-cancer effects	CTUh	4.07E-03	0.00E+00	0.00E+00	2.85E-03	1.87E-05	0.00E+00	0.00E+00	1.25E-03	-4.88E-05	6.45E-06
Human toxicity, cancer effects	CTUh	4.18E-04	0.00E+00	0.00E+00	2.95E-04	7.28E-07	0.00E+00	0.00E+00	1.32E-04	-1.28E-05	3.03E-06
Particulate matter	kg PM2.5 eq	8.58E+00	1.76E+00	0.00E+00	3.75E+00	7.81E-02	1.50E+00	0.00E+00	1.57E+00	-1.16E-01	3.52E-02
Ionizing radiation HH	kBq U235 eq	6.53E+02	0.00E+00	0.00E+00	3.84E+02	1.61E+00	0.00E+00	0.00E+00	2.52E+02	2.97E+00	1.27E+01
Ionizing radiation E (interim)	CTUe	9.54E-03	0.00E+00	0.00E+00	4.95E-03	1.59E-05	0.00E+00	0.00E+00	4.48E-03	5.64E-05	3.93E-05
Photochemical ozone formation	kg NMVOC eq	5.79E+01	1.90E+01	3.60E+00	1.27E+01	7.15E+00	9.25E+00	1.32E+00	5.97E+00	-1.28E+00	2.51E-01
Acidification	molc H+ eq	3.48E+02	7.73E+01	0.00E+00	1.47E+02	5.40E+00	6.05E+01	0.00E+00	6.01E+01	-1.89E+00	3.12E-01
Terrestrial eutrophication	molc N eq	1.55E+03	3.46E+02	0.00E+00	6.49E+02	2.87E+01	2.71E+02	0.00E+00	2.65E+02	-4.83E+00	5.78E-01
Freshwater eutrophication	kg P eq	4.82E+00	0.00E+00	0.00E+00	3.48E+00	2.08E-03	0.00E+00	0.00E+00	1.48E+00	-1.55E-01	1.73E-02
Marine eutrophication	kg N eq	2.69E+02	2.54E+00	0.00E+00	1.88E+02	2.61E+00	2.04E+00	0.00E+00	7.36E+01	-4.22E-01	5.81E-02
Freshwater ecotoxicity	CTUe	2.89E+04	0.00E+00	0.00E+00	1.52E+04	4.83E+02	0.00E+00	0.00E+00	1.41E+04	-1.13E+03	2.37E+02
Land use	kg C deficit	3.92E+05	0.00E+00	0.00E+00	2.77E+05	0.00E+00	0.00E+00	0.00E+00	1.15E+05	-1.25E+02	1.11E+02
Water resource depletion	m3 water eq	6.03E+01	0.00E+00	0.00E+00	3.54E+01	9.45E-03	0.00E+00	0.00E+00	2.52E+01	-1.03E+00	7.45E-01
Mineral, fossil & ren resource depletion	kg Sb eq	2.92E-02	0.00E+00	0.00E+00	1.25E-02	1.52E-04	0.00E+00	0.00E+00	1.64E-02	-6.52E-06	2.68E-04

Table 6-3: Results prior to normalization for each impact category for 1 tonne of lamb sold to retailers or food service or manufacturing (total and per life cycle stage).

Impact category	Unit	Total	Feed	Animal production	Slaughterhouse	Packaging
Climate change	kg CO2 eq	2.41E+04	8.40E+03	1.53E+04	2.83E+02	1.48E+02
Climate change exLUC	kg CO2 eq	2.08E+04	5.09E+03	1.53E+04	2.83E+02	1.48E+02
Ozone depletion	kg CFC-11 eq	8.31E-05	3.30E-05	1.88E-05	2.96E-05	1.73E-06
Human toxicity, non-cancer effects	CTUh	9.75E-03	9.55E-03	2.18E-04	-1.76E-05	6.65E-06
Human toxicity, cancer effects	CTUh	5.74E-04	5.77E-04	-5.70E-07	-5.91E-06	3.06E-06
Particulate matter	kg PM2.5 eq	1.15E+01	2.30E+00	9.07E+00	3.91E-02	1.33E-01
Ionizing radiation HH	kBq U235 eq	1.09E+02	4.00E+01	2.22E+01	3.42E+01	1.28E+01
Ionizing radiation E (interim)	CTUe	1.01E-03	3.95E-04	2.25E-04	3.50E-04	4.07E-05
Photochemical ozone formation	kg NMVOC eq	2.69E+01	1.80E+01	6.42E+00	3.96E-01	2.12E+00
Acidification	molc H+ eq	4.88E+02	7.80E+01	4.06E+02	1.04E+00	3.21E+00
Terrestrial eutrophication	molc N eq	2.17E+03	3.50E+02	1.81E+03	1.40E+00	7.82E+00
Freshwater eutrophication	kg P eq	7.02E+00	7.08E+00	-6.14E-03	-7.01E-02	1.75E-02
Marine eutrophication	kg N eq	3.01E+02	1.38E+02	1.62E+02	1.35E-01	7.20E-01
Freshwater ecotoxicity	CTUe	3.19E+04	3.22E+04	-1.08E+02	-4.95E+02	2.39E+02
Land use	kg C deficit	5.53E+05	5.53E+05	-2.83E+01	-5.69E+01	1.11E+02
Water resource depletion	m3 water eq	3.50E+01	3.40E+01	5.67E-01	-3.68E-01	7.46E-01
Mineral, fossil & ren resource depletion	kg Sb eq	2.12E-02	2.01E-02	2.97E-04	4.61E-04	2.83E-04

7 Interpretation

According to the PEFCR Guidance 5.2 (European Commission, 2016), the interpretation phase shall include the following steps:

- Assessment of robustness of the Product Environmental Footprint model
- Identification of hotspots
- Estimation of uncertainty; and
- Conclusions, recommendations and limitations

The limitations of the study shall be clearly stated and described.

Robustness of the PEF model

The PEF results rely on impact assessment methods which are not equally robust. They can be classified as follows:

High robustness

- Climate change
- Ozone depletion
- Particulate matter

Medium robustness

- Ionizing radiation
- Photochemical ozone formation
- Resource depletion (fossil – mineral)
- Acidification
- Eutrophication (marine, terrestrial, freshwater)

Low robustness

- Human toxicity (cancer and non-cancer)
- Freshwater ecotoxicity
- Land use
- Water resource depletion

Identification of hotspots

For each impact category, hot spots shall be identified concerning life cycle stages, process and elementary flow. In each case, the assessment shall account for the cumulative contribution required to reach at least 50% to any impact category (from the largest contribution in descending order, summed up to make up for at least 50% of the total environmental impact result in an impact category)

The procedure to identify hotspots is detailed in the PEF guidance (European Commission, 2016).

Estimation of uncertainties

The uncertainties associated with the data robustness shall also be reported:

- Uncertainty related to primary data collection
- Uncertainty associated with use of secondary data, either from the EC database or from the GFLI database.

Conclusions, limitations and recommendations

The conclusions of the PEF study shall always be accompanied with a clear description on the limitations of the study.

The list below is a non-exhaustive compilation of limiting factors for a PEF study

- Assumptions made throughout the study
- Data gaps in secondary database
- To be expanded

8 Reporting, Disclosure and Communication

The purpose of this FCR RED MEAT is to facilitate the comparison within the same animal species and to provide guidance to drive environmental impact improvements in the value chain.

This FCR RED MEAT is primarily meant for B2B communication, which involves drafting and communicating a complete report on the PEF study, including results on all impact categories, DQR assessment and underlying assumptions (see PEF guide for complete instructions).

However, based on the screening study and supporting studies three impact categories were selected as most reliable and relevant for communication How these impact categories were pre-selected is further explained in the screening study (TS Red meat pilot, 2016). Note that for B2C communication, the PEF guidance states that ideally only 3-4 indicators should be used (European Commission, 2016). The following impact categories shall be used for communication.

Table 8-1: Currently selected impact categories for communication.

Impact category	Main contributing elementary flows
Terrestrial eutrophication	Ammonia at farm and cultivation > 90% the remainder is energy related
Acidification	Ammonia at animal farm and cultivation >80 %, the remainder is energy use related NOx, Sox
Climate Change	CH_4, CO_2 from LUC, N_2O, fossil carbon related emissions

Climate change is selected as an impact for communication because of societal demand; however screening and supporting studies show that two other impacts have a higher environmental burden (for further explanation on the impact categories selected see the screening study on UECBV website).

The impact category score for 'climate change' shall be broken down in three sub-categories in the report:

- Climate change – fossil
- Climate change – biogenic methane emissions
- Climate change – land use and land use change

No biogenic CO2 uptake and capture are recorded, following the simplified approach for biogenic carbon reporting of the PEF Guidance 5.2. See for carbon sequestration in soil, paragraph 4.7.

9 Verification

According to ISO 14044 and to the PEF Guide, any PEF study claiming to be in line with the PEF Guide and any PEF study for external communication shall be critically reviewed in order to ensure that:

- The methods used to carry out the PEF study are consistent with the PEF Guide
- The methods used to carry out the PEF study are scientifically and technically valid
- The data used are appropriate, reasonable and meet the defined data quality requirements
- The interpretation of results reflects the limitations identified
- The study report is transparent, accurate and consistent

The Red Meat Technical Secretariat recommends focusing the verification on the following aspects

- Is the breakdown of the slaughtered animal, into animal parts and product groups done according to the recommendations in this FCR RED MEAT
- Is the calculation for the animal farming section predominantly based on primary data, as is recommended in this FCR RED MEAT, and are data sources and calculation methods accurately reported?
    - If secondary data has been used, are these determined in accordance to the procedures described in this FCR RED MEAT, and has the data quality been modified accordingly?
    - If the procedures have been followed correctly, does the secondary data from national databases/statistics meet the requirements as stated in this FCR RED MEAT

10 Reference literature

European Commission. (2016). *Guidance for the implementation of the EU Product Environmental Footprint (PEF) during the Environmental Footprint (EF) pilot phase - draft version 5.2*.

FAO LEAP. (2015). *Greenhouse gas emissions and fossil energy use from small ruminant supply chains - Guidelines for assessment*. Retrieved from http://www.fao.org/partnerships/leap/resources/resources/en/

FAO LEAP. (2016a). *Environmental Performance of Large Ruminant Supply Chains : Guidelines for quantification*.

FAO LEAP. (2016b). *Environmental performance of pig supply chains - Draft for public review*. Retrieved from http://www.fao.org/3/a-bl094e.pdf

Goedkoop, M., Heijungs, R., Huijbregts, M., Schryver, A. De, Struijs, J., & Zelm, R. Van. (2009). *ReCiPe 2008 A life cycle assessment method which comprises harmonised category indicators at the midpoint and the endpoint level. Report 1 Characterisation.* Den Haag.

Jongbloed, A. W., & Kemme, P. A. (2006). De uitscheiding van stikstof en fosfor door varkens, kippen, kalkoenen, pelsdieren, eenden, konijnen en parelhoeders in 2002 en 2006.

Mckiernan, B., Gaden, B., & Sundstrom, B. (2007). Dressing percentages for cattle. *Prime Facts*, *340*(January), 7–9. Retrieved from http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/103992/dressing-percentages-for-cattle.pdf

Technical Secretariat Dairy PEF. (2018). Product Environmental Footprint Category Rules for Dairy Products, 168. Retrieved from http://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR-DairyProducts_2018-04-25_V1.pdf

TS Red meat FCR. (2019). *FCR RED MEAT; Update Screening study*.

List of annexes

Annex I – Representative product

The screening report and its annexes are available on the UECBV website.

Annex II – Example formulas to convert carcase weight to live weight

If no direct measurement of live weight of incoming living animals in the slaughterhouse data is available, live weight shall be determined on the basis of the method that is commonly used in the country of production and that is applicable for the animal type being under study. In the following tables (Table 0-1), some example conversion calculations from carcase weight to live weight are shown.

Table 0-1: Example of current Methods to estimate live weight for animals in several countries that produce for EU consumption

Country	Animal category	Equation LW = Live weight HSCW = hot slaughtered carcase weight
Pigs		
The Netherlands	Mixed castrated males and females	LW = 5+HSCW*1.20
	Mixed males and females	LW = 5+HSCW*1.21
	Males	LW = 5+HSCW*1.22
France	Pigs Sows	LW=HSCW*1,26 LW=HSCW*1,27
Denmark	Pigs Sows	LW = 7,01 + HSCW * 1,19 LW = HSCW * 1,305 -2,103
Cattle		
Australia (Mckiernan, Gaden, & Sundstrom, 2007)	Young cattle steers and heifers	LW = HSCW/0.50 to HSCW /0.59 depending on fat and muscle score
	Heavy steers	LW = HSCW/0.48 to HSCW/0.58 depending on fat and muscle score
	Cows < 200 kg CW	LW = HSCW/0.38 to HSCW/0.50 depending on fat and muscle score
	Cows 200-250 kg CW	LW = HSCW/0.41 to HSCW/0.56 depending on fat and muscle score
	Cows 250 kg	LW = HSCW/0.42 to HSCW/0.56 depending on fat and muscle score
	Bulls	LW = HSCW/0.48 to HSCW/0.58 depending on fat and muscle score
France	Dairy Cow (Holstein) Suckler Cow (Charolaise) Suckler young bull (Charolais) Dairy Young Bull (Holstein)	LW = HSCW*2,08 LW = HSCW*1,88 LW = HSCW*1,72 LW = HSCW*1,92
Ireland	Steers and heifers	LW = HSCW/0.52 to HSCW/0.59 depending on fat and muscle score (usually a figure of HSCW/0.545 is used)

	Young Bulls	LW = HSCW/0.53 to HSCW/0.60 depending on fat and muscle score (usually a figure of 1/0.57 is used)
	Cows <250 kg CW	LW = HSCW/0.45 to HSCW/0.50 depending on fat and muscle score
	Cows >250 kg CW	LW = HSCW/0.47 to HSCW/0.54 depending on fat and muscle score
Lamb		
UK	Lamb	LW=HSCW/0.48

Annex III – Feed PEFCR

This annex provides a summary of the feed PEFCR rules to give the red meat FCR RED MEAT user a quick guide to the essentials of the feed PEFCR.

How has it been designed?

It is valid for EU feed mill operations working under the CPA 10.91 product group "Manufacture of prepared feeds for farm animals (Eurostat ISSN 1977-0375)". It involved other institutional and non-institutional partners, such as Mercosur countries (Brazil-sustainable soya) as well as FAO.

Many of the suggestions of the LEAP guidelines are translated to requirements that should be fulfilled in the feed pilot PEFCR. The remit of the Feed Pilot is to deliver a freely accessible harmonized database namely GFLI into the global market.

Scope of the feed-PEFCR

1) Cradle to gate for either internal or external use but without comparison

2) Cradle to gate PEF studies of compound feed for comparison, either between alternatives (e.g. sourcing, raw materials choices) or over time (e.g. trend monitoring).

3) Feed PEFCR can be used for single feed, compound feed and home grown feed (cultivation section of feed PEFCR).

Functional unit

There is only a reference unit; the reference flow is 1 ton of animal feed product delivered to the livestock farm (or fish farm) entry gate.

Representative product

The representative product is a virtual compound feed product and consists of the average composition of feed materials consumed by the EU compound feed industry in the time period 2009-2013

Allocation

Economic plus two physical alternatives to ensure that the influence of allocation is properly described in the conclusion of the study.

Within system boundaries

Cultivation (including capital goods), transport, processing of crops (excluding capital goods), animal-based feed materials and feed additives

For animal protein or products from the dairy processing industry such as whey powders no specific requirements on LCI modelling are set. Animal manure can re-enter the lifecycle at the cultivation stage. Biodiversity loss shall be reported as additional information (ReCiPe).

The rules for homegrown feed are indirectly covered by the feed PEFCR. The scope of the Feed PEFCR is compound feed but it also gives rules on how to define environmental impact of crops and roughage production

Outside the system boundaries

Feed utilization in animal production systems and all subsequent processes in the value chain.

Other considerations about system boundaries

System boundaries need to be extended when big changes are being studied.

Additional LCA modelling should be considered when the national supply of raw materials or area for cultivation is greater than 5%

System limitations

No distinction between specific cultivation practices.

EF impact categories

Feed is considered by default an intermediate product; therefore, all the default PEF impact categories shall be included in the assessment. The impact on climate change rely of ILCD method, ENVIFOOD protocol recommendations (Food SCP, 2013) and LEAP feed guidelines (FAO LEAP 2015).

Data quality

Primary data is required for feed mill and in- and outbound transport. Primary data collection is subject to the DQR system

Secondary data requirements:

1. Compliance to ILCD/PEF nomenclature

2. Acceptable DQR (Data Quality Requirement score)

Data gaps

• Select similar processes/products (feed ingredients proxies) from secondary database when data is not available.

• Select similar geographical datasets (database can be used as proxies)

• Adapt logistics and energy provision when other datasets are used as a proxy

Annex IV – Explanatory note on how to allocate manure when its application is outside the animal farm

Manure is a co-product from the live animal production. Manure produced by animals can be applied as a natural organic fertilizer and soil improver to the fields producing feed for the livestock production system in question at the farm, for other crops grown on the farm or for other crops grown by a third party. If manure is applied on land used for feed production within the farm, impacts related to manure use are included in the feed production at the farm and thus taken into account in relation to the environmental impact of feed used. Thus, the fact that manure fully or partly substitutes synthetic fertilizer that otherwise would be needed for that production is automatically accounted for in the assessment. If manure is applied in other situations, it is considered as a co-product and is handled according to the Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organizations: Handling of multifunctional processes section 5.10. Here it is stated that if a direct substitution- effect can be robustly modelled this should be done and the resource use and emissions profile data subtracted in a directly representative manner.
Manure is considered to be a co-product of which the impact can be taken into account by direct substitution modelling. 'Direct substitution may be modelled as a form of allocation based on an underlying physical relationship when a direct, empirically-demonstrable substitution effect can be identified. For example, when manure nitrogen is applied to agricultural land, directly substituting an equivalent amount of the specific fertilizer nitrogen that the farmer would otherwise have applied, the animal husbandry system from which the manure is derived is credited for the displaced fertilizer production (taking into account differences in transportation, handling, and emissions)'(EC 2013) .
The fact that such 'exported' manure is allocated all environmental costs related to its transportation from farm to destination for use as well as emissions that exceed the emissions from using the equivalent amount of synthetic fertilizer ensures that all impacts related to manure handling and utilization are accounted for within the assessment. Only the net value of the substitution is credited to the manure producing farm.
For manure both nitrogen and phosphorous are important nutrients and in cases where environmental regulations are established that limits the total amount of nitrogen and phosphorous used on agricultural land (like in many places in the EU) and where consequently the use of manure results in less use of synthetic fertilizer then the animal husbandry system should be credited with the replaced N and P in the fertilizer type most frequently used in the relevant country and taken into account the substitution efficiency of the particular type of manure and typical difference in transport cost and emissions. In the absence of primary information demonstrating avoided fertilizer the default value for avoided fertilizer shall be 50% of the primary nutrients in the manure. The 50% represents a baseline, you can improve the data if you have a higher regional level data. These parameters may change depending on soil, the climatic conditions and animal breed.

Manure is also feed stock for energy recovery in i.e. biogas plants (while maintaining or even increasing its fertilizer value). If manure is used for energy recovery at the farm alleviating the energy use from other sources at the farm, this is taken into account within the system boundaries. If manure is used for energy recovery outside the farm, the animal farm is credited with the effective replaced energy production taking into account transport and other costs related to manure handling at the biogas plant.

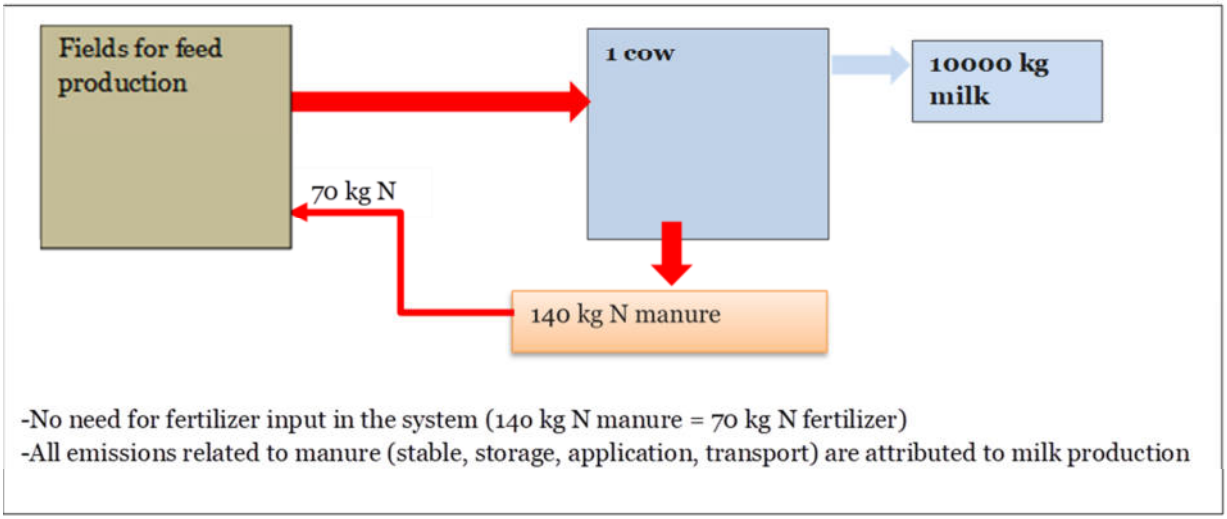
Please look at some examples reported in the next page to understand the manure system for cows.

References:

EC 2013. Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. Official Journal of the European Union L124 Vol 46, pp 43-44.
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2013:124:FULL&from=EN

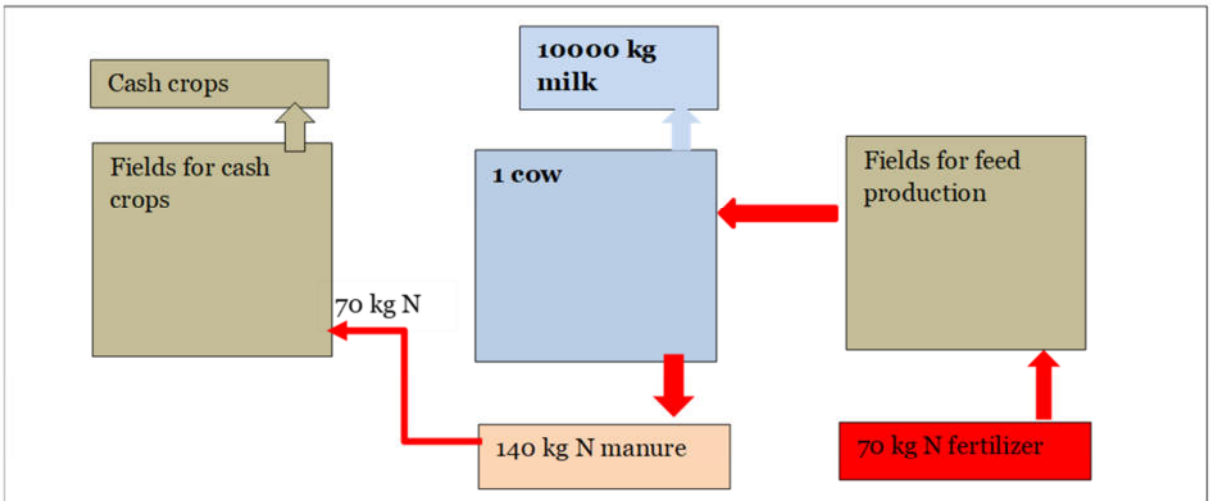
Life cycle assessment of a sustainable agriculture system using manure as a fertilizer
https://www.researchgate.net/publication/280246633_Life_cycle_assessment_of_a_sustainable_agriculture_system_using_manure_as_a_fertilizer

Case 1: Manure used on fields for feed production



-No need for fertilizer input in the system (140 kg N manure = 70 kg N fertilizer)
-All emissions related to manure (stable, storage, application, transport) are attributed to milk production

Case 2: Manure used elsewhere and fields used for feed production receives fertilizer



- 70 kg N fertilizer are attributed to ml production (for feed production), but is credited for the emissions saved due to fertilizer replacement (70 kg N used for cash crops). Net results zero.
-All emissions related to manure (stable, storage, application, transport) are attributed to milk production

Annex V – Mass vs. economic allocation

Why mass allocation for meat

Theoretically biophysical allocation is the preferred method of allocation at slaughterhouse level. During the development of this document, the FCR RED MEAT assigned a project to INRA to elaborate the biophysical method at slaughterhouse. Although it showed promise on theoretical level, it was not yet specific enough to be applied on an operational level at slaughterhouses. For example, for pork the methodology is not yet sufficiently robust (age and breed of monogastric species will not allow a reasonable fit in biophysical modelling). Consequently, mass allocation shall be used as a proxy until advances permit the use of biophysical allocation in the future.

Why no economic allocation

The price variability in the meat sector presents significant challenges when trying to apply an economic allocation. Prices vary considerably depending on unpredictable circumstances (i.e. embargos, new market penetration, pandemics, etc…)

The non-carcase meat outputs from a slaughterhouse will fluctuate between being sold for human food, for pet food or sold for other purposes e.g pharma or biofuel, - livers, kidneys and hearts as an example. If economic allocation is applied, the footprint will change from year to year depending on the market conditions and fluctuations and the price differences. Consequently the benchmark of the environmental performance would need to be recalculated over time and potentially could incur the risk of greenwashing.

The FCR RED MEAT aims to use a high degree of primary data, therefore the allocation method should be equally robust and not based on old and generic economic data.

It is believed that slaughterhouses should have good and robust data-sets on the volumes they produce and their destinations into the different product groups (see paragraph 5.3.3) to which these volumes are sold. This enables a more accurate environmental footprint if allocation is based on mass instead of economy. Therefore' economic allocation shall not be used.

The charts below reported (1 – 2 – 3- 4 - Source UECBV SG) show examples of price variability for the three meat species between a liver (to be considered as ABP) and products.

PRICE VARIABILITY: BEEF CUTS VERSUS BEEF BYPRODUCTS

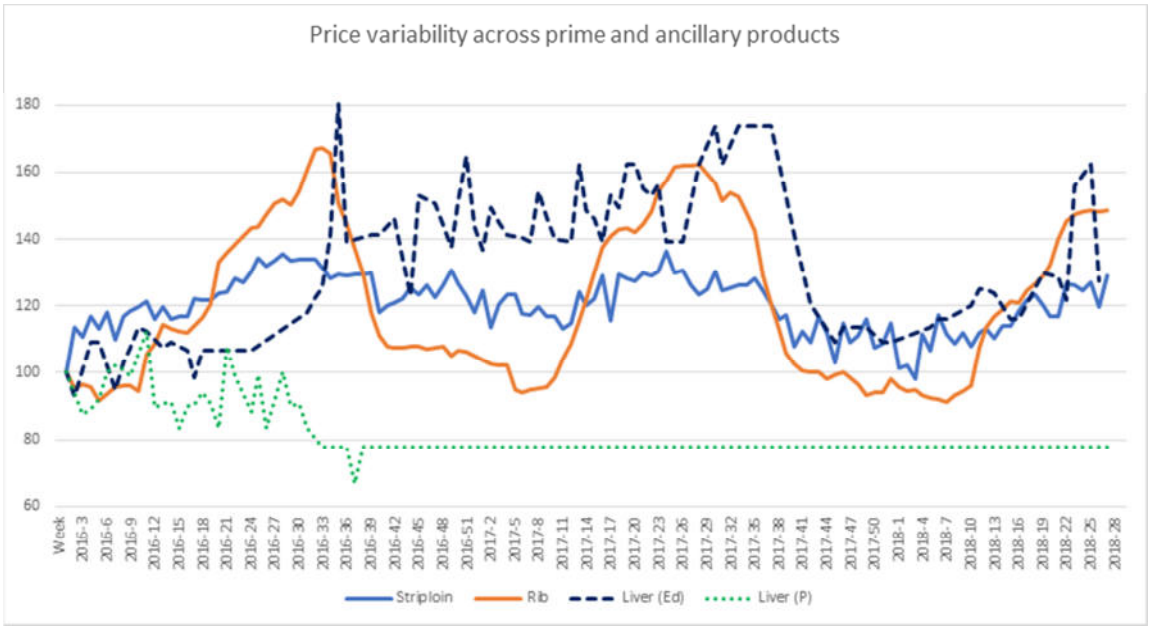


Chart 1(Ed= Edible P = Petfood)

PRICE VARIABILITY:LAMB CUTS VERSUS LAMB BYPRODUCTS

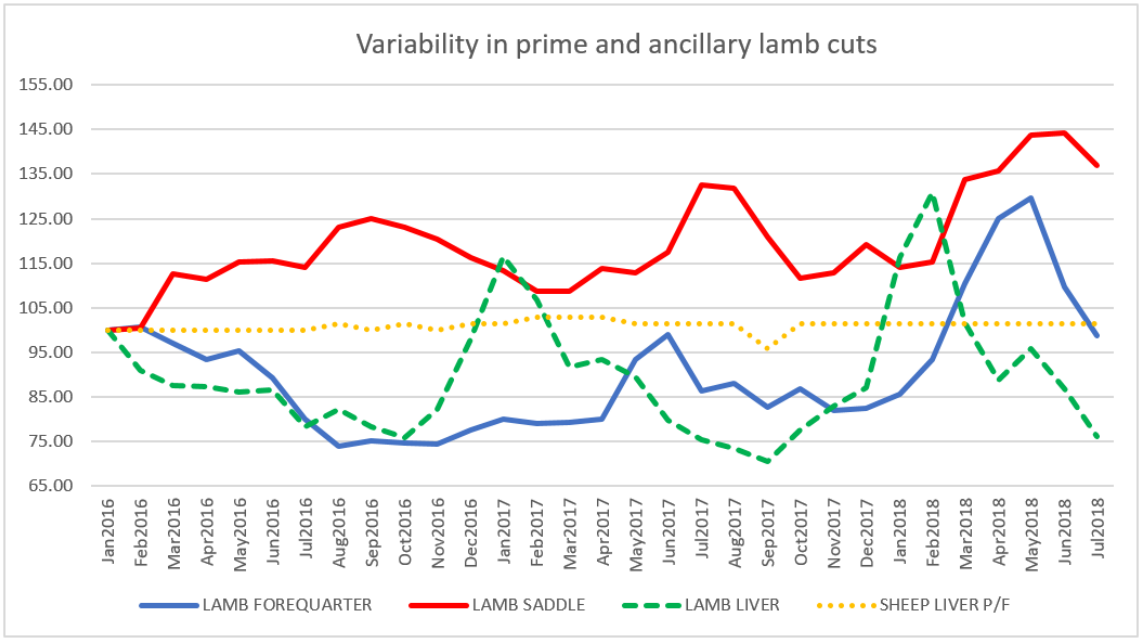


Chart 2(P/F= Petfood)

PRICE VARIABILITY: PORK CUTS VERSUS PORK BYPRODUCTS

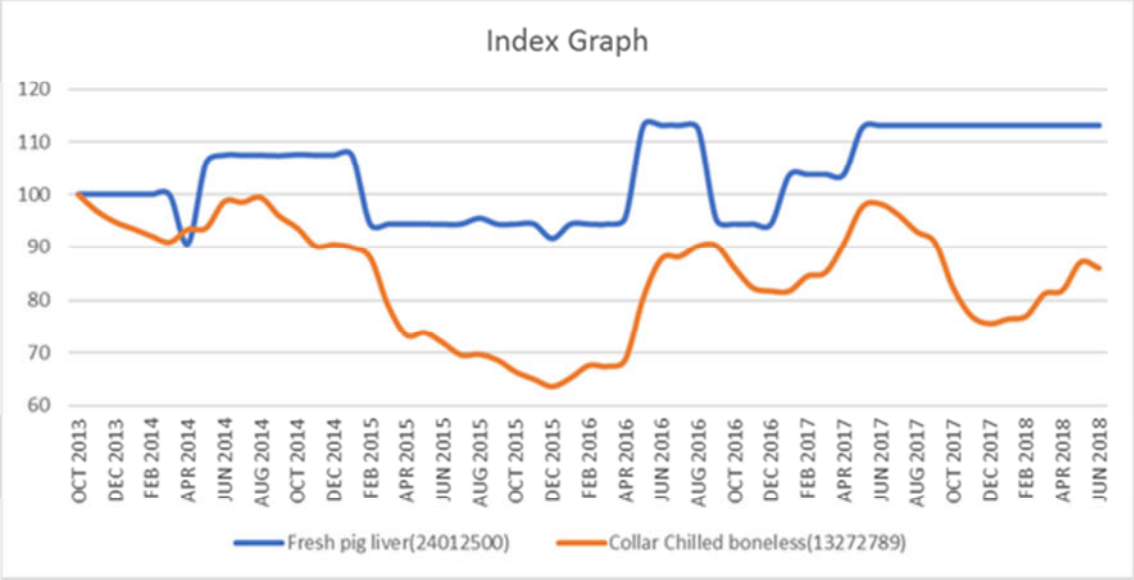


Chart 3

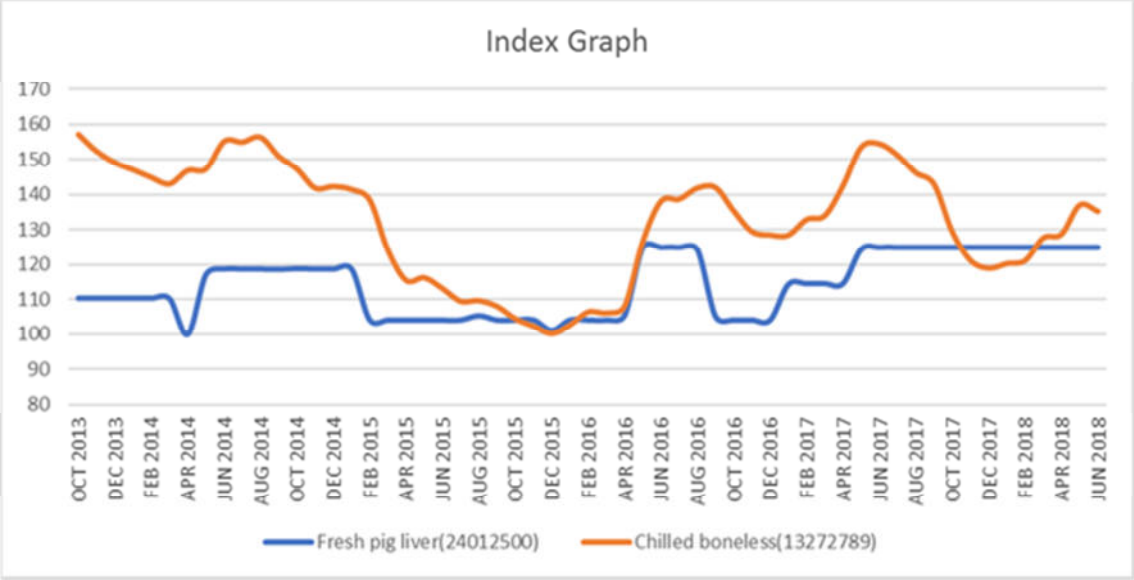


Chart 4

Annex VI – Consultation and stakeholders

The FCR RED MEAT has been developed between 2014 and 2019. Two web-based consultations were put in place. The consultations were carried out through the DG ENVI Wiki platform, to which more than 250 stakeholders, including LCA-practitioners, public authorities, NGO´s and industry stakeholders, had access.

The first virtual consultation was organised in December 2014 on the scope and representative product of the red meat pilot. This consultation phase also included a physical consultation which took place on 19 December 2014.
Another virtual consultation was carried out during August and September 2016.

An open internet-based consultation via the EF virtual consultation Forum enabled a broadening of the participation of stakeholders from different parts of the world. The use of the EF virtual consultation Forum also had the advantage of facilitating participation from interested parties who were unable to attend meetings, e.g. NGOs, SMEs, stakeholders from non-EU or developing countries and environmental groups.

The participating stakeholders included amongst others:

- ADEME - French Environment and Energy Management Agency – Public sector
- DG ENVI – European Commission – Public sector
- Du Pont - Packaging Materials and Packaging Solutions – Private sector
- ENEA (IT) - Italian National Agency for new technologies, energy and sustainable economic development – Public sector
- EFFPRA – European Renderers Organisation – Private Sector
- FEDIAF – European Petfood industry – Private sector
- FEFAC – European Feed Industry- Private sector
- Nordic Environmental Footprint (NEF) – Public sector/Academy
- Soltub ltd. (Hungary) – Consultancy - Private sector
- Thinkstep – Consultancy – Private sector

During the public consultations, interested parties were given adequate time for review and access the details and sources of information used.

No	Activity	TS	Stakeholders	SC
1	Analysis of existing PCRs and scope definition + draft definition of representative product	X		
2	1st physical consultation (scope, draft definition of representative product)	X		
3	Written feedback on 1st consultation document		X	
4	Analysis and feedback of results for 1st physical consultation	X		
5	Approval of scope and representative product definition			X
6	PEF Screening (impact assessment, interpretation and conclusion, report)	x		
7	Sending draft PEF screening to EC and helpdesk for technical checks			
8	Draft PEFCRs based on PEF screening	X		

9	1st virtual consultation (results PEF screening and draft PEFCRs, additional environmental information)	X		
10	Written feedback on 1st draft PEFCR		X	
11	Analysis and feedback of comments from 1st virtual Consultation	X		
12	Second draft of the PEFCR	X		
13	Approval of draft PEFCR (based on the results of the screening)			X
14	PEFCR supporting studies	X		
15	2nd consultation (final PEFCR, benchmark, verification, and classes of performance where appropriate and relevant)	x	x	
16	Analysis of and feedback on comments from the 2nd Consultation	x		
17	Review of the final FCR RED MEAT by external reviewers			
18	Analysis of comments from the Review, and Feedback on Review comments	X		
19	Revising final FCR + summary of all feedback	X		
20	Approval of final FCR RED MEAT			x
21	Release of the final FCR RED MEAT	X		

Annex VII – Review Statement

PhD Mirko Miseljic – Environmental Civil Engineer with FORCE Technology.

Reviewer

Mirko Miseljic, Specialist, Applied Environmental Assessment group, Clean Air Technologies Department, Force Technology.

Study commissioner

The commissioner of the review is the European Livestock and Meat Trading Union (UECBV).

Reviewed study

The review is performed of the following: "Footprint Category Rules Red Meat Version 1.0" developed by the Technical Secretariat for the Red Meat Pilot, dated July 2019 (Version 1.0).

Review procedure

The purpose of the review was to provide an independent 3rd party external review that the study was made according to the guidance provided by the PEF Guide (Annex II to Recommendation (2013/179/EU) and the Product Environmental Footprint Category Rules (PEFCR) Guidance (version 5.2). Further, also as an integral part of the PEFCR Guidance document, the study is also assessed according to ISO 14040, ISO 14044 and good LCA practice.

The review is a post-study external review and is of the type "Critical review by internal or external experts", as described in § 6.2. of ISO 14044, and was performed in the period from June 2018 to August 2019.

The "Footprint Category Rules (FCR) Red Meat Version 0.6" document and "PEF Pilot Red Meat Screening Study Version 0.6" supporting document, along with PEFCR Guidance (version 5.2) and the PEF Guide, was first sent to the reviewer in June 2018, who during the review period on several occasions gave in written comments to the commissioner. The commissioner, along with the Technical Secretariat for the Red Meat Pilot, provided answers for these with a plan of the amendment procedure. In August 2019 a final review statement was made according to the latest versions of the "Footprint Category Rules (FCR) Red Meat Version 1.0" and "PEF Pilot Red Meat Screening Study Version 1.0" documents.

Review statement

The FCR Red Meat document (version 1.0) has been reviewed with respect to claimed compliance with the PEF Guide (Annex II to Recommendation (2013/179/EU), PEFCR Guidance (version 5.2), ISO 14040 and ISO 14044. The approach in the FCR Red Meat document is consistent with the PEF Guide (Annex II to Recommendation (2013/179/EU), PEFCR Guidance (version 5.2), ISO 14040 and ISO 14044, and the applied methods in the FCR Red Meat document are in general scientifically and technically valid. Further, the used data in this context is appropriate and reasonable according to the goal and scope of the FCR Red Meat document. However, according to ISO 14040 & 14044, LCAs that are intended to be used in comparative assertions and disclosed to the public require a panel review, consisting of at least three external reviewers.

In the FCR Red Meat a functional unit of 1 ton of fresh/frozen red meat is applied, and only if the same representative meat product from the same animal species is assessed a comparison can be made. In that context, it needs to be noted that the approach considers a meat product including inedible animal parts (such as bone), when calculating environmental impacts of a meat product.

The red meat product system is complicated. This is due to that many products, e.g. meat, hides, edible offal and inedible offal (e.g. used for pet food, biogas production), are produced, and the allocated/distributed environmental impacts of upstream processes (especially, feed production and farming) to the many products can be done in different ways. In the FCR Read Meat document the recommended allocation approach is according to mass, even though biophysical approach is stated as being the best option. However, the biophysical approach is considered immature at this point of time, while economic allocation is considered inapplicable due to large variations in price of animal products. The reviewer recognises the presented issues but considers it very important that the LCA practitioner is made aware of that there are differences in results according to the choice of allocation, as is partially presented in the document by comparing results when applying mass and biophysical allocation approaches. However, results from economic allocation should also be exemplified here.

If reflecting to other LCA studies that considered different farm allocation approaches for red meat products, it is noticeable that in e.g. Thoma et al. (2013)[1] where it is shown that the straight forward beef-milk mass allocation approach only differs up to approximately 10 % (mean values compared) from other considered allocation approaches. However, this issue needs further elaboration in future FCR Red Meat work, as stated in the supporting study document (preliminary LCA screening study for pork, beef and lamb), even though the mass and biophysical approach differences are quantified in terms of environmental impacts. Further, the FCR Red Meat and supporting document, conclude that farm data and allocation is of central importance for calculating environmental LCA impacts for the considered meat and animal products.

The FCR Red Meat (version 1.0) is primarily developed by the meat sector and aims to improve the environmental performance of the sector and the farming stages. There is no PCR-like document of sufficient quality for the livestock meat sector, but the PEFCR Guidance (version 5.2) contains some meat assessment guidelines.

The initial FCR Red Meat document (version 1.0) is a stepping stone towards more environmentally friendlier products, so more environmentally friendlier meat products can be distinguished. Hereby it is acknowledged that there is room for improvement. Within the lines of the whole PEFCR work, the FCR Red Meat applicability and comparison of products can only be performed on the exact same meat products.

Mirko Miseljic — 26/08-2019

Mirko Miseljic — Date

[1] Thoma G., Jolliet O. and Wang Y., 2013; *A biophysical approach to allocation of life cycle environmental burdens for fluid milk supply chain analysis*, International Dairy Journal, Volume 31, Supplement 1, 2013, Pages S41-S49, ISSN 0958-6946, https://doi.org/10.1016/j.idairyj.2012.08.012.

Dr. Stewart Ledgard - Principal Scientist with Agresearch and an Adjunct Professor of the Life Cycle Management Centre at Massey University in New Zealand.

Document was submitted for revision to Dr. Stewart Ledgard. Due to timing constrains, his final review statement was not available on time for this version.

His final comments and how they were addressed in v1.0 of FCR RED MEAT are included in the table below. Once available, review statement from Dr. Stewart Ledgard, will be included in this section

Template for CR comments and commissioner & practitioner responses

Date: 30 July 2019	Document: FCR RED MEAT	Project: FCR RED MEAT

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner& practitioner
SFL							
	528			ed	UK is given as an example only	Replace “i.e.” with “e,g,”	solved
	530			tech		Add “hoggets,” after “lambs”	Solved phrase added, pending revision of TS
	547-548				Suggest indicating it includes production, distribution and use of all inputs	Add “, as well as the production, distribution and use of all inputs.” To end of sentence	Solved phrase added, pending revision of TS
	564			ed	Typo	Replace “Owes” with “Ewes”	Solved
	682		Table 5-1	tech	Unclear what the DQR numbers in table refer to, e.g. are they required levels of DQR, or typical levels, or something else? For example, why are some 1.6 and others 4?	Add footnote to table to explain what the DQR numbers refer to	FootNote added: The DQR is a semi-quantitative assessment of the quality of data based on representativeness and precision. The most relevant processes driving the environmental profile of a product, shall be assessed by using data with higher quality (lower DQR) compared to the less relevant processes, allowing to focus the attention in data collection where it really matters.
	752		Table 5-2	tech	A good summary table. However, Number 8 has Waste and mentions category I, and has it all going to rendering. BUT back on page 10 under the list of the fate of this material ALL of them have it to incineration or landfill.	Should ‘Cat I+II ABP’ be ‘Cat II+III ABP”?	Table used for illustration purposes: Rendering of Cat I and II is correct.
	862			tech	It would be relevant for beef to state the	Add words of “and proportion of dairy	HB: the PCR red meat is

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2 **Type of comment:** **ge** = general **te** = technical **ed** = editorial

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner& practitioner
					proportion derived from dairy animals	animals"	only applicable for specialized beef farms, so it is not relevant to include at this place
	889			ed	Typo	"from" not "form"	solved
	978		Table 5-15	tech	Sheep meat is more than just Lamb	Change 'Lamb' to 'sheep'	Solved, changed to "Sheep"
	980-981			tech	Add wording to indicate this is <u>only</u> acceptable where it is proven that manure is used for its nutrient value and not in excess of crop requirements; otherwise it is treated as a waste and emissions revert to the animal production system. This is in line with LEAP nutrient guidelines as well as PEFCR for dairy. The latter state "provided proof is given that it is sold and used for fertiliser replacement at optimal rates for crops (i.e. if excess is applied it is treated as a Residual)".	Add wording from PEFCRDairy here, i.e. "provided proof is given that it is sold and used for fertiliser replacement at optimal rates for crops (i.e. if excess is applied it is treated as a Residual)".	HB: In the PCR for red meat the baseline assumption is that manure is by default used in a less effective manner than synthetic fertilizers. That is why the baseline replacement factor is 50%. Only if the user can proof that the application is more effective a higher replacement rate can be used. The advantage of this approach is that it is as a baseline assumed that the use is less effective than fertilizers and the burden of proof for better performance is at the user. The disadvantage is that when it is used really ineffective by arable farmers the credits are overestimated. We did not choose for the dairy way of formulating the effectiveness criterion

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							because what is deemed as excessive use can differ a lot between countries and regions (I know this from the Dutch history of legislation in allowable manure application). A second complication is that excessive use should be determined on crop rotation level and not per crop (although this also differ for P and N fractions).
	1017		Table 5-16		In first row it is unclear what "sections 5.4.2.4 to 0" means. Should it be 5.4.2.4 to 5.4.2.9??	Change to define actual sections referred to	solved
		Annex IV			Useful summary. But almost entirely confined to compound feeds, with nothing on home-grown feeds or grazing. Ideally it would add something related to home-grown feeds or grazing. However, the latter is covered in LEAP. I do not have access to the FeedPEFCR to understand how well it covers home-grown feeds or grazing.		Check with Hans HB: The rules for homegrown feed are indirectly covered by the feed PEFCR. The scope of the Feed PEFCR is compound feed but it also gives rules on how to define environmental impact of crops and roughage production.
		1311		tech	See point relating to line 980-981 above. If the use of manure to avoid fertiliser (and not in excess of crop requirements) CANNOT be demonstrated, then it is a residue and all emissions should go to the	Insert ""provided proof is given that it is sold and used for fertiliser replacement at optimal rates for crops (i.e. if it cannot be demonstrated or excess is applied it	Added, should check with Hans. Not adapted, see also answer above related to line 980

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					livestock production. It is inappropriate to assign a 50% nutrient benefit when it might simply be being dumped somewhere.	is treated as a Residual)".	

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