ClimateHero

J.H. Orsing AB– Product Carbon Footprint: *Aspirator Tube Bio*, including comparison with fossil-based Aspirator Tube

J.H. Orsing AB
Org. 556099-9632

Torbornavägen 26
253 68 Helsingborg

Product Carbon Footprint for Aspirator Tube Bio

Background

J.H. Orsing AB provides dental solutions, such as saliva ejectors and aspirator tubes. In order to understand the climate impact of the life cycle phases, as well as the potential of driving down emissions, ClimateHero (556815-2754) has on behalf of Orsing conducted a Life Cycle Analysis of the product Aspirator Tube Bio. The report also includes a comparison with Aspirator Tube made in fossil-based plastic, to better understand the climate benefit of the product when bio plastics are used.

Scope

1) A GHG Product Carbon Footprint of the product Aspirator Tube Bio "Cradle-to-Grave"

The defined **functional unit** is one Aspirator Tube Bio (average weight 2,78 gram/unit), consisting of *I'm Green™* HDPE, with a technical life span of 1 use. The *I'm Green* ™ plastics is delivered from Brazil. The production is set in Helsingborg, Sweden, and the defined Gate-to-Grave scenario is the European market. At the end of its life cycle, the product is treated as medical waste and therefore incinerated.

2) A comparison with the same product produced in fossil-based PE instead of bioplastic, with the purpose of identifying the climate benefit Cradle-to Grave as well as Cradle-to-Gate.

Key assumptions for the comparison:

- The weight is based on an average for all Aspirator Tube articles (with a range of 1,92-3,12 grams) and is the same for both the biobased product and the fossil-based. Also, the production data are the same for both products, based on information from Orsing's facilities.
- The fossil plastic granulate is transported from Orsing's manufacturer in Egypt, compared to the bio-based plastic which is manufactured in Brazil.
- In both scenarios, the packaging is identical except for the material of the plastic bag: the fossil-based Aspirator Tube product is packaged in a fossil-based plastic bag, whereas the Aspirator Tube Bio product is packaged in a bio-based plastic bag.

All assumptions for the fossil-based Aspirator Tube are based on data from Orsing's production of that same product.

<u>Out of scope:</u> Design work and other general overhead emissions are not included (i.e. commuting).

Additional assumptions are found in the appendix.

<u>Inventory date and version:</u> October 2025, v1.0

Summary of Results

The fossil carbon footprint of Aspirator Tube Bio across its entire life cycle (cradle-to-grave) is calculated to be 5,92 g CO_2e per unit, of which the cradle-to-gate phase accounts for 5,02 g CO_2e per unit.

When considering fossil greenhouse gas emissions only (*GWP-fossil*), Aspirator Tube Bio shows a 68% lower cradle-to-grave impact compared to the fossil-based Aspirator Tube. When biogenic emissions and land-use change (luluc) are included, the total climate impact (*GWP-total*) is 72% lower for Aspirator Tube Bio.

The main drivers behind the difference are related to material origin and end-of-life treatment.

- The use of bio-based plastic reduces emissions by 59% in the Material Acquisition phase and by 98% in the End-of-Life phase compared to the fossil-based alternative.

- By using 100% renewable energy, the Production phase represents less than 2% of the total climate impact.

Summary in numbers:

<u>GWP-fossil</u>

1) Total emissions GWP-fossil, Cradle-to-Gate: 5,02 gram CO_2e per functional unit

2) Total emissions GWP-fossil, Cradle-to-Grave: 5,92 gram CO_2e per functional unit

3) Aspirator Tube Bio has 47% lower fossil emissions Cradle-to-Gate than the fossil-based Aspirator Tube (5,02 gram CO_2e /functional unit versus 9,51 gram CO_2e /functional unit)

4) Aspirator Tube Bio has 68% lower fossil emissions Cradle-to-Grave than the fossil-based Aspirator Tube (5,92 gram CO_2e /functional unit versus 18,52 gram CO_2e /functional unit).

<u>GWP-total</u>

5) Total emissions GWP-total, Cradle-to-Gate: -4,23 gram CO_2e per functional unit

6) Total emissions GWP-total, Cradle-to-Grave: 5,23 gram CO_2e per functional unit

7) Aspirator Tube Bio has 72% lower emissions Cradle-to-Grave than the fossil-based Aspirator Tube (5,23 gram CO_2e/functional unit versus 18,52 gram CO_2e /functional unit).

Method

Climate calculations are based on the GHG Product Standard framework, that is developed by the global standard Greenhouse Gas Protocol and closely linked to the GHG Corporate Standard. The GHG Protocol Corporate Standard defines emissions in three scopes:

8) Scope 1 – The company's direct emissions from vehicles, combustion, processes, or leakages.
9) Scope 2 – The company's indirect emissions (electricity, heating, cooling) from energy purchased and consumed.
10) Scope 3 – Greenhouse gas emissions that occur upstream and downstream in the company's value chain, as a consequence of the company's operations.

The GHG Product Standard serves as the foundational framework for calculating the lifecycle emissions associated with a specific product/service. Lifecycle emissions are tracked "Cradle-to-Grave". This means that all significant emissions directly linked to the product from all three scopes (1, 2 and 3) are accounted for, e.g. materials, transportation and energy use.

Emissions are calculated and presented as Global Warming Potential fossils (*GWP-fossil*), as well as *GWP-total*. *GWP-total* includes *GWP-fossil* as well as separate calculations of biogenic emissions *(GWP-biogenic*), and land use change (*GWP-luluc*).

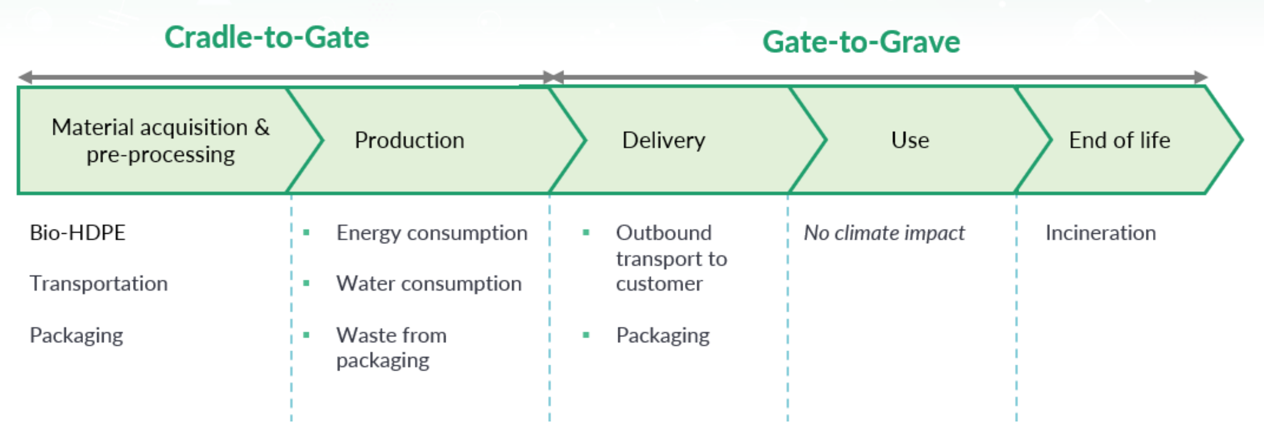
Allocation method 100% cut-off has been used, which means that emissions from waste management End-of-Life is included.

Data collection has prioritized acquiring primary activity data, such as actual weight etc, but allocation has been made when actual data has not been achievable. Emission factors are partly from supplier data and partly from databases such as DESNZ (formerly BEIS) (2025), see further details in Appendix 2.

Total greenhouse gas emissions are quantified in terms of carbon dioxide equivalents (CO_2e). This unit accounts for variations in the global warming potential of different greenhouse gases, such as carbon dioxide, nitrogen oxides and methane. Each greenhouse gas is assigned a specific factor to reflect its distinct impact on global warming.

Life cycle stage definition

The following life cycle stages and respective activity blocks are defined in the *Cradle-to-Grave* assessment of emissions.



Cradle-to-Gate: Material acquisition includes pre-processing of the materials and transportation to Orsing's production site, including packaging materials. Carbon contents are stored in the bio-plastic. Production includes emissions from energy and water consumption, as well as waste from the packaging materials and water.

Gate-to-Grave: Delivery includes outbound transportation to end customers and packaging (with biogenic uptake from bioplastic and cardboard). No impact exists in the Use-phase. End-of-life-phase includes emissions associated with the waste disposal of the product as well as packaging materials.

Appendix 1. further details the process map of materials and energy flows including biogenic emissions and uptakes.

Result

The **Cradle-to-Grave** fossil carbon footprint is calculated to be **5,92 grams CO_2e per functional unit,** of which **Cradle-to-Gate** is calculated as **5,02 grams CO_2e per functional unit**. Detailed results are presented in Table 1 below.

Key Findings

- **Largest impact from materials**
  The main emission driver is the bioplastic, accounting for 62% of total emissions Cradle-to-Grave, followed by the transportation of the bio-plastic accounting for 20%.
- **Low impact from production**
  Production phase has a very low impact (<2%) due to only renewable energy being used. After installation of heat exchangers, enabling the water to be recycled within the internal system, the water consumption has furthermore decreased from 10 800m^3 to 800m^3, making the impact from water consumption ten times lower, now only accounting for ~0,04% of the total impact.

Phase	GWP-fossil (g CO_2e)	Share of total (%)	Share of total, Cradle-to-Gate (%)
Material acquisition	4,92	83,1%	98,0%
Plastics	3,67	61,9%	73,0%
Transport of plastics	1,20	20,3%	24,0%
Packaging	0,05	0,9%	1,0%
Production	0,10	1,7%	2,0%
Energy	0,05	0,9%	1,0%
Water	<0,01	<0,1%	<0,1%
Waste from packaging	0,05	0,8%	0,9%
Total climate impact (Cradle-to-Gate)	5,02	84,8%	100%
Delivery	0,73	12,3%	
Packaging materials	0,45	7,5%	
Transport	0,28	4,7%	
Use	0,00	0,0%	
Not applicable	0,00	0,0%	
End of life	0,17	2,9%	
Waste management	0,17	2,9%	
Total climate impact (Gate-to-Grave)	0,90	15,2%	
Total climate impact (Cradle-to-Grave)	**5,92**	**100%**	

Table 1. Result GWP-fossil

Climate Impact (GWP-total)
When including emissions from biogenic sources as well as land use and land-use change (luluc), the total greenhouse gas emissions amount to **5,23 g CO_2e per unit Cradle-to-Grave.** Detailed results are presented in Table 2 below.

Key Findings

- **Net Carbon Balance**
  The total net carbon balance over the full life cycle of Aspirator Tube Bio is 0,39 g CO_2e per unit, considering incineration is assumed. This is primarily due to the fact that the biogenic emissions from the bioplastic in the End-of-Life phase are slightly higher than the carbon uptake occurring during the bio plastic production.
  For the cardboard packaging material, the net carbon balance is 0 g CO_2, based on the assumption that also the cardboard is incinerated.

- **Impact of Sugarcane Cultivation**
  The cultivation of sugarcane used in the production of the bio-based plastic contributes to an increase in soil carbon stocks. Since the sugarcane is cultivated on former pastureland with moderate to severe degradation, this results in a net reduction of -1,08 g CO_2e per unit.

Phase	**GWP-fossil (g CO_2e)**	**GWP-biogenic (g CO_2)**	**GWP-luluc (g CO_2e)**	**GWP-total (g CO_2e)**
Material acquisition	4,92	-8,07	-1,08	**-4,23**
Production	0,10	0,00	0,00	**0,10**
Delivery	0,73	-0,42	0,00	**0,31**
Use	0,00	N/A	N/A	**N/A**
End of life	0,17	8,88	0,00	**9,05**
Total	**5,92**	**0,39**	**-1,08**	**5,23**

Table 2. Results GWP-total

Comparison with fossil-based Aspirator Tube

The **Cradle-to-Grave** fossil carbon footprint is calculated to be **18,52 gram CO_2e per functional unit** for the fossil-based Aspirator Tube, of which **9,51 gram CO_2e are emissions Cradle-to-Gate**.

Key findings, GWP-fossil:

- Aspirator Tube Bio has **68% lower emissions GWP-fossil Cradle-to-Grave** than the fossil-based Aspirator Tube (5,92 gram CO_2e /unit versus 18,52 gram CO_2e /unit).

- Aspirator Tube Bio has **47% lower emissions GWP-fossil Cradle-to-Gate** than the fossil-based Aspirator Tube (5,02 gram CO_2e /unit versus 9,51 gram CO_2e /unit).

- The difference stems from bio plastic having 59% less emissions from the material phase, and 98% less emissions from incineration of the plastics in the End-of-Life-phase.

- Furthermore, if the compared case product would have been produced elsewhere, the difference would most likely be even larger since the production phase at Orsing has a very low impact due to renewable energy being used in production.

Even though the emissions from transporting the Aspirator Tube bio-based plastic granulate are higher than from the fossil-based Aspirator Tube — due to the longer transport distance (Brazil compared to Egypt) — the total impact of material production and transportation combined is still significantly lower (48%) for the bio-based material (4,87 g CO_2e per functional unit) compared to the fossil-based one (9,35 g CO_2e per functional unit).

Phase	**Aspirator Tube Bio, GWP-fossil (g CO_2e)**	**Fossil-based, GWP-fossil (g CO_2e)**	**Aspirator Tube Bio vs. Fossil-based (%)**
Material acquisition	4,92	9,40	-48%
Plastics incl. transport	*4,87*	*9,35*	*-48%*
Packaging	*0,05*	*0,05*	*-4%*
Production	0,10	0,10	-2%
Cradle-to-Gate (total)	5,02	9,51	-47%
Delivery	0,73	0,79	-8%
Use	0,00	0,00	N/A
End of life	0,17	8,23	-98%
Gate-to-Grave (total)	0,90	9,02	-90%
Total climate impact (Cradle-to-Grave)	5,92	18,52	-68%

Table 3. Comparison between bio plastic and fossil plastic products (GWP-fossil)

Key findings, GWP-total:

When biogenic emissions are included, the Aspirator Tube has an even greater advantage than the fossil-based Aspirator Tube: **Aspirator Tube Bio has 72% lower emissions GWP-total Cradle-to-Grave compared to the fossil-based Aspirator Tube** (5,23 gram CO_2e /unit versus 18,52 gram CO_2e /unit).

	Aspirator Tube Bio				Aspirator Tube (fossil-based)				
Phase	**GWP-fossil (g CO_2e)**	**GWP-biogenic (g CO_2)**	**GWP-luluc (g CO_2e)**	**GWP-total (g CO_2e)**	**GWP-fossil (g CO_2e)**	**GWP-biogenic (g CO_2)**	**GWP-luluc (g CO_2e)**	**GWP-total (g CO_2e)**	**Bio vs. Fossil-based**
Material acquisition	4,92	-8,07	-1,08	**-4,23**	9,40	0,00	0,00	**9,40**	**-145%**
Production	0,10	0,00	0,00	**0,10**	0,10	0,00	0,00	**0,10**	**0%**
Delivery	0,73	-0,42	0,00	**0,31**	0,79	-0,19	0,00	**0,60**	**-48%**
Use	0,00	0,00	0,00	**0,00**	0,00	0,00	0,00	**0,00**	**N/A**
End of life	0,17	8,88	0,00	**9,05**	8,23	0,19	0,00	**8,42**	**7%**
Total	**5,92**	**0,39**	**-1,08**	**5,23**	**18,52**	**0,00**	**0,00**	**18,52**	**-72%**

Table 4. Comparison of GWP-total between bio plastic and fossil plastic products

Sensitivity analysis and discussion

The calculated carbon footprint GWP-fossil is estimated to vary from –30% to +35% (4,16-8,08 g CO_2e /unit) due to uncertainties in data quality. The variation is mainly due to uncertainty regarding the weight of the bioplastic (it being an average), and transportation. Further details regarding the variation in the different life cycle phases follows.

Material acquisition

The activity data for the bioplastic is an average of all sold Aspirator Tube Bio, with a ranging weight of 1,92-3,12 grams. This means that the smallest Aspirator Tube Bio would have ~30% lower emission, with a results of 3,52 grams CO_2e Cradle-to-Gate and 4,29 grams CO_2e Cradle-to-Grave, while the largest Aspirator Tube Bio would have ~10% higher emissions, with a results of 5,62 grams CO_2e Cradle-to-Gate and 6,56 grams CO_2e Cradle-to-Grave.

Production

Production consists of extrusion, a manufacturing process used to create continuous lengths of plastic products with a fixed cross-sectional profile. In this method, the raw material is heated and forced through a shaped die using a high-pressure extruder. When the material exits the mold, it takes the shape of the mold opening and is then cooled and cured to obtain its final shape.

When it comes to the Production phase there is no difference between the biobased and the fossil-based plastic – that is, the variables are assumed to be the same in the two scenarios, therefore the emissions are also the same. The impact from Production is furthermore very low (<2%) and this is solely because Orsing have both electricity and heating from 100% renewables sources and very low water consumption due to the installed heat exchanger. Due to its small impact on the overall results, even large variations would have an insignificant effect on the overall impact.

Delivery

Delivery phase includes both transportations to end consumer and packaging materials. Distance has been calculated based on an average of Orsing's clients, where 95% are in Europe. If transportation instead would be to the most faraway customer, in Australia, transport emissions would increase by 350% GWP-fossil, resulting in a 16% rise in total life cycle emissions (6,90 g CO_2 cradle-to-grave).

The scenarios between the Aspirator Tube Bio and the fossil-based in the Delivery-phase are basically the same, except from the fact that solely fossil-based plastic is used for the latter, while packaging for the Aspirator Tube Bio consist of both fossil and biobased plastic. This leads to a 1% reduction of climate impact GWP-fossil for the Aspirator Tube Bio Cradle-to-Grave.

Use

No impact is assumed in the use phase.

End of Life

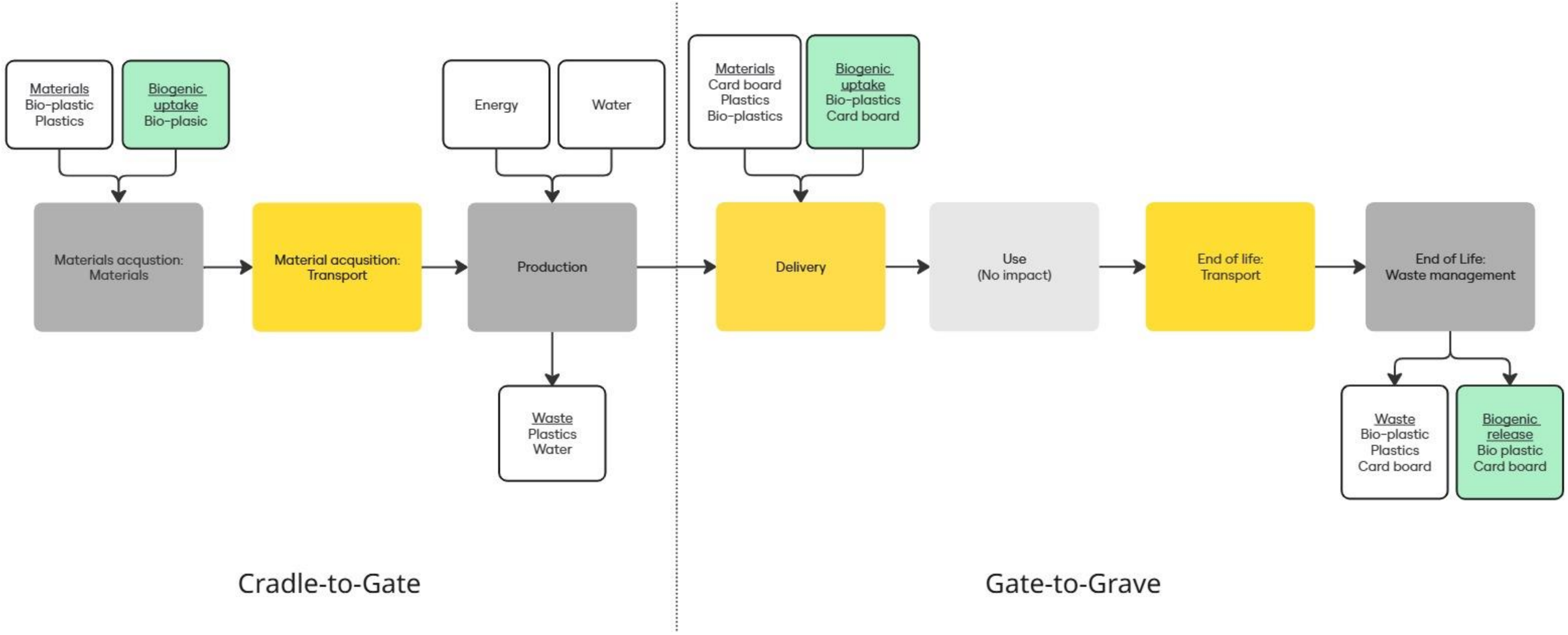
In the End-of-Life phase incineration has been assumed for Aspirator Tube Bio as it is considered medical waste. Incineration has also been assumed for the packaging material as customers are worldwide with a variation of waste management methods and incineration is the most conservative assumption. Considering the packaging's low impact of the overall result, the result wouldn't change significantly even if the packaging were to be recycled. The benefits of recycling the material would, however, still be of importance, even if that's not something that is shown in this report.

Recommendations for further analysis

To conclude, some recommendations for further analysis can be done to achieve higher quality data and even lower climate impact:

- Request more environmentally friendly way of transport methods (i.e. train or lorry on electric or HVO)
- Investigate the possibilities to reduce the amount of packaging, especially fossil-based

Appendix 1. Process map of material and energy flows



Appendix 2. Key assumptions and applied emission factors

Phase	Assumption	Data quality
1. Material acquisition	• Activity data for the I'm Green™ HDPE are an average and calculated based on specific data for the different articles, grams per functional unit. Emission factor for the I'm Green™ HDPE is gathered from supplier data (Braskem 2023). • To include the emissions from the wasted materials, the total amount of the bioplastic includes an assumed waste of 3%, based on conservative sample data from Orsing. • Activity data for the transportation of the material are based on supplier data (Braskem, 2023) regarding the I'm Green™ plastics. Emission factors from DESNZ (formerly BEIS), 2025. • Activity data for the packaging materials (plastics) are based on specific data from the manufacturing site in Helsingborg, Sweden. Allocation has been made based on total sold Aspirator Tube Bio during 2024, compared to total sold product overall. Emission factors are from DESNZ (formerly BEIS), 2025. Compared case: • The same method has been applied for the materials, with the exception that a general emission factor is applied for the fossil-based PE, gathered from DESNZ (formerly BEIS), 2025. • Activity data for the transportation of the material are based on data from Orsing. Emission factors are from DESNZ (formerly BEIS), 2025.	Medium-High
2. Production	• Activity data for the energy and water consumption are based on specific data from the manufacturing site in Helsingborg, Sweden. Allocation has been made based on total sold Aspirator Tube Bio during 2024, compared to total sold product overall, as it is assumed that Orsing's products require similar amounts of energy and water. • Electricity and heating are calculated based on the contract type (100% renewable energy in both cases). Upstream emissions for electricity are calculated as grid-average regardless of contract type. Compared case: • The Production phase is assumed to be the same.	High
3. Delivery	• Emissions from packaging are allocated based on total weight of each packaging material for the product (cardboard, bioplastic bag, and bag and wrapping in fossil-based plastic). Emission factors are from DESNZ (formerly BEIS), 2025. • Activity data for outbound transport to customers are calculated based on estimated average distance and emission factors gathered from DESNZ (formerly. BEIS), 2025. Compared case: • Same method has been applied, with the difference that no bioplastic has been used for packaging of the fossil-based Aspirator Tube.	Medium
4. Use	• No climate impact is identified in the Use-phase.	High
5. End of life	• Incineration has been assumed for both the Aspirator Tube Bio and packaging materials. Emission factors are from EPA, 2025. Compared case: • For the compared case the same scenario has been assumed.	Medium

Data quality definition:
- Low = Based on general data or conservative estimates
- Medium = Specific data with some level of estimation
- High = Specific data with specific emission factors from supplier or activity (high confidentiality)