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LCA of Oatly “No” Sugars and Oatly Oat Drink (Whole/Semi/Light), 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 "No" Sugars and Oatly Oat Drink (Whole, Semi and Light) to cow's milk in five key sales markets in Europe: Germany, the Netherlands, the United Kingdom, Sweden, and Finland. 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 went through a critical review according to ISO 14040/14044/14071 standards. This addendum should be read in conjunction with the main report. The methodology, data use, and assumptions made, are described in detail in the main report, and have remained unchanged for this report. The only change that applies to the products in scope for this addendum concerns the recipe of the products, which is similar to the recipe analysed in the main report but with few differences as further described in Chapter 3 (Life Cycle Inventory) below. The main conclusions from the Oatly Barista study therefore also apply to this addendum.

The functional unit considered for this study is 1 liter of Oatly product/cow's milk at retail, including packaging manufacturing and packaging end of life. 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 (plastic, beverage carton, aseptic/chilled) in each country. The foreground data for Oatly "No" Sugars and Oatly Oat Drink (Whole, Semi and Light) 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]. For the cow's milk, data and statistics at a national level were used.

The 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 February and April 2023.

Results

As can be seen in Table 1 below, Oatly "No" Sugars products in scope have a lower impact than cow's milk for climate change (50% to 69% lower), fine particulate matter formation (56% to 93% lower), terrestrial acidification (69% to 79% lower), freshwater eutrophication (47% to 61% lower), marine eutrophication (70% to 79% lower), land use (17% to 57% lower), land occupation (32% to 61% lower) and water consumption (5% to 25% lower). The conclusions for the remaining impact categories (mineral resource scarcity and fossil resource scarcity) varied depending on the case, being either higher, similar or lower for Oatly "No" Sugars compared to cow's milk. The impact for fossil resource scarcity is related to different distribution distances (with Oatly "No" Sugars for the Dutch market and the chilled version of Oatly "No" Sugars for the UK market having relatively short transport distances), and the impact for mineral resource scarcity is related to the use of aluminium in ambient beverage cartons. Table 1 presents the differences in detail.

[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.

TABLE 1: RELATIVE DIFFERENCES OF OATLY "NO" SUGARS COMPARED TO COW'S MILK AT RETAIL INCLUDING PACKAGING END-OF-LIFE. FOR EXAMPLE, -69% INDICATES THAT OATLY "NO" SUGARS HAS A 69% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY "NO" SUGARS. YELLOW: THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS. THE RESULTS REFER ONLY TO PRODUCTS PRODUCED AT OATLY'S HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND; CLD = CHILLED

Country	Product	Climate change	Fine particulate matter	Terrestrial acidify-cation	Freshwater eutrophi-cation	Marine eutrophi-cation	Land use	Land occu-pation	Mineral resource scarcity	Fossil resource scarcity	Water consum-ption
		kg CO_2 eq	*kg PM2.5 eq*	*kg SO_2 eq*	*kg P eq*	*kg N eq*	*m^2a crop eq*	*m^2a*	*kg Cu eq*	*kg oil eq*	*m^3*
DE	Oatly "No" Sugars	-69%	-89%	-79%	-61%	-79%	-42%	-58%	-4%	-3%	-14%
	Oatly "No" Sugars (cld)	-66%	-89%	-79%	-61%	-79%	-41%	-58%	-25%	-2%	-13%
NL	Oatly "No" Sugars	-64%	-93%	-75%	-55%	-71%	-17%	-32%	43%	-12%	-25%
UK	Oatly "No" Sugars	-62%	-88%	-69%	-50%	-73%	-37%	-48%	33%	-8%	-12%
	Oatly "No" Sugars (cld)	-64%	-90%	-73%	-52%	-73%	-37%	-47%	1%	-21%	-11%
SE	Oatly "No" Sugars	-50%	-56%	-75%	-47%	-70%	-51%	-55%	10%	31%	-5%
FI	Oatly "No" Sugars	-67%	-65%	-78%	-49%	-75%	-57%	-61%	-9%	11%	-10%

Table 2 indicates that the Oatly Oat Drink (Whole, Semi and Light) products in scope have a lower impact than cow's milk for climate change (58% to 80% lower), fine particulate matter formation (60% to 92% lower), terrestrial acidification (64% to 82% lower), freshwater eutrophication (45% to 60% lower), marine eutrophication (62% to 78% lower), land occupation (18% to 65% lower), and water consumption (13% to 49% lower). The conclusions for the remaining impact categories (land use, mineral resource scarcity and fossil resource scarcity) varied depending on the country and factory.

TABLE 2: RELATIVE DIFFERENCES OF OATLY OAT DRINK (WHOLE, SEMI AND LIGHT) COMPARED TO COW'S MILK AT RETAIL INCLUDING PACKAGING END-OF-LIFE. FOR EXAMPLE, -66% INDICATES THAT OATLY OAT DRINK HAS A 66% LOWER IMPACT COMPARED TO COW'S MILK. THE DIFFERENCES HAVE BEEN COLOR-CODED AS FOLLOWS: RED – MORE THAN 10% DIFFERENCE FAVORING COW'S MILK. GREEN – MORE THAN 10% DIFFERENCE FAVORING OATLY OAT DRINK (WHOLE, SEMI AND LIGHT). YELLOW: THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS. THE RESULTS REFER ONLY TO PRODUCTS PRODUCED AT OATLY'S HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS (FOR THE PRODUCTS AVAILABLE IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM), AND OATLY'S END-TO-END FACTORY IN LANDSKRONA, SWEDEN (FOR THE PRODUCTS AVAILABLE IN SWEDEN AND FINLAND). COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND.

Country	Product	Climate change	Fine particulate matter	Terrestrial acidify-cation	Freshwater eutrophi-cation	Marine eutrophi-cation	Land use	Land occu-pation	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*
DE	Oatly Oat drink Whole	-66%	-88%	-76%	-57%	-73%	-28%	-49%	2%	3%	-15%
	Oatly Oat drink Semi	-67%	-89%	-78%	-60%	-77%	-36%	-54%	-1%	0%	-15%
NL	Oatly Oat drink Whole	-60%	-92%	-71%	-50%	-62%	4%	-18%	53%	-6%	-26%
	Oatly Oat drink Semi	-62%	-92%	-74%	-53%	-68%	-8%	-26%	48%	-9%	-26%
UK	Oatly Oat drink Whole	-58%	-87%	-64%	-45%	-65%	-22%	-36%	41%	-3%	-13%
	Oatly Oat drink Semi	-60%	-87%	-68%	-48%	-70%	-31%	-43%	36%	-6%	-14%
	Oatly Oat drink Light	-63%	-88%	-70%	-51%	-75%	-39%	-49%	31%	-9%	-15%

TABLE 2 (CONTINUED)

Country	Product	Climate change kg CO2 eq	Fine particulate matter kg PM2.5 eq	Terrestrial acidify-cation kg SO2 eq	Freshwater eutrophi-cation kg P eq	Marine eutrophi-cation kg N eq	Land use m2a crop eq	Land occu-pation m2a	Mineral resource scarcity kg Cu eq	Fossil resource scarcity kg oil eq	Water consum-ption m3
SE	Oatly Oat drink Whole	-65%	-60%	-75%	-45%	-63%	-43%	-48%	22%	-43%	-46%
	Oatly Oat drink Semi	-67%	-63%	-77%	-49%	-69%	-50%	-54%	18%	-46%	-46%
	Oatly Oat drink Light	-70%	-65%	-80%	-52%	-74%	-57%	-59%	13%	-49%	-47%
FI	Oatly Oat drink Whole	-77%	-68%	-78%	-48%	-68%	-50%	-55%	1%	-50%	-48%
	Oatly Oat drink Semi	-78%	-70%	-80%	-51%	-73%	-56%	-60%	-2%	-52%	-49%
	Oatly Oat drink Light	-80%	-72%	-82%	-53%	-78%	-62%	-65%	-6%	-55%	-49%

The significance of the differences has been determined by an uncertainty analysis and are integrated in the conclusions below. A sensitivity analyses which compares the Whole, Semi and Light Oat Drink products to cow's milk with corresponding fat content, shows results in a similar range (e.g. 56%-80% lower climate change impact for Oatly Oat Drink).

The main report included further sensitivity analyses, which also apply to the products evaluated in this addendum, as these products are very similar and show a comparable or lower impact than Oatly Barista produced in the same factories. 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 (chilled distribution, 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 Oatly "No" Sugars and Oaty Oat Drink (Whole, Semi and Light).

Oatly "No" Sugars:

- Oatly "No" Sugars has a significant lower impact than cow's milk for the impact categories climate change (50% to 69% lower), fine particulate matter formation (56% to 93% lower), terrestrial acidification (69% to 79% lower), land occupation (32% to 61% lower), freshwater eutrophication (47% to 61% lower), and marine eutrophication (70% to 79% lower).
- Oatly "No" Sugars has a lower impact than cow's milk for water consumption (5% to 25% lower) and land use (17% to 57% lower), though the difference is not significant in some cases.
- For mineral resource scarcity and fossil resource scarcity, the differences between Oatly "No" Sugars and cow's milk vary between significantly higher, lower, or insignificant (25% lower to 43% higher for mineral resource scarcity, 21% lower to 31% higher for fossil resource scarcity).

Oatly Oat Drink (Whole/Semi/Light):

- Oatly Oat Drink (Whole, Semi and Light) has a significantly lower impact than cow's milk for the impact categories climate change (58% to 80% lower), fine particulate matter formation (60% to 92% lower), terrestrial acidification (64% to 82% lower), freshwater eutrophication (45% to 60% lower), and marine eutrophication (62% to 78% lower).
- Oatly Oat Drink (Whole, Semi and Light) has a lower impact than cow's milk for water consumption (13% to 49% lower) and land occupation (18% to 65% lower), though the difference is not significant in some cases. For land use (-62% lower to 4% higher), Oatly Oat Drink (Whole, Semi and Light) has a

lower (though in some cases not significantly) land use impact than cow's milk for all cases except for Oatly Oat Drink Whole at retail in the Netherlands, where the difference is comparable (4% higher, though not significant).

- For fossil resource scarcity, the Oatly Oat Drink (Whole, Semi and Light) produced in Landskrona, Sweden (available at retail in Sweden and Finland) has a significantly lower impact than cow's milk (43% to 55% lower). The Oatly Oat Drink produced in Vlissingen, the Netherlands (available at retail in the Netherlands, Germany and the United Kingdom), has a lower or higher fossil resource scarcity than cow's milk (though not significant), depending on the case (9% lower to 3% higher). This is related to the use of renewable energy at the Oatly factory in Landskrona.
- When it comes to mineral resource scarcity, Oatly Oat Drink (Whole, Semi and Light) has in most cases a higher impact than cow's milk (6% lower to 53% higher) which can be mainly attributed to the use of aluminium in ambient beverage cartons.

Overall, the analysis of Oatly Barista (in the main report), Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) in the markets assessed lead to similar conclusions when comparing 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.

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)[2] and will from now on be referred to in this addendum as "the main report". This addendum investigates 4 further products from Oatly: Oatly "No" Sugars, Oatly Oat Drink Whole (2.8% fat), Oatly Oat Drink Semi (1.5% fat), and Oatly Oat Drink Light (0.5% fat), for key European markets. The exact products and markets in scope are listed in Table 3 and Table 4 below. Like with Oatly Barista in the main report, these products are compared to cow's milk produced in the country of sale.

The methodology, data use, and assumptions made, are described in detail in the main report, and have remained unchanged for this report. The main change that applies to the new products in scope is the recipe of the products, which is similar to the recipe analysed in the main report but with few differences as further described in Chapter 3 (Life Cycle Inventory) below. Another change is that fewer distribution scenarios are included (but using the exact same distribution data), and that Oatly "No" Sugars is also available as a chilled version in two countries (based on chilled packaging that was included as a sensitivity analysis in the main report). The packaging size is identical to the main report (1 liter beverage carton) for all products.

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 the same review panel as for 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.

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 impact of Oatly "No" Sugars and Oatly Oat Drink (Whole, Semi and Light) for five European markets, and in addition 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 "No" Sugars (chilled or ambient) or Oatly Oat Drink Whole/Semi/Light (ambient), including packaging, at retail or food service.
- 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)

[2] 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

Table 3 and Table 4 list the reference flows related to the Oatly products in scope, as well as for their cow's milk equivalents.

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.

TABLE 3: REFERENCE FLOWS OF THE OATLY "NO" SUGARS PRODUCTS AND COW'S MILK

Oatly "No" Sugars…				**…Compared with cow's milk**			
Reference flow	Storage condition	Produced in	Sold in	Reference flow	Cow's milk	Produced in	Sold in
1 liter	Ambient	Vlissingen, the Netherlands	United Kingdom	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (HDPE container)	United Kingdom	United Kingdom (under chilled conditions)
1 liter	Chilled	Vlissingen, the Netherlands	United Kingdom	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (HDPE container)	United Kingdom	United Kingdom (under chilled conditions)
1 liter	Ambient	Vlissingen, the Netherlands	Germany	1 liter	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Germany	Germany (under ambient conditions)
1 liter	Chilled	Vlissingen, the Netherlands	Germany	1 liter	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Germany	Germany (under ambient conditions)
1 liter	Ambient	Vlissingen, the Netherlands	Netherlands	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	The Netherlands	The Netherlands (under chilled conditions)
1 liter	Ambient	Vlissingen, the Netherlands	Sweden	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Sweden	Sweden (under chilled conditions)
1 liter	Ambient	Vlissingen, the Netherlands	Finland	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Finland	Finland (under chilled conditions)

TABLE 4: REFERENCE FLOWS OF THE OATLY OAT DRINK (WHOLE/SEMI/LIGHT) PRODUCTS AND COW'S MILK

Oatly Oat Drink (ambient storage)…				**…Compared with cow's milk**			
Reference flow	Local name	Produced in	Sold in	Reference flow	Cow's milk	Produced in	Sold in
1 liter	Oatly Oat Drink 2,8%	Landskrona, Sweden	Sweden	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Sweden	Sweden (under chilled conditions)
1 liter	Oatly Oat Drink 2,8%	Landskrona, Sweden	Finland	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Finland	Finland (under chilled conditions)
1 liter	Oatly Oat Drink 1,5%	Landskrona, Sweden	Sweden	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Sweden	Sweden (under chilled conditions)
1 liter	Oatly Oat Drink 1,5%	Landskrona, Sweden	Finland	1 liter	Mix of HTST-treated whole and (semi-)	Finland	Finland (under chilled conditions)

					skimmed milk (beverage carton)		
1 liter	Oatly Oat Drink 0,5%	Landskrona, Sweden	Sweden	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Sweden	Sweden (under chilled conditions)
1 liter	Oatly Oat Drink 0,5%	Landskrona, Sweden	Finland	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	Finland	Finland (under chilled conditions)
1 liter	Oatly Oat Drink Whole GB	Vlissingen, the Netherlands	United Kingdom	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (HDPE container)	United Kingdom	United Kingdom (under chilled conditions)
1 liter	Oatly Oat Drink Semi	Vlissingen, the Netherlands	United Kingdom	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (HDPE container)	United Kingdom	United Kingdom (under chilled conditions)
1 liter	Oatly Oat Drink Light	Vlissingen, the Netherlands	United Kingdom	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (HDPE container)	United Kingdom	United Kingdom (under chilled conditions)
1 liter	Oatly Haferdrink Voll	Vlissingen, the Netherlands	Germany	1 liter	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Germany	Germany (under ambient conditions)
1 liter	Oatly Haferdrink Fettarm	Vlissingen, the Netherlands	Germany	1 liter	Mix of UHT-treated whole and (semi-) skimmed milk (beverage carton)	Germany	Germany (under ambient conditions)
1 liter	Oatly Haverdrank Vol	Vlissingen, the Netherlands	Netherlands	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	The Netherlands	The Netherlands (under chilled conditions)
1 liter	Oatly Haverdrank halfvol	Vlissingen, the Netherlands	Netherlands	1 liter	Mix of HTST-treated whole and (semi-) skimmed milk (beverage carton)	The Netherlands	The Netherlands (under chilled conditions)

Oatly "No" Sugars

Oatly "No" Sugars are sugar-free oat drinks with added vitamins and minerals. For these products, the manufacturing processing conditions, which involve the breaking down of carbohydrates into natural sugars, have been changed compared to other oat drinks, making this a product that contains no sugars.

Oatly "No" Sugars is solely produced in the hybrid factory located in Vlissingen, the Netherlands, and from there distributed to the Netherlands, Germany, United Kingdom, Sweden, and Finland. For all markets, "No" Sugars is produced as an ambient product. For the German and UK markets, also a chilled version is produced next to the ambient version. This entails a different beverage carton, as well as chilled distribution (transport and warehouses).

Oatly Oat Drink

Oatly Oat Drink Whole/Semi/Light is an oat-based drink, that is fortified with calcium, minerals, and vitamins. In line with the fat content (2.8%, 1.5% and 0.5% for Whole, Semi and Light respectively), also rapeseed oil is added (not in the light version). The drink is known under different market names in the countries in scope (as mentioned in Table 4), but in this report they are consistently referred to as Oatly Oat Drink Whole/Semi/Light.

The three types of Oatly Oat Drink are produced in Oatly's End-to-End factory[3] located in Landskrona, Sweden, and the hybrid factory[4] located in Vlissingen, the Netherlands, and all concern ambient products. The factory in Sweden supplies to Sweden and Finland, whereas the factory in the Netherlands supplies to the Netherlands, Germany, and the United Kingdom. On the Dutch and German markets, no Light version is available.

Cow's milk

Since the Oatly products in this study can replace both (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. Section 1.3 of the main report describes which data has been used to define this country-average mix of cow's milk.

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 four independent and qualified external experts has been compiled, reflecting a balanced combination of qualifications (LCA, dairy, nutrition) and backgrounds (academic, research institute, non-governmental organisation).

- Jasmina Burek (chair): Assistant Professor at University of Massachusetts Lowell (based in the US)
- Joanna Trewern: Food Systems and Sustainable Diets expert (based in the UK)
- Jens Lansche: LCA expert (based in Switzerland)
- Hayo van der Werf: LCA expert (based in France)

This is the same review panel that has also reviewed the main report. Since they 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 III.

2. Calculation method

This addendum follows the exact same methodological standards and approaches as listed in chapter 2 of the main report. One small addition to this report is the land occupation indicator. 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. To also give an indication of solely the land occupied by the production of the drinks, the land occupation indicator was added, which shows land occupation results without characterization, with the unit m^2a[5].

[3] End-to-End (E2E) Factory: The entire production chain happens within Oatly's own factory. From grains to the finished product.
[4] 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.
[5] The ReCiPe 2016 method 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 does not differentiate by location/geography. 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 fewer sensitivity and uncertainty analyses. The sensitivity analyses considered for the addendum include a comparison of Oatly Oat Drink Whole/Semi/Light to cow's milk with corresponding fat contents. Furthermore, 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), difference in storage conditions (chilled vs ambient), 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 "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) 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 recipe for the "No" Sugars products is slightly different and the manufacturing processing conditions, which involves the breaking down of carbohydrates into natural sugars, have been changed compared to other oat drinks, making this a product that contains no sugar.
- For the Whole/Semi/Light Oat drink, the proportions of oat base and rapeseed oil are slightly different than Oatly Barista.

For the cow's milk, the exact same data has been used as in the main report. More detail on how the cow's milk has been modelled can be found in section 3.2 of the main report.

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.

Table 5 lists the results for the key impact categories for the Oatly "No" Sugar products, and Table 6 provides the same for the Oatly Oat Drink (Whole, Semi and Light). The results for all impact categories are included in Appendix II. Table 7 and Table 8 provide an overview of the relative differences of the Oatly products and cow's milk.

These tables indicate that:

- For all countries, Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) 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, land occupation and water consumption. These results are consistent with the results from the main report on Oatly Barista.
- For land use, the impact of Oatly Oat Drink is lower than cow's milk, except for Oatly Oat Drink Whole and Semi at retail in the Netherlands, where the impacts are comparable to cow's milk.
- For the fossil and mineral resource scarcity impact categories, "No" Sugars and Oatly Oat Drink have a higher, comparable or lower impact than cow's milk.

TABLE 5: RESULTS FOR KEY IMPACT CATEGORIES FOR OATLY "NO" SUGARS AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING. ALL PRODUCTS ARE PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY.

Retail Germany						
Impact category	**Unit**	**Oatly "No" Sugars - ambient**		**Oatly "No" Sugars - chilled**		**Cow's milk DE**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.515	*-69%*	0.558	*-66%*	1.652
Climate change – excl LUC and peat ox	kg CO_2 eq	0.411	*-67%*	0.448	*-64%*	1.247
Climate change – only LUC	kg CO_2 eq	0.018	*-81%*	0.023	*-76%*	0.096
Climate change – only peat ox	kg CO_2 eq	0.086	*-72%*	0.087	*-72%*	0.309
Fine particulate matter formation	kg PM2.5 eq	4.42E-04	*-89%*	4.30E-04	*-89%*	4.01E-03
Terrestrial acidification	kg SO_2 eq	1.42E-03	*-79%*	1.41E-03	*-79%*	6.64E-03
Freshwater eutrophication	kg P eq	1.68E-04	*-61%*	1.68E-04	*-61%*	4.33E-04
Marine eutrophication	kg N eq	4.33E-04	*-79%*	4.37E-04	*-79%*	2.09E-03
Land use	m^2a crop eq	0.527	*-42%*	0.534	*-41%*	0.912
Land occupation	m^2a	0.584	*-58%*	0.591	*-58%*	1.404
Mineral resource scarcity	kg Cu eq	1.09E-03	*-4%*	8.49E-04	*-25%*	1.13E-03
Fossil resource scarcity	kg oil eq	0.119	*-3%*	0.119	*-2%*	0.122
Water consumption	m^3	7.85E-03	*-14%*	7.96E-03	*-13%*	9.11E-03
Retail Netherlands						
Impact category	**Unit**	**Oatly "No" Sugars - ambient**				**Cow's milk NL**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.495	*-64%*			1.369
Climate change – excl LUC and peat ox	kg CO_2 eq	0.391	*-64%*			1.093
Climate change – only LUC	kg CO_2 eq	0.018	*-80%*			0.088
Climate change – only peat ox	kg CO_2 eq	0.086	*-54%*			0.189
Fine particulate matter formation	kg PM2.5 eq	3.84E-04	*-93%*			5.20E-03
Terrestrial acidification	kg SO_2 eq	1.26E-03	*-75%*			5.00E-03
Freshwater eutrophication	kg P eq	1.50E-04	*-55%*			3.34E-04
Marine eutrophication	kg N eq	4.34E-04	*-71%*			1.49E-03
Land use	m^2a crop eq	0.544	*-17%*			0.652
Land occupation	m^2a	0.648	*-32%*			0.950
Mineral resource scarcity	kg Cu eq	9.33E-04	*43%*			6.51E-04
Fossil resource scarcity	kg oil eq	0.096	*-12%*			0.109

Water consumption	m^3	8.27E-03	*-25%*			1.10E-02
Retail United Kingdom						
Impact category	**Unit**	**Oatly "No" Sugars - ambient**		**Oatly "No" Sugars - chilled**		**Cow's milk UK**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.521	*-62%*	0.493	*-64%*	1.374
Climate change – excl LUC and peat ox	kg CO_2 eq	0.417	*-66%*	0.383	*-69%*	1.224
Climate change – only LUC	kg CO_2 eq	0.018	*-81%*	0.023	*-75%*	0.093
Climate change – only peat ox	kg CO_2 eq	0.086	*51%*	0.086	*51%*	0.057
Fine particulate matter formation	kg PM2.5 eq	4.50E-04	*-88%*	3.80E-04	*-90%*	3.65E-03
Terrestrial acidification	kg SO_2 eq	1.45E-03	*-69%*	1.26E-03	*-73%*	4.66E-03
Freshwater eutrophication	kg P eq	1.98E-04	*-50%*	1.88E-04	*-52%*	3.93E-04
Marine eutrophication	kg N eq	4.52E-04	*-73%*	4.51E-04	*-73%*	1.66E-03
Land use	m^2a crop eq	0.536	*-37%*	0.542	*-37%*	0.855
Land occupation	m^2a	0.616	*-48%*	0.624	*-47%*	1.180
Mineral resource scarcity	kg Cu eq	1.03E-03	*33%*	7.78E-04	*1%*	7.72E-04
Fossil resource scarcity	kg oil eq	0.123	*-8%*	0.106	*-21%*	0.134
Water consumption	m^3	7.98E-03	*-12%*	8.04E-03	*-11%*	9.07E-03
Retail Sweden						
Impact category	**Unit**	**Oatly "No" Sugars - ambient**				**Cow's milk SE**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.565	*-50%*			1.124
Climate change – excl LUC and peat ox	kg CO_2 eq	0.461	*-51%*			0.945
Climate change – only LUC	kg CO_2 eq	0.018	*-67%*			0.054
Climate change – only peat ox	kg CO_2 eq	0.087	*-31%*			0.125
Fine particulate matter formation	kg PM2.5 eq	4.85E-04	*-56%*			1.11E-03
Terrestrial acidification	kg SO_2 eq	1.57E-03	*-75%*			6.22E-03
Freshwater eutrophication	kg P eq	1.52E-04	*-47%*			2.86E-04
Marine eutrophication	kg N eq	4.33E-04	*-70%*			1.47E-03
Land use	m^2a crop eq	0.537	*-51%*			1.103
Land occupation	m^2a	0.615	*-55%*			1.366
Mineral resource scarcity	kg Cu eq	1.04E-03	*10%*			9.41E-04
Fossil resource scarcity	kg oil eq	0.128	*31%*			0.097
Water consumption	m^3	8.13E-03	*-5%*			8.52E-03
Retail Finland						
Impact category	**Unit**	**Oatly "No" Sugars - ambient**				**Cow's milk FI**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.567	*-67%*			1.711
Climate change – excl LUC and peat ox	kg CO_2 eq	0.463	*-60%*			1.163
Climate change – only LUC	kg CO_2 eq	0.018	*-49%*			0.035
Climate change – only peat ox	kg CO_2 eq	0.087	*-83%*			0.513
Fine particulate matter formation	kg PM2.5 eq	5.08E-04	*-65%*			1.45E-03
Terrestrial acidification	kg SO_2 eq	1.63E-03	*-78%*			7.37E-03
Freshwater eutrophication	kg P eq	1.87E-04	*-49%*			3.65E-04
Marine eutrophication	kg N eq	4.45E-04	*-75%*			1.77E-03
Land use	m^2a crop eq	0.538	*-57%*			1.259
Land occupation	m^2a	0.621	*-61%*			1.61
Mineral resource scarcity	kg Cu eq	1.03E-03	*-9%*			1.13E-03
Fossil resource scarcity	kg oil eq	0.132	*11%*			0.119
Water consumption	m^3	8.19E-03	*-10%*			9.07E-03

TABLE 6: RESULTS FOR KEY IMPACT CATEGORIES FOR OATLY OAT DRINK (WHOLE, SEMI AND LIGHT) AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING. THE PRODUCTS AVAILABLE AT RETAIL IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM ARE PRODUCED IN THE HYBRID FACTORY LOCATED IN VLISSINGEN, THE NETHERLANDS. THE PRODUCTS AVAILABLE AT RETAIL IN SWEDEN AND FINLAND ARE PRODUCED IN THE END-TO-END FACTORY IN LANDSKRONA, SWEDEN. COW'S MILK REPRESENTS AN AVERAGE COW'S MILK PRODUCT AT RETAIL FOR EACH COUNTRY.

Retail Germany								
Impact category	**Unit**	**Oatly Oat drink Whole**		**Oatly Oat drink Semi**				**Cow's milk DE**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.569	-66%	0.540	-67%			1.652
Climate change – excl LUC and peat ox	kg CO_2 eq	0.443	-64%	0.425	-66%			1.247
Climate change – only LUC	kg CO_2 eq	0.018	-81%	0.018	-81%			0.096
Climate change – only peat ox	kg CO_2 eq	0.108	-65%	0.098	-68%			0.309
Fine particulate matter formation	kg PM2.5 eq	4.82E-04	-88%	4.57E-04	-89%			4.01E-03
Terrestrial acidification	kg SO_2 eq	1.62E-03	-76%	1.48E-03	-78%			6.64E-03
Freshwater eutrophication	kg P eq	1.85E-04	-57%	1.74E-04	-60%			4.33E-04
Marine eutrophication	kg N eq	5.66E-04	-73%	4.77E-04	-77%			2.09E-03
Land use	m^2a crop eq	0.660	-28%	0.585	-36%			0.912
Land occupation	m^2a	0.717	-49%	0.642	-54%			1.404
Mineral resource scarcity	kg Cu eq	1.15E-03	2%	1.11E-03	-1%			1.13E-03
Fossil resource scarcity	kg oil eq	0.125	3%	0.122	0%			0.122
Water consumption	m^3	7.73E-03	-15%	7.70E-03	-15%			9.11E-03
Retail Netherlands								
Impact category	**Unit**	**Oatly Oat drink Whole**		**Oatly Oat drink Semi**				**Cow's milk NL**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.549	-60%	0.521	-62%			1.369
Climate change – excl LUC and peat ox	kg CO_2 eq	0.423	-61%	0.405	-63%			1.093
Climate change – only LUC	kg CO_2 eq	0.018	-80%	0.018	-80%			0.088
Climate change – only peat ox	kg CO_2 eq	0.108	-43%	0.098	-48%			0.189
Fine particulate matter formation	kg PM2.5 eq	4.24E-04	-92%	3.99E-04	-92%			5.20E-03
Terrestrial acidification	kg SO_2 eq	1.46E-03	-71%	1.32E-03	-74%			5.00E-03
Freshwater eutrophication	kg P eq	1.66E-04	-50%	1.55E-04	-53%			3.34E-04
Marine eutrophication	kg N eq	5.66E-04	-62%	4.77E-04	-68%			1.49E-03
Land use	m^2a crop eq	0.677	4%	0.602	-8%			0.652
Land occupation	m^2a	0.782	-18%	0.707	-26%			0.950
Mineral resource scarcity	kg Cu eq	9.96E-04	53%	9.60E-04	48%			6.51E-04
Fossil resource scarcity	kg oil eq	0.102	-6%	0.099	-9%			0.109
Water consumption	m^3	8.15E-03	-26%	8.12E-03	-26%			1.10E-02
Retail United Kingdom								
Impact category	**Unit**	**Oatly Oat drink Whole**		**Oatly Oat drink Semi**		**Oatly Oat drink Light**		**Cow's milk DE**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.576	-58%	0.547	-60%	0.515	-63%	1.374
Climate change – excl LUC and peat ox	kg CO_2 eq	0.449	-63%	0.431	-65%	0.411	-66%	1.224
Climate change – only LUC	kg CO_2 eq	0.018	-81%	0.018	-81%	0.018	-81%	0.093
Climate change – only peat ox	kg CO_2 eq	0.108	90%	0.098	71%	0.086	51%	0.057
Fine particulate matter formation	kg PM2.5 eq	4.90E-04	-87%	4.65E-04	-87%	4.38E-04	-88%	3.65E-03
Terrestrial acidification	kg SO_2 eq	1.66E-03	-64%	1.51E-03	-68%	1.38E-03	-70%	4.66E-03
Freshwater eutrophication	kg P eq	2.14E-04	-45%	2.04E-04	-48%	1.93E-04	-51%	3.93E-04
Marine eutrophication	kg N eq	5.84E-04	-65%	4.95E-04	-70%	4.12E-04	-75%	1.66E-03
Land use	m^2a crop eq	0.669	-22%	0.594	-31%	0.518	-39%	0.855
Land occupation	m^2a	0.750	-36%	0.675	-43%	0.598	-49%	1.180
Mineral resource scarcity	kg Cu eq	1.09E-03	41%	1.05E-03	36%	1.01E-03	31%	7.72E-04
Fossil resource scarcity	kg oil eq	0.130	-3%	0.126	-6%	0.123	-9%	0.134
Water consumption	m^3	7.86E-03	-13%	7.83E-03	-14%	7.74E-03	-15%	9.07E-03
Retail Sweden								
Impact category	**Unit**	**Oatly Oat drink Whole**		**Oatly Oat drink Semi**		**Oatly Oat drink Light**		**Cow's milk SE**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.398	-65%	0.369	-67%	0.341	-70%	1.123692
Climate change – excl LUC and peat ox	kg CO_2 eq	0.298	-68%	0.279	-70%	0.261	-72%	0.944601
Climate change – only LUC	kg CO_2 eq	0.022	-59%	0.022	-60%	0.022	-60%	0.054062
Climate change – only peat ox	kg CO_2 eq	0.079	-37%	0.068	-46%	0.058	-54%	0.125029
Fine particulate matter formation	kg PM2.5 eq	4.40E-04	-60%	4.15E-04	-63%	3.89E-04	-65%	1.11E-03

Terrestrial acidification	kg SO_2 eq	1.54E-03	*-75%*	1.40E-03	*-77%*	1.27E-03	*-80%*	6.22E-03
Freshwater eutrophication	kg P eq	1.57E-04	*-45%*	1.47E-04	*-49%*	1.36E-04	*-52%*	2.86E-04
Marine eutrophication	kg N eq	5.48E-04	*-63%*	4.59E-04	*-69%*	3.77E-04	*-74%*	1.47E-03
Land use	m^2a crop eq	0.629	*-43%*	0.554	*-50%*	0.479	*-57%*	1.103
Land occupation	m^2a	0.711	*-48%*	0.635	*-54%*	0.560	*-59%*	1.366
Mineral resource scarcity	kg Cu eq	1.14E-03	*22%*	1.11E-03	*18%*	1.07E-03	*13%*	9.41E-04
Fossil resource scarcity	kg oil eq	0.055	*-43%*	0.052	*-46%*	0.049	*-49%*	0.097
Water consumption	m^3	4.64E-03	*-46%*	4.60E-03	*-46%*	4.54E-03	*-47%*	8.52E-03
Retail Finland								
Impact category	**Unit**	**Oatly Oat drink Whole**		**Oatly Oat drink Semi**		**Oatly Oat drink Light**		**Cow's milk FI**
Climate change – incl LUC and peat ox	kg CO_2 eq	0.400	*-77%*	0.371	*-78%*	0.343	*-80%*	1.711
Climate change – excl LUC and peat ox	kg CO_2 eq	0.300	*-74%*	0.281	*-76%*	0.263	*-77%*	1.163
Climate change – only LUC	kg CO_2 eq	0.022	*-37%*	0.022	*-38%*	0.022	*-38%*	0.035
Climate change – only peat ox	kg CO_2 eq	0.079	*-85%*	0.068	*-87%*	0.058	*-89%*	0.513
Fine particulate matter formation	kg PM2.5 eq	4.63E-04	*-68%*	4.38E-04	*-70%*	4.12E-04	*-72%*	1.45E-03
Terrestrial acidification	kg SO_2 eq	1.61E-03	*-78%*	1.47E-03	*-80%*	1.33E-03	*-82%*	7.37E-03
Freshwater eutrophication	kg P eq	1.91E-04	*-48%*	1.80E-04	*-51%*	1.70E-04	*-53%*	3.65E-04
Marine eutrophication	kg N eq	5.60E-04	*-68%*	4.71E-04	*-73%*	3.89E-04	*-78%*	1.77E-03
Land use	m^2a crop eq	0.631	*-50%*	0.555	*-56%*	0.481	*-62%*	1.259
Land occupation	m^2a	0.716	*-55%*	0.641	*-60%*	0.566	*-65%*	1.605104
Mineral resource scarcity	kg Cu eq	1.14E-03	*1%*	1.10E-03	*-2%*	1.06E-03	*-6%*	1.13E-03
Fossil resource scarcity	kg oil eq	0.060	*-50%*	0.057	*-52%*	0.054	*-55%*	0.119
Water consumption	m^3	4.70E-03	*-48%*	4.67E-03	*-49%*	4.60E-03	*-49%*	9.07E-03

TABLE 7: RELATIVE DIFFERENCES OF OATLY "NO" SUGARS COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE, -69% INDICATES THAT OATLY "NO" SUGARS HAS A 69% LOWER IMPACT COMPARED TO COW'S MILK. THE COLOUR SCALE USES GREEN TONES TO SHOW WHERE OATLY "NO" SUGARS HAS A LOWER IMPACT THAN COW'S MILK, AND RED TONES WHERE COW'S MILK HAS A LOWER IMPACT THAN OATLY "NO" SUGARS. THE ABBREVIATION (CLD) INDICATES THE PRODUCT CONCERNS A CHILLED VERSION. ALL OTHER PRODUCTS ARE AMBIENT. OTHER ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND.

Country of sale	Product	Climate change *kg CO2 eq*	Fine particulate matter *kg PM2.5 eq*	Terrestrial acidify-cation *kg SO2 eq*	Freshwater eutrophi-cation *kg P eq*	Marine eutrophi-cation *kg N eq*	Land use *m2a crop eq*	Land occu-pation *m2a*	Mineral resource scarcity *kg Cu eq*	Fossil resource scarcity *kg oil eq*	Water consum-ption *m3*
DE	Oatly "No" Sugars	-69%	-89%	-79%	-61%	-79%	-42%	-58%	-4%	-3%	-14%
	Oatly "No" Sugars (cld)	-66%	-89%	-79%	-61%	-79%	-41%	-58%	-25%	-2%	-13%
NL	Oatly "No" Sugars	-64%	-93%	-75%	-55%	-71%	-17%	-32%	43%	-12%	-25%
UK	Oatly "No" Sugars	-62%	-88%	-69%	-50%	-73%	-37%	-48%	33%	-8%	-12%
	Oatly "No" Sugars (cld)	-64%	-90%	-73%	-52%	-73%	-37%	-47%	1%	-21%	-11%
SE	Oatly "No" Sugars	-50%	-56%	-75%	-47%	-70%	-51%	-55%	10%	31%	-5%
FI	Oatly "No" Sugars	-67%	-65%	-78%	-49%	-75%	-57%	-61%	-9%	11%	-10%

TABLE 8: RELATIVE DIFFERENCES OF OATLY OAT DRINK (WHOLE, SEMI AND LIGHT) COMPARED TO COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. FOR EXAMPLE, -66% INDICATES THAT OATLY "NO" SUGARS HAS A 66% LOWER IMPACT COMPARED TO COW'S MILK. THE COLOUR SCALE USES GREEN TONES TO SHOW WHERE OATLY OAT DRINK HAS A LOWER IMPACT THAN COW'S MILK, AND RED TONES WHERE COW'S MILK HAS A LOWER IMPACT THAN OATLY OAT DRINK. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND.

Country of sale	Product	Climate change	Fine particulate matter	Terrestrial acidify-cation	Freshwater eutrophi-cation	Marine eutrophi-cation	Land use	Land occu-pation	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*
DE	Oatly Oat drink Whole	-66%	-88%	-76%	-57%	-73%	-28%	-49%	2%	3%	-15%
	Oatly Oat drink Semi	-67%	-89%	-78%	-60%	-77%	-36%	-54%	-1%	0%	-15%
NL	Oatly Oat drink Whole	-60%	-92%	-71%	-50%	-62%	4%	-18%	53%	-6%	-26%
	Oatly Oat drink Semi	-62%	-92%	-74%	-53%	-68%	-8%	-26%	48%	-9%	-26%
UK	Oatly Oat drink Whole	-58%	-87%	-64%	-45%	-65%	-22%	-36%	41%	-3%	-13%
	Oatly Oat drink Semi	-60%	-87%	-68%	-48%	-70%	-31%	-43%	36%	-6%	-14%
	Oatly Oat drink Light	-63%	-88%	-70%	-51%	-75%	-39%	-49%	31%	-9%	-15%
SE	Oatly Oat drink Whole	-65%	-60%	-75%	-45%	-63%	-43%	-48%	22%	-43%	-46%
	Oatly Oat drink Semi	-67%	-63%	-77%	-49%	-69%	-50%	-54%	18%	-46%	-46%
	Oatly Oat drink Light	-70%	-65%	-80%	-52%	-74%	-57%	-59%	13%	-49%	-47%
FI	Oatly Oat drink Whole	-77%	-68%	-78%	-48%	-68%	-50%	-55%	1%	-50%	-48%
	Oatly Oat drink Semi	-78%	-70%	-80%	-51%	-73%	-56%	-60%	-2%	-52%	-49%
	Oatly Oat drink Light	-80%	-72%	-82%	-53%	-78%	-62%	-65%	-6%	-55%	-49%

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 in Figure 1 and Figure 2. Section 5.1.1 of the main report explains in detail what 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. It also contains a more detailed contribution analysis for cow's milk.

In Figure 3 and Figure 4, a more detailed contribution analysis is provided for the Oatly products, explaining the differences that can be observed between them.

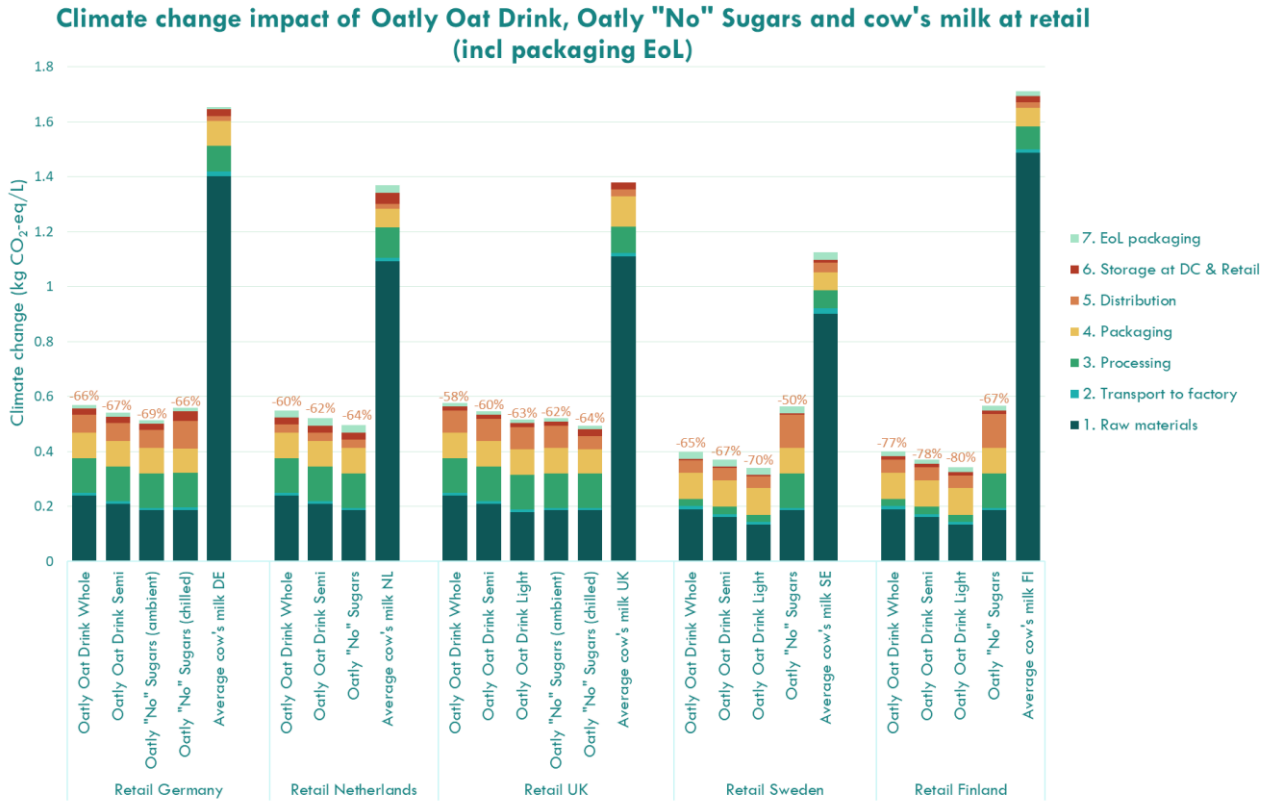
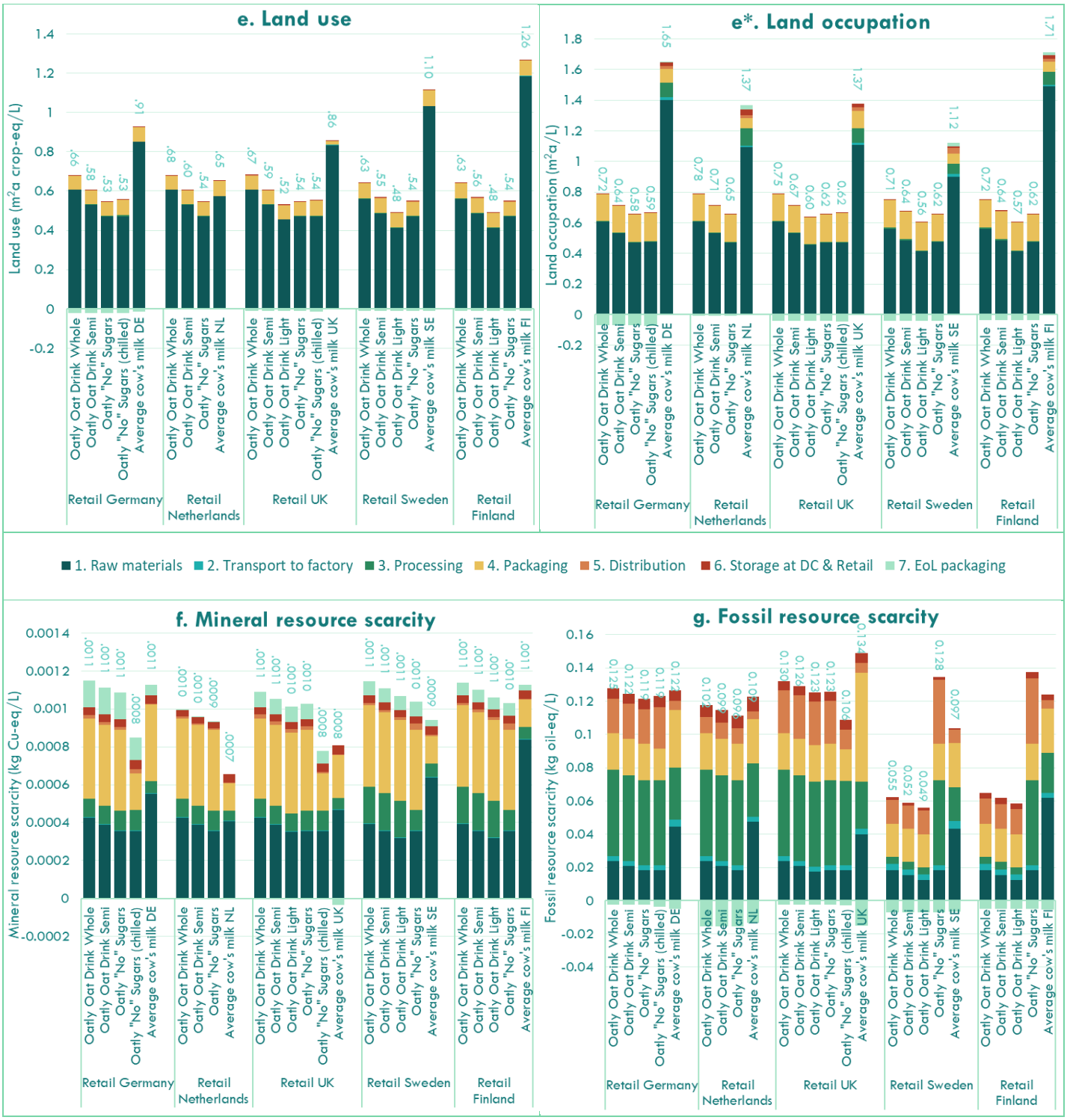


FIGURE 1: CLIMATE CHANGE IMPACT OF 1L OATLY "NO" SUGARS, OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING. ALL OATLY "NO" SUGARS IS PRODUCED IN THE HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS. OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AVAILABLE AT RETAIL IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM IS PRODUCED IN VLISSINGEN, WHEREAS THE OAT DRINK (WHOLE/SEMI/LIGHT) AVAILABLE IN SWEDEN AND FINLAND IS PRODUCED IN OATLY'S END-TO-END FACTORY IN LANDSKRONA, SWEDEN.


a. Fine particulate matter formation
Fine particulate matter formation (kg PM2.5-eq/L)
b. Terrestrial acidification
Terrestrial acidification (kg SO2-eq/L)
Oatly Oat Drink Whole
Oatly Oat Drink Semi
Oatly "No" Sugars
Oatly "No" Sugars (chilled)
Oatly Oat Drink Light
Average cow's milk DE
Average cow's milk NL
Average cow's milk UK
Average cow's milk SE
Average cow's milk FI
Retail Germany
Retail Netherlands
Retail UK
Retail Sweden
Retail Finland
1. Raw materials
2. Transport to factory
3. Processing
4. Packaging
5. Distribution
6. Storage at DC & Retail
7. EoL packaging
c. Freshwater eutrophication
Freshwater eutrophication (kg P-eq/L)
d. Marine eutrophication
Marine eutrophication (kg N-eq/L)


e. Land use
Land use (m²a crop-eq/L)
e*. Land occupation
Land occupation (m²a/L)
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)
g. Fossil resource scarcity
Fossil resource scarcity (kg oil-eq/L)
Oatly Oat Drink Whole
Oatly Oat Drink Semi
Oatly "No" Sugars
Oatly "No" Sugars (chilled)
Oatly Oat Drink Light
Average cow's milk DE
Average cow's milk NL
Average cow's milk UK
Average cow's milk SE
Average cow's milk FI
Retail Germany
Retail Netherlands
Retail UK
Retail Sweden
Retail Finland

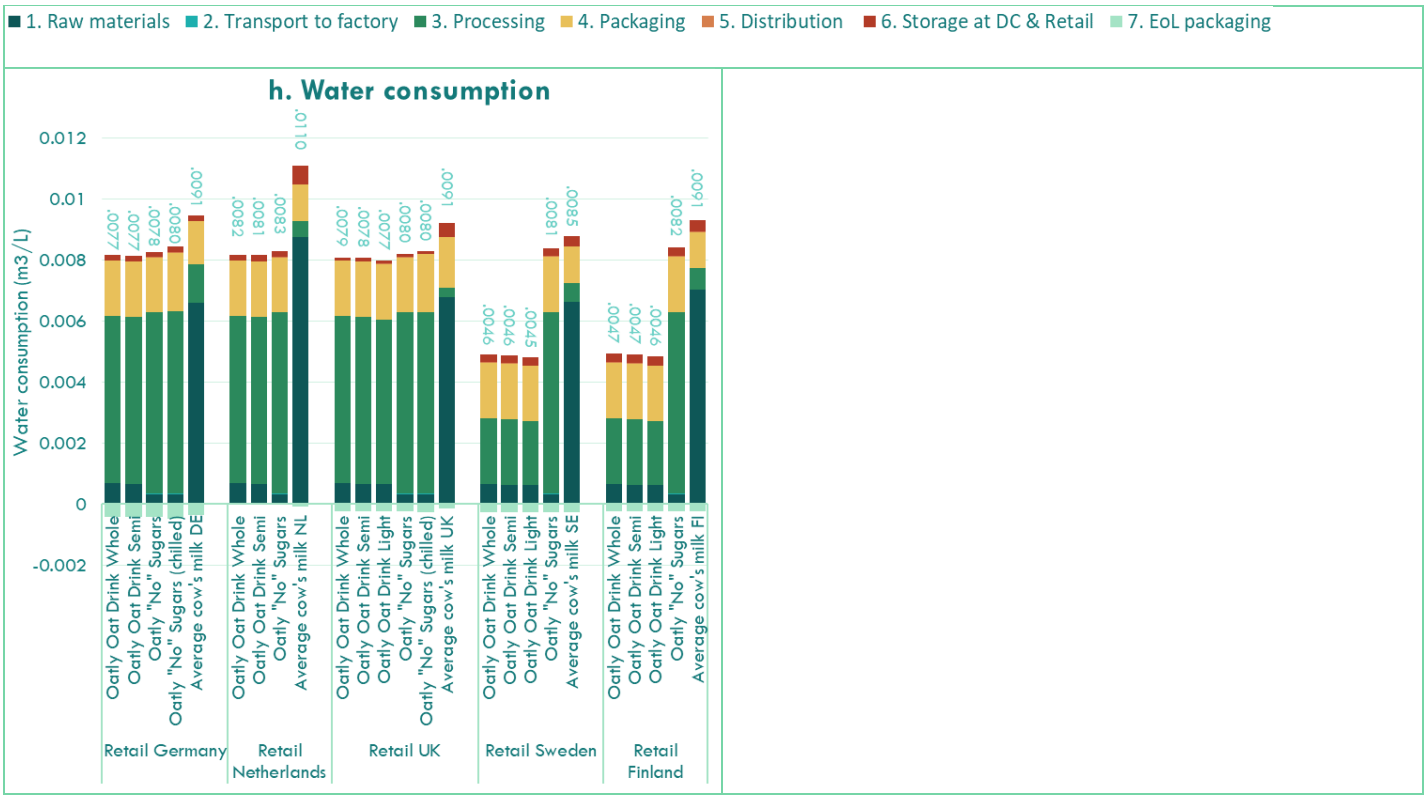
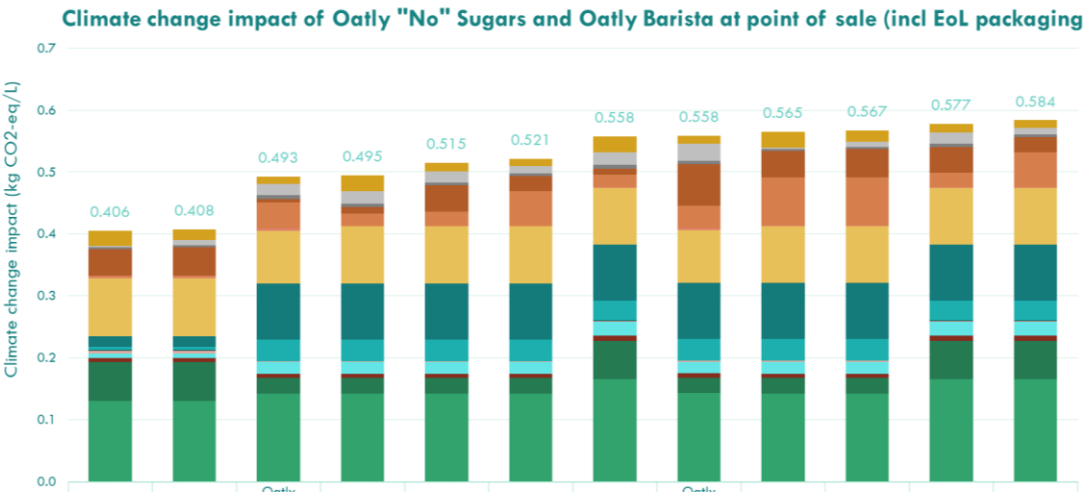


FIGURE 2: KEY IMPACT CATEGORIES OF 1L OATLY "NO" SUGARS, OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AND COW'S MILK AT RETAIL INCLUDING END-OF-LFIE (EOL) OF PACKAGING. ALL OATLY "NO" SUGARS IS PRODUCED IN THE HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS. OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AVAILABLE AT RETAIL IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM IS PRODUCED IN VLISSINGEN, WHEREAS THE OAT DRINK (WHOLE/SEMI/LIGHT) AVAILABLE IN SWEDEN AND FINLAND IS PRODUCED IN OATLY'S END-TO-END FACTORY IN LANDSKRONA, SWEDEN. IMPACT CATEGORY E* (LAND OCCUPATION) CONCERNS AN ADDITIONAL IMPACT CATEGORY AS EXPLAINED IN CHAPTER 2.

Figure 3 shows a detailed contribution analysis for the climate change impact category for Oatly "No" Sugars. As a reference, it also shows the impact of the main Oatly Barista products for the markets in scope. Oatly "No" Sugars is solely produced in Vlissingen, the Netherlands. All products have a lower impact than Oatly Barista produced in the same factory due to the lower input of oats and rapeseed oil. The chilled versions of Oatly "No" Sugars, which are only available in the UK and DE, have a lower impact for packaging and EoL as the packaging does not contain aluminium. Combined with a relatively short distribution distance, this leads to the chilled version of Oatly "No" Sugars available in the UK having the lowest impact. The impact of the ambient version for the UK is higher because it is distributed through a distribution center much further away. The other differences between the products can be explained by different distribution distances.



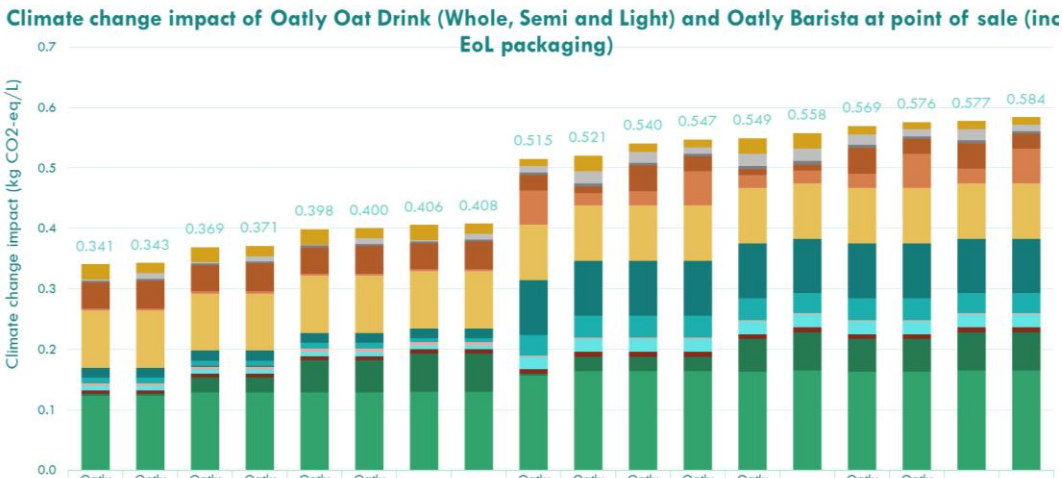
	Oatly Barista Retail SE	Oatly Barista Retail FI	Oatly "No" Sugars (cld) Retail UK	Oatly "No" Sugars Retail NL	Oatly "No" Sugars Retail DE	Oatly "No" Sugars Retail UK	Oatly Barista Retail NL	Oatly "No" Sugars (cld) Retail DE	Oatly "No" Sugars Retail SE	Oatly "No" Sugars Retail FI	Oatly Barista Retail DE	Oatly Barista Retail UK
10. Packaging End of Life	0.025	0.017	0.012	0.026	0.013	0.012	0.026	0.012	0.026	0.018	0.013	0.012
09b. Storage at retail	0.002	0.009	0.018	0.020	0.018	0.011	0.020	0.028	0.002	0.009	0.018	0.011
09a. Storage at DC	0.003	0.003	0.005	0.005	0.005	0.004	0.005	0.006	0.003	0.003	0.005	0.004
08b. Distribution to retail	0.043	0.045	0.005	0.010	0.042	0.025	0.010	0.066	0.043	0.045	0.042	0.025
08a. Distribution to DC	0.002	0.002	0.043	0.020	0.023	0.056	0.020	0.036	0.078	0.078	0.023	0.056
07b. Transport of packaging material	0.002	0.002	0.003	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001
07a. Packaging	0.094	0.094	0.085	0.092	0.092	0.092	0.092	0.085	0.092	0.092	0.092	0.092
06. Processing - Oatly Barista	0.017	0.017	0.090	0.091	0.091	0.091	0.090	0.091	0.091	0.091	0.090	0.090
05. Processing - Oat base	0.006	0.006	0.035	0.035	0.035	0.035	0.033	0.035	0.035	0.035	0.033	0.033
04b. Transport of other ingredients to factory	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.001
04a. Transport of oats to factory	0.005	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
03. Oats milling	0.007	0.007	0.019	0.019	0.019	0.019	0.022	0.019	0.019	0.019	0.022	0.022
02. Oats transport to mill	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.007	0.007	0.007	0.008	0.008
01b. Other ingredient production	0.063	0.063	0.025	0.025	0.025	0.025	0.063	0.025	0.025	0.025	0.063	0.063
01a. Oat cultivation	0.130	0.130	0.142	0.142	0.142	0.142	0.165	0.143	0.143	0.143	0.165	0.165
Total	0.406	0.408	0.493	0.495	0.515	0.521	0.558	0.558	0.565	0.567	0.577	0.584

FIGURE 3: CLIMATE CHANGE IMPACT OF OATLY "NO" SUGARS AND OATLY BARISTA AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING, SORTED FROM LOW TO HIGH IMPACT. ALL OATLY "NO" SUGARS IS PRODUCED IN THE HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS. FOR OATLY BARISTA THE PRIMARY PRODUCTION LOCATIONS ARE INCLUDED: OATLY BARISTA AVAILABLE AT RETAIL IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM IS PRODUCED IN THE HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS, WHEREAS OATLY BARISTA AVAILABLE IN SWEDEN AND FINLAND IS PRODUCED IN OATLY'S END-TO-END FACTORY IN LANDSKRONA, SWEDEN. (CLD) REFERS TO THE CHILLED VERSION OF OATLY "NO" SUGARS. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND; CLD = CHILLED

Figure 4 shows a detailed contribution analysis for the climate change impact category for Oatly Oat Drink (Whole, Semi and Light) products, as well as Oatly Barista (as reference).

The figure shows that all Oatly Oat Drink varieties (Whole, Semi and Light), have a comparatively lower impact than Oatly Barista produced in the same factory. This is because a slightly lower input of oat base per liter of drink, hence a lower contribution of oat cultivation. The differences between whole, semi and light varieties can be explained by a different quantity of rapeseed oil (part of the "other ingredients" category).

The Oatly products produced in Landskrona, Sweden, have a lower impact for processing than the Oatly products produced in Vlissingen, the Netherlands, as the Swedish factory uses renewable energy.



	Oatly Oat Drink Light Retail SE	Oatly Oat Drink Light Retail FI	Oatly Oat Drink Semi Retail SE	Oatly Oat Drink Semi Retail FI	Oatly Oat Drink Whole Retail SE	Oatly Oat Drink Whole Retail FI	Oatly Barista Retail SE	Oatly Barista Retail FI	Oatly Oat Drink Light Retail UK	Oatly Oat Drink Semi Retail NL	Oatly Oat Drink Semi Retail DE	Oatly Oat Drink Semi Retail UK	Oatly Oat Drink Whole Retail NL	Oatly Barista Retail NL	Oatly Oat Drink Whole Retail DE	Oatly Oat Drink Whole Retail UK	Oatly Barista Retail DE	Oatly Barista Retail UK
10. Packaging End of Life	0.025	0.017	0.025	0.017	0.025	0.017	0.025	0.017	0.012	0.026	0.013	0.012	0.026	0.026	0.013	0.012	0.013	0.012
09b. Storage at retail	0.002	0.009	0.002	0.009	0.002	0.009	0.002	0.009	0.011	0.020	0.018	0.011	0.020	0.020	0.018	0.011	0.018	0.011
09a. Storage at DC	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.004	0.005	0.005	0.005	0.004	0.005	0.004
08b. Distribution to retail	0.043	0.045	0.043	0.045	0.043	0.045	0.043	0.045	0.025	0.010	0.042	0.025	0.010	0.010	0.042	0.025	0.042	0.025
08a. Distribution to DC	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.056	0.020	0.023	0.056	0.020	0.020	0.023	0.056	0.023	0.056
07b. Transport of packaging material	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
07a. Packaging	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
06. Processing - Oatly Barista	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.091	0.091	0.091	0.091	0.090	0.090	0.090	0.090	0.090	0.090
05. Processing - Oat base	0.009	0.009	0.010	0.010	0.009	0.009	0.006	0.006	0.034	0.036	0.036	0.036	0.036	0.033	0.036	0.036	0.033	0.033
04b. Transport of other ingredients to factory	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001
04a. Transport of oats to factory	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
03. Oats milling	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.021	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
02. Oats transport to mill	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
01b. Other ingredient production	0.003	0.003	0.024	0.024	0.054	0.054	0.063	0.063	0.003	0.024	0.024	0.024	0.053	0.063	0.053	0.053	0.063	0.063
01a. Oat cultivation	0.124	0.124	0.129	0.129	0.129	0.129	0.130	0.130	0.157	0.164	0.164	0.164	0.163	0.165	0.163	0.163	0.165	0.165
Total	0.341	0.343	0.369	0.371	0.398	0.400	0.406	0.408	0.515	0.521	0.540	0.547	0.549	0.558	0.569	0.576	0.577	0.584

FIGURE 4: CLIMATE CHANGE IMPACT OF OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AND OATLY BARISTA AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING, RANKED FROM LOW TO HIGH IMPACT. FOR OATLY BARISTA, ONLY THE PRIMARY PRODUCTION LOCATIONS ARE INCLUDED. OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AND OATLY BARISTA AVAILABLE AT RETAIL IN GERMANY, THE NETHERLANDS AND THE UNITED KINGDOM IS PRODUCED IN THE HYBRID FACTORY IN VLISSINGEN, THE NETHERLANDS, WHEREAS OATLY OAT DRINK (WHOLE/SEMI/LIGHT) AND OATLY BARISTA AVAILABLE IN SWEDEN AND FINLAND IS PRODUCED IN OATLY'S END-TO-END FACTORY IN LANDSKRONA, SWEDEN. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND.

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, as well as several choices with regard to characteristics of the systems under study (e.g. inclusion of use stage, comparison to chilled version of Oatly Barista, comparison to 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 in the main report demonstrated 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) because of their different underlying metrics. Furthermore, the sensitivity analyses in the main report concluded that using different product characteristics (chilled distribution, 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 considered in this study are to the Oatly Barista investigated in the main report (and having a relatively lower impact), 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 two analyses: a sensitivity analysis that considers the fat content of the products, and an uncertainty analysis.

Figure 5 compares Oatly Oat Drink (Whole/Semi/Light) to cow's milk with a corresponding fat content. The percentages indicate how the environmental impact of the Oatly product compares to cow's milk. What can be observed is that the lower the fat content of the Oatly Oat Drink, the lower the difference with cow's milk with a corresponding fat content. These differences are however minor, and the percentage difference is very similar to the comparison with the average cow's milk (somewhat bigger in case of whole version and lower for the light versions). When comparing the oat drinks to average cow's milk, Oatly Oat Drink has a 58% to 80% lower impact, when comparing them to cow's milk with corresponding fat contents, Oatly Oat Drink has a 56% to 80% lower impact.

This analysis has not been done for Oatly "No" Sugars, as the main attribute of this product is not its fat content, but its lower sugar content. The main report contains more information (and a sensitivity analyses) on nutritional properties of Oatly Barista and cow's milk.

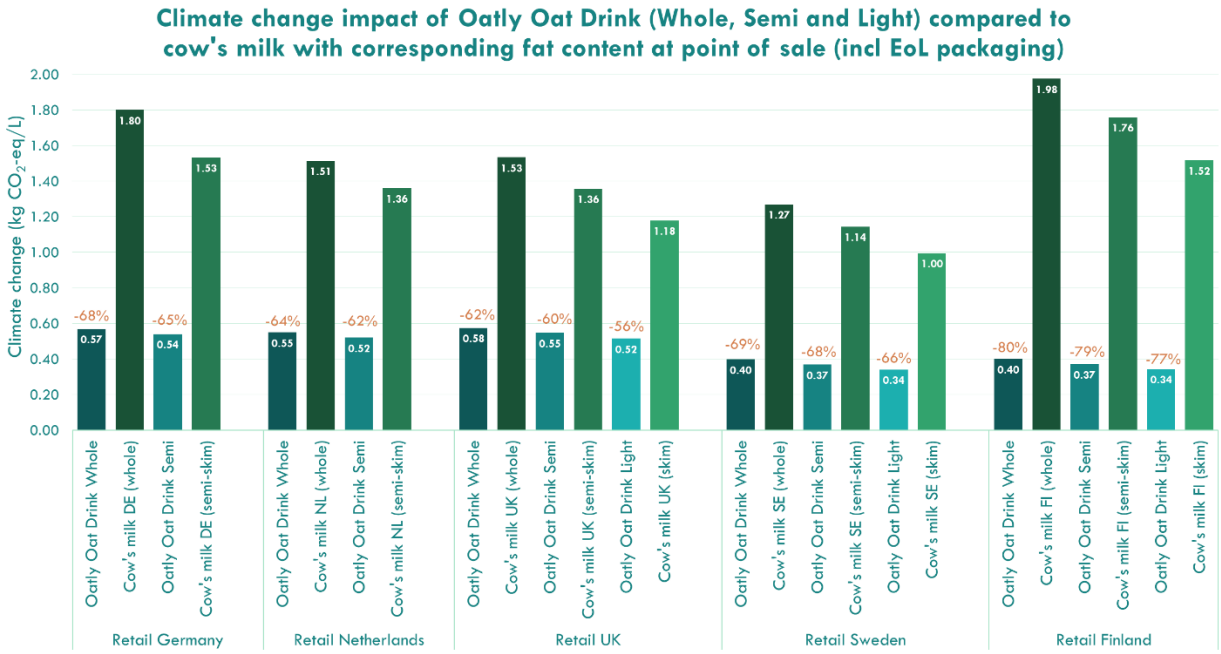


FIGURE 5: CLIMATE CHANGE IMPACT OF 1L OATLY OAT DRINK (WHOLE/SEMI/LIGHT) TO 1L COW'S MILK WITH DIFFERENT FAT CONTENT, AT RETAIL INCLUDING END-OF-LIFE (EOL) OF PACKAGING.

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 6 shows the climate change impact results including uncertainty ranges for the 95% confidence interval; meaning that 95% of the results lay within this range. 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 "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) have lower uncertainty ranges due to the use of primary (foreground) data.

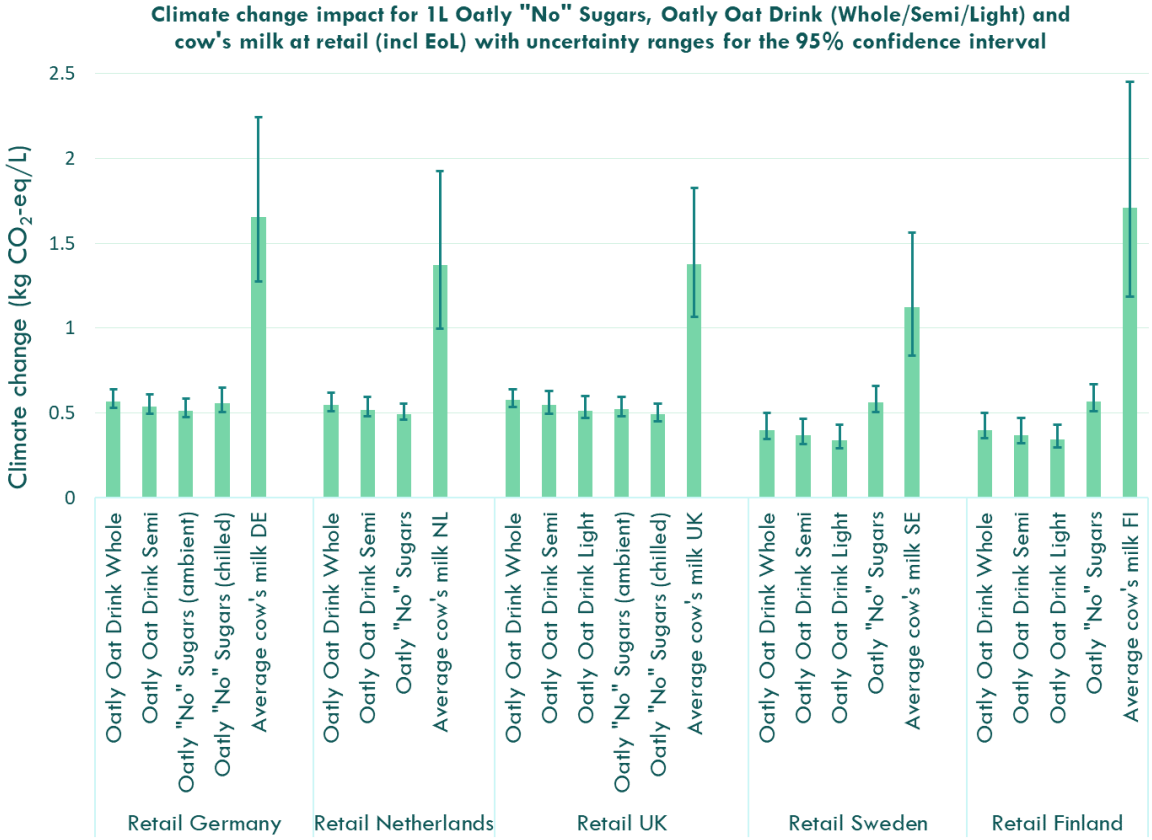


FIGURE 6: CLIMATE CHANGE IMPACT FOR 1L OATLY "NO" SUGARS, OATLY OAT DRINK (WHOLE/SEMI/LIGHT), AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING, WITH UNCERTAINTY RANGES FOR THE 95% CONFIDENCE INTERVAL.

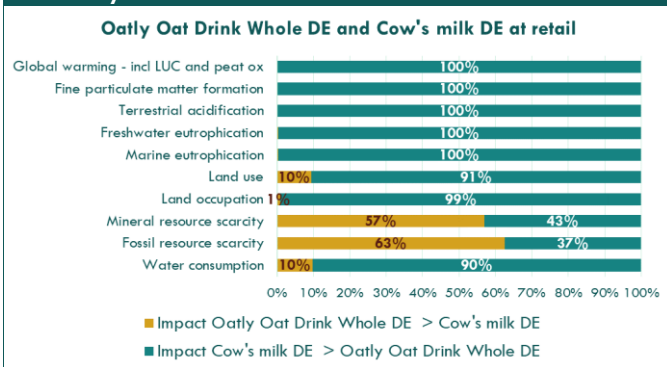
The graph gives an impression of how Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) compares to cow's milk when taking these uncertainties into consideration. Generally speaking, if the error bars of the 95% uncertainty interval do not overlap, one can assume differences between products are statistically significant (Payton et al., 2003). It should be noted that this is just an approximation, as uncertainty was estimated for the data.

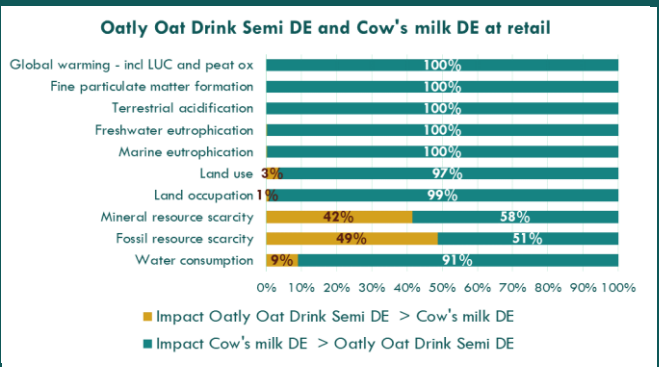
A more accurate way to compare two products is a paired Monte Carlo analysis, which considers the uncertainty of the difference between two products (thus accounting for correlation in data). The number of runs (from the total of 1000 runs) is counted in which product A has a higher impact than product 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).

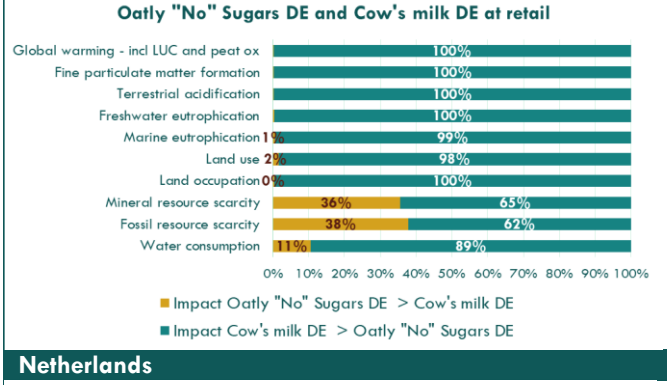
Figure 7 below shows the outcome of this paired Monte Carlo analysis for all products in scope, and for all impact categories. It shows that for climate change, fine particulate matter formation, terrestrial acidification, freshwater eutrophication and marine eutrophication, the impact of Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) is consistently and significantly lower than the impact of cow's milk. When it comes to land

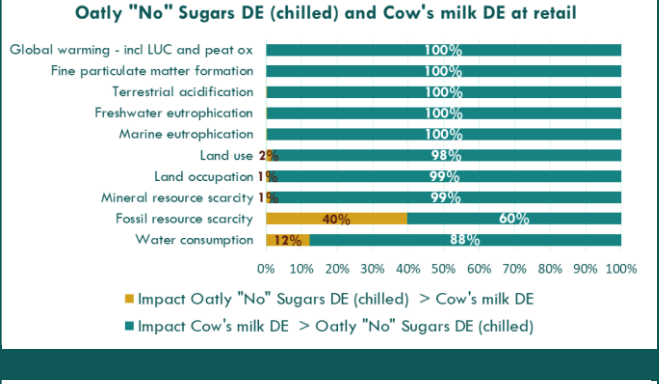
occupation, the impact of Oatly “No” Sugars is significantly lower for all cases. For the Oatly Oat Drink products, land occupation is lower in all cases, but not significantly lower in case of Oatly Oat Drink whole in the Netherlands. For water consumption, the impact is lower for all Oatly products, yet not significant in a number of cases. For land use, Oatly Oat Drink Whole at retail NL is the only product which has a higher impact than cow’s milk. The other products have a lower land use impact, though not significant in a few cases. For mineral resource scarcity and fossil resource scarcity, the differences between Oatly “No” Sugars or Oatly Oat Drink (Whole/Semi/Light) and cow’s milk varies between significantly higher, lower or insignificant.

Germany

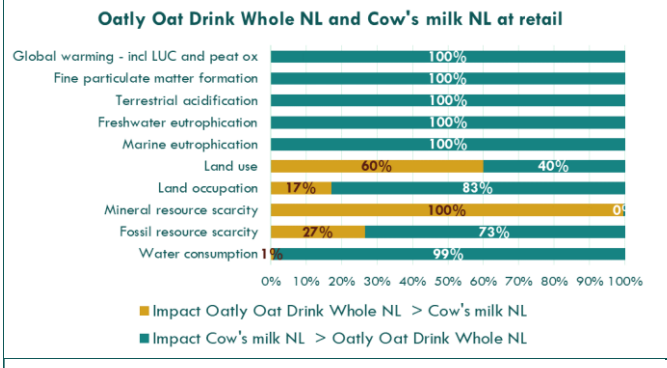


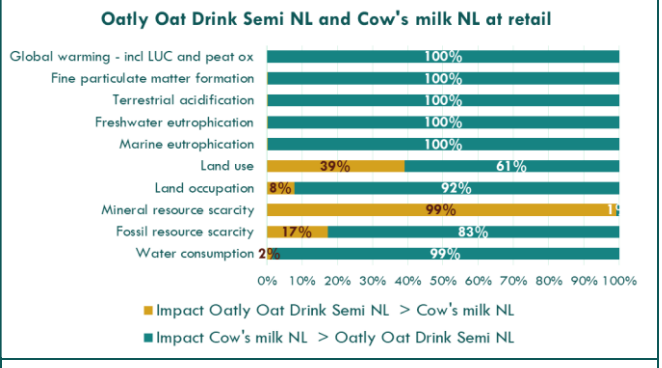


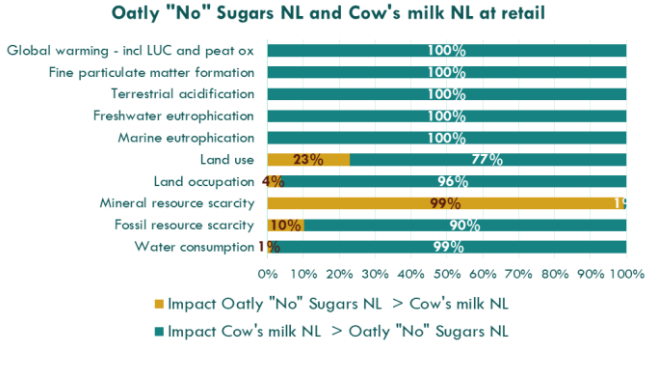




Netherlands

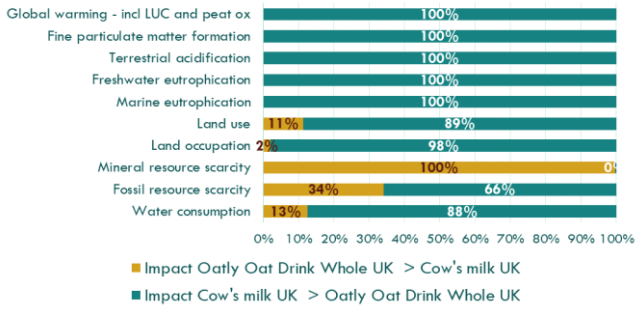




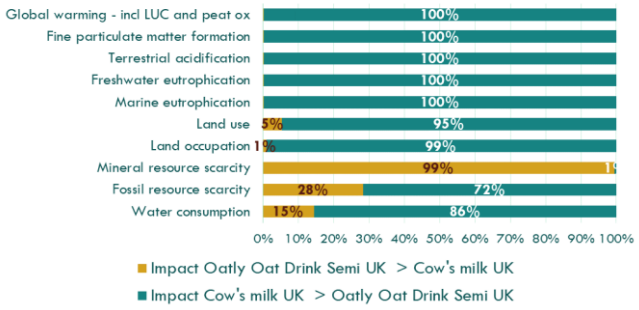


United Kingdom

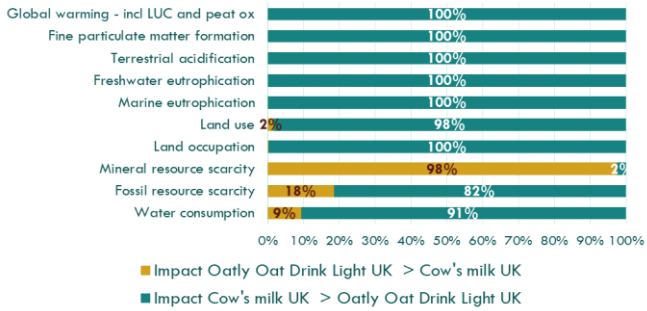
Oatly Oat Drink Whole UK and Cow's milk UK at retail



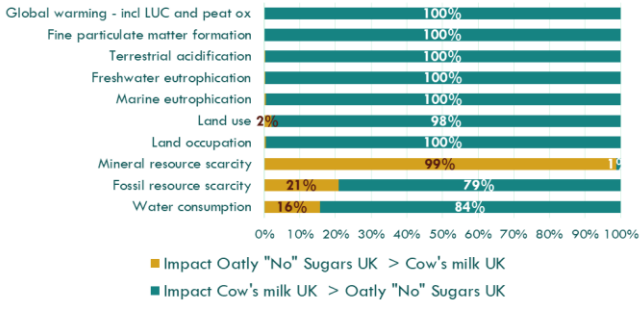
Oatly Oat Drink Semi UK and Cow's milk UK at retail



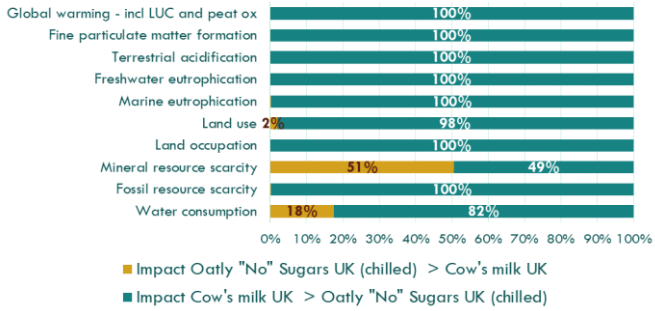
Oatly Oat Drink Light UK and Cow's milk UK at retail



Oatly "No" Sugars UK and Cow's milk UK at retail

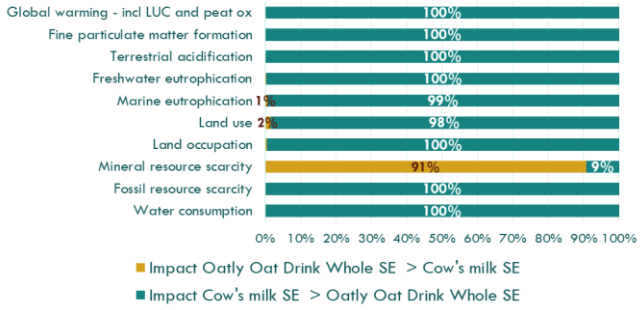


Oatly "No" Sugars UK (chilled) and Cow's milk UK at retail

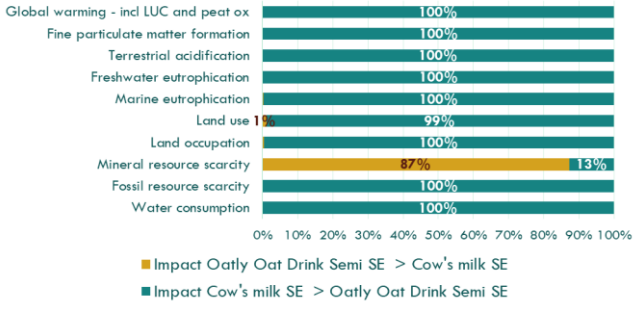


Sweden

Oatly Oat Drink Whole SE and Cow's milk SE at retail



Oatly Oat Drink Semi SE and Cow's milk SE at retail



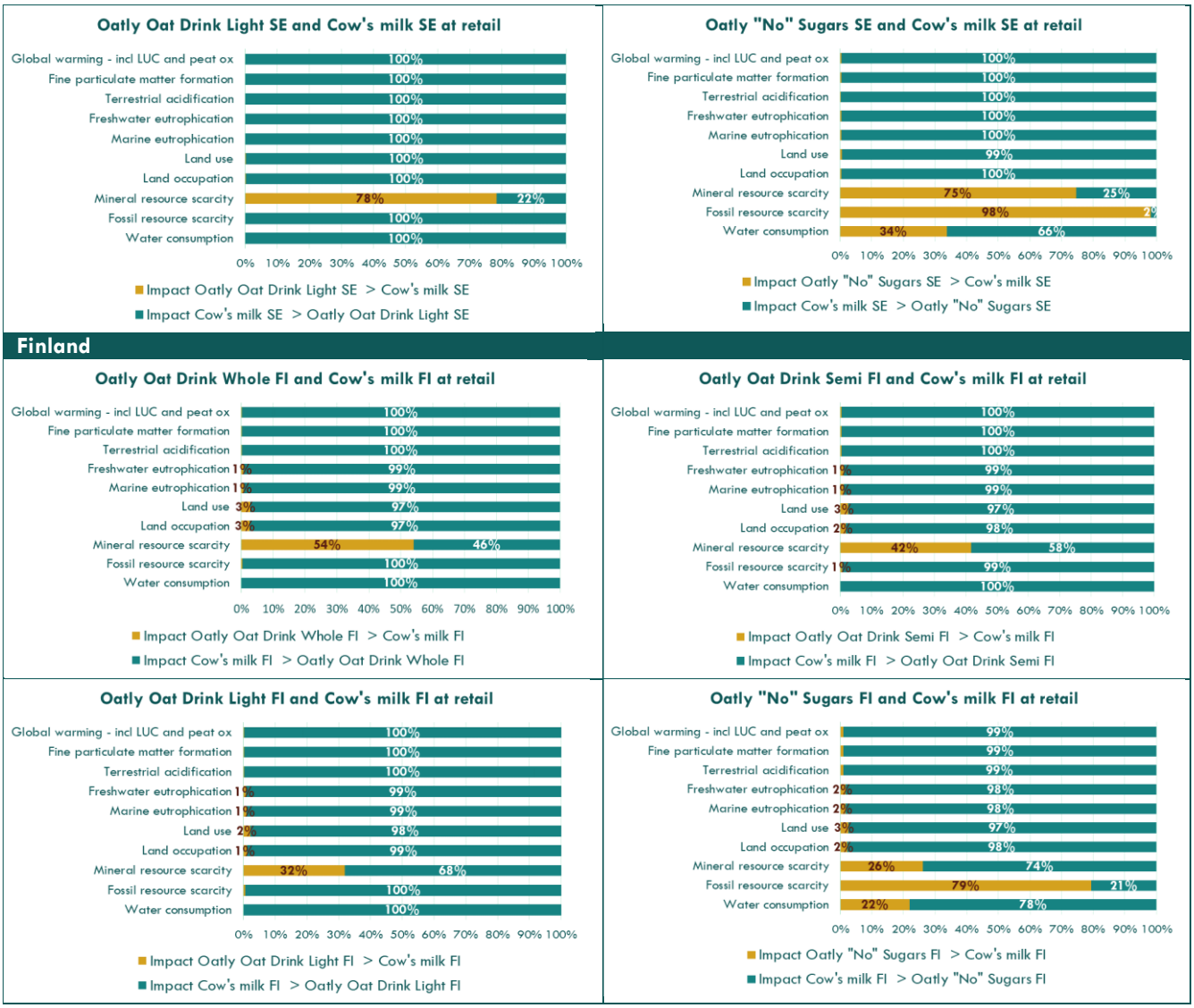


FIGURE 7: PAIRED MONTE CARLO ANALYSIS OF 1L OATLY "NO" SUGARS, OATLY OAT DRINK (WHOLE/SEMI/LIGHT), AND COW'S MILK AT RETAIL INCLUDING END-OF-LIFE (EOL) PACKAGING, SHOWING THE PERCENTAGE OF MONTE CARLO RUNS IN WHICH ONE PRODUCT HAS A HIGHER IMPACT THAN THE OTHER. FOR EXAMPLE, FOR CLIMATE CHANGE, OATLY OAT DRINK WHOLE AT RETAIL IN GERMANY HAS A LOWER IMPACT THAN COW'S MILK FOR 100% OF THE 1000 MONTE CARLO SIMULATIONS PERFORMED. ABBREVIATIONS USED: DE = GERMANY, NL = THE NETHERLANDS, UK = THE UNITED KINGDOM, SE = SWEDEN, FI = FINLAND.

6. Conclusion

A Life Cycle Assessment (LCA) has been performed to compare the environmental performance of Oatly "No" Sugars and Oat Drink (Whole, Semi and Light) to cow's milk in five key sales markets in Europe: Germany, the Netherlands, the United Kingdom, Sweden, and Finland. The functional unit considered for this study is 1 liter of Oatly product/cow's milk at the point of sale, 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 Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) 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, and marine eutrophication. For water consumption and land occupation, Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) also have a consistently lower impact, though the difference is marginal for some cases. For land use, all Oatly products have a lower impact than cow's milk (though in some cases not significantly) except for Oatly Oat Drink Whole in the Netherlands, where the impact is comparable to cow's milk. For mineral resource scarcity and fossil resource scarcity, the differences between both systems vary depending on the case. When it comes to mineral resource scarcity, Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) have in most cases a higher impact than cow's milk which can be mainly attributed to the use of aluminum in ambient beverage cartons. The fossil resource scarcity impact is to a large extent determined by the processing step, which is lower for products produced in the Landskrona factory (Sweden) due to the use of renewable energy in that factory.

The significance of the abovementioned differences has been determined by an uncertainty analysis. A sensitivity analysis which compares the Whole, Semi and Light Oat Drink products to cow's milk with corresponding fat content, shows results in a similar range.

In the main report additional sensitivity analyses were carried out, of which the conclusions also apply to the current products, as they are of similar or lower impact than Oatly Barista produced in the same factories. The main report concluded 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 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 (chilled distribution, 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.

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.

7. References

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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 Full LCIA Results

Oatly "No" Sugars at retail (incl EoL packaging), per liter

Impact category	Unit	Oatly "No" Sugars DE	Oatly "No" Sugars DE (chilled)	Oatly "No" Sugars NL	Oatly "No" Sugars UK	Oatly "No" Sugars UK (chilled)	Oatly "No" Sugars SE	Oatly "No" Sugars FI
Global warming - incl LUC and peat ox	kg CO2 eq	0.515	0.558	0.495	0.521	0.493	0.565	0.567
Global warming - excl LUC and peat ox	kg CO2 eq	0.411	0.448	0.391	0.417	0.383	0.461	0.463
Global warming - only LUC	kg CO2 eq	0.018	0.023	0.018	0.018	0.023	0.018	0.018
Global warming - only peat ox	kg CO2 eq	0.086	0.087	0.086	0.086	0.086	0.087	0.087
Stratospheric ozone depletion	kg CFC11 eq	2.26E-06	2.30E-06	2.25E-06	2.26E-06	2.27E-06	2.29E-06	2.29E-06
Ionizing radiation	kBq Co-60 eq	2.89E-02	2.94E-02	2.62E-02	3.30E-02	3.42E-02	3.39E-02	3.39E-02
Ozone formation, Human health	kg NOx eq	1.24E-03	1.32E-03	9.95E-04	1.34E-03	1.05E-03	1.58E-03	1.65E-03
Fine particulate matter formation	kg PM2.5 eq	4.42E-04	4.30E-04	3.84E-04	4.50E-04	3.80E-04	4.85E-04	5.08E-04
Ozone formation, Terrestrial ecosystems	kg NOx eq	1.42E-03	1.50E-03	1.17E-03	1.52E-03	1.23E-03	1.77E-03	1.84E-03
Terrestrial acidification	kg SO2 eq	1.42E-03	1.41E-03	1.26E-03	1.45E-03	1.26E-03	1.57E-03	1.63E-03
Freshwater eutrophication	kg P eq	1.68E-04	1.68E-04	1.50E-04	1.98E-04	1.88E-04	1.52E-04	1.87E-04
Marine eutrophication	kg N eq	4.33E-04	4.37E-04	4.34E-04	4.52E-04	4.51E-04	4.33E-04	4.45E-04
Terrestrial ecotoxicity	kg 1,4-DCB	0.905	0.924	0.807	0.900	0.813	0.986	0.979
Freshwater ecotoxicity	kg 1,4-DCB	2.13E-02	2.03E-02	2.17E-02	2.16E-02	2.03E-02	2.12E-02	2.17E-02
Marine ecotoxicity	kg 1,4-DCB	1.68E-02	1.56E-02	1.73E-02	1.74E-02	1.56E-02	1.67E-02	1.74E-02
Human carcinogenic toxicity	kg 1,4-DCB	1.50E-02	1.14E-02	1.43E-02	1.39E-02	9.81E-03	1.42E-02	1.42E-02
Human non-carcinogenic toxicity	kg 1,4-DCB	0.433	0.420	0.430	0.446	0.422	0.421	0.443
Land use	m2a crop eq	0.527	0.534	0.544	0.536	0.542	0.537	0.538
Land occupation	m2a	0.584	0.591	0.648	0.616	0.624	0.615	0.621
Mineral resource scarcity	kg Cu eq	1.09E-03	8.49E-04	9.33E-04	1.03E-03	7.78E-04	1.04E-03	1.03E-03
Fossil resource scarcity	kg oil eq	1.19E-01	1.19E-01	9.59E-02	1.23E-01	1.06E-01	1.28E-01	1.32E-01
Water consumption	m3	7.85E-03	7.96E-03	8.27E-03	7.98E-03	8.04E-03	8.13E-03	8.19E-03

Oatly Oat Drink (Whole, Semi, Light) at retail (incl EoL packaging), per liter

Impact category	Unit	Oatly Go Blue Whole DE	Oatly Go Blue Semi DE	Oatly Go Blue Whole NL	Oatly Go Blue Semi NL	Oatly Go Blue Whole UK	Oatly Go Blue Semi UK	Oatly Go Blue Light UK	Oatly Go Blue Whole SE	Oatly Go Blue Semi SE	Oatly Go Blue Light SE	Oatly Go Blue Whole FI	Oatly Go Blue Semi FI	Oatly Go Blue Light FI
Global warming - incl LUC and peat ox	kg CO2 eq	0.569	0.540	0.549	0.521	0.576	0.547	0.515	0.398	0.369	0.341	0.400	0.371	0.343
Global warming - excl LUC and peat ox	kg CO2 eq	0.443	0.425	0.423	0.405	0.449	0.431	0.411	0.298	0.279	0.261	0.300	0.281	0.263
Global warming - only LUC	kg CO2 eq	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.022	0.022	0.022	0.022	0.022	0.022
Global warming - only peat ox	kg CO2 eq	0.108	0.098	0.108	0.098	0.108	0.098	0.086	0.079	0.068	0.058	0.079	0.068	0.058
Stratospheric ozone depletion	kg CFC11 eq	2.90E-06	2.50E-06	2.90E-06	2.50E-06	2.91E-06	2.50E-06	2.12E-06	2.66E-06	2.25E-06	1.88E-06	2.66E-06	2.26E-06	1.88E-06
Ionizing radiation	kBq Co-60 eq	3.16E-02	3.09E-02	2.88E-02	2.81E-02	3.57E-02	3.49E-02	3.36E-02	2.53E-02	2.46E-02	2.38E-02	2.53E-02	2.46E-02	2.37E-02
Ozone formation, Human health	kg NOx eq	1.35E-03	1.28E-03	1.10E-03	1.04E-03	1.45E-03	1.38E-03	1.31E-03	1.14E-03	1.08E-03	1.01E-03	1.21E-03	1.15E-03	1.08E-03
Fine particulate matter formation	kg PM2.5 eq	4.82E-04	4.57E-04	4.24E-04	3.99E-04	4.90E-04	4.65E-04	4.38E-04	4.40E-04	4.15E-04	3.89E-04	4.63E-04	4.38E-04	4.12E-04
Ozone formation, Terrestrial ecosystems	kg NOx eq	1.60E-03	1.48E-03	1.35E-03	1.23E-03	1.70E-03	1.58E-03	1.47E-03	1.42E-03	1.30E-03	1.18E-03	1.49E-03	1.37E-03	1.25E-03
Terrestrial acidification	kg SO2 eq	1.62E-03	1.48E-03	1.46E-03	1.32E-03	1.66E-03	1.51E-03	1.38E-03	1.54E-03	1.40E-03	1.27E-03	1.61E-03	1.47E-03	1.33E-03
Freshwater eutrophication	kg P eq	1.85E-04	1.74E-04	1.66E-04	1.55E-04	2.14E-04	2.04E-04	1.93E-04	1.57E-04	1.47E-04	1.36E-04	1.91E-04	1.80E-04	1.70E-04
Marine eutrophication	kg N eq	5.66E-04	4.77E-04	5.66E-04	4.77E-04	5.84E-04	4.95E-04	4.12E-04	5.48E-04	4.59E-04	3.77E-04	5.60E-04	4.71E-04	3.89E-04
Terrestrial ecotoxicity	kg 1,4-DCB	0.995	0.924	0.897	0.826	0.991	0.919	0.853	1.059	0.987	0.921	1.053	0.981	0.915
Freshwater ecotoxicity	kg 1,4-DCB	2.57E-02	2.24E-02	2.61E-02	2.28E-02	2.60E-02	2.27E-02	1.98E-02	2.63E-02	2.30E-02	2.01E-02	2.68E-02	2.35E-02	2.06E-02
Marine ecotoxicity	kg 1,4-DCB	1.80E-02	1.71E-02	1.85E-02	1.76E-02	1.85E-02	1.77E-02	1.69E-02	1.92E-02	1.83E-02	1.75E-02	1.99E-02	1.90E-02	1.82E-02
Human carcinogenic toxicity	kg 1,4-DCB	1.57E-02	1.54E-02	1.50E-02	1.47E-02	1.46E-02	1.43E-02	1.38E-02	1.60E-02	1.56E-02	1.52E-02	1.60E-02	1.56E-02	1.52E-02
Human non-carcinogenic toxicity	kg 1,4-DCB	0.496	0.460	0.494	0.458	0.510	0.473	0.435	0.471	0.435	0.397	0.492	0.456	0.419
Land use	m2a crop eq	0.660	0.585	0.677	0.602	0.669	0.594	0.518	0.629	0.554	0.479	0.631	0.555	0.481
Land occupation	m2a	0.717	0.642	0.782	0.707	0.750	0.675	0.598	0.711	0.635	0.560	0.716	0.641	0.566
Mineral resource scarcity	kg Cu eq	1.15E-03	1.11E-03	9.96E-04	9.60E-04	1.09E-03	1.05E-03	1.01E-03	1.14E-03	1.11E-03	1.07E-03	1.14E-03	1.10E-03	1.06E-03
Fossil resource scarcity	kg oil eq	1.25E-01	1.22E-01	1.02E-01	9.92E-02	1.30E-01	1.26E-01	1.23E-01	5.53E-02	5.21E-02	4.90E-02	6.00E-02	5.68E-02	5.37E-02
Water consumption	m3	7.73E-03	7.70E-03	8.15E-03	8.12E-03	7.86E-03	7.83E-03	7.74E-03	4.64E-03	4.60E-03	4.54E-03	4.70E-03	4.67E-03	4.60E-03

Oatly "No" Sugars at retail (incl EoL packaging), per kg

Density of Oatly "No" Sugars = 1.035 kg/L

Impact category	Unit	Oatly "No" Sugars DE	Oatly "No" Sugars DE (chilled)	Oatly "No" Sugars NL	Oatly "No" Sugars UK	Oatly "No" Sugars UK (chilled)	Oatly "No" Sugars SE	Oatly "No" Sugars FI
Global warming - incl LUC and peat ox	kg CO2 eq	0.497	0.539	0.478	0.503	0.476	0.546	0.548
Global warming - excl LUC and peat ox	kg CO2 eq	0.397	0.433	0.378	0.403	0.370	0.445	0.447
Global warming - only LUC	kg CO2 eq	0.017	0.023	0.017	0.017	0.022	0.017	0.017
Global warming - only peat ox	kg CO2 eq	0.084	0.084	0.084	0.084	0.083	0.084	0.084
Stratospheric ozone depletion	kg CFC11 eq	2.18E-06	2.23E-06	2.18E-06	2.19E-06	2.19E-06	2.21E-06	2.21E-06
Ionizing radiation	kBq Co-60 eq	2.80E-02	2.84E-02	2.53E-02	3.19E-02	3.30E-02	3.27E-02	3.27E-02
Ozone formation, Human health	kg NOx eq	1.20E-03	1.27E-03	9.61E-04	1.29E-03	1.01E-03	1.53E-03	1.60E-03
Fine particulate matter formation	kg PM2.5 eq	4.27E-04	4.16E-04	3.71E-04	4.35E-04	3.67E-04	4.69E-04	4.91E-04
Ozone formation, Terrestrial ecosystems	kg NOx eq	1.37E-03	1.45E-03	1.13E-03	1.47E-03	1.18E-03	1.71E-03	1.77E-03
Terrestrial acidification	kg SO2 eq	1.37E-03	1.37E-03	1.21E-03	1.40E-03	1.22E-03	1.51E-03	1.58E-03
Freshwater eutrophication	kg P eq	1.63E-04	1.63E-04	1.45E-04	1.91E-04	1.82E-04	1.47E-04	1.80E-04
Marine eutrophication	kg N eq	4.19E-04	4.22E-04	4.19E-04	4.36E-04	4.36E-04	4.18E-04	4.30E-04
Terrestrial ecotoxicity	kg 1,4-DCB	0.874	0.893	0.779	0.870	0.785	0.952	0.946
Freshwater ecotoxicity	kg 1,4-DCB	2.06E-02	1.96E-02	2.10E-02	2.09E-02	1.96E-02	2.05E-02	2.10E-02
Marine ecotoxicity	kg 1,4-DCB	1.63E-02	1.51E-02	1.67E-02	1.68E-02	1.51E-02	1.61E-02	1.68E-02
Human carcinogenic toxicity	kg 1,4-DCB	1.45E-02	1.10E-02	1.38E-02	1.34E-02	9.48E-03	1.38E-02	1.38E-02
Human non-carcinogenic toxicity	kg 1,4-DCB	0.418	0.406	0.416	0.431	0.408	0.407	0.428
Land use	m2a crop eq	0.509	0.516	0.525	0.518	0.523	0.518	0.520
Land occupation	m2a	0.564	0.571	0.626	0.595	0.603	0.594	0.600
Mineral resource scarcity	kg Cu eq	1.05E-03	8.20E-04	9.02E-04	9.91E-04	7.52E-04	1.00E-03	9.96E-04
Fossil resource scarcity	kg oil eq	1.15E-01	1.15E-01	9.26E-02	1.19E-01	1.02E-01	1.23E-01	1.28E-01
Water consumption	m3	7.58E-03	7.69E-03	7.99E-03	7.71E-03	7.77E-03	7.85E-03	7.91E-03

Oatly Oat Drink (Whole, Semi, Light) at retail (incl EoL packaging), per kg

Density of Oatly Oat Drink Whole = 1.036 kg/L, Semi = 1.037 kg/L, and Light = 1.038 kg/L

Impact category	Unit	Oatly Go Blue Whole DE	Oatly Go Blue Semi DE	Oatly Go Blue Whole NL	Oatly Go Blue Semi NL	Oatly Go Blue Whole UK	Oatly Go Blue Semi UK	Oatly Go Blue Light UK	Oatly Go Blue Whole SE	Oatly Go Blue Semi SE	Oatly Go Blue Light SE	Oatly Go Blue Whole FI	Oatly Go Blue Semi FI	Oatly Go Blue Light FI
Global warming - incl LUC and peat ox	kg CO2 eq	0.549	0.521	0.530	0.502	0.556	0.527	0.496	0.384	0.356	0.328	0.387	0.358	0.330
Global warming - excl LUC and peat ox	kg CO2 eq	0.428	0.409	0.409	0.390	0.434	0.416	0.396	0.287	0.269	0.252	0.290	0.271	0.254
Global warming - only LUC	kg CO2 eq	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.021	0.021	0.021	0.021	0.021	0.021
Global warming - only peat ox	kg CO2 eq	0.105	0.094	0.105	0.094	0.105	0.094	0.083	0.076	0.066	0.056	0.076	0.066	0.056
Stratospheric ozone depletion	kg CFC11 eq	2.80E-06	2.41E-06	2.80E-06	2.41E-06	2.81E-06	2.41E-06	2.04E-06	2.57E-06	2.17E-06	1.81E-06	2.57E-06	2.18E-06	1.81E-06
Ionizing radiation	kBq Co-60 eq	3.05E-02	2.98E-02	2.78E-02	2.71E-02	3.44E-02	3.37E-02	3.24E-02	2.44E-02	2.37E-02	2.29E-02	2.44E-02	2.37E-02	2.29E-02
Ozone formation, Human health	kg NOx eq	1.30E-03	1.24E-03	1.06E-03	1.00E-03	1.40E-03	1.33E-03	1.27E-03	1.10E-03	1.04E-03	9.74E-04	1.17E-03	1.10E-03	1.04E-03
Fine particulate matter formation	kg PM2.5 eq	4.66E-04	4.41E-04	4.10E-04	3.85E-04	4.73E-04	4.48E-04	4.22E-04	4.25E-04	4.00E-04	3.75E-04	4.47E-04	4.22E-04	3.97E-04
Ozone formation, Terrestrial ecosystems	kg NOx eq	1.54E-03	1.43E-03	1.30E-03	1.19E-03	1.64E-03	1.52E-03	1.41E-03	1.37E-03	1.25E-03	1.14E-03	1.43E-03	1.32E-03	1.21E-03
Terrestrial acidification	kg SO2 eq	1.57E-03	1.43E-03	1.41E-03	1.27E-03	1.60E-03	1.46E-03	1.33E-03	1.49E-03	1.35E-03	1.22E-03	1.55E-03	1.41E-03	1.28E-03
Freshwater eutrophication	kg P eq	1.78E-04	1.68E-04	1.60E-04	1.50E-04	2.07E-04	1.96E-04	1.86E-04	1.52E-04	1.41E-04	1.31E-04	1.84E-04	1.74E-04	1.64E-04
Marine eutrophication	kg N eq	5.46E-04	4.60E-04	5.46E-04	4.60E-04	5.63E-04	4.77E-04	3.97E-04	5.29E-04	4.43E-04	3.63E-04	5.41E-04	4.55E-04	3.75E-04
Terrestrial ecotoxicity	kg 1,4-DCB	0.961	0.891	0.866	0.796	0.956	0.886	0.822	1.022	0.952	0.887	1.016	0.946	0.881
Freshwater ecotoxicity	kg 1,4-DCB	2.48E-02	2.16E-02	2.52E-02	2.20E-02	2.51E-02	2.19E-02	1.91E-02	2.54E-02	2.21E-02	1.93E-02	2.59E-02	2.26E-02	1.98E-02
Marine ecotoxicity	kg 1,4-DCB	1.74E-02	1.65E-02	1.78E-02	1.70E-02	1.79E-02	1.71E-02	1.63E-02	1.85E-02	1.77E-02	1.69E-02	1.92E-02	1.84E-02	1.76E-02
Human carcinogenic toxicity	kg 1,4-DCB	1.52E-02	1.48E-02	1.45E-02	1.41E-02	1.41E-02	1.38E-02	1.33E-02	1.54E-02	1.51E-02	1.46E-02	1.54E-02	1.51E-02	1.46E-02
Human non-carcinogenic toxicity	kg 1,4-DCB	0.479	0.444	0.477	0.441	0.492	0.456	0.419	0.455	0.419	0.383	0.475	0.440	0.403
Land use	m2a crop eq	0.637	0.564	0.654	0.581	0.646	0.573	0.499	0.607	0.534	0.462	0.609	0.536	0.463
Land occupation	m2a	0.692	0.619	0.755	0.682	0.724	0.651	0.576	0.686	0.612	0.539	0.691	0.618	0.545
Mineral resource scarcity	kg Cu eq	1.11E-03	1.07E-03	9.62E-04	9.25E-04	1.05E-03	1.01E-03	9.74E-04	1.10E-03	1.07E-03	1.03E-03	1.10E-03	1.06E-03	1.02E-03
Fossil resource scarcity	kg oil eq	1.21E-01	1.18E-01	9.87E-02	9.56E-02	1.25E-01	1.22E-01	1.18E-01	5.34E-02	5.03E-02	4.72E-02	5.79E-02	5.48E-02	5.17E-02
Water consumption	m3	7.46E-03	7.43E-03	7.87E-03	7.83E-03	7.59E-03	7.55E-03	7.46E-03	4.47E-03	4.44E-03	4.37E-03	4.53E-03	4.50E-03	4.43E-03

Appendix III Critical Review Statement and Report

Critical Review Statement

The life cycle assessment (LCA) study "*LCA of Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light), 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). The study is an addendum to the report "LCA of Oatly Barista and comparison with cow's milk", published on December 7, 2022. Blonk Consultants commissioned the same panel of external experts to review this study including international experts comprising:

- Jasmina Burek (chair): Assistant Professor, University of Massachusetts Lowell, US
- Jens Lansche: LCA expert and project manager, Switzerland
- Joanna Trewern: Food Systems and Sustainable Diets expert, UK
- 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 Final Draft Report, a version of the document submitted on April 11th, 2023. The critical review was performed based on ISO 14044:2006 (2006) and followed the ISO/TS (2014) critical review process guidelines. This study follows closely methods of previously peer reviewed report *"LCA of Oatly Barista and comparison with cow's milk"*, and thus, the critical review was performed at the end of the LCA study. The critical review panel found the LCA study to be in conformance with ISO 14040 and ISO 14044 (2006; 2006) including:

- the methods used to carry out the LCA were consistent with the 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 process involved a review of the draft final report, for which only minor points were suggested by the critical review panel. The reviewers' comments were provided via email. 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 review panel concludes 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 stakeholders in completing this study.

April 13, 2023

Dr. Jasmina Burek	Dr. Jens Lansche	Dr. Joanna Trewern	Dr. Havo van der Werf
Panel Chair	Panel Member	Panel Member	Panel Member

LCA of Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light), and comparison with cow's milk

Version of the document submitted on April 11, 2023

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 "No" Sugars and Oatly Oat Drink (Whole/Semi/Light), and comparison with cow's milk"*. The study was commissioned by Oatly and life cycle assessment (LCA) was performed by Blonk Consultants. A panel of reviewers carried a critical review out and prepared the **Critical Review Report,** as defined in ISO 14044:2006 (2006). The **Critical Review Report** applies to the final version of the "*LCA of Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) report, and comparison with cow's milk"* published in April 2023.

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 used to support a comparative assertion intended to be disclosed to the public, a panel conducted the critical review (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. The reviewers participated in communication via email. The critical review report (Chapter 4) 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 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 review panel concludes that the study generally conforms to the applicable ISO standards as a comprehensive study that may be disclosed to the public.

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 Chapter 4.

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). The authors appropriately defined the goal of the study and functional unit for comparison of one liter (1 L) Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) and cow's milk products. The study is comprehensive in scope and contains a wealth of information and data related to Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) product supply chains in their respective production countries. The authors provided information 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 life cycle assessment approach. In a baseline scenario, Oatly "No" Sugars and Oatly Oat Drink were compared to 1 L of cow's milk at the point of sale. A cow's milk average product includes economic allocation for crop cultivation and processing, biophysical allocation at farm, and mass allocation (dry matter) at processing plant. The life cycle impact assessment was performed using nine key midpoint environmental impact categories from the ReCiPe 2016 impact assessment method (Huijbregts et al., 2016). Overall, the methodology and the selection of results of the impact assessment 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

Overall, the data used is considered appropriate and reasonable for the goal and scope of the study. In parallel to proprietary stakeholder life cycle inventory (LCI) data necessary to perform LCA of Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) in different locations, the study included different cow's milk supply chains from recent literature and LCI databases. The authors of the final report clearly described LCIs and data sources. Also, the authors provided information about robustness and limitations of the data used for Oatly "No" Sugars and Oatly Oat Drink (Whole/Semi/Light) and cow's milk product LCI.

3.4. Interpretation and Limitations within the Goal of the Study

The authors present a large variety of results addressing various aspects 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 extensive addendum to the main report following the 14040/14044 International Standards (ISO 14040, 2006; ISO 14044, 2006). The addendum describes the LCA framework including goal and scope, LCI, LCIA, results and interpretation, uncertainty analysis and conclusion. The key aspects of the data used for LCAs shown in this addendum are

described in the LCI section and accompanied with the main report documents, which provides more details on the data sources, scenario, and sensitivity analyses. 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 Guidance document, - Guidance for the development of Product Environmental Footprint Category Rules (PEFCRs), version 6.3, December 2017. 238.

Huijbregts, M.A.J., Steinmann, Z.J.N., Elshout, P.M.F., Stam, G., Verones, F., Vieira, M.D.M., Zijp, M., van Zelm, R., 2016. ReCiPe 2016: A harmonized life cycle impact assessment method at midpoint and enpoint level - report 1 : characterization, National Institute for Public Health and the Environment.

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).

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).

4. List of Specific Reviewer Comments Recommendations and Corresponding Responses

Critical Review Panel provided comments on two iterations of the draft report. These comments were addressed and/or incorporated in the final version of the report by the LCA partitioners. 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.

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
HW	204-208			Te.	The land occupation indicators has been added.	It would be of interest to briefly explain why this indicator was added and to give a reference for this method (e.g. of what characterisation method is it part?)	More detail was added in a footnote.
HW	240				Table numbers are wrong.	Change “Table 3” to “Table 5” Change “Table 4” to “Table 6”	Table numbers are updated in the new version.
HW	241				Table numbers are wrong.	Change “Table 5” to “Table 7” Change “Table 6” to “Table 8”	Table numbers are updated in the new version.
HW	291				“A contribution analysis shows the influence”	Change “influence” to “contribution”.	Corrected in the new version.
HW	421				“The figure below”	Change “The figure below” to “Figure 7”.	Corrected in the new version.
HW	455				“to a large extend”	Change “extend” to “extent”.	Corrected in the new version
HW	458				“an uncertainty analyses”	Change “analyses” to “analysis”.	Corrected in the new version
HW	459				“sensitivity analyses”	Change “analyses” to “analysis”.	Corrected in the new version
JT	10-11				‘slightly different recipe of the products.’ A line to say these are described in the main report would be helpful here. I prefer the language used lines 122-124 which is clearer and less subjective.	Insert line to signpost to later section which outlines the recipe differences.	Added in the new version
JT	31-32		Table 1		‘The conclusions for the remaining impact categories (mineral resource scarcity and fossil resource scarcity) varied depending on the country.’ Table 1 shows higher scores for fossil and mineral resource impacts for some Oatly products than cow’s milk, yet this is not reflected in the text. It is interesting that higher fossil and mineral resource impacts only seem to be the case for ambient products, suggesting this is not only dependent on the country of production as currently indicated in the text.	Indicate that scores for mineral and fossil resource scarcity were higher for Oatly products than cow’s milk in some cases. Update text to reflect variation due to product type (ambient vs chilled) as well as country. Briefly outline contribution analysis results to give elaboration on why f&m resource impacts are higher for these products.	Added explanation in the new version

1 Initials of the **Reviewer**

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

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
					The contribution analysis (Fig 1, f and g; lines 316-344) suggests higher impacts for ambient products due to transportation distances, processing methods and packaging – it would be good to briefly outline this here.		
JT	90-103				The implications of results for mineral resource scarcity are not included in this section.	These should be included with any elaboration on the mineral resource scarcity scores (similar to renewable energy elaboration lines 102-103).	Added in the new version
JT	470-471				'A detailed analysis of the main drivers and opportunities linked to the environmental impact of Oatly products can be found in the main report.'	Replace 'linked to' with more positive language e.g., 'to improve' or 'to reduce'	Kept linked to as it also refers to drivers (hotspots) of the Oatly products.
JL	Footnote			ed	"2022": I assume this refers to the year of publication.	Change "2022" to "2023"	Yes, corrected in the new version.
JL	37-38		Table 1 legend		"THE DIFFERENCES HAVE BEEN COLOR-CODED AS DIFFERENCE FAVORING OATLY BARISTA. YELLOW: THE DIFFERENCE IS 10% OR LOWER INDICATING SIMILAR PERFORMANCE FOR THE COMPARED PRODUCTS."	Explain also color-codes green and red (as it is done in legend of table 2).	Corrected in the new version
JL	98				"Simi"	Change "Simi" to "Semi"	Corrected in the new version
JL	213-216				"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), difference in storage conditions (chilled vs ambient), applying different allocation methods (economic allocation for cow's milk)."	Add "…applying a different functional unit (including nutritional characteristics)"	Added in the new version.
JL	281				"THE COLOUR SCALE USES GREEN TONES TO TO"	Remove one "to"	Corrected in the new version.
JL	352-353				"…whereas oalty's oat drink (whole/semi/light) and oalty barista…."	Replace "oalty's" by "6atly's* and "oalty" by "6atly"	Corrected in the new version

1 Initials of the **Reviewer**

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

Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
JB	Line 7			ed	"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)"	Proposed change is to mention that previous study has gone through ISO Critical Review process.	Added in the new version.
JB	Line 10			ed	" The only change that applies to the products in scope for this addendum concerns a slightly different recipe of the products." Does it affect the conclusions from the earlier study?	Proposed change is to mention it is not affecting conclusions from the previous study (which I believe is mentioned in Line 105	Added in the new version.
JB	Line 11			ed	Suggest replacing or adding numerical values to statements including "lower", "significant" to strengthen the conclusions	Proposed change is to add numerical values to each statement	The line number might not be correct here, but I assume you meant the conclusions of the executive summary. I added numerical values to the statements.
JB	Line 114			ed		Same as Line 7	A few lines down it is mentioned that "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, 2014), carried out by the same review panel as for the main report."
JB	Line 116			ed	There is also variability in terms of delivery (chilled and ambient) and maybe packaging?	Proposed change is to mention varieties chilled and ambient and packaging - is it 1 litre for all?	Added to the new version.
JB	Line 121			te	Apart from recipe no difference in packaging size? - is weight of the package scaled up linearly?	Proposed change is to clarify packaging size and scalability compared to previous study.	Added to the new version.
JB	Line 125 to 127			ed	One line paragraphs should be avoided	Proposed change is to add some more content (see next row)	Adjusted in the new version.
JB	Line 125 to 127			te	Audience would benefit from more information about the critical review and ISO recommendations regarding added elements of the LCA such as similar products.	Proposed change is to add that critical review refers only to one specific LCA study for which the past review is valid and that in this case review focused on specifically added elements of the LCA and assessed the overall conformance with ISO 14040 and ISO 14044	Added in the new version.

1 Initials of the **Reviewer**

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Reviewer[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Response of the commissioner & practitioner
JB	Line 133			ge	"of a selection of Oatly products"	Proposed change is to list all of the Oatly products that have been evaluated in the goal	Adjusted in the new version.
JB	Line 146			ed	Make sure all the tables and figures labels match the cross-referenced figures/tables in the text	Proposed change is to update fields.	Fields have been updated.
JB	Line 157 & Line 167			ed	Oatly Oat Drink Oatly "No" Sugars Previously and in title Oatly "No" Sugars was mentioned first and followed by Oatly Oat Drink	Proposed change is to keep order in mentioning Oatly "No" Sugars first throughout the report.	Changed order in the new version.
JB	Line 187			te		Proposed change is to add "panel of external independent experts"	Adjusted in the new version.
JB	Line 199			te	"This addendum includes a shortened review statement applying specifically to this addendum." Will the addendum be combined with the main report. If so, we can modify the previous review report and statement to address this. According to ISO standard "When an updated LCA study is based on a previous LCA study, with a similar goal and scope to the one that has been reviewed, the reviewer(s) of this updated LCA study may refer to the previous critical review process. The review may focus on the specifically **added or modified** elements of the LCA, but still shall assess the overall conformance of the updated LCA study with ISO 14040 and ISO 14044.	Proposed change depends if the addendum is integrated with the main report.	It will not be combined into one document, it will be a separate document.

1 Initials of the **Reviewer**

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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: April 13, 2023

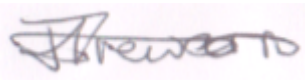
Name: Jasmina Burek

Signature: 

Name: Jens Lansche

Signature: 

Name: Joanna Trewern

Signature: 

Name: Hayo van der Werf

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