

Violife 100% vegan alternative to cheese vs. dairy cheese in Europe, UK, US, Canada and Japan.

Life Cycle Assessment
Technical Summary

April 2022 – original study

February 2025 - Annex with updated LCA results

<i>LIFE CYCLE ASSESSMENT</i>	3
<i>METHOD</i>	3
<i>CRITICAL REVIEW</i>	3
<i>FUNCTIONAL UNIT</i>	3
<i>ENVIRONMENTAL IMPACT INDICATORS CONSIDERED</i>	3
<i>FROM CRADLE-TO-GRAVE</i>	3
<i>DATA COLLECTION AND MODELLING</i>	4
<i>RESULTS AND DISCUSSION</i>	5
<i>CLIMATE CHANGE IMPACTS</i>	5
<i>LAND OCCUPATION</i>	7
<i>WATER CONSUMPTION</i>	8
<i>CONCLUSIONS AND OUTLOOK</i>	9
<i>EXTERNAL COMMUNICATIONS</i>	9
<i>CALCULATION OF EQUIVALENCIES</i>	9
<i>ABOUT QUANTIS</i>	10
<i>REFERENCES</i>	10

VIOLIFE 100% VEGAN ALTERNATIVE TO CHEESE VS. DAIRY CHEESE. LCA TECHNICAL SUMMARY

Violife is a world leading vegan brand, owned by Upfield, which offers a range of versatile products including alternatives to dairy cheese which can be used for cooking or eating on their own. In 2022, Quantis was commissioned to conduct a Life Cycle Assessment (LCA) of certain Violife vegan alternatives to cheese products (“Violife Product”) sold in Europe, the UK, the United States, Canada, and Japan, compared to dairy (cow and sheep) cheese sold in the same markets. The study included 33 Violife Products (a “product” refers to a recipe / packaging / market combination). This document provides a summary of the study scope, functional unit and system boundaries, method and data sources, climate impacts and land occupation results, and equivalencies used for comparative claims for the Violife products.

LIFE CYCLE ASSESSMENT

Life cycle assessment (LCA) is a metric-based methodology used to assess environmental impacts resulting from a product or service, for example, greenhouse gas emissions, waste production, water, land, and energy use. Environmental impacts are calculated over the life cycle of a product, from extraction of raw materials to the end-of-life.

METHOD

This study followed the regionalized LCA methodology described by Liao et al. (2020) to compare the environmental impacts of 1 kg of Violife Products to the same amount of dairy cheese sold in Europe, UK, Canada, United States, and Japan. Data was collected with a cradle-to-grave approach for the product recipe, key ingredients sourcing countries, production factory, energy mixes, packaging designs, transportation, and end-of-life scenarios. Spatially differentiated agricultural life cycle inventory data were generated (archetypes), as well as land use change (LUC) emissions for Violife Products to dairy cheese using an attributional approach as per PAS 2050 (BSI, 2012), aligned with the latest international standards for dairy products, published by the International Dairy Federation (IDF, 2015) and the European Dairy Association (EDA, 2016).

CRITICAL REVIEW

The LCA respects ISO 14040 and 14044 standards for public disclosure of results. The study has been peer reviewed by a panel of three independent experts on topics such as LCA, agronomy and dairy production.

FUNCTIONAL UNIT

The functional unit (FU) is a reference unit for which all results are calculated and presented. For Violife Products and dairy cheese, the functional unit (FU) was to provide the function of 1 kg of cheese or cheese alternative, packaged, for the relevant consumer (domestic or professional).

ENVIRONMENTAL IMPACT INDICATORS CONSIDERED

The assessment includes a total of 16 indicators: 14 environmental impact indicators from the European Commission Environmental Footprint (EF) 3.0 method and two additional indicators: land occupation ($m^2.y$), which reflects the total area of land used over one year and is a proxy for biodiversity and ecosystem services (Nemecek et al. 2011, Milà i Canals et al. 2012), and water consumption (m^3), the total amount of fresh water consumed (ISO 14046), which includes, for example, evapotranspiration of irrigation water.

FROM CRADLE-TO-GRAVE

The LCA considers all identifiable activities across the product life cycle (cradle-to-grave) for certain Violife Products in Europe, UK, Canada, United States, and Japan (see Figure 1).

The study includes impacts from:

- Farming (crop production or milk production)
- Product manufacturing of Violife Products or dairy cheese
- Packaging manufacturing of Violife Products or dairy cheese
- Distribution
- Retail
- Consumer use
- Packaging end-of-life

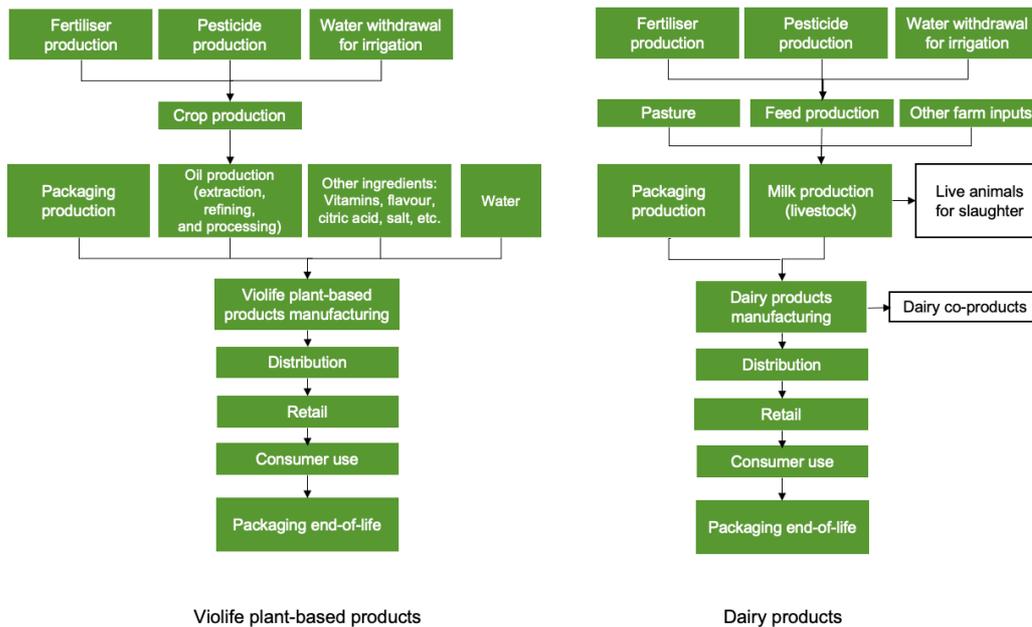


Figure 1. Schematic of the systems evaluated

The study does not include impacts from:

- Capital goods at the distribution centre and at the point of retail.
- Labour, commuting of workers, administrative work, cattle insemination, and disease control processes.
- Food loss and food waste during distribution, at retail point and at the consumer’s home.

DATA COLLECTION AND MODELLING

- Violife Products: primary data for the recipes and ingredient sourcing for Violife Products, as well as their product and packaging manufacturing and distribution, were provided by Violife.
- Dairy cheese for Europe: Default data representative of European averages and published by the European Dairy Association and the European Commission were used to model dairy processing and distribution.
- Dairy cheese for UK: Data representative of UK dairy practices were used to model dairy processing. Data representative of European averages and published by the European Dairy Association and the European Commission were used to model distribution.
- Dairy cheese for Canada and United States: Default data representative of Canada and US averages and published by the USDA were used. Canadian milk modelling was updated with the latest available data from Dairy Farmers of Canada (DFC, 2018).
- Dairy cheese for Japan: Default data representative of Europe, US, Australia and New Zealand were used for the percentage of cheese that is imported to Japan (86%). For cheese produced in Japan (14%), default data representative for New Zealand was used as a proxy.

All data has been assessed to ensure that it meets the quality standards required to make comparative assertions. Data was compiled for different product recipes, key ingredient sourcing countries, production factory locations, energy mixes, packaging designs, transportation, and end-of-life scenarios. Spatially differentiated agricultural life cycle inventory data were generated (archetypes), as well as LUC emissions for agricultural ingredients in all markets relevant to each system’s supply chain. The LCA modelling tool SimaPro version 9.3 was used to model individual datasets (such as oilseeds and packaging) required for 100% plant-based products and for the life cycle of dairy products.

RESULTS AND DISCUSSION

CLIMATE CHANGE IMPACTS

Table 1 shows that all Violife Products assessed have lower climate impacts than dairy cheese. The climate impacts of 1 kg Violife Products vary between 2.2 and 4.2 kg CO₂-eq per kg of product depending on recipe and market, whereas the impacts for dairy cheese vary between 6.1 and 13.5 kg CO₂-eq per kg dairy cheese.

PRODUCTS COMPARED (Violife / dairy cheese)	Climate impacts (kg CO ₂ -eq/kg product)		Calculated savings	
	Violife	Dairy	kg CO ₂ -eq/kg	%
EUROPE				
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	2.6	10.6	8.0	-75%
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	2.2	10.2	8.0	-79%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	2.9	11.8	8.9	-75%
Original / Cheddar, grated, 200 g (old doypack), EU	2.6	11.6	9.0	-77%
Original / Cheddar, sliced, 200 g (hard tray), EU	2.9	11.8	8.9	-76%
Mature cheddar fl. / Cheddar, block, 200 g, EU	2.3	11.3	9.0	-80%
Prosociano / Parmesan, wedge, 200 g, EU	3.1	13.3	10.2	-77%
Creamy original / Cream cheese, tub, 200 g, EU	2.6	6.5	3.9	-60%
Feta flavour / Feta, block, 200 g, EU	2.6	6.4	3.8	-59%
UK				
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	2.2	10.3	8.1	-79%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	2.5	11.5	9.0	-78%
Original / Cheddar, grated, 200 g (old doypack), UK	2.7	11.7	9.0	-77%
Original / Cheddar, sliced, 200 g (hard tray), UK	3.0	11.9	8.9	-75%
Epic mature / Cheddar, block, 200 g, UK	2.6	11.5	8.9	-78%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	2.7	11.7	9.0	-77%
Prosociano / Parmesan, wedge, 200 g, UK	3.1	13.4	10.3	-77%
Creamy original / Cream cheese, tub, 200 g, UK	2.6	6.5	3.9	-60%
Feta flavour / Feta, block, 200 g, UK	2.7	6.4	3.7	-58%
CANADA				
Mozzarella flavour / Mozzarella, grated, 227 g, CA	3.1	9.5	6.5	-68%
Cheddar flavour / Cheddar, sliced, 200 g, CA	3.1	10.3	7.2	-70%
Prosociano / Parmesan, wedge, 200 g, CA	3.6	11.8	8.2	-70%
Creamy original / Cream cheese, tub, 200 g, CA	2.9	6.1	3.1	-51%
Feta flavour / Feta, block, 200 g, CA	3.0	7.1	4.1	-58%
US				
Mozzarella flavour / Mozzarella, grated, 227 g, US	4.2	10.6	6.4	-60%
Cheddar flavour / Cheddar, sliced, 200 g, US	2.9	11.1	8.2	-74%
Cheddar flavour / Cheddar, sliced, 751 g, US	3.3	10.9	7.6	-70%
Prosociano / Parmesan, wedge, 200 g, US	3.4	12.8	9.4	-74%
Creamy original / Cream cheese, tub, 200 g, US	2.8	6.5	3.7	-57%
Feta flavour / Feta, block, 200 g, US	2.8	7.2	4.4	-61%
JAPAN				
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	2.8	12.5	9.7	-78%
Cheddar flavour / Cheddar, grated, 200 g, JP	2.2	12.9	10.7	-83%
Cheddar flavour / Cheddar, sliced, 140 g, JP	2.8	13.5	10.7	-79%
Creamy original / Cream cheese, tub, 150 g, JP	2.3	7.8	5.5	-71%

Table 1. Climate change impacts for Violife Products in Europe, UK, Canada, US, and Japan, and dairy cheese in the same markets. Results are expressed in kg CO₂-eq per kg of product

Figure 2 shows that the main drivers of climate impacts for Violife Products are the farm / ingredients stage (coconut farming and associated LUC emissions), as well as the distribution stage, which can vary significantly depending on distances travelled to consumer markets.

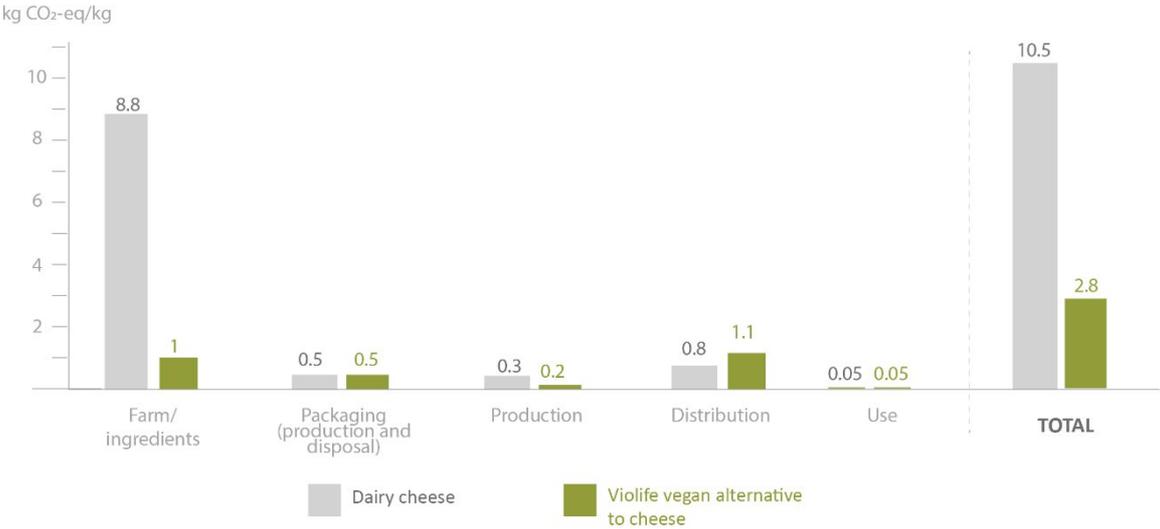


Figure 2. Average climate change results per life cycle stage for 1 kg of product in Europe, UK, US, Canada and Japan.

There are opportunities for further reducing the environmental impacts of 100% plant-based cheese alternatives by reducing the transportation distances by refrigerated transportation and optimizing the distribution, improving and reducing the packaging of products sold in Japan, avoiding land use change related climate risks and implementing regenerative agricultural practices. Meanwhile, it is important to consider potential constraints, such as the choice of oils based on consumer preferences (taste, nutritional benefits, and product function).

LAND OCCUPATION

In terms of land occupation, all Violife Products have lower results compared to dairy cheese (Table 2). The land occupation of 1 kg Violife Products varies between 1.5 and 2.2 m².y per kg of product depending on recipe and market, whereas that of dairy cheese varies between 5.2 and 14 m².y per kg of dairy cheese.

PRODUCTS COMPARED (Violife/ dairy cheese)	Land occupation (m ² .y /kg product)		Calculated savings	
	Violife	Dairy	m ² .y /kg	%
EUROPE				
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	1.8	10.1	8.3	-83%
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	1.6	10.0	8.4	-84%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	1.7	11.0	9.3	-84%
Original / Cheddar, grated, 200 g (old doypack), EU	1.8	11.0	9.2	-84%
Original / Cheddar, sliced, 200 g (hard tray), EU	1.7	11.0	9.3	-84%
Mature cheddar fl. / Cheddar, block, 200 g, EU	1.5	10.9	9.4	-86%
Prosociano / Parmesan, wedge, 200 g, EU	2.2	13.1	10.9	-83%
Creamy original / Cream cheese, tub, 200 g, EU	1.5	5.7	4.2	-73%
Feta flavour / Feta, block, 200 g, EU	1.9	11.6	9.7	-84%
UK				
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	1.6	9.1	7.5	-82%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	1.7	10.0	8.3	-83%
Original / Cheddar, grated, 200 g (old doypack), UK	1.8	10.1	8.3	-83%
Original / Cheddar, sliced, 200 g (hard tray), UK	1.7	10.1	8.4	-83%
Epic mature / Cheddar, block, 200 g, UK	2.1	10.0	7.9	-79%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	1.9	10.1	8.2	-81%
Prosociano / Parmesan, wedge, 200 g, UK	2.2	12.0	9.8	-82%
Creamy original / Cream cheese, tub, 200 g, UK	1.5	5.2	3.7	-71%
Feta flavour / Feta, block, 200 g, UK	1.9	11.6	9.7	-84%
CANADA				
Mozzarella flavour / Mozzarella, grated, 227 g, CA	1.8	10.4	8.6	-83%
Cheddar flavour / Cheddar, sliced, 200 g, CA	1.9	11.5	9.6	-84%
Prosociano / Parmesan, wedge, 200 g, CA	2.2	13.4	11.2	-84%
Creamy original / Cream cheese, tub, 200 g, CA	1.5	5.9	4.4	-74%
Feta flavour / Feta, block, 200 g, CA	1.9	11.7	9.8	-84%
US				
Mozzarella flavour / Mozzarella, grated, 227 g, US	1.8	10.9	9.0	-83%
Cheddar flavour / Cheddar, sliced, 200 g, US	1.9	12.0	10.1	-84%
Cheddar flavour / Cheddar, sliced, 751 g, US	1.8	11.8	10.1	-85%
Prosociano / Parmesan, wedge, 200 g, US	2.2	14.0	11.8	-84%
Creamy original / Cream cheese, tub, 200 g, US	1.5	6.1	4.6	-75%
Feta flavour / Feta, block, 200 g, US	1.9	11.7	9.8	-84%
JAPAN				
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	1.7	12.2	10.5	-86%
Cheddar flavour / Cheddar, grated, 200 g, JP	1.7	13.4	11.7	-87%
Cheddar flavour / Cheddar, sliced, 140 g, JP	1.7	13.3	11.6	-87%
Creamy original / Cream cheese, tub, 150 g, JP	1.5	6.9	5.4	-78%

Table 2. Land occupation for Violife Products in Europe, UK, Canada, US, and Japan, and dairy cheese in the same market. Results are expressed in m²-year per kg of product.

WATER CONSUMPTION

LCA results show that for 11 out of 33 (27%) Violife Products, water consumption is significantly lower compared to its dairy counterpart; for the other 22 products noted with an asterisk (*) in Table 3, water savings are not considered significantly better.

The quality of water consumption data in LCA databases is not robust enough to support external communications and comparative claims.

PRODUCTS COMPARED (Violife/ dairy cheese)	Water consumption (m ³ /kg product)		Calculated savings	
	Violife	Dairy	m ³ /kg	%
EUROPE				
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	0.030	0.058	0.028	-48% *
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	0.026	0.054	0.028	-52%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	0.039	0.067	0.029	-42% *
Original / Cheddar, grated, 200 g (old doypack), EU	0.030	0.063	0.033	-52%
Original / Cheddar, sliced, 200 g (hard tray), EU	0.039	0.067	0.029	-43% *
Mature cheddar fl. / Cheddar, block, 200 g, EU	0.027	0.061	0.034	-55%
Prosociano / Parmesan, wedge, 200 g, EU	0.145	0.073	-0.072	98% *
Creamy original / Cream cheese, tub, 200 g, EU	0.024	0.039	0.015	-39% *
Feta flavour / Feta, block, 200 g, EU	0.026	0.024	-0.002	9% *
UK				
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	0.026	0.054	0.029	-53%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	0.033	0.063	0.029	-47% *
Original / Cheddar, grated, 200 g (old doypack), UK	0.030	0.064	0.034	-53%
Original / Cheddar, sliced, 200 g (hard tray), UK	0.039	0.068	0.029	-43% *
Epic mature / Cheddar, block, 200 g, UK	0.029	0.061	0.031	-52%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	0.031	0.064	0.032	-51%
Prosociano / Parmesan, wedge, 200 g, UK	0.145	0.073	-0.071	97% *
Creamy original / Cream cheese, tub, 200 g, UK	0.024	0.039	0.015	-40% *
Feta flavour / Feta, block, 200 g, UK	0.026	0.024	-0.002	9% *
CANADA				
Mozzarella flavour / Mozzarella, grated, 227 g, CA	0.029	0.081	0.052	-64%
Cheddar flavour / Cheddar, sliced, 200 g, CA	0.036	0.092	0.056	-61%
Prosociano / Parmesan, wedge, 200 g, CA	0.145	0.103	-0.041	40% *
Creamy original / Cream cheese, tub, 200 g, CA	0.024	0.053	0.029	-55%
Feta flavour / Feta, block, 200 g, CA	0.026	0.030	0.004	-12% *
US				
Mozzarella flavour / Mozzarella, grated, 227 g, US	0.037	0.067	0.031	-46% *
Cheddar flavour / Cheddar, sliced, 200 g, US	0.036	0.070	0.034	-48% *
Cheddar flavour / Cheddar, sliced, 751 g, US	0.028	0.065	0.037	-57%
Prosociano / Parmesan, wedge, 200 g, US	0.145	0.078	-0.067	86% *
Creamy original / Cream cheese, tub, 200 g, US	0.024	0.041	0.018	-43% *
Feta flavour / Feta, block, 200 g, US	0.026	0.024	-0.002	9% *
JAPAN				
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	0.037	0.065	0.028	-43% *
Cheddar flavour / Cheddar, grated, 200 g, JP	0.033	0.062	0.029	-46% *
Cheddar flavour / Cheddar, sliced, 140 g, JP	0.041	0.070	0.029	-41% *
Creamy original / Cream cheese, tub, 150 g, JP	0.025	0.042	0.016	-39% *

Table 3. Water consumption for Violife Products in Europe, UK, US, Canada, and Japan, and dairy cheese in the same market. Results are expressed in m³ per kg of product

CONCLUSIONS AND OUTLOOK

This study shows that Violife Products have at least 50% lower climate impacts and occupy at least 30% less land than dairy cheese. The climate impacts of Violife Products are dominated by coconut oil production and distribution to consumer markets. When moving towards transparency of sustainable supply chains and developing potential mitigation strategies, producers can only understand the impacts of their products and look for opportunities to reduce these impacts if they thoroughly assess their product supply chains. When moving towards more sustainable 100%

vegan alternatives to cheese, a key factor would be to reduce impacts related to the product distribution and the embodied environmental impacts from coconut oil through better understanding and improvements in supply chain sourcing, farm level agricultural practices, and product recipe design.

EXTERNAL COMMUNICATIONS

For this study, 33 representative products in the five main markets were selected. For external communications and claims a conservative approach was used since Violife’s entire product portfolio was not assessed. For comparative claims communicating on product categories, the lowest climate change savings of all products evaluated globally and in each market is used.

Reduction percentages are rounded conservatively so that they are easy to understand by the general public and to avoid overclaiming (e.g., 58% savings is rounded to 55% savings), therefore claims percentages may be different than the calculated percentages in Table 2. A conservative approach avoids misleading communication and greenwashing.

CALCULATION OF EQUIVALENCIES

Equivalencies are used to put into perspective the climate and land occupation results of Violife Products and dairy cheeses to render the information more meaningful and understandable for a larger audience. The equivalencies were calculated based on the CO₂-eq savings when comparing Violife Products and dairy cheese, by converting the savings amount into equivalencies of different daily activities such as CO₂-eq emissions of charging a smartphone over night or driving a car. Table 4 and 5 presents the data sources and units used for the equivalencies calculated.

EQUIVALENCIES FOR RETAIL PRODUCTS			
Equivalency	Equivalency unit	Climate change (kg CO ₂ e _q)	Source
Charging a phone overnight (EU/UK)	Daily	0.008	PEFCR Retail and ecoinvent
Charging a phone overnight (CA)	Daily	0.004	PEFCR Retail and ecoinvent
Charging a phone overnight (US)	Daily	0.011	PEFCR Retail and ecoinvent
Charging a phone overnight (JP)	Daily	0.013	PEFCR Retail and ecoinvent
Driving a car (petrol car EURO 5)	1 km	0.35	ecoinvent
Flying by plane	1 km	0.22	ecoinvent
Equivalency	Equivalency unit	Land Occupation (m ² .y)	Source
Average size of a parking spot	m ²	17.7	Internet various sources
Average pizza size (14 in / 35 cm)	m ²	0.10	Internet various sources
EQUIVALENCIES FOR PROFESSIONAL PRODUCTS			
Equivalency	Equivalency unit	Climate change (kg CO ₂ e _q)	Source
3 combi oven	Daily	15	https://doi.org/10.1093/ijlct/ctt068
Commercial fridge	Daily	19.5	https://www.energy.gov/eere/femp/purchasing-energy-efficient-commercial-refrigerators-and-freezers
Industrial dishwasher	Daily	5	https://www.energy.gov/eere/femp/purchasing-energy-efficient-commercial-dishwashers
Kitchen aid	Hourly	0.2	https://www.kasa.cz/document/9/8/4/doc_2182489.pdf
Equivalency	Equivalency unit	Land Occupation (m ² .y)	Source
Cucumbers fields	1 hectare	10,000	-
Average size restaurant kitchens	1 restaurant	98	https://yourbusiness.azcentral.com/national-average-size-restaurant-kitchen-29446.html

Table 4. Equivalencies units and sources

Per capita consumption of dairy cheese	Source
Europe	Statista - https://www.statista.com/statistics/527195/consumption-of-cheese-per-capita-worldwide-country/
United Kingdom	Statista - https://www.statista.com/statistics/281114/household-consumption-of-cheese-in-the-united-kingdom-uk/
Canada	https://www.clal.it/en/?section=tabs_consumi_procapite
United States	Statista - https://www.statista.com/statistics/183785/per-capita-consumption-of-cheese-in-the-us-since-2000/
Japan	https://www.clal.it/en/?section=tabs_consumi_procapite

Table 5. Per capita consumption of dairy cheese in Europe, UK, Canada, US and Japan.

For further information, please contact ESGinquiries@upfield.com for vegan alternative to cheese information.

ABOUT QUANTIS

Quantis guides top organizations to define, shape and implement intelligent environmental sustainability solutions. In a nutshell, our creative geeks take the latest science and make it actionable. They deliver resilient strategies, robust metrics, useful tools, and credible communications.

With offices in the US, France, Switzerland, Germany and Italy and clients around the world, Quantis is a key partner in inspiring sustainable change on a global scale.

Discover Quantis at www.quantis-intl.com

REFERENCES

Boulay A-M et al (2018) The WULCA consensus characterization model for water scarcity footprints: assessing impacts of water consumption based on available water remaining (AWARE). *Int J Life Cycle Assess* 23:368–378

EDA (2016) Product Environmental Footprint Category Rules for Dairy Products. Draft report (28 July 2016). The European Dairy Association. Brussels, Belgium

Eurostat database. URL: <https://ec.europa.eu/eurostat/data/database> Access June 2016

FAO and WHO. 2011. Codex Alimentarius – Milk and Milk Products. Second edition. The Food and Agriculture Organization of the United Nations and the World Health Organisation. Rome, Italy

FAO, IDF, IFCN 2014. World mapping of animal feeding systems in the dairy sector. Food and Agriculture Organisation of the United Nations, the International Dairy Federation, the IFCN Dairy Research Network. Rome, Italy

IDF (2015) A common carbon footprint approach for Dairy. The IDF guide to standard life cycle assessment methodology for the dairy sector. International Dairy Federation. Brussels, Belgium

ISO (2006) Environmental management – life cycle assessment – requirements and guidelines, ISO 14044:2006(E). International Organization for Standardization, Geneva

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

JRC-IES (2011). International Reference Life Cycle Data System (ILCD) Handbook- Recommendations for Life Cycle Impact Assessment in the European context. First edition November 2011. European Commission-Joint Research Centre - Institute for Environment and Sustainability. Publications Office of the European Union, Luxembourg

JRC-IES (2017) Product Environmental Footprint Category Rules Guidance. Version 6.2, June 2017. European Commission-Joint Research Centre - Institute for Environment and Sustainability.

Fazio, S. Castellani, V. Sala, S., Schau, EM. Secchi, M. Zampori, L., Supporting information to the characterisation factors of recommended EF Life Cycle Impact Assessment methods, EUR 28888 EN, European Commission, Ispra, 2018, ISBN 978-92-79-76742-5, doi:10.2760/671368, JRC109369

Liao, X., Gerichhausen, M.J.W., Bengoa, X. et al. Large-scale regionalised LCA shows that plant-based fat spreads have a lower climate, land occupation and water scarcity impact than dairy butter. *Int J Life Cycle Assess* (2020). <https://doi.org/10.1007/s11367-019-01703-w>

Nemecek T., Bengoa X., Lansche J., Mouron P., Riedener E., Rossi V. & Humbert S. (2015) Methodological Guidelines for the Life Cycle Inventory of Agricultural Products. Version 3.0, July 2015. World Food LCA Database (WFLDB)

Poore J., Nemecek T. (2019) Reducing food's environmental impacts through producers and consumers". February 22, 2019.

Thoma G, Popp J, Nutter D, et al (2013) Greenhouse gas emissions from milk production and consumption in the United States: A cradle-to-grave life cycle assessment circa 2008. *Int Dairy J* 31:S3–S14. doi: 10.1016/j.idairyj.2012.08.013

ANNEX A – Emission factor update

February 2025

This annex presents the updated Life Cycle Assessment (LCA) results originally published in the April 2022 report, *Violife Vegan Alternative to Cheese vs. Dairy Cheese – LCA*. The study was revised to provide the most up-to-date lifecycle assessment results for Flora Food Group’s plant-based cheeses in comparison to their dairy-based equivalents. The results of the updated study were used in Flora Food Group’s 2024 Avoided Pressures assessment and in a 2024 study analyzing Flora FG’s comparative product category performance.

Updates to the Original Study

The following modifications were implemented:

1. Emission Factor (EF) Updates

- EF data was updated to ecoinvent v.3.9.1 and WFLDB v.3.9.1 across the 16 impact indicators considered in the original study.
- The previous study utilized WFLDB 3.5, WFLDB 3.6, AGRIBALYSE 3, ecoinvent 3.6, and ecoinvent 3.7.1.
- The impact assessment method applied to these indicators are EF 3.1.

2. Addition of the Water Withdrawal Impact Category

- The Water withdrawal category was included to align with the scope of the avoided pressures analysis.
- The impact assessment method used for Water withdrawal is Water Footprint 2.0.

The original study followed ISO 14040 and ISO 14044 standards, and all updates presented herein adhere to the same methodological framework. While the initial Violife LCA study underwent peer review, the specific updates listed above were not, as the methodology and approach remain unchanged. However, **Quantis** conducted a technical review of the updates.

Results and interpretation

The updated results are provided in Tables A1, A2, and A3. Due to the EF update, the calculated savings between Violife and dairy cheeses, have changed as follows:

- **Climate Impact Savings:** savings have decreased compared to the original study. However, all SKUs still demonstrate a significantly lower climate impact than dairy cheeses, with the lowest percentage savings now at 41%;

- **Land occupation savings:** Improvements in savings have been observed compared to the original study. All products continue to show a substantially lower land footprint, with the lowest percentage savings now at 76%;
- **Water consumption:** Changes are less uniform, with some cheeses showing significantly higher savings while others exhibit significantly lower savings. Overall, results are not considered significantly better than dairy – for this reason, and due to the limited robustness of water consumption data in LCA databases, it is not recommended to use these results for making comparative communication claims.
- **Water withdrawal:** results show that for 6 out of 33 Violife products (i.e. product/country combinations), water withdrawal impact is significantly lower compared to their dairy counterparts. For 19 products, water withdrawal savings are better but not significantly, and in 8 cases, they are worse (not significantly). Similarly to water consumption, it is not recommended to use these results should for comparative communication claims.

CLIMATE CHANGE IMPACTS

Table A1. Climate change impacts for Violife Products in Europe, UK, Canada, US, and Japan, and dairy cheese in the same markets. Results are expressed in kg CO₂-eq per kg of product

PRODUCTS COMPARED (Violife / dairy cheese)	Climate impacts (kg CO ₂ -eq/kg product)		Calculated savings	
	Violife	Dairy	kg CO ₂ -eq/kg	%
EUROPE				
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	3.0	8.8	5.8	-66%
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	2.5	8.4	5.9	-70%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	3.4	9.8	6.4	-65%
Original / Cheddar, grated, 200 g (old doypack), EU	3.0	9.6	6.6	-69%
Original / Cheddar, sliced, 200 g (hard tray), EU	3.3	9.8	6.5	-66%
Mature cheddar fl. / Cheddar, block, 200 g, EU	2.4	9.4	7.0	-74%
Prosociano / Parmesan, wedge, 200 g, EU	4.0	11.0	7.0	-64%
Creamy original / Cream cheese, tub, 200 g, EU	2.9	5.4	2.5	-46%
Feta flavour / Feta, block, 200 g, EU	3.1	5.7	2.6	-46%
UK				
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	2.5	8.6	6.1	-71%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	2.9	9.5	6.6	-69%
Original / Cheddar, grated, 200 g (old doypack), UK	3.0	9.7	6.7	-69%
Original / Cheddar, sliced, 200 g (hard tray), UK	3.4	9.9	6.5	-66%
Epic mature / Cheddar, block, 200 g, UK	3.0	9.5	6.5	-68%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	3.1	9.6	6.5	-68%
Prosociano / Parmesan, wedge, 200 g, UK	4.0	11.1	7.1	-64%
Creamy original / Cream cheese, tub, 200 g, UK	2.9	5.5	2.6	-47%
Feta flavour / Feta, block, 200 g, UK	3.1	5.7	2.6	-46%
CANADA				
Mozzarella flavour / Mozzarella, grated, 227 g, CA	3.5	8.7	5.2	-60%
Cheddar flavour / Cheddar, sliced, 200 g, CA	3.5	9.4	5.9	-63%
Prosociano / Parmesan, wedge, 200 g, CA	4.5	10.6	6.1	-58%
Creamy original / Cream cheese, tub, 200 g, CA	3.3	5.6	2.3	-41%
Feta flavour / Feta, block, 200 g, CA	3.4	6.4	3.0	-47%
US				
Mozzarella flavour / Mozzarella, grated, 227 g, US	4.6	9.7	5.1	-53%
Cheddar flavour / Cheddar, sliced, 200 g, US	3.3	10.1	6.8	-67%
Cheddar flavour / Cheddar, sliced, 751 g, US	3.7	9.9	6.2	-63%
Prosociano / Parmesan, wedge, 200 g, US	4.3	11.6	7.3	-63%
Creamy original / Cream cheese, tub, 200 g, US	3.1	6.0	2.9	-48%
Feta flavour / Feta, block, 200 g, US	3.3	6.5	3.2	-49%
JAPAN				
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	3.1	10.7	7.6	-71%
Cheddar flavour / Cheddar, grated, 200 g, JP	2.6	10.9	8.3	-76%
Cheddar flavour / Cheddar, sliced, 140 g, JP	3.2	11.5	8.3	-72%
Creamy original / Cream cheese, tub, 150 g, JP	2.6	6.8	4.2	-62%

LAND OCCUPATION

Table A2. Land occupation for Violife Products in Europe, UK, Canada, US, and Japan, and dairy cheese in the same market. Results are expressed in m²-year per kg of product.

PRODUCTS COMPARED (Violife/ dairy cheese)	Land occupation (m ² .y /kg product)		Calculated savings	
	Violife	Dairy	m ² .y /kg	%
EUROPE				
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	1.6	10.4	8.8	-85%
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	1.5	10.3	8.8	-85%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	1.6	11.4	9.8	-86%
Original / Cheddar, grated, 200 g (old doypack), EU	1.6	11.4	9.8	-86%
Original / Cheddar, sliced, 200 g (hard tray), EU	1.6	11.4	9.8	-86%
Mature cheddar fl. / Cheddar, block, 200 g, EU	1.4	11.3	9.9	-88%
Prosociano / Parmesan, wedge, 200 g, EU	2.2	13.4	11.2	-84%
Creamy original / Cream cheese, tub, 200 g, EU	1.3	5.9	4.6	-78%
Feta flavour / Feta, block, 200 g, EU	1.7	11.6	9.9	-85%
UK				
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	1.5	9.5	8.0	-84%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	1.6	10.5	8.9	-85%
Original / Cheddar, grated, 200 g (old doypack), UK	1.6	10.6	9.0	-85%
Original / Cheddar, sliced, 200 g (hard tray), UK	1.6	10.5	8.9	-85%
Epic mature / Cheddar, block, 200 g, UK	2.0	10.5	8.5	-81%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	1.8	10.5	8.7	-83%
Prosociano / Parmesan, wedge, 200 g, UK	2.2	12.5	10.3	-82%
Creamy original / Cream cheese, tub, 200 g, UK	1.3	5.5	4.2	-76%
Feta flavour / Feta, block, 200 g, UK	1.7	11.6	9.9	-85%
CANADA				
Mozzarella flavour / Mozzarella, grated, 227 g, CA	1.6	10.6	9.0	-85%
Cheddar flavour / Cheddar, sliced, 200 g, CA	1.8	11.7	9.9	-85%
Prosociano / Parmesan, wedge, 200 g, CA	2.2	13.7	11.5	-84%
Creamy original / Cream cheese, tub, 200 g, CA	1.4	6.0	4.6	-77%
Feta flavour / Feta, block, 200 g, CA	1.7	11.7	10.0	-85%
US				
Mozzarella flavour / Mozzarella, grated, 227 g, US	1.7	11.2	9.5	-85%
Cheddar flavour / Cheddar, sliced, 200 g, US	1.8	12.2	10.4	-85%
Cheddar flavour / Cheddar, sliced, 751 g, US	1.6	12.2	10.6	-87%
Prosociano / Parmesan, wedge, 200 g, US	2.2	14.3	12.1	-85%
Creamy original / Cream cheese, tub, 200 g, US	1.3	6.3	5.0	-79%
Feta flavour / Feta, block, 200 g, US	1.7	11.7	10.0	-85%
JAPAN				
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	1.6	12.5	10.9	-87%
Cheddar flavour / Cheddar, grated, 200 g, JP	1.6	13.7	12.1	-88%
Cheddar flavour / Cheddar, sliced, 140 g, JP	1.6	13.7	12.1	-88%
Creamy original / Cream cheese, tub, 150 g, JP	1.3	7.1	5.8	-82%

WATER CONSUMPTION & WATER WITHDRAWAL

Table 3. Water consumption and Water Withdrawal for Violife Products in Europe, UK, US, Canada, and Japan, and dairy cheese in the same market. Results are expressed in m³ per kg of product

PRODUCTS COMPARED (Violife/ dairy cheese)	Water consumption (m ³ /kg product)		Calculated savings		Water withdrawal (m ³ /kg product)		Calculated savings	
	Violife	Dairy	m ³ /kg	%	Violife	Dairy	m ³ /kg	%
EUROPE								
Mozzarella flavour / Mozzarella, grated, 200 g (old doypack), EU	0.046	0.061	0.015	-25%	0.15	0.28	0.13	-46%
Mozzarella flavour / Mozzarella, block, 2.5 kg, EU	0.042	0.057	0.015	-26%	0.13	0.26	0.13	-50%
Cheddar flavour / Cheddar, sliced, 200 g (hard tray), EU	0.071	0.071	0	0%	0.20	0.31	0.11	-35%
Original / Cheddar, grated, 200 g (old doypack), EU	0.046	0.066	0.02	-30%	0.15	0.30	0.15	-50%
Original / Cheddar, sliced, 200 g (hard tray), EU	0.071	0.071	0	0%	0.20	0.31	0.11	-35%
Mature cheddar fl. / Cheddar, block, 200 g, EU	0.043	0.065	0.022	-34%	0.13	0.29	0.16	-55%
Prosociano / Parmesan, wedge, 200 g, EU	0.285	0.075	-0.21	280%	0.45	0.34	-0.11	32%
Creamy original / Cream cheese, tub, 200 g, EU	0.025	0.041	0.016	-39%	0.11	0.18	0.07	-39%
Feta flavour / Feta, block, 200 g, EU	0.039	0.029	-0.01	34%	0.14	0.10	-0.04	40%
UK								
Mozzarella flavour / Mozzarella, block, 2.5 kg, UK	0.042	0.060	0.018	-30%	0.13	0.27	0.14	-52%
Cheddar flavour / Cheddar, sliced, 500 g (refi), UK	0.066	0.068	0.002	-3%	0.18	0.31	0.13	-42%
Original / Cheddar, grated, 200 g (old doypack), UK	0.046	0.069	0.023	-33%	0.15	0.31	0.16	-52%
Original / Cheddar, sliced, 200 g (hard tray), UK	0.071	0.074	0.003	-4%	0.20	0.33	0.13	-39%
Epic mature / Cheddar, block, 200 g, UK	0.053	0.067	0.014	-21%	0.15	0.30	0.15	-50%
Epic mature / Cheddar, grated, 150 g (old doypack), UK	0.051	0.069	0.018	-26%	0.16	0.31	0.15	-48%
Prosociano / Parmesan, wedge, 200 g, UK	0.285	0.079	-0.206	261%	0.45	0.36	-0.09	25%
Creamy original / Cream cheese, tub, 200 g, UK	0.025	0.042	0.017	-40%	0.11	0.18	0.07	-39%
Feta flavour / Feta, block, 200 g, UK	0.039	0.029	-0.01	34%	0.14	0.10	-0.04	40%
CANADA								
Mozzarella flavour / Mozzarella, grated, 227 g, CA	0.049	0.071	0.022	-31%	0.15	0.24	0.09	-38%
Cheddar flavour / Cheddar, sliced, 200 g, CA	0.070	0.078	0.008	-10%	0.19	0.27	0.08	-30%
Prosociano / Parmesan, wedge, 200 g, CA	0.288	0.088	-0.2	227%	0.46	0.29	-0.17	59%
Creamy original / Cream cheese, tub, 200 g, CA	0.028	0.049	0.021	-43%	0.12	0.16	0.04	-25%
Feta flavour / Feta, block, 200 g, CA	0.042	0.037	-0.005	14%	0.14	0.10	-0.04	40%
US								
Mozzarella flavour / Mozzarella, grated, 227 g, US	0.054	0.062	0.008	-13%	0.18	0.26	0.08	-31%
Cheddar flavour / Cheddar, sliced, 200 g, US	0.068	0.064	-0.004	6%	0.19	0.27	0.08	-30%
Cheddar flavour / Cheddar, sliced, 751 g, US	0.045	0.060	0.015	-25%	0.15	0.26	0.11	-42%
Prosociano / Parmesan, wedge, 200 g, US	0.285	0.070	-0.215	307%	0.46	0.29	-0.17	59%
Creamy original / Cream cheese, tub, 200 g, US	0.025	0.039	0.014	-36%	0.11	0.16	0.05	-31%
Feta flavour / Feta, block, 200 g, US	0.039	0.029	-0.01	34%	0.14	0.10	-0.04	40%
JAPAN								
Mozzarella flavour / Mozzarella, sliced, 140 g, JP	0.053	0.068	0.015	-22%	0.17	0.28	0.11	-39%
Cheddar flavour / Cheddar, grated, 200 g, JP	0.065	0.065	0	0%	0.18	0.27	0.09	-33%
Cheddar flavour / Cheddar, sliced, 140 g, JP	0.073	0.073	0	0%	0.20	0.30	0.1	-33%
Creamy original / Cream cheese, tub, 150 g, JP	0.027	0.043	0.016	-37%	0.11	0.17	0.06	-35%