Atria Suomi Oy broiler products – carbon footprint

Calculation execution

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1. Starting point

In this work, we have calculated the carbon footprint of Atria Suomi Oy's broiler production chain per packaged product. The review includes emissions from primary production, transport and processing up to the finished, packaged product. Primary production took into account hen rearing, laying, hatchery and broiler breeding.

Figure 1. *The production chain taken into account in the review. The green arrows describe the logistics considered in the review.*

Because of their high homogeneity of activity, chick rearing and hatcheries were sampled according to a square root sample. For broiler farms, more than 50 % of the production volume was examined. The farms to be calculated were selected according to their willingness to participate.

Chick farms	Laying houses	Hatcheries	Broiler farms
4	4	1.0	35

Table 1. *Sampling in the review.*

Initial data on primary production were collected on a farm-by-farm basis. We made use of the ready-made information available on the farms, supplemented by farmers' own information. Existing data from production was utilised for the production plant. Each unit was calculated as a separate entity, after which the carbon footprint of the production chain was calculated according to need for the actual chicks and the eggs laid and hatched.

A mass and energy based production model was created of the processing of meat on the poultry line of the Atria Nurmo and Sahalahti plants. This was used as the basis for the carbon balance of a broiler production line. The carbon balance was used to determine the per-product emissions caused by the production. As the final result, we were able to determine the kg CO2e / kg for a packaged product.

The results reflect the carbon footprint of Atria Suomi Oy's chicken products. They cannot be generalised as the carbon footprint of other manufacturers or other products.

2. Calculation method and system limits

The calculation was carried out in accordance with the standards ISO 14040 and ISO 14044 and was largely in line with the Product Environmental Footprint (PEF) guidelines, which define the collection of initial data and the implementation of carbon calculations more precisely than the standards. There is no specific PEF product group guidelines for broiler or other poultry production. The work utilised the draft of the PEF guidelines (Footprint Category Rules Red Meat, Version 1.0) for red meat, where applicable. This work examines the carbon footprint of products, not other environmental impacts.

The following were excluded from the scope of the review:

- Emissions from the life cycle of primary production machinery, equipment and buildings.
- Emissions from the lifecycle of vehicles.
- Emissions from the lifecycle of the production installation and equipment.
- Emissions from non-production activities such as office space, marketing, etc.
- Emissions of oils, refrigerants, etc. from production equipment. For refrigerants, the emissions resulting from the addition thereof have been taken into account.
- Emissions from the final use of meat products. The review is limited to the slaughterhouse gate, i.e. neither the transport of the product to the grocery stores nor the emissions caused by the store and the consumer have not been taken into account in the review.

The carbon footprint was calculated by looking at the primary greenhouse gases, CO2, methane and nitrous oxide, which were converted into CO2 equivalents (kg CO2e) per kg product and per packaging.

3. Calculation execution

3.1 PRIMARY PRODUCTION

The calculation of the broiler production chain is based on the separate carbon footprints of broiler breeders, laying houses, hatchery and broiler breeders. The average carbon footprint of a day-old chick was calculated as a weighted average of the total emissions of the nurseries, laying houses and hatchery. The calculation took into account the depletion and rejection in each stage of production. The carbon emissions of each broiler farm included its real need for day-old chicks, with consideration for depletion and rejection.

The calculation is based on farm-specific primary data, which was obtained from farms using existing data, interviews with farmers and from Atria's systems. The review was carried out over a 12-month period and the data were collected in February-March 2021. The review period is 2020. Since then, there have been no significant changes in activity or production on the farms. Depending on the operation of the farm, the initial data covers:

- Animal data (incoming and outgoing quantity, length of rotation, carcass weight)
- Feeding (all components and component specific quantities)
- Farm's own feed grain crops (plant species, yield level, fertiliser and pesticide inputs, liming)
- Soil analysis of arable land (soil type, soil organic matter, pH)
- Manure treatment
- Electricity consumption/year and sources
- Heat consumption/year and sources
- Fuel consumption per year
- Transport to the farm (e.g. purchased feed, bedding, fertilizers), animal transport has been taken into account in the context of logistics and therefore they are not included in the farm-specific reviews.

Sources of emissions taken into account in the calculation of the production chain of primary production:

Indigenous fodder farming:

- Direct and indirect emissions of nitrous oxide from soil, fertilisers and plant residues
- Greenhouse gas emissions from the manufacture of nitrogen fertilisers, liming materials and plant protection products
- Soil CO2 emissions due to liming
- Fuel emissions from cultivation and grain drying
- Impact of changes in land use and organic soils

Livestock production:

- Emissions from feed grown by the farm itself: kg CO2e /kg of crop produced, calculated on the basis of emissions
- Emissions from for purchased feed: according to the life cycle model, taking into account the emissions from their production
- Emissions from manure before its fertiliser application (fertiliser emissions taken into account in crop emissions) and from litter according to the life cycle model
- Emissions from heating
- Emissions from electricity
- Fuel emissions (other than from cultivation)
- Emissions from transport excluding animal transport (these are taken into account in the review of the production chain as a whole)

The direct and indirect nitrogen emissions from fertilisers, soils and plant residues left in the field have been taken into account in the calculation of feed cultivation. With regard to fertilisers and plant protection products, in addition to emissions caused by use, emissions caused during their manufacture have been taken into account.

To define peat fields, we used the Finnish classification, taking into account the following soil types: BCt, Ct, LCt, SCt, Tm. The soil type was examined from the parcel-specific soil analysis data. IPCC emission factors for peat fields were used in the calculation of emissions from peat fields. Peat fields on farms were very few, 1.08% of the total area.

Feeding data were calculated as component specific dry matter. In the case of feed grown by the farm itself, the emissions were transferred directly to feeding according to the kilograms fed to the animals. For purchased cereal feeds, the emission factors of the Feed-Print database were used, taking into account the emissions of production according to the life cycle model; fertilisers, fuels, manufacturing, freight and land use changes. For factory feeds, feed-specific emission factors were calculated according to their raw material content.

Methane and nitrous oxide emissions caused by manure and litter were taken into account in manure emissions. The formation of emissions depends on the specific manure composition of the animal species, the amount of manure, the length of the animal cycle, the type of manure storage and the geographical location of the farm. Geographical location affects the volatility of methane and nitrogen through the ambient temperature. Direct nitrous oxide emissions from manure storage were determined on the basis of the total nitrogen excreted in accordance with IPCC 2019 tier 2 for each manure treatment method separately. Methane and indirect NOx emissions were determined in accordance with IPCC 2019 tier 2. Production emissions according to the life cycle model were taken into account in the emission factors for bedding.

Electricity consumption data were obtained directly from farms and hatcheries. National emission factors for electricity used were used as emission factors for electricity. District heating, peat and wood pellets were used for heating. District heat emission factors reported by Motiva were used as the emission factors for the area. The emission factors used for peat and wood pellets are reported by Statistics Finland.

Fuel consumption data was obtained directly from the farms. The emission factors for fossil fuels used are in accordance with the GHG Protocol. Transportation of bedding, feed and fertilisers were taken into account. Their emissions were calculated on the basis of distance, weight and the means of transport used.

The results of the calculation shall be the emissions of the main greenhouse gases, carbon dioxide, nitrous oxide and methane, that are emitted in primary production, expressed in terms of CO2 equivalents (kg CO2e). The conversion factors used are the IPCC's CO2 1, nitrous oxide 298 and methane, biogenic, 34 and methane, fossil, 36.75 (100-year global warming potential, GWP).

3.2 LOGISTICS

Logistics included the transport of animals during their lifetime. The transport of meat after slaughter is sporadic and difficult to trace; they have not been specifically taken into account. The logistical review shall include the following information:

- transfer of chicks into the laying house
- transfer of eggs to the hatchery
- transfer of chicks to a rearing establishment
- transfer of the hens to the slaughterhouse
- transfer of broilers to the slaughterhouse

The review was limited inside the Nurmo and Sahalahti plants' walls, so the logistics of finished packaged products from the factory onwards have not been taken into account in the review.

Individual transport of primary production, cultivation and other use of machinery related to agricultural activities are not included in the emissions of logistics, but are included in the emissions of primary production energy.

3.3 PRODUCTION PLANT

The animals are sent to the poultry lines of the Atria Nurmo and Sahalahti production plants alive, where the slaughter, meat processing, possible seasoning and product packaging take place. For the production plant, Atria's own production and monitoring data for 2020 were used as the starting point. The data has been collected from Atria's own systems, Atria's personnel, and Atria's service providers and suppliers. A carbon emission factor per kilogram of carcass weight was used for chicken in the calculation of primary production.

Mass and energy analyses were carried out on the production processes of poultry lines, on the basis of which the lines' carbon balances were formed. For the purpose of the review, the following information was collected concerning the poultry lines:

- Emissions from animal logistics (calculated in the calculation of primary production).
- Material/mass flows allocated to the production of the product concerned:
    - Number of animals (kilograms in body weight) to be taken for slaughter.
    - Recipe ingredients for salted, flavoured and marinated products.
    - Flows transferred between different production processes (volume).

  - Flows from different stages of the production process (volumes and whether the flow has a monetary value or entails costs).
  - Products manufactured for sale (volume).
  - Water used for the various process steps (quantity).
  - Waste water from different process stages (quantity and quality).
  - Detergents used in production (quantity and quality).
  - Packaging materials used to package the products (quantity and quality).
  - Refrigerants added to refrigeration equipment (quantity and quality).
  - Processed side streams with no monetary compensation.
  - Waste flows (volume).
  - Quantities of waste allocated to the manufacture of the products concerned (quantity by type of waste).
- Energy inputs allocated to the production of the products concerned:
  - Electrical energy (MWh).
  - Thermal energy (MWh).
  - Fuels (not used in the poultry line).
- Emission factors for all mass and energy flows:
  - The emission factor of the meat ingredient was obtained from the results of the calculation of primary production.
  - Emission factors for other raw materials were mapped using data banks and literature sources.
  - The emission factors for electricity and heat were derived from national guidelines.
    - The emission factor of electricity is derived from the residual distribution guidelines of the Energy Authority. The positive impact of the Nurmo plant's own solar power plant on the coefficient has been taken into account for Nurmo.
    - For heat, the emission factor is derived from consumption and market-based emission factors. Peat, fuel oil, wood chips and natural gas are used for heat production.
  - Emission factors for packaging materials come from the material manufacturers.
  - Otherwise, emission factors have been retrieved from the international EcoInvent database or derived using that database.

Figure 2 presents an overview of the data considered. In addition, within the poultry line, the examination was divided into two parts: 1) the slaughterhouse and cutting plant and 2) the packing plant. In the overview, dark green arrows represent the inputs considered for the examination, bright green arrows are the outgoing currents with monetary value and red arrows are the outgoing currents without monetary value. At the end of the review, all emissions resulting from the operation of the plant will be accumulated with bright green streams.

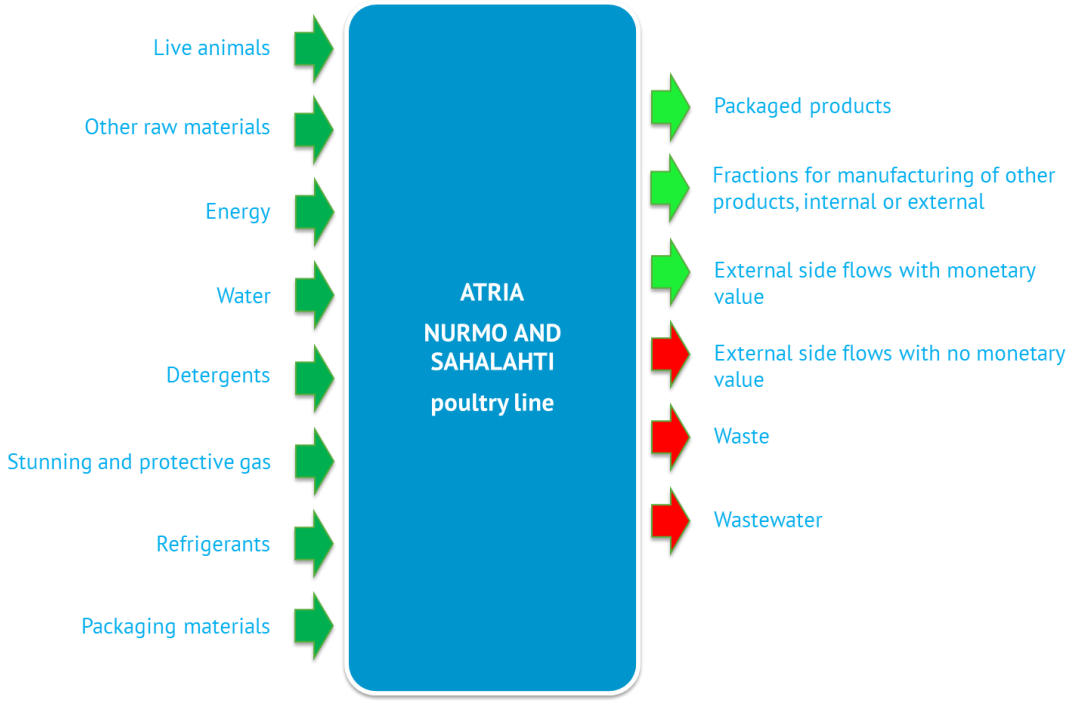

Figure 2. *An outline of the production plant's information considered in the review.*

3.4 PACKAGING MATERIALS

Atria uses the products of several material suppliers in its packaging. Packages include various upper and lower membranes, as well as stickers and coloured ribbon. Boxes, vacuum packs and shrink bags are also used. In principle, emission factors determined by the manufacturers of different materials have been used in the calculation. Regarding products for which no coefficients were obtained from manufacturers, these were determined using a databank. Emissions from the use of coloured ribbon were not taken into account, as its individual emission factor was not available, its consumption per container is marginal and the impact on the whole is non-existent. In addition to the actual material consumption, a 3% material loss was taken into account in the calculation.

3.5 PHASED IMPLEMENTATION OF THE CARBON CALCULATION IN THE PRODUCTION CHAIN

There is as yet no standardised methodology for the calculation of the meat production chain and the allocation criteria for meat emissions vary according to the different examination methods. Mass-based allocation has been used in this review. This means that the emissions allocated to the different process steps are granulated in relation to the masses/weights for the outgoing flows from that process step which have a monetary value (yielding sales revenue).

For the carbon calculation, mass and energy analyses of chicken production processes were carried out, which led to the production's carbon balances. In the carbon balance, the basic principle is that the sum of the flows entering each process step is the sum of the outgoing flows. The production processes of the products concerned were subdivided in such a way that all inputs meant for the production of the products concerned can be distinguished from the production processes of the products concerned. At the same time, the subsection from which some or all of the inputs are allocated to the manufacture of other products were outlined. In this way, emissions from the manufacture of other products do not load the products under consideration.

For the purposes of the carbon balance, descriptive emission factors have been mapped for each input and process flow, which can be used to convert each mass and energy flow into CO2 equivalents (kg CO2e). In the carbon balance, emissions from all mass and energy streams causing emissions are accumulated for products and side streams with a sales value. Thus, through the carbon balance, it was possible to determine the emissions allocated to the production of each of the products concerned.

Emissions per kg of product produced were obtained by dividing the total emissions of production of the product concerned by the kilos produced. The result of the review is a value describing the carbon footprint of the product concerned, i.e. the total cumulative emissions of the product concerned from the production chain. The result of the calculation describes the amount of emissions, expressed in kilograms of CO2, are generated when one kilogram of the packaged product under review is produced.

4. Results

Figures 3, 4 and 5 show the carbon footprint results of Nurmo's eight packaged chicken products and how emissions are divided into different components. Corresponding results for six Sahalahti products (one product is calculated with two different packaging materials) are shown in Figures 6, 7 and 8. The carbon footprint results include emissions from primary production, logistics, the production plant, spices and marinades, and packaging materials. The review is limited to the plant.

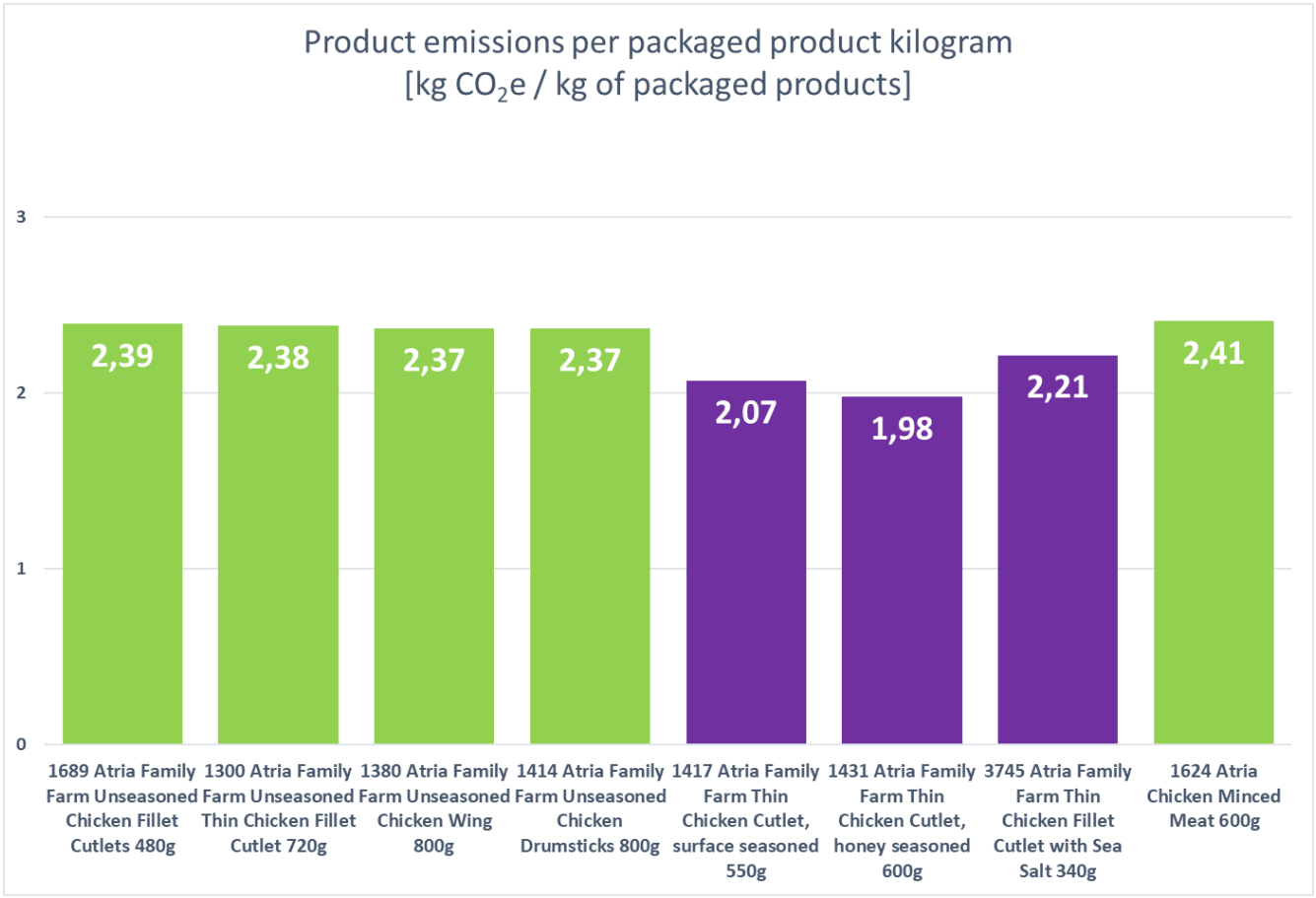

Figure 3. *Carbon footprints of eight broiler products from Nurmo (kg CO2e / kg).*

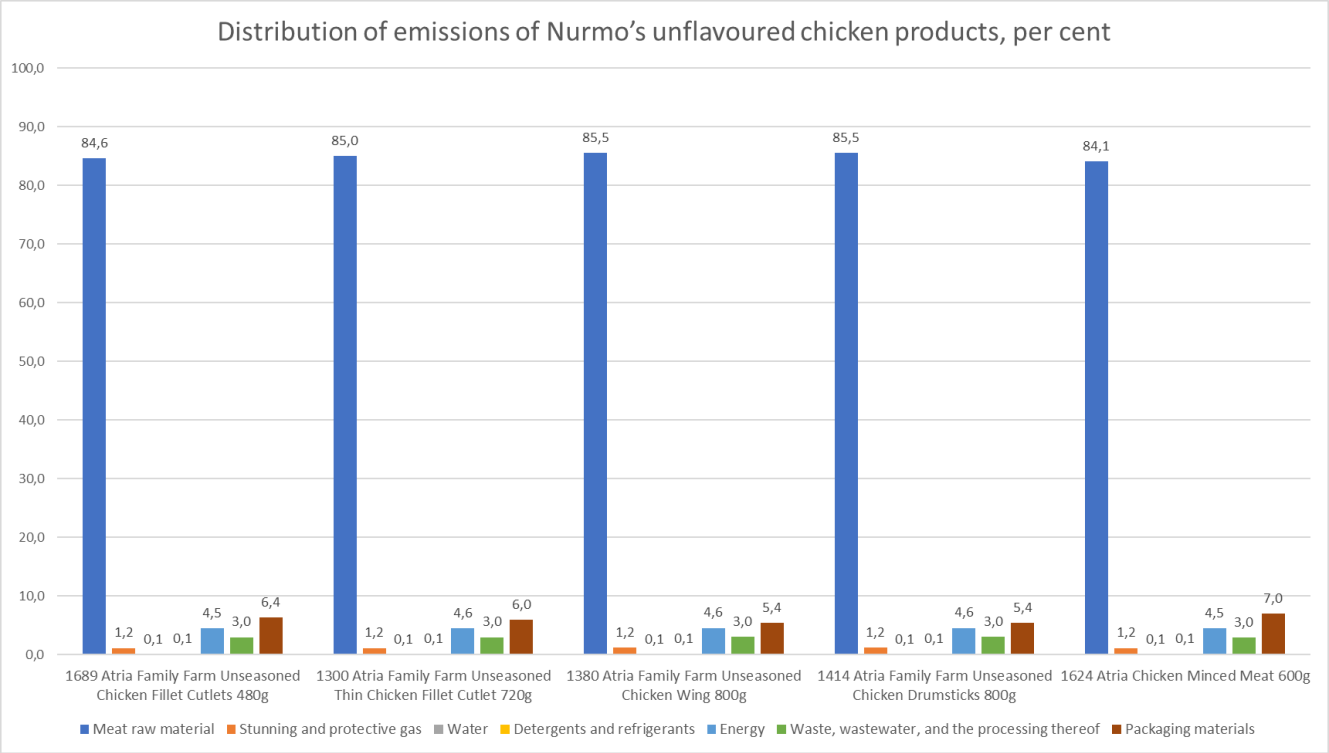

Figure 4. *Distribution of emissions of Nurmo's unflavoured chicken products.*

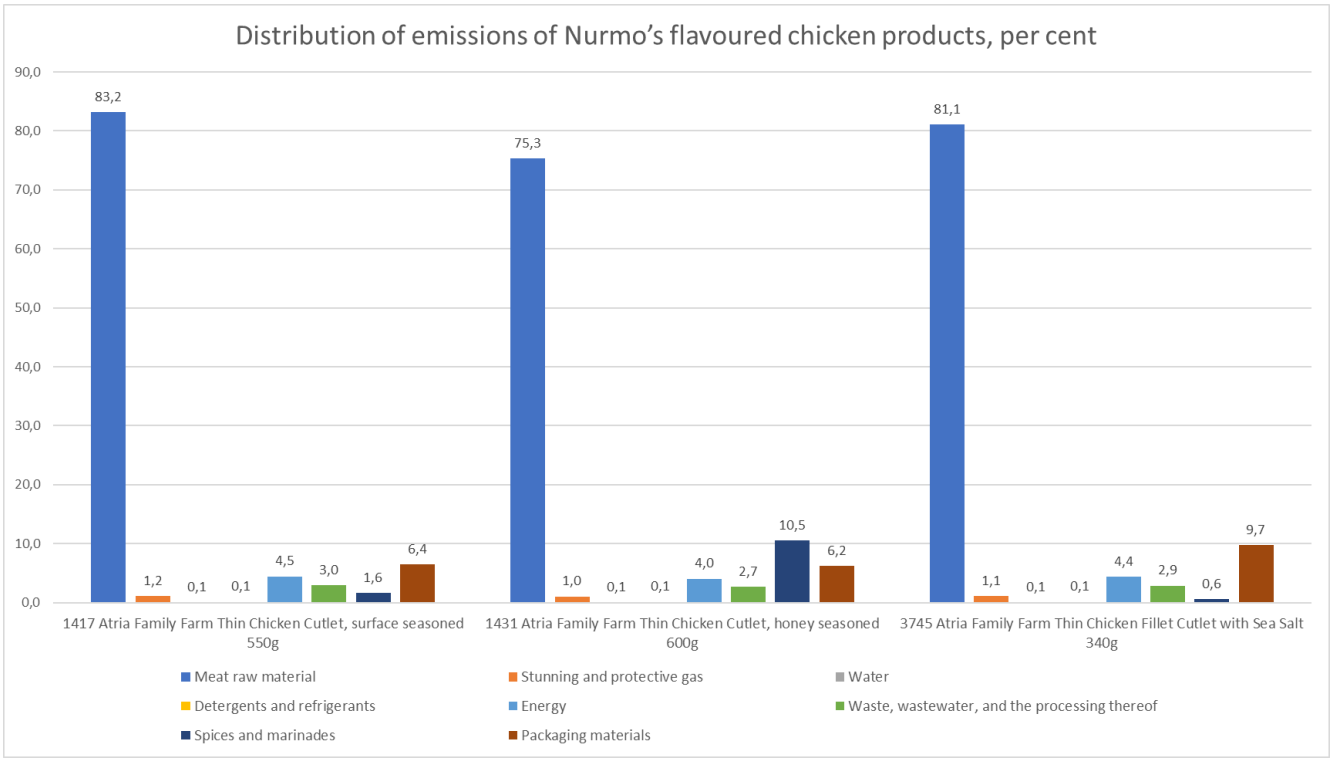

Figure 5. *Distribution of emissions of Nurmo's flavoured chicken products.*

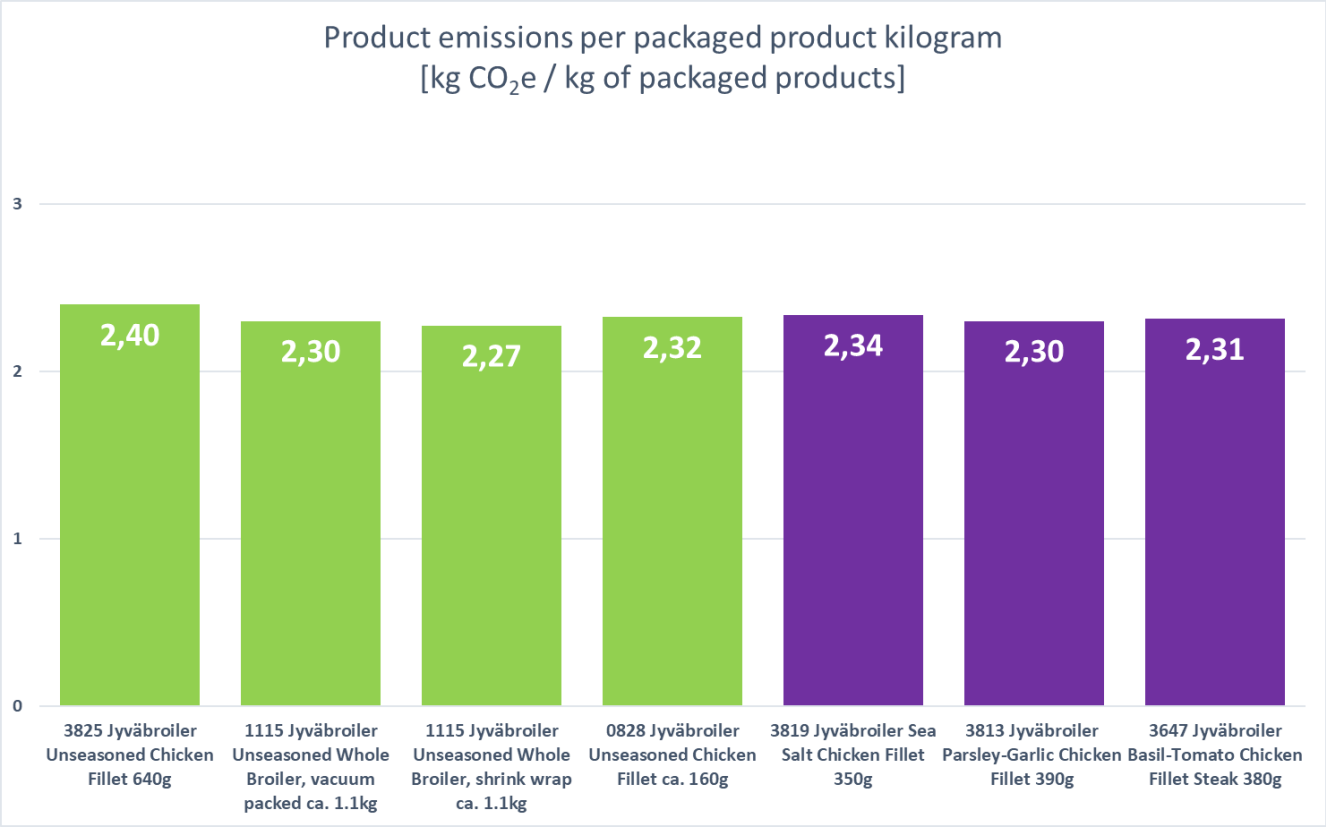

Figure 6. Carbon footprints (kg CO2e / kg) of Sahalahti's six chicken products. Product 1115 has been calculated with two different packaging materials.

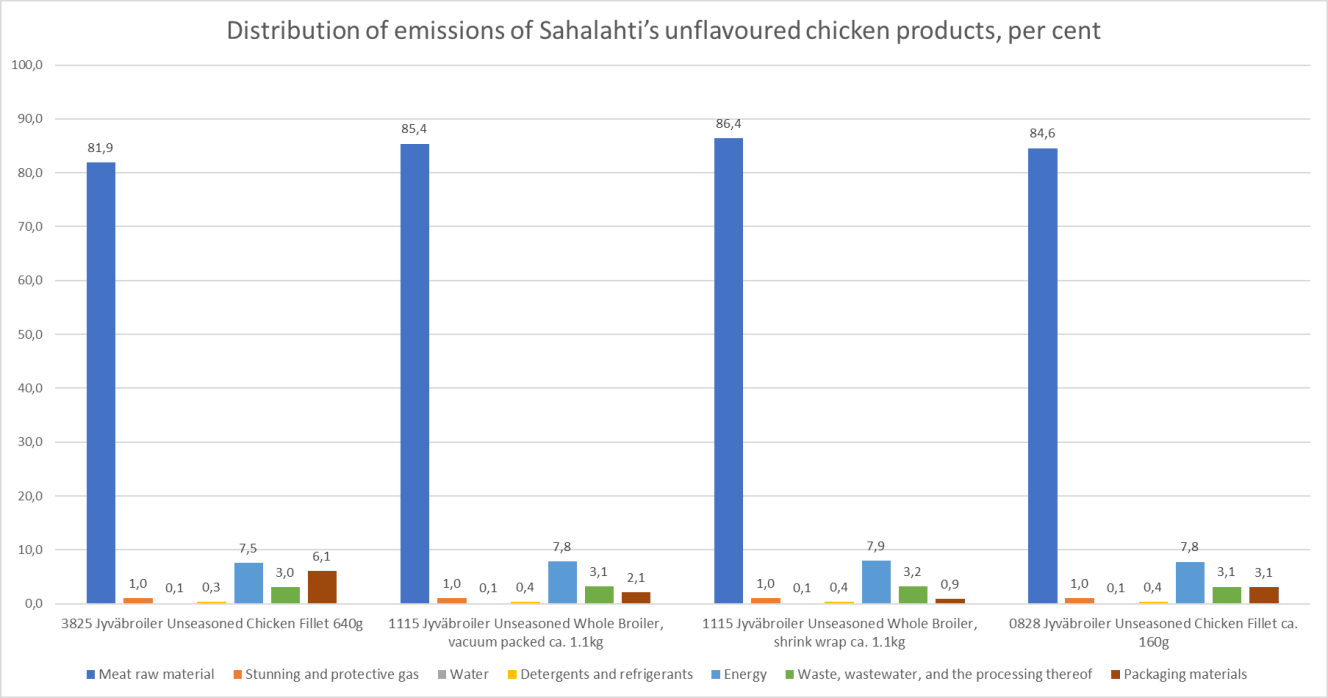

Figure 7. Distribution of emissions of Sahalahti's unflavoured chicken products.

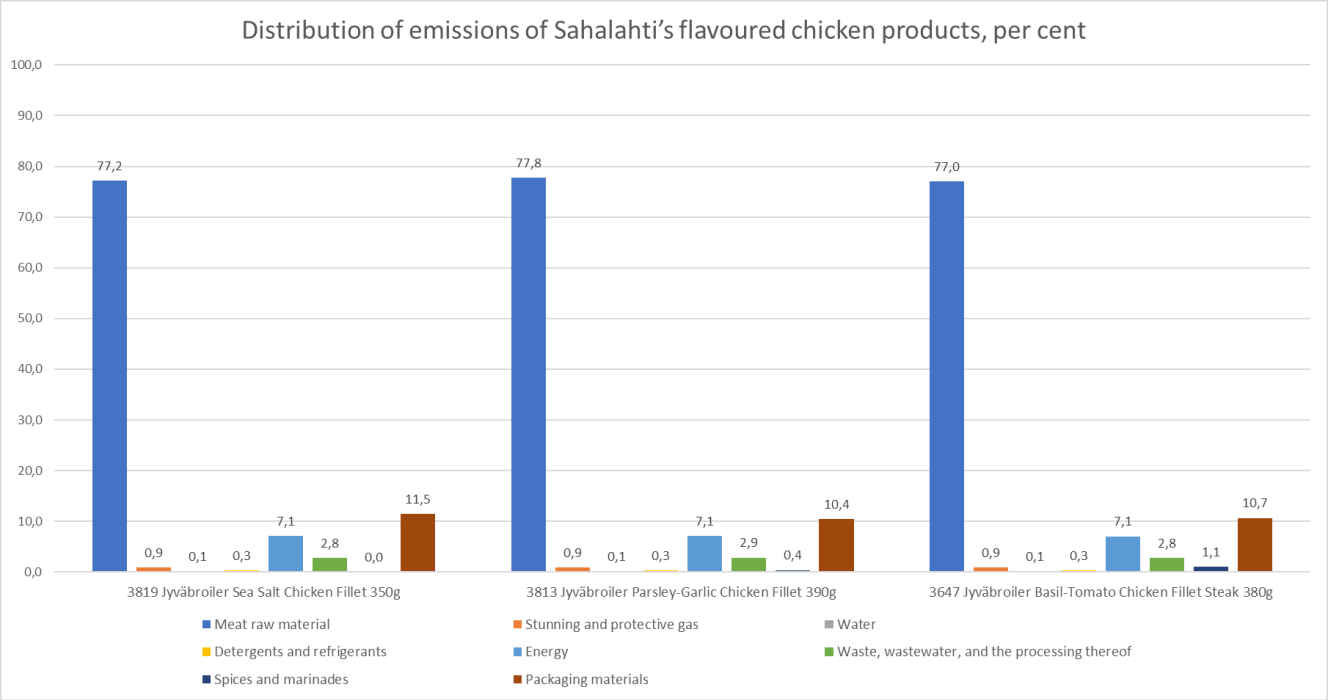

Figure 8. *Distribution of emissions of Sahalahti' flavoured chicken products.*