LCA of 22 frozen food products and their alternatives

Short Summary Report

PRé

Fact-based sustainability

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For more than thirty years PRé has been at the forefront of life cycle thinking and has built on its knowledge and experience in sustainability metrics and impact assessments to provide state of the art methods, consulting services and software tools. Internationally, leading organizations work with PRé to integrate sustainability into their product development procedures in order to create business growth and business value. PRé has an office in the Netherlands and a global partner network to support large international or multi-client projects.

Get in touch with us

Do you have a sustainability challenge for us? We would be happy to discuss it together.

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This report is a highly shortened version of the full ISO report that was reviewed by the review panel.

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Goals of the study

Nomad Foods, Europe's leading frozen food company, is interested in learning more about the potential trade-offs between a frozen food supply chain and one using alternative preservation methods. For example, while a frozen supply chain requires energy for both the initial freezing and frozen storage during the life cycle, there are possible benefits in terms of food preservation, such as less food waste due to the low-perishable nature of frozen food. This study examines these potential trade-offs to determine if there are significant differences in the environmental impact between frozen and non-frozen food products (goal 1).

To analyse this, the environmental impact of 22 frozen food products is compared to their alternatives (equivalent products using alternative preservation methods, such as fresh products, jars and cans). The products selected are from the product categories: fish, plant-based proteins and vegetables. To ensure that differences in environmental impact between the frozen food product and its alternative stem solely from the preservation method and not from other factors, the ingredient composition, manufacturing efficiencies, ingredient and product distribution routes, and location of consumption remain constant. More specifically, the most notable differences between the frozen products and their alternatives will be inherent differences in the product manufacturing, temperature of transport vehicles, the storage temperatures and technologies, and food loss and waste.

In parallel, this study also reports the carbon footprint (climate change impact of the life cycle) of the 22 Nomad Foods frozen products for sale and consumption in one specific country per product (goal 2).

The study was executed to conform to ISO 14040/44: 2006 and has been externally reviewed by an independent review panel.

Scope of the study

To calculate the environmental impact of the 22 products and their alternatives, Life Cycle Assessment (LCA) was used. Life Cycle Assessment measures the potential impacts on the environment associated with the life cycle of a product, process, or service. It typically includes every part of the life cycle, the so-called life cycle stages. The scope of this study is cradle to grave, meaning it includes all life cycle stages, from the farming and wild capture of raw ingredients to consumed product, including end-of-life of the package and any non-consumed food product.

Figure 1 - Life cycle stages of Nomad Foods products

Data from 2019 was collected from Nomad Foods and its suppliers for processes which are under Nomad Foods' direct or operational control. Data was also collected for some upstream processes which were anticipated to have a considerable contribution (e.g. wild capture of fish) and from retailers for food loss and waste percentages. Data from Nomad Foods is linked to Life Cycle Inventory (LCI) databases which contain, for example, the emissions and inputs for 1 kWh of solar electricity. Collected data is supplemented with data from relevant literature and the Product Environmental Footprint (PEF)[1] method where appropriate.

For the comparison of the potential environmental impact of the 22 frozen food products with their alternatives (goal 1), the unit of analysis (i.e. the functional unit) was 3 portions of consumed product (since an average OECD household consists of 2.6 people). For the calculation of the carbon footprint of the 22 frozen products (goal 2), a functional unit of 1 kg of consumed product was used.

The main environmental issue (impact category) assessed in this study is global warming potential (i.e. the carbon footprint) which measures the potential impact on climate change. While they are not used for detailed analysis, the full range of other impact categories from the EF 3.0 impact assessment method of the PEF are also calculated to identify potential trade-offs. An example of a trade-off is that one product has a lower carbon footprint, but higher impact on water scarcity than the other.

To determine the importance and sensitivity of the various modelling approaches used and assumptions made, a series of sensitivity analyses were performed on storage time, retail and consumer electricity source, consumer preparation type and packaging size of the alternative product.

Results

Main differences between frozen versus other preservation methods

The results and corresponding interpretation steps provided insights into the differences in carbon footprint between the frozen and non-frozen food product. In general, from this study, it can be concluded that there are four main factors that determine whether the carbon footprint of a frozen product is higher or lower than that of an alternative, based on the scope of this study. These factors are not necessarily main contributors to the impact, but they are the **main sources of differences between the frozen and non-frozen products**. They are as follows:

1. The electricity mix used by retail and consumer. An energy mix with a lower carbon footprint per kWh is beneficial for frozen products. The products included in this study use the average country electricity mix in the country of consumption. Over time, these mixes are expected to move in the direction of lower carbon footprint, thereby moving in favour of the frozen product.
2. The number of days the consumer keeps the frozen product in their freezer. A shorter freezer storage time is beneficial for the carbon footprint of frozen products.

[1] This method is developed by the European Commission to standardize LCA's of products and allow for fair comparison between products.

In this study, a frozen storage time of 30 days is used based on default values of the PEF method [1]. If the carbon footprint of electricity mixes is lower, the sensitivity to the frozen storage days is less significant.

3. The amount of food loss and waste at retail and consumer. If the food loss and waste of the alternative product is higher than that of the frozen product, whether this is due to high perishability, low turnover or other reasons, the carbon footprint of the frozen product is more likely to be favourable. Since the amount of food loss and waste can influence the outcomes of the comparison, data on this should be specific to the product and the preservation method.
4. The inherent carbon footprint of the product itself. If the production of the product (i.e. the ingredients cultivation and manufacturing) has a higher carbon footprint, the effect of wasting this product will also be higher. So, a change in the food loss and waste percentage of products with a relatively high production (at the point of leaving the factory) carbon footprint will have a larger absolute effect than the same change for a product with a relatively low production carbon footprint. Since the food loss and waste percentages are in general lower for frozen food products, the frozen food product is more likely to have a lower carbon footprint than its alternative if the inherent carbon footprint of the product is high.

Carbon footprint of frozen products and their alternatives

Figure 2 shows the numerical carbon footprint of the Nomad Foods frozen products under study, compared to the alternative product modelled.

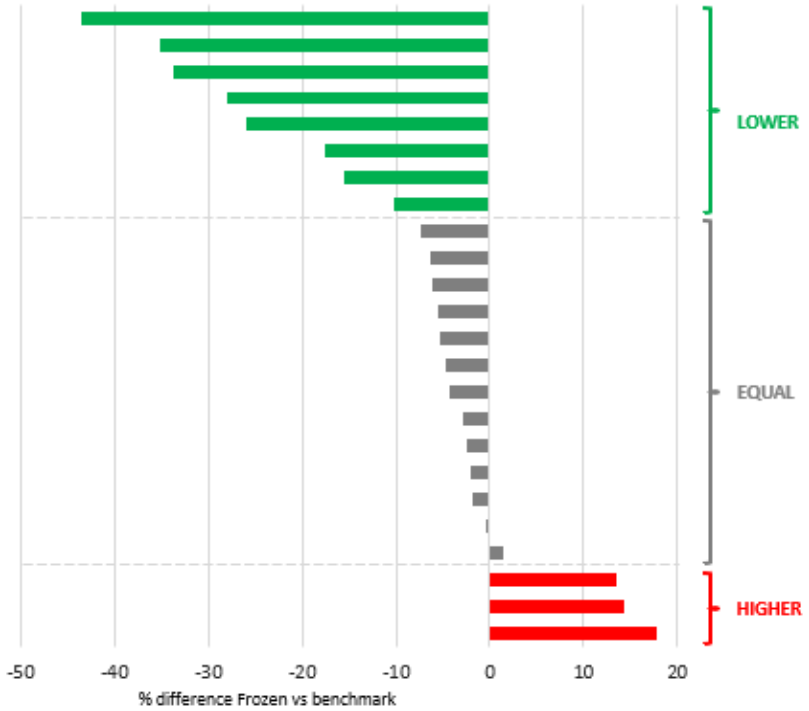

Figure 2 - Comparison of carbon footprint of the frozen product and its alternative

Relative impact of life cycle stages to the carbon footprint

The relative contribution of life cycle stages to the carbon footprint varies slightly for different products and product types, and between the frozen product and its alternative.

- In most cases, when looking at the carbon footprint, **ingredient production** (which is the same for the frozen product and its alternative) is the most contributing life cycle stage. This means cultivation of the vegetables, catching of the fish or, in the case of the Atlantic Salmon fillet, farming the fish. For fish products, the main impact comes from the catching operations (e.g. fuel usage) of the fish itself (for wild-caught fish) and production of fish feed (for farmed fish). For plant-based products, the main contributors to the carbon footprint within the cultivation varies with common sources being fuel-use during planting and harvesting, land-use change, herbicide and pesticide production, and irrigation efforts.
- The relative contribution of **manufacturing** to the carbon footprint varies between the products. For the Green Cuisine products (vegetarian burger, falafel and chicken-less nuggets), it has a significant contribution to the overall carbon footprint, while for the pure vegetable products it does not. The fish products lie somewhere in the middle, with manufacturing being a bigger or smaller contributor to the overall carbon footprint depending on the case. The impact of this stage is mainly driven by the energy use, where the share of renewable electricity sources in the electricity mix used by the factory has a large influence.
- For most products under study, **packaging** has a fairly low, but not scientifically insignificant contribution to the carbon footprint, with the exception of the jarred and canned alternative products where the impact is significant. In contrast, many of the frozen products are packaged in a cardboard and/or thin plastic film that has a relatively low impact.
- For the frozen and alternative products under study, **distribution** between the factory, distribution centres and retail does not have a large impact to the overall carbon footprint.
- **Storage at retail and the consumer** is a significant contributor to the carbon footprint of most products under study, with the share of renewables in the electricity mix determining the extent of the impact.
- The **food waste** at retail and consumer are seen to contribute significantly to the carbon footprint, most notably the consumer food losses for fresh alternatives. In the screening study leading up to this study, it became clear that the food loss and waste percentages at retail and the consumer used have a significant effect on the overall results. To acknowledge the importance of these numbers and their relative uncertainty, the results are shown with the default food loss and waste percentages in general, but a *tipping point* is calculated as well.
- For most products (both fresh and frozen) in this study, **consumer preparation** has a scientifically significant contribution to the overall carbon footprint, although in many cases it is still a relatively low share. The main products where consumer preparation has a larger contribution to the overall carbon footprint is when the product is prepared in the oven. This impact is among others influenced by the local electricity mix.

Since retail and consumer can have a big share of the environmental impact of a product, environmental impact studies of food products and labels based on these, should include the whole life cycle (cradle-to-grave) instead of excluding the retail, consumer and end-of-life life cycle stages (cradle-to-gate).

Limitations of the study

While this study attempted to be as accurate and detailed as possible, limitations still exist, as in any LCA study. Most notably, there are limitations in the selection of the alternative products, the secondary data sources (such as literature) used and modelling approaches. The concluding statement is expressed with these limitations in mind.

Conclusions

Considering the results, interpretation, sensitivity analysis and uncertainty assessments, **this study shows that when it comes to carbon footprint, there is no general advantage or disadvantage to using frozen food products compared to products using alternative preservation methods. However, it does support the hypothesis that when food loss and waste rates in the retail and consumer stages are lower for a frozen product compared to a non-frozen alternative, this may compensate for the additional energy use caused by a frozen supply chain when looking at carbon footprint.**

This conclusion is based on the overall conservative approach that was used in this study on multiple fronts, meaning that the differences stem solely from the preservation method and not from other factors such as the ingredient composition, processing efficiencies, ingredient distribution route, and location of consumption.

Conclusions on all environmental issues:

While this study covered a wide range of environmental issues (impact categories), it mainly investigated the carbon footprint of the products. The results and uncertainty assessment have shown that the carbon footprint is not always a good representation of the results on other impact categories. So, conclusions based on the carbon footprint cannot be generalized to overall environmental impact.

In many of the studied products, the trend as to which product has a lower impact - the frozen or the alternative - is fairly constant when looking at the other impact categories. However, without exception there are trade-offs in all products under study, where there is an advantage of one product in one impact category but not in another. Further research could look further into these trade-offs.