# Horizon Organic Milk Carbon Footprint & Summary Life Cycle Assessment Results

MARCH 2021

## INTRODUCTION

Danone North America (Danone) commissioned Nicholson Consulting to conduct a cradle-to-grave Life Cycle Assessment (LCA) considering the environmental impacts associated with the production of its Horizon Organic whole milk half gallons sold in the United States in 2018.

## LIFE CYCLE ASSESSMENT

A Life Cycle Assessment (LCA) is an ISO-standardized framework used to 1) compile an inventory of material, energy, and water inputs and outputs, characteristic of each stage of a product life cycle and 2) quantify a product's contributions to a specified suite of resource use and emissions-related environmental impact categories.

This LCA began in July 2019 and includes data collected for the U.S. Horizon Organic milk system during the 2018 calendar year. The methodology used within this LCA is in accordance with the ISO 14040 series standards for conducting an LCA (ISO, 2006a; ISO, 2006b).

## OBJECTIVE AND INTENDED USE OF LCA

The primary purpose of this LCA (hereafter referred to as "study") is to improve visibility into Horizon Organic milk's current life cycle emission hotspots and identify potential areas for improving environmental performance.

Historically, related research has focused on the proximate, ecological impacts of food production. However, increasing awareness of the cumulative contributions made by food systems to macro-scale environmental change through resource use and emissions is spurring a wealth of new research. This study supports the ongoing shift from local to global in approaching the environmental management of food systems. It informs dialogues as diverse as the policy relevance of product eco-labeling and the identification of key leverage points for reducing food system emissions.

## FUNCTIONAL UNIT AND SYSTEM BOUNDARIES

Using the ISO 14040 standard series and ISO 14046 methodology, this study documents the life cycle impact assessment results for a functional unit equal to one half gallon of packaged, delivered and consumed Horizon Organic whole milk. The cut-off boundary for this study ends with the consumption of a half gallon of milk and the disposal of associated packaging. Since product losses at the retail level and consumer level are included, impacts from the disposal of lost product are considered.

This analysis includes multiple environmental impact categories including climate change as measured by the emission of greenhouse gases (GHGs) expressed as carbon dioxide equivalents ($CO_2$-eq), as well as a range of other environmentally relevant impacts including ozone depletion, photochemical oxidant formation, acidification, eutrophication, land occupation, toxicity, fossil depletion, and water scarcity. The US EPA TRACI 2.1, ReCiPe, USEtox™, and the AWARE impact assessment methodologies are used to calculate environmental impacts from the life cycle inventory data.

## LIFE CYCLE PHASES ASSESSED

The Horizon Organic milk product system includes the following life cycle phases:

**Crops on Dairy Farm:** Organic crops grown as fodder on organic dairy farms in the Horizon supply network include maize, grass-clover mix, sorghum, alfalfa, and perennial grass and comprise an average of 55.2% of total feed. Remaining feed imported from other sources includes grass (silage, and hay), wheat, maize (silage and grain), soy, and other grains. Feed crop data, including fertilizer and land inputs, yield, and harvesting energy, was provided by a randomized representative sample of organic dairy farms in the Horizon supply network (herein referred to as the "organic dairy farm sample") using the Cool Farm Tool. Feed crops from other farms were modeled using Ecoinvent 3.4 datasets updated to reflect U.S. water and land requirements.

**Enteric Fermentation:** Enteric fermentation refers to the digestive process in ruminant animals in which bacteria break down food into soluble products that can be utilized by the animal. Methane is produced in the rumen by these bacteria as a by-product of the fermentation process. This methane is exhaled or belched by cows and accounts for the majority of emissions released from the animal. Methane is also produced to a lesser extent in the large intestines and expelled as gas. Enteric fermentation was calculated using the Intergovernmental Panel on Climate Change (IPCC, 2019) Tier 2 method for each herd sub-category type as identified by the organic dairy farm sample.

**Manure Management:** Cow manure is produced in large volumes on organic dairy farms and emits varying levels of methane and nitrous oxide depending on how it is stored, treated, and applied to land. The majority of manure waste produced in the organic dairy farm sample is handled via dry lot, liquid/slurry manure storage, and compositing. Data were reported by the organic dairy farm sample using the Cool Farm Tool.

**Milking on Farm:** Milking operations on the farm require energy and inputs for cooling, pump operations, lighting, ventilation, manure handling, feeding equipment and provision of water. Primary data were provided by the organic dairy farm sample for fat and protein corrected milk (FPCM) production, electricity, natural gas, propane, gasoline, and diesel using the Cool Farm Tool. Allocation between FPCM and beef produced from the farm is calculated based on the International Dairy Federation 2015 methodology.

**Transport to Plant:** Raw organic milk is collected from organic dairy farmers in the Horizon supply network and transported an average of 776 miles (1249 km) to Danone processing plants. Transportation distances from farm to plant were provided by Danone.

**Milk Processing:** Horizon Organic whole milk half gallons are processed at ten manufacturing facilities in the U.S. For the purpose of this study, data was taken from three Danone-owned manufacturing facilities processing whole milk half gallons: Dallas, Mount Crawford, and Salt Lake City. Upon arrival to the facility, the raw milk is separated into cream and fluid milk components, pasteurized, formulated into whole milk, homogenized, cooled and packaged. A documented product loss rate of 1.2% is used (Burek, 2017). Plant energy usage data were tracked and provided by Danone. Horizon-specific production emissions were calculated using a revenue-based allocation method.

**Packaging:** Horizon Organic whole milk refrigerated half gallons are packaged into half gallon paperboard gable top containers. Packaging data was provided by Danone packaging suppliers.

**Distribution:** The average total distance travelled from plant to retail is 834 miles (1,342 km). By leg, average plant to retail is 511 miles (822 km) and distribution center to retail is 632 miles (1017 km). Transport data provided by Danone.

**Retail:** Horizon Organic whole milk is assumed to be refrigerated for three days at a retail outlet before sale. Danone reports a 0.21% retail loss rate; for this study a more conservative estimate of 1% was assumed, and damaged/refused product is modeled as returned to Danone manufacturing facilities for proper disposal. Refrigeration electricity data at retailers has been calculated using the EPA Energy Star Commercial Refrigerator Energy Calculator (2010a).

**Consumer Use:** Use of Horizon organic whole milk by consumers includes round trip transport to the point of purchase, at-home refrigeration, and wasted product. For this study, a round trip distance of 10 miles was assumed and allocated between a purchase of 20 items (Quantis, 2010); a Danone-recommended refrigeration period of 10 days was assumed; and 20% product loss at the household was assumed (USDA, 2018).

**End of Life:** Disposal of wasted product and empty packaging is associated with GHG emitting activities including transport, processing, and storage. For this study, a distance of 50 miles is assumed for container transport to a recycling facility, landfill, or incinerator (EPA, 2017), and 16% of containers are assumed to be recycled (Carton Council, 2018). Wasted product is assumed to be disposed of via the consumer's sink and eventually treated at a local municipal wastewater treatment facility.

## DATA SOURCES AND ASSUMPTIONS

Primary data for Horizon Organic milk were provided by dairy farmers in the Horizon supply network through the Cool Farm Tool, an industry platform to collect farm data. Dairy processing data, product loss rates, and distribution distances were provided by Danone facilities and logistics staff. Packaging data were provided by a Danone packaging manufacturer.

Background inventory data for the Horizon Organic milk system (i.e., for the provision of onsite fuels, electricity, transport modes, off-farm feed inputs, packaging inputs, etc.) were derived primarily from the Ecoinvent 3.4 database. LCA modeling was conducted using SimaPro 8.3 LCA software and MS Excel was used to compile and examine inventory results.

## SUMMARY RESULTS

### Carbon Footprint


The climate change impact result for Horizon Organic milk is driven by emissions produced at the dairy farm, particularly emissions associated with enteric fermentation and manure management, followed by feed crop production.

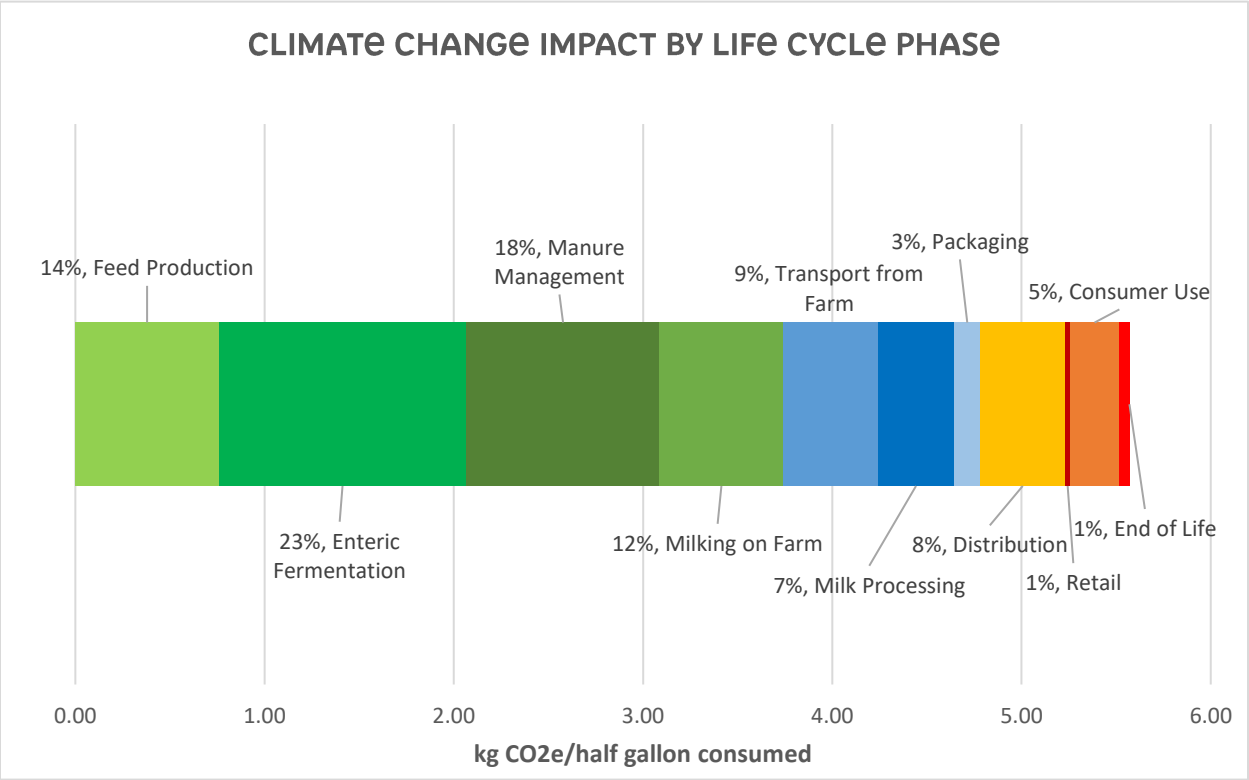


**Figure 1: Horizon Organic whole milk half gallon climate change impact by life cycle phase, 2018**

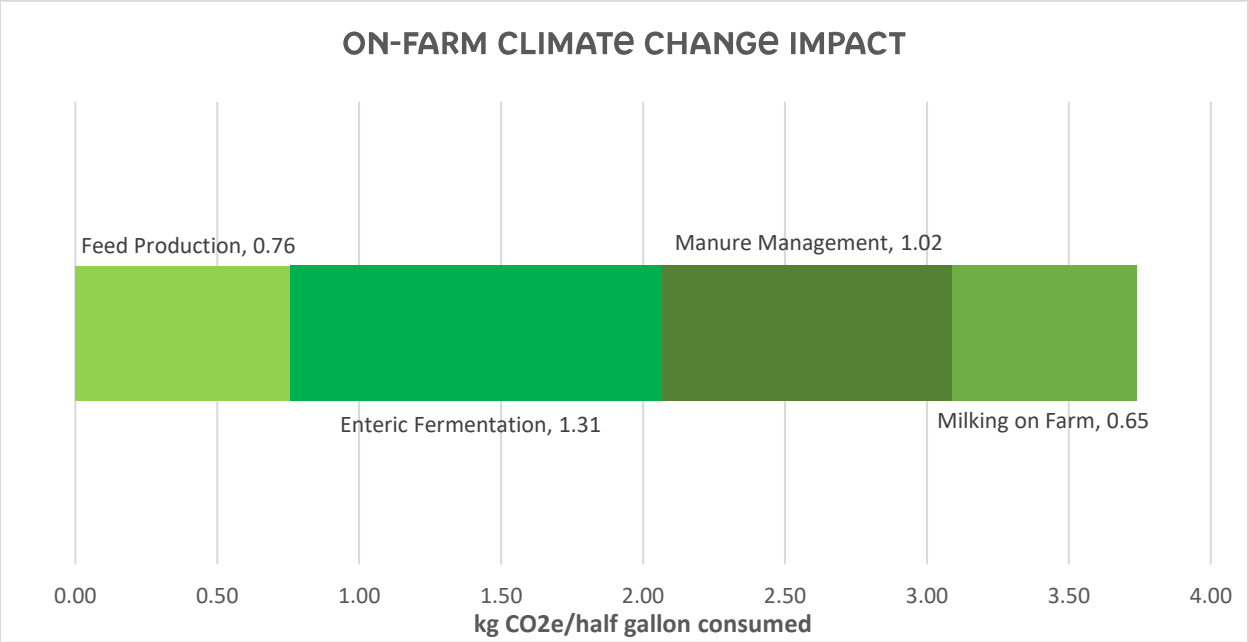


**Figure 2: Horizon Organic whole milk half gallon on-farm climate change impact, 2018**

## OTHER ENVIRONMENTAL INDICATORS ASSESSED

| Impact Category | Unit | Horizon Organic whole milk (cradle-to-grave impacts per consumed half gallon) |
|---|---|---|
| **Climate change** | kg CO2 eq | 5.58 |
| **Ozone depletion** | kg CFC-11 eq | 0.00 |
| **Smog** | kg O3 eq | 0.36 |
| **Acidifi-cation** | kg SO2 eq | 0.04 |
| **Eutrophication** | kg N eq | 0.03 |
| **Human toxicity, cancer** | cases | 0.00 |
| **Human toxicity, non-cancer** | cases | 0.00 |
| **Freshwater eco-toxicity** | PAF.m3.day | 0.08 |
| **Respiratory effects** | kg PM2.5 eq | 0.00 |
| **Fossil fuel depletion** | MJ surplus | 5.26 |
| **Land use** | $m^2$a crop eq | 1.94 |
| **Water use** | m3 | 3.15 |
| **Water scarcity** | m3 | 65.7 |

**Table 1. Horizon Organic milk cradle-to-grave impacts per consumed half gallon of whole milk, 2018**

**Table 1** shows the absolute cradle-to-grave impacts of a consumed half gallon of Horizon Organic whole milk based on 2018 inputs. **Figure 3** shows that the stages contributing most to the total life cycle impact of the Horizon Organic milk system are milk production on the farm, milking, transport to the processor, and retail/distribution. At the farm level, feed dominates impact across most environmental categories with the exception of ozone depletion, followed by enteric fermentation and manure management for climate change, manure management for acidification, and milking for ozone depletion, smog, respiratory effects, and fossil fuel depletion, and water use. The impacts from feed are dominated by production of hay, grass silage, grass, and corn grain. Results presented in this section assume a functional unit of one delivered and consumed half gallon of Horizon Organic milk.

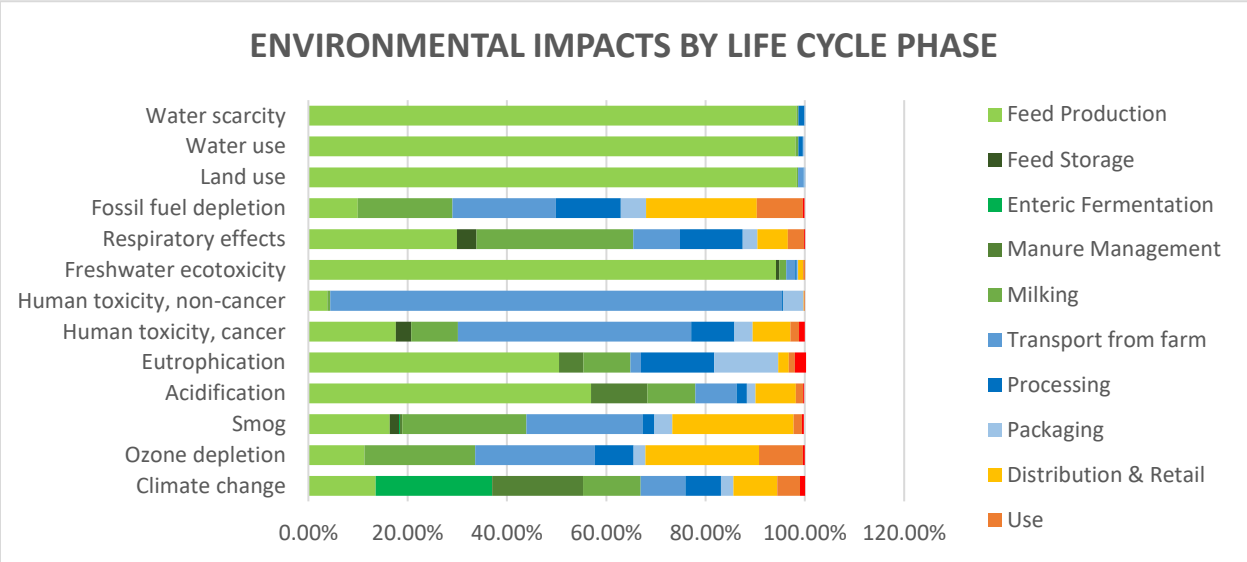


**Figure 3: Horizon organic whole milk half gallon environmental impacts by life cycle phase, 2018**

## CONCLUSIONS

This study represents a comprehensive LCA and establishes a scientifically sound and defensible baseline for GHG emissions, water consumption and other environmental impacts associated with production and consumption of Horizon Organic whole milk half gallons in 2018.

GHG emissions from the Horizon Organic milk system are heavily influenced by feed production for dairy cows, and methane and nitrous oxide from enteric fermentation and manure management.

Horizon Organic milk is sensitive to product loss rates, storage times experienced at retail and the consumer level, and consumer transport assumptions. Consumer loss rates in the US are as high as 20%, and efforts to minimize the amount of spoiled or wasted product at the consumer and during distribution result in scaled environmental savings across the whole value chain.

It should be noted that caution must be taken when interpreting the results of this, or any, LCA. The goal and scope of LCA studies may differ, thereby rendering comparison challenging. While this LCA explores a wide breadth of environmental impacts, study limitations must be considered, such as the representativeness of dairy farming data from external sources. Additionally, this LCA exclusively focuses on emissions from Danone-specific organic dairy milk and does not account for differences in sourcing or production for other organic dairy value chains in the US and beyond.

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