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Life Cycle Assessment update on Corbion algae-derived omega-3

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Executive summary

- Algae-based omega-3 helps expand the global supply beyond the limits of marine resources.

  In its updated Life Cycle Assessments (LCA) on algae-derived omega-3 solutions, Corbion reports improvements across most environmental impact categories for its AlgaPrime™ DHA. Compared with the 2021 LCA, climate change impacts were reduced by 18% and 23%, and water use decreased by 44–54% per kg of omega-3 DHA for AlgaPrime™ DHA biomass and AlgaPrime™ DHA LS A2, respectively. Main drivers behind these improvements are 'algae strain and manufacturing process optimization' resulting in higher DHA content and higher production efficiencies, intensified engagement with suppliers and responsible sourcing programs. For the first time the LCA also covered Corbion's AlgaVia™ DHA.

- Compared to average fish oil, the updated LCA shows that Corbion's algae-derived omega-3 DHA solutions have a 40–50% lower climate change impact. Since the carbon footprint of fish oil varies per species, fishing region, and fish oil processing technique the difference may vary when compared to specific species, depending also on the utilization of wild fish or by products. Similarly, the carbon footprint of alternative algae-derived omega-3 solutions may vary between each other due to differences in the microorganisms and feedstock efficiencies, manufacturing scale and supply chain set-up, and product forms.

- Since 2021, more omega-3 producers have also adopted LCAs, contributing to more transparent and data-driven sustainability benchmarks across the industry. As an early adopter, Corbion continues to build on its leadership by further improving the environmental performance of its algae-derived omega-3 through innovation in manufacturing processes (fermentation, downstream processing, and extraction) and active engagement with key suppliers, customers, and other stakeholders. Algae-based production operates as a controlled and scalable system with ongoing potential for environmental improvement.

- While algae-based omega-3 may show higher impacts in some agriculture-related categories, this does not provide a complete comparison with fish oil. This is because important impacts of fisheries on marine biodiversity are not yet fully captured in current assessment methods. For example, the impact of fisheries on (local) fish stocks, by-catches and applied fishing techniques on fish stocks and marine ecosystems are not included in this LCA.

This update builds on the 2021 study (Davis, et al. 2021), using for the most recent data across the full production chain and Corbion's expanded product range.

What is new in this updated assessment?

- AlgaPrime™ product enhancements and new product: crude algal oil (AlgaPrime™ and AlgaVia™ DHA oil)
- Corbion production data from 2025
- Most recent supplier data for the Corbion's supply chain of sugar and electricity (2021-2023)
- Updated secondary databases and LCA characterization methods

Introduction

Long-chain omega-3 polyunsaturated fatty acids, particularly docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), are essential nutrients for human and animal health. Robust evidence confirms their role in cardiovascular health, neurodevelopment, visual function, and regulation of inflammation in humans (Clader 2017, EFSA 2011).

In aquaculture species such as Atlantic salmon, adequate dietary intake of DHA and/or EPA is required to maintain optimal growth, tissue integrity, immune competence, and product quality (Bou, et al. 2017, Zatti, et al. 2023, Samuelsen, Kousoulaki and Bogevik 2024). Importantly, changes in aquafeed formulation directly influence the omega-3 content of farmed seafood, with implications for public health nutrition (Hamilton, et al. 2020, de Roos, et al. 2017).

In companion animals, clinical evidence demonstrates that DHA and EPA supplementation supports dermatological health, joint function, cognitive performance, and cardiovascular health in dogs and cats (Magalhães, et al. 2021, Carlisle, et al. 2024). Recent studies further confirm that algae-derived DHA from *Schizochytrium sp.* is both safe and effective in dogs when included in their diet. The DHA is effectively absorbed and utilized by the body, improving coat quality and supporting its broader adoption in modern pet nutrition formulations (Zhang, et al. 2025).

Despite their importance, the global supply of long-chain omega-3 fatty acids remains constrained. A systems-level analysis of the global omega-3 cycle demonstrated a structural imbalance between supply and

nutritional demand (Tocher, et al. 2019, Glencross, et al. 2025, Carrus and Wiarda 2026).

Historically, fish oil derived from wild-capture fisheries has been the primary commercial source of DHA and EPA. However, global marine fisheries production has plateaued. The Food and Agriculture Organization of the United Nations (FAO) reports that the majority of assessed fish stocks are fully exploited, limiting the expansion of marine ingredient supplies (FAO 2022, FAO 2024). Recent industry statistics from IFFO confirm that global fish oil production has remained relatively stable at approximately one million metric tons annually, reflecting biological and regulatory constraints rather than market demand (IFFO 2023).

At the same time, aquaculture continues to expand and now provides more than half of aquatic animal foods for human consumption. Feed formulations have shifted significantly over the past two decades, reducing reliance on marine proteins and oils through increased use of plant-based and alternative ingredients (Ytrestøyl, Aas and Åsgård 2015, Kok, et al. 2026). While this transition has reduced pressure on forage fisheries, plant oils do not naturally contain sufficient DHA or EPA. Consequently, declining marine oil inclusion has contributed to reduced omega-3 levels in farmed fish in several markets (de Roos, et al. 2017). Bridging the widening gap between finite marine supply and growing omega-3 demand remains a central challenge for global nutrition systems (Hamilton, et al. 2020, Tocher, et al. 2019, Glencross, et al. 2025). Microalgae are the original biological source of DHA and EPA in nature. In marine ecosystems, fish accumulate these fatty acids through trophic transfer. Commercial production of omega-3 oils from microalgae has advanced significantly over the past decade, particularly through heterotrophic fermentation systems that enable controlled, land-based production (Winwood 2013). Unlike capture fisheries, fermentation-based production is independent of marine ecosystem variability and can scale according to demand. Recent studies show that the replacement of fish oil with AlgaPrime™ omega-3 DHA has no detrimental effect on growth performance, feed intake, or pigmentation of farmed salmon (Zatti, et al. 2023).

Corbion commercializes omega-3 DHA products based on algae fermentation using *Schizochytrium sp.* to produce biomass that is rich in DHA. The omega-3 products are offered in different forms, for different applications:

1. AlgaPrime™ DHA biomass is a dried microalgae powder available in two versions: AlgaPrime™ DHA P1 biomass, containing a DHA min. 40.0 % (wt/wt) of product and AlgaPrime™ DHA P3 biomass, containing a DHA min. 35.0% (wt/wt) of product. AlgaPrime™ DHA P1 and P3 biomass provide a source of omega-3 feed ingredients for aquaculture, livestock, and pet food. These products are suitable for incorporation into dry and extruded, feed and pet food formulations.

2. AlgaPrime™ DHA LS A2 (liquid suspension of biomass) is a blend of DHA-rich microalgal biomass and vegetable oil. It contains a DHA min. 33.5 % (wt/wt) of product and provides a source of omega-3 for use in compound feed and other formulated applications. The suspension format allows precise dosing and facilitates incorporation in liquid application processes, such as coating or post-extrusion addition.

3. AlgaPrime™ and AlgaVia™ DHA Oil is a crude algal oil containing DHA min. 55.0 % (wt/wt) of product. It provides a concentrated source of omega-3 for use in formulated systems.

In 2021, Corbion published the first cradle-to-gate life cycle assessment (LCA) of commercially produced heterotrophic algae-derived DHA, using industrial-scale data (Davis, et al. 2021). This study helped establish an important standard for environmental transparency in commercial omega-3 production.

Environmental performance varies substantially across omega-3 production pathways. For fish oil, impacts depend on fishery characteristics, fleet fuel consumption, species composition, and allocation between fish meal and fish oil (Davis, et al. 2021, Newton, Maiolo, et al. 2023, Deville, et al. 2025, McKuin, et al. 2022, The Centre for Feed Innovation (CFI) 2025). Methodological choices, particularly co-product allocation, can significantly influence reported greenhouse gas emissions. Moreover, marine ingredient production remains inherently dependent on wild fish stocks and ecosystem dynamics.

In contrast, heterotrophic algae production is an industrial biotechnology system. Its environmental footprint is primarily driven by feedstock production, energy use, fermentation efficiency, and downstream processing (McKuin, et al. 2022, The Centre for Feed Innovation (CFI) 2025, Davis, et al. 2021). These parameters are measurable, controllable, and subject to continuous improvement. Recent advances in industrial fermentation efficiency, renewable energy integration, and resource optimization have reduced greenhouse gas emissions and improved overall environmental performance per unit of DHA produced (Davis, et al. 2021).

This whitepaper presents an updated cradle-to-gate LCA of Corbion's heterotrophic algae-derived omega-3 DHA, incorporating the latest operational data and recent technological improvements. The products covered are AlgaPrime™ DHA P1 and P3 biomass, AlgaPrime™ DHA LS A2 (liquid suspension of biomass) and crude algal oil (AlgaPrime™ DHA and AlgaVia™ DHA oil). Results are evaluated across key environmental impact categories, including climate change, land use, and freshwater use, and are compared with fish oil-derived omega-3. The analysis on climate change is extended to other microalgae and canola oil omega-3 sources, based on literature data. By combining updated scientific literature with standardized LCA methodology under ISO 14040 and ISO 14044 and more recent guidelines for omega-3 supply chains (GOED 2026), this assessment provides transparent and robust information to support resilient and sustainable omega-3 supply strategies.

How does Corbion produce algae-derived omega-3 products?

AlgaPrime™ and AlgaVia™ DHA products are manufactured via fermentation in Orindiúva, Brazil, using sugar from sugarcane as feedstock. The production site is co-located with a sugar mill, enabling the efficient use of energy from sugarcane by-products (renewable energy). This energy is used both for the sugar mill and for the Corbion algae plant. The main elements of the production system considered in the life cycle assessment are shown in Figure 1. Figure 2 shows the Corbion plant in Orindiúva and its vicinity, with the sugar mill, biomass boiler to cogenerates steam and electricity as well as the sugarcane fields. The fermentation process is based on sugarcane that is verified as responsibly sourced according to the Corbion Cane Sugar Code[1] and Policy[2]. The sugarcane Corbion uses is verified deforestation-free, based on satellite imagery monitoring studies, which cover deforestation and land conversion over the past 20 years.

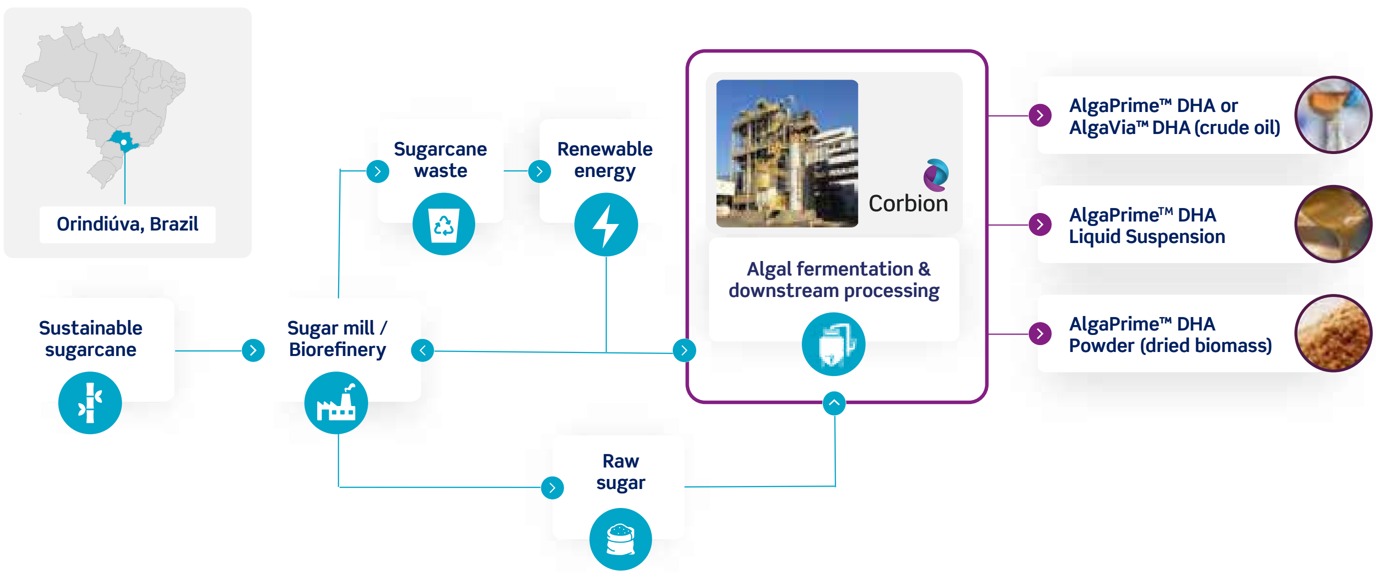

Figure 1 – The Corbion production system of algae-derived omega-3 DHA (docosahexaenoic acid) considered for the life cycle assessment study.

[1] https://www.corbion.com/-/media/corbion/files/pla-pdfs-12-of-24/corbion-cane-sugar-code_545064.pdf
[2] 1426005-cor-cane-sugar-policy_2.pdf

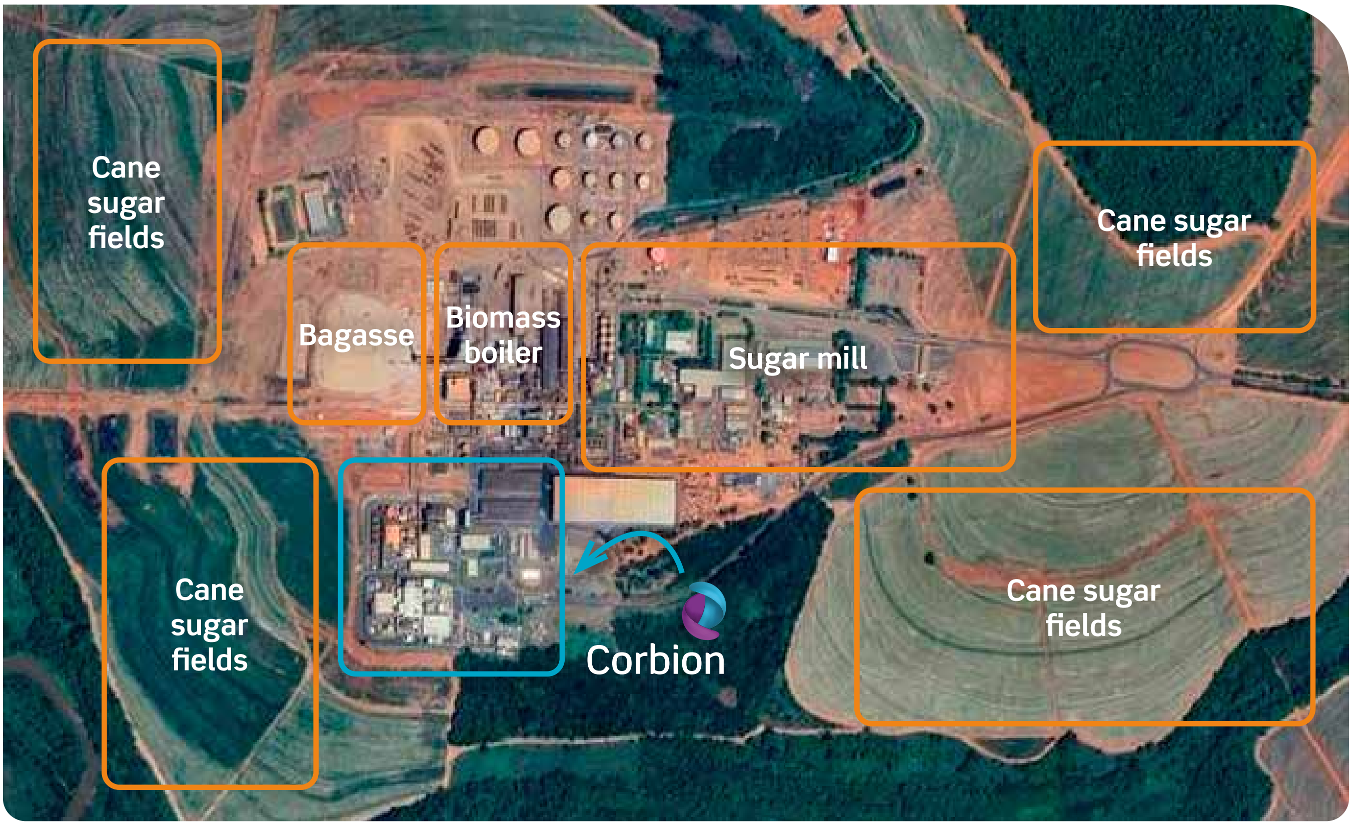

Figure 2 – Corbion algal DHA production system in Orindiúva, Brazil, fully integrated with the cane sugar farming, as well as sugar and energy.

Methodology

The goal and scope, process description, and life cycle inventory are based on Davis, et al. 2021, where additional details are provided. The changes in this study, compared to Davis, et al. 2021, aim to improve data quality for the life cycle inventory and to use the most recent impact assessment methods. The methodology conforms with ISO 14040/44 and ISO 14067, verified by PRé Sustainability (third party review) and aligned with the LCA guidelines for Omega-3 supply chains (GOED 2026). The LCA was performed with SimaPro software.

Goal of the study: Quantify the environmental footprint of AlgaPrime™ DHA P1 and P3 biomass, AlgaPrime™ LS A2 (Liquid Suspension), and crude algal DHA oil produced at Corbion's site in Orindiúva, Brazil. The scope of the study is cradle-to-gate.

Functional unit: 1 kg of long-chain omega-3 fatty acids (DHA + EPA). This functional unit allows comparison between the different algae-derived omega-3 products and fish oil. For AlgaPrime™ DHA P1 and P3 biomass, AlgaPrime™ LS A2 (Liquid Suspension), and crude algal DHA oil, DHA is the only long-chain omega-3 fatty acid, whereas in the case of crude fish oil and canola oil, both EPA and DHA are present and included in the functional unit. We use the average content of DHA in Corbion algal products based on product weight.

Scope: This cradle-to-gate LCA study covers Corbion production of the algae-derived omega-3 DHA products in Orindiúva, Brazil, using manufacturing data from 2025. It includes (1) sugarcane cultivation and harvest, (2) processing of sugarcane to sugar (with energy and ethanol as co-products), and (3) fermentation and downstream processing steps at Corbion, to deliver the final products (see Figure 1). Packaging and transport of finished products are excluded from the system boundaries.

Characterization method and environmental impact categories: method Environmental Footprint (EF) 3.1, implemented in SimaPro. The study covers the six most relevant impact categories defined by the Product Environmental Footprint Category Rules (PEFCR) guidelines for animal feed (European comission 2018).

Allocation approach: economic allocation (using 4-year average market prices).

Life cycle inventory and data collection for Corbion products:

- Primary data: Actual manufacturing data for Corbion production 2025; supplier data for sugar and energy (2020-2023); land conversion data for sugarcane and the vegetable oil obtained from satellite imagery studies covering historical data of the past 20 years.

- Background databases: ecoinvent 3.11 APOS and Agri-footprint 6.0 (economic).

Life cycle inventory and data collection for crude fish oil and other microalgae systems

The production of fish oil relies on the capture of small pelagic marine fish and fish trimmings from fish processing facilities. Wild fish are caught and transported to fishmeal plants, where they are processed into fish meal and fish oil (FMFO). Fish oil production relies also on by-products, such as trimmings and offal, processed at the FMFO plants. The data for crude fish oil is based on LCA databases ecoinvent 3.11 and Agri-footprint 6.0, as well as recent literature sources (Deville, et al. 2025, Newton, Maiolo, et al. 2023). The allocation factors in the Agri-footprint datasets were modified to reflect the average market prices of fish oil and fish meal in the period of 2021-2024 (OECD-FAO Agricultural Outlook 2024-2033). The DHA content of the different fish oil species is taken from (Glencross, et al. 2025) and (Newton, Malcorps, et al. 2025).

Recently, The Centre for Feed Innovation (CFI) 2025 published a state of industry report, which provides an overview the carbon footprint of DHA + EPA derived from fish oil from leading species (anchovy, herring, and menhaden) as well as omega-3 DHA + EPA derived from microalgae (*Schizochytrium sp.*, *Crypthecodinium cohnii* and phototrophic microalgae). The results of this report are also considered in this study.

Life cycle inventory and data collection for canola oil

An alternative, land-based source of DHA + EPA is delivered via newly developed canola variants with 9-11% DHA + EPA (Silva, et al.). Based on Aquaterra® Omega-3 website, carbon impact for canola is between 2.30 to 2.64 CO_2eq/kg oil and Aquaterra® Omega-3 canola oil has been independently verified at 2.57 kg of CO_2eq/kg oil (Aquaterra Omega-3 2026).

The data for omega-3 DHA + EPA derived from fish oil, canola oil and microalgae systems other than Corbion may not fully reflect the actual production across all producers. In addition, the use of different sources and methodologies may limit full comparability; therefore, the interpretation of the results should consider this uncertainty.

Life cycle assessment results

Environmental footprint of Corbion algae-derived omega-3 DHA

The Life Cycle Impact Assessment (LCIA) results for the most relevant impact categories are shown in Table 1.

The impacts of the different omega-3 product forms are broadly similar and show a small variation only (±11%), reflecting:

- The similarity of the production processes, as shown in Figure 1;
- The fact that most impacts are associated with the supply chain shared across Corbion's algae-derived products.

The remaining variation between products is related to downstream processing steps required to obtain the different product forms and the use of vegetable oil in the liquid suspension for AlgaPrime™ DHA LS A2 liquid suspension of biomass.

Impact category	Unit	AlgaPrime™ DHA P1 biomass	AlgaPrime™ DHA P3 biomass	AlgaPrime™ DHA LS A2 liq. susp.	Crude algal DHA oil
Climate change	kg CO_2 eq	3.39	3.71	3.60	3.83
Particulate matter	disease inc.	1.04E-06	1.11E-06	1.03E-06	1.27E-06
Acidification	mol H+ eq	6.80E-02	7.21E-02	7.04E-02	8.23E-02
Eutrophication, terrestrial	mol N eq	2.59E-01	2.75E-01	2.73E-01	3.14E-01
Land use	Pt (soil index quality)	1056	1123	1477	1286
Water use	m3 depriv.	0.422	0.402	0.422	0.444

Table 1 - Results for the relevant impact assessment categories for the Corbion algae-derived Omega-3 DHA products, per 1 kg of omega-3 DHA. The DHA content used is average values, based on the percentage of product weight.

The process contributions for the different products, described in detail in Davis, et al. 2021, remain unchanged in this study. Sugarcane cultivation and sugar mill stages contribute the most to climate change, particulate matter, acidification, eutrophication, and land use. Likewise, vegetable oil contributes significantly to the environmental performance of the AlgaPrime™ DHA LS A2 (liquid suspension).

The major impact of water consumption is related to the algae production stage. The water consumed at Corbion's facility is withdrawn from the local river in a region with a medium water-stress level. Water consumption is primarily due to the evaporation in the cooling towers. Water used in fermentation is largely recycled within the process, and a smaller amount is returned to the sugar mill where it is treated and applied in the sugarcane fields. The impact of water use from sugarcane cultivation is not significant because sugarcane is not an irrigated crop in the sourcing area.

Progress compared to previous LCA results

In its previous 2021 LCA study (Davis, et al. 2021), Corbion analyzed in detail AlgaPrime™ DHA P1 biomass and AlgaPrime™ DHA LS liquid suspension. Compared with the 2021 LCA, per kg of omega-3, the carbon footprint of these two products decreased by 18% for AlgaPrime™ DHA P1 biomass and 23% for AlgaPrime™ DHA LS liquid suspension (Figure 3). The progress over the last four years is explained by:

- Improvement of Corbion's algae strain and manufacturing process, resulting in higher DHA content in the final products and improved production efficiency. This reflects Corbion's innovation program and continuous improvement efforts.
- Engagement with suppliers and the responsible sourcing program, resulting in the use of more recent and more detailed supplier data for sugar and energy source. These actions contributed to reductions in the carbon footprint through the adoption of more sustainable agricultural practices. Examples include the continuation of sourcing from areas that are verified deforestation-free in the last 20 years, switching to organic fertilizers and reduction of energy usage at farms.

Next to the improvements in climate change impact, water use decreased by 54% for AlgaPrime™ DHA P1 biomass and 44% AlgaPrime™ DHA LS liquid suspension - per kg of omega-3 DHA, mostly driven by improvements in the manufacturing process and higher DHA content in the products. In other environmental impact categories, land use decreases (18–49% per kg omega-3 DHA) as well as particulate matter (16–23% per kg omega-3 DHA).

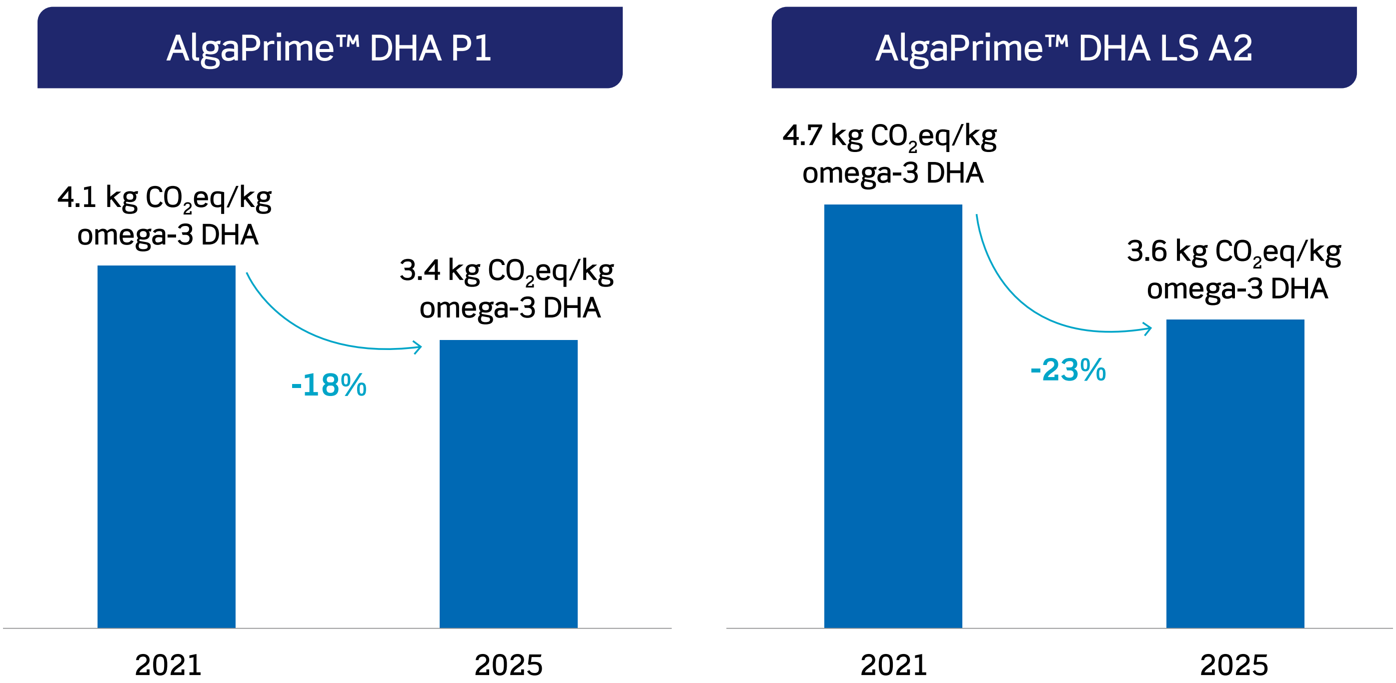

Figure 3 – Progress in the carbon footprint of our AlgaPrime™ DHA Liquid suspension and AlgaPrime™ DHA P1 biomass products, between the 2021 study (Davis, et al. 2021) and the current update. In 2021, the average omega-3 DHA content of both products was 30% (wt/wt product) and in the 2025 study it is 36% (wt/wt product) for AlgaPrime™ DHA liquid suspension and 40% (wt/wt product) for AlgaPrime™ DHA P1 biomass. The DHA content used represents average values based on the percentage of product weight.

On the other hand, acidification and eutrophication increase (20–43% per kg omega-3 DHA) due to changes in input data from sugarcane farming and updates in the modelling of agricultural emissions to align with the most recent IPCC methodology[3]. Comparison of the environmental impacts between the two studies is influenced also by updates to databases (ecoinvent 3.6 to 3.11 and Agri-footprint v4 to v 6.0) and characterization models (EF 3.0 to EF 3.1).

How do Corbion algae-derived omega-3 products compare with other omega-3 sources?

Figure 4 shows the climate change results for omega-3 (EPA + DHA) across different production systems. The grey bars are based on the study from The Centre for Feed Innovation (CFI) 2025, which reports that heterotrophic production with *Schizochytrium sp.* deliver comparable or lower climate change impact than fish oil in leading species and production systems (anchovy, herring, and menhaden).

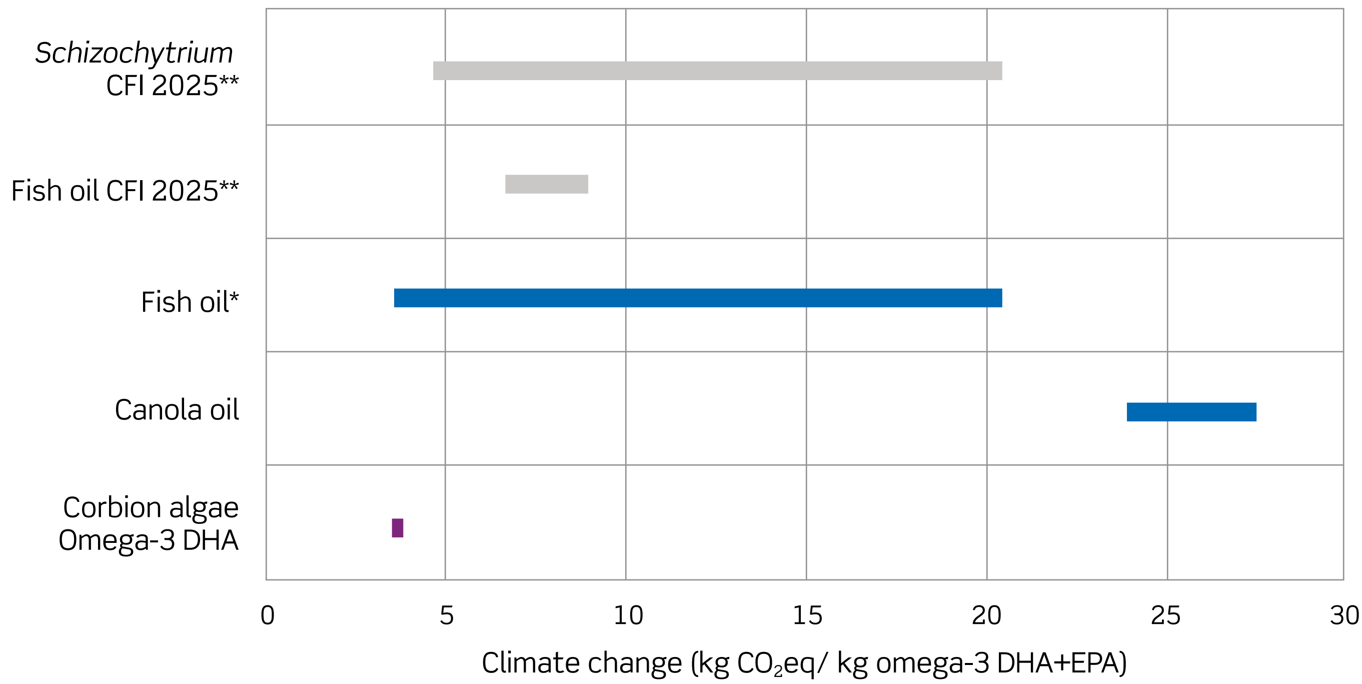

Figure 4 – Climate change life cycle impacts of fish oil and algal oil sources per functional unit of EPA and DHA. **data from (The Centre for Feed Innovation (CFI) 2025) * Crude fish oil, based on LCA databases ecoinvent 3.11, Agri-footprint 6.0, (Deville, et al. 2025, Newton, Maiolo, et al. 2023)

The study concludes also that phototrophic systems are more carbon and resource-intensive due to lower productivity and higher energy requirements for cultivation and harvesting. The phototrophic systems use sunlight and CO_2 to grow algae in open ponds or closed photobioreactors and the emissions depend largely on algae system and production system. Examples include the cultivation of *Phaeodactylum tricornutum* in closed photobioreactors resulting in 146 kg CO_2eq/kg DHA + EPA and *Nannochloropsis* oculate produced in open pound systems with 7,650 kg CO_2eq/kg EPA.

[3] IPCC - Intergovernmental Panel on Climate Change

The blue bar in Figure 4 shows the results on climate change for DHA and EPA derived from fish and krill oil, covering additional data sources and fish species than the CFI (2025) report. The results for fish oil vary significantly amongst the different data sources depending on fish species, the use of whole fish or trimmings at the FMFO plant, geography and the allocation approach for by-products.

These emissions are primarily caused by fossil fuel consumption in fisheries, transport and fishmeal and fish oil processing plants (Newton, Maiolo, et al. 2023, Deville, et al. 2025).

The results in Figure 4 for *Schizochytrium sp.* demonstrate how feedstock efficiency, yield, and energy source determine environmental performance across production systems. Corbion omega-3 products are also based on *Schizochytrium sp.* fermentation. However, they are produced at commercial scale and fully integrated with the upstream supply chain, enabling the use of renewable energy and relying on sugar produced using agricultural best practices. The lower carbon footprint of Corbion algal based omega-3 DHA is a result of this unique setup that is sustainable by design.

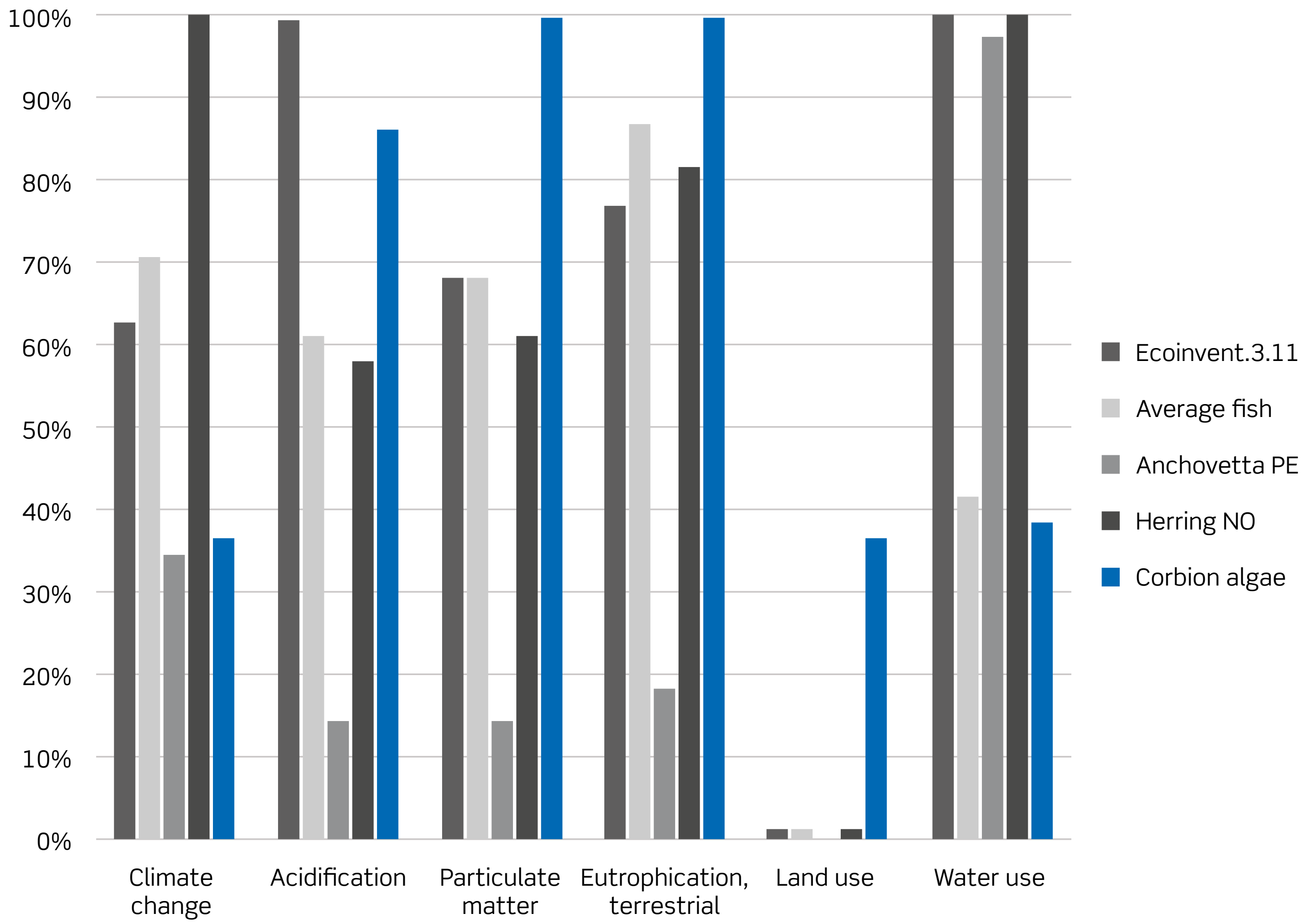

Figure 5 – Results for the environmental footprint of Corbion omega-3 DHA and omega-3 from fish oil. The fish oil datasets are based on ecoinvent 3.11 "Fish oil, from anchovy {GLO}| market for fish oil | APOS" and the average of the Agri-footprint 6.0 datasets "Average fish" (20% EPA + DHA content) as well as Anchoveta from Peru PE (30% DHA + EPA content) and Herring from Norway NO (13% DHA + EPA content). The various products are compared per 1 kg of omega-3 (EPA + DHA) and the maximum value is set to 100%.

Canola oil derived DHA + EPA has a higher climate impact, related to the farming of canola seeds and its relatively lower DHA + EPA content (9-11%), when compared with most fish oils and algae derived products.

Figure 5 shows that Corbion algae omega-3 DHA has a lower impact than average fish oil in the climate change impact category. Overall, Corbion algae-derived omega-3 DHA shows approximately 40–50% lower climate change impact than average fish oil, although results vary depending on species and the production system (based on the ecoinvent 3.11 and Agri-footprint 6.0 datasets). Fish oil from Peruvian anchovy has one of the highest DHA contents (around 30%) (Newton , Malcorps, et al. 2025, Glencross, et al. 2025), resulting in omega-3 with the lowest carbon footprint, comparable to Corbion algae-derived omega-3[4]. Similarly, fish oil produced from trimmings or by-products, such as mackerel, results in lower climate impacts. On the other hand, omega-3 originating from fish oil of species such as herring, blue whiting and sandeel from the Atlantic Ocean have higher climate impacts.

The algae-derived omega-3 DHA products have higher impact on particulate matter than fish oils, which is related to the production of renewable energy from sugarcane by-products. Land use for fish oil omega-3 is low because fisheries rely on marine resources rather than agricultural land, which are not characterized in any of the EF 3.1 land-use impact categories. Regarding water use, the results for fish oil differ between the ecoinvent and Agri-footprint databases; therefore, no conclusions can be drawn. For all other impact categories, results are driven by significant fossil-fuel consumption for fish capture and fish oil production (as concluded also by the CFI report (2025)), as well as fuel use in sugarcane farming (eutrophication, acidification). Interpretation of environmental impact beyond climate remains a challenge because some literature data either considers only climate change (The Centre for Feed Innovation (CFI) 2025), or uses different characterization methods and therefore cannot be directly compared (eg. ReCiPe 2016 v1.1 (Deville, et al. 2025), CML Baseline (Newton, Maiolo, et al. 2023).

Replacing or supplementing fish oil with omega-3 from algal sources delivers measurable sustainability gains by relieving pressure on wild fisheries and decoupling omega-3 production from marine ecosystems. However, a limitation of fish oil LCAs is that these ecosystem impacts are not considered in environmental impact categories because this is not yet standard practice in LCA studies e.g. (European Comission 2021).

[4] Peruvian fish oil with high DHA + EPA content has higher market prices which are not considered for the allocations performed in this study.

Conclusions and outlook

In conclusion, the use of Corbion algae-derived omega-3 DHA in feed can contribute positively to maintaining or improving omega-3 levels in aqua feed, livestock feed, pet food, or human nutrition supplementation while reducing pressure on marine resources. Corbion algae-derived omega-3 DHA can contribute to improving the carbon footprint across these applications. However, in other environmental impact categories, algae production can have higher impacts than fish oil due to the agricultural stage. A limitation of this assessment is that marine fisheries are not represented in the current LCA land-use impact model. In recent years there have been significant development in methodologies to account for ecosystem impacts of fisheries, including fish stocks depletion and seabed impacts of fishing (European Union 2025, Standford-Clark, Loiseau and Hélias 2024, Hélias 2025). The use of these emerging methodologies for the LCA of fish oil could support a more holistic interpretation of the impacts of marine and terrestrial production systems.

Looking forward, the production of Corbion algae-derived omega-3 DHA at commercial scale still has optimization potential, for example through the further development of algae strains with higher sugar to omega-3 DHA yield and through improvement of the production process to increase energy and water use efficiency. Additionally, reductions can be achieved through engagement with the sugar mill on improvements in both sugarcane cultivation and sugar processing. Corbion is committed to reducing impacts on climate, water, and biodiversity and to actively engaging with suppliers and other stakeholders to make progress. These efforts are aligned with the company strategy, including Net-Zero validated targets, Corbion's target of verified deforestation-free raw materials and responsible sourcing of raw materials.

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