

# **LCA of Ready-to-Serve Lasagne Bolognese Packed in Aluminium Foil Containers**

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Executive Summary

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## Executive Summary

### “LCA of Ready-to-Serve Lasagne Bolognese Packed in Aluminium Foil Containers”

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Packaging within the food supply chain has to fulfil a variety of purposes: the protection of the packed product, the warranty of a safe transportation and storage at the retailers and households and the supply of food in the right portion.

Ready-to-serve lasagne is part of the food consumption in both family households and single households. To serve respective needs it is sold in different portion sizes either chilled or deep frozen. Ready-to-serve lasagne can be prepared in an oven or in a microwave.

Aluminium foil containers are frequently used for packing and serving ready-to-serve lasagne due to their heat resistance and heat conductivity, ductility and light weight. These properties are relevant along the production chain, during filling, cooling and freezing. Additional reasons to use aluminium foil containers are the flexibility of either heating lasagne in an oven or in a microwave and the possibility to store and re-heat leftovers.

This study investigates the environmental performance of the packaging with respect to its function within the life cycle of ready-to-serve lasagne and the environmental relevance of stages and interdependencies within the life cycle of ready-to-serve lasagne while taking consumption patterns into consideration. Due to its market relevance lasagne Bolognese is considered.

The functional unit for the ready-to-serve lasagne life cycle is defined as **“the preparation of 1 kg ready-to-serve lasagne Bolognese ready to consume in single portions of 400g or 1000g”** reflecting small portion and family portions.

The life cycle inventory for ready-to-serve lasagne encompasses the whole food supply system starting with the cultivation of wheat and tomatoes and animal husbandry ending with ready-to-serve lasagne ready to be eaten at home. Included are the production of ingredients (pasta, sauce Bolognese, sauce Béchamel, etc.), production and disposal of packaging, transports, distribution processes, domestic refrigeration and preparation in an electric baking oven or microwave. All processes occur in Europe, except for parts of the durum wheat cultivation. The cold chain is maintained over the whole life cycle of lasagne. Recycling is considered using the cut-off approach and therefore no credits are given for end-of-life recycling.

Following two lasagne compositions are investigated:

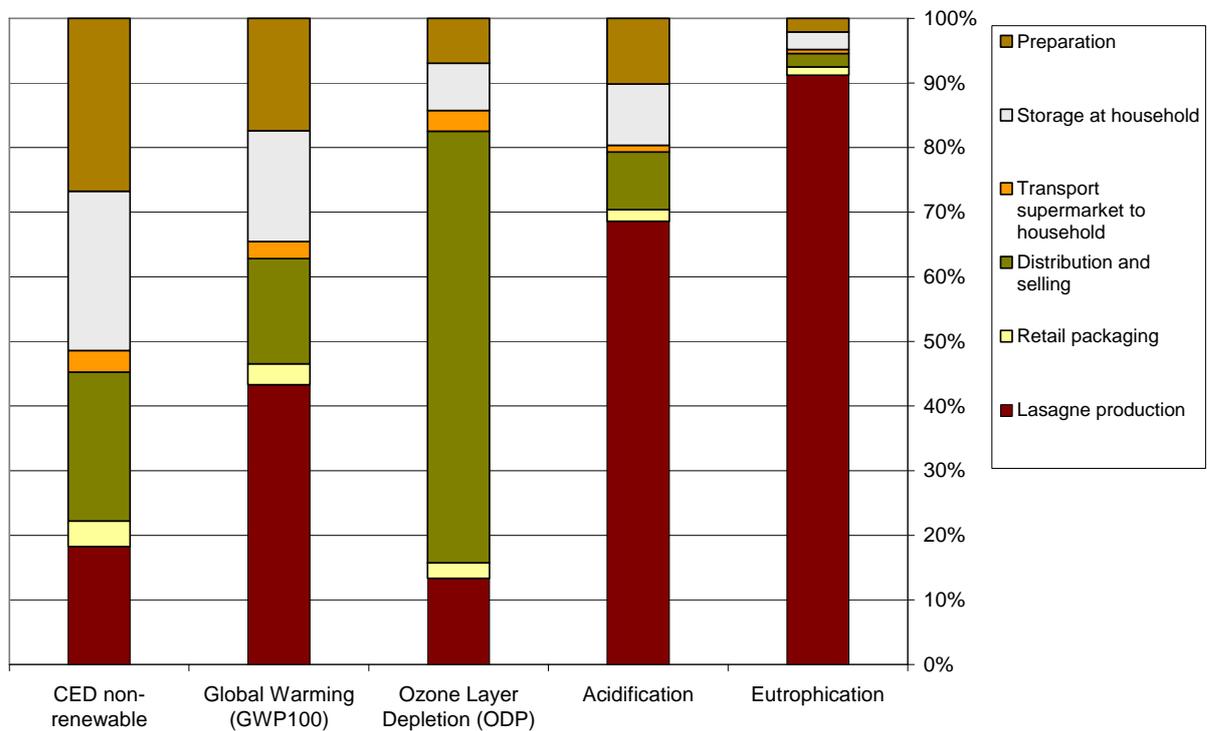
- Pork-based lasagne Bolognese: pasta is about 26 weight-%, 20 weight-% pork, 5 weight-% tomato paste, 5 weight-% cheese
- Beef-based lasagne Bolognese: pasta is about 26 weight-%, 12 weight-% beef, 5 weight-% tomato paste, 5 weight-% cheese

Both compositions are calculated for a 400 gram and 1.000 gram portion as well as for a chilled and deep frozen preparation.

As standard case it is assumed that chilled lasagne is consumed after one day in the refrigerator at home and after 30 days for deep frozen lasagne. Average household appliances for cooling and preparation are assumed. No food loss is considered along the supply chain.

The results of the study are calculated for ten environmental indicators. The main impact assessment and discussion is based on a selection of five widely accepted indicators. These are Cumulative Energy Demand (CED), non-renewable [MJ-eq.], Global Warming [kg CO<sub>2</sub> eq.], Ozone Layer Depletion (ODP) [kg CFC-11 eq.], Acidification [kg SO<sub>2</sub> eq.] and Eutrophication [kg PO<sub>43</sub>-eq.].

Figure 1 shows the result for these five categories for 400 gram beef based frozen ready-to-serve lasagne. The contribution of the different phases varies from indicator to indicator.

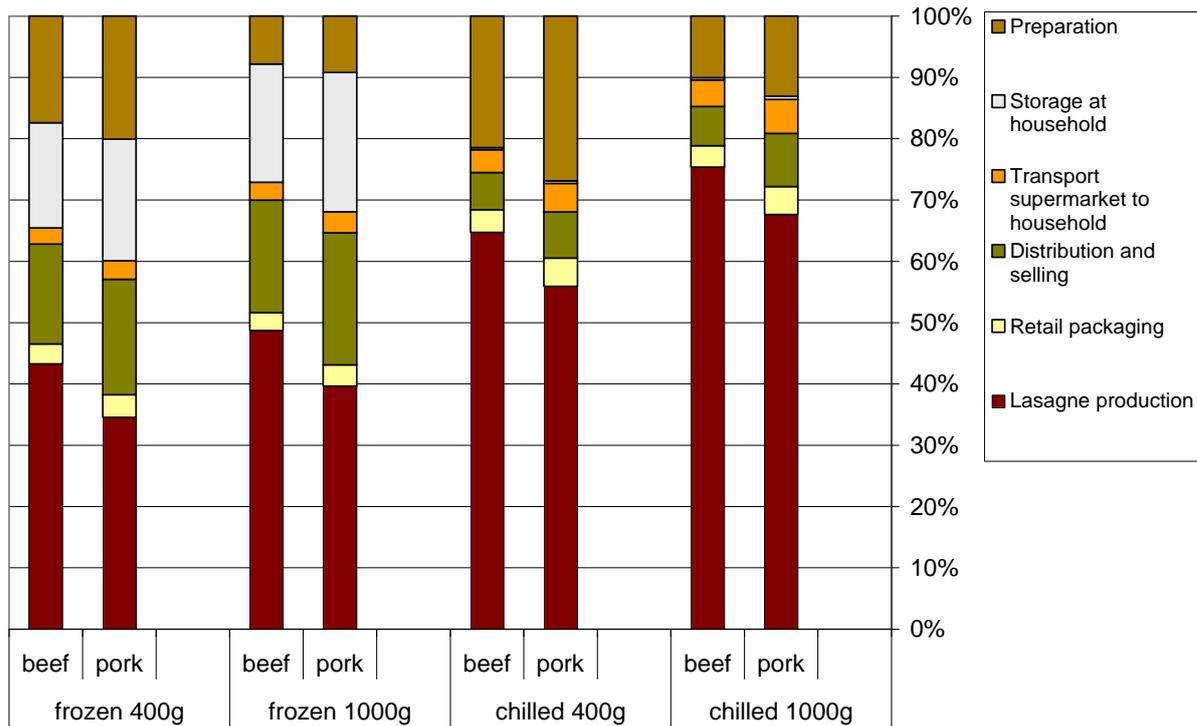


**Figure 1: Results of the standard case for 1 kg beef based ready-to-serve lasagne packed, frozen and prepared in 400 grams portions with regard to the selected impact categories; the results are scaled to 100%.**

Both meat types of lasagne (pork and beef) exhibit a similar burden regarding non-renewable CED (Cumulative Energy Demand) and ODP (Ozone Depletion). In the other indicators beef-based lasagne exhibits higher impacts. The provision of 1 kg pork causes less environmental impacts in comparison with 1 kg beef mainly due to less methane emissions and better fodder efficiency. As in these two types of lasagne the pork-based lasagne has a higher share of meat (20%) than the beef-based lasagne (12%) impacts are levelled out and both types exhibit similar burdens in some indicators. With respect to lasagne production itself, sauce Bolognese is dominating its impact in all types of lasagne (frozen, chilled, pork-based, and beef-based) and all indicators due to the environmental impacts associated with the meat production for the sauce.

Furthermore clear difference in the indicator results between deep-frozen and chilled lasagne Bolognese are observable in all other categories, except eutrophication and acidification. The highest difference is found in the indicators CED and ODP, and the smallest in the eutrophication potential. As the difference of frozen and chilled lasagne derives mainly from the different energy consumption in the cold chain, eutrophication is not as much affected as the energy-related indicators CED, GWP and ODP.

Figure 2 shows the scores for greenhouse gas emissions for beef and pork ready-to-serve lasagne, both as deep frozen and chilled preparation, as well as a small portion of 400 grams and a family portion of 1.000 grams.



**Figure 2: Results for 1 kg beef and pork based ready-to-serve lasagne Bolognese packed in 400g and 1.000 g aluminium containers. Assumptions: Lasagne is produced and consumed in Europe, average transport distances for grocery shopping, storage in freezer for 30 days and 1 day in refrigerator for deep-frozen and chilled lasagne respectively, preparation in an average electric oven.**

The most relevant aspect concerning GHG emissions in the life cycle of ready-to-serve lasagne is the lasagne production itself including the necessary raw materials. The impact of the production phase is also predominant in the other impact category indicators not shown in the figure.

Within the sensitivity analysis the relevance of the underlying assumptions for the standard case has been investigated. Different domestic storage times in refrigerators and freezers as well as different preparation ways (oven, microwave) were considered. Also the relevance of food losses and the energy efficiency of household appliances were taken into consideration.

The storage time of deep-frozen food in particular has a strong influence on the results. In an extreme storage scenario (360 days) this phase dominates the energy related indicators CED, GWP and ODP.

Another important issue is the preparation in the electric oven. This step is responsible for between 0.7% (eutrophication, beef-based, chilled, 1000g) and 43% (non-renewable CED, beef-based, chilled, 400g) of the overall impacts. Selecting an energy efficient oven reduces the overall impacts and amounts to 22% for the non-renewable CED. Due to a better heating efficiency the microwave causes lower impacts.

Regarding packaging portion sizes, 1 kg lasagne prepared out of 400 gram packages exhibit higher burdens than 1 kg lasagne prepared out of 1000 gram portion packages. This is mainly due to the assumption that for both options the oven has to be heated once to prepare one portion, which means more heating for the smaller portion.

In conclusion the most relevant aspect in the life cycle of ready-to-serve lasagne is the production of lasagne itself for the most indicators. In descending order of importance for the most indicators handling in the household is followed by distribution and selling. The relevance of packaging is comparably low in all categories.

In order to improve the environmental performance of the consumption of lasagne the consumer can buy size-adequate portion packages to avoid wastage of food and optimize the energy consumption for the storage and preparation of lasagne. Packaging manufacturers can contribute to an improvement by e.g further optimizing the packaging.

This study investigated lasagne Bolognese. Thus, no conclusions can be drawn for options not investigated as e.g. other ingredients, other packaging sizes, other packaging materials, other ways of preparation etc.