Lifecycle Assessment and carbon footprint calculation of Animal Feed

George Tice, Scientific, Policy and Regulatory Consultant, Wicklow, Ireland

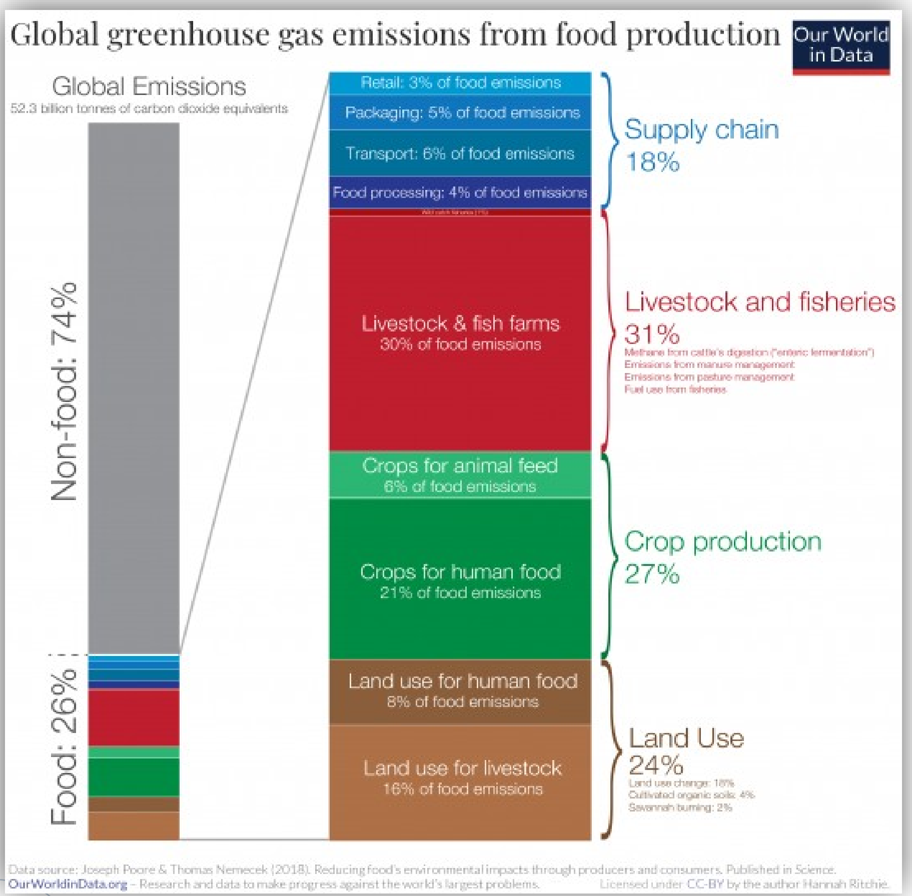
Topics

1. The requirement for Carbon footprint measurement and reduction for Feed Producers and the Livestock Industry

2. What is Lifecycle assessment and how is it calculated?

3. How is the carbon footprint of Compound feed calculated?

The Sustainability of Food



- The food system plays a crucial role in the context of climate change & measures to reduce emissions.
- **Livestock & fisheries account for 31% of food emissions.**

Source: https://ourworldindata.org/environmental-impacts-of-food

3

The International Context – Global Climate Neutrality goals

1990

2015

Paris Agreement

Maximum of 2°C – strive for 1,5 °C

European Green Deal

2021

COP26 Glasgow

Global methane pledge of 30% emission reduction in 2030

2030

EU Targets

30% methane reduction compared to 2020

55% reduction GHG compared to 1990

2050

Achieving climate neutrality targets

Scope 3 (Supply Chain) Emission Targets of Retailers

Retailer	Ahold Delhaize	TESCO	Carrefour	LIDL
Target around 2030	37% (2030)	39% FLAG* (2032 vs. 2019)	30% (2030 vs. 2019)	75% of suppliers join SBTi** in 2026
Net zero target	2050	2050		

- FLAG= absolute reduction of scope 3 on forest, land, agriculture

** SBTi=Science based target initiative to reduce CO2 based on the Paris agreements.

Data from company's website - open source

"4.2% is the annual reduction required by SBTi for a 1.5°C trajectory alignment."

https://sciencebasedtargets.org/reports/sbti-progress-report-2021

Albert Heijn Upgrades CO2 Emission Reduction Target

November 25, 2022 6:58 AM

“Dutch retailer Albert Heijn has announced that it is upgrading its target of reducing CO2 emissions in its value chain (scope 3) from 15% to 45% by 2030 compared to 2018.

Albert Heijn has already mapped the exact carbon emissions in its poultry and pork supply chains.”

https://www.esmmagazine.com/retail/albert-heijn-upgrades-co2-emission-reduction-target-227045

The legislative requirements emerging from the European Green Deal and the need to for Agrifood companies to MAP and REDUCE emissions

- **Corporate Sustainability Reporting Directive**

  Companies in the food supply chain must report carbon footprint from 2025/2026

- **The Industrial Emissions Directive**

  Will require Intensive pig and poultry units to measure carbon footprint/emissions from 2027/2028

- **Green Claims Initiative**

  Carbon footprint calculations and declarations required for making claims

- **Sustainable Food Systems Framework will be proposed by EU Commission end of 2023 – legislative timelines to be confirmed**

  Sustainability labelling of food products

  Common standards for agrifood products

NutriForum 24

The importance of Feed

- 1kg of Chicken has carbon footprint = ~3.3kgCO2eq
- 1kg of compound feed has a carbon footprint = ~1.5kgCO2eq
- Compound feed contributes ~70% of the total carbon footprint of chicken sold at the supermarket
- …so any reduction in footprint of compound feed has a significant impact on the final meat product

Environmental implications of alternative pork and broiler production systems in the US, China, Brazil and the EU. A report by Blonk Sustainability Consultants on behalf of World Animal Protection. 2022.https://blonksustainability.nl/news-and-publications/publications

Hickmann FMW, Andretta I, Létourneau-Montminy M-P, Remus A,Galli GM, Vittori J and Kipper M (2021). Mannanase Supplementation as an Eco-Friendly Feed Strategy to Reduce the Environmental Impacts of Pig and Poultry Feeding Programs. Front. Vet. Sci. 8:732253.

The European Feed and Livestock Industry Response

Topics

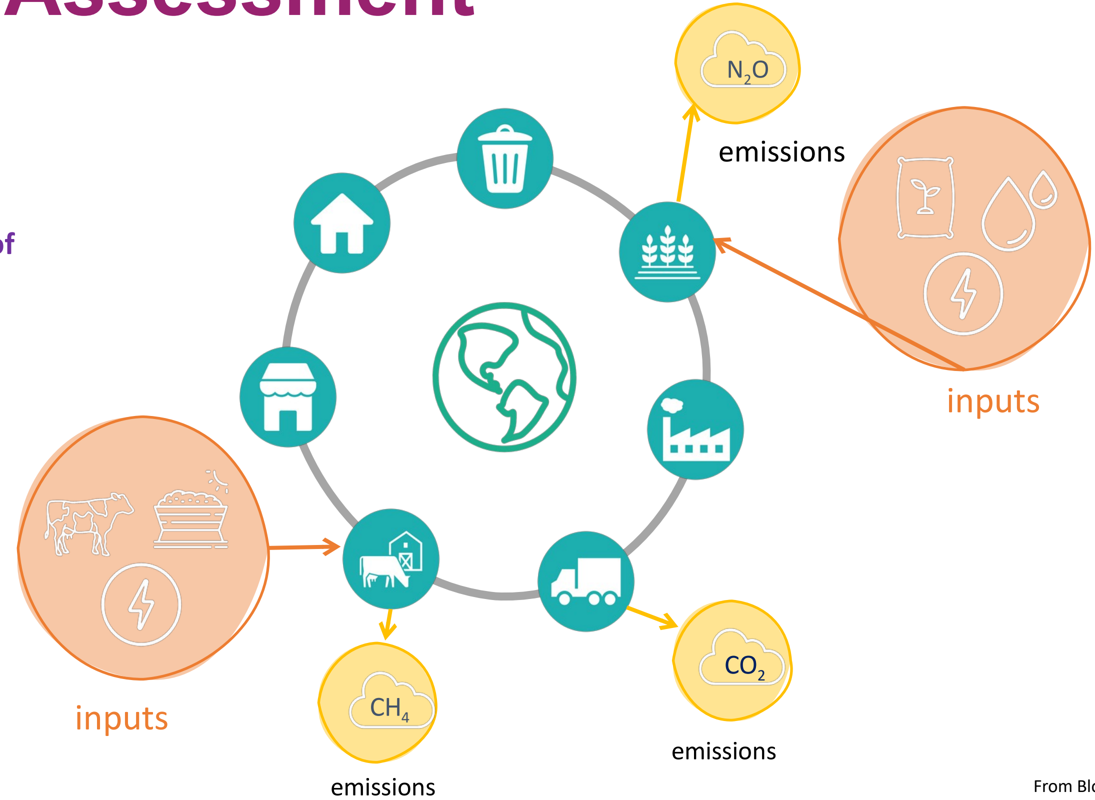
1. The requirement for Carbon footprint measurement and reduction for Feed Producers and the Livestock Industry ✓

2. What is Lifecycle assessment and how is it calculated?

3. How is the carbon footprint of Compound feed calculated?

Lifecycle Assessment

LCA is a methodological framework to evaluate the environmental impact associated with the life cycle of a product or service



From Blonk Sustainability Consultants

Strengths of Life Cycle Assessment

Holistic approach

Takes the whole lifecycle into account

Quantifies all inputs and outputs of material flows

Trustworthy and sound basis for sustainability claims

- *Greenhouse Gas Emissions*
- *Water consumption*
- *Land use*
- *Fossil resources – non renewable, minerals, fuels etc*
- *Fresh water eutrophication*
- *Acidification*
- *Ecotox*
- *And more*

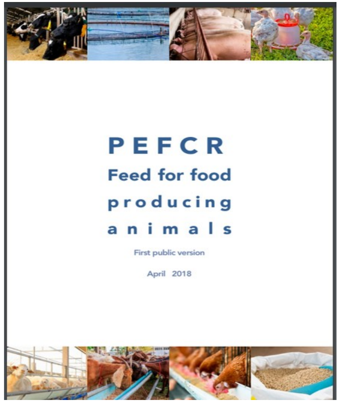
Investigates multiple environmental impacts

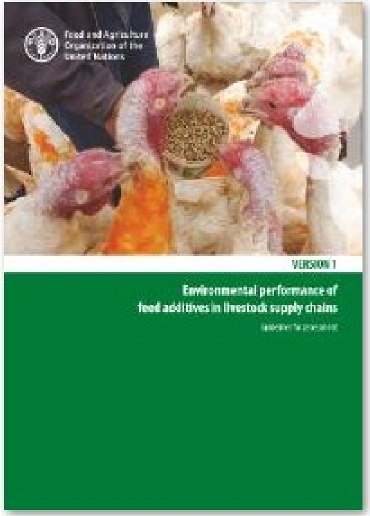
Performed according to international guidelines and using credible, validated data

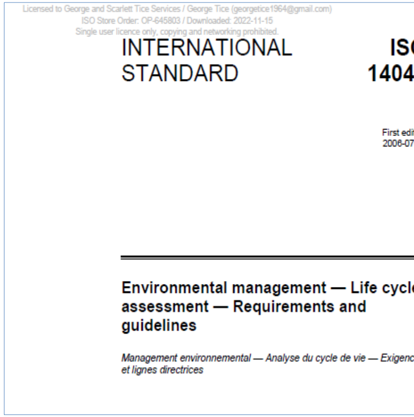
From Blonk Sustainability Consultants

Rules for Measuring and Reporting Carbon Footprint of Feed and Feed Additives

- **Product Environmental Footprint Category Rules (PEFCR) for Animal feed:**
  - Published by the European Commission
- **FAO LEAP Guidelines for Life Cycle Assessment of Feed Additives (2020):**
  - Developed by the Food and Agriculture Organization (FAO)
- **ISO 14040 and 14044**:
  - International Standards for Life Cycle Assessment (LCA)
- **ISO/TS 14067 - Greenhouse gases**:
  Carbon footprint of products, Requirements and guidelines for quantification and communication







Product Environmental Category Rules – the European Commission

Consistent and specific set of rules to calculate the environmental impact of a product category

30.12.2021 EN Official Journal of the European Union L 471/1

II

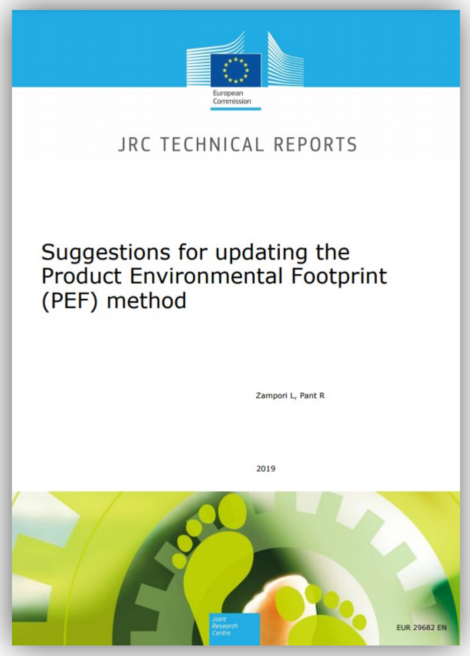
(Non-legislative acts)

RECOMMENDATIONS

COMMISSION RECOMMENDATION (EU) 2021/2279

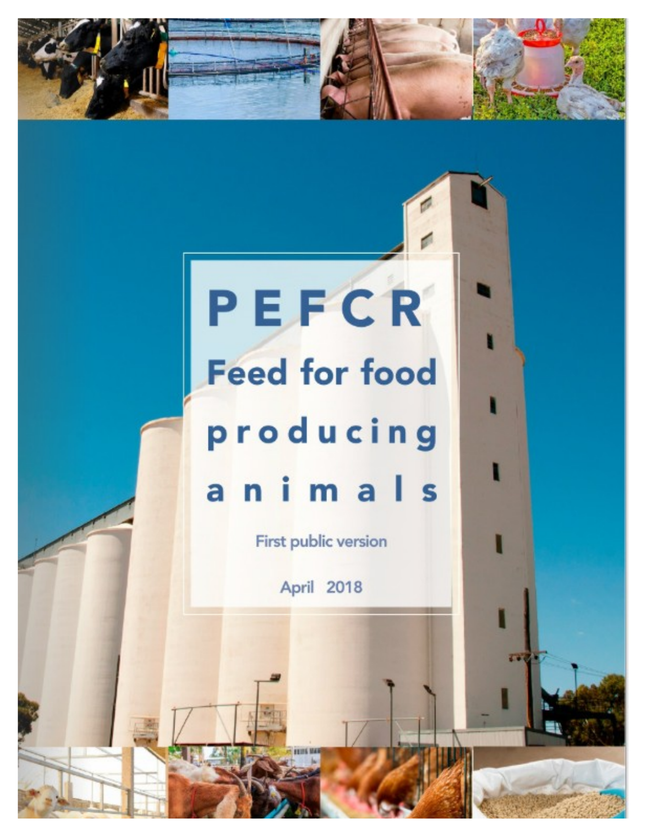
of 15 December 2021

on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations



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

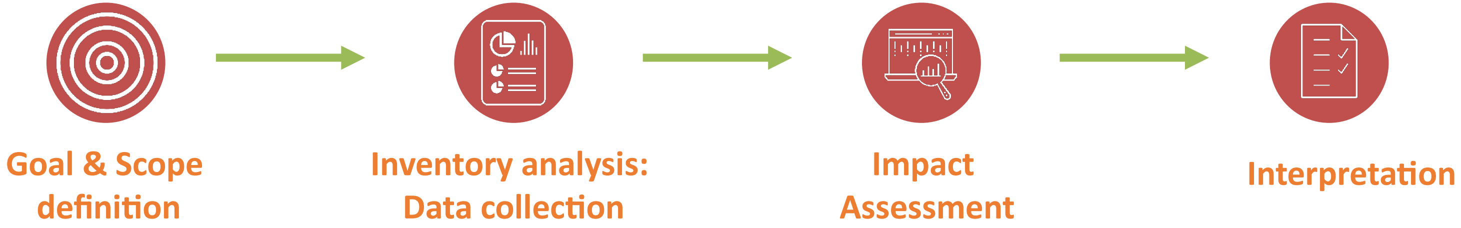
Product Environmental Footprint (PEF) FOR FEED



PEFCR - Feed for food producing animals (fefacfeedpefcr.eu)

Table of contents

Steps of an LCA

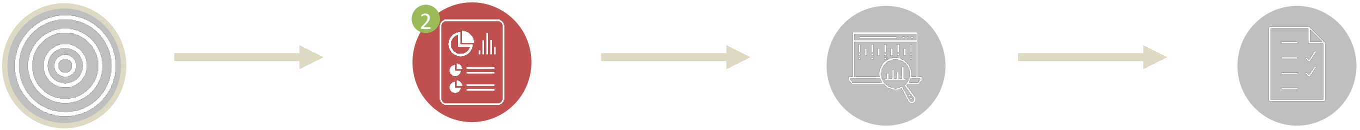


From Blonk Sustainability Consultants

Inventory analysis

Steps of an LCA

Main part of LCA study



Inventory analysis:
Data collection

Preferably primary data

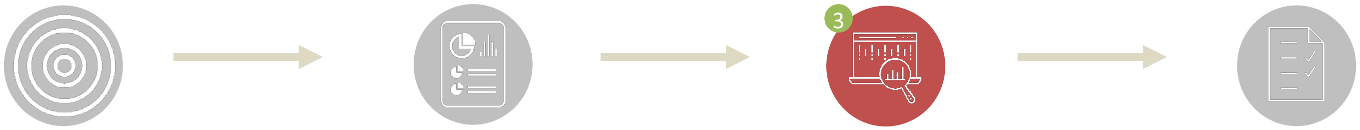
Use of background databases

- *Collection of data*
- *Data modelling*
- *Result:*
  Inventory table, an extensive list of environmental interventions

From Blonk Sustainability Consultants

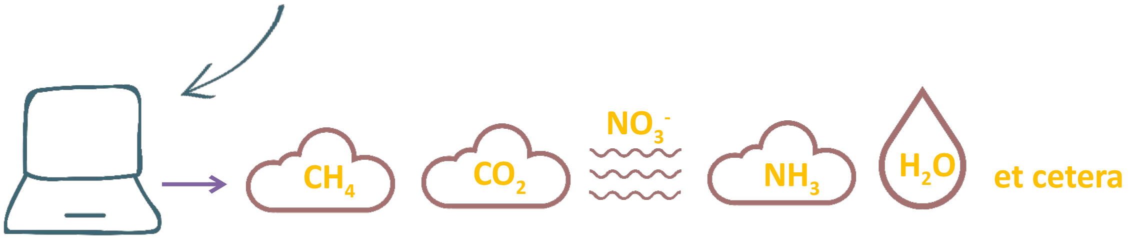
Impact assessment

Steps of an LCA



Impact Assessment

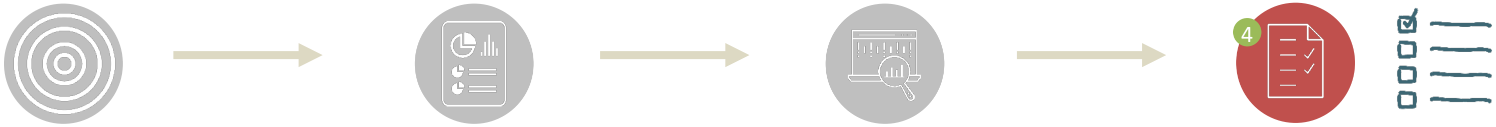
- *Translate inventory table into impact indicator results*



From Blonk Sustainability Consultants

Interpretation

Steps of an LCA



Interpretation

- *Consistency check*
- *Completeness check*
- *Contribution analysis*
- *Sensitivity analysis*
- *Discussion & conclusions*

From Blonk Sustainability Consultants

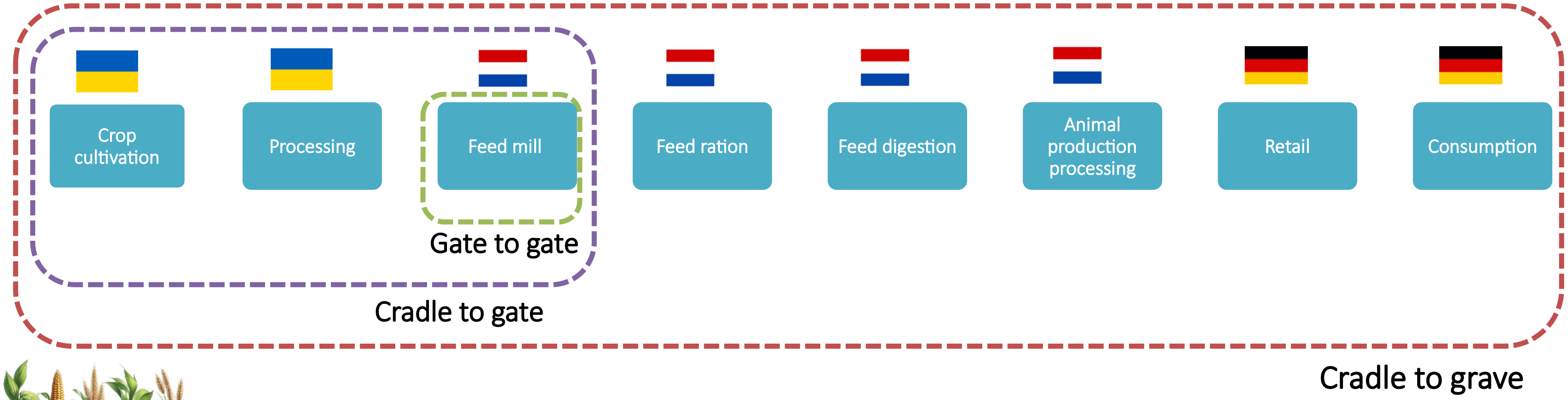
Environmental impact categories

- With LCA different environmental impacts are measured: eg
  - Global Warming: kg CO2 eq
  - Water: m3
  - Terrestial Acidification: KgSO2eq.
  - Freshwater Europhication: KgP equivalent
  - Marine Eutrophication: kgN eq
  - Particlulate matter: kgPM2.5eq
  - Ozone depletion: kgCFC eq

- There are different impact assessment methods available for calculating environmental impact, e.g.:
  - **<u>ReCiPe method</u>: 18 impact categories**
  - **EF 3.1 – 16 categories**

System boundaries

The system boundaries define which parts of the life cycle and which processes belong to the analysed system.



From Blonk Sustainability Consultants

Impact allocation – example of Soyabean meal, Economic allocation

Soybeans (1 ton)
revenue: € 240+160=400

Soybean meal (0.8 ton)
Value: €300/ton soybean meal = €240/ton soybeans

The allocation fraction is :
60% (240/400)

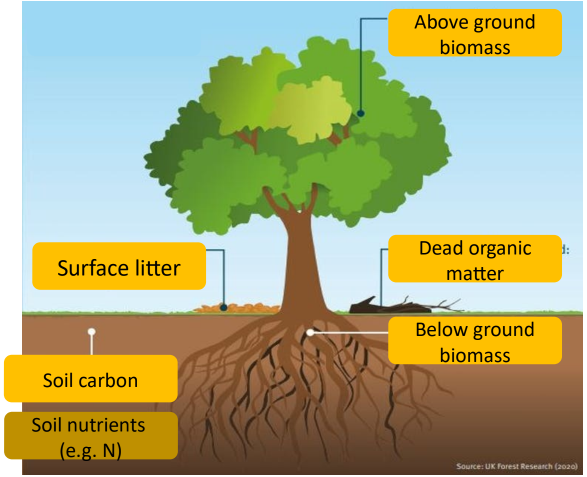
Soybean oil (0.2 ton)
Value: €800/ton soybean oil
= €160/ton soybeans

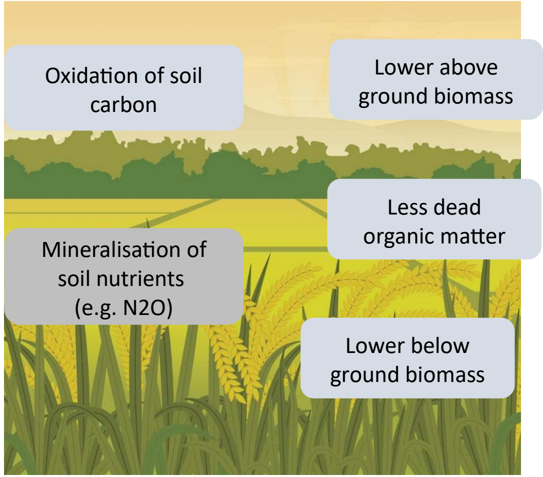
The allocation fraction is :
40% (160/400)

Other options are **Mass** and **Energy** allocation

From Blonk Sustainability Consultants

Land Use Change

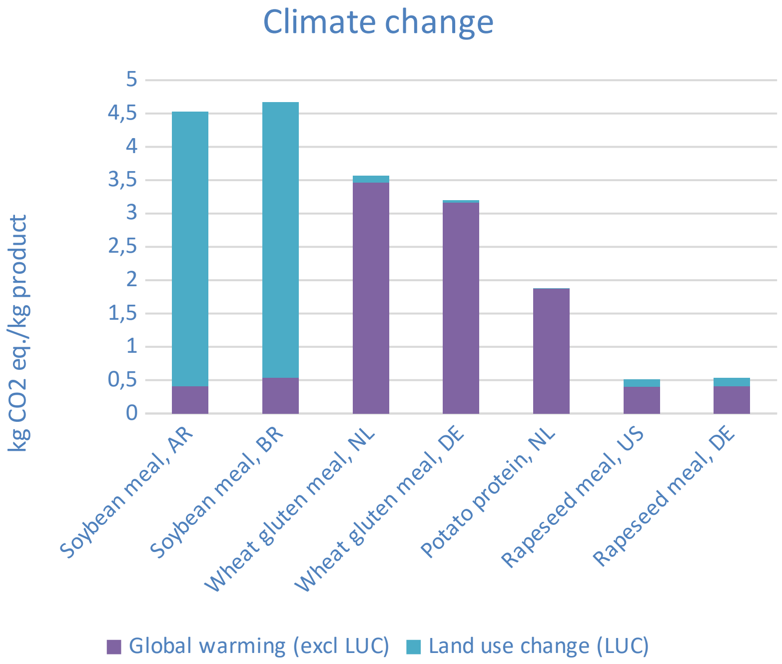




From Blonk Sustainability Consultants

Land Use Change

- Land use change is the change in the purpose for which land is being used by humans.
- Reported in kg CO_2 eq. as part of climate change impact
- LUC should be **reported separately**, because of the potential great impact on the results

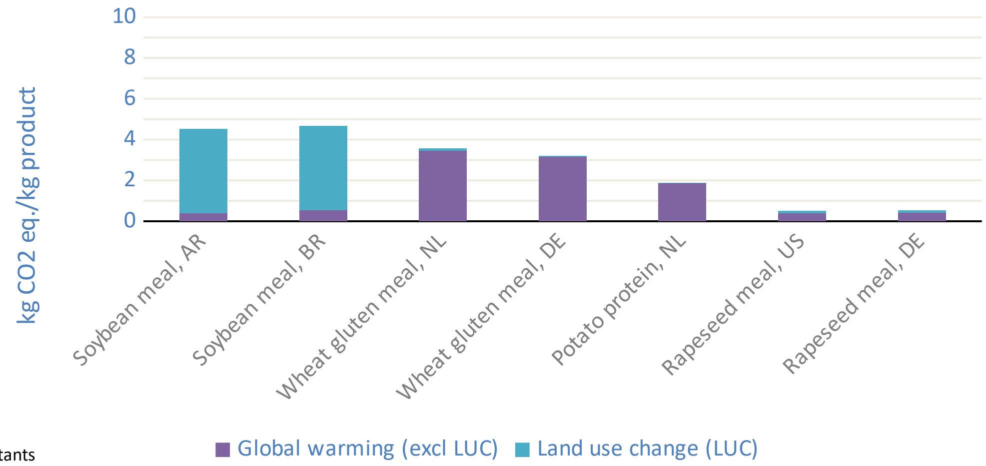


From Blonk Sustainability Consultants

Functional unit

The functional unit qualitatively and quantitatively describes the function(s) and duration of the product

- For example
  - 1 kg of soyabean meal
  - 1 kg FPCM (fat and protein corrected milk) produced in the UK
  - 1 tonne of Compound feed



From Blonk Sustainability Consultants

Overview databases used for LCA analysis

- Feed database:
  - ***Agri-footprint***
  - ***Feedprint***
  - ***GFLI***
  - ***Nevedi***
- Food database:
  - RIVM
  - AgriBalyse,
  - EF agro food
  - LCA food (DK)
- Background database:
  - Ecoinvent
  - ELCD
  - USLCI
  - EF background

The Global Feed Lifecycle Assessment Institute - GFLI

The Global Feed LCA Institute is an independent animal nutrition and food industry non-profit institute with the purpose of:

- developing a publicly available Animal Nutrition Life Cycle Analysis (LCA) database;
- supporting the meaningful environmental assessment of animal nutrition products; and
- stimulating continuous improvement.

GFLI database

The database allows feed, livestock and aquaculture sectors to:

- use data based on a harmonized methodology;
- calculate the environmental footprint of products in a transparent and trustworthy manner; and
- benchmark and make meaningful comparisons.

Makes it possible to produce feed with a lower footprint; resulting also in food products with a lower footprint/kg (farmed fish/pig/poultry).

Provided by GLFI, 12/3/2024

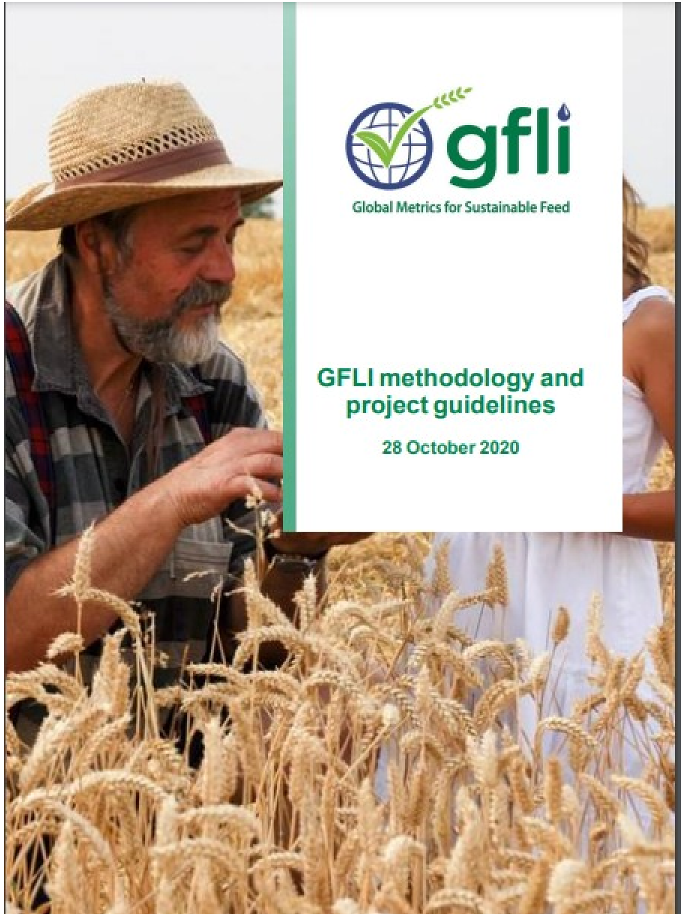
More on the GFLI

Public database of feed ingredient datasets generated using the LCA methodology.

Ambition to make animal nutrition life cycle analysis more **transparent** and **meaningful** though a **harmonised methodology.**

Aligned with the standards common for this sector:

- **FAO/LEAP feed guidelines 2016 (FAO, 2016);**
- **Feed PEF database methodology 2017 for EF 2.0 (Blonk et al., 2017) and EF 3.0 data (European Commission, 2020);**
- **Feed PEFCR 2018 (European Commission, 2018a);**
- **FAO/LEAP feed additives guidelines 2020 (FAO/LEAP, 2020)**



Market Mix data – example from GLFI

- Ingredients sourced in one country may come from a variety of countries,
- Each with a different footprint
- Trade data is accessed and a market mix is assumed to calculate the final footprint
- In GLFI RER suffix is used to refer to “European Sourced” product

Market mix for	Commodity	Source Country	Percent in mix
Germany	Maize	Germany	62.32%
Germany	Maize	Poland	10.65%
Germany	Maize	Ukraine	9.18%
Germany	Maize	France	8.52%
Germany	Maize	Hungary	5.61%
Germany	Maize	Czechia	1.73%
Germany	Maize	Netherlands	0.83%
Germany	Maize	Russian Federation	0.64%
Germany	Maize	Romania	0.52%

100%

An example data - from GFLI

Product	Unit	Global warming - Excluding LUC & peat(kg CO2 eq / ton product)
Fat from animals, beef, at processing/RER Energy S	ton	26769
Fat from animals, pig, at processing/RER Energy S	ton	17506
Fat from animals, poultry, at processing/RER Energy S	ton	7726
Crude rice bran oil, at processing/CN Energy S	ton	2491
Crude peanut oil (solvent), at processing/IN Energy S	ton	etc
Crude soybean oil (solvent), at processing/IN Energy S	ton	etc

Guidance on Plan Environmental Footprint measurement for feed manufacturers - FEFAC

7 step plan

- Accessing GLFI database
- Reading PEFCR Feed , especially re energy consumption at manufacturing site
- Training and consider use of consultants
- Assess origin of ingredients and transport
- Conduct an LCA study and consider the use of consultants and software to do so
- Consider Soy sourcing

https://fefac.eu/wp-content/uploads/2021/10/SR_Step-wise-engagement-plan-for-feed-manufacturers-on-environmental-footprinting.pdf

Integration of Carbon footprint calculation into final meat product

Transport

FEED SOURCING

Environmental impact
of ingredients Sourced
GLFI,
Agrifootprints
etc

PEFCR for Feed

Transport

FEED MANUFACTURE

Tonne of feed
produced for producer
Diet composition
Factory energy
consumption

LIVESTOCK FARM

Emissions on pig
and poultry farms
Measured from:
Feed
Manure
Energy

Transport

MEAT PRODUCT

Emissions from
From slaughter
and processing

PEFCRs for meat products not yet agreed by EU Commission

How can farmers and livestock companies calculate the footprint of the final meat product and provision of that data to food companies and retailers?

Consultancies that combine LA expertise, IT integration and livestock/ meat production understanding, for example

- Opteinics™
- Sustell™
- Agrecalc
- Eggbase
- ……….

Then further integration of livestock data into processing and final product data for supply to retailers, for example

- Blonk Sustainability Consultants
- Mondra Coalition
- ……………..

Topics

1. The requirement for Carbon footprint measurement and reduction for Feed Producers and the Livestock Industry ✓

2. What is Lifecycle assessment and how is it calculated? ✓

3. How is the carbon footprint of Compound feed calculated?

A worked example of reducing the carbon footprint of compound feed using enzymes

- Beta-mannanase breaks down β-mannans in swine and poultry feed
  - prevents an inflammatory feed induced immune response
  - enabling the reduction in the energy matrix of swine and broiler diets[1].

- Independent validation that there will be no impact on final animal performance from reduction in energy matrix
  - 60kcal reduction in matrix for broiler diets and 55MJ reduction NE in swine diets[2]

References

Hickmann FMW, Andretta I, Létourneau-Montminy M-P, Remus A,Galli GM, Vittori J and Kipper M (2021). Mannanase Supplementation as an Eco-Friendly Feed Strategy to Reduce the Environmental Impacts of Pig and Poultry Feeding Programs. Front. Vet. Sci. 8:732253

Lifecycle assessment of both Hemicell production and its supplementation in broiler and swine diets, September 2023. A Report by Blonk Consultants for Elanco Animal Health.

Study Guidelines

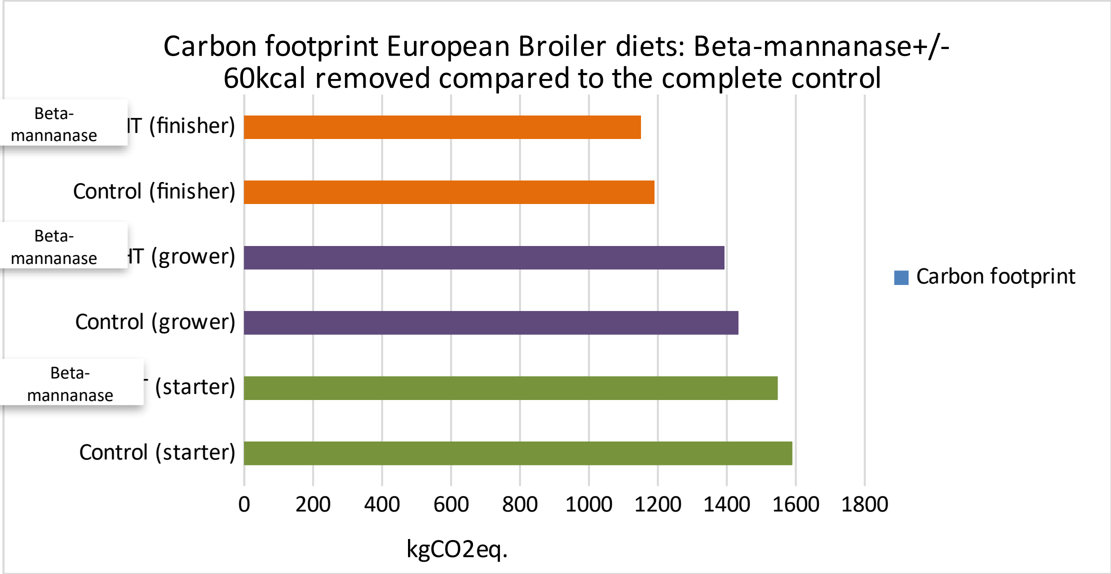
Scope of the LCA – performed by Blonk Consultants

- LCA for the beta-mannanse performed and aligned to FAO LEAP Guidelines for Life Cycle Assessment of Feed Additives (2020) and ISO 14040 and 14044.

- Independent Nutritionists formulated representative broiler and swine diets using least cost formulation software.
- System boundary: cradle-to-feedmill gate;
- Modelled in Simapro in alignment with the Feed PEFCR
- Results calculated with ReCiPe 2016 methodology;
- Functional Unit: 1 tonne feed

Broiler

Results per ton feed



Summary:

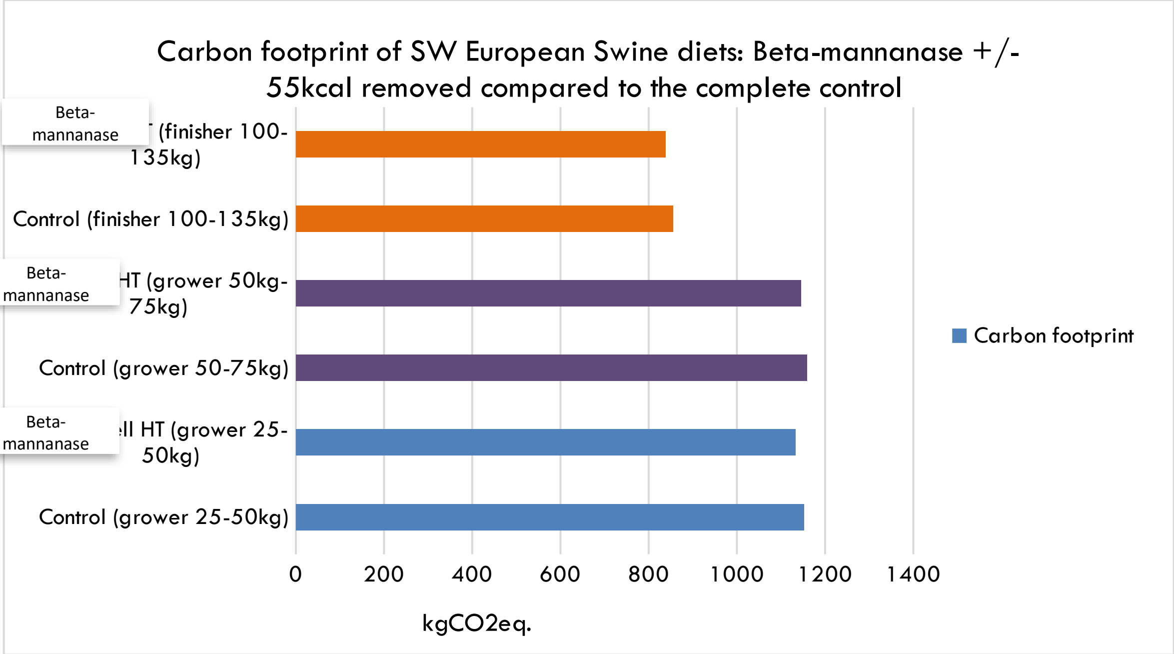
- In <u>all beta-mannanase</u> diets **a small reduction** in the global warming impact was found compared to the control.
- The reformulated diets had less calories largely due to a reduction in soybean meal and soybean oil. These ingredients had a high associated LUC impact.
- **Reductions in the carbon footprint of the beta- mannanase diets are largely due to a reduction LUC impact.**

(1000: EURO BROILER)	Control (starter)	Beta-mannanase (starter)	% reduction	Control (grower)	Beta-mannanase (grower)	% reduction	Control (finisher)	Beta-mannanase (finisher)	% reduction
Carbon footprint	1589	1547	3%	1433	1394	3%	1190	1151	3%
CF excluding LUC	**545**	**538**	**1%**	**539**	**533**	**1%**	**519**	**513**	**1%**
CF LUC only	1045	1009	3%	894	861	4%	671	638	5%

Broiler: Europe

Ingredient	Dataset from Agrifootprint	EURO BROILER STARTER	EURO BROILER STARTER - with BM	EURO BROILER GROWER	EURO BROILER GROWER with BM	EURO BROILER FINISHER -	EURO BROILER FINISHER- with BM	25-50	50-75	100-135
		Percentage included						*Difference in ingredients*		
MAIZE 7.2%	Maize, dried, market mix, at regional storage {RER} Economic, U	40.00	40.00	40.00	40.00	50.00	5[illegible]	Starter	Grower	Finisher
WHEAT 9.5%	Wheat grain, dried, market mix, at regional storage/RER Economic	16.02	17.18	19.93	21.09	15.89	17.05	1.2	1.2	1.2
SOYA-45.4%	Soybean meal (solvent), market mix, at regional storage {RER} Economic, U	33.97	33.79	27.33	27.15	19.39	19.21	-0.2	-0.2	-0.2
SUNFLOWER MEAL - 38%	Sunflower seed meal (solvent), market mix, at regional storage {RER} Economic, U	2.00	2.00	3.00	3.00	4.00	4.00	0.0	0.0	0.0
RAPE.M '00'-32.5%	Rapeseed meal (solvent), market mix, at regional storage {RER} Economic, U	1.50	1.50	2.50	2.50	4.00	4.00	0.0	0.0	0.0
SBO-soyaoil	Crude soybean oil (solvent), at processing/RER Economic S	2.88	1.89	3.97	2.98	3.71	2.72	-1.0	-1.0	-1.0
SODIUM-BICARBONATE	Sodium bicarbonate {RER}| soda production, solvay process | APOS, S	0.13	0.13	0.09	0.10	0.03	0.04	0.0	0.0	0.0
LIMESTONE FLOUR	Limestone, unprocessed {RoW}| limestone quarry operation | Cut-off, S - Copied from ecoinvent U	1.18	1.19	1.11	1.11	1.03	1.03	0.0	0.0	0.0
B-SALT	Economic, U	0.27	0.27	0.28	0.27	0.27	0.27	0.0	0.0	0.0
MONO CALCIUM PHOSPHATE	Monocalcium phosphate	0.58	0.57	0.48	0.48	0.41	0.41	0.0	0.0	0.0
L-LYSINE-HCl	Biolys®, 54.6% L-Lysine, at Evonik plant {US} Economic, U	0.34	0.34	0.33	0.33	0.35	0.36	0.0	0.0	0.0
DL-METHIONINE	MetAMINO®, 99% DL-Methionine, at Evonik plant {BE} Economic, U	0.35	0.35	0.28	0.28	0.22	0.22	0.0	0.0	0.0
L-THREONINE	ThreAMINO®, 98.5% L-Threonine, at Evonik plant {HU} Economic, U	0.14	0.14	0.11	0.11	0.10	0.10	0.0	0.0	0.0
L-VALINE	Economic, U	0.08	0.08	0.06	0.06	0.04	0.04	0.0	0.0	0.0
L-ARGININE	Total minerals, additives, vitamins, at plant {RER} Economic, U	0.04	0.04	0.02	0.02	0.04	0.04	0.0	0.0	0.0
PHYTASE 1000 FTU (200g/t)	Enzymes {GLO}| market for enzymes | APOS, S	0.02	0.02	0.02	0.02	0.02	0.02	0.0	0.0	0.0
HEMICELL XT - mill	Hemicell XT		0.02		0.02		0.02	0.02	0.02	0.02
VITS & MINS - S/GR	Total minerals, additives, vitamins, at plant {RER} Economic, U	0.50	0.01	0.50	0.01		0.01	-0.5	-0.5	0.0
VITS & MINS - FIN	Total minerals, additives, vitamins, at plant {RER} Economic, U		0.50		0.50	0.50		0.5	0.5	-0.5

Swine Results – 1 ton feed, Southwest Europe



Summary:

- These results are compared assuming the same FCR.
- The reformulated diets' carbon footprint impact dropped 1-4% on the baseline, depending on the scenario.
- The reformulated diets had less calories largely due to a reduction in soybean meal and animal fat.
- **Reductions in the carbon footprint of the Beta-mannanase diets are largely due to a reduction LUC impact.**

Northeast Europe	Grower; 25-50kg			Grower; 50-75kg			Finisher; 100-135kg		
	Control	Beta-mannanase	% reduction	Control	Beta-mannanase	% reduction	Control	Beta-mannanase	% reduction
Carbon footprint	1177	1155	1.9%	1200	1183	1.4%	897	859	4.2%
CF excluding LUC	573	570	0.4%	580	582	-0.3%	560	552	1.4%
CF LUC only	604	585	3.2%	619	601	2.9%	337	307	8.8%

Swine: 55kcal SW Europe scenario

		Percentage included						Difference in ingredients		
Elanco specified ingredient	**Dataset from Agrifootprint**	**Pigs 25 to 50 kg**	**Pigs 25 to 50 kg +BM**	**Pigs 50 to 75 kg**	**Pigs 50 to 75 kg +BM**	**Pigs 100 to 135 kg**	**Pigs 100 to 135 kg +BM**	**25-50**	**50-75**	**100-135**
Barley 10.8 % CP	Barley grain, dried, market mix, at regional storage {RER} Economic, U	14.78	15.98	14.65	15.36	25.88	31.19	1.2	0.7	5.3
Corn (F2012)	Maize, dried, market mix, at regional storage {RER} Economic, U	30.00	30.00	30.00	30.00	30.00	25.62	0.0	0.0	-4.4
Wheat 11.2 % CP (F2012)	Wheat grain, dried, market mix, at regional storage {RER} Economic, U	30.00	30.00	30.00	30.00	30.00	30.00	0.0	0.0	0.0
Sunflower 28 CP (F2012)	Sunflower seed, market mix, at regional storage {RER} Economic, U							0.0	0.0	0.0
Soybean meal 45,5% CP (F2012)	Soybean meal (solvent), market mix, at regional storage {RER} Economic, U	21.67	21.39	22.22	22.06	11.60	11.03	-0.3	-0.2	-0.6
Animal mixed fat (F2012)	Blonk process mix	1.29	0.27	1.26	0.36	0.65		-1.0	-0.9	-0.6
Calcium carbonate (F2012)	Calcium carbonate, precipitated {RER}| calcium carbonate production, precipitated | APOS, S	0.74	0.77	0.75	0.88	0.72	0.81	0.0	0.1	0.1
Monocalcium phosphate	Monocalcium phosphate	0.45	0.50	0.28	0.49	0.25	0.40	0.0	0.2	0.1
Salt (F2012)	Sodium chloride, powder {RER}| production | APOS, S	0.44	0.44	0.44	0.44	0.45	0.45	0.0	0.0	0.0
DL METHIONINE (F2012)	MetAMINO®, 99% DL-Methionine, at Evonik plant {BE} Economic, U	0.04	0.04	0.01	0.01	0.00	0.00	0.0	0.0	0.0
L-LYSINE HCL (F2012)	Biolys®, 54.6% L-Lysine, at Evonik plant {US} Economic, U	0.23	0.24	0.09	0.09	0.15	0.16	0.0	0.0	0.0
L-THREONINE (F2012)	ThreAMINO®, 98.5% L-Threonine, at Evonik plant {HU} Economic, U	0.06	0.06			0.01	0.01	0.0	0.0	0.0
Natuphos Phytase 500 FTU/kg	Enzymes {GLO}| market for enzymes | APOS,	0.10	0.10	0.10	0.10	0.10	0.10	0.0	0.0	0.0
Hemicell XT 55 kcal/kg	Hemicell XT		0.01		0.01		0.01	0.0	0.0	0.0
Premix for grower	Total minerals, additives, vitamins, at plant {RER} Economic, U	0.20	0.20	0.20	0.20	0.20	0.20	0.0	0.0	0.0

Topics

1. The requirement for Carbon footprint measurement and reduction for Feed Producers and the Livestock Industry ✓

2. What is Lifecycle assessment and how is it calculated? ✓

3. How is the carbon footprint of Compound feed calculated? ✓

Elanco™