ClimateHero

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

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Product Carbon Footprint for a Hygoformic 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 a Hygoformic® Bio – one of Orsing most sold product. The report also includes a comparison with Hygoformic 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 saliva ejector Hygoformic® Bio “Cradle-to-Grave”

The defined **functional unit** is one Hygoformic® Bio (3,94 gram/unit), consisting of *I’m Green™* LDPE and HDPE and a metal wire, with a technical life span of 1 use. The *I’m Green* ™ plastics is delivered from Brazil, and the metal wire is from France. 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 PP 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 of the products and their individual components is identical, with the same proportion of plastic and metal in each case, and 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 Hygoformic product is packaged in a fossil-based plastic bag, whereas the Hygoformic Bio product is packaged in a bio-based plastic bag.

All assumptions for the fossil-based Hygoformic are based on data from Orsing’s previous 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 Hygoformic Bio across its entire life cycle (cradle-to-grave) is calculated to be 11,52 g CO_2e per unit, of which the cradle-to-gate phase accounts for 10,55 g CO_2e per unit.

When considering fossil greenhouse gas emissions only (*GWP-fossil*), Hygoformic Bio shows a 38% lower cradle-to-grave impact compared to the fossil-based Hygoformic. When biogenic emissions and land-use change (luluc) are included, the total climate impact (*GWP-total*) is 41% lower for Hygoformic 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 50% 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 1% of the total climate impact.

Summary in numbers:

GWP-fossil

1) Total emissions GWP-fossil, Cradle-to-Gate: 10,55 gram CO_2e per functional unit

2) Total emissions GWP-fossil, Cradle-to-Grave: 11,52 gram CO_2e per functional unit

3) Hygoformic Bio has 16% lower fossil emissions Cradle-to-Gate than the fossil-based Hygoformic (10,55 gram CO_2e /functional unit versus 12,53 gram CO_2e /functional unit)

4) Hygoformic Bio has 38% lower fossil emissions Cradle-to-Grave than the fossil-based Hygoformic (11,52 gram CO_2e /functional unit versus 18,67 gram CO_2e /functional unit).

GWP-total

5) Total emissions GWP-total, Cradle-to-Gate: 4,44 gram CO_2e per functional unit

6) Total emissions GWP-total, Cradle-to-Grave: 11,06 gram CO_2e per functional unit

7) Hygoformic Bio has 41% lower emissions Cradle-to-Grave than the fossil-based Hygoformic (11,06 gram CO_2e/functional unit versus 18,67 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*).

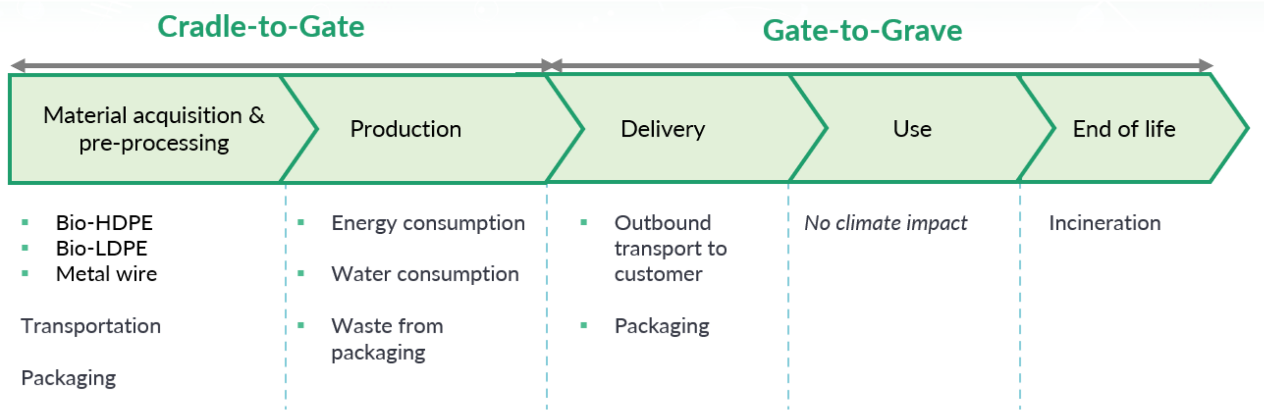
Allocation method 100% cut-off has been used, which means that emissions from waste management End-of-Life is included.

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 and cardboard (packaging). Production includes emissions from energy and water consumption, as well as waste from the packaging materials and water. Packaging materials are assumed to be incinerated, leading to a carbon release from cardboard.

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 **11,52 gram CO_2e per functional unit,** of which **Cradle-to-Gate** is calculated to **10,55 g 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 metal wire, standing for 59% of total emissions Cradle-to-Grave, while the bioplastics stands for 21%.
- **Low impact from production**
  Production phase has a very low impact (<0,5%), because only renewable energy is used. After installation of heat exchangers, enabling the water to be recycled within the internal system, the water consumption has furthermore decreased from 10 800m3 to 800m3, making the impact from water consumption ten times lower now only standing for ~0,01% of the total impact.
- **20% lower impact for Hygoformic L has**
  Orsing also provides a smaller size for the Hygoformic Bio, the Hygoformic Bio L. It has approximately 20% lower climate impact (8,26 g CO_2e Cradle-to-Gate and 9,14 g CO_2e Cradle to Grave than the regular Hygoformic Bio.

Phase	GWP-fossil (g CO_2e)	Share of total (%)	Share of total, Cradle-to-Gate (%)
Material acquisition	10,48	90,9%	99,4%
Plastics	2,43	21,1%	23,0%
Metals	6,75	58,5%	64,0%
Transport of plastics	0,80	6,9%	7,6%
Transport of metals	0,48	4,2%	4,5%
Packaging	0,03	0,3%	0,3%
Production	0,07	0,6%	0,6%
Energy	0,05	0,4%	0,5%
Water	<0,01	<0,1%	0,02%
Waste from packaging	0,01	0,1%	0,12%
Cradle-to-Gate (total)	10,55	91,5%	100%
Delivery	0,78	6,8%	
Packaging materials	0,41	3,5%	
Transport	0,38	3,3%	
Use	0,00	0,0%	
Use	N/A	N/A	
End of life	0,19	1,7%	
Waste management	0,19	1,7%	
Gate-to-Grave (total)	0,98	8,5%	
Total climate impact (Cradle-to-Grave)	11,52	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 **11,06 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 Hygoformic Bio is 0,26 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 –0,72 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 acquition	10,48	-5,40	-0,72	**4,37**
Production	0,07	0,01	0,00	**0,08**
Delivery	0,78	-0,28	0,00	**0,51**
Use	0,00	0,00	0,00	**N/A**
End of life	0,19	5,92	0,00	**6,11**
Total	11,52	0,26	-0,72	**11,06**

Table 2. Results GWP-total

Comparison with **fossil-based Hygoformic**

The **Cradle-to-Grave** fossil carbon footprint is calculated to **18,67 gram CO_2e per functional unit** for the fossil-based Hygoformic, of which **12,53 gram CO_2e are emissions Cradle-to-Gate**.

Key findings, GWP-fossil:

- Hygoformic Bio has **38% lower emissions GWP-fossil Cradle-to-Grave** than the fossil-based Hygoformic (11,52 gram CO_2e /unit versus 18,67 gram CO_2e /unit).

- Hygoformic Bio has **16% lower emissions GWP-fossil Cradle-to-Gate** than the fossil-based Hygoformic (10,55 gram CO_2e /unit versus 12,53 gram CO_2e /unit).

- The difference stems from bio plastic having 50% less emissions from the material phase, and ~ 95% 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 Hygoformic bio-based plastic granulate are higher than from the fossil-based Hygoformic — due to the longer transport distance (Brazil compared to Egypt) — the total impact of material production and transportation combined is still significantly lower (by 38%) for the bio-based material (3,22 g CO_2e per functional unit) compared to the fossil-based one (5,21 g CO_2e per functional unit).

Phase	**Hygoformic Bio, GWP-fossil (g CO_2e)**	**Fossil-based, GWP-fossil (g CO_2e)**	**Hygoformic Bio vs. Fossil-based (%)**
Material acquisition	10,48	12,47	-16%
Plastics incl. transport	*3,22*	*5,21*	*-38%*
Metal incl. transport	*7,23*	*7,23*	*0%*
Packaging	*0,03*	*0,03*	*0%*
Production	0,07	0,07	0%
Cradle-to-Gate (total)	10,55	12,53	-16%
Delivery	0,78	0,83	-6%
Use	0,00	0,00	N/A
End of life	0,19	5,31	-96%
Gate-to-Grave (total)	0,98	6,14	-84%
Total climate impact (Cradle-to-Grave)	11,52	18,67	-38%

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

Key findings, GWP-total:

When biogenic emissions are included, the Hygoformic has an even greater advantage than the fossil-based Hygoformic: **Hygoformic Bio has 41% lower emissions GWP-total Cradle-to-Grave compared to the fossil-based Hygoformic** (11,06 gram CO_2e /unit versus 18,67 gram CO_2e /unit).

	Hygoformic Bio				Hygoformic (fossil-based)				
Phase	**GWP-fossil (g CO_2e)**	**GWP-biogenic (g COe)**	**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	10,48	-5,40	-0,72	**4,37**	12,47	-0,01	0,00	**12,45**	**-65%**
Production	0,07	0,01	0,00	**0,08**	0,07	0,01	0,00	**0,08**	**0%**
Delivery	0,78	-0,28	0,00	**0,51**	0,83	-0,19	0,00	**0,64**	**-21%**
Use	0,00	0,00	0,00	**0,00**	0,00	0,00	0,00	**0,00**	**N/A**
End of life	0,19	5,92	0,00	**6,11**	5,31	0,19	0,00	**5,50**	**11%**
Total	**11,52**	**0,26**	**-0,72**	**11,06**	**18,67**	**0,00**	**0,00**	**18,67**	**-41%**

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 –35% to +30% (7,37-15 g CO_2e /unit) due to uncertainties in data quality. The variation is mainly due to uncertainty in the emission data for the metal wire. Further details regarding the variation in the different life cycle phases follows.

Since the metal wire is the same in the compared cases, there is high certainty in the calculated climate benefit of using bioplastics instead of fossil-based plastics.

<u>Material acquisition</u>

The activity data for the bioplastic and the metal are of similar high quality (actual data). Regarding the emissions factors, the quality is higher for the bioplastic (supplier data) while more generic factor is used for the metal wire, leading to higher uncertainties regarding the wire. Considering the metal is the largest emission driver, the uncertainties generate even larger variation.

If the metal were produced with a higher share of recycled material and/or by using 100% renewable energy, the emissions from the wire could furthermore decrease by up to 50%. This would reduce the overall impact by around 30% GWP-fossil, corresponding to total emissions of 8,15 grams CO_2e (Cradle-to-Grave).

<u>Production</u>

Production consists of basically two steps:

- 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.
- Wire feeding and bending, which is done in a custom-built machine, where steel wire is fed into the extruded tube and then enters a forming cylinder to give Hygoformic Bio 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 (<1%) 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.

<u>Delivery</u>

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 11% rise in total life cycle emissions (12,84 g CO_2).

The scenarios between the Hygoformic 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 Hygoformic Bio consist of both fossil and biobased plastic. This leads to a -1% reduction of climate impact GWP-fossil for the Hygoformic Bio Cradle-to-Grave.

Use

No impact is assumed in the use phase.

End of Life

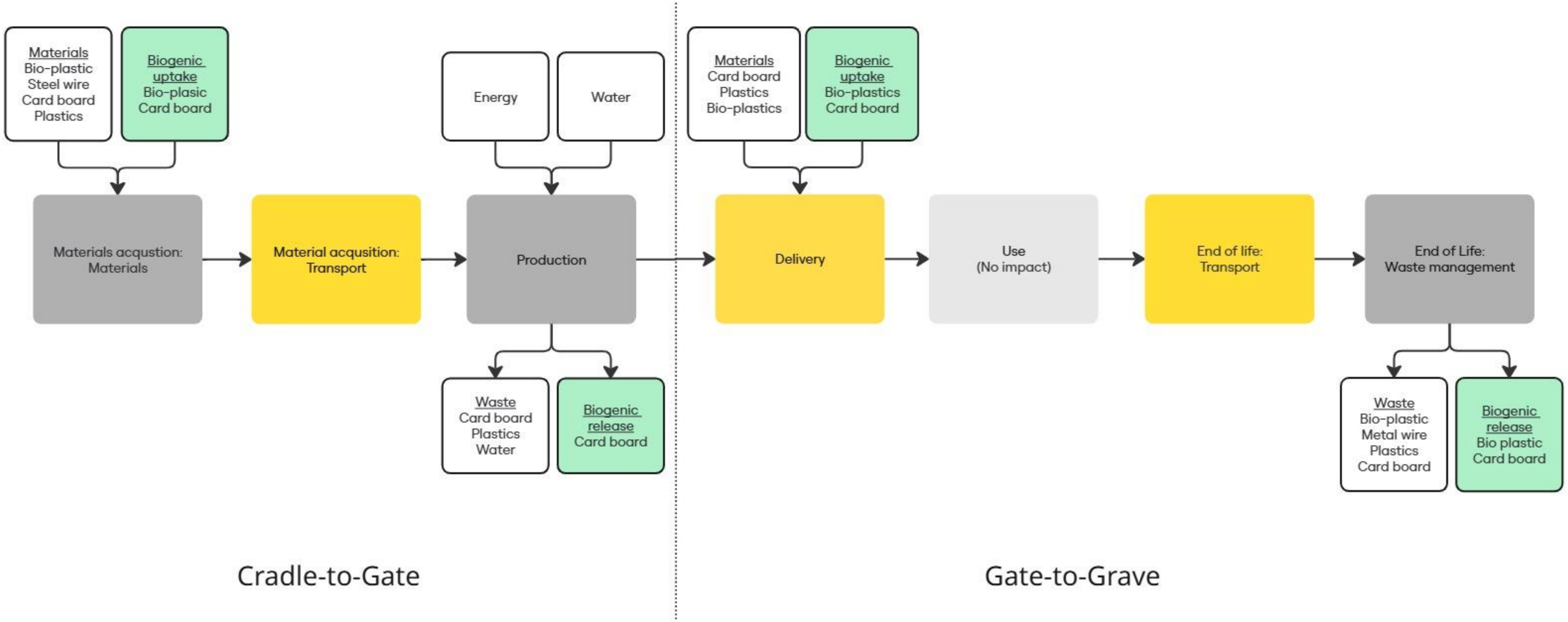
In the End-of-Life phase incineration has been assumed for Hygoformic Bio as it is considered medical waste. Incineration has also been assumed for the packaging material as customers are worldwide with a variation of waste management methods and incineration is the most conservative assumption. If recycling, however, would be assumed for the packaging materials, it would reduce the GWP-total for the whole life cycle with 3% (11,15 CO_2e /unit instead of 11,52 CO_2e /unit).

Recommendations for further analysis

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

- Acquiring more details regarding the metal wire and request wire based on a higher degree of recycled materials and/or produced with a higher degree of renewables
- Request more environmentally friendly way of transport methods (i.e. train or lorry on electric or HVO)

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™ LDPE and HDPE are calculated based on specific data, gram per functional unit. Emission factor for the I'm Green™ HDPE are gathered from supplier data (Braskem 2023), and the same is applied for the I'm Green™ LDPE while it is assumably somewhat lower. • Activity data for the metal wire is calculated based on specific data, gram per functional unit. A general emission factor from Boverket, 2025 is applied. • To include the emissions from the wasted materials, the total amount of both the bioplastic and the metal wire include 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, 2025. • Activity data for the packaging materials (plastics and cartons) is based on specific data from the manufacturing site in Helsingborg, Sweden. Allocation has been made based on total sold Hygoformic 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 PP, gathered from DESNZ, 2025. • Activity data for the transportation of the material are based on data from Orsing. Emission factors are from DESNZ (formerly BEIS), 2025.	Medium
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 Hygoformic 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 Hygoformic.	Medium
4. Use	• No climate impact is identified in the Use-phase.	High
5. End of life	• Incineration has been assumed for both the Hygoformic 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)