Supporting Information

The Life Cycle Inventory (LCI) data for cultivated meat (CM) production are provided in detail in this Supplementary Information (SI) document. This SI also explains the approach used for selecting proxy data when Life Cycle Assessment (LCA) data were unavailable in the ecoinvent database. Additionally, Product Environmental Footprint (PEF) method LCA data for selected scenarios and for livestock meat from the Agri-footprint database are included. Finally, the composition of the main product and by-product of the process is presented.

Content

SI 1 Characteristics of common inputs used in unit processes

This section describes how inputs that occur across multiple unit processes are modelled in this study.

SI 1.1 Demineralised water

The production of demineralized water through reverse osmosis (RO) is modelled as follows.

Table SI 1. LCI of water demineralization (RO)

I/O	Item	Amount/1l	Unit	Characteristic/Source
Input	Tap water	1.4000	l	Tap water {Europe without Switzerland} market for
Input	Electricity	0.0013	kWh	Electricity, low voltage CZ
Input	Filter	0.000004	pc	See below
Output	Wastewater	0.4000	l	Wastewater, average {Europe without Switzerland} market for
Output	Demineralized water	1.0000	l	

SI 1.2 Electricity

For electricity, three scenarios are considered, which only take into account the electricity consumed within the production process at the production site (e.g. electricity for mixing of the medium). In the inputs, the energy mix was not changed. Similar approach was used in the study Sinke et al., 2023, where the 2030 forecast energy mix Global average electricity mix was used.

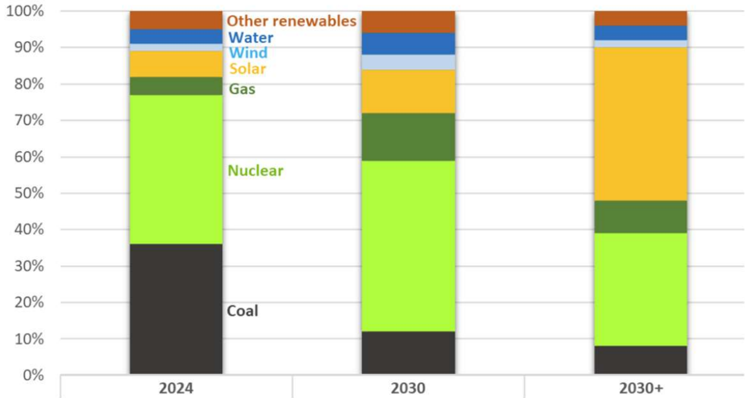

Fig. SI 1. Electricity mix composition for evaluated scenarios 2024, 2030, 2030+

Defined sub scenarios are the following:

- **2024** Czech energy mix as defined in the ecoinvent database - low voltage market for - **basic sub scenario**
- **2030** – predicted Czech energy mix in 2030. The prediction is made according to the conservative scenario of the analysis Evaluation of resource adequacy of the energy system of the Czech Republic until 2040 prepared by the company ČEPS (Czech Electric Power Transmission System) (ČEPS, 2022). The conservative scenario of the analysis was chosen based on the precautionary principle.
- **2030+** - in the 2030 scenario, the share of electricity from solar sources is increased by 30%. This scenario characterizes the realistic situation of the use of own photovoltaic panels mounted on the roof of the future production facility, which are assumed to cover 30% of the total annual electricity consumption.

SI 1.3 Heat

The process **Heat, district or industrial, natural gas, at boiler modulating, >100kW** from ecoinvent was adjusted based on the site conditions – values of CO_2 emissions and electricity consumption were adjusted according to the expected specific type of boiler (see the table below). Only the electricity consumption was changed in the process from the ecoinvent database, all other inputs and outputs remained unchanged.

Table SI 2. Electricity consumption and CO2 emissions of steam boiler

Steam boiler	Amount	Unit
Electricity for running the boiler	84	kWh
Natural gas for boiler	3600	MJ
CO_2 from boiler	228	kg

SI 1.4 Wastewater treatment

For the modelling of wastewater was the following ecoinvent process was considered: **wastewater average {Europe without Switzerland}| market for wastewater**. This process includes transportation to water treatment plant and the treatment with these characteristics: (The wastewater has a content of Total Organic Carbon (TOC): 0.1091 kg/m^3, Chemical Oxygen Demand (COD): 0.42534 kg/m^3 and Biochemical Oxygen Demand (BOD): 0.20572 kg/m^3. TOC is equal to C present in the wastewater, COD is calculated as TOC/0.2565 and BOD is calculated as COD/0.53034.). Wastewater recycling is not considered.

SI 1.5 Equipment

Process equipment mainly consists of bioreactors and centrifuges. Their expected lifetime is related to the volume of the processed substance. The estimate of service life and the method of modelling individual items of equipment is shown in the table

Table SI 3. Modelling of process equipment

Equipment	Process	Lifetime [mil. l]	Stainless Steel [t]	Electromotor	Other Equipment
Reactor	Hydrolysis	10	8	3.5 kW	No
Centrifuge	Filtration 1 + Centrifuge	10	1	11 kW	No
Reactor	Medium preparation	30	8	3.5 kW	No
Reactor	Cultivation	30	11	3.4 kW	Electronics, for control units (8 kg)
Centrifuge	Centrifuge	10	1	20 kW	No

The recycling of stainless steel was considered and therefore 90% of the stainless-steel was considered as an avoided product (pig-iron market).

SI 1.6 Transportation

In relevant cases, **market for processes** from SimaPro databases were selected, this type of processes already include transport. For other processes, the average distance of 500 km was used and process: Transport, freight, lorry 16-32 metric ton, EURO6 {RER}. **Transports of Soy Protein Isolate (SPI)** was modelled from USA, respectively from China to Rotterdam by container ship and then to Prague by truck – the details are below.

SI 1.7 Filters

There are three types of filters used in the production of CM:

- Filter for Filtration 1 process – price 200 EUR – base filter.
- Filter of Filtration 2 process – price 80 EUR – modelled as 0,5 of the base filter.
- Filter of water demineralisation – price 10 EUR - modelled as 0,05 of the base filter.

The inventory for this filter (200 EUR one) was based on the amount of inputs materials – PVDF membrane, polypropylene cage and silicone seals. Nonwoven polypropylene was used as a proxy for PVDF membrane and polypropylene cage was envisaged to be produced by injection moulding.

Table SI 4. LCI of the base filter – Filtration 1

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	PVDF membrane	135	g	Textile, nonwoven polypropylene
Input	Polypropylene cage	186	g	Polypropylene granulate (RER) and Injection moulding (RER)
Input	Silicone	3	g	Silicone product (RER)
Output	Filter	1	ks	

SI 2 Inventory data of unit processes

SI 2.1 Hydrolysis

The first process step is hydrolysis of SPI in presence of different enzymes, the main output of which is the hydrolysate, which enters the next process steps.

Table SI 5. LCI of Hydrolysis

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Soy Protein Isolate	327.047	kg	Soybean protein isolate, at processing (see below the variants) plus appropriate transport
Input	Electricity for mixing, pumping and control	210.526	kWh	Electricity, low voltage CZ, market for
Input	Heat	3,337.647	MJ	Heat, natural gas, ecoinvent adjusted
Input	Demineralized water	6,541.988	l	RO process, see above
Input	Tap water for rinsing	1,089.493	kg	Tap water {Europe without Switzerland}| market
Input	NaOH for cleaning	8.721	kg	Sodium hydroxide, without water, in 50% solution state {RER}| (17,422 kg)
Input	Enzymes	10,926	g	Enzymes, {RER} production
Input	Equipment - stainless steel	4.143	kg	Market for steel, chromium steel 18/8, hot rolled {GLO}|
Input	Equipment - electromotor 3,5 kW	0.013	kg	Electric motor for electric scooter, GLO
Output	Hydrolysate	5,178.235	l	
Output	Wastewater	2,888.539	l	Wastewater, average {Europe without Switzerland}| market
Output	By product (cont. 80% of H2O)	314.519	kg	Potato starch as an avoided product

SI 2.1.1 Soy Protein Isolate

From the perspective of LCA results, SPI represents the input associated with the greatest impacts. Therefore, considerable attention was paid to this input in the analysis and calculations were made for three variants of SPI.

3 different SPI production location were considered:

- **CN (SPI from China)** – **basic sub scenario** which correspond to actual current supplier from China
    - from soya dry mix in China (BR – 47.96%; US – 30%; CN – 14%),
    - transported to Rotterdam (Sea route & distance - ports.com - Port of Guangzhou (Canton) to Port of Rotterdam: 11,166 nautical miles = 20,679 km by container ship) and then to Prague 870 km by transport lorry, Euro 6)
- **NL (SPI from Netherlands)**

- from soya dry mix in NL (soy produced in (BR - 33%; US – 58.5%, 8.5% other sources)
- transported to Prague 870 km by transport lorry, Euro 6

- **SPI US (SPI from United States of America)**
  - from soya dry mix in the US (soy produced in the US), transported to Rotterdam (Sea route & distance - ports.com - Rotterdam – New York: 3,918 nautical miles = 7,250 km by container ship) and then to Prague 870 km by transport lorry, Euro 6).

SI 2.1.2 Enzymes

Enzymes were modelled with the ecoinvent process Enzymes, {RER} production that is based on the production of enzymes from potato starch, electricity and heat modelled based on alfa amylase, glucoamylase and cellulase produced by NOVOZYMES (nowadays NOVONESIS). In the ecoinvent database, there are also three different enzymes—alpha-amylase, glucoamylase, and cellulase—produced by NOVOZYME (nowadays NOVONESIS). Their environmental impacts were compared with the ecoinvent process for "Enzymes" and it was found that, except for the Land Use (LU) category, the impact of enzyme production was higher for the ecoinvent Enzyme process compared to the impacts of the three enzymes produced by NOVOZYME. Ultimately, the "Enzymes" process from the ecoinvent 3 database was used because it was also referenced in the study by Tuomisto et al. (2022), and the greater impacts provide a more conservative, and therefore safer, estimate. Nielsen et al. (2007) also provide LCA analysis for enzymes but unfortunately without primary data.

SI 2.2 Filtration 1 and centrifuge 1

In this phase, the hydrolyzate is filtered and centrifuged.

Table SI 6. LCI of Filtration + centrifuge 1

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Hydrolysate	5,178.23	l	Hydrolysis
Input	Electricity for centrifuge	25.89	kWh	Electricity, low voltage CZ, market for
Input	Filter (Supplier EU, 200€/pc)	4.14	pc	Filter
Input	Electricity for pumping	8.42	kWh	Electricity, low voltage CZ, market for
Input	Demineralized water for cleaning	1,035.65	l	RO process, see above
Input	Tap water	1,035.65	l	Tap water {Europe without Switzerland}| market
Input	Centrifuge	0.49	kg	Market for steel, chromium steel 18/8, hot rolled {GLO}|
Input	Electromotor (11 kW)	0.04	kg	Electric motor for electric scooter, GLO
Output	Filtered hydrolysate	4,919.32	l	
Output	Used filter candle	4.14	pc	Omitted
Output	Wastewater	2330.21	l	Wastewater, average, market for, Europe without Switzerland

SI 2.3 Medium preparation

Table SI 7. LCI of Medium preparation

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Filtered hydrolysate	4,919.323	l	Filtration 1
Input	Electricity	96.405	kWh	Electricity, low voltage CZ, market for
Input	Heat	1,936.714	MJ	Heat, natural gas at boiler, ecoinvent adjusted
Input	Demineralized water	41,697.120	l	RO
Input	Glucose	351.380	kg	Glucose {GLO}| market for glucose

Input	Salts	372.82	kg	Mainly from ecoinvent database, where possible RER and market for processes. Where not GLO processes were used and in case of production processes transport was modelled separately. Choline chloride was modelled as hydrolysis product, based on Mattick et al., 2015 and Tuomisto 2022 and sodium selenite is based on stoichiometric as it is described in Riesner et al, 2023, see below.
Input	Carboxymethylcellulose	37.481	kg	Carboxymethyl cellulose, powder {GLO}| market for carboxymethyl cellulose
Input	Ethanolamine	684.020	g	Triethanolamine, market for
Input	Ferric citrate solution	93.701	l	Ferric citrate preparation based on patent, see below
Input	Cysteine (anhydrous)	9.370	kg	Based on Mattick et al., 2015 and Tuomisto et al, 2022 as an average amino acid (50 % L-Lysine and 50 % threonine). based on the study of Marinussen & Kool 2010, see below
Input	Demi water for rinsing	2,342.535	kg	RO
Input	Tap water for rinsing	2,342.535	kg	Tap water {Europe without Switzerland}| market for tap water
Input	Heat (heating up the rinsing water – steam)	195.836	MJ	Heating up the rinsing water - steam
Input	Equipment - stainless steel	12.494	kg	Market for steel, chromium steel 18/8, hot rolled {GLO}|
Input	Equipment - electromotor 3,5 kW	0.039	kg	Electric motor, for electric scooter {GLO}
Output	Medium	46,850.696	l	
Output	Wastewater	5,622.084	l	

SI 2.3.1 Cysteine (anhydrous)

Modelled according to Mattick et al., 2015 and Tuomisto et al, 2011 as an average amino acid (50 % L-Lysine and 50 % threonine). The inventories in both studies are based on the study of Marinussen & Kool 2010.

Table SI 8. LCI of Cysteine

I/O	Item	Amount	Unit	Characteristic/Source
Input	L-Lysine	0.5	kg	Table SI 9.
Input	L-Threonine	0.5	kg	Table SI 10.
Output	Cysteine	1	kg	

Table SI 9. LCI of L-Lysine

I/O	Item	Amount	Unit	Characteristic/Source
Input	Ammonia, liquid	0.155	kg	Market for ammonia liquid (RER)
Input	Ammonium sulphate, as N	0.095	kg	Market for ammonium sulfate RER
Input	Ascorbic acid	0.004	kg	Market for ascorbic acid GLO
Input	Citric acid	0.005	kg	Market for citric acid GLO
Input	Electricity, medium voltage	3.935	kWh	Market for electricity, medium voltage Europe without Switzerland
Input	Glucose	3.8	kg	Market for glucose GLO
Input	Nitric acid, without water, in 50% solution state	0.0015	kg	Market for nitric acid, without water, in 50% solution state RER
Input	Phosphate rock, as P2O5, beneficiated, dry	0.0067	kg	Market for phosphate rock, as P2O5, beneficiated, dry RER
Input	Steam, in chemical industry	5.8	kg	Market for steam, in chemical industry RER
Input	Tap water	76.6	kg	Market for tap water Europe without Switzerland
Output	L-Lysine	1	kg	

Table SI 10. LCI of L-Threonine

I/O	Item	Amount	Unit	Characteristic/Source
Input	Ammonia, liquid	0.7	kg	Ammonia production, partial oxidation, liquid RER
Input	Ascorbic acid	0.005	kg	Market for ascorbic acid GLO
Input	Electricity, medium voltage	12.05	kWh	Market for electricity, medium voltage Europe without Switzerland
Input	Glucose	4	kg	Market for glucose | glucose | APOS, S - GLO
Input	Nitric acid, without water, in 50% solution state	0.0015	kg	Market for nitric acid, without water, in 50% solution state - RER
Input	Phosphate rock, as P2O5, beneficiated, dry	0.00126	kg	Market for phosphate rock, as P2O5, beneficiated, dry - GLO
Input	Steam, in chemical industry	20	kg	Market for steam, in chemical industry RER
Input	Tap water	9	kg	Market for tap water Europe without Switzerland
Output	L-Threonine	1	kg	

Ecoinvent also contains data for the various amino acids produced by Evonik. These datasets were created in the GaBi model and converted to SimaPro format as a system process. Therefore, no Agri-footprint background processes are used. For the reason that Sinke et al. 2023, Mattick et al., 2015 and Tuomisto et al, 2022 used data based on Marinussen & Kool 2010, we decided for the same approach.

SI 2.3.2 Sodium selenite

Inventory data for sodium selenite is based on stoichiometric as it is described in Riesner et al, 2023. Firstly, the selenite oxide is produced by the combustion of selenite (Se + air + heat → SeO_2 + products of combustion) and then the sodium selenite is produced: $SeO_2 + 2\ NaOH \rightarrow Na_2SeO_3 + H_2O$.

Table SI 11. LCI of Selenium oxide

I/O	Item	Amount	Unit	
Input	Selenium	711	g	Selenium, GLO, market for
Input	Oxygen	288	g	Oxygen liquid, RER, market for
Output	Selenium oxide	1000	g	

Table SI 12. LCI of Selenium selenite

I/O	Item	Amount	Unit	
Input	Selenium oxide	641.6	g	Table SI 11.
Input	NaOH	925	g	Sodium hydroxide, without water, in 50% solution state {RER}
Output	Selenium selenite	1000	g	

SI 2.3.3 Ferric citrate solution

Table SI 13. Ferric citrate solution

I/O	Item	Amount	Unit	Characteristic/Source
Input	Ferric citrate	1.22	kg	International patent application WO2017021921A1
Input	Demineralised water	20	l	RO
Input	Electricity	0.5	kWh	Electricity. low voltage, CZ
Output	Ferric citrate solution	20	l	

Composition of ferric citrate was based on international patent application: WO2017021921A1 - Process for the preparation of pharmaceutical grade ferric citrate - Google Patents. As pharmaceutical grade is not required, acetone and isopropanol were not considered. In the article Mattick et. al. 2015 there was used just iron sulphate for inputs and Iron and citrate ions as output.

Table SI 14. LCI of Ferric citrate

I/O	Item	Amount	Unit	Characteristic/Source
Input	Ferric chloride hexahydrate	3.855	kg	Iron (III) chloride, without water, in 40% solution state, (2,313 kg as it is monohydrate)
Input	Deionised water	5.48	kg	Deionised water {Europe without Switzerland}| market for
Input	Sodium hydroxide	1.464	kg	Sodium hydroxide, without water, in 50% solution state {RER}|
Input	Citric acid	1.2	kg	Citric acid, {RER}, production
Input	Electricity	1	kWh	Electricity, low voltage, {Europe without Switzerland}
Output	Ferric citrate	1.2	kg	

SI 2.3.4 Choline chloride

Modelled as hydrolysed product, based on Mattick et al., 2015 and Tuomisto 2022.

Table SI 15. Hydrolysed choline chloride

I/O	Item	Amount	Unit	Characteristic/Source
Input	Chlorine, liquid	1.69E-05	kg	Market for chlorine, liquid RER
Input	Diesel, burned in agricultural machinery	1.332353	MJ	Market for diesel, burned in agricultural machinery GLO
Input	Electricity, medium voltage	0.155882	MJ	Market for electricity, medium voltage – Europe without Switzerland
Input	Enzymes	0.0012	kg	Market for enzymes GLO
Input	Lime, hydrated, packed	4.41E-04	kg	Market for lime, hydrated, packed RER
Input	Natural gas, high pressure	0.035793	m3	Market for natural gas, high pressure - Europe without Switzerland
Input	Sodium hydroxide, without water, in 50% solution state	3.97E-04	kg	Market for sodium hydroxide, without water, in 50% solution state GLO
Input	Sulfuric acid	6.32E-04	kg	Market for sulfuric acid RER
Output	Hydrolysed product	1	kg	

SI 2.4 Filtration 2

In this process step, the medium is filtered before entering the cultivation process. So, the main output is the filtered medium.

Table SI 16. LCI of Filtration 2

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Medium	46,850.70	l	Medium preparation
Input	Filter	4.69	pc	EU supplier 80€ pc (2,345 pc of the filter with the price 200 EUR)
Input	Electricity	19.52	kWh	Electricity, low voltage CZ, market for
Output	Filtered medium	46,382.19	l	
Output	Wastewater	468.51	l	Wastewater, average, market for, Europe without Switzerland

SI 2.5 Cultivation

In this process step, the cells are cultivated, with the primary output being the cultivated cells themselves, dispersed in the residual medium.

Table SI 17. LCI of Cultivation

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Filtered medium	46,382.19	l	Filtration
Input	Electricity, excl. compressor	340.77	kWh	Electricity, low voltage CZ, market for
Input	Heat	3,379.37	MJ	Heat, natural gas at boiler, ecoinvent adjusted
Input	Demineralized water	157.76	l	RO
Input	Tap water cleaning	157.76	l	Tap water {Europe without Switzerland}| market for
Input	Inoculum (cultivated cells)	1.58	kg	Cultivated cells (BMT - 5kg/30days)
Input	Electricity for compressor	277.82	kWh	Electricity, low voltage CZ, market for (Calculated as adiabatic compression to 2 barg)
Input	Compressed CO_2 – abiotic	97.37	kg	Carbon dioxide, liquid {RER}| market for
Input	Equipment - stainless steel	17.01	kg	Market for steel, chromium steel 18/8, hot rolled {GLO}|
Input	Equipment - electromotor 3,5 kW	0.0387	kg	Electric motor for electric scooter, GLO
Input	Electronics, for control units	0.0124	kg	Electronics, for control units {RER}| electronics production, for control units | Cut-off, U
Output	Cells + Medium	46,382.19	l	
Output	Wastewater	315.53	l	Wastewater, average, market for, Europe without Switzerland
Output	Waste gas	4,199.49	kg	Modelled as air with a higher concentration (4%) of CO_2 (extra CO_2 quantified in the next lines)
Output	CO_2 – abiogenic – emitted to air	97.37	kg	Carbon dioxide, fossil
Output	CO_2 – biogenic – emitted to air	162.27	kg	Carbon dioxide, biogenic

SI 2.6 Centrifuge

The final step of the main production process is the centrifugation of the cultivated cells.

Table SI 1. LCI of Centrifuge _OLD

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Cells + Medium	46,382.19	l	Cultivation
Input	Electricity for centrifuge	231.91	MJ	Electricity, low voltage CZ, market for
Input	Electricity for pumping	55.22	MJ	Electricity, low voltage CZ, market for
Input	Tap water rinsing	473.29	l	Tap water {Europe without Switzerland} market for tap water
Input	Demineralized water – rinsing	709.93	l	RO
Input	Equipment – stainless steel	4.63	kg	Market for steel, chromium steel 18/8, hot rolled {GLO}
Input	Equipment – electromotor 20 kW	0.58	kg	Electric motor for electric scooter, GLO
Output	Cells	1,000.00	kg	Main product
Output	Wastewater	1,183.22	l	Wastewater average
Output	Residual medium	45,383.55	l	By-product

SI 2.7 Cells cultivation

As part of this step, a tiny amount of output cells is cultivated in a small-volume laboratory process and returned as an input (cultivated cells) to the cultivation process.

Table SI 2. LCI of Cells cultivation

I/O	Item	Amount/FU	Unit	Characteristic/Source
Input	Cells	0.0002	kg	Neglected

Input	Electricity	20.0611	kWh	Electricity, low voltage CZ, market for
Input	Heat	63.2470	MJ	Heat, natural gas at boiler, ecoinvent adjusted
Input	Tap water	724.1301	l	Tap water {Europe without Switzerland} market for tap water
Input	SPI	3.1553	kg	Soybean protein isolate, at processing (see above the variants) plus appropriate transport
Output	Waste media	377.0525	l	Wastewater, average, market for, Europe without Switzerland
Output	Cultivated cells	1.5776	kg	
Output	Wastewater	306.0593	l	Wastewater, average, market for, Europe without Switzerland

Note: Only SPI is included as a key medium ingredient; other medium inputs for this step were excluded due to their insignificance.

SI 2.8 Air conditioning of the factory and other utilities – per day

This process characterizes **the one-day operation** of air conditioning and other utilities serving as support for the main production process.

Table SI 3. LCI of Air conditioning of the factory and other utilities

I/O	Item	Amount/day	Unit	Characteristic/Source
Input	Electricity for air-condition	99	kWh	Electricity, low voltage CZ, market for
Input	Electricity for ventilation of compressor room and boiler house	57.6	kWh	Electricity, low voltage CZ, market for
Input	Electricity - cooling with dry coolers	67.2	kWh	Electricity, low voltage CZ, market for
Input	Demineralized water	1,563	l	RO
Input	Electricity for Feedwater pump	4.6	kWh	Electricity, low voltage CZ, market for
Output	Wastewater	1,563	l	Wastewater, average, market for, Europe without Switzerland

The air conditioning performance/energy consumption calculation is based on the quantification of the waste heat generated by the main process. There is an assumption of air conditioning 177 days per year.

SI 2.9 Office consumption

This process characterizes **the one-day operation** of the administrative office (240 m2), in which 25 employees of the planned plant work.

- **Electricity consumption:** Based on the Office Building Energy Insights - Enectiva for 1 m2 of a used area the average value of 110 kWh/m2 a year was taken. For 240 m2 it is 26 400 kWh yearly and 72,32 kWh daily.
- **Water consumption:** Water consumption estimation is based on Směrná čísla roční potřeby vody - TZB-info: 18 l/employee and on Technical answers - building performance and Building Regulations and sustainable refurbishment (bsria.com): 40 l/per employee, 30l/employee was taken and for 25 employees the water consumption is 750 l a day (for 250 working days a year – 513,69l/day).

Table SI 4. LCI of office area

I/O	Item	Amount /day	Unit	
Input	Electricity	72.32	kWh	Electricity, low voltage CZ, market for
Input	Tap water	513.69	l	Market for tap water
Output	Wastewater	450	l	Wastewater, average, market for, Europe without Switzerland

SI 3 LCA results – PEF method impact categories (Characterisation)

Table SI 5. LCA results – PEF method impact categories (Characterisation)

Characteristic	Pig meat, at slaughterhouse {RER}	Pig meat, at slaughterhouse {US}	Chicken meat, at slaughterhouse {RER}	Chicken meat, at slaughterhouse {US}	Beef meat, at processing {IE}	Dairy cow meat, at slaughterhouse {RER}	Dairy cow meat, at slaughterhouse {US}	BENE Meat - CN SPI - CZ energy mix 2024	BENE Meat - US SPI - CZ energy mix 2030 +
Acidification (mol H+ eq)	0,100291	0.118687	0.071032	0.065703	0.283128	0.101111	0.165575	0.022264	0.015845
Climate change (kg CO2 eq)	5,951164	4.573741	3.672417	2.013204	31.65415	8.890412	9.96	5.282456	3.287009
Ecotoxicity, freshwater - part 1 (CTUe)	225,1452	451.2999	145.0171	252.1755	299.0984	250.7156	333.7623	140.0334	93.33539
Ecotoxicity, freshwater - part 2 (CTUe)	309,4333	612.8363	198.5297	343.6834	380.2406	344.4636	451.9906	167.5196	100.4365
Particulate matter (disease inc.)	8,04E-07	8.67E-07	6.62E-07	5.97E-07	4.66E-06	1.01E-06	1.2E-06	1.56E-07	1.27E-07
Eutrophication, marine (kg N eq)	0,029869	0.021352	0.01558	0.013172	0.254926	0.05309	0.031408	0.008015	0.005923
Eutrophication, freshwater (kg P eq)	0,001955	0.001801	0.001146	0.00105	0.005851	0.001649	0.001445	0.002492	0.001292
Eutrophication, terrestrial (mol N eq)	0,439794	0.52092	0.316126	0.290368	0.578518	0.405027	0.724857	0.061249	0.043775
Human toxicity, cancer (CTUh)	2,36E-09	2.11E-09	1.39E-09	1.3E-09	8.37E-09	2.21E-09	1.85E-09	2.89E-09	2.49E-09
Human toxicity, non-cancer (CTUh)	1,69E-07	1.08E-07	8.74E-08	7.06E-08	4.09E-07	1.41E-07	1.36E-07	8.49E-08	6.53E-08
Ionising radiation (kBq U-235 eq)	0,341038	0.316038	0.179196	0.173752	0.339804	0.231151	0.246611	0.541021	0.530178
Land use **(Pt)**	551,0851	296.246	344.9299	224.3756	2 464.67	651.7845	321.2402	183.9181	125.9308
Ozone depletion (kg CFC11 eq)	2,95E-07	2.54E-07	1.98E-07	1.85E-07	7.95E-07	2.47E-07	2.69E-07	2.03E-07	1.85E-07
Photochemical ozone formation (kg NMVOC eq)	0,018439	0.015274	0.014164	0.013259	0.064415	0.029711	0.015459	0.013417	0.009809
Resource use, fossils **(MJ)**	32,25954	33.44723	20.45033	19.6979	73.55296	25.50787	29.10836	53.07551	47.28875
Resource use, minerals and metals (kg Sb eq)	2,08E-05	0.000023	1.03E-05	0.000011	0.000045	1.29E-05	1.33E-05	3.04E-05	3.15E-05
Water use (m3 depriv.)	2,853822	6.229122	1.939087	3.595052	2.397988	2.287607	8.422026	3.983409	4.356551

SI 4 Composition of product and by-product

Table SI 6. Composition of cultivated meat in comparison with reared meat

Meat cut	Per 100 g	Beef, steak cuts, raw	Chicken, raw	Chicken breast, skinless, raw	Turkey, breast, skinless, raw	Reared meat avg.	Cultivated meat, 84% moisture	Cultivated meat, 78% moisture	Cultivated meat, 70% moisture
Protein	(g)	21.0	22.8	23.8	23.6	21.3	11.5	15.8	19.2
Sat. fat	(g)	1.9	0.6	0.4	0.5	2.3	0.3	0.4	0.5
Fat	(g)	4.5	1.9	1.3	1.6	7.0	1.2	1.7	2.0
Energy	(kcal)	123	113	109	106	148			
Vit. B12	(µg)	1.9	0.7	0.4	1	1.3	25.3	34.8	42.2
Na	(mg)	59	78	59	62	62	22	30	37
Zn	(mg)	1.7	1.4	0.7	0.5	1.9	1.8	2.5	3.0
P	(mg)	167	202	218	208	195	230	316	383
Fe	(mg)	1.3	0.7	0.4	0.6	1.2	15	20.6	25.0

Note: The CM composition was measured in the laboratory using a sample from a pilot-scale process with a moisture content of 84%. The values of the individual components were converted to represent typical values for CM products manufactured in full-scale production (at 78% moisture and 70% moisture). All calculations within the LCA are performed using a functional unit with 70% moisture.

Table SI 7. Hydrolysis sediment composition

Item	Amount	Unit
Water content	79.23	g/100 g
Dry matter	20.77	g/100 g
Protein	10.38	g/100 g
Carbohydrates	6.31	g/100 g
Fat after hydrolysis	3.49	g/100 g
Ash	0.59	g/100 g
Salt (calculated from sodium)	0.125	g/100 g
Energy value	412.9	kJ/100 g

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