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LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk

Addendum to the report "LCA of Oatly Barista and comparison with cow's milk", published on 7 December 2022

Blonk CONSULTANTS

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Executive summary

Introduction

A Life Cycle Assessment (LCA) has been performed to compare the environmental performance of Oatly Barista to cow's milk in five sales markets in Europe: Denmark, Norway, Belgium, Italy, and Spain. This study is an addendum to the report "LCA of Oatly Barista and comparison with cow's milk", which was published by Blonk Consultants on December 7th 2022 (Blonk Consultants, 2022) and covered Germany, the Netherlands, the United Kingdom, Sweden, Finland, and the United States. This addendum should be read in conjunction with the main report. The methodology, data choices, and assumptions made, are described in detail in the main report, and have remained unchanged for this report, except for an update of energy and water use in the Oatly factories.

The functional unit considered for this study is 1 liter of Oatly Barista/cow's milk at retail, including packaging manufacturing and packaging end of life. Both the ambient and chilled version were modelled for Oatly Barista for all markets, except for the Norwegian market, where only the ambient version was assessed. For cow's milk, a country-specific average market mix of skimmed, semi-skimmed, and whole milk was considered, as well as the most common heat treatment type (HTST or UHT) and packaging format (beverage carton, aseptic/chilled) in each country. The foreground data for Oatly Barista is based on company-specific data from Oatly and refers to production from Oatly's End-to-End (E2E) factory in Landskrona, Sweden, and Oatly's hybrid factory in Vlissingen, the Netherlands[1]. In this addendum, updated data (from 2022) has been used for the factories. For the cow's milk from Denmark, Belgium, Italy, and Spain, datasets from Agri-footprint 6.3 were used, which have been reviewed by the European Dairy Association. Norwegian cow's milk has been derived from a previous critically-reviewed LCA study performed for Oatly (Blonk Consultants, 2024), and was modelled using the same methodology as the cow's milk available in Agri-footprint.

Like the main report, this study has been performed and critically reviewed according to ISO 14040/14044/14071 standards for comparative assertions to be disclosed to the public and is in line with LCA guidelines including the European Product Environmental Footprint Category Rules (PEFCR). The analysis was done for key impact categories from the ReCiPe 2016 impact assessment method (including an uncharacterised land occupation indicator). The study was conducted between March and June 2024.

Results

Ambient Oatly Barista

As can be seen in Table 1 below, the ambient Oatly Barista for the five markets in scope has a lower impact than cow's milk for climate change (48% to 76% lower), fine particulate matter formation (50% to 92% lower), terrestrial acidification (61% to 84% lower), freshwater eutrophication (44% to 73% lower), marine eutrophication (41% to 78% lower), and water consumption (51% to 88% lower). For the Danish market, Oatly Barista has a comparable land use (1% higher) and land occupation (6% lower) impact, which is related to the relatively high milk yield yet relatively low feed intake of Danish dairy cows. For the remaining countries, Oatly Barista has a lower impact than cow's milk for land use (35%-72% lower) and land occupation (42%-72%). For mineral resource scarcity, Oatly Barista has a comparable impact (9% lower) in Norway and Belgium and 83% higher impact in Denmark. This is attributable to a combination of factors (aluminium use in ambient packaging of Oatly Barista as opposed to chilled beverage carton used for cow's milk in Denmark and Norway; the use of minerals for the generation of renewable energy in Oatly's factories; and the relatively high milk yields yet low feed intake, thus relatively low use of mineral fertilizers, of Danish dairy systems). For Italy and Spain, Oatly Barista has a 18%-24% lower mineral resource scarcity impact, mainly attributable to the relatively high feed input (hence mineral fertilizer input) for Italian and Spanish dairy cows. The fossil resource scarcity impact is 20%-39% lower for Oatly Barista in Denmark and

[1] End-to-End (E2E) Factory: The entire production chain happens within Oatly's own factory. From grains to the finished product. Hybrid Factory: A Hybrid factory is an Oatly oatbase factory that pumps the oatbase through a pipe to a contract manufacturer next door. The contract manufacturer-neighbour fills and packs the products for Oatly.

Norway, as it is sourced from the Swedish factory which uses renewable energy for processing. The Oatly Barista available in Italy, Spain and Belgium on the other hand, comes from the Dutch factory, where fossil-based thermal energy is used during processing, and has a comparable (0% for Italy) or higher (17%-20% for Belgium and Spain) fossil resource scarcity impact compared to cow's milk. Also, the long distribution distance from the Dutch factory contributes significantly to the fossil resource scarcity impact for Oatly Barista available in Italy and Spain.

TABLE 1 RELATIVE DIFFERENCES OF AMBIENT OATLY BARISTA COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE, -58% INDICATES THAT OATLY BARISTA HAS A 58% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY BARISTA, YELLOW – THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS, RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. COW'S MILK REPRESENTS AN AVERAGE MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS AND SE = SWEDEN. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Country of sale	Impact category / Product	Climate change	Fine particulate matter	Terrestrial acidifi-cation	Freshwater eutrophi-cation	Marine eutrophi-cation	Land use	Land occupation	Mineral resource scarcity	Fossil resource scarcity	Water consum-ption
		kg CO2 eq	kg PM2.5 eq	kg SO2 eq	kg P eq	kg N eq	m2a crop eq	m2a	kg Cu eq	kg oil eq	m3
Denmark	Oatly Barista SE Factory	-58%	-50%	-61%	-44%	-41%	1%	-6%	83%	-20%	-58%
Norway	Oatly Barista SE Factory	-76%	-69%	-84%	-73%	-78%	-72%	-69%	-9%	-39%	-75%
Belgium	Oatly Barista NL Factory	-52%	-92%	-74%	-54%	-68%	-35%	-42%	-9%	17%	-51%
Italy	Oatly Barista NL Factory	-58%	-90%	-76%	-55%	-65%	-44%	-51%	-18%	0%	-85%
Spain	Oatly Barista NL Factory	-48%	-73%	-66%	-64%	-72%	-65%	-72%	-24%	20%	-88%

Figure 1 shows the contribution of all life cycle stages to the climate change impact of ambient Oatly Barista and cow's milk, showing that raw materials are the main contributor to the climate change impact of all products in scope. For Oatly Barista, the impact of the raw materials is mainly determined by oats and rapeseed oil, whereas for cow's milk, feed and cow's emissions (linked to enteric fermentation and manure management) are the main contributors.

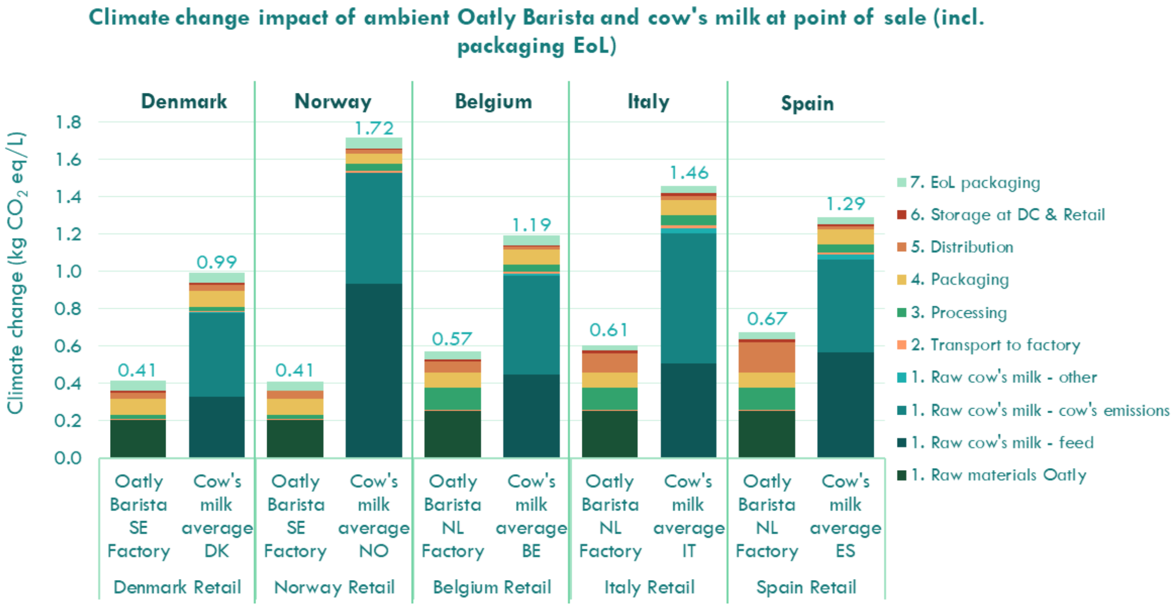


FIGURE 1 CLIMATE CHANGE IMPACT OF AMBIENT OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, NO = NORWAY, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

Chilled Oatly Barista

As can be seen in Table 2 below, the chilled Oatly Barista for the four markets in scope has a lower impact than cow's milk for climate change (41% to 57% lower), fine particulate matter formation (53% to 92% lower), terrestrial acidification (62% to 76% lower), freshwater eutrophication (46% to 65% lower), marine eutrophication (41% to 72% lower), and water consumption (50% to 88% lower). The impact of Oatly Barista is lower for land use (35%-64% lower) and land occupation (42%-72% lower) for all countries except for Denmark, where the impact is comparable (2% higher for land use and 5% lower for land occupation). For mineral resource scarcity, Oatly Barista in Denmark has a 43% higher impact, whereas the Oatly Barista available in the other markets has a 26%-38% lower impact. The low impact of the Danish cow's milk is mainly attributable to high productivity of Danish cows (high milk yield with relatively low feed intake). For fossil resource scarcity, the impact is 23% lower for Oatly Barista sold in Denmark, 1% higher for Oatly Barista sold in Italy and 24% higher for Oatly Barista sold in Spain.

For the Belgian Oatly Barista, the fossil resource scarcity impact is 19% lower when sourced from the Swedish Factory, while it is 13% higher when sourced from the Dutch factory. The use of fossil-based thermal energy at the factory in the Netherlands and the long distribution distances (to the Italian and Spanish market) contribute to the relatively high fossil resource scarcity impact of Oatly Barista.

TABLE 2 RELATIVE DIFFERENCES OF CHILLED OATLY BARISTA COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE, -57% INDICATES THAT OATLY BARISTA HAS A 57% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY BARISTA, YELLOW – THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS, RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. COW'S MILK REPRESENTS AN AVERAGE MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS AND SE = SWEDEN. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Country of sale	Impact category / Product	Climate change	Fine particulate matter	Terrestrial acidification	Freshwater eutrophication	Marine eutrophication	Land use	Land occupation	Mineral resource scarcity	Fossil resource scarcity	Water consumption
		kg CO2 eq	kg PM2.5 eq	kg SO2 eq	kg P eq	kg N eq	m2a crop eq	m2a	kg Cu eq	kg oil eq	m3
Denmark	Oatly Barista SE Factory	-57%	-53%	-62%	-46%	-41%	2%	-5%	43%	-23%	-56%
Belgium	Oatly Barista SE Factory	-57%	-92%	-72%	-59%	-69%	-35%	-42%	-30%	-19%	-59%
	Oatly Barista NL Factory	-50%	-92%	-75%	-57%	-68%	-35%	-42%	-26%	13%	-50%
Italy	Oatly Barista NL Factory	-55%	-90%	-76%	-56%	-65%	-43%	-50%	-34%	1%	-84%
Spain	Oatly Barista NL Factory	-41%	-72%	-65%	-65%	-72%	-64%	-72%	-38%	24%	-88%

Figure 2 on the next page shows the contribution of all life cycle stages to the climate change impact of chilled Oatly Barista and cow's milk, showing similar trends as explained for Figure 1.

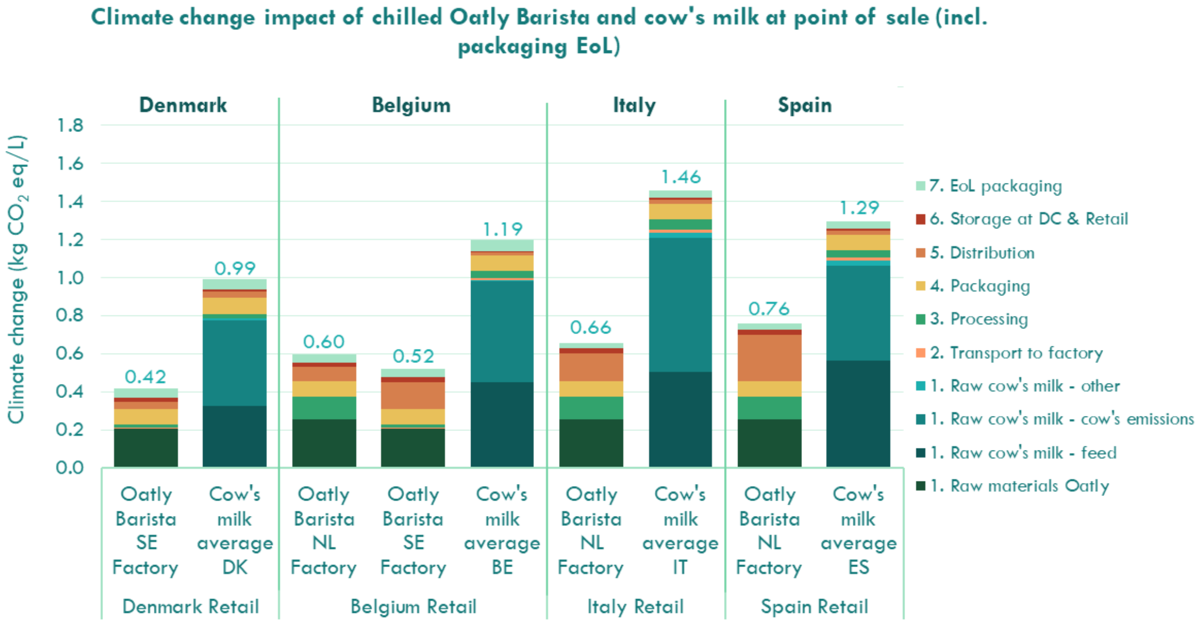


FIGURE 2 CLIMATE CHANGE IMPACT OF CHILLED OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

The significance of the differences between Oatly Barista and cow's milk has been determined by an uncertainty analysis.[2]

The main report included further sensitivity analyses, which also apply to the products evaluated in this addendum, as the products in this addendum are very similar and show a comparable impact to Oatly Barista in the main report. These sensitivity analyses pointed out that using a different impact assessment method (ReCiPe endpoint, EF3.0 single score) confirmed the overall higher environmental footprint of cow's milk compared to Oatly Barista for all countries in scope. It also showed that results in the impact categories land use, mineral resource scarcity and water impact categories are less robust, as they result in different trends when using a different impact assessment method (EF 3.0). Furthermore, the sensitivity analyses in the main report concluded that using different product characteristics (inclusion of use stage, using economic allocation for cow's milk, a functional unit based on nutritional characteristics), did not lead to different conclusions on the environmental footprint of Oatly Barista compared to cow's milk.

Conclusions

Based on the results, the following conclusions can be drawn for the ambient and chilled versions of Oatly Barista:

Ambient Oatly Barista:

- Oatly Barista has a lower impact than cow's milk for the impact categories climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication, marine eutrophication, and water consumption.
- For mineral resource scarcity, Oatly Barista has a higher impact than cow's milk for the Danish market, a comparable impact for the Norwegian and Belgian markets, and a lower impact for the Italian and Spanish markets.
- For fossil resource scarcity, Oatly Barista has a lower impact than cow's milk for the Danish and Norwegian market, a comparable impact for the Italian market and higher impact than cow's milk for the Belgian and Spanish market.

[2] It should be noted that the use of yellow colours in Table 1 and Table 2, which indicates comparable results, mostly (though not always) corresponds to insignificant differences as pointed out by the uncertainty analysis. The results of the uncertainty analysis can be found in section 5.2.

- For land use and land occupation, Oatly Barista has a comparable impact to cow's milk for the Danish markets, and a lower impact for all other markets.

Chilled Oatly Barista:

- Oatly Barista has a lower impact than cow's milk for the impact categories climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication, marine eutrophication, and water consumption.
- For mineral resource scarcity, Oatly Barista has a higher impact than cow's milk for the Danish market, whereas the impact is lower for all other markets.
- For fossil resource scarcity, Oatly Barista has a lower impact than cow's milk for the Danish market, a comparable impact for the Italian market and a higher impact for the Spanish market. For Belgium, the fossil resource scarcity impact of Oatly Barista is lower than cow's milk when Oatly Barista is sourced from the Swedish factory, but higher when sourced from the Dutch factory.
- For land use and land occupation, Oatly Barista has a comparable impact to cow's milk for the Danish markets, and a lower impact for all other markets.

Overall, the analysis of Oatly Barista and its comparison to cow's milk in the markets assessed led to similar conclusions as in the main report.

A detailed analysis of the main drivers and opportunities linked to the environmental impact of Oatly products can be found in the main report.

1. Goal & Scope

1.1 Introduction

This report is an addendum to the report "LCA of Oatly Barista and comparison with cow's milk", which was published by Blonk Consultants on December 7th 2022 (Blonk Consultants, 2022)[3] and will from now on be referred to in this addendum as "the main report". This addendum investigates 5 further products from Oatly: Oatly Barista sold in Denmark, Norway, Belgium, Italy, and Spain. Like the Oatly Barista that was modelled for European countries in the main report, they are produced at the Vlissingen (located in the Netherlands) and Landskrona (located in Sweden) factories. The exact products and markets in scope are listed in Table 3 below. In line with the main report, these products are compared to cow's milk produced in the country of sale. The packaging size is identical to the European products in the main report (1 liter beverage carton) for all products.

The methodology, data choices, and assumptions made, are described in detail in the main report, and have remained unchanged for this report. The following has been updated in this report:

- The energy and water use at the Dutch and Swedish factories has been updated to 2022 data.
- Background data have been updated to the following database versions: Agri-footprint 3.6, and Ecoinvent 3.9.
- Country-specific distribution data from the Dutch and Swedish factories to Denmark, Norway, Belgium, Italy and Spain for both ambient and chilled versions of Barista.

Like the main report, this addendum has been subject to a critical review according to ISO 14040/14044 and ISO/TS 14071:2014 standards (ISO, 2006b, 2006a, 2014), carried out by a review panel consisting of five LCA experts (three of which had already reviewed the main report). The review of the addendum focused particularly on elements that were added or changed compared to the main report and assessed the overall conformance with ISO 14040/14044 standards.

This addendum is not a stand-alone report and should be read in conjunction with the main report. It should be noted that the climate change impact results from this study do not always correspond with those mentioned on Oatly's packaging/web page as the latter are calculated by a different LCA provider that uses different background data and/or different system boundaries.

1.2 Goal and scope

1.2.1 Goal

The goal of this study is in line with the goal mentioned in section 1.2 of the main report: to assess the environmental impacts of a selection of Oatly Barista products, and compare them to cow's milk in their respective markets. Further details on the intended use of this study can be found in section 1.2 of the main report.

1.2.2 Scope

The function based on which the two systems are compared is defined as follows: the provision of cow's milk or oat-based drinks, to be added to food and beverage items for taste and texture, provided in 1 liter packaging at point of sale.

The functional units associated with both systems are:

- Oat drink: 1 liter of Oatly Barista (chilled or ambient), including packaging, at retail.

[3] Link to the publication: https://website-production-s3bucket-1nevfd7531z8u.s3.eu-west-1.amazonaws.com/public/website/download/fabc1628-d8e1-4cf8-aacc-1a9694908a42/LCA%20Oatly%20and%20comparison%20to%20cow's%20milk%20(07-12-2022)%20-%20final.pdf

- Cow's milk: 1 liter of HTST (high temperature short time pasteurization) or UHT (ultra-high temperature pasteurization) whole, and (semi-)skimmed cow's milk (using a country-average mix of these three milk types), including packaging, at retail (chilled or ambient storage)

Table 3 lists the reference flows related to the Oatly products in scope, as well as for their cow's milk equivalents. It should be noted that the chilled version of Oatly Barista is not available in Norway. For Belgium, the chilled version of Oatly Barista is assessed sourced from both the Swedish and Dutch factories.

The system boundaries considered for this addendum are from cradle-to-point of sale (including packaging end-of-life), in line with the main report. More details on the system boundaries can be found in section 1.3.2 from the main report.

Nutritional properties of Oatly Barista and cow's milk can be found in Appendix V.

TABLE 3: REFERENCE FLOWS, LOCAL NAME, STORAGE CONDITION, TYPE, PRODUCTION LOCATION AND COUNTRY OF SALE OF THE OATLY BARISTA PRODUCTS AND COW'S MILK

Oatly Barista				…Compared with cow's milk				Sold in
Reference flow	Local name	Storage condition	Produced in	Reference flow	Storage condition	Cow's milk type	Produced in	Country
Ambient								
1 liter	Oatly Havredrik Barista Edition	Ambient	Landskrona, Sweden	1 liter	Chilled	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Denmark	Denmark
1 liter	Oatly Havredrikk Barista Edition	Ambient	Landskrona, Sweden	1 liter	Chilled	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Norway	Norway
1 liter	Oatly Haver/Oat Barista Edition	Ambient	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Belgium	Belgium
1 liter	Oatly Avena/Avoine Barista Edition	Ambient	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Italy	Italy
1 liter	Oatly Avena/Avoine Barista Edition	Ambient	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Spain	Spain
Chilled								
1 liter	Oatly Havredrik Barista Edition	Chilled	Landskrona, Sweden	1 liter	Chilled	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Denmark	Denmark
1 liter	Oatly Hafer/Oat Barista Edition	Chilled	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Belgium	Belgium
1 liter	Oatly Haver/Oat Barista Edition	Chilled	Landskrona, Sweden	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Belgium	Belgium
1 liter	Oatly Avena/Avoine Barista Edition	Chilled	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Italy	Italy
1 liter	Oatly Avena/Avoine Barista Edition	Chilled	Vlissingen, the Netherlands	1 liter	Ambient	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Spain	Spain

Oatly Barista

Oatly Barista is an oat-based drink that is fortified with calcium, vitamin D, riboflavin, vitamin B12, and iodine. Next to that, oil is added as a functional ingredient that provides structure and texture to the drink. "Barista" refers to the oat drink's functionality in coffee, for which Oatly Barista's foamability and stability are leading properties. Oatly Barista is known under different market names in the countries in scope (as mentioned in Table 3), but in the remainder of this report, it is consistently referred to as "Oatly Barista" for all countries.

Oatly Barista also has a "chilled" version which entails different production and storage requirements. More specifically, it uses a different packaging concept which does not contain aluminum and it is transported and stored chilled. The factory process is identical for chilled and ambient products, yet the ambient version is cooled down to 25 degrees Celsius whilst the chilled product requires cooling to about 5 degrees Celsius. The energy demand for this additional step is estimated to be very small compared to the overall process, so the average energy consumption was used for both versions. It should be noted that the chilled version of Oatly Barista is not yet available in all sales markets, but has been added since all required data were present.

Cow's milk

Since the Oatly products in this study can replace skimmed, semi-skimmed and whole cow's milk, the country-average mix of (semi-)skimmed and whole cow's milk has been selected for the comparison. Table 4 describes which data have been used to define this country-average mix of cow's milk, and section 1.3 of the main report provides further background information.

TABLE 4 MARKET MIX FOR COW'S MILK IN TERMS OF FAT CONTENT, HEAT TREATMENT TYPE, AND PACKAGING TYPE

	Denmark	Norway	Belgium	Italy	Spain
Fat content	(Vargas-Bello-Pérez, et al., 2020)	Statista (2022)	(StatBel, 2024)	IStat (2024)	(Ministerio de Agricultura, Pesca y Alimentación, 2022).
Skimmed	44%	8.2%	6.2%	41%	25%
Semi-skimmed	36%	69.7%	57.6%	33%	46%
Whole milk	20%	22%	36.2%	26%	29%
Thermal treatment	(Rysstad & Kolstad, 2006)	(Rysstad & Kolstad, 2006)	(Rysstad & Kolstad, 2006)	(Rysstad & Kolstad, 2006)	(Rysstad & Kolstad, 2006)
HTST	x	x			
UHT			x	x	x
Packaging	Oatly, personal communication	Oatly, personal communication	Borginon (2002)	(Cammarelle, Viscecchia, & Bimbo, 2021).	(Herrero, at al., 2021).
Multilayer carton 1L - HTST	x	x		x	
Multilayer carton 1L - UHT			x		x

1.2.3 Critical review

A critical review is carried out according to ISO 14040/14044 and ISO/TS 14071:2014 standards (ISO, 2014), in order to assess whether this study is consistent with LCA principles and meets all criteria related to methodology, data, interpretation and reporting. Because of the comparative nature of this LCA, the review is conducted by a panel.

A review panel of five independent and qualified external experts has been compiled, reflecting a balanced combination of qualifications (LCA, dairy, sustainable food systems) and backgrounds.

- Jasmina Burek (chair): Assistant Professor at University of Massachusetts Lowell (based in the US)
- Joseph Poore: Food Sustainability expert at the University of Oxford (based in the UK), with assistance of Valentina Caldart, Agri-environmental data lead (Hestia), University of Oxford (based in the UK)

- Jens Lansche: LCA expert (based in Switzerland)
- Hayo van der Werf: LCA expert (based in France)

Since a review panel (with 3 out of 5 of the above reviewers) had already reviewed the main report, and have verified the methodology, data and assumptions made there, for this addendum only one review round was needed. The full review statement and report can be found in Appendix VI of the main report. This addendum includes a shortened review statement applying specifically to this addendum.

The critical review statement and report can be found in Appendix VI.

2. Calculation method

This addendum follows the exact same methodological standards and approaches as listed in chapter 2 of the main report. One small change is that the land occupation indicator is now included as additional impact category (instead of only in the appendix). In the ReCiPe impact assessment method, land use is expressed as intensity of the land use relative to annual crops (see M. A. J. Huijbregts, Steinmann, Elshout, & Stam, 2016 for more information), and hence the unit used is m^2a crop-eq. Due to several flaws related to the methodology of this indicator,[4] the land occupation indicator was added, which shows land occupation results without characterization, with the unit m^2a, and thus reflects the surface area needed to produce the products in scope. Table 5 provides an overview of the impact categories used in this study, including a description of the indicators and characterisation factors belonging to these categories.

TABLE 5 OVERVIEW OF KEY IMPACT CATEGORIES (CLASSES OF ENVIRONMENTAL IMPACT TO WHICH LIFE CYCLE INVENTORY DATA ARE RELATED) USED FOR THIS STUDY. IT ALSO INCLUDES RESPECTIVE INDICATORS (QUANTIFIABLE REPRESENTATION OF AN IMPACT CATEGORY) AND CHARACTERISATION FACTORS (FACTORS THAT REPRESENT THE IMPACT INTENSITY OF A SUBSTANCE RELATIVE TO THE COMMON UNIT OF THE IMPACT CATEGORY'S INDICATOR)

Impact category	Indicator	Characterisation Factor	Unit	Description
Impact categories belonging to the ReCiPe impact assessment method				
Climate change	Infrared radiative forcing increase	Global warming potential (GWP)	kg CO_2-eq to air	Increase in global average temperature by the emission of greenhouse gases. The widely used global warming potential (GWP) quantifies the integrated infrared radiative forcing increase of a greenhouse gas (GHG), expressed in kg CO_2-eq. Emissions related to peat oxidation (abbreviated as peat ox in tables and figures) as well as land use change (abbreviated as LUC in tables and figures) are included, but reported separately as required by LCA guidelines such as the PEFCR
Fine particulate matter formation	PM2.5 population intake increase	Particulate matter formation potential (PMFP)	kg PM2.5-eq to air	Fine Particulate Matter with a diameter of less than 2.5 µm (consisting of organic and inorganic substances) affects the respiratory tract and lungs when inhaled. Particulate matter formation potentials (PMFP) are expressed in kg primary PM2.5-equivalents.
Terrestrial acidification	Proton increase in natural soils	Terrestrial acidification potential (TAP)	kg SO_2-eq to air	Inorganic acids released into the atmosphere—such as sulphates, nitrates, and phosphates—which cause changes in the acidity of the soil. Acidification potentials considers the fate of a pollutant in the atmosphere and the soil.
Freshwater eutrophication	Phosphorus increase in freshwater	Freshwater eutrophication potential (FEP)	kg P-eq to freshwater	Accumulation of nutrients in water overstimulate plant growth, which reduces the level of oxygen. FEP is based on the fate of phosphorus, which is the limiting nutrient in freshwater.
Marine eutrophication	Dissolved inorganic nitrogen increase in marine water	Marine eutrophication potential (MEP)	kg N-eq to marine water	Accumulation of nutrients in water overstimulates plant growth, which reduces the level of oxygen. MEP is based on the fate of and exposure to nitrogen, which is the limiting nutrient in marine waters.
Land use	Occupation and time-integrated land transformation	Agricultural land occupation potential (LOP)	$m^2 \times yr$ annual cropland-eq	The characterisation factor refers to the relative species loss caused by a specific land use type (e.g. annual crops, permanent crops, forestry, urban land, pasture) proportionate to the relative species loss resulting from annual crop production.
Water use	Increase of water consumed	Water consumption potential (WCP)	m^3 water-eq consumed	Quantity of water used, expressed as m3 of water consumed per m^3 of water extracted
Mineral resource scarcity	Increase of ore extracted	Surplus ore potential (SOP)	kg Cu-eq	The primary extraction of a mineral resource will lead to an overall decrease of the concentration of that resource in ores worldwide. The SOP expresses the average extra amount of ore produced in the future caused by the extraction of a mineral resource considering all future production of that mineral resource.
Fossil resource scarcity	Upper heating value	Fossil fuel potential (FFP)	kg oil-eq	Depletion of resources that contain hydrocarbons, such as coal, oil or natural gas. FFP is defined as the ratio between the higher heating value of a fossil resource and the energy content of crude oil.
Additional impact category				
Land occupation	Land area	N/A	m^2 a	Occupation or use of a certain area of land for a certain period of time. The inventory data is not characterised.

[4] The ReCiPe 2016 method for land use considers species richness in different land uses by applying a characterization factor (CF) by land type. Certain land types like forests, grassland and permanent crops get a lower characterisation factor (CF < 1) than annual crops (CF = 1). However, this method is somewhat outdated and only provides one global CF per land use type, without differentiating by location/geography, whereas biodiversity varies substantially by geography. Furthermore, the unit m2a crop-eq can be hard to interpret. To also provide an indication of the actual land surface used for each of the products, this addendum adds a land occupation indicator (m^2 of total land occupied per year), which does not characterise land use (CF = 1 for all land use types). Additional land impact assessment methods were evaluated in the sensitivity analysis in the main report, including the EF 3.0 method which uses the LANCA model to quantify land use.

Since the products in scope of this addendum are very similar to the products investigated in the main report, this report contains no sensitivity analyses. Only an uncertainty analysis is included.

The main report can be consulted to obtain more insight into results of the sensitivity analyses with regard to applying different impact assessment methods (EF 3.0, 20-year timeframe for global warming), applying a different scope (cradle-to-grave), applying different allocation methods (economic allocation for cow's milk) and applying a different functional unit (including nutritional characteristics).

3. Life Cycle Inventory

This addendum covers Oatly Barista produced at Oatly's end-to-end factory located in Landskrona, Sweden, and the hybrid factory located in Vlissingen, the Netherlands. More details on these factories and the production process can be found in section 3.1.1 of the main report.

The data used for the manufacturing of the Oatly products of this addendum is identical to Oatly Barista as described in section 3.1.2 of the main report, except for the following:

- The resource use at the factories (energy and water use) has been updated with 2022 data.
- The sourcing countries for oats have been updated for the Dutch factory.
- Transport from the factories to Belgium, Denmark, Spain, Italy and Norway (to distribution centers and retail) has been added based on data provided by Oatly.

An overview of the data used to model the Oatly products can be found in Appendix II.

For the raw cow's milk from Denmark, Belgium, Italy and Spain data from Agri-footprint has been used, in line with the datasets used in the main report. For Norway, data for cow's milk was derived from a previous critically-reviewed LCA study performed for Oatly (Blonk Consultants, 2024), and was modelled using the same methodology as the cow's milk datasets available in Agri-footprint. An overview of the data that was used to generate these datasets can be found in Appendix III. Section 3.2 of the main report contains further information on how the subsequent life cycle stages were modelled.

4. Life Cycle Impact Assessment (LCIA)

This chapter provides an overview of the key results for all products in scope, whereas the next chapter (Life Cycle Interpretation) provides a more detailed account of the stages and processes contributing most to the impact.

The results for the key impact categories are listed in Table 6 for the ambient Oatly Barista, and in Table 7 for the chilled Oatly Barista. The results for all impact categories are included in Appendix IV.

Table 8 and Table 9 provide an overview of the relative differences of the Oatly products and cow's milk.

These tables indicate that:

- For all countries, the ambient and chilled version of Oatly Barista have a lower impact than cow's milk when it comes to the environmental impact categories climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication, marine eutrophication, and water consumption.
- For land use and land occupation, the ambient and chilled Oatly Barista have a lower impact than cow's milk for all markets except for Denmark, where the impact is comparable.
- For the mineral resource scarcity impact category, the chilled and ambient Oatly Barista have a higher impact than cow's milk in Denmark, and a lower or comparable impact for the remaining countries (comparable for Norway only).
- For fossil resource scarcity, Oatly Barista has a lower impact than cow's milk for the ambient and chilled version in Denmark, the ambient version in Norway, and the chilled version in Belgium (when sourced from the Swedish factory). Results are comparable for both versions in Italy, and lastly they are higher for both options in Spain and Belgium (for the latter, this is the case only when the chilled version is sourced from the Dutch factory).

Note that the differences observed between Oatly Barista and cow's milk are in some cases not significant, as determined by the uncertainty analysis in chapter 5.2. A further explanation of what causes the differences that can be observed between products can be found in the next chapter (Life Cycle Interpretation).

These results are in line with the results from the main report on Oatly Barista, where relative differences between Oatly Barista and cow's milk are of the same order of magnitude for the same categories[5].

TABLE 6: RESULTS FOR KEY IMPACT CATEGORIES FOR THE AMBIENT OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Denmark Retail				
Impact category		**Cow's milk average DK**	**Oatly Barista SE Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	0.978	0.414	*-58%*
Climate change - excl LUC and peat ox	kg CO_2 eq	0.805	0.310	*-62%*
Climate change - only LUC	kg CO_2 eq	0.095	0.022	*-77%*
Climate change - only peat ox	kg CO_2 eq	0.078	0.082	*6%*
Fine particulate matter formation	kg PM2.5 eq	0.000776	0.000390	*-50%*
Terrestrial acidification	kg SO_2 eq	0.00374	0.00146	*-61%*
Freshwater eutrophication	kg P eq	0.000208	0.000117	*-44%*
Marine eutrophication	kg N eq	0.000960	0.000564	*-41%*
Land use	m^2a crop eq	0.654	0.663	*1%*
Land occupation	m^2a	0.822	0.771	*-6%*
Mineral resource scarcity	kg Cu eq	0.000590	0.00108	*83%*
Fossil resource scarcity	kg oil eq	0.0636	0.0506	*-20%*
Water consumption	m^3	0.00763	0.00321	*-58%*

[5] When comparing the average relative difference between (ambient) Oatly Barista and cow's milk for the impact categories in scope, the Oatly products in this report have on average a relative lower impact than the Oatly products in the main report for all impact categories except for climate change (on average 61% lower than cow's milk in main report and 58% lower in this report), fine particulate matter (on average 76% lower than cow's milk in the main report and 75% lower in this report), and fossil resource scarcity (on average 10% lower than cow's milk in the main report and 5% lower in this report).

Norway Retail				
Impact category	**Unit**	**Cow's milk average NO**	**Oatly Barista SE Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.721	0.410	*-76%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.186	0.306	*-74%*
Climate change - only LUC	kg CO_2 eq	0.072	0.022	*-69%*
Climate change - only peat ox	kg CO_2 eq	0.462	0.082	*-82%*
Fine particulate matter formation	kg PM2.5 eq	0.00139	0.000435	*-69%*
Terrestrial acidification	kg SO_2 eq	0.00946	0.00155	*-84%*
Freshwater eutrophication	kg P eq	0.000471	0.000127	*-73%*
Marine eutrophication	kg N eq	0.00271	0.000582	*-78%*
Land use	m^2a crop eq	2.297	0.653	*-72%*
Land occupation	m^2a	2.342	0.735	*-69%*
Mineral resource scarcity	kg Cu eq	0.00130	0.00118	*-9%*
Fossil resource scarcity	kg oil eq	0.101	0.0616	*-39%*
Water consumption	m^3	0.0162	0.00405	*-75%*

Belgium retail				
Impact category	**Unit**	**Cow's milk average BE**	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.194	0.574	*-52%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.032	0.442	*-57%*
Climate change - only LUC	kg CO_2 eq	0.153	0.019	*-88%*
Climate change - only peat ox	kg CO_2 eq	0.009	0.113	*1221%*
Fine particulate matter formation	kg PM2.5 eq	0.00626	0.000521	*-92%*
Terrestrial acidification	kg SO_2 eq	0.00621	0.00162	*-74%*
Freshwater eutrophication	kg P eq	0.000319	0.000146	*-54%*
Marine eutrophication	kg N eq	0.00194	0.000613	*-68%*
Land use	m^2a crop eq	1.010	0.654	*-35%*
Land occupation	m^2a	1.255	0.724	*-42%*
Mineral resource scarcity	kg Cu eq	0.00142	0.00129	*-9%*
Fossil resource scarcity	kg oil eq	0.109	0.127	*17%*
Water consumption	m^3	0.00865	0.00427	*-51%*

Italy Retail				
Impact category		**Cow's milk average IT**	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.456	0.606	*-58%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.291	0.475	*-63%*
Climate change - only LUC	kg CO_2 eq	0.155	0.018	*-88%*
Climate change - only peat ox	kg CO_2 eq	0.010	0.113	*1032%*
Fine particulate matter formation	kg PM2.5 eq	0.00552	0.000545	*-90%*
Terrestrial acidification	kg SO_2 eq	0.00732	0.00173	*-76%*
Freshwater eutrophication	kg P eq	0.000344	0.000156	*-55%*
Marine eutrophication	kg N eq	0.00176	0.000618	*-65%*
Land use	m^2a crop eq	1.171	0.661	*-44%*
Land occupation	m^2a	1.529	0.749	*-51%*
Mineral resource scarcity	kg Cu eq	0.00151	0.00123	*-18%*
Fossil resource scarcity	kg oil eq	0.137	0.137	*0%*
Water consumption	m^3	0.0275	0.00420	*-85%*

Spain Retail				
Impact category	**Unit**	**Cow's milk average ES**	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.293	0.672	*-48%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.136	0.540	*-52%*
Climate change - only LUC	kg CO_2 eq	0.153	0.019	*-88%*
Climate change - only peat ox	kg CO_2 eq	0.004	0.113	*3059%*
Fine particulate matter formation	kg PM2.5 eq	0.00234	0.000643	*-73%*
Terrestrial acidification	kg SO_2 eq	0.00583	0.00200	*-66%*

Freshwater eutrophication	kg P eq	0.000450	0.000162	*-64%*
Marine eutrophication	kg N eq	0.00226	0.000621	*-72%*
Land use	m^2a crop eq	1.865	0.658	*-65%*
Land occupation	m^2a	2.658	0.734	*-72%*
Mineral resource scarcity	kg Cu eq	0.00171	0.00129	*-24%*
Fossil resource scarcity	kg oil eq	0.133	0.160	*20%*
Water consumption	m^3	0.0350	0.00424	*-88%*

TABLE 7 RESULTS FOR KEY IMPACT CATEGORIES FOR THE CHILLED OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Denmark Retail				
Impact category		**Cow's milk average DK**	**Oatly Barista SE Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	0.978	0.419	*-57%*
Climate change - excl LUC and peat ox	kg CO_2 eq	0.805	0.313	*-61%*
Climate change - only LUC	kg CO_2 eq	0.095	0.024	*-75%*
Climate change - only peat ox	kg CO_2 eq	0.078	0.083	*6%*
Fine particulate matter formation	kg PM2.5 eq	0.000776	0.000363	*-53%*
Terrestrial acidification	kg SO_2 eq	0.00374	0.00141	*-62%*
Freshwater eutrophication	kg P eq	0.000208	0.000113	*-46%*
Marine eutrophication	kg N eq	0.000960	0.000566	*-41%*
Land use	m^2a crop eq	0.654	0.667	*2%*
Land occupation	m^2a	0.822	0.778	*-5%*
Mineral resource scarcity	kg Cu eq	0.000590	0.000846	*43%*
Fossil resource scarcity	kg oil eq	0.0636	0.0487	*-23%*
Water consumption	m^3	0.00763	0.00336	*-56%*

Belgium retail						
Impact category	**Unit**	**Cow's milk average BE**	**Oatly Barista SE Factory**	***Difference compared to cow's milk***	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.194	0.519	*-57%*	0.596	*-50%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.032	0.412	*-60%*	0.459	*-56%*
Climate change - only LUC	kg CO_2 eq	0.153	0.024	*-84%*	0.024	*-84%*
Climate change - only peat ox	kg CO_2 eq	0.009	0.083	*868%*	0.113	*1225%*
Fine particulate matter formation	kg PM2.5 eq	0.00626	0.000494	*-92%*	0.000497	*-92%*
Terrestrial acidification	kg SO_2 eq	0.00621	0.00176	*-72%*	0.00158	*-75%*
Freshwater eutrophication	kg P eq	0.000319	0.000129	*-59%*	0.000138	*-57%*
Marine eutrophication	kg N eq	0.00194	0.000591	*-69%*	0.000613	*-68%*
Land use	m^2a crop eq	1.010	0.653	*-35%*	0.661	*-35%*
Land occupation	m^2a	1.255	0.723	*-42%*	0.730	*-42%*
Mineral resource scarcity	kg Cu eq	0.00142	0.000988	*-30%*	0.00104	*-26%*
Fossil resource scarcity	kg oil eq	0.1092	0.0880	*-19%*	0.124	*13%*
Water consumption	m^3	0.00865	0.00356	*-59%*	0.00432	*-50%*

Italy Retail				
Impact category		**Cow's milk average IT**	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.456	0.656	*-55%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.291	0.519	*-60%*
Climate change - only LUC	kg CO_2 eq	0.155	0.024	*-85%*
Climate change - only peat ox	kg CO_2 eq	0.010	0.113	*1035%*
Fine particulate matter formation	kg PM2.5 eq	0.00552	0.000539	*-90%*
Terrestrial acidification	kg SO_2 eq	0.00732	0.00174	*-76%*

Freshwater eutrophication	kg P eq	0.000344	0.000152	*-56%*
Marine eutrophication	kg N eq	0.00176	0.000618	*-65%*
Land use	m^2a crop eq	1.171	0.670	*-43%*
Land occupation	m^2a	1.529	0.758	*-50%*
Mineral resource scarcity	kg Cu eq	0.00151	0.000999	*-34%*
Fossil resource scarcity	kg oil eq	0.137	0.138	*1%*
Water consumption	m^3	0.0275	0.00434	*-84%*
Spain Retail				
Impact category	**Unit**	**Cow's milk average ES**	**Oatly Barista NL Factory**	***Difference compared to cow's milk***
Climate change - incl LUC and peat ox	kg CO_2 eq	1.293	0.756	*-41%*
Climate change - excl LUC and peat ox	kg CO_2 eq	1.136	0.619	*-46%*
Climate change - only LUC	kg CO_2 eq	0.153	0.024	*-84%*
Climate change - only peat ox	kg CO_2 eq	0.004	0.113	*3069%*
Fine particulate matter formation	kg PM2.5 eq	0.00234	0.000651	*-72%*
Terrestrial acidification	kg SO_2 eq	0.00583	0.00206	*-65%*
Freshwater eutrophication	kg P eq	0.000450	0.000159	*-65%*
Marine eutrophication	kg N eq	0.002255	0.000621	*-72%*
Land use	m^2a crop eq	1.865	0.666	*-64%*
Land occupation	m^2a	2.658	0.742	*-72%*
Mineral resource scarcity	kg Cu eq	0.00171	0.001061	*-38%*
Fossil resource scarcity	kg oil eq	0.133	0.165	*24%*
Water consumption	m^3	0.0350	0.00433	*-88%*

TABLE 8 RELATIVE DIFFERENCES OF AMBIENT OATLY BARISTA COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE,52% INDICATES THAT OATLY BARISTA HAS A 52% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY BARISTA, YELLOW – THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS, RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. COW'S MILK REPRESENTS AN AVERAGE MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS AND SE = SWEDEN. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Country of sale	**Impact category** / **Product**	**Climate change**	**Fine particulate matter**	**Terrestrial acidifi-cation**	**Freshwater eutrophi-cation**	**Marine eutrophi-cation**	**Land use**	**Land occupation**	**Mineral resource scarcity**	**Fossil resource scarcity**	**Water consum-ption**
		kg CO2 eq	*kg PM2.5 eq*	*kg SO2 eq*	*kg P eq*	*kg N eq*	*m2a crop eq*	*m2a*	*kg Cu eq*	*kg oil eq*	*m3*
Denmark	Oatly Barista SE Factory	-58%	-50%	-61%	-44%	-41%	1%	-6%	83%	-20%	-58%
Norway	Oatly Barista SE Factory	-76%	-69%	-84%	-73%	-78%	-72%	-69%	-9%	-39%	-75%
Belgium	Oatly Barista NL Factory	-52%	-92%	-74%	-54%	-68%	-35%	-42%	-9%	17%	-51%
Italy	Oatly Barista NL Factory	-58%	-90%	-76%	-55%	-65%	-44%	-51%	-18%	0%	-85%
Spain	Oatly Barista NL Factory	-48%	-73%	-66%	-64%	-72%	-65%	-72%	-24%	20%	-88%

TABLE 9 RELATIVE DIFFERENCES OF CHILLED OATLY BARISTA COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE, -57% INDICATES THAT OATLY BARISTA HAS A 57% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY BARISTA, YELLOW – THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS, RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. COW'S MILK REPRESENTS AN AVERAGE MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS AND SE = SWEDEN. FURTHER INFORMATION ON THE INDICATORS USED FOR THE IMPACT CATEGORIES CAN BE FOUND IN TABLE 5.

Country of sale	Impact category / Product	Climate change	Fine particulate matter	Terrestrial acidifi-cation	Freshwater eutrophi-cation	Marine eutrophi-cation	Land use	Land occupation	Mineral resource scarcity	Fossil resource scarcity	Water consum-ption
		kg CO2 eq	*kg PM2.5 eq*	*kg SO2 eq*	*kg P eq*	*kg N eq*	*m2a crop eq*	*m2a*	*kg Cu eq*	*kg oil eq*	*m3*
Denmark	Oatly Barista SE Factory	-57%	-53%	-62%	-46%	-41%	2%	-5%	43%	-23%	-56%
Belgium	Oatly Barista SE Factory	-57%	-92%	-72%	-59%	-69%	-35%	-42%	-30%	-19%	-59%
	Oatly Barista NL Factory	-50%	-92%	-75%	-57%	-68%	-35%	-42%	-26%	13%	-50%
Italy	Oatly Barista NL Factory	-55%	-90%	-76%	-56%	-65%	-43%	-50%	-34%	1%	-84%
Spain	Oatly Barista NL Factory	-41%	-72%	-65%	-65%	-72%	-64%	-72%	-38%	24%	-88%

5. Life Cycle Interpretation

5.1 Contribution analysis

A contribution analysis shows the contribution of individual life cycle stages to the overall impact results. Contribution analyses are provided for all products in scope and for all key impact categories. Section 5.1.1 of the main report explains in detail which processes contribute to the different impact categories and can be consulted to better understand what is behind the results and the differences that can be observed between the Oatly products and cow's milk. Notable differences from the main report are included below.

5.1.1 Comparison of Oatly Barista and cow's milk

The contribution analysis for the climate change impact category is shown in Figure 3 for ambient Oatly Barista, and in Figure 4 for the chilled Oatly Barista. Figure 5 shows the contribution analysis for the other impact categories, with graphs including both the ambient and chilled version of Oatly Barista.

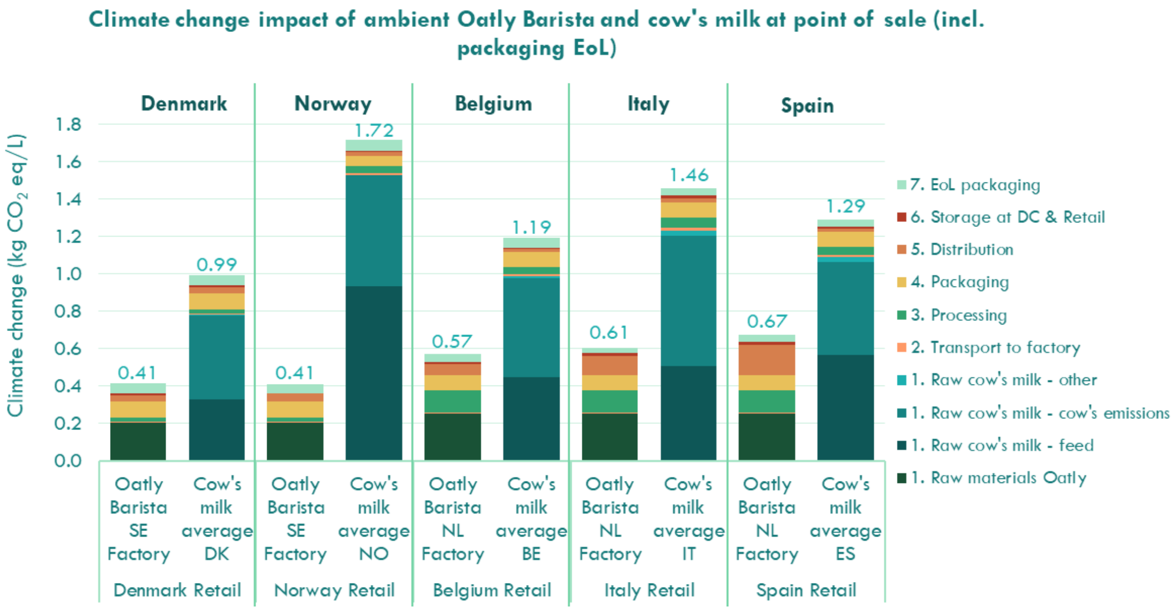


FIGURE 3: CLIMATE CHANGE IMPACT OF AMBIENT OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, NO = NORWAY, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

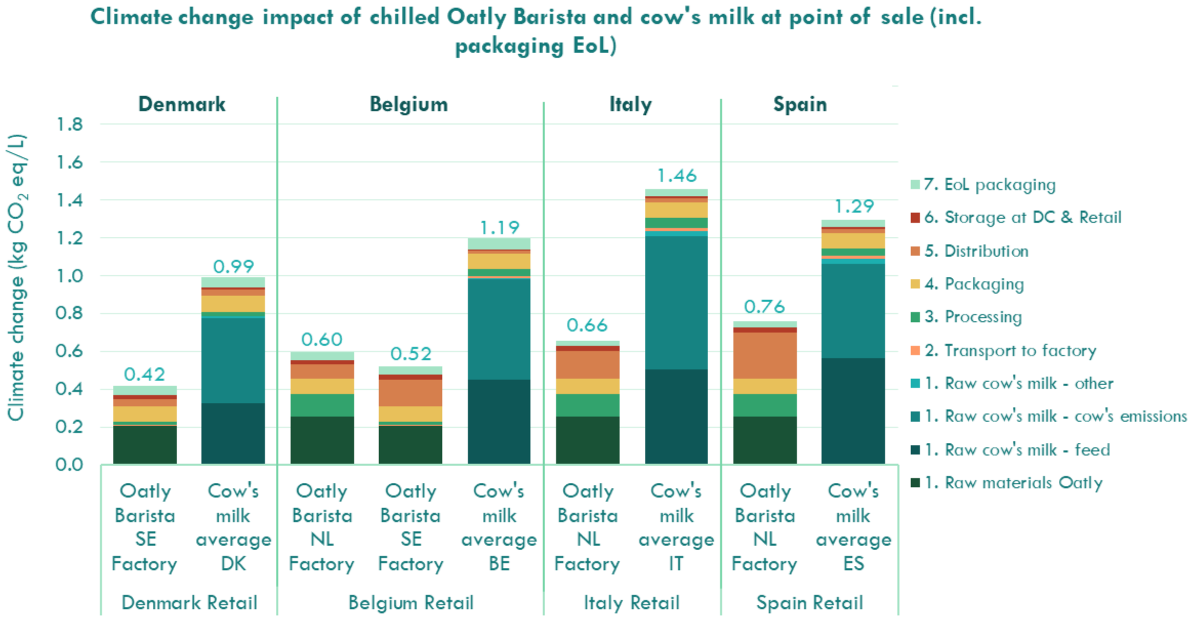


FIGURE 4 CLIMATE CHANGE IMPACT OF CHILLED OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, NO = NORWAY, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

The results from Figure 3, Figure 4, and Figure 5 show that, similar to the results in the main report, the raw material stage is for the Oatly products the **largest contributor** to the climate change impact category in the European markets, as well as to most other impact categories. Exceptions are the mineral resource scarcity category for ambient Oatly Barista, which is mainly linked to packaging (with a high impact for the ambient beverage carton due to use of aluminium), the water consumption category, which is mainly linked to water consumption at the Oatly factories, and the fossil resource scarcity category, which is (except for the Danish and Norwegian markets where raw materials have the highest impact) either linked to distribution (with Oatly products having longer distribution distances than the locally produced cow's milk), or the use of natural gas for processing at the Dutch factory (as opposed to biogas used in the Swedish factory).

The drivers for **mineral resource scarcity impact** (Figure 5f) are the use of aluminium in the ambient packaging of Barista, which leads to higher impacts for Oatly's packaging, when the cow's milk product is chilled and hence doesn't contain aluminium. This is the case for Denmark and Norway. Processing is also a driver for Oatly's impact due the use of minerals for the renewable electricity production. This leads to a higher processing impact for Oatly products compared to their dairy equivalents. Last, the relatively high impact of the raw materials stage for all products is linked to the use of mineral fertilizers during cultivation (Oatly agricultural ingredients, cow's feed). It is worth mentioning that the overall impact of Danish cow's milk is particularly low due to the high productivity of Danish cows (high milk yield with relatively low feed intake[6]).

Oatly Barista produced in the Dutch factory has a relatively high **fossil resource scarcity impact** (Figure 5g) due to the use of natural gas (for heat) during processing. The processing impact for cow's milk is lower as less heat is required. The cow's milk processing impact of each country is different depending on the national electricity mix. The distribution stage of Oatly Barista has a relatively high fossil resource scarcity impact due to the longer distribution distances of Oatly Barista compared to the locally produced cow's milk. The distribution impact is particularly high for countries situated far away from the Oatly factories, such as Italy and Spain.

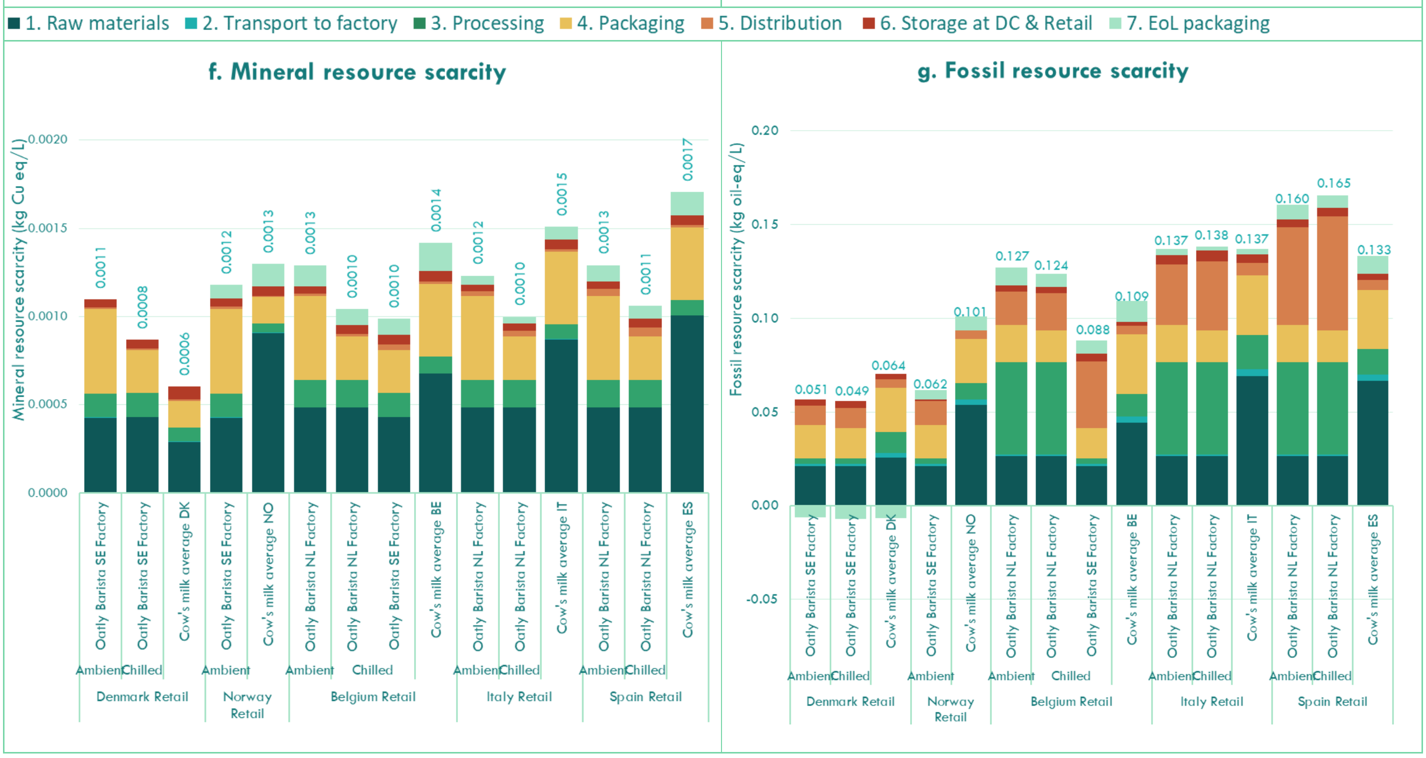
The **Land use** (Figure 5e) **and land occupation** (Figure 5e*) **impacts** are higher for cow's milk than for Oatly Barista, except for Denmark, where the difference is negligible. For cow's milk, the impact results for land use and

[6] For Denmark about 0.65 kg dry matter feed intake per kg milk yield as opposed to 0.7-1.0 kg dry matter feed intake per kg milk for the other countries. See Appendix III for dairy data.

land occupation are dominated by feed cultivation. The land use and land occupation impact of packaging is mainly attributable to the carton board used in the beverage cartons for Oatly Barista and cow's milk.

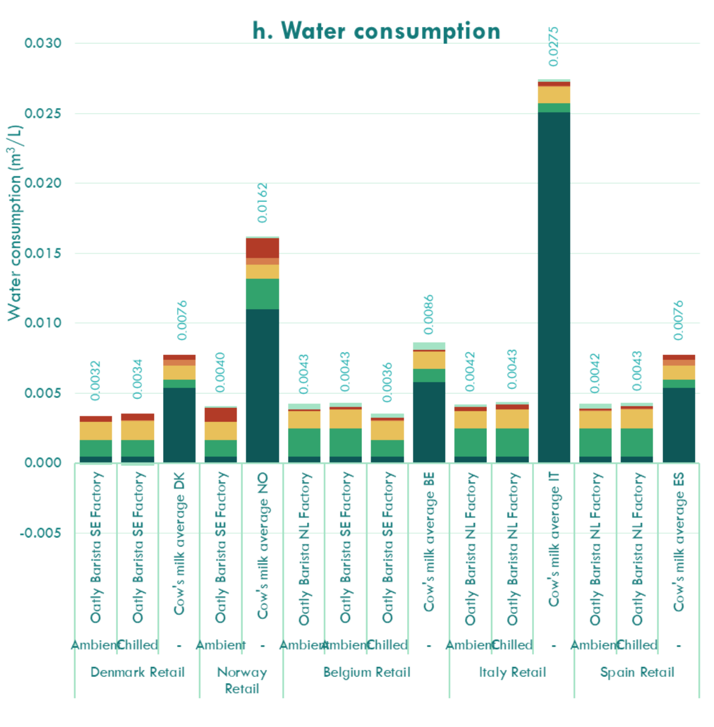
It is worth mentioning, that even if the scope of this report is not to compare results with the main report, Oatly's processing stage in the Dutch factory has seen a slight reduction in impact for climate change, mineral resource scarcity and water consumption. This is due to a switch in their electricity source, from hydropower to wind power, since the main report was published.

1. Raw materials 2. Transport to factory 3. Processing 4. Packaging 5. Distribution 6. Storage at DC & Retail 7. EoL packaging
e. Land use
Land use (m²a crop eq/L)
0.66 0.67 0.65 0.65 2.30 0.65 0.66 0.65 1.01 0.66 0.67 1.17 0.66 0.67 1.86
e*. Land occupation
Land occupation (m²a/L)
0.77 0.78 0.82 0.74 2.34 0.72 0.73 0.72 1.26 0.75 0.76 1.53 0.73 0.74 2.66
Oatly Barista SE Factory
Cow's milk average DK
Cow's milk average NO
Oatly Barista NL Factory
Cow's milk average BE
Cow's milk average IT
Cow's milk average ES
Ambient Chilled
Denmark Retail
Norway Retail
Belgium Retail
Italy Retail
Spain Retail



1. Raw materials 2. Transport to factory 3. Processing 4. Packaging 5. Distribution 6. Storage at DC & Retail 7. EoL packaging
f. Mineral resource scarcity
Mineral resource scarcity (kg Cu eq/L)
0.0011 0.0008 0.0006 0.0012 0.0013 0.0013 0.0010 0.0010 0.0014 0.0012 0.0010 0.0015 0.0013 0.0011 0.0017
g. Fossil resource scarcity
Fossil resource scarcity (kg oil-eq/L)
0.051 0.049 0.064 0.062 0.101 0.127 0.124 0.088 0.109 0.137 0.138 0.137 0.160 0.165 0.133
Oatly Barista SE Factory
Cow's milk average DK
Cow's milk average NO
Oatly Barista NL Factory
Cow's milk average BE
Cow's milk average IT
Cow's milk average ES
Ambient Chilled
Denmark Retail
Norway Retail
Belgium Retail
Italy Retail
Spain Retail

■ 1. Raw materials ■ 2. Transport to factory ■ 3. Processing ■ 4. Packaging ■ 5. Distribution ■ 6. Storage at DC & Retail ■ 7. EoL packaging



■ 1. Raw materials ■ 2. Transport to factory ■ 3. Processing ■ 4. Packaging ■ 5. Distribution ■ 6. Storage at DC & Retail ■ 7. EoL packaging

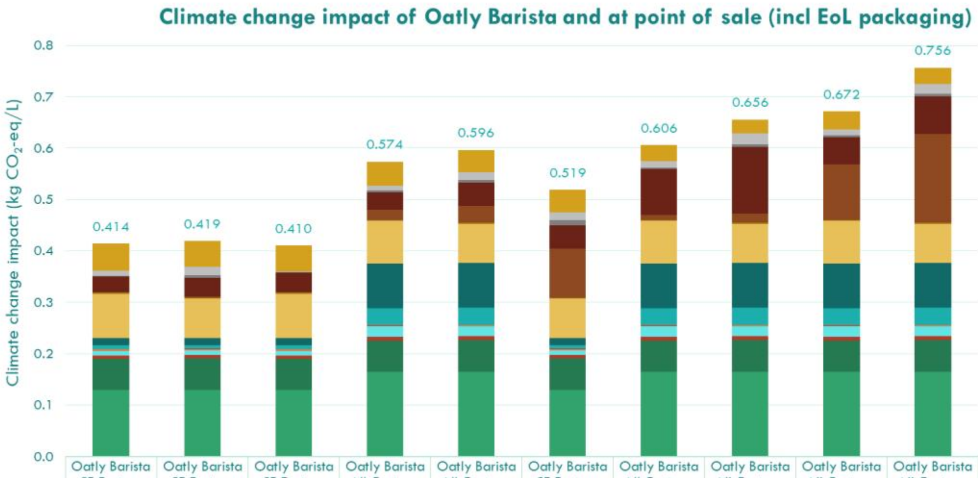
FIGURE 5: KEY IMPACT CATEGORIES OF OATLY BARISTA (CHILLED AND AMBIENT), AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. IMPACT CATEGORY e* (LAND OCCUPATION) CONCERNS AN ADDITIONAL IMPACT CATEGORY AS EXPLAINED IN CHAPTER 2. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, NO = NORWAY, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

5.1.2 Oatly Barista

Figure 6 shows a detailed contribution analysis for the climate change impact category for Oatly Barista. The production location (either Swedish or Dutch factory) is one of the main factors responsible for differences in the climate change impact of the products in scope. Where the Dutch factory uses thermal energy from fossil resources, the Swedish factory uses biogas. Also, a difference in the impact of the raw materials can be observed between the two production locations due to the different countries from which the oats are sourced.

The chilled version of Oatly Barista has a higher climate change impact than the ambient version (sourced from the same factory), due to the additional impact related to refrigerated transport and storage.

Furthermore, the difference between products can be explained by the transport distances from the factories to the distribution centres and retail in the different countries.



	Oatly Barista SE Factory Ambient	Oatly Barista SE Factory Chilled	Oatly Barista SE Factory Ambient	Oatly Barista NL Factory Ambient	Oatly Barista NL Factory Chilled	Oatly Barista SE Factory Chilled	Oatly Barista NL Factory Ambient	Oatly Barista NL Factory Chilled	Oatly Barista NL Factory Ambient	Oatly Barista NL Factory Chilled
	Denmark Retail		Norway Retail	Belgium Retail			Italy Retail		Spain Retail	
10. End of Life of Packaging	0.052	0.050	0.050	0.047	0.043	0.043	0.031	0.027	0.036	0.031
9b. Storage at retail	0.010	0.017	0.001	0.009	0.016	0.016	0.013	0.021	0.012	0.019
9a. Storage at DC	0.002	0.005	0.002	0.003	0.005	0.010	0.003	0.005	0.003	0.005
8b. Distribution to Retail	0.030	0.037	0.037	0.035	0.045	0.045	0.089	0.130	0.053	0.073
8a. Distribution to DC	0.002	0.003	0.002	0.020	0.032	0.097	0.011	0.017	0.109	0.172
7b. Transport of packaging material	0.002	0.001	0.002	0.001	0.003	0.001	0.001	0.003	0.001	0.003
7a. Packaging	0.086	0.077	0.086	0.083	0.076	0.077	0.083	0.076	0.083	0.076
6. Processing - Oatly Barista	0.014	0.014	0.014	0.086	0.087	0.014	0.086	0.087	0.086	0.087
5. Processing - oat base	0.007	0.007	0.007	0.034	0.034	0.007	0.034	0.034	0.034	0.034
4b. Transport of other ingredients to factory	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.001
4a. Transport of oats to factory	0.003	0.003	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.002
3. Oats milling	0.009	0.009	0.009	0.019	0.019	0.009	0.019	0.019	0.019	0.019
2. Oats transport to mill	0.006	0.006	0.006	0.008	0.008	0.006	0.008	0.008	0.008	0.008
1b. Other ingredient production	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
1a. Oat cultivation	0.129	0.129	0.129	0.164	0.165	0.129	0.164	0.165	0.164	0.165
Total	0.414	0.419	0.410	0.574	0.596	0.519	0.606	0.656	0.672	0.756

FIGURE 6: CLIMATE CHANGE IMPACT OF OATLY BARISTA AMBIENT AND CHILLED AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. IT INCLUDES OATLY BARISTA PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS AND IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN.

5.1.3 Cow's milk

Figure 7 shows the contribution analysis for climate change impact of raw cow's milk. As further explained in the main report, most of the climate change impact comes from the biogenic methane emissions originating primarily from enteric fermentation and manure management. One of the factors explaining the overall low impact of Danish and Belgian milk is the relatively high milk yields (around 9 and 10 tonnes/year for Belgian and Danish cows, as opposed to 7-8 tonnes/year for the other countries), and relatively low feed intake per kg of milk produced. The comparatively high impact of Norwegian milk is mainly attributable to feed cultivation on peat soils. The relatively high methane emissions in the Italian dairy system are related to the liquid slurry system without crust (second most common system in Italy), which results in higher emissions than the slurry systems with crust or solid storage systems that are present in other countries.

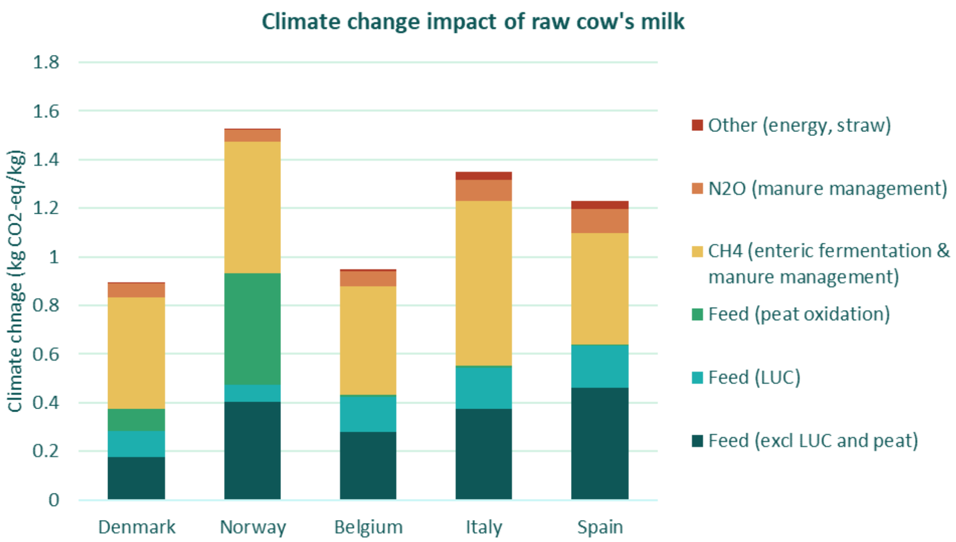


FIGURE 7 CONTRIBUTION ANALYSIS FOR THE CLIMATE CHANGE IMPACT OF RAW COW'S MILK IN DENMARK, NORWAY, BELGIUM, ITALY, AND SPAIN.

5.2 Sensitivity and uncertainty analyses

Sensitivity analyses serve to evaluate the robustness of the results by assessing the influence of several assumptions and modelling choices that have been made. In the main report, sensitivity analyses were performed to evaluate the choice of impact assessment method, the choice of functional unit, the choice of allocation method, as well as several choices with regard to characteristics of the systems under study (e.g. inclusion of use stage, comparison to the ambient version of cow's milk). Next to that, an uncertainty analysis has been performed to determine the range in outcomes when considering uncertainties with regard to data quality.

These sensitivity analyses for the main report demonstrated that using a different impact assessment method (ReCiPe endpoint, EF3.0 single score) confirmed that Oatly Barista has a lower impact than cow's milk for the majority of impact categories for all countries in scope. It also showed that results for the impact categories land use, mineral resource scarcity and water impact categories are less robust, as they result in different trends when using a different impact assessment method (EF 3.0) because of their different underlying metrics. Furthermore, the sensitivity analyses in the main report concluded that using different product characteristics (inclusion of use stage, using economic allocation for cow's milk), did not lead to different conclusions on the environmental footprint of Oatly Barista compared to cow's milk.

Considering how similar the Oatly products in this study are to the Oatly Barista investigated in the main report (and having a relatively lower impact for most categories)[7], it was not deemed necessary to repeat all sensitivity analyses. The conclusions that were drawn based on the sensitivity analyses in the main report also apply to the products in this addendum. This chapter therefore just includes an uncertainty analysis.

Uncertainty in inventory data has been determined using the pedigree matrix, as described in section 2.4.1 of the main report. With this data, a Monte Carlo analysis was run in SimaPro to assess the uncertainty range for each product.

Figure 8 shows the climate change impact results including uncertainty ranges for the 95% confidence interval; meaning that of the 1000 times that the analysis has been repeated, 95% of the intervals that were generated include the true mean value. The graph shows a higher uncertainty range for cow's milk, which is caused by the higher uncertainty factors attributed to emissions from manure management and enteric fermentation and to feed intake (see section 2.7.1 of the main report). Oatly Barista has lower uncertainty ranges due to the use of primary (foreground) data.

[7] When comparing the average relative difference between (ambient) Oatly Barista and cow's milk for the impact categories in scope, the Oatly products in this report have on average a relative lower impact than the Oatly products in the main report for all impact categories except for climate change (on average 61% lower than cow's milk in main report and 58% lower in this report), fine particulate matter (on average 76% lower than cow's milk in the main report and 75% lower in this report), and fossil resource scarcity (on average 10% lower than cow's milk in the main report and 5% lower in this report).

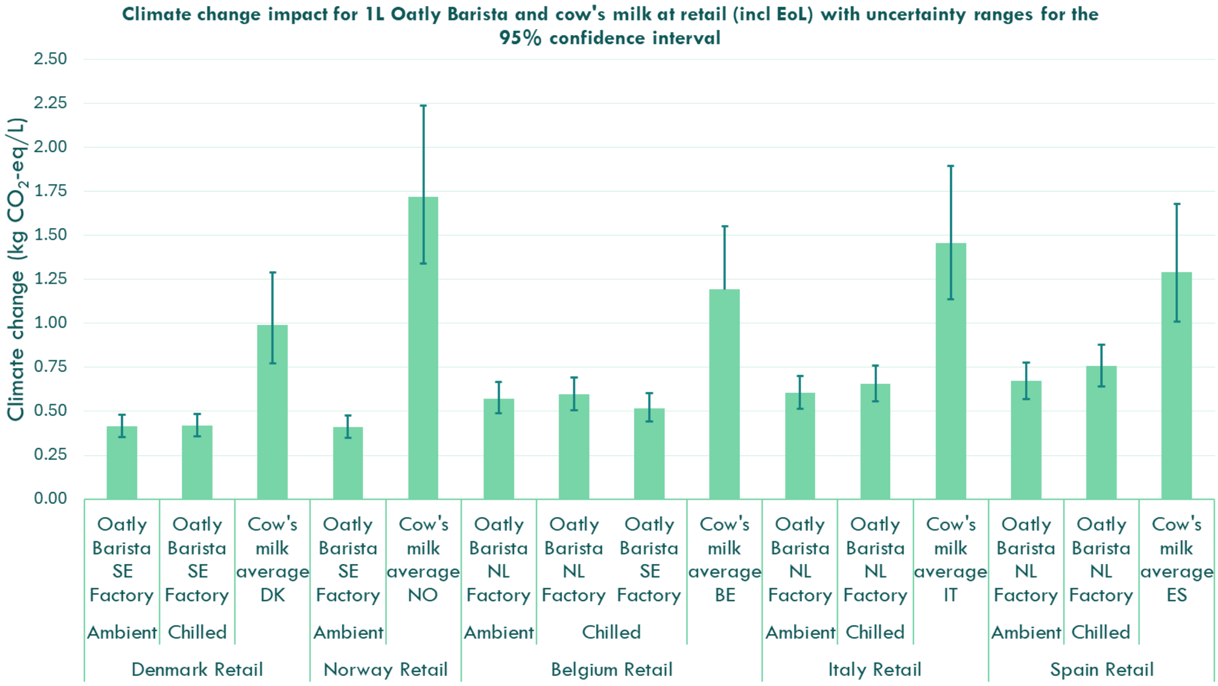


FIGURE 8 CLIMATE CHANGE IMPACT FOR 1L OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING, WITH UNCERTAINTY RANGES FOR THE 95% CONFIDENCE INTERVAL.

The graph gives an impression of how Oatly Barista compares to cow's milk when taking these uncertainties into consideration. Generally speaking, if the error bars of the 95% uncertainty interval do not overlap, one can assume differences between products are statistically significant (Payton et al., 2003).

A more accurate way to compare two products is a paired Monte Carlo analysis, which considers the uncertainty of the difference between two products (thus accounting for correlation in data). The number of runs (from the total of 1000 runs) is counted in which product A has a higher impact than product B. In general, it can be assumed that if >90% of the Monte Carlo runs are favourable for one product, the difference can be considered significant (Goedkoop et al., 2013).

Figure 9 below shows the outcome of this paired Monte Carlo analysis for all products in scope, and for all impact categories. It shows that for climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication, marine eutrophication, and water consumption, the impact of Oatly Barista is consistently and significantly lower than the impact of cow's milk.

The land use and land occupation impact of Oatly Barista (ambient and chilled) is significantly lower for all countries except for Denmark, where the difference is not significant.

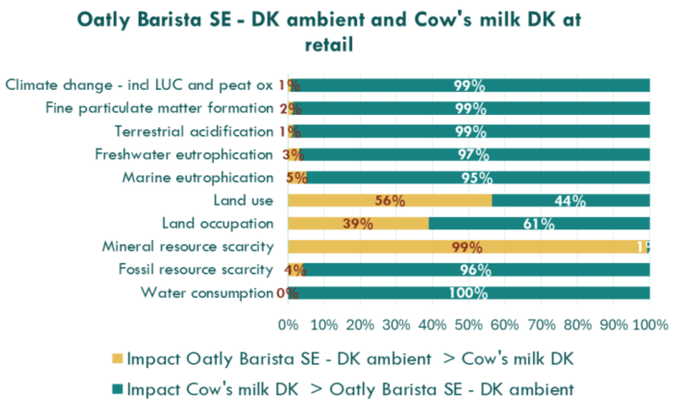
For mineral resource scarcity, the impact of Oatly Barista is significantly lower than cow's milk for the chilled and ambient Oatly Barista available in Belgium, Italy and Spain. For the ambient Oatly Barista in Norway, the mineral resource scarcity impact is lower than cow's milk, but this difference is not significant. For the chilled and ambient Oatly Barista in Denmark, the mineral resource scarcity impact is significantly higher than for cow's milk.

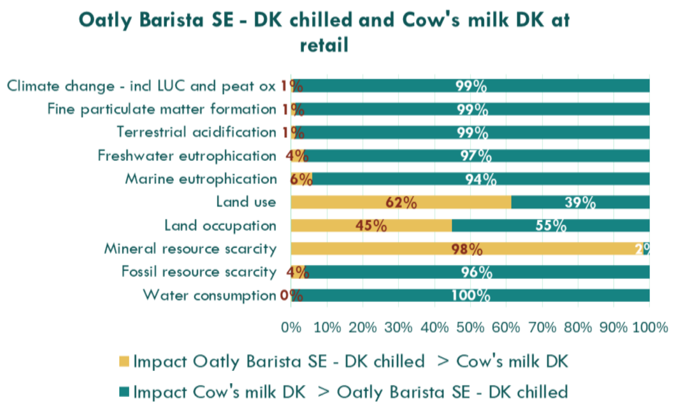
For fossil resource scarcity, Oatly Barista has a significantly lower impact than cow's milk for the Danish market (both ambient and chilled), the Norwegian market (only ambient available), and the Belgian market (only for the chilled version sourced from the Swedish factory). Oatly Barista has a significantly higher fossil resource scarcity impact than cow's milk for the Belgian market (ambient and chilled Oatly Barista sourced from the Dutch factory), and the Spanish market (both ambient and chilled). For the Italian market, the difference between Oatly Barista and cow's milk is not significant.

It should be noted that the results shown here concern just an approximation rather than an accurate reflection of uncertainty ranges, as uncertainty was estimated for the data in absence of information on variability of the data.

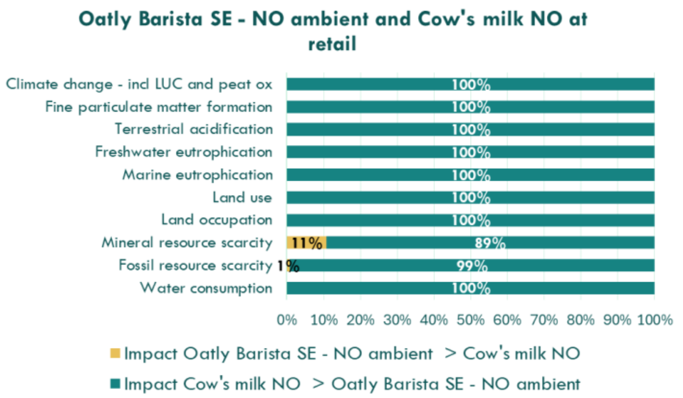
Ambient Oatly Barista	Chilled Oatly Barista

Denmark

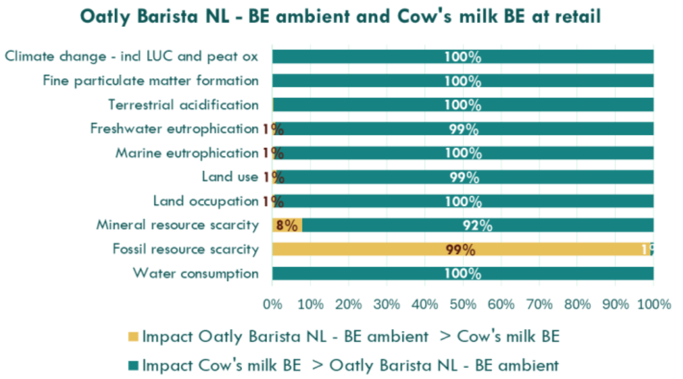


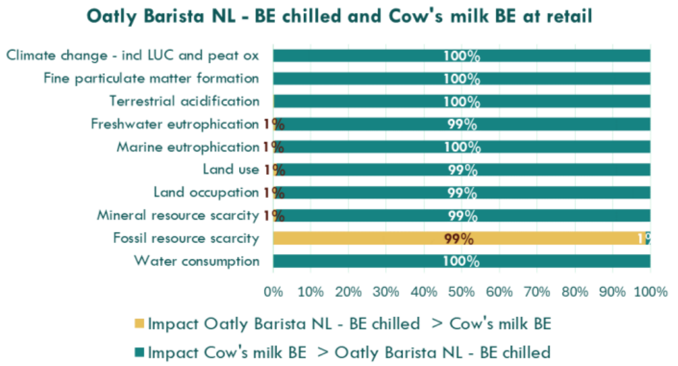


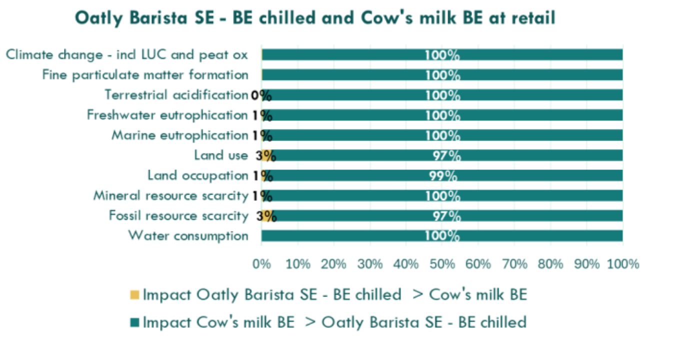
Norway



Belgium







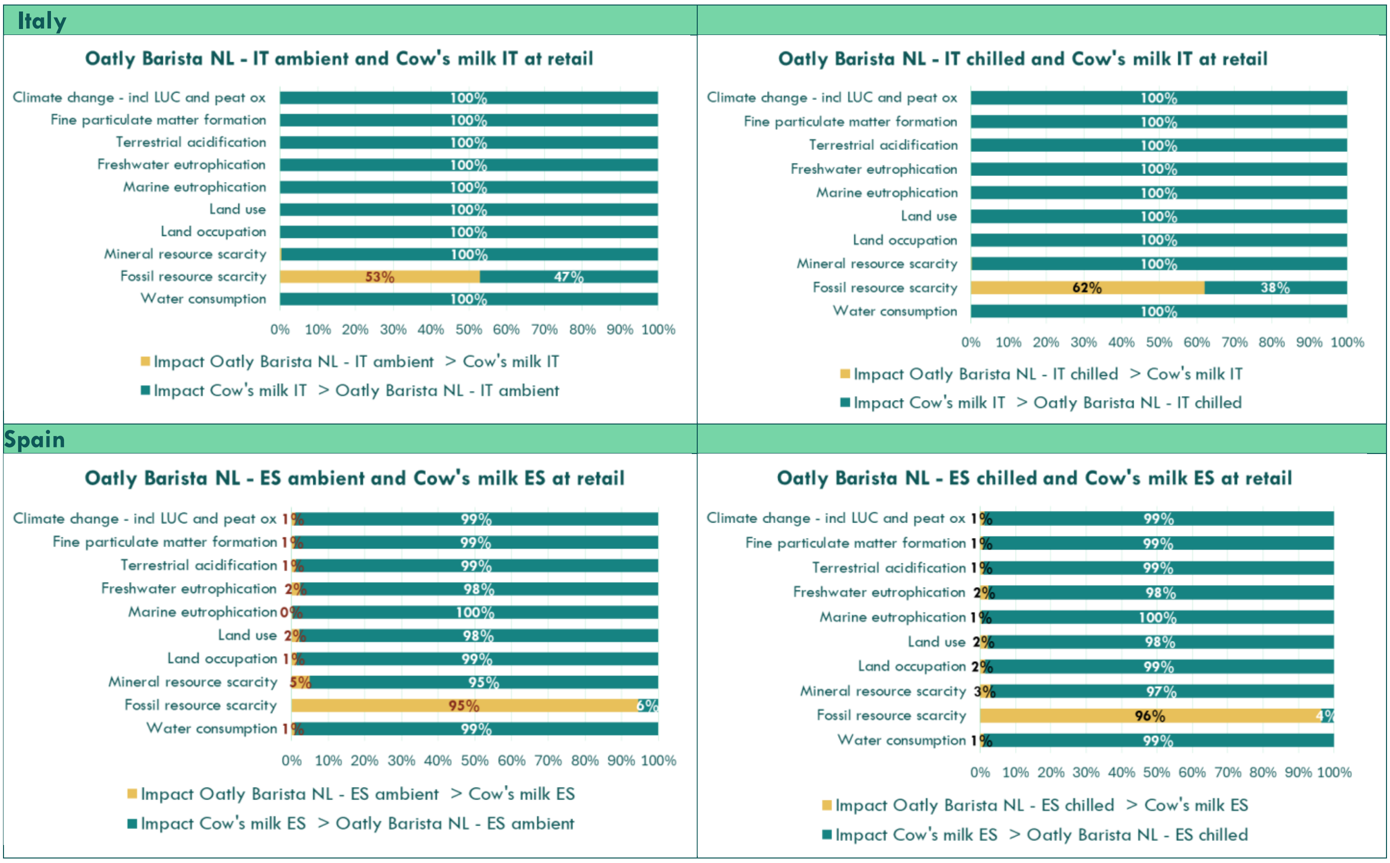


FIGURE 9 PAIRED MONTE CARLO ANALYSIS OF 1L OATLY BARISTA AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING, SHOWING THE PERCENTAGE OF MONTE CARLO RUNS IN WHICH ONE PRODUCT HAS A HIGHER IMPACT THAN THE OTHER. FOR EXAMPLE, FOR CLIMATE CHANGE, AMBIENT OATLY BARISTA AT RETAIL IN DENMARK HAS A LOWER IMPACT THAN COW'S MILK FOR 99% OF THE 1000 MONTE CARLO SIMULATIONS PERFORMED. ABBREVIATIONS USED: NL = THE NETHERLANDS, SE = SWEDEN, DK = DENMARK, NO = NORWAY, BE = BELGIUM, IT = ITALY, AND ES = SPAIN.

6. Conclusion

A Life Cycle Assessment (LCA) has been performed to compare the environmental performance of Oatly Barista to cow's milk in five sales markets in Europe: Belgium, Denmark, Spain, Italy, and Norway. The functional unit considered for this study is 1 liter of Oatly product (ambient and chilled) and cow's milk at retail, including packaging manufacturing and packaging end of life. The study has been performed and critically reviewed according to ISO 14040/14044/14071 standards for comparative assertions to be disclosed to the public.

The results show that the ambient and chilled Oatly Barista in all markets have a lower impact than cow's milk for the impact categories climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication, marine eutrophication, and water consumption. For land use and land occupation, the ambient and chilled Oatly Barista have a lower impact than cow's milk for all markets except for Denmark, where the impact is comparable. The relatively low land use and land occupation impact of Danish cow's milk is mainly related to relatively high milk production of Danish cows combined with a relatively low feed intake.

For the mineral resource scarcity impact category, the chilled and ambient Oatly Barista have a higher impact than cow's milk in Denmark, and a lower impact for the other countries. The relatively high impact of Oatly Barista in the mineral resource scarcity impact category can be explained by the use of aluminium in the ambient beverage carton, as well as the use of minerals in the generation of renewable energy (wind turbines) used at the Oatly factories. Cow's milk has a relatively high mineral resource scarcity impact due to the use of mineral fertilizers for the cultivation of feed. The low impact of the Danish cow's milk is an exception; it is attributable to the high productivity of Danish cows: they have a high milk yield yet a relatively low feed intake, meaning relatively low use of mineral fertilizers for cultivation.

For fossil resource scarcity, Oatly Barista has a lower impact than cow's milk for the ambient and chilled version in Denmark, the ambient version in Norway, and the chilled version in Belgium (when sourced from the Swedish factory). Oatly Barista has a comparable impact for both versions in Italy, and a higher impact for both options in Spain, and Belgium (when the chilled version is sourced from the Dutch factory). The relatively high fossil resource scarcity impact for Oatly Barista is related to the use of (fossil-based) thermal energy for processing at the Dutch factory and the longer distribution distances (especially to the Spanish and Italian market). Processing of cow's milk requires less heat, and less transport as it is produced locally.

The significance of the differences has been determined by an uncertainty analysis. In the main report additional sensitivity analyses were carried out (see section 5.2 of the main report), of which the conclusions also apply to the current products, as they are of similar or relatively lower impact than the Oatly Barista in the main report. The main report concluded that using a different impact assessment method (ReCiPe endpoint, EF3.0 single score[8]) confirmed the overall higher environmental footprint of cow's milk compared to Oatly products for all countries in scope. It also showed that results in the impact categories land use, mineral resource scarcity and water impact categories are less robust, as they result in different trends when using a different impact assessment method (EF 3.0). Furthermore, the sensitivity analyses in the main report concluded that using different product characteristics (inclusion of use stage, using economic allocation for cow's milk, functional unit based on nutritional characteristics), did not lead to different conclusions on the environmental footprint of Oatly products compared to cow's milk.

A detailed analysis of the main drivers and opportunities linked to the environmental impact of Oatly products can be found in the main report. It should be noted that the Dutch factory has switched to electricity from wind instead of hydropower, which has resulted in a lower impact of the processing stage for the climate change, mineral resource scarcity and water consumption categories.

Conclusions and recommendations presented here are subject to the assumptions and limitations addressed in this report and the main report. Any comparative assessment intended to be disclosed to the public, should transparently refer to the conclusions of these studies, and be accompanied by the critical review statement.

[8] EF 3.0 is the environmental impact assessment method from the European Commission's Product Environmental Footprint (PEF) method

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Appendix I Oatly production modelling (Confidential)

This appendix is not available in this version of the report due to confidential data.

Appendix II Oatly production modelling (Non-confidential)

Life cycle stage	*Description of data*	*Data quality*
1a. Oat cultivation	Modelled using oat cultivation datasets from Agri-Footprint 6. Agri-footprint datasets consider cultivation-related inputs and resources (yield, water consumption, land occupation/ transformation, input of manure, fertilizers, lime, pesticides, start material, energy and transport of inputs), as well as emissions related to the use of these inputs and resources (nitrous oxide, ammonia, nitrate, nitric oxide, carbon dioxide, phosphorus, pesticide, heavy metals). Emissions from land use change and peat oxidation are included as well. The sourcing countries for the factories are listed below, including the yields for oat cultivation as used in Agri-footprint (these are based on FAO statistics; more information on data used can be found in the publicly available Agri-footprint 6 Methodology Report, Part 2 – Data). • Landskrona factory SE: oats from Sweden (yield of 4054 kg/ha) • Vlissingen factory NL: oats from Sweden (yield of 4054 kg/ha), Finland (yield of 3386 kg/ha) and the UK (yield of 5653 kg/ha)	*Good*
1b. Other ingredient production	The quantity of other ingredients used during processing or added to the final product are provided by Oatly. These include enzymes, calcium carbonate, vitamins, salt, and rapeseed oil. Rapeseed oil and a proxy for vitamins was derived from the Agri-footprint database, whereas the other ingredients were modelled using datasets from ecoinvent 3.9.	*Good*
2. Oats transport to mill	To account for transport from oat cultivation to mills, estimates are provided by Oatly (as location of farmers is not available). • Oats destined for Vlissingen factory (NL): An estimate of 300km is assumed for the transportation between the oat fields and the ports. We assume diesel trucks from the oat fields to the port, and a consecutive transportation from the port to the mill in Belgium by sea and diesel trucks. • Oats destined for Landskrona factory (SE): An estimate of 300km is assumed for the transportation between the Swedish oat fields to the mills in Sweden and Denmark using diesel trucks. All trucks are modelled with a capacity >20t, a load factor of 80% and an empty return.	*Fair*
3. Oats milling	Primary data was provided by Oatly on energy use (electricity and heat), and water consumption for the 2 mills in Sweden, 1 mill in Denmark and 1 mill in Belgium The oat hulls are going to either animal feed or biogas production. In two Swedish mills, they are used to generate heat for the milling process. For one of the Swedish mills, no information on energy use was available. An estimate was made by assuming the same energy requirements as for the other Swedish mill, but assuming fossil-based energy sources as a conservative assumption for heat. Public information was available for the electricity source in their sustainability report.	*Good*
4a. Transport of oats to factory	Distance based on locations of the mills and the Oatly factory. Transport was modelled using diesel trucks.	*Very good*
5. Processing – oat base	The input use (energy, heat, water) to generate oat base and finished product was provided by Oatly based on data from the production facilities in scope. Water use includes both water in the recipe (final product), and water used for processing (mainly cleaning). The quantity of water going to wastewater treatment is also recorded.	*Very good*

6. processing – Oatly Barista	The input use (energy, heat, water) to generate oat base and finished product was provided by Oatly based on data from the production facilities in scope. Water use includes both water in the recipe (final product), and water used for processing (mainly cleaning). The quantity of water going to wastewater treatment is also recorded. To account for losses during processing, an estimation was provided by Oatly of 5% losses during the production. This concerns a maximum and is based on an interview with Oatly's factory controller (Veljanovski, 2022).	*Very good*
7a. packaging	Primary data on packaging composition is supplied by the packaging manufacturer. Next to the materials used (such as LDPE, aluminum, paperboard), energy was accounted for processing these materials based on ecoinvent datasets (sheet rolling for aluminum, injection moulding for the HDPE cap etc). BioPE is used in all beverage cartons used by Oatly. It is generated with sugarcane cultivated in Brazil. A BioPE dataset has been calculated by Quantis (Quantis, 2022) and its climate change impact is slightly higher than regular PE (excl LUC). Land use change was added from Blonk's LUC database to account for the risk of deforestation attributed to sugar cane cultivation in Brazil. Secondary packaging (corrugated board) is also included.	*Very good*
7b. Transport of packaging material	Upstream data for packaging (e.g. of raw materials) is already included in the ecoinvent datasets used. Transport (assuming diesel trucks) was added from the packaging manufacturing facilities to Oatly's corresponding factories based on their locations.	*Very good*
8a. Distribution to DC	The transport from the factory to the distribution center is provided by Oatly. Oatly uses trucks with a capacity of 21.5-36 tonnes (Månsson, 2022) (modelled as >20ton trucks with a load factor of 80%). For chilled distribution, refrigerated truck transport was modelled based on ecoinvent datasets for refrigerated transport. Since ecoinvent only included a small refrigerated transport option (truck < 16 ton), transport for a >20 ton truck was modelled using the same assumptions as for the smaller trucks: 20% higher fuel use for the refrigeration machine, and the use and emission of 1.71E-5 kg R134/tkm.	*Good*
8b. Distribution to Retail	Transport data is provided by Oatly. An additional 50 km of last mile distribution was added.	*Fair*
9. Storage at DC and retail	For European countries, this is based on defaults for ambient storage provided by the PEFCR, with storage duration provided by the Dairy PEFCR (section 6.4): • 1 week of storage at DC (assuming 3x storage volume) • 3 days chilled storage at retail (HTST) • 14 days ambient storage at retail (UHT) Loss rates at retail were provided by Oatly.	*Fair-Poor*
10. End of Life of Packaging	The EoL of the packaging material is calculated using the Circular Footprint Formula (CFF) from the PEFCR. The CFF is only applied for primary packaging materials, using country-specific parameters as provided in Annex C of the PEFCR. The CFF annex provides recycling rates for liquid packaging board as a whole. It is assumed that only the paper part of the beverage carton can be recycled (into pulp). All of the plastic and aluminum is assumed to be incinerated and/or landfilled (Kremser et al., 2022; Thoden van Velzen & Smeding, 2022), using country-specific incineration/landfill rates. For secondary packaging material (corrugated board) no CFF was applied, and dataset was selected that already includes recycled material.	*Fair*

Appendix III Dairy datasets

A) Cow's milk for Denmark, Belgium, Italy and Spain

The datasets for raw milk have been derived from Agri-footprint 6.3. The dairy datasets available in Agri-footprint were originally developed during the Environmental Footprint (EF 3.0) (European Commission, 2022) agro-food database development (2021), and most of the datasets were developed in partnership with the European Dairy Association (EDA). This was done through involving country specific experts reviewing datapoints and providing alternative sources to improve the representativeness of the dataset.

Below a summary is provided of the data used for Danish, Belgian, Italian and Spanish dairy systems, as derived from the Agri-footprint methodology document. Table A below lists the data sources used.

TABLE A: DATA SOURCES FOR DAIRY FARM PARAMETERS

Parameter	*Country*	*Source*
Milk yield and characteristics	DK	(SEGES, 2021)
	BE	(UNFCCC, 2021)
	IT	(Eurostat, 2021b; UNFCCC, 2021)
	ES	(CONAFE, 2021)
Animal mortality	DK	(FAO, 2018c; SEGES, 2021)
	BE	(FAO, 2018c; Landbouwmonitoringnetwerk (LMN), 2019)
	IT, ES	(FAO, 2018c)
Herd composition and sold animals	DK	(Mogensen et al., 2015; SEGES, 2021; UNFCCC, 2021)
	BE	(Van Mierlo and Bracequené, 2020)
	IT	(FAO, 2018c; UNFCCC, 2021)
	ES	(MAPA, 2020)
Feed intakes	DK, IT, ES	(Leip, 2017)
	BE	(Landbouwmonitoringnetwerk (LMN), 2019; Leip, 2017)
Bedding materials	DK	(SEGES, 2021)
	BE	(Wageningen UR, 2021b)
	IT	(Famiglietti et al., 2018)
	ES	(MAPA, 2020)
Water use	DK, ES	(Wageningen UR, 2021b)
	BE	(Van Mierlo and Bracequené, 2020)
	IT	(Famiglietti et al., 2018)
Energy use	DK, ES	(Wageningen UR, 2021b)
	BE	(Van Mierlo and Bracequené, 2020)
	IT	(Famiglietti et al., 2018)
Time spent on pasture and manure management system	DK, BE, ES, IT	(UNFCCC, 2021)
Compound feed formulation	DK	(Leip, 2017; Nielsen, 2021)
	BE, IT	(Leip, 2017)
	ES	(MAPA, 2020)

The herd at the farm consists of dairy cows, and replacement animals (calves < 1 year, calves 1-2 years and heifers). In most cases, for comparability or data gaps, 100 dairy cows was used as a reference value. The amount of the replacement animals is dependent on the dairy cows replacement rates, various animal mortalities, age of calving and age of slaughtering. The dairy herd composition can be seen in Table B.

TABLE B: HERD SIZE AT VARIOUS COUNTRY DAIRY FARMS, AND OTHER HERD DYNAMICS PARAMETERS.

Herd size and dynamics	*DK*	*BE*	*IT*	*ES*
Female Calves < 1 yr	50	36	38	37
Female Calves 1-2 yr	46	32	35	33
Heifers	7	5	13	3
Dairy cows	100	100	100	100
Dairy cows replacement rate (%)	35	33	32	27
Dairy cows mortality (%)	5.4	4.4	4.0	4.0
Dairy cows average weight mortality (kg)	653	600	603	675
Heifer mortality (%)	4.0	4.0	4.0	4.0
Heifers average weight mortality (kg)	555	501	540	574
Calves 1-2 yr mortality (%)	4.0	4.0	4.0	4.0
Female Calves 1-2 yr average weight mortality (kg)	327	412	405	338
Calves <1 yr mortality (%)	8.0	8.0	8.0	8.0
Female Calves <1 yr average weight mortality (kg)	186	229	225	40
Age at first calving (years)	2.2	2.3	2.3	2.1
Age at slaughtering (years)	5.6	5.8	6.9	5.3

Dairy farms are a multi output systems, where together with milk, also sold animals are leaving the farm. In all cases, part of the dairy cows herd is replaced each year: these cows, that reached the end of their productive life, are typically culled and sent directly to the slaughterhouse. Most of male calves and part of female calves (not needed for replacement) are sold for further rearing or sometimes directly for slaughtering. In some countries, it is also typical to sell part of the grown animals (e.g., grown calves or heifers).

TABLE C: MILK OUTPUT (AND ITS CHARACTERISTICS) AND SOLD ANIMALS AT VARIOUS COUNTRY DAIRY FARMS.

Outputs and characteristics	*DK*	*BE*	*IT*	*ES*
Milk (kg dairy cow^{-1})	10068	9097	7329	8310
Milk protein content (%)	3.5	3.7	3.5	3.3
Milk Fat content (%)	4.3	4.5	4.0	3.7
FPCM Milk (kg dairy cow^{-1})	10593	10048	7442	7990
Culled dairy cows (#)	29.5	28.3	28	30.7
Culled dairy cows average weight (kg)	653	600	603	675
Sold Calves < 1 yr	26.8	46.6	38.6	45.3
Sold Calves < 1 yr average weight (kg)	45	45	45	40
Sold Calves 1-2 yr	-	-	-	-
Sold Calves <1-2 yr average weight (kg)	-	-	-	-
Sold Heifers	14.3	-	-	-
Sold Heifers average weight (kg)	555	-	-	-

Energy consumption at a dairy farm consists of electricity, diesel, and natural gas, see table below for the consumption of electricity and natural gas. The diesel consumption for land management is incorporated in the cultivation and production of roughage. Also, water is used at the dairy farm, both as drinking water and cleaning water. The source of drinking water is commonly groundwater. Irrigation water is considered in the pasture and roughages cultivation inventory. Bedding materials, in the form of wheat straw and saw dust, are considered in dairy cows' housing.

TABLE D: YEARLY ENERGY CONSUMPTION AND WATER USE AT VARIOUS COUNTRY DAIRY FARMS.

Country	*Electricity*	*Natural Gas*	*Fuel*	*Water*	*Wheat straw*	*Saw dust*
	MJ/dairy cow			**m3/dairy cow**	**kg/dairy cow**	
DK	1480	0	0	41.8	44	6.25
BE	1364	0	1.1	40.6	55	125
IT	1963	0	0	47.6	675	0
ES	1480	0	0	41.8	730	1825

The feed intakes of the various countries dairy farms are displayed in the table below. The various animals ration consists of (1) concentrates, also called compound feeds, (2) fresh grass, which animals eat in pastures, (3) farm grown feed, that mostly consists of grass silage and maize silage, and (4) single ingredients, like for instance straw. For calves, the feed ration depends on their age. When calves are very young and stabled, they are usually fed with raw milk directly from the cows.

TABLE E: DRY MATTER INTAKE (DMI, KG/ANIMAL/YEAR) OF THE ANIMALS ON THE VARIOUS COUNTRIES' DAIRY FARMS PER VARIOUS FEED FED. DRY MATTER (DM, %) CONTENT AND CRUDE PROTEIN (CP, % OF DM) CONTENT OF THE OVERALL DIET.

Type of animal	*Compound feeds intake*	*Fresh grass intake*	*Farm grown feed intake*	*Single ingredients intake*	*Overall diet dry matter content*	*Overall diet crude protein content*
DK	**DMI, kg/animal/year**				**DM, %**	**CP, % of DM**
Calves < 1 yr	67	6	2029	0	47.1	18.3
Calves 1-2 yr	279	1807	956	0	24.2	18.5
Dairy cows	2480	29	4049	0	52.4	16.7
Heifers	279	1807	956	0	24.2	18.5
BE	**DMI, kg/animal/year**				**DM, %**	**CP, % of DM**
Calves < 1 yr	458	10	936	0	42.4	12.1
Calves 1-2 yr	377	1743	921	0	22.2	20.8
Dairy cows	1441	3460	1375	225	32.7	18.1
Heifers	377	1743	921	0	22.2	20.8
IT	**DMI, kg/animal/year**				**DM, %**	**CP, % of DM**
Calves < 1 yr	779	108	568	0	65.1	22.1
Calves 1-2 yr	493	1423	2228	0	28.7	22.1
Dairy cows	1320	1108	4850	257	39.4	20.3
Heifers	493	1423	2228	0	28.7	22.1
ES	**DMI, kg/animal/year**				**DM, %**	**CP, % of DM**
Calves < 1 yr	522	265	175	0	35.3	27.1
Calves 1-2 yr	233	1215	2125	0	27.4	26.8
Dairy cows	2095	2269	1710	0	27.7	26.9
Heifers	233	1215	2125	0	27.4	26.8

Calculated emissions are CH_4 from enteric fermentation and various manure management related emissions: CH_4, N_2O direct and indirect, NH_3, NO_X, NMVOC and $PM_{2.5}$. Also, NMVOC emissions from silage feeding are included. All these emissions have been calculated with the APS-footprint tool (Blonk Consultants, 2020a, 2020b).

For each country specific dairy farm, animal-specific manure management shares have been considered (UNFCCC, 2021) accounting for the time share that animals spend outside in the pasture. This has an effect on the ration of excretions dropped in the stable and on the pasture. Days spent on the pasture reflect full 24 hours spent outside.

TABLE F: YEARLY EXCRETION OF NITROGEN, PHOSPHOROUS, MANURE, AND METHANE EMISSION DUE TO ENTERIC FERMENTATION FOR EACH ANIMAL TYPE ON THE AVERAGE DUTCH DAIRY FARM.

Type of animal	*Calves < 1 yr*	*Calves 1-2 yr*	*Dairy cows*	*Heifers*
DK	%	%	%	%
Percentage of time spent outside	0	36	5	36
Liquid/Slurry with natural crust	100	100	86	100
Anaerobic digester	0	0	14	0
BE	%	%	%	%
Percentage of time spent outside	6	6	14	0
Pit storage > 1 month	9	66	70	22
Solid storage	28	9	10	9
Dry lot	64	26	20	69
IT	%	%	%	%
Percentage of time spent outside	5	5	5	5
Solid storage	0	70	56	70
Liquid/Slurry without natural crust	100	30	44	30
ES	%	%	%	%

Percentage of time spent outside	63	63	0	63
Daily spread	0	0	9	0
Solid storage	60	60	46	60
Liquid/Slurry with natural crust	40	40	45	40

The feed material compositions of the daily ration have been mostly based on a model shared by (Leip, 2017), based on import/export feed ingredients statistics and allocation to various animal types.

Roughage is produced on the dairy farm, with a fraction of the manure which is excreted by the dairy cattle. These are in principle with the same methodology described previously for other types of cultivations.

B) Cow's milk for Norway

Norwegian cow's milk has been modelled for the critically reviewed LCA report for Oatly Creamy Oats (Blonk Consultants, 2024), using the same methodology as for the dairy datasets available in Agri-footprint. More information on how dairy systems are modelled can be found in section 3.2 of the main report.

The data on Norwegian dairy systems is derived from TINE 2022, NIR 2022 (Norwegian Environment Agency, 2022)) and Samsonstuen 2024. For the electricity use at farm data were sourced from Koesling et al 2015. To the author's knowledge, no literature source reported on diesel use at farm, hence it was assumed that no diesel is used as a conservative approach (the approach is conservative in terms of the comparison between cow's milk and Oatly Barista, since the impact of Norwegian cow's milk might be slightly underestimated in this study). Data about water use was also not available or outdated, for this reason an average water use at farm from Sweden and Finland was deemed representative for Norway.

More details on the exact data sources used and assumptions made can be found in the table below.

Data point	Value (per year)	Explanation/source
General details		
Farming method	Conventional	
Year	2022	
Geography	Norway	
Average annual temperature	2.88	
Total herd size	330621	TINE 2022
OUTPUTS		
Milk (total weight) (kg)	1454103700	Milk yield (8050, from TINE) multiplied by number of dairy cows (see below)
Protein content (%)	3.54	TINE 2022
Fat content (%)	4.28	TINE 2022
Total livestock to slaughter (liveweight) (kg)	42687000	SSB 2022
RESOURCE USE		
Electricity use (MJ)	916600044	Koesling et al 2015 (1410 kWh per dairy cow /year)
Gas use (MJ)	0	
Diesel use (MJ)	0	
Water consumption (kg)	6979697760	Average from SE and FI (SIK, 2013) as no up to date Norwegian data was available (Eide 2002).
HOUSING SYSTEMS		
Housing - Heifers	36033	TINE 2022
Housing - Calves 1-2 year	40537	TINE 2022
Housing - Calves <1 year	73417	TINE 2022
Housing - Dairy cows	180634	TINE 2022
Housing system dairy cows		
RATION		Feed rations are based on data from Samsonstuen 2024. Ingredients are modelled to represent Norwegian conditions, thus using Norwegian cultivation data from AFP as well as Norwegian market mixes in case of feed from outside the farm. Transport from cultivation country to Norway, as well as within Norway, is added.

Concentrate feed	2857	Based on Samsonstuen 2024, main ingredients were included: Barley, Oats, Wheat bran, Soybean meal, Rapeseed meal, Rapeseed cake extracted, Maize grain, Beet pulp, Molasses, Palm oil, Urea and Salt, vitamins, minerals
Minerals	86	
Grass silage, grown on farm, NO	14172	Based on Samsonstuen 2024
Grass for grazing, permanent pasture, NO	1760	Based on Samsonstuen 2024
Total feed intake (kg/animal)	18789	Total of the above
Gross energy intake (MJ/animal)	119841	Calculated with values from feedipedia
Digestibility (% of GE)	67.82%	Calculated with values from feedipedia
Crude protein in diet (% of DM)	16.66%	Calculated with values from feedipedia
Percentage of silage (% of GE)	39.51%	GE provided by silage/total GE
HOUSING		
Straw for bedding (kg/animal)	44	Based on Danish dairy system, as no Norwegian data was available
Saw dust (kg/animal)	6.25	Based on Danish dairy system, as no Norwegian data was available
Type (e.g. housed/ free ranging)	housed	
MANURE MANAGEMENT		
Liquid slurry without natural crust cover	48.8%	Based on Samsonstuen 2024 and NIR 2022
Liquid slurry with natural crust cover	49.7%	Based on Samsonstuen 2024 and NIR 2022
Cattle and swine deep bedding	0.2%	Based on Samsonstuen 2024 and NIR 2022
Dry lot	0.1%	Based on Samsonstuen 2024 and NIR 2022
Solid storage	0.8%	Based on Samsonstuen 2024 and NIR 2022
TIME SPENT DISTRIBUTION		
Time spent grazing (%)	13.8%	Samsonstuen 2024
Time spent in open yard areas (%)	0%	Samsonstuen 2024
Time spent in buildings (%)	86.2%	Samsonstuen 2024
Housing system Heifers and Calves 1-2 years		
RATION (in kg as is)		Feed rations are based on data from Samsonstuen 2024. Ingredients are modelled to represent Norwegian conditions, thus using Norwegian cultivation data from AFP as well as Norwegian market mixes in case of feed from outside the farm. Transport from cultivation country to Norway, as well as within Norway, is added.
Concentrate feed	397	
Grass silage, grown on farm, SE	7212	
Grass for grazing, permanent pasture, SE	1720	
Total feed intake (kg/animal)	9329	Total of the above
Gross energy intake (MJ/animal)	47013	Calculated with values from feedipedia
Digestibility (% of GE)	63.63%	Calculated with values from feedipedia
Crude protein in diet (% of DM)	14.63%	Calculated with values from feedipedia
Percentage of silage (% of GE)	13.55%	GE provided by silage/total GE
HOUSING		
Straw for bedding (kg/animal)	44	Based on Danish dairy system, as no Norwegian data was available
Saw dust (kg/animal)	6.25	Based on Danish dairy system, as no Norwegian data was available
Type (e.g. housed/ free ranging)	housed	
MANURE MANAGEMENT		
Liquid slurry without natural crust cover	48.6%	Based on Samsonstuen 2024 and NIR 2022
Liquid slurry with natural crust cover	41.6%	Based on Samsonstuen 2024 and NIR 2022
Cattle and swine deep bedding	3.7%	Based on Samsonstuen 2024 and NIR 2022
Dry lot	1.4%	Based on Samsonstuen 2024 and NIR 2022
Solid storage	4.6%	Based on Samsonstuen 2024 and NIR 2022
TIME SPENT DISTRIBUTION		
Time spent grazing (%)	16.8%	Based on Samsonstuen 2024
Time spent in open yard areas (%)	0%	Based on Samsonstuen 2024
Time spent in buildings (%)	83.2%	Based on Samsonstuen 2024
Housing system calves <1 year		
RATION (kg as is)		The quantity of feed consumed is based on data from Denmark, as Norwegian data was not available. This was deemed appropriate

		as calves don't have a big contribution compared to dairy cows and heifers. Norwegian data was used to model the feed ingredients.
Concentrate feed	78	
Grass silage, grown on farm, NO	4281	
Grass for grazing, permanent pasture, NO	40	Based on Samsonstuen 2024
Straw	154	
Total feed intake (kg/animal)	4553	Total of the above
Gross energy intake (MJ/animal)	41348	Calculated with values from feedipedia
Digestibility (% of GE)	80.0%	Calculated with values from feedipedia
Crude protein in diet (% of DM)	18.3%	Calculated with values from feedipedia
Percentage of silage (% of GE)	90.5%	GE provided by silage/total GE
HOUSING		
Straw for bedding (kg/animal)	0	
Saw dust (kg/animal)	0	
Type (e.g. housed/ free ranging)	housed	
MANURE MANAGEMENT		
Manure management system	liquid/slurry with natural crust cover	Based on Denmark
TIME SPENT DISTRIBUTION		
Time spent grazing (%)	33%	Based on Denmark
Time spent in open yard areas (%)	0%	Based on Denmark
Time spent in buildings (%)	67%	Based on Denmark

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Appendix IV Full LCIA Results

1 L Ambient Oatly Barista at retail (incl EoL packaging)

Impact category	Unit	Oatly Barista SE - DK ambient	Oatly Barista SE - NO ambient	Oatly Barista NL - BE ambient	Oatly Barista NL - IT ambient	Oatly Barista NL - ES ambient
Climate change - incl LUC and peat ox	kg CO2 eq	0.414	0.410	0.574	0.606	0.672
Climate change - excl LUC and peat ox	kg CO2 eq	0.310	0.306	0.442	0.475	0.540
Climate change - only LUC	kg CO2 eq	0.0221	0.0224	0.0187	0.0185	0.0187
Climate change - only peat ox	kg CO2 eq	0.082	0.082	0.113	0.113	0.113
Stratospheric ozone depletion	kg CFC11 eq	0.00000278	0.00000279	0.00000302	0.00000303	0.00000306
Ionizing radiation	kBq Co-60 eq	0.0256	0.0270	0.0480	0.0399	0.0450
Ozone formation, Human health	kg NOx eq	0.00102	0.00120	0.00141	0.00161	0.00210
Fine particulate matter formation	kg PM2.5 eq	0.000390	0.000435	0.000521	0.000545	0.000643
Ozone formation, Terrestrial ecosystems	kg NOx eq	0.00131	0.00155	0.00176	0.00191	0.00243
Terrestrial acidification	kg SO2 eq	0.00146	0.00155	0.00162	0.00173	0.00200
Freshwater eutrophication	kg P eq	0.000117	0.000127	0.000146	0.000156	0.000162
Marine eutrophication	kg N eq	0.00056	0.00058	0.00061	0.00062	0.00062
Terrestrial ecotoxicity	kg 1,4-DCB	0.944	0.990	1.046	1.093	1.218
Freshwater ecotoxicity	kg 1,4-DCB	0.0266	0.0259	0.0264	0.0278	0.0275
Marine ecotoxicity	kg 1,4-DCB	0.0185	0.0175	0.0173	0.0193	0.0189
Human carcinogenic toxicity	kg 1,4-DCB	0.0154	0.0155	0.0167	0.0165	0.0173
Human non-carcinogenic toxicity	kg 1,4-DCB	0.467	0.469	0.505	0.535	0.537
Land use (Total)	m2a crop eq	0.663	0.653	0.654	0.661	0.658
Land use (Transformation)	m2a crop eq	0.00125	0.00152	0.00208	0.00247	0.00329
Mineral resource scarcity	kg Cu eq	0.00108	0.00118	0.00129	0.00123	0.00129
Fossil resource scarcity	kg oil eq	0.051	0.062	0.127	0.137	0.160
Water consumption	m3	0.00321	0.00405	0.00427	0.00420	0.00424
Land occupation	m2a	0.771	0.735	0.724	0.749	0.734

1 L Chilled Oatly Barista at retail (incl EoL packaging)

Impact category	Unit	Oatly Barista SE - DK chilled	Oatly Barista NL - BE chilled	Oatly Barista SE - BE chilled	Oatly Barista NL - IT chilled	Oatly Barista NL - ES chilled
Climate change - incl LUC and peat ox	kg CO2 eq	0.419	0.596	0.519	0.656	0.756
Climate change - excl LUC and peat ox	kg CO2 eq	0.313	0.459	0.412	0.519	0.619
Climate change - only LUC	kg CO2 eq	0.0237	0.0241	0.0241	0.0239	0.0241
Climate change - only peat ox	kg CO2 eq	0.083	0.113	0.083	0.113	0.113
Stratospheric ozone depletion	kg CFC11 eq	0.00000280	0.00000306	0.00000285	0.00000308	0.00000312
Ionizing radiation	kBq Co-60 eq	0.0264	0.0494	0.0409	0.0394	0.0471
Ozone formation, Human health	kg NOx eq	0.00101	0.00144	0.00170	0.00172	0.00229
Fine particulate matter formation	kg PM2.5 eq	0.000363	0.000497	0.000494	0.000539	0.000651
Ozone formation, Terrestrial ecosystems	kg NOx eq	0.00131	0.00178	0.00208	0.00201	0.00261
Terrestrial acidification	kg SO2 eq	0.00141	0.00158	0.00176	0.00174	0.00206
Freshwater eutrophication	kg P eq	0.000113	0.000138	0.000129	0.000152	0.000159
Marine eutrophication	kg N eq	0.00057	0.00061	0.00059	0.00062	0.00062
Terrestrial ecotoxicity	kg 1,4-DCB	0.909	1.031	1.089	1.095	1.237
Freshwater ecotoxicity	kg 1,4-DCB	0.0254	0.0252	0.0247	0.0266	0.0264
Marine ecotoxicity	kg 1,4-DCB	0.0170	0.0158	0.0160	0.0177	0.0175
Human carcinogenic toxicity	kg 1,4-DCB	0.0116	0.0127	0.0122	0.0127	0.0136
Human non-carcinogenic toxicity	kg 1,4-DCB	0.451	0.485	0.456	0.517	0.522
Land use (Total)	m2a crop eq	0.667	0.661	0.653	0.670	0.666
Land use (Transformation)	m2a crop eq	0.00126	0.00218	0.00244	0.00270	0.00366
Mineral resource scarcity	kg Cu eq	0.00085	0.00104	0.00099	0.00100	0.00106
Fossil resource scarcity	kg oil eq	0.049	0.124	0.088	0.138	0.165
Water consumption	m3	0.00336	0.00432	0.00356	0.00434	0.00433
Land occupation	m2a	0.778	0.730	0.723	0.758	0.742

Appendix V Nutritional composition of Oatly Barista and cow's milk

Nutritional data is provided for whole cow's milk for the countries in scope. All values are provided per 100 ml.

		Oatly Barista	Cow's milk				
	Unit	EU	Belgium	Denmark	Spain	Italy	Norway
Energy	kJ	257.0	271	269	273.6	264	264
	kcal	61.0	65	64.3	65.4	63	63
Fat	g	3.0	3.6	3.5	3.8	3.6	3.4
of which saturated	g	0.3	2.2	2.3	2.3	not reported	not reported
essential fatty acids	g	0.8	0.98	0.9	1.23	not reported	not reported
Carbohydrates	g	7.1	4.8	4.8	4.7	4.7	4.5
of which sugars	g	3.4	4.8	not reported	not reported	not reported	not reported
Fiber	g	0.8	0.0	0.0	0.0	0	0
Protein	g	1.1	3.3	3.4	3.1	3.3	3.4
Sodium	mg	0.0	50	45	48	47	not reported
Vitamin D	µg	1.1	0.8	0.10	0.03	0.03	0
Riboflavin	mg	0.2		0.17	0.19	not reported	not reported
Vitamin B12	µg	0.4	0.31	not reported	0.3	0.2	not reported
Calcium	mg	120	120	116	124	120	130
Iodine	µg	22.5	20	24.3	not reported	15	16
Iron	mg	not reported	0.0	0.0	not reported	0.2	0
Potassium	mg	not reported	155	not reported	157	150	not reported
Vitamin A	µg	not reported	33	30	46	40	not reported
Phosphorus	mg	not reported	95	not reported	92	95	not reported

Source Oatly: https://www.oatly.com/en-gb/products/oat-drink/oat-drink-barista-edition-1l

Source Belgium: https://www.internubel.be/Groups.aspx?lId=1&gId=67&mgId=66&pId=4160

Source Denmark: https://www.food.dtu.dk/english/#:~:text=At%20the%20forefront%20of%20healthy,and%20creates%20sustainable%20technological%20solutions.

Source for Spain: https://www.fen.org.es/storage/app/media/informe-la-leche-como-vehiculo-de-salud-para-la-poblacion-2015-ok.pdf

Source Italy: https://bda.ieo.it

Source for Norway: https://vkm.no/download/18.27c517ea18beb99c14bc5873/1701246824798/Mapping%20of%20nutrients,%20food%20additives%20and%20contaminants%20in%20plant-based%20and%20gluten-free%20food%20products_Final_29.11.2023.pdf

Appendix VI Critical Review Statement and Report

Critical Review Statement

The life cycle assessment (LCA) study *LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk* addendum to the report *"LCA of Oatly Barista and comparison with cow's milk"* was commissioned by Oatly (commissioner of the study) and carried out by Blonk Consultants (practitioner of the LCA study). Blonk Consultants commissioned a panel of external experts to review the study *LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk*. The study was critically reviewed by an international panel of experts comprising:

- Jasmina Burek (chair): Assistant Professor, University of Massachusetts Lowell, United States
- Jens Lansche: LCA expert and project manager, Switzerland
- Joseph Poore: Director of the Oxford Martin Programme on Food Sustainability, United Kingdom
- Hayo van der Werf: LCA expert, France

All members of the review panel were independent of any party with a commercial interest in the study. The following is a final statement by the external review panel based on the review of the Draft Report, a version of the document submitted on July 12, 2024.

Critical Review Process
The critical review was performed based on ISO 14044:2006 standard, by a panel of interested parties (ISO 14044, 2006). The critical review panel followed the ISO/TS critical review process guidelines (ISO/TS, 2014). The panel performed the critical review at the end of the LCA study, after LCA practitioners provided the full draft of the LCA report. This is because this study closely follows methods of previously peer reviewed report "LCA of Oatly Barista and comparison with cow's milk", by the same expert panel. Two subsequent sets of review comments were performed after LCA practitioners provided the full draft of the LCA report to the critical review panel. The reviewers took part in communication via email. The critical review report (Appendix VI) includes panel review comments and recommendations and the corresponding responses given by the practitioner of the LCA study.

The critical review panel found the LCA study to be in conformance with ISO 14040 and ISO 14044 standards (ISO 14040, 2006; ISO 14044, 2006) including:

- the methods used to carry out the LCA were consistent with the applicable international standards
- the methods used to carry out the LCA were scientifically and technically valid
- the data used were appropriate and reasonable in relation to the goal of the study
- the interpretations reflected the limitations identified and the goal of the study, and
- the study report was transparent and consistent.

The critical review did not verify nor validate the goals that are chosen for an LCA by the commissioner of the LCA study, nor the ways in which the LCA results are used (ISO/TS, 2014). Finally, following the ISO/TS standard (ISO/TS, 2014) this critical review in no way implies an endorsement of any comparative assertion that is based on an LCA study. The panel asserts conformity with the ISO standards followed (ISO 14040, 2006; ISO 14044, 2006; ISO/TS, 2014) and a scientifically and technically valid methodological approach and results interpretation.

The critical-review process involved the following:

- a review of a draft report according to the above criteria and recommendations for improvements to the study and the report; and
- a review of the final version of the report, in which the authors of the study fully addressed the points as suggested in the draft critical review.

Because the *LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk* study builds on the foundations of the previous LCA studies study for Oatly, i.e., "*LCA of Oatly Barista and comparison with cow's milk",* reviewed by the same external review panel, all reviewers' comments were provided via email including:

- June 18, 2024 – reviewers provided comments on the draft of the final LCA report via email.
- July 8, 2024 - reviewers validated changes from the previous review and identified minor editorial changes on the final LCA report via email.

After each review, the LCA practitioner responded and/or and documented the adopted changes and implementation in the next version of the draft report. The Critical Review Report (Appendix VI) includes panel review comments and recommendations and the corresponding responses given by the practitioner of the LCA study.

The review panel concludes based on the goals set forth to review this study, that the study generally conforms to the applicable ISO standards as a comprehensive study that may be disclosed to the public.

The reviewers recognize the tremendous work of the LCA practitioners and stakeholder in completing this study.

July 12, 2024

Dr. Jasmina Burek	Dr. Jens Lansche	Dr. Joseph Poore	Dr. Hayo van der Werf
Panel Chair	Panel Member	Panel Member	Panel Member

LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk

Addendum to the report "LCA of Oatly Barista and comparison with cow's milk", published on 7 December 2022

Version of the document submitted on July 12, 2024

Critical Review Report

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1. Introduction

The **Critical Review Report** is the summary report documenting the critical review process according to the ISO/TS 14071:2014 Standard - Environmental management -- Life cycle assessment -- Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006. The **Critical Review Report** provides details of the complete review process (ISO/TS, 2014) and includes all review comment iterations of the study "*LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk*", which is addendum to the report *"LCA of Oatly Barista and comparison with cow's milk".* The study "*LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk*" was commissioned by Oatly and life cycle assessment (LCA) was performed by Blonk Consultants. The critical review was commissioned by the practitioners of the LCA study. Critical review was carried out by a panel of reviewers, as defined in ISO 14044:2006 (ISO 14044, 2006). The **Critical Review Report** was prepared by the critical review panel. The **Critical Review Report** applies to the final version *"LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk"*, published on July 12, 2024.

2. Critical Review Process

The critical review panel followed the ISO/TS critical review process guidelines (ISO/TS, 2014). Because this LCA study includes results which are intended to be used to support a comparative assertion intended to be disclosed to the public, per critical review process guidelines (ISO/TS, 2014), the critical review was conducted by a panel.

Two sets of reviewer comments were provided after LCA practitioners provided the full draft of the LCA report to the critical review panel. The critical review report includes panel review comments and recommendations, and the corresponding responses given by the practitioner of the LCA study.

Per critical review process guidelines (ISO/TS, 2014), the goal of this critical review was to verify that:

- the methods used to carry out the LCA study are consistent with the 14040/14044 International Standards (ISO 14040, 2006; ISO 14044, 2006),
- the methods used to carry out the LCA are scientifically and technically valid,
- the data used are appropriate and reasonable in relation to the goal of the study,
- the interpretations reflect the limitations identified and the goal of the study,
- the study report is transparent and consistent.

However, critical review can neither verify nor validate the goals that are chosen for an LCA by the commissioner of the LCA study, nor the ways in which the LCA results are used (ISO/TS, 2014). Finally, following the ISO/TS standard (ISO/TS, 2014) this critical review in no way implies an endorsement of any comparative assertion that is based on an LCA study.

The review was performed by an independent expert panel composed of four members. The critical-review process involved the following:

- a review of a draft report according to the above criteria and recommendations for improvements to the study and the report; and

- a review of the final version of the report, in which the authors of the study fully addressed the points as suggested in the critical review.

3. Critical Review Results

This section includes a summary of the critical review. A complete list of comments addressing specific statements on the draft LCA report provided by the critical review panelists and subsequent revisions is provided in Appendix VI.

The reviewers recognize the remarkable effort by the LCA practitioners (Blonk Consultants) in conducting the comparative LCA study as well as the stakeholder (Oatly) that provided primary data as well as critical comments. The critical review panel pointed out both the strengths as well as key areas of improvement necessary to conform to the 14040/14044 International Standards (ISO 14040, 2006; ISO 14044, 2006).

3.1. Consistency with 14040/14044 International Standards

The final LCA report is consistent with the 14040 and 14044 International Standards (ISO 14040, 2006; ISO 14044, 2006) and the European Product Environmental Footprint Category Rules (PEFCR) (European Commission, 2017). It was not deemed necessary to repeat all sensitivity analyses, considering that the environmental impacts related to Oatly Barista (main report), are comparable to the results of Oatly Barista at point-of-sale Denmark, Norway, Belgium, Italy and Spain. Thus, the conclusions that were drawn based on the sensitivity analyses in the main report also apply to the products in this addendum.

The study is comprehensive in scope and contains a wealth of information and data related to Oatly Barista product supply chains in their respective sales countries, i.e., Denmark, Norway, Belgium, Italy and Spain. The authors provided information about why the critical review is being undertaken and what data collection covered and to what level of detail and how comparison with the milk was conducted.

3.2. Life Cycle Assessment Approach and Life Cycle Impact Assessment Method

The authors computed results following the attributional LCA approach. In a baseline scenario, Oatly Barista was compared to 1 l of cow milk at the point of sale, i.e., Denmark, Norway, Belgium, Italy and Spain. The life cycle impact assessment was performed using ten key midpoint environmental impact categories from the ReCiPe 2016 impact assessment method (Huijbregts et al., 2016). Overall, the methodology to evaluate the results of the impact assessment and support conclusion are considered appropriate for the goal and scope of the study.

3.3. Data Used for Life Cycle Inventory in Relation to the Goal of the Study

The life cycle inventory (LCI) data necessary to perform LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain markets was taken from the main Oatly Barista report with exception to (1) energy and water use at the Vlissingen and Landskrona factories was updated to 2022 data, (2) background data have been updated to Agri-footprint 3.6, and Ecoinvent 3.9 LCI databases, (3) country-specific distribution data from the Vlissingen and Landskrona factories to Denmark, Norway, Belgium, Italy and Spain, for both ambient and chilled versions of Barista was updated to recent year, and (4) Denmark, Norway, Belgium, Italy and Spain cow's milk supply chain LCI data was obtained from recent literature and LCI database. The authors of the final report clearly described LCIs and data sources. Also, authors provided information about robustness and limitations of the data used for Oatly Barista and cow's milk LCI and assumptions for uncertainty analyses. Overall, the data used is considered appropriate and reasonable for the goal and scope of the study. Finally, the analysis of Oatly Barista and its comparison to cow's milk in the markets assessed lead to similar conclusions as in the main report.

3.4. Interpretation and Limitations within the Goal of the Study

The selected results help to understand the study's conclusions and adequately support derived interpretation. Overall, interpretation of results and limitations of the study discussed in the report are considered appropriate for the goal of the study.

3.5. Transparency and Consistency of the Final Report

The authors provided an addendum report following the 14040/14044 International Standards (ISO 14040, 2006; ISO 14044, 2006) and supplemental information with information concerning the data and methodology used and differences from the main report. The addendum report describes the LCA framework including goal and scope, LCI, LCIA, results and interpretation and conclusion. The key aspects of the data used is described in the LCI section and accompanied with the main Oatly Barista report, which provides more details on the data sources. Overall, the information given in the documentation is considered appropriate for understanding the methodology and data basis for most topics.

Literature

European Commission, 2017. Product Environmental Footprint Category Rules Guidance. PEFCR Guid. Doc. - Guid. Dev. Prod. Environ. Footpr. Categ. Rules (PEFCRs), version 6.3, December 2017. 238.

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ISO/TS, 2014. ISO/TS 14071:2014 - Environmental management -- Life cycle assessment -- Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006 [WWW Document]. URL https://www.iso.org/standard/61103.html (accessed 6.21.19).

ISO 14040, 2006. ISO 14040:2006 - Environmental management - life cycle assessment - principles and framework [WWW Document]. ISO. URL https://www.iso.org/standard/37456.html (accessed 2.22.17).

ISO 14044, 2006. Environmental management - Life cycle assessment — Requirements and guidelines (International Organization for Standardization).

4. List of Specific Reviewer Comments Recommendations and Corresponding Responses

The Critical Review Panel provided comments on 2 iterations of the draft report. These comments were addressed and/or incorporated in the final version of the report by the LCA practitioners. The review statement and review panel report including comments of the experts and any responses to recommendations made by the reviewers or by the panel have been included in the final LCA report.

Template for CR comments and commissioner & practitioner responses

Date: March 2024 – July 2024	Document: **LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk**	Project:

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
HW	27			ed	Change "June2024" to "June 2024"	Adjust	Done.
HW	63			ed	Change "Oatly Barista" to "ambient Oatly Barista"	Adjust.	Done.
HW	76			ed	Change "three" to "four".	Adjust.	Done.
HW	100			ed	Change "Oatly Barista" to "chilled Oatly Barista"	Adjust	Done.
HW	122			ed	Change "Oatly Barista and Oaty Ambient and chilled" to "Oatly Barista ambient and chilled versions"	Adjust.	Done.
HW	149			ed	Change "lead" to "led".	Adjust.	Done.
HW			Table 3	ed	Strange that Oatly for Belgium has a German name (Hafer), and that Oatly for Italy has a French name (Avoine). Also Reference flow and storage condition for cow's milk for Belgium is not given in the "chilled" part of this table.	Check.	Hafer corrected to haver. IT is part of IT/FR/ES/PT market group, so Avena/Avoine Barista Edition is used on that pack.
HW	198			ed	Change "list" to "lists"	Adjust.	Done.
HW	206			ed	I would suggest to further develop the tiitle of this table, e.g. : REFERENCE FLOWS, LOCAL NAME, STORAGE CONDITION, TYPE, PRODUCTION LOCATION AND COUNTRY OF SALE OF THE OATLY BARISTA PRODUCTS AND COW'S MILK	Adjust.	Done.
HW	240			te	Mention also the contribution of Valentina Caldart.	Adjust.	Done.
HW	330			ed	Change "END-TO-END FACTORY" to "END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY"	Adjust.	Done.
HW	389			ed	Change "as well as" to "as well as to"	Adjust.	Done.
HW	390			ed	Delete "for".	Adjust.	Done.
HW	391-392			te	Fig. 5f does not show the contribution of mineral fertilizer use for cultivation. Normally, the contribution of mineral fertiliser use to mineral resource scarcity would be part of the production of raw materials, i.e. oats or milk. If it is this that you want to point out, it requires a bit more explanation.	Adjust.	Done. Rephrased as packaging is only largest contributor for ambient version.

1 Initials of the **Reviewer**
2 **Type of comment: ge** = general **te** = technical **ed** = editorial

Template for CR comments and commissioner & practitioner responses

Date: March 2024 – July 2024	Document: **LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk**	Project:

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of com-ment[2]	Comments	Proposed change	Response of the commissioner & practitioner
HW	393-394			te	Regarding fossil resource scarcity, it would be good to also mention that for the SE factory the contribution of packaging is important (more so than that of distribution and processing).	Adjust.	Done. For DK and NO actually raw materials has slightly higher contribution than packaging.
HW	426			ed	Change "E*" to "e*"	Adjust.	Done.
HW	476			ed	Change "in" to "for".	Adjust.	Done.
HW	510-511			ed	"When it comes to fossil resource scarcity, the impact of the Oatly Barista is significantly lower for Norway, Denmark and Belgium produced in Sweden." This can be deleted, since lines 518-523 give a more detailed account of results for fossil resource scarcity, including what is said here.	Adjust.	Done.
HW	539			ed	Change "three" to "five".	Adjust.	Done.
HW	550			ed	Change "remaining" to "other".	Adjust.	Done.
HW	762			te	Polish, Irish and French dairy systems are mentioned here, this must be an error.	Can you correct?	Done.
HW	765		Table A	te	Not the right table, I think.	Can you check?	Done, table still had to be updated.
HW	786		Table D	te	I assume that these data are per cow per year. So, it would be good to add "Yearly" to the title of the table.	Adjust.	Done.
HW	793		Table E	te	For DK and ES calves < 1 yr are present twice in the table, heifers are missing.	Can you check?	Done. Corrected.
HW	807			ed	Delete "where,"	Adjust.	Done.
HW	817-818			te	"no literature source reported on diesel use at farm, hence it was assumed that no diesel is used as a conservative approach." You cannot really call thuis a conservative approach, a conservative approach is one in which your assumptions are such that there is no risk of underestimating the impact. If you assume that no diesel was used you probably will underestimate the impact. A better approach here would be, for example, to assume that diesel consumption is identical to that of Sweden, the neighbour country. This is what you do for water use as mentioned in the next sentence.	Can you adjust?	It is a conservative assumption in relation to the comparison to Oatly products. If cow's milk would be considered stand alone, this would indeed not be a conservative assumption.

1 Initials of the **Reviewer**
2 **Type of comment: ge** = general **te** = technical **ed** = editorial

Template for CR comments and commissioner & practitioner responses

Date: March 2024 – July 2024	Document: **LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk**	Project:

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
JP			Table 5	ed	The units in this table are not consistent with the units in the data tables. E.g., for land occupation in Table 1 you have the units m2a, but in this table you have m2 * yr.	Make units consistent throughout report.	Done.
JP	435			ed	"Countries" should read "country's".	Change text.	Done, rephrased.
JP			Appendix II	ed	Sometimes you use "tons" rather than "tonnes".	Fix instances.	Done.
JP			Fig. 5	ed	The display of the text "Ambient" and "Chilled" in the figures is sometimes overlapping.	Fix text (e.g., reduce font size slightly).	Done. Reduced font size a bit. Still slight overlap but reducing font size even further compromises readability.
VC	107		Fig 2	ed	NO = Norway can be removed from list of abbreviations since it's not used in this figure	Remove NO = Norway	Done.
VC	145			ed	For Belgium, the fossil resource scarcity impact of Oatly Barista is lower than cow's milk when Oatly Barista is sourced from the Swedish factory, but higher impact when sourced from the Dutch factory.	Remove the second "impact"	Done.
VC	255			ed	Too many closing brackets in "crops (see M. A. J. Huijbregts, Steinmann, Elshout, & Stam, 2016) for more information),"	Remove bracket after 2016	Done.
VC			Table 5	ed	"The widely.." should be capitalised (Increase in global average temperature by the emission of greenhouse gases. the widely used global warming potential (GWP) quantifies the…)	Capitalise "The widely"	Done.
VC			Table 5	ed	"Accumulation of nutrients in water overstimulate" – should be "overstimulates"	Change verb for both marine and freshwater eutrophication	Done.
VC			Table 5	ed	"The primary extraction of a mineral resource will lead to an overall decrease the concentration of that resource in ores worldwide" – missing "of" (decrease OF thew concentration)	Add "of"	Done.
VC	311			ed	"Results area comparable" should be "are comparable"	Fix typo	Done.
VC			Figure 5h	ed	Some of the "Ambient" and "Chilled" terms are overlapping which makes it difficult to read	Get rid of the overlapping	Done. Reduced font size a bit. Still slight overlap but reducing font size even further compromises readability.

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

Template for CR comments and commissioner & practitioner responses

Date: March 2024 – July 2024	Document: **LCA of Oatly Barista for Denmark, Norway, Belgium, Italy and Spain, and comparison with cow's milk**	Project:

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
VC	712			ge	The table says that fiber residue in the NL factory is used for biogas. Is the biogas used within the factory/is there any plan to do that in the near future? If yes, it could be interesting to mention it in the report?		It is actually mainly used as animal feed, this is corrected.
VC			Appendix II, 2&3	ed	From text in box 2, it looks like one of the mills is in Belgium and the others in Sweden, while box 3 says the mills are in Sweden and Denmark	Make the two consistent	Done.
JB	255			ed	Extra parentheses (see M. A. J. Huijbregts, Steinmann, Elshout, & Stam, 2016) for more information)	Remove middle parentheses	Done.
JB	403			te	Adding numerical values for milk yield and feed intake of Danish cows would strengthen the statement.	Provide numerical values of milk yield and feed intake vs the other countries range	Done.
JB	539			ed	Three sales markets	Change "three" to "five"	Done.
JB	762			ed	"Polish, Irish and French dairy systems,"	Replace with correct markets	Done.
JB	765		Table A	ed		Add milk yield and feed intake and Update reference	Done.
JB	793		Table E	te		Add an explanation of differences between compound and farm grown feed intake for different countries.	This is an Annex copied from the Agri-footprint methodology document. Further information can be found in that document.
JL			Table 4		The "x" used in the table are of different size	Adjust	Done.
JL			Table 5		"kg N-eq to marine water" instead of "Kg N-eq to marine water"	Correct	Done
JL	311				"Results are comparable" instead of "Results area comparable"	Correct	Done.
JL	390				"Exceptions are" instead of "Exceptions for are"	Correct	Done.
JL			Figure 5		"Ambient" and "chilled" overlap for some markets	Adjust	Done. Reduced font size a bit. Still slight overlap but reducing font size even further compromises readability.
JL	475				"than" instead of "that"	Correct	Done.

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Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of com-ment[2]	Comments	Proposed change	Response of the commissioner & practitioner
JL	539				"five" instead of "three"	Correct	Done.
JL			Appendix III – Table E		Font size fpr type of animal for DK differs from other countries	Adjust	Done.
JL	816				"To the author's knowledge, no literature source reported on diesel use at farm, hence it was assumed that no diesel is used as a conservative approach" It does not seem plausible that no diesel/fuel is used on Norwegian dairy farms and it should not be called a conservative approach to go with this assumption.	Please check	It is a conservative assumption in relation to the comparison to Oatly products. If cow's milk would be considered stand alone, this would indeed not be a conservative assumption.
Comments on revised version dated June 21, 2024							
HW	476			ed	Change "in" to "for".	Adjust.	Done
HW	801		Table A	ed	"CONAFE, 2021" is not in reference list.	Adjust.	Done
HW	900			ed	"Norwegian Environmental Agency (2022)" is present in reference list but does not seem to be cited in the report.	Can you check?	It is cited (as reference for the NIR) in the second paragraph under B) Cow's milk for Norway

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5. Self-declaration of independence

I, the signatory, hereby declare that:

- I am not a full-time or part-time employee of the commissioner or practitioner of the LCA study
- I have not been involved in defining the scope or carrying out any of the work to conduct the LCA study at hand, i.e. I have not been part of the commissioner's or practitioner's project team(s)
- I do not have vested financial, political, or other interests in the outcome of the study

I declare that the above statements are truthful and complete.

Date: July 12, 2024

Name: Dr. Jasmina Burek

Signature:

Name: Dr. Jens Lansche

Signature:

Name: Dr. Joseph Poore

Signature:

Name: Dr. Hayo van der Werf

Signature:

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