GAIN
Green Aquaculture Intensification

SUMMER SCHOOL

FROM AUGUST 30TH TO SEPTEMBER 3RD

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773330 (GAIN)

GAIN Green Aquaculture Intensification

SUMMER SCHOOL

LCA HANDS-ON SESSION

DR. SILVIA MAIOLO

PERFECTFOOD

*(**PERFECT FOOD** is a spin-off of LCE-Life Cycle Engineering)*

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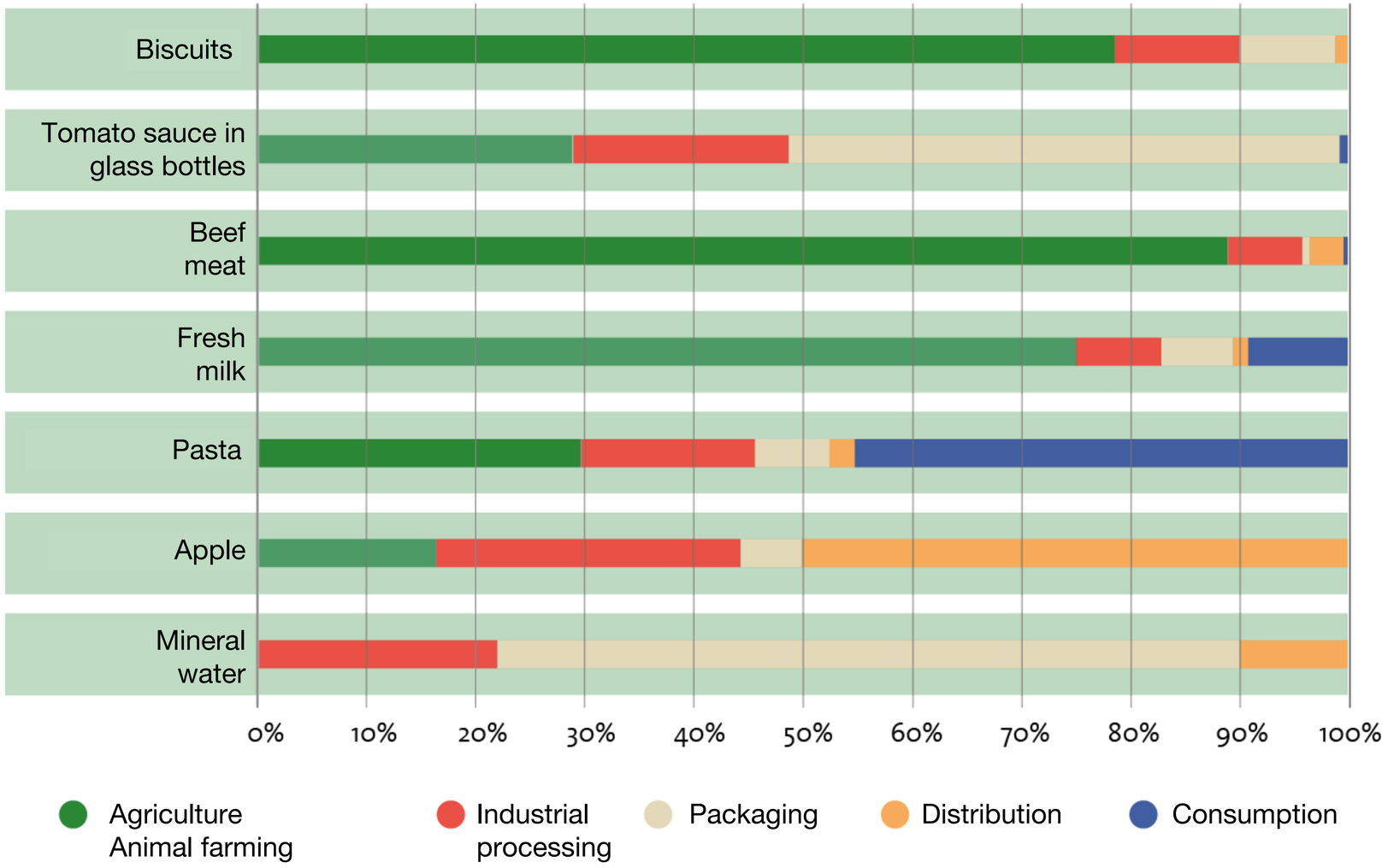
LIFE CYCLE ASSESSMENT (LCA) - USAGE

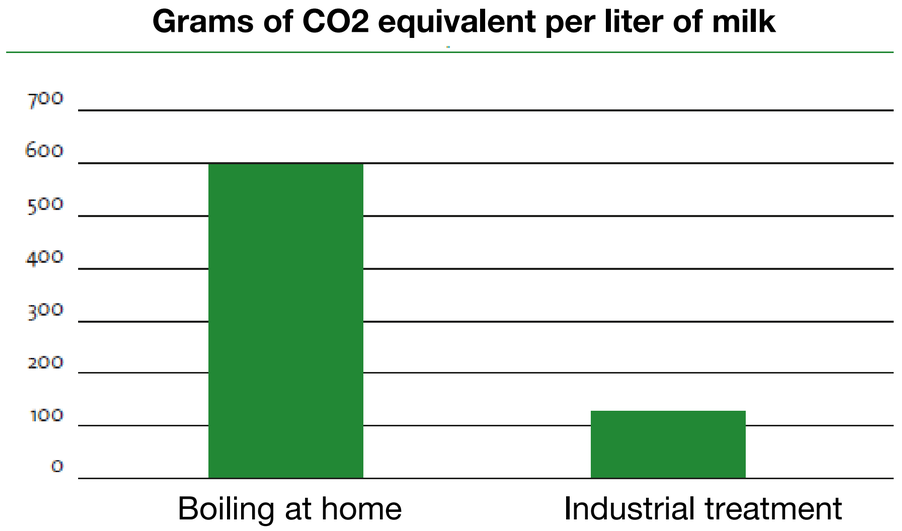
To measure and compare



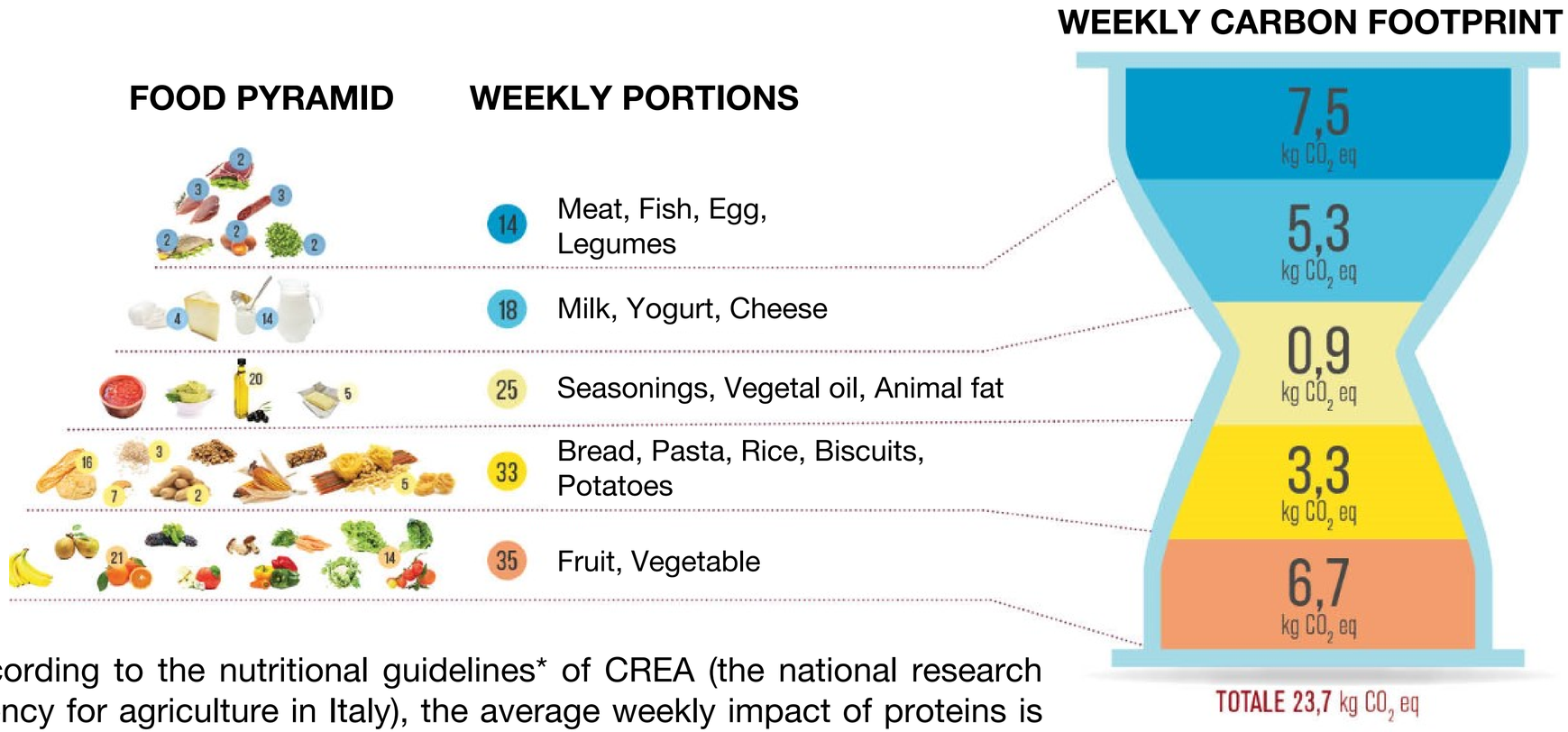
Source:

… But be careful to make **meaningful** comparisons. The **function** must be the same!
I cannot compare 1 kg of lettuce with 1 kg of meat: they have totally different nutritional values!

For example, it is ok to compare:



SPEAKING OF FOOD….



According to the nutritional guidelines* of CREA (the national research agency for agriculture in Italy), the average weekly impact of proteins is in line with that of other types of food.

In fact, for the latter the impact per kg of product is lower but the quantities consumed are much higher.

*CREA – Linee guida per una sana alimentazione (Italian version)
https://www.crea.gov.it/documents/59764/0/LINEE-GUIDA+DEFINITIVO.pdf/28670db4-154c-0ecc-d187-1ee9db3b1c65?t=1576850671654

SPEAKING OF FEED….

Feed4Future carbon neutral offering now available for Skretting customers

SKRETTING
a Nutreco company

Feed & services for aquaculture | Transparency & trust | Sustainability | Innovation

Sustainability | Carbon footprint

21 September 2020

With food production accounting for around a quarter of the world's greenhouse gas emissions, carbon footprint reduction is one of the most effective ways that supply chains can address the climate change challenge.

– First-to-market low impact feed now available for Italian farmers, taking Italian aquaculture to new levels of sustainability

LCA - HOW DOES IT WORK?

Pasta LCA, from field to plate

https://www.youtube.com/watch?v=4OiOlbxowvY&t=4s

LCA - HOW DOES IT WORK?

It all depends on the **GOAL**!

Examples on Biscuits

I am asked to provide:

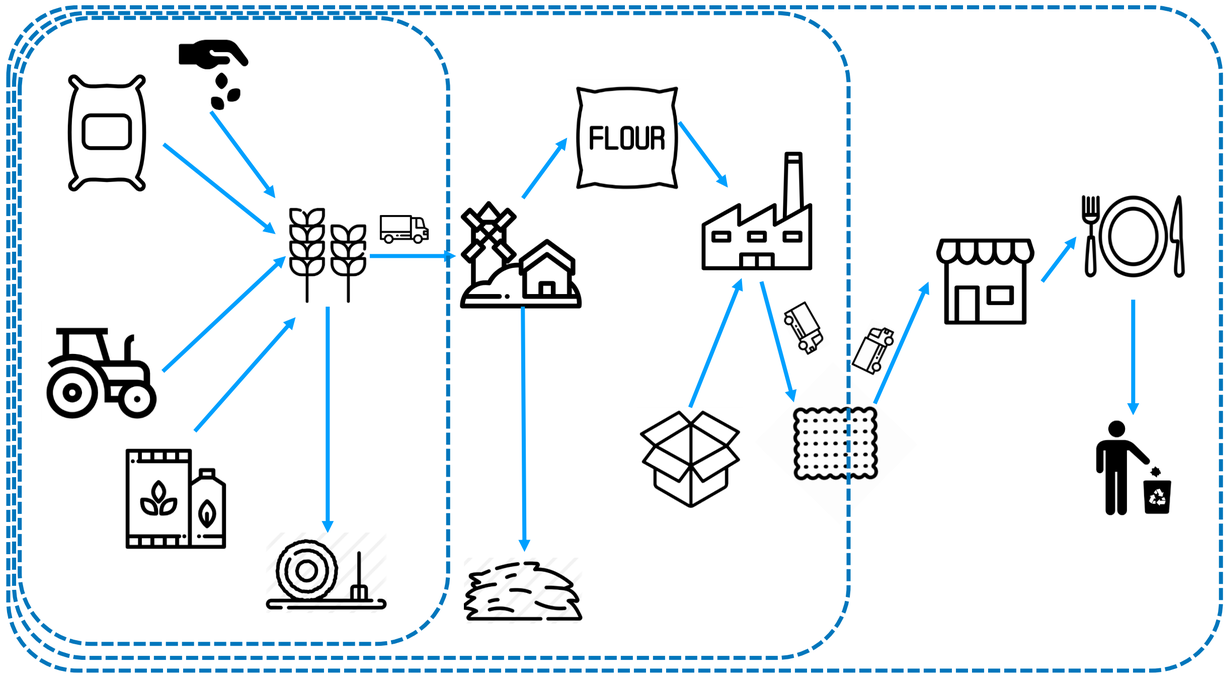
- On average, the Carbon Footprint (CF) of a biscuit produced in the World → very quick review of scientific references
- On average, the CF of a biscuit produced in Europe → integration of previous data with information taken from technical reports on European products *
- On average, the CF of biscuits produced by THIS specific company → integration of previous data with a quick LCA on the company (collection of primary data from the company)
- the CF of THIS biscuits, produced by THIS company, in THIS year, in THIS plant → in-depth analysis on the product, collecting all the primary data necessary to correctly describe that specific production process.

* For instance: https://www.environdec.com/library

Once I have chosen the goal, I can define the **SCOPE**

Keeping to use the examples on Biscuits

- what is the object to measure? → [QUANTITY] of the biscuits [NAME], produced in [YEAR] by the company [BRAND]
- How? → Define the impact assessment METHOD and the impact CATEGORIES to use
- How many pieces of the supply chain should I consider? → Define the system BOUNDARIES
- Which data should I collect? How accurate should I be? → make a detailed INVENTORY of the processes involved and, if possible, identify those that can certainly be overlooked (because of their negligible contribution to impact)
- …




PAUSE

EXERCISE

ELSEVIER

Journal of Cleaner Production

Volume 289, 20 March 2021, 125155

From feed to fork – Life Cycle Assessment on an Italian rainbow trout (*Oncorhynchus mykiss*) supply chain

Silvia Maiolo [a], Andrea Alberto Forchino [a], Filippo Faccenda [b], Roberto Pastres [a]

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https://doi.org/10.1016/j.jclepro.2020.125155

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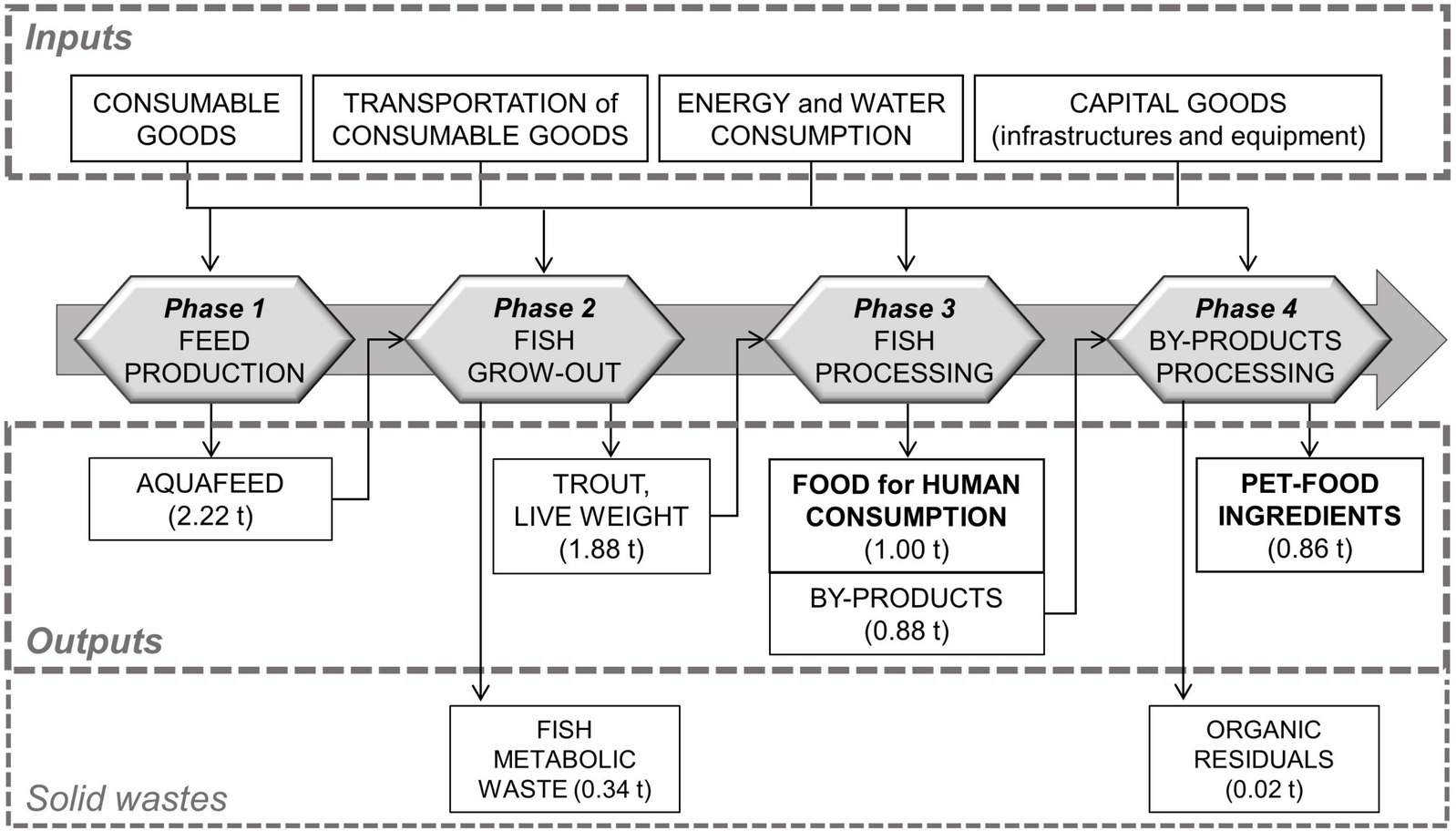
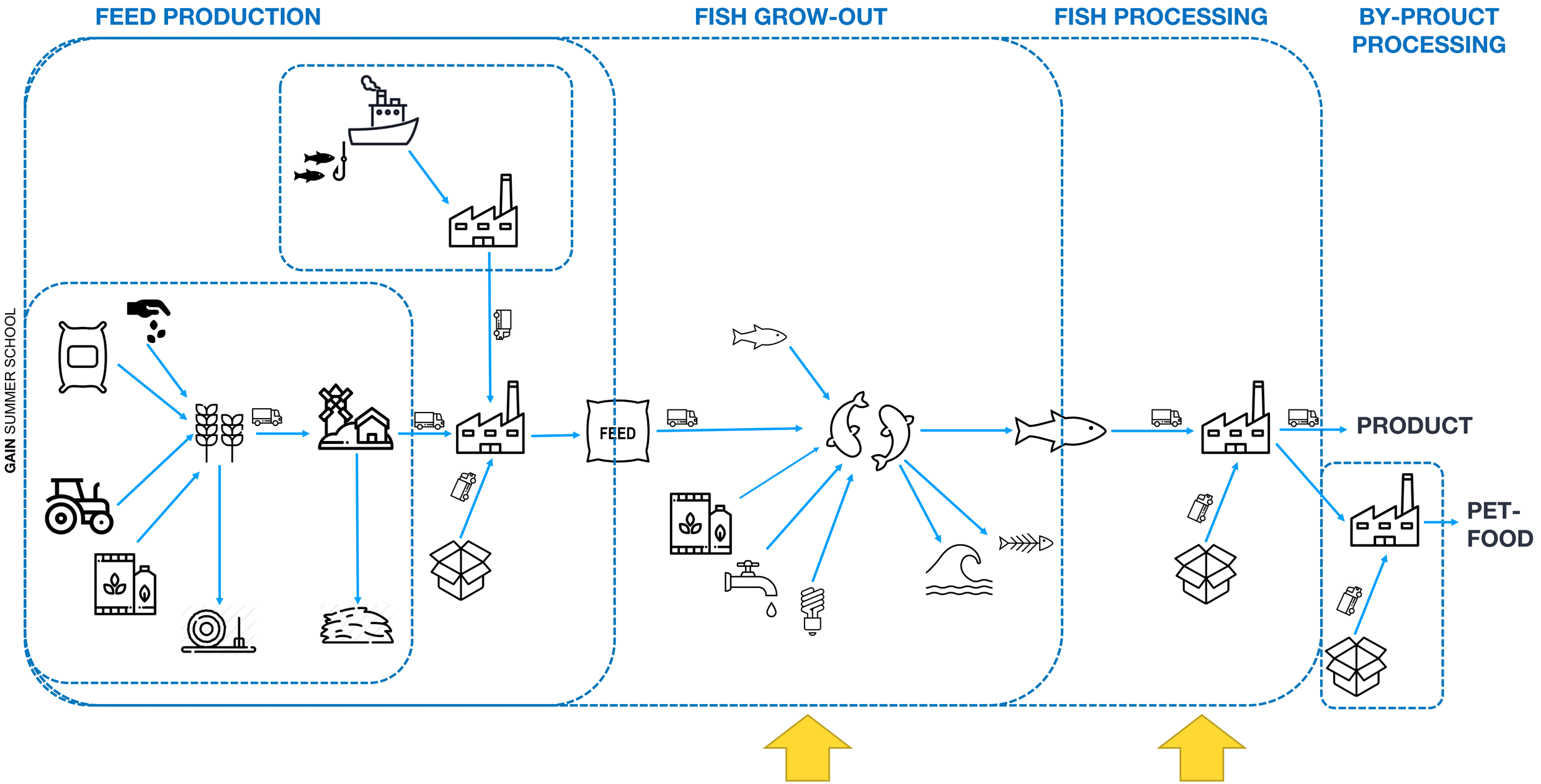
Mass balance




FEED PRODUCTION
FISH GROW-OUT
FISH PROCESSING
BY-PROUCT PROCESSING
GAIN SUMMER SCHOOL
FEED
PRODUCT
PET-FOOD

1 IMPACT ASSESSMENT of FISH GROW-OUT

FISH GROW-OUT	INVENTORY		IMPACT ASSESSMENT	
INPUTS				
Aquafeed	1.100,00	kg		kg CO2 eq. to air
Road transport of inputs (aquafeed, chemicals)	294.800,00	kg km		kg CO2 eq. to air
Electricity (Country energy grid)	300,00	kwh		kg CO2 eq. to air
Diesel	28,63	l		kg CO2 eq. to air
Water (from river)	213.725,61	m3		kg CO2 eq. to air
Dead biomass (incinerated)	226,99	kg		kg CO2 eq. to air
OUTPUTS				
Product: trout at marketable size (live weight)	1.000,00	kg		kg CO2 eq. to air

DATABASE			
1 kg	Feed	=	2,0000 kg CO2 eq. to air
1 kg km	Transport (lorry 16-32 metric ton, EURO3)	=	0,0001 kg CO2 eq. to air
1 Kwh	Electricity (Country energy grid, low voltage)	=	0,3900 kg CO2 eq. to air
1 Kwh	Diesel, burned in agricultural machinery	=	0,2900 kg CO2 eq. to air
1 m3	Water (from river)	=	0,0000 kg CO2 eq. to air
1 m3	Tap water (European average)	=	0,2200 kg CO2 eq. to air
1 kg	treatment of biowaste, municipal incineration	=	0,0370 kg CO2 eq. to air
	Diesel, energy content		10,45 kWh/l

2 IMPACT ASSESSMENT of FISH PROCESSING

FISH PROCESSING	INVENTORY		IMPACT ASSESSMENT	
INPUTS				
Trout at marketable size (live weight)	1.877,61	kg		kg CO2 eq. to air
Road transport of trout	93.880,39	kg km		kg CO2 eq. to air
Road transport of the other inputs	24.387,69	kg km		kg CO2 eq. to air
Electricity (Country energy grid)	766,06	kwh		kg CO2 eq. to air
Water (from water supply system)	30,60	m3		kg CO2 eq. to air
OUTPUTS				
Product: food for human consumption	1.000,00	kg		kg CO2 eq. to air
By-products: a mix of viscera, heads and frames	880,00	kg		

3 IMPACT ALLOCATION

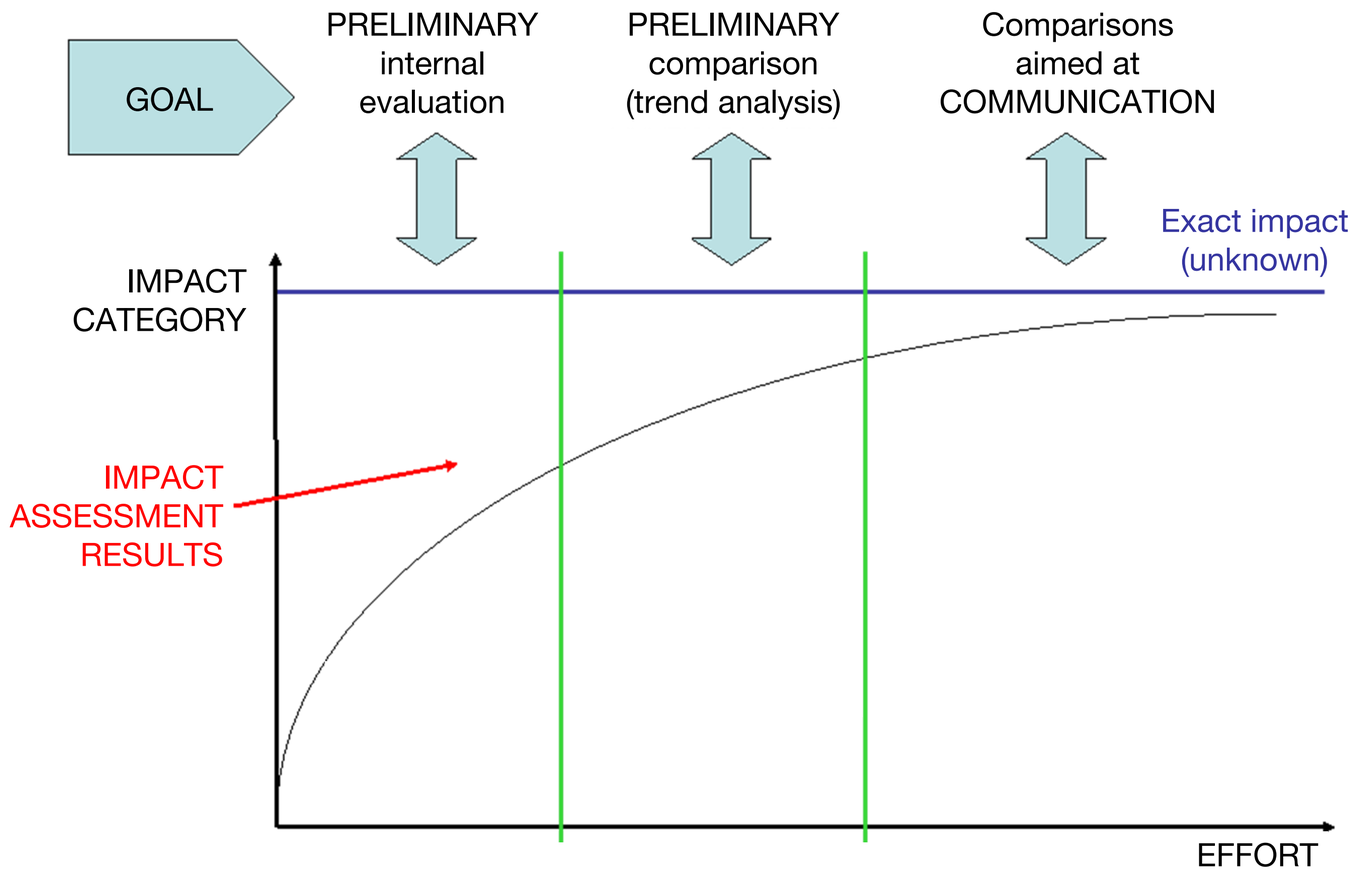
The impacts of the whole supply chain is scaled to 1'000 kg of food for human consumption plus 880 kg of by-products produced alongside
How can I split the impact between the two?

	kg	%	€	%
Product: food for human consumption	1.000,0		7.000,0	
By-products: a mix of viscera, heads and frames	880,0		44,0	
Total	1.880,0		7.044,0	

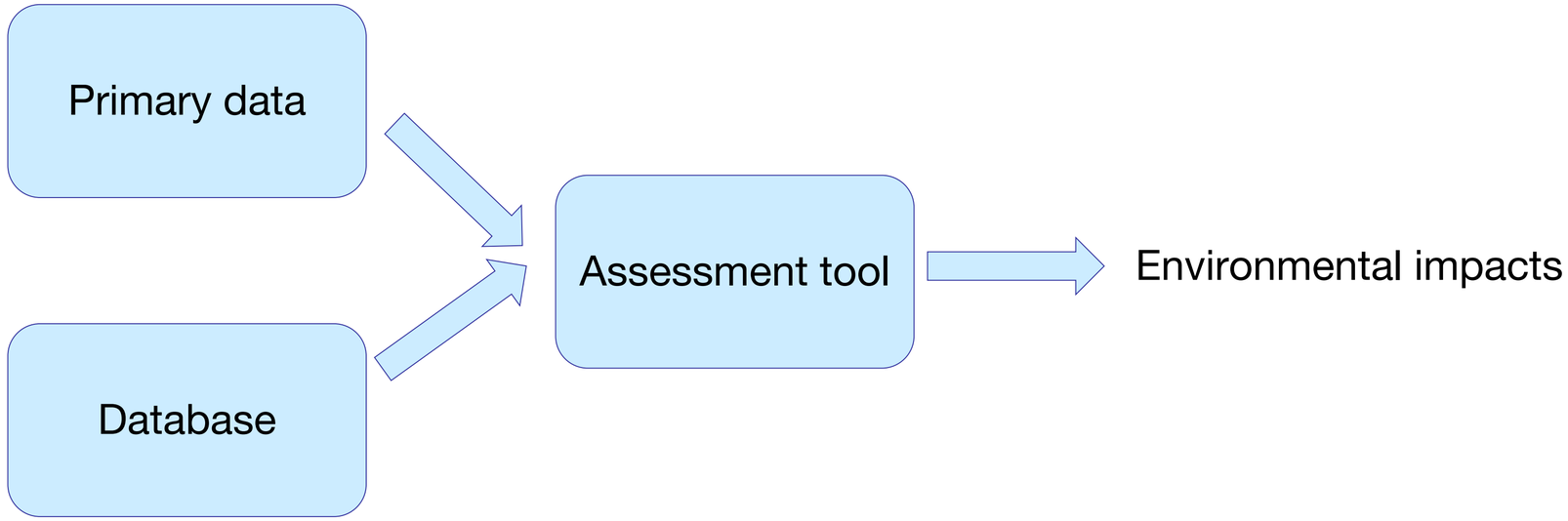
ALLOCATION		
MASS	ECONOMIC	
		kg CO2 eq. / kg of product
		kg CO2 eq. / kg of product

SOURCE	ECONOMIC VALUE
BMTI S.c.p.A (2018). Wholesale prices of trout fillet (Figure D)	7 €/kg
my estimate	0,05 €/kg

HOW MUCH EFFORT?



A QUICK RECAP



DATABASES

Huge and internationally accepted databases, each containing thousands of processes.

Some of them are free, some are not.

Ecoinvent is internationally recognized as the largest and most consistent database on the market.
Its data covers most industrial sectors, is presented transparently and well documented.
Ecoinvent was created by the non-profit association of the same name, founded by various Swiss public bodies (including the Polytechnic of Zurich, the Polytechnic of Lausanne and the Federal Center of Excellence for Agricultural Research - Agroscope). https://www.ecoinvent.org/

Agri-footprint is entirely dedicated to the agri-food sector. Given the complexity of the sector, the database offers a range of alternative models for each reference (allocation methods) and a high level of detail relating to fertilizers and the impact related to land use. The database is a project of Blonk Consultants, a leading Dutch consultancy firm in the environmental, nutrition and health sectors.
https://www.agri-footprint.com/

Agribalyse
This database is entirely dedicated to the agri-food sector. The database is a French project born from a broad partnership between public and private research institutes, coordinated by ADEME (Agency for the Environment and Energy) and INRAE (the National Institute of Agronomic Research)
https://www.ademe.fr/en/agribalyse-program

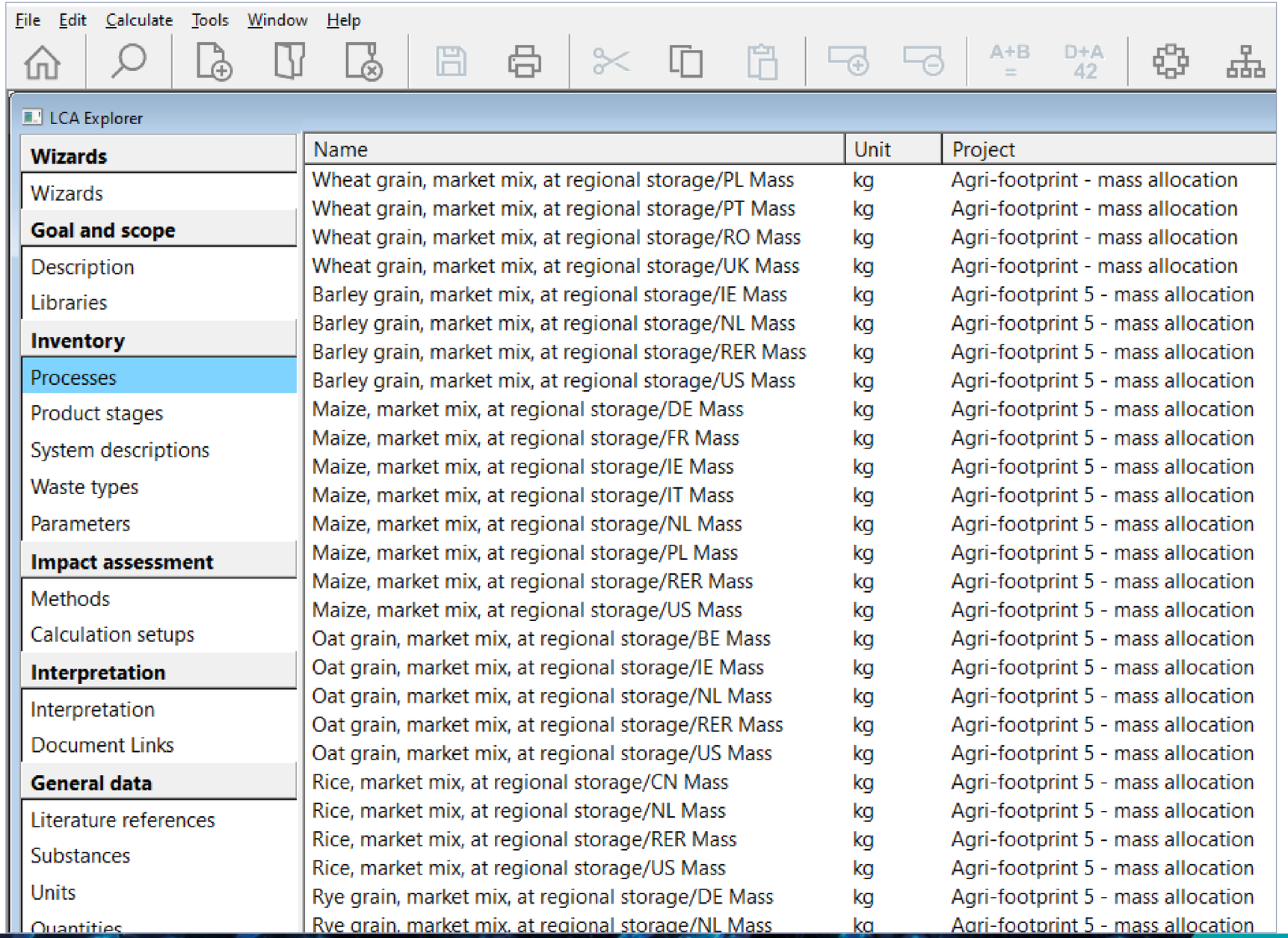
The GFLI database, created by the association of the same name (Global Feed LCA Institute), is part of a project launched in 2015 in the United States. Free and transparent, it was created to provide tools to support a correct assessment of the impact of feed production.
The project (and the database) are promoted by various associations of feed producers (Europe, America, Canada and the international federation) and by international companies in the sector.
https://globalfeedlca.org/gfli-database/database-and-tool/

ASSESSMENT TOOL

There are 3 main software that help us model the processes (they automatically convert them into the desired environmental impacts).

PS: **openLCA** is completely free, without any license cost.

SimaPro


File Edit Calculate Tools Window Help
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Wizards
Wizards
Goal and scope
Description
Libraries
Inventory
Processes
Product stages
System descriptions
Waste types
Parameters
Impact assessment
Methods
Calculation setups
Interpretation
Interpretation
Document Links
General data
Literature references
Substances
Units
Quantities
Name
Unit
Project
Wheat grain, market mix, at regional storage/PL Mass kg Agri-footprint - mass allocation
Wheat grain, market mix, at regional storage/PT Mass kg Agri-footprint - mass allocation
Wheat grain, market mix, at regional storage/RO Mass kg Agri-footprint - mass allocation
Wheat grain, market mix, at regional storage/UK Mass kg Agri-footprint - mass allocation
Barley grain, market mix, at regional storage/IE Mass kg Agri-footprint 5 - mass allocation
Barley grain, market mix, at regional storage/NL Mass kg Agri-footprint 5 - mass allocation
Barley grain, market mix, at regional storage/RER Mass kg Agri-footprint 5 - mass allocation
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Maize, market mix, at regional storage/FR Mass kg Agri-footprint 5 - mass allocation
Maize, market mix, at regional storage/IE Mass kg Agri-footprint 5 - mass allocation
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Oat grain, market mix, at regional storage/BE Mass kg Agri-footprint 5 - mass allocation
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Oat grain, market mix, at regional storage/NL Mass kg Agri-footprint 5 - mass allocation
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Rice, market mix, at regional storage/CN Mass kg Agri-footprint 5 - mass allocation
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Rice, market mix, at regional storage/RER Mass kg Agri-footprint 5 - mass allocation
Rice, market mix, at regional storage/US Mass kg Agri-footprint 5 - mass allocation
Rye grain, market mix, at regional storage/DE Mass kg Agri-footprint 5 - mass allocation
Rye grain, market mix, at regional storage/NL Mass kg Agri-footprint 5 - mass allocation

Average production of organic RYE GRAIN for feed purposes, in Switzerland
(Database: Ecoinvent v.3)

Products			
	Rye grain, feed, organic {CH}| production	**1**	kg
Resources – Land			
	Occupation, construction site	**2E-06**	m^2a
	Occupation, industrial area	**5E-05**	m^2a
	Transformation, from unknown	**1E-06**	m^2
	Transformation, to industrial area	**1E-06**	M^2
Materials/fuels			
	Building, multi-storey {RER}| construction	**8E-06**	m^3
	Rye grain, organic {GLO}| market for	**1E+00**	kg
	Tap water {CH}| market for	**6E-02**	kg
Electricity/heat			
	Electricity, low voltage {CH}| market for	**3E-02**	kWh
	Heat, district or industrial, natural gas {CH}| market for heat	**1E-01**	MJ
Emissions to air			
	Water/m3	**5E-05**	m^3
Waste to treatment			
	Wastewater, average {CH}| treatment of, capacity 1.1E10l/year	**4E-05**	m^3

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PERFECTFOOD

https://perfect-food.eu/
https://www.linkedin.com/company/perfectfoodconsulting/

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