Carbon balance of Bio Bulgaria, 2023

Calculation of greenhouse gas emissions

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1. Introduction

The fifth and sixth reports of the Intergovernmental Panel on Climate Change (IPCC) confirmed that climate change is due to increased greenhouse gas concentrations from human activities. The rise in concentration at the current rate will lead to an increase in the global average annual temperature with +2° in 2050 and with +3.2° to 2100. The consequences of this warming will include rising sea levels, more frequent and more severe natural disasters, reduced freshwater resources and agricultural production.

The Paris Agreement, signed in 2015 at the Conference of the Parties to the United Nations Framework Convention on Climate Change, outlines the main goals for tackling this problem – limiting rising temperatures of up to +1.5°, compared to the average temperature of the pre-industrial era. This can be achieved by reducing greenhouse gas emissions. The European Union has therefore adopted a number of measures in the Green Deal, signed in 2020 and its main objective is achieving net zero emissions in 2050. Additional short-term targets that have been set and are described in the "Fit for 55" package, aiming for a 55% reduction in emissions by 2030.

Private companies have an important role to play in this transition in both mitigating climate change and adapting our society to future. The first step in this process is to calculate a company's carbon footprint. This is achieved by examining the company's activities in detail, defining clear calculation boundaries and identifying sources of greenhouse gas emissions. In this way emissions reduction targets can also be set and a strategic plan with concrete steps can be built.

This document describes in detail the calculation of greenhouse gas emissions associated with the activities of Bio Bulgaria Ltd. for the year 2023. The company distributes food products under the brand “Harmonica”. The calculation includes Scope 1, Scope 2 and Scope 3 emissions according to the Greenhouse Gas Protocol[1] classification (referred to as the Protocol onwards) where possible and falls within the defined boundaries of the study.

1.1. Main principals of the Protocol

At the heart of the Protocol are a number of principles that aim to ensure that the information reported has **relevance**, **completeness**, **consistency**, **transparency** and **accuracy** and all of them are represented in the calculation of the greenhouse gas emissions associated with the company's activities.

Greenhouse gas (GHG) emissions reporting and reporting practices are still evolving and are new to different industries and types of companies. Despite that the principles listed here are part of established and widely accepted principles of financial reporting and accountability. They also reflect the results of a broadly collaborative process involving diverse stakeholders including technical, financial and environmental specialists.

GHG inventories according to the Protocol are also necessary for the development of any company. The calculation of the carbon balance is motivated by five business objectives:

- Managing GHG risks and identifying reduction opportunities
- Public reporting and participation in voluntary GHG programs
- Participating in mandatory reporting programs
- Participating in GHG markets
- Recognition for early voluntary action.

1.2. The company

Established in 2006, the company's main objective is to produce organic food products in Bulgaria and distribute them on the market under the brand "Harmonica". They are pioneers in this field in the country and their products are successfully distributed in organic and health food stores, cafes, restaurants. The first and most emblematic product is the yoghurt, which is produced with the fresh milk from farms in the Troyan Balkan Mountains, where the animals are roaming free-range and feeding with pasture grass for most of the year.

The company's focus is to seek the best solutions and way of working in food production, starting from the wild and clean nature, through animal husbandry practices on the farms and finally reaching the end consumers.

1.3. Scope of calculations

Scopes 1 and 2 according to the Protocol are included in their entirety in the study. Scope 3 is subject to discussion and definition. The boundaries of this report focus on the calculation of GHG emissions associated with the production and use of food products. Emissions related to agricultural practices represent the largest share of the company's footprint, and therefore our efforts have been focused primarily on finding specific factors that reflect as accurately as possible the uniquness of the Bio Bulgaria products.

In Scope 1, we calculated transportation-related emissions from company-owned vehicles as well as emissions associated with cooling systems.

In Scope 2, we included electricity consumed for office and warehouse needs. Additionally, we have calculated there the electricity that is consumed by an electric car.

Scope 3 is the most complex one for defining boundaries and finding relevant emission factors. We decided to include categories for data relating to the products with which Bio Bulgaria carries out its main activity. These are:

- Raw materials
- Packaging
- Incoming freight of raw materials
- Energy for production
- Outbound freight of products
- Energy for product use
- Not-consumed products, waste

The figure below is a schematic representation of the categories we included in our framework with the most significant portion of the company's footprint.

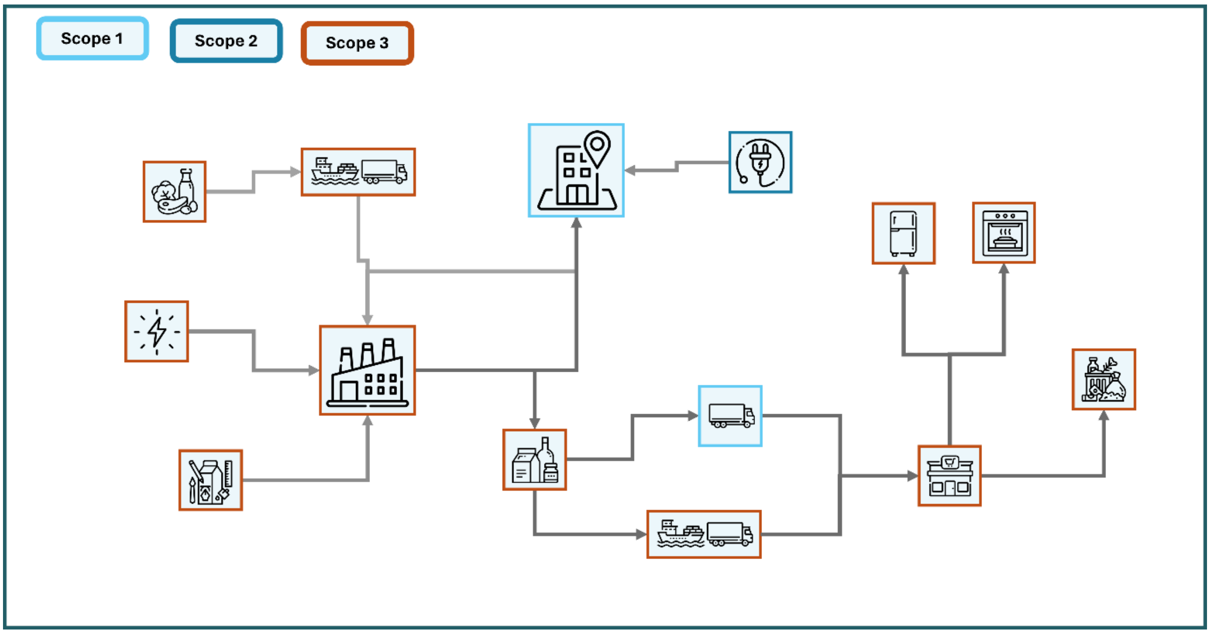

Figure 1. Flow map of scope of calculation with most relevant categories.

There are additional categories in Scope 3 that are relevant to company's activities, but as they do not represent a large proportion of emissions, they are not included in this study. These are:

- Waste from office and warehouse
- Water use in the office and warehouse
- Capital goods
- Travel
- Services

1.4. Carbon footprint for 2021

The company's first report on its carbon balance is published before 2022, when the carbon footprint of the company was estimated for year 2021 and it was **145 tonnes CO_2 eq**. It is important to note that GHG emissions related to organic farming and raw materials transportation are not then taken into account.

This report therefore represents an improvement in GHG emissions reporting and an extension of coverage.

2. Limitations

The activities of Bio Bulgaria and the products it trades are subject to organic farming standards. For this reason the emission factors are quite different from those for conventional manufacturing and are difficult to measure for all Harmonica products. Organic farming is much more environmentally friendly than conventional practices in terms of water use, soil, water and air pollution and does not threaten local biodiversity. The relatively small prevalence of this type of agricultural practice, including livestock, poses difficulties for the calculation of emission factors. Additionally, differences in agricultural practices vary in different geographical areas of the world and this strongly influences the calculation of emission factors.

3. Methodology

The calculation of the carbon footprint is based on three principles:

- **Accurate process and product data**

We first need accurate data on product quantities, energy or fuel consumed, distances travelled, etc.

- **Emission factors**

For each process and/or product, we need to find an emission factor that applies to the type of data we are working with and represents the carbon footprint of a unit of process and/or product. It is expressed in kg or tonne CO_2 eq./unit.

- **Percentage of uncertainty**

This represents a range of "+" or "-", within which it is possible to estimate our calculations, i.e. what we present as the result of the calculations is an average. Various considerations affect the calculation of the uncertainty. Emission factors are in most cases averages associated with the production of a good or service. In order to be fully accurate, it is necessary calculation of all emissions associated with all work processes and raw materials and energy used in the production chain. The choice of emission factors and their formation affects the uncertainty. Additionally, the uncertainty increases according to any assumption we make when we do not have accurate data or emission factors. The three basic principles are applied and described in detail for each of the categories in the chapters below. The final carbon footprint result reflects all of them.

4. Carbon footprint of Bio Bulgaria

The carbon balance of Bio Bulgaria for 2023 amounts to **1,414.03 tons CO_2 eq**. Divided into the three scopes, the GHG emissions look as follows:

Table 1. Carbon footprint of Bio Bulgaria for 2023.

Category	Emissions tons CO_2 eq.	Percentage
Scope 1	68.09	4.80%
Scope 2	6.5	0.5%
Scope 3	1,339.45	94.70%
Total	1,414.03	100%

4.1. Scope 1

The data collected for Scope 1 relates to fuel used in 2023 and is collected through invoices for the amount of fuel paid by company. We also include emissions associated with refrigeration systems and fluorinated greenhouse gases (F-gases: HFCs, PFCs and SF_6). These gases are part of the Kyoto Protocol and can be several thousand times more potent than carbon dioxide.

4.1.1. Data collected

In the table we show the fuel consumed for cars and trucks operated or owned by the company.

Table 2. Fuel consumption for 2023.

Fuel	Consumption, litres
Gasoline	5,296.14
Diesel fuel	23,714.69
Propane-butane, LPG	2,808.32

In 2023 we didn't make any measurements of potential leakage of F-gases from vehicle cooling systems, the office and warehouse. Therefore, we here take the same calculations and leakage assumptions described in the previous Carbon Balance in 2021 report published in 2022.

Table 3. Potential leakages of cooling gases.

Gas	Potential leakage, kg
R410a	0.13
R449	0.24
R134a	0.05
R404a	0.01

4.1.2. Emission factors

For the calculation of emissions related to the use of fuels and F-gases, we used factors from the French database Base empreinte[2], created by the French Environmental Agency for ecological transition ADEME. According to the Protocol's reporting rules, we only need to take emission factors related to the combustion of fuels. This means that factors relating to the extraction, processing and transport of these fuels are not included in the calculations here.

Table 4. Emission factors for fuels and F-gases.

Fuel or gas	Emission factor kg CO_2 eq./l or kg
Gasoline	0.67 kg CO_2 eq./l.
Diesel fuel	2.5 kg CO_2 eq./l.
Propane-butane, LPG	1.6 kg CO_2 eq./l..
R410a	1920 kg CO_2 eq./kg.
R449	1394 kg CO_2 eq./kg.
R134a	1300 kg CO_2 eq./kg.
R404a	3940 kg CO_2 eq./kg.

4.1.3. Results

Taking the amount of fuel used and the potential leakage of gases containing fluorine, we multiply them by the emission factors and obtain the following results:

Table 5. Emissions of fuel consumption and cooling gasses.

Fuel or F-gas	Emissions kg CO_2 eq.
Gasoline	3,551.43
Diesel fuel	59,365.77

Propane-butane, LPG	4,490.22
R410a	241.92
R449	334.56
R134a	65.00
R404a	39.40

Total Scope 1 emissions amount to **68.1 tonnes CO_2 eq**. Its distribution according to the Protocol categories looks like this:

Table 6. Emissions under Scope 1.

Emission categories		Emission sources	CO_2 (kg CO_2 eq.)	CH_4 (kg CO_2 eq.)	N_2O (kg CO_2 eq.)	HFCs (kg CO_2 eq.)	PFCs (kg CO_2 eq.)	SF_6 (kg CO_2 eq.)	Other gases (kg CO_2 eq.)	Total (kg CO_2 eq.)
Scope 1	1-1	Direct emissions from stationary combustion sources								
	1-2	Direct emissions from mobile sources with combustion engine	66,745.03	51.80	610.59	-	-	-	-	**67,407.42**
	1-3	Direct emissions from processes								
	1-4	Direct fugitive emissions	-	-	-	680.88	-	-	-	**680.88**
	Total Scope 1		**66,745.03**	**51.80**	**610.59**	**680.88**	**-**	**-**	**-**	**68,088.30**

4.1.4. Uncertainty

Each of the factors comes with a certain percentage of uncertainty, which defines the limits of + or - relative to our result, where the calculated carbon footprint is likely to vary.

In total for the Scope 1 calculations, we obtained 8.6% percent uncertainty, amounting to 5,873.88 kg CO_2 eq.

4.2. Scope 2

Scope 2 covers emissions related to the amount of electricity used, as well as those related to the energy consumed for heating by fossil fuels. The company uses electricity for its heating needs and therefore we cannot distinguish between the two types of consumption, so they are presented together. The distinction here comes from the consumption in the office and that in the company's warehouse. The energy for the office is supplied by the Bulgarian electricity mix of energy sources. The energy in the warehouse is supplied by a certified green electricity supplier, TOKI. Additionally, in this category we have included the electricity consumed by one electric vehicle - Nissan Leaf.

4.2.1. Data collected

The amount of electricity consumed is extracted from invoices issued during the year to the company.

Table 7. Consumption of energy by consumer.

User	Energy consumption kWh
Office	6,504.00
Warehouse	56,715.00
Electric car	1,271.40

At this time, it is not possible to gather data on the energy consumed by the electric car, but we know how many kilometres it travels on average per week - 30 km. So, for the whole year we have 7,800 kilometres covered. From an electric vehicle database[3] we checked what energy consumption the specific model - 0.163 kWh/km and multiplying this factor by the kilometres travelled, we obtained 1,271.40 kWh.

4.2.2. Emission factors

The emission factors for energy produced by the Bulgarian energy mix are taken from Electricity maps[4], and we decided to use the 2022 factor, which is 0.54 kg CO_2 eq./kWh.

Our decision is based mainly on the fact that Bio Bulgaria uses the services of the company Toki, which issue certificates for energy supplied by renewable sources. Toki's certificates indicate the emissions saved from the energy consumed compared to the usual electricity mix for Bulgaria. From this information and according to our calculations, it is clear that Toki used the 2022 factor and we can assume that the electricity supplied was generated from PV farms.

Also, at the end of 2023, when the calculations began, official emission factor data were not yet available for 2023[5]. In order to be consistent in our clculations, we decided to use the one for 2022 everywhere.

4.2.3. Results

Taking into account all the factors described, we obtained the following results:

Table 8. Emission for energy consumption.

User	Emissions kg CO_2 eq.
Office	3,479.64
Warehouse	2,518.15

Electric car	493.30

Total Scope 2 emissions amount to **6.5 tonnes CO_2 eq**. Its distribution according to the Protocol categories looks like this:

Table 9. Emissions under Scope 2.

Emission categories	Emission sources		CO_2 (kg CO_2 eq.)	CH_4 (kg CO_2 eq.)	N_2O (kg CO_2 eq.)	HFCs (kg CO_2 eq.)	PFCs (kg CO_2 eq.)	SF_6 (kg CO_2 eq.)	Other gases (kg CO_2 eq.)	Total (kg CO_2 eq.)
Scope 2	2-1	Indirect emissions from electricity consumption	6,491.09	-	-	-	-	-	-	6,491.09
	2-2	Indirect emissions from steam, heat or cooling consumption								
		Total Scope 2	6,491.09	-	-	-	-	-	-	6,491.09

4.2.4. Uncertainty

Each of the factors comes with a certain percentage of uncertainty, which defines the limits of plus or minus relative to our result, where the calculated carbon footprint is likely to vary.

In total for the Scope 2 calculations, we obtained 12% percent uncertainty, amounting to 778.22 kg CO_2 eq.

4.3. Scope 3

For the purposes of calculating the relevant categories in Scope 3, we identified data relevant to the specific activities of the company. As noted at the beginning, in section 1.3. Scope of calculation, the main objective here is to identify emissions associated with food production, as this is the most essential part of Bio Bulgaria's business.

Accordingly, the data collected does not fully cover all categories, as the information is not always available or relevant for this study. The following table presents what percentage of available information we have for each category.

Table 10. Percentage of data collected for identified categories in Scope 3.

Category	Data type	Collected data
Raw materials	Kg	100%
Packaging	Kg	100%
Incoming freight of raw materials	kg.km	98,53%
Energy for production	kWh	0%
Outbound freight of products	Kg.km	0%

Energy for product use	kWh	50%
Not-consumed products, waste	Kg	0%
Waste from office and warehouse	L	Out of scope
Water use in the office and warehouse	м³	Out of scope
Capital goods	Unit	Out of scope
Travel	person.km	Out of scope
Services	keuro	Out of scope

Based on the available information, emission factors were selected or formed to calculate the CO_2 eq. emissions associated with the relevant category.

4.3.1. Raw materials

4.3.1.1. Data collected

Here we show all the quantities of raw materials the company has purchased in 2023 to use for their production of its products.

Table 11. Quantities of raw materials.

	Raw material	kg		Raw material	kg
1	Raw organic cow milk	875,961.00	**48**	Organic rice balls with cocoa	521.20
2	Organic sugar	109,875.00	**49**	Organic hazelnut tahini	520.00
3	Organic rye	32,087.00	**50**	Organic elderberry fruit	500.00
4	Organic bell peppers	26,087.00	**51**	Organic millet	475.00
5	Spelt organic flour	24,525.00	**52**	Organic semolina flour from roasted chickpeas	463.00
6	Organic coconut oil	15,460.00	**53**	Sea salt, fine	400.00
7	Organic sunflower	13,675.00	**54**	Himalayan salt fine	400.00
8	Wheat flour Type 550		**55**	Organic white sesame tahini	372.00
9	Organic peanuts	11,250.00	**56**	Organic nettle	220.00
10	Organic powder milk - skimmed		**57**	Organic peanut oil	180.00
11	Organic sesame seeds, peeled	7,675.00	**58**	Oat flakes fine	175.00
12	Organic sunflower tahini	7,232.00	**59**	Organic cow butter	130.00

13	Organic raspberries	7,110.00	60	Bio herbaceous elderberry	120.00
14	Organic cocoa mass	6,400.00	61	Lemon acid	100.00
15	Organic strawberries frozen	4,851.50	62	Organic garlic	72.00
16	Organic sesame unpeeled	4,500.00	63	Organic olive oil	70.00
17	Bio inulin	4,000.00	64	Organic white long rice	50.00
18	Organic black sesame	3,975.00	65	Organic brown lentils	50.00
19	Organic cocoa butter	3,575.00	66	Organic brown long rice	50.00
20	Organic white semolina flour rice	3,356.00	67	Organic mursal tea	50.00
21	Organic tomato puree	2,880.00	68	Organic chia	50.00
22	Organic lemon juice	2,880.00	69	Popcorn	50.00
23	Organic oil sunflower	2,520.00	70	Organic mint	37.50
24	Organic rosehip dried, fruit	2,500.00	71	Organic dried roses	35.00
25	Organic sugar syrup	2,220.00	72	Organic antioxidant from rosemary	30.00
26	Organic coconut fine sawdust	2,125.00	73	Organic cocoa powder	30.00
27	Organic chickpeas	1,950.00	74	Organic white beans	25.00
28	Organic cocoa powder	1,800.00	75	Organic brown rice basmati	25.00
29	Organic herbal honey	1,729.55	76	Organic flaxseed broken	25.00
30	Organic hazelnuts	1,727.00	77	Green peas	25.00
31	Organic sugar Demerara	1,700.00	78	White basmati rice	25.00
32	Organic petmez	1,521.00	79	Fig, pieced	25.00
33	Milk chocolate for glazing	1,404.68	80	Red beans	25.00
34	Organic cherries frozen	1,350.00	81	Pasta from pistachio	24.00
35	Organic cocoa beans	1,055.00	82	Probiotics	21.00
36	White chocolate for glazing	977.19	83	Organic lemon oil	20.00

37	Dark chocolate for glazing	854.07	84	Organic egg yolk powder	20.00
38	Organic onion	831.80	85	Bio lyophilised raspberries	16.00
39	Organic raw almonds	800.00	86	Pistachio	12.00
40	Bio oligofructose	800.00	87	Apple slices	12.00
41	Organic semolina chickpea flour	770.00	88	Organic egg powder	10.00
42	Organic flour, wheat-pea	725.00	89	Organic egg Yolk	10.00
43	Organic buckwheat	700.00	90	Apricot pieces	10.00
44	Cow's ghee	624.70	91	Blue plums pieces	10.00
45	Organic elderflower blossom	622.50	92	Dried white Mulberries	10.00
46	Organic milk powder full fat	550.00	93	Organic vanilla bourbon powder	6.50
47	Organic coconut flour	540.00	94	Organic vanilla extract	6.00

4.3.1.2. Emission factors

Here we describe in detail the selection and/or formation of emission factors for the raw materials for which we found reliable information. For 23 of the 94 raw materials we examined, we found or formed emission factors, and while this number is not large, we were able to cover 93.62% emissions related to the total in kilograms.

Organic raw cow's milk	**0.940 kg CO_2 eq./kg.**

The factor for raw organic milk was selected from the French database Base empreinte. There we found 11 factors for cow's milk, covering milk production on the farm. 6 of those factors are relate to organic production and are classified according to the Agribalise[6] system, which covers not only greenhouse gas emissions but seeks to assess the overall environmental impact of the agricultural and livestock practices.

As we know that the milk for Harmonica's products comes from two farms in Bulgaria where the animals are raised freely grazing most of the year in mountainous areas, we decided to choose the following emission factor - "Organic, number 5, fed mainly grass and natural forage, pasture, France". The factor is calculated only in the range of on-farm production, without taking into account energy used for transport and processing. Additionally, it is created through a detailed study of farms in France and its use directly in the Bulgarian context is not possible with complete certainty. This affects the percentage of uncertainty, which we set to 10%.

Organic sugar	**0.7676 kg CO_2 eq./kg.**

The formation of the emission factor for this raw material is an average of several studies. Fairtrade International[7] have published a report on the calculation and reduction of emissions related to sugar production. Various production practices from farms in different countries around the world are considered, and the scope of the study is not the same everywhere. The countries included are Belize, El Salvador, Costa Rica, Eswatini, Fiji, India, Mauritania. Additional information is taken from an article comparing energy and GHG emissions[8].

The factors we chose to use to calculate the average value, include emissions for transport to Europe. As Harmonica buys raw materials from different producers from different parts of the world, we took an average of the following factors from the two sources cited - Costa Rica, 0.91 kg CO_2 eq./kg and 0.85 kg CO_2 eq./kg; Eswatini, 0.80 kg CO_2 eq./kg; Fiji, 0.84 kg CO_2 eq./kg; Brazil, 0.438 kg CO_2 eq./kg. Since we take an average from different sources, we also decided to apply a higher uncertainty of 30%.

Organic rye	**0.47 kg CO_2 eq./kg.**

The organic rye factor here is taken from the CarbonCloud[9] platform, where we found a specific factor for rye cultivation in Bulgaria. The emission factors in this platform are generated from data submitted at country level to the Food and Agricultural Organisation of the United Nations (FAO) and it is not specified whether production is conventional or organic. However, since the factor is specific to Bulgaria and has a rather large difference compared to the one given in Base empreinte - 0.725 kg CO_2 eq./kg - we decided that it is good enough to be applied in this case. The uncertainty percentage here is again 30%.

Organic bell peppers	**0.07 kg CO_2 eq./kg.**

The CarbonCloud factor is again taken here, as it was made for Bulgaria, but again, the method of production isn't considered. This is why we apply a high uncertainty of 30%.

Spelt Organic flour	**0.71 kg CO_2 eq./kg.**

There is an emission factor for the production of this type of flour in the context of Romania from CarbonCloud of 0.71 kg CO_2 eq./kg. In comparison, the factor for spelt flour in Base empreinte is much higher - 1.16. kg CO_2 eq./kg. The factor includes emissions from growing spelt and from processing it into flour. We decided to take the region-specific factor again and set a high uncertainty of 30%.

Organic sunflower	**0.44 kg CO_2 eq./kg.**

Since we do not have enough information from the producer and about the agricultural practices, we cannot select a specific factor from Base empreinte, where again there are 5 different emission factors for organic production. We therefore calculated an average factor of 0.4396 kg CO_2 eq./kg. This does not include transport related emissions as the factor only shows the carbon footprint at the farm production level. We take a low uncertainty rate because the average value of the emission factor is based on calculations relating only to organic production - 10%.

Organic wheat flour	**0.609 kg CO_2 eq./kg.**

The factor was made from an average of all organic wheat production factors from Base empreinte. There are 24 in total and the average value is 0.417 kg CO_2 eq./kg. According to a report[10] on emissions at different stages in flour production, transport emissions amount to 0.022 kg CO_2 eq./kg. Additionally, the emissions from flour production are 0.170 kg CO_2 eq./kg (average of two types of wheat, hard and soft). The final sum of emissions is then 0.609 kg CO_2 eq./kg. Here we decided to leave the uncertainty rate at 20%, as the calculations are taken from several sources and the data are not country specific.

Organic milk powder, skimmed	**14.6 kg CO_2 eq./kg.**

According to Base empreinte, powder milk, whether it is whole, skimmed or semi-skimmed have the same emission factor of 14.8 kg CO_2 eq./kg, and it is not stated whether this is organic or conventional production. In CarbonCloud, the skimmed milk factor for Belgium and 14.64 kg CO_2 eq./kg, which is almost the same as the French factor. Taking into account the difference between the emission factor for conventional milk production of 1.14 kg CO_2 eq./kg, and the one for organic production, which we chose - 0.940 kg CO_2 eq./kg, we decided to reduce the factor for powder milk to 14.6 kg CO_2 eq./kg to reflect this difference. The uncertainty rate is 30% in this case as we are uncertain about the exact emissions in dry milk production.

On the other hand, the article[11] presents a study on dry milk in Ireland, which is focused on the whole life cycle assessment of milk production. One of the factors calculated is that of global warming potential. For semi-skimmed milk powder, the factor amounts to 1.52 kg CO_2 eq./kg and includes raw milk transport, processing and Packing. We can add this factor to the chosen 0.940 for organic milk production and we get - 2.46 kg CO_2 eq./kg, a number quite different from Base empreinte and CarbonCloud. Nonetheless, we decided to use the factor based in Base empreinte, and because of all our assumptions, we use a high uncertainty rate of 30%.

Organic sesame peeled	**1.190 kg CO_2 eq./kg.**

We did not find an emission factor for organic production, but there is one related to the specific country of origin specific emission factor for 2023 - Pakistan. The factor is 1.190 kg CO_2 eq./kg and is taken from CarbonCloud. In comparison, the global average according to the same platform is 2.21 kg CO_2 eq./kg, while Base empreinte reports a factor of 5.21 kg CO_2 eq./kg. We decided to apply the factor from Pakistan and determine a high degree of uncertainty of 40%, since it is not clear how the factor relates to the organic production but is much lower than the average presented in Base empreinte.

We note here that over the period 2017-2022 production has increased from 35,163 tonnes to 152,341 tonnes, most likely due to an increase in conventional production and organic has not developed at a similar rate. This has some influence on the factor, but we cannot estimate it with certainty.

Organic sunflower tahini	**2.94 kg CO_2 eq./kg.**

CarbonCloud has a factor for unsalted organic sesame seed tahini of 2.94 kg CO_2 eq./kg, and this is a factor for in-store product. It is used here, but with a high uncertainty of 30%.

Organic raspberries	**0.30 kg CO_2 eq./kg.**

We found several options for the emission factor here. One is from Base empreinte and is equal to 1.47 kg CO_2 eq./kg, but refers to raspberries, which are conventionally grown. The CarbonCloud has a factor for organic raspberries 2.02 kg CO_2 eq./kg, but it refers to the final product in the store, where emissions associated with transport, packaging, storage in the US are also taken. There is also an emission factor for raspberries produced in Bulgaria - 0.30 kg CO_2 eq./kg, which we have considered and applied, but with 30% uncertainty.

Organic frozen strawberries	**0.190 kg CO_2 eq./kg.**

CarbonCloud has an emission factor for strawberries that is specific to Bulgaria - 0.11 kg CO_2 eq./kg. Again, the factor does not distinguish conventional from organic farming, but we found a big difference when we compare it with the factor in Base empreinte, 0.177 kg CO_2 eq./kg, referring to conventional agriculture. These factors refer to agricultural production and do not include emissions related to transport and processing. We found in CarbonCloud a factor for frozen fruit of 0.19 kg CO_2 eq./kg and decided that this factor relates most closely to the one sought by us, and again we decided to apply a high uncertainty rate of 30%.

Organic sesame, unpeeled	**2.04 kg CO_2 eq./kg.**

The factor is taken from CarbonCloud and refers to the country of production - Uganda and is 2.04 kg CO_2 eq./kg. Again, no factor for specific organic production was found, so we determined a high degree of uncertainty - 40%.

Bio inulin	**2.64 кг CO_2 екв./кг**

According to CarbonCloud, the factor for inulin is 2.64 kg CO_2 eq./kg, but it is not specific to organic production. No factor is given in Base empreinte, so we will use 2.64 kg CO_2 eq./kg, with an uncertainty of 40%.

Organic black sesame	**1.67 kg CO_2 eq./kg.**

For this raw material, an emission factor was taken from CarbonCloud, which is specific for Bolivia - 1.67 kg CO_2 eq./kg. Again, there is no data for organic production, but the factor differs from previous ones. The uncertainty is increased to 40%.

Organic tomato puree	**0.775 kg CO_2 eq./kg.**

Base empreinte and CarbonCloud have different factors for tomato puree, 0.902 kg CO_2 eq./kg and 0.61 kg CO_2 eq./kg, respectively, but no difference is indicated in either of them for organic or conventional production.

We found a scientific paper[12] stating that the carbon footprint of packaged, pressed, organically grown tomatoes in a 400g pack is 0.31 kg CO_2 eq. To convert this footprint to one for 1 kg of product, we multiplied by 2.5 to get 0.775 kg CO_2 eq./kg. The emission factor includes emissions related to tomato cultivation, processing, packaging and transport. The focus is the production in Italy of products that are consumed in Sweden. In this case, we decided to leave a low uncertainty of 10% as the origin of the tomato puree is also from Italy in the case of Bio Bulgaria.

Dark chocolate for glazing	**17.1 kg CO_2 eq./kg.**

The factor is taken from Base empreinte where it is 17.1 kg CO_2 eq. /kg for dark chocolate with a minimum of 70% cocoa. We determined a low percentage of uncertainty of 10%.

Cow's ghee	**14.85 kg CO_2 eq./kg.**

In CarboCloud there is a ghee factor which is 14.85 kg CO_2 eq./kg and refers to a product in Sweden. Since the country of origin for this raw material is Germany, we assume that the factor is sufficiently accurate. The uncertainty of the calculation here would be 10%.

Sea salt / Himalayan salt	**0.06 kg CO_2 eq./kg.**

Factors that distinguish the two types of salt have not been found. CarbonCloud has a factor equal to 0.06 kg CO_2 eq./kg, which is confirmed by the following scientific paper[13]. As we cannot be sure at this stage about the difference in the extraction of the two types of salt, we decided to determine the high uncertainty rate of 30%.

Organic peanut butter	**2.18 kg CO_2 eq./kg.**

The factor is taken from CarbonCloud - 2.18 kg CO_2 eq./kg and refers to organic peanut butter sold in the USA. The percentage of the uncertainty here is 30%, as the factor taken for refers to the ready market product in the US, the raw material here comes from China.

Pistachio paste	**3.07 kg CO_2 eq./kg.**

The emission factor is taken from a scientific study[14]. There, 3.07 kg CO_2 eq./kg was calculated for a cream made from almonds. A similar factor was not calculated for pistachios, but since the emission factors for growing raw almonds and pistachios (1.92 kg CO_2 eq./kg and 1.74 kg CO_2 eq./kg) are similar, we assume that the factor can be applied. We will increase uncertainty of 30% to reflect these assumptions.

Pistachio	**2.45 kg CO_2 eq./kg.**

The factor per kg of pistachio chosen here is again taken from CarbonCloud and is 2.45 kg CO_2 eq./kg. Different factors have been reported in different scientific papers - 2.33 kg CO_2 eq./kg[15], 2.119 kg CO_2 eq./kg[16], 2.53 kg CO_2 eq./kg[17]. Since the different factors are close to each other, we decided to put a low uncertainty of 10%.

4.3.1.3. Results

The total emissions from raw materials, that we were able to calculate are **1,202,315.64 kg CO_2 eq.**

Table 12. Emissions for different raw materials

Raw material	Emissions kg CO_2 eq.
Organic raw cow's milk	823,403.34
Organic sugar	84,340.05
Organic rye	15,080.89
Organic bell peppers	1,826.09
Spelt Organic flour	17,412.75
Organic sunflower	6,011.53
Organic wheat flour	7,155.75
Organic milk powder, skimmed	160,600.00

Organic sesame peeled	9,133.25
Organic sunflower tahini	21,262.08
Organic raspberries	2,133.00
Organic frozen strawberries	921.79
Organic sesame unpeeled	9,180.00
Organic inulin	10,560.00
Organic black sesame	6,638.25
Organic tomato puree	2,232.00
Dark chocolate for glazing	14,604.60
Cow's ghee	9,276.80
Sea salt, fine	24.00
Himalayan salt, fine	24.00
Organic peanut butter	392.40
Pistachio paste	73.68
Pistachio	29.40

4.3.1.4. Uncertainty

The uncertainty in emissions is 8.3%, amounting to 99,437.70 kg CO_2 eq.

4.3.2. Packaging

In this section we present the calculations made for the packaging materials that Bio Bulgaria uses in the production of the products put on the market.

4.3.2.1. Data collected

The quantities of packaging materials placed on the market are as follows:

Table 13. Quantities and type of packaging materials used.

Type of packaging	Quantities, kg
Glass, colourless	39,268.40
Plastic, PP	8,120.27
Paper	1,315.67
Aluminium	1,089.96

4.3.2.2. Emission factors

The emission factors for all packaging materials are taken from Base empreinte database and are the following:

Table 14. Emission factors for the packaging materials.

Type of packaging	Emission factor kg CO_2 eq./kg
Glass, colourless	0.810
Plastic, PP	1.88
Paper	0.39
Aluminium	3.22

4.3.2.3. Results

The emissions related to the use of packaging materials are **51,096.28 kg CO_2 eq.**

Table 15. Emissions per type of packaging material.

Type of packaging	Emissions kg CO_2 eq.
Glass, colourless	31,807.41
Plastic, PP	15,266.11
Paper	513.11
Aluminium	3,509.66

4.3.2.4. Uncertainty

The emissions related to our uncertainty calculation are 13.9% and amount to 7,091.82 kg CO_2 eq.

4.3.3. Incoming freight of raw materials

4.3.3.1. Assumptions

Based on data provided on the origin of raw materials, we have estimated with a high uncertainty the emissions associated with the transport of raw materials.

We created several categories to standardize the calculations, as we do not have exact data on distances travelled, but we have countries of origin. Also, in some of the emission factors for the production of the raw materials are taken into consideration transport-related emissions. Therefore, most of the emission factors that include transport emissions refer to deliveries in Europe. Thus, in order to avoid double accounting, we only calculate distance within Europe.

For products that are produced in Bulgaria, we put a distance of 200 km from the farms to the place of production. For milk only, we put 160 km because we have information on the exact location of the farms. For products that are delivered first to Europe from various countries around the world and then transported to Bulgaria, we decided to put a distance of 1 000 km on all. This is necessary as we cannot determine the exact starting point of transport to Bulgaria so far. Finally, for products coming from Greece we set a distance of 500 km. We need these decisions because the emission factors for incoming freight require data related to the quantity transported and the distance travelled.

4.3.3.2. Emission factor

For the calculations in this category we used the following factor - 0.06085 kg CO_2 eq./ton.km

4.3.3.3. Results

Total transport-related emissions are **18,778.30 kg CO_2 eq**. Again, these emissions do not cover all raw materials, but we were able to make calculations for 92.05% of emissions of all transported raw materials.

Table 16. Emissions related to transport of raw materials.

Raw material	Emissions kg CO_2 eq.
Organic raw cow's milk	8,528.36
Organic sugar	6,685.89
Organic rye	390.50
Organic bell peppers	793.70
Spelt Organic flour	298.47
Organic sunflower	166.42
Organic wheat flour	714.99
Organic milk powder, skimmed	669.35
Organic sesame, peeled	88.01
Organic raspberries	86.53
Organic frozen strawberries	59.04
Organic tomato puree	175.25
Dark chocolate for glazing	51.97
Cow's ghee	38.01
Organic hazelnut tahini	6.33
Organic elderberry fruit	6.09
Sea salt, fine	12.17
Organic nettle	2.68
Bio herbaceous elderberry	1.46
Organic mursal tea	1.52
Organic mint	1.14
Organic dried roses	0.43

4.3.3.4. Uncertainty

The uncertainty of these calculations is high – 40.7%, because we are not working with exact data, but with many assumptions. The result is 7,647.20 kg CO_2 eq.

4.3.4. Energy for production

This category includes the amount of energy consumed during the production of the products that Bio Bulgaria sells under the Harmonica brand. As the products are diverse and are produced in different ways and in different places, this category is too complex to calculate at this stage.

The first step that Bio Bulgaria can take is to contact a producer to whom it sends raw materials and outsources the production of a product. This producer could calculate how much energy is used for the amount of energy needed for Bio Bulgaria products, knowing how much energy it used throughout the year, the amount of products it produced in total and the amount of products made only for the company. In this way we will have accurate data on the energy consumed.

4.3.5. Outbound freight of products

This category is calculated with two types of data similarly to the incoming freight. First, we need to know the quantity in tonnes of products that are exported and then the kilometres that they travel. Here we can also collect data on units per product as well as final destination and with that calculate it will be possible to find out the distance.

The second type of data required relates to what type of transport is being used to move the cargo - whether it is trucks, trains, planes or ships. This is relevant as each of the transport modes listed has different emission factors. Additionally, they differ by the size of the vehicle and the presence or absence of cooling chambers.

At this time, it is not possible to calculate these emissions, but we recognize this category as highly relevant to the company's overall footprint.

4.3.6. Energy for product use

In this section, we calculate emissions related to the storage and/or cooking of some of Bio Bulgaria's products. We have covered the most sold products and we achieved about 90% of the emission calculations in this category.

4.3.6.1. Assumptions

Since Bio Bulgaria products are food products, they can be stored under a variety of conditions and consumed by a variety of end users. Therefore, the calculation of emissions in this category is based on several key assumptions:

- For products that need to be stored in a refrigerator, we use an average value for the energy consumption of a family refrigerator - 4.3 kWh[18] which has volume of 0.566337 м³ [19].

- For products with a short shelf-life, such as fresh milk, yoghurt, cottage cheese, kefir, ayran - we assume that they are consumed within 80% of their shelf life. This means that fresh milk with a shelf life up to 5 days, will be refrigerated on average up to 4 days. The same logic applies to other short-lived products.

- For products with a long shelf life - cheese and yellow cheese - we use a 5-month period. This decision was taken after many discussions.

- The energy to run a refrigerator is not affected by how many products are stored. However, we do not consider it appropriate to attribute to one product the emissions associated with all the energy consumed by the refrigerator for a certain number of days. Therefore, we have calculated what proportion each product will take in the refrigerator, based on the volume of an average family refrigerator and the volume of one Harmonica product. Also, we assume that the refrigerator is always ¾ full as this is the recommended fullness in terms of efficient energy consumption.

- To calculate the emissions associated with electricity use, we use an emission factor for the Bulgarian electricity mix of energy sources for 2022 of 0.54, choosing the same factor for electricity as the one applied in our Scope 2 calculations.

4.3.6.2. Emission factors

Here we present the emission factors for energy consumption for use of one unit of product, calculated following the assumptions described above.

Organic fresh milk	**0.021765133 kg CO_2 eq. / unit of product**

The shelf life of fresh milk is 5 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **17.28 kWh** = 4.32*(5*0.8).

The volume of 1l fresh milk is 0.001. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.002354** = 0.001/ (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the fresh milk, we multiplied the energy in kWh used for storage of the product, by its volume: **0.04 kWh** = 0.002354 * 17.28. We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.021765133 kg CO_2 eq. / unit product** = 0.04 * 0.54

Organic yogurt, cow milk 3.6%	**0.026118159 kg CO_2 eq. / unit of product**

The shelf life of organic yogurt with fat content of 3.6% is 15 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **51.84 kWh** = 4.32*(15*0.8).

The volume of yogurt is 0.0004. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000942** = 0.0004 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the yogurt, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.05 kWh** = 0.000942 * 51.84**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.026118159 kg CO_2 eq. / unit product =** 0.05 * 0.54.

Organic yogurt, cow milk 2%	**0.026118159 kg CO_2 eq. / unit of product**

The shelf life of organic yogurt with fat content of 2% is 15 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **51.84 kWh** = 4.32*(15*0.8).

The volume of yogurt is 0.0004. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000942** = 0.0004 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the yogurt, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.05 kWh** = 0.000942 * 51.84**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.026118159 kg CO_2 eq. / unit product =** 0.05 * 0.54.

Organic yogurt, full fat	**0.026118159 kg CO_2 eq. / unit of product**

The shelf life of organic yogurt with full fat content is 15 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **51.84 kWh** = 4.32*(15*0.8).

The volume of yogurt is 0.0004. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000942** = 0.0004 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the yogurt, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.05 kWh** = 0.000942 * 51.84**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.026118159 kg CO_2 eq. / unit product =** 0.05 * 0.54.

Organic white cheese from cow milk	**0.314234104 kg CO_2 eq. / unit of product**

The shelf-life of organic cheese is 240 days, but according to our assumption here we calculate with shorter shelf-life period – 150 days. According to the rest of the assumptions, the energy needed for its storage is **648.00 kWh** = 4.32*150.

The volume of the cheese is 0.000385. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000906** = 0.000385 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the cheese, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.59 kWh =** 0.000906 * 648.00**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.314234104 kg CO_2 eq. / unit of product =** 0.59 * 0.54.

Organic goat white cheese 200 g	**0.12406126 kg CO_2 eq. / unit of product**

The shelf life of organic white goat cheese 150 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **518.40 kWh** = 4.32*(150*0.8).

The volume of the cheese is 0.00019. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000447** = 0.00019 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the cheese, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.23 kWh =** 0.000447 * 518.40**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.12406126 kg CO_2 eq. / unit of product** = 0.23 * 0.54.

Organic cow yellow cheese 300 g.	**0.23343105 kg CO_2 eq. / unit of product**

The shelf-life of organic yellow cheese is 240 days, but according to our assumption here we calculate with shorter shelf-life period – 150 days. According to the rest of the assumptions, the energy needed for its storage is **648.00 kWh** = 4.32*150

The volume of the yellow cheese is 0.000286. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000673** = 0.000286 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the yellow cheese, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.44 kWh =** 0.000673 * 648.00**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.23343105 kg CO_2 eq. / unit of product =** 0.44 * 0.54.

Organic goat yellow cheese 200 g.	**0.12406126 kg CO_2 eq. / unit of product**

The shelf life of organic yellow goat cheese is 150 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **518.40 kWh** = 4.32*(150*0.8).

The volume is 0.00019. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000447** = 0.00019/(0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the yellow cheese, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.23 kWh =** 0.000447 * 518.40**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.12406126 kg CO_2 eq. / unit of product =** 0.23 * 0.54.

Organic cow's milk curd 500 g	0.03146368 kg CO_2 eq. / unit of product

The shelf life of organic curd from cow milk is 13 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **44.93 kWh** = 4.32*(13*0.8).

The volume of the curd is 0.000556. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.001309** = 0.000556 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the curd, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.06 kWh** = 0.001309 * 44.93**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.03146368 kg CO_2 eq. / unit of product** = 0.06 * 0.54.

Organic cream cheese 125 g	0.01815212 kg CO_2 eq. / unit of product

The shelf life of organic cream cheese is 30 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **103.68 kWh** = 4.32*(30*0.8).

The volume of the cream cheese is 0.000139. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000327** = 0.000139 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the cream cheese, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.03 kWh** = 0.000327 * 103.68. We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.01815212 kg CO_2 eq. / unit of product =** 0.03 * 0.54.

Organic ayran 500 ml	0.02829467 kg CO_2 eq. / unit of product

The shelf life of organic ayran is 13 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **44.93 kWh** = 4.32*(13*0.8).

The volume of the ayran is 0.0005. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.001177** = 0.0005 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the ayran, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.05 kWh =** 0.001177 * 44.93**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.02829467 kg CO_2 eq. / unit of product** = 0.05 * 0.54.

Organic kefir 500 ml	**0.02829467 kg CO_2 eq. / unit of product**

The shelf life of organic kefir is 13 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **44.93 kWh** = 4.32*(13*0.8).

The volume of the kefir is 0.0005. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.001177** = 0.0005 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the kefir, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.05 kWh =** 0.001177 * 44.93**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.02829467 kg CO_2 eq. / unit of product** = 0.05 * 0.54.

Organic cow butter 200 g.	**0.00357558 kg CO_2 eq. / unit of product**

The shelf life of organic butter is 37 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **127.87 kWh** = 4.32*(37*0.8).

The volume of the butter is 0.0000222. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000052** = 0.0000222 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the butter, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.01 kWh =** 0.000052 * 127.87**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.00357558 kg CO_2 eq. / unit of product =** 0.01 * 0.54.

Organic sour cream 12% 200 g.	**0.01194035 kg CO_2 eq. / unit of product**

The shelf life of organic sour cream is 13 days. According to the energy arguments of the refrigerator, the energy needed for its storage is **44.93 kWh** = 4.32*(13*0.8).

The volume of the cream is 0.000211. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000497** = 0.000211/(0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the sour cream, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.02 kWh** = 0.000497 * 44.93**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.01194035 kg CO_2 eq. / unit of product** = 0.02* 0.54.

Organic cow ghee 215 g.	**0.17655 kg CO_2 eq. / unit of product**

This product does not need to be kept in the refrigerator, but it needs to be cooked, but it needs to be cooked. Thus, based on our research, it takes about 10 minutes to heat cooking oil or ghee on a stove that on average uses 2kWh energy. Therefore, 10 minutes is equal to 16.67% of one hour and the energy of one stove will be **0.33 kWh** = 0.1667*2.

In order to find the emissions associated with the energy consumption for cooking, we had to do another calculation and multiply the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and we got the emission factor per unit of product: **0.17655 kg CO_2 eq. / unit of product =** 0.33 * 0.54.

Organic coconut oil 240 ml	**0.3830467 kg CO_2 eq. / unit of product**

The shelf-life of organic coconut oil is 240 days, but according to our assumption here we calculate with shorter shelf-life period – 150 days. According to the rest of the assumptions, the energy needed for its storage is **648.00 kWh** = 4.32*150.

The volume of the coconut oil is 0.000253. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000596** = 0.000253 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

Similarly to the ghee, the coconut oil needs to the cooked. Using the same logic we calculated 0.33 kWh needed for cooking.

To get the proportional energy that relates only to the butter, we multiplied the energy in kWh used for the storage of the product, by its volume and added the energy needed for cooking&: **0.72 kWh =** 0.000596 * 648.00 + 0.33**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.3830467 kg CO_2 eq. / unit of product** = 0.72 * 0.54.

Organic boza from rye 250 ml	**0.00544128 kg CO_2 eq. / unit of product**

The shelf-life of organic boza is 5 days According to the energy arguments of the refrigerator, the energy needed for its storage is **17.28 kWh** = 4.32*(5*0.8).

The volume of the boza is 0.00025. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.000589** = 0.00025 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the boza, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.01 kWh =** 0.000589 * 17.28**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.00544128 kg CO_2 eq. / unit of product** = 0.01 * 0.54.

Organic boza from rye 500 ml	**0.01088257 kg CO_2 eq. / unit of product**

The shelf-life of organic boza is 5 days According to the energy arguments of the refrigerator, the energy needed for its storage is **17.28 kWh** = 4.32*(5*0.8).

The volume of the boza is 0.0005. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.001177** = 0.0005 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the boza, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.02 kWh =** 0.001177 * 17.28**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: 0**.01088257 kg CO_2 eq. / unit of product** = 0.02 * 0.54.

Organic boza from rye 1 l	**0.02176513 kg CO_2 eq. / unit of product**

The shelf-life of organic boza is 5 days According to the energy arguments of the refrigerator, the energy needed for its storage is **17.28 kWh** = 4.32*(5*0.8).

The volume of the boza is 0.001. Thus, we divided its volume by ¾ of the volume of the refrigerator and got **0.0002354** = 0.001 / (0.566337*0.75), which is the percentage of space occupied by one unit of product.

To get the proportional energy that relates only to the boza, we multiplied the energy in kWh used for the storage of the product, by its volume: **0.04 kWh =** 0.0002354 * 17.28**.** We then did another calculation to find the emissions associated with this energy consumption. We multiplied the resulting kWh by the emission factor for electricity from the Bulgarian electricity mix and obtained the emission factor per unit of product: **0.02176513 kg CO_2 eq. / unit of product** = 0.04 * 0.54.

4.3.6.3. Results

Total emissions in this category are **67,255.51 kg CO_2 eq.**

Table 17. Emissions for each type of product.

Product	Emissions kg CO_2 eq.
Organic fresh milk	1,854.00
Organic yogurt, cow milk 3.6%	15,910.92
Organic yogurt, cow milk 2%	4,239.63
Organic yogurt, cow milk full fat	2,352.02
Organic white cheese from cow milk	20,770.43
Organic goat white cheese 200 g	679.05
Organic cow yellow cheese 300 g	8,728.10
Organic goat yellow cheese 200 g	132.62
Organic cow's milk curd 500 g	285.01
Organic cream cheese 125 g	693.92
Organic ayran 500 ml	897.67
Organic kefir 500 ml	1,400.73
Organic cow butter 200 g	144.82
Organic sour cream 12% 200 g.	199.32
Organic cow ghee 215 g	428.05
Organic coconut oil 240 ml	3,777.60
Organic boza from rye 250 ml	208.61
Organic boza from rye 500 ml	2,722.85
Organic boza from rye 1l	1,830.14

4.3.6.4. Uncertainty

Since we again made suggestions and worked with averaged data, we have here a 21.25% uncertainty in the calculations, which equates to 14,290.05 kg CO_2 eq.

4.3.7. Not-consumed products, waste

For this category, information on the quantity of products that have not been purchased by final customers and that have expired must additionally be collected. How this waste is treated is important to select the right factor, as organic waste can be treated in different ways.

Another type of waste that could be included in the calculations is the waste accumulated in the office and warehouse of Bio Bulgaria. With regular monitoring of the quantities, it is easy to calculate the emissions and report them afterwards. The waste in the office is separated, and therefore treated differently, rather than landfilled and the associated emission factors are also specific. Recycling of waste and composting of organic waste can be counted as emissions saved and therefore is also important to monitor.

4.3.8. Water use in the office and the warehouse

This category can also be calculated easily with data from the invoices the company received every month for water consumption.

4.3.9. Capital goods

Data on this category have already been collected during a previous calculation and could again easily be added. Here, we consider data related to the buildings owned or used by the company, the vehicles in use, and any kind of equipment are needed - computers, printers, furniture. According to the Protocol rules, emissions in this category are reported only if the capital goods are purchased in the reporting year. Also, no amortisation period is taken into account and emissions are taken as a whole.

4.3.10. Business travels

This category is also beyond the scope of the current study due to the fact that emissions here do not represent a significant portion of the company's overall footprint.

Here we collect information about all the business trips our employees have taken during the year. Emission factors vary according to the mode of travel and duration.

This category also includes data on the daily commute of the company's employees.

4.3.11. Services

This category includes all services for which the company has paid during the year. The data collected may relate, for example, to the use of hotels, catering, restaurants during business trips. Additionally, this category can include services needed for the maintenance or use of a database server, emails, website, but also those related to marketing, social activities, education, administrative activities.

4.3.12. Results from Scope 3

The total emissions in Scope 3 are **1,339.5 tons CO_2 eq**. In the table bellow, we can see how they are divided according to the categories of Scope 3 emission in the Protocol.

The uncertainty here is 8%, 107,755.38 kg CO_2 eq.

Table 18. Emissions in Scope 3, by categories according to the Protocol.

Emission categories		Emission sources	CO_2 (kg CO_2 eq.)	CH_4 (kg CO_2 eq.)	N_2O (kg CO_2 eq.)	HFCs (kg CO_2 eq.)	PFCs (kg CO_2 eq.)	SF_6 (kg CO_2 eq.)	Other gases (kg CO_2 eq.)	**Total (kg CO_2 eq.)**
Scope 3	3-1	Purchased goods or	(Ctrl) 3,411.92	-	-	-	-	-	-	1,253,411.92
	3-2	Capital goods	-	-	-	-	-	-	-	-
	3-3	fuels and energy (not included in scope 1 and	-	-	-	-	-	-	-	-
	3-4	Upstream freight and	18,778.30	-	-	-	-	-	-	18,778.30
	3-5	Waste generated	-	-	-	-	-	-	-	-
	3-6	Business travels	-	-	-	-	-	-	-	-
	3-7	Employees commuting	-	-	-	-	-	-	-	-
	3-8	Upstream leased assets	-	-	-	-	-	-	-	-
		Other indirect emissions	-	-	-	-	-	-	-	-
	3-9	Dowstream freight and	-	-	-	-	-	-	-	-
	3-10	Transformation des	-	-	-	-	-	-	-	-
	3-11	Use of sold products	67,255.51	-	-	-	-	-	-	67,255.51
	3-12	End-of-life of sold products	-	-	-	-	-	-	-	-
	3-13	Downstream leased	-	-	-	-	-	-	-	-
	3-14	Franchises	-	-	-	-	-	-	-	-
	3-15	Investments	-	-	-	-	-	-	-	-
		Total Scope 3	1,339,445.74	-	-	-	-	-	-	**1,339,445.74**

5. Summary

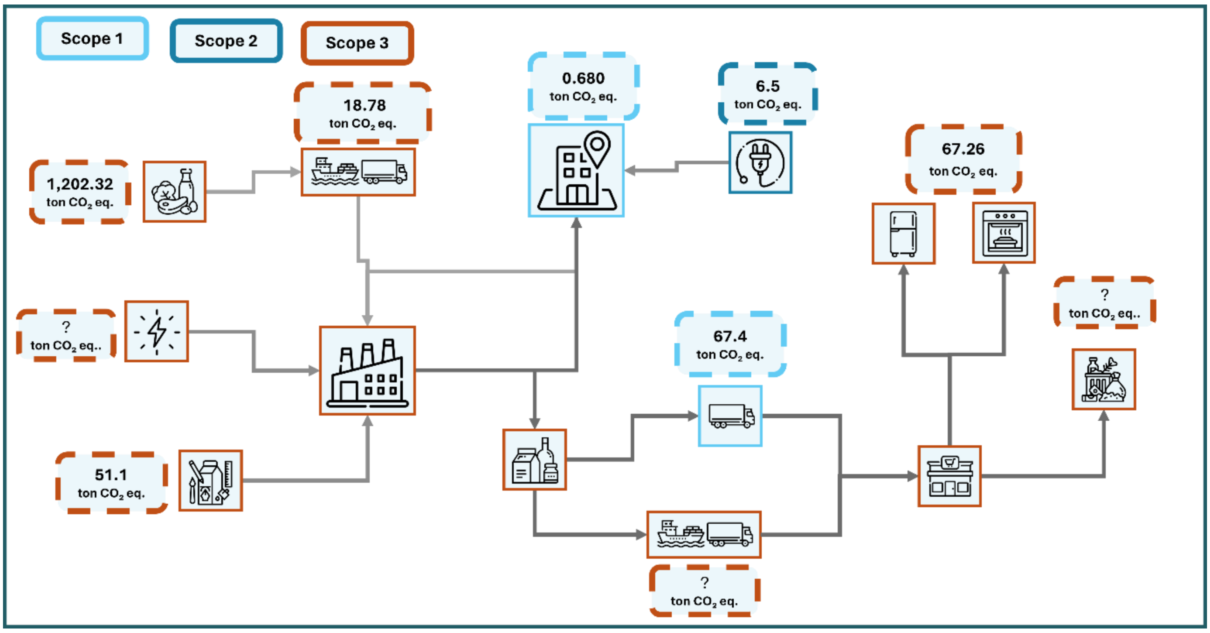

Figure 2. Flow map of emissions from relevant categories.

In addition to Scopes 1 and 2, which we calculated, we identified a total of seven categories in Scope 3 that have the greatest effect on the company's carbon footprint. These mainly relate to the production, transport and use of Harmonica's products. Because the data required for the categories are diverse and requires the involvement of multiple stakeholders, it was not possible to calculate them in their entirety. However, we believe that we have been able to estimate about 90% of the associated emissions.

The calculation of emissions associated with organic production of agricultural and animal products is quite labour-intensive. The reasons for this are due to the lack of emission studies for this topic and the few emission factors available. Additionally, the benefits that these practices have for the environment and biodiversity are not always reflected in the emission factors for the carbon footprint. Often emissions, related to conventional and organic production are similar. To verify this in the case of Harmonica, we decided to compare the calculated emissions for organic raw materials with those produced conventionally.

The results we obtained show that the GHG emissions of the raw materials chosen by Bio Bulgaria are 17.88% lower than those of the same raw materials produced conventionally. It is important to note that we have had cases where we have selected emission factors for Bio Bulgaria's raw materials that are associated with conventional production but are regionally specific. For these commodities, we then chose the average factors presented in Base empreinte or CarbonCloud.

Table 19. Comparison between emission from raw materials from Harmonica and conventionally produced.

Raw materials	Emissions tons CO_2 eq.
Raw materials, Harmonica	1,202.32
Raw materials, conventional	1,464.1
Calculated reduction	17.88%

6. Actions for reduction of the carbon footprint

Reducing a company's carbon footprint requires continuous and comprehensive action in all areas affecting its operations. The following actions have been identified and can have a major impact on the carbon balance.

- Choice of supplier
- Product solutions
- Cleaner means of transport
- Intelligent route planning
- Choice of raw materials

- Packaging materials
- Trainings for the employees
- Marketing and communications
- Cooperation with customers and suppliers
- Support for climate initiatives

At Harmonica, we understand that each of us has a role to play in the fight against climate change. With these measures, we aim not only to reduce our carbon footprint, but also to set an example of responsible and sustainable business behaviour, because we believe that together we can make a significant difference and the time to act is now.

7. References

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[1] You can read more about the Protocol and its principals, here
[2] The database with emission factors can be accessed freely here
[3] Electric vehicles, https://ev-database.org/car/1019/Nissan-Leaf-24-kWh
[4] A website showing dynamically the production and consumption of electricity in different countries, with the carbon footprint of each calculated based on the different modes of production. . https://app.electricitymaps.com/zone/BG?lang=en
[5] The factor for 2023 is 0.388 kg CO_2 eq./kWh. This is a clear indication of the rapidly growing electricity generation industry in Bulgaria.
[6] Collaborative project, which provides a database and methodology for assessment of ecological and organic practices, https://doc.agribalyse.fr/documentation-en.
[7] The report can be read here.
[8] Seabra, J. & Macedo Isias, Energy balance and GHG emissions in the production of organic sugar and ethanol in Sao Francisco Sugar Mill, https://www.researchgate.net/publication/237671973_Energy_balance_and_GHG_emissions_in_the_production_of_organic_sugar_and_ethanol_at_Sao_Francisco_Sugar_Mill.
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