Anthesis summary report:

Sustainability evaluation of CKF fruit punnet packaging

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1 Background and scope

Plastics are known for their functional properties and low cost, which have led them to become a vital part of the packaging world. However, there is an increasing focus globally on the issue of waste plastic entering the environment, and particularly the marine environment. This has resulted in a general focus on plastic food and drink packaging as being a significant and very visible contributor to the problem.

There are alternative materials available which are apparently more eco-friendly for many food packaging applications, but the advantages of these need to be considered as a whole, taking account of various environmental impacts and their ability to protect the packaged product and avoiding food wastage. A single carbon footprint indicator is not sufficient for this comparison.

CKF is a major supplier of packaging to the food industry and offers pulp-based fruit punnets as an alternative to PET plastic packaging. One of CKF's larger customers has requested that CKF provide a sustainability evaluation of these two packaging material alternatives.

CKF therefore engaged Anthesis, in the international sustainability consultancy, to carry out **A focused sustainability evaluation.** The scope of this evaluation comprises quantitative and qualitative parts:

- A quantified carbon footprint assessment for each packaging type, and;
- Semi-quantitative assessment of other environmental impacts for each packaging type.

The fruit shelf-life characteristics for each kind of packaging are outside the scope of this evaluation, as there many other factors that can affect these.

2 Comparative carbon footprint

The results below represent a calculated carbon footprint of a CKF pulp-based punnet compared to a modelled PET punnet of the same dimensions. Cradle-to-grave impacts are accounted for, from upstream impacts of extraction of raw materials and packaging, to end-of-life.

Methodology

A cut-off lifecycle approach has been adopted for this study. This means that benefits associated with creation of recycled content are allocated to the system using that content, and using recycled materials in the studied system means lower impacts.

The study includes assessment of biogenic carbon. Biogenic carbon is carbon which is part of the natural carbon cycle (sometimes called the short-term carbon cycle). It refers to carbon that is taken up (or released) by plants. Some of this carbon is considered stored – when the product remains in landfill. In this approach biogenic carbon content of recycled materials is not considered stored.

Key assumptions are listed below:

- The PET punnet was modelled based on specifications of 135x114x43 mm, without a lid.
- Transportation of PET punnet was assumed to be a 1:1:1 split between the three routes provided.
- Recycling rates used are the current average UK rates for packaging: 71.4% for general packaging (used for the PET punnet), and 81.9% for paper and cartons.

Raw materials and manufacturing impacts for PET are calculated using average industry data. This assumes amorphous PET manufacture out of ethylene glycol and PTA, including:

- material and energy input
- waste
- air and water emissions.

Extrusion and thermoforming are the manufacturing phases considered. This includes:

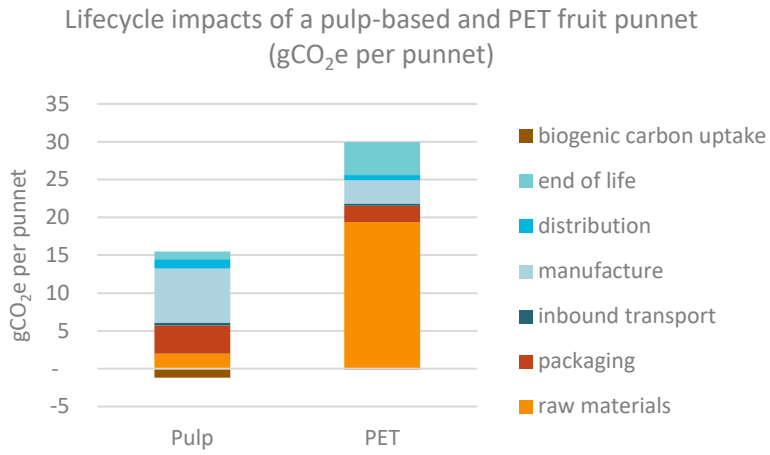
- water and energy consumptions
- required auxiliaries such like detergents and solvents
- production infrastructure - direct emissions to air (VOC)
- wastewater treatment of the used auxiliaries
- end of life of the production wastes incinerated and recycled externally.

Data sources

Pulp punnet raw materials, manufacturing and distribution data	Data provided by CKF for Product EC 2843, Moulded Pulp Punnet
PET punnet specifications	Coveris punnets catalogue 2018
Pulp and PET packaging material weights	Valipac 2017 industrial packaging weights overview
PET packaging transport routes	Data provided by CKF
Pulp and PET punnet end of life	UK Statistics on Waste 2018
PET manufacturing & raw materials data	Based on emissions factors from Ecoinvent 3.4. These factors are based on data provided across the industry.
Emissions factors	Ecoinvent 3.4 cutoff.

Results

The chart below shows the carbon footprint of the two punnet types in gCO_2e.



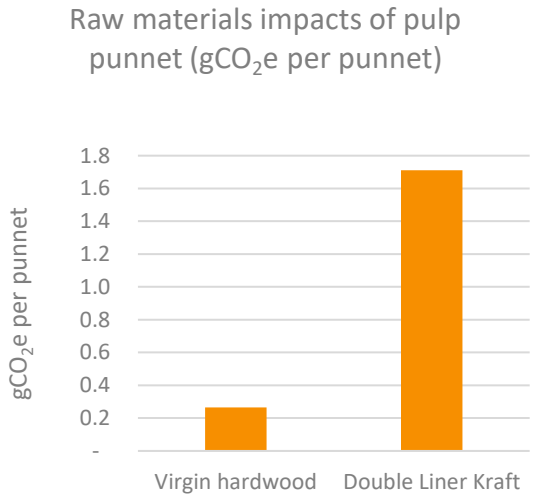
The raw material and manufacturing impacts are lower for the board-based punnet across every lifecycle stage, except for secondary packaging where the impacts are greater. This is mostly because fewer punnets can stack into a box, meaning more packaging is used per punnet.

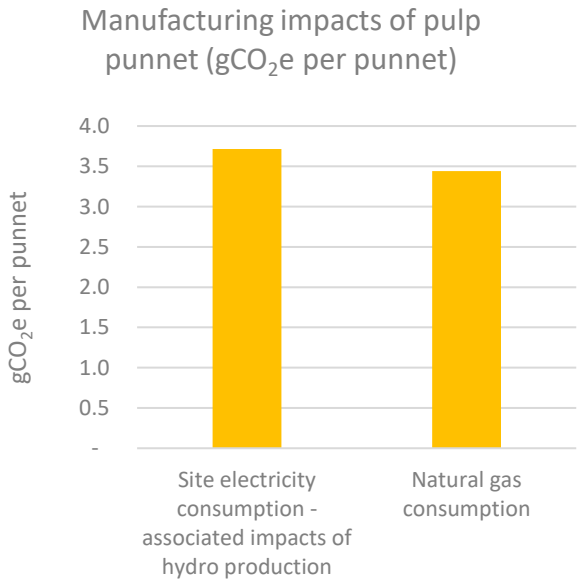
Natural gas consumption is an important contributor to the overall lifecycle impacts. There are also some impacts from the renewable hydro power used, attributable to the use of lubricants etc.

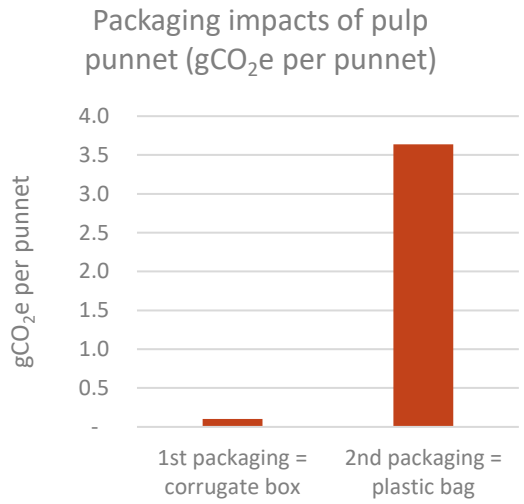
End-of-life impacts are minimised by the high recycling rates, although the impacts for plastic are higher because there is a greater burden on sorting.

Biogenic carbon is carbon which is part of the natural carbon cycle (sometimes called the short-term carbon cycle). It refers to carbon that is taken up (or released) by plants. Some of this carbon is considered stored – when the product remains in landfill. In this approach biogenic carbon content of recycled materials is not considered stored.

Pulp punnet impacts



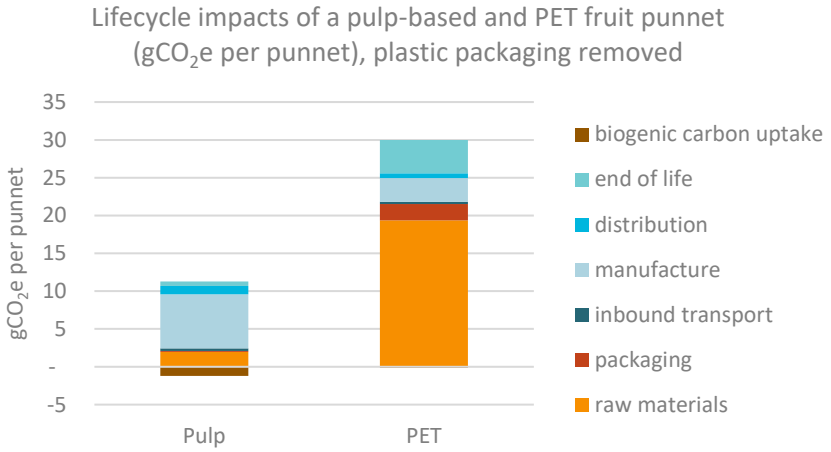




- **Raw material** impacts are dominated by the Double Liner Kraft, although this only makes up 20% of the mass of the pulp. Double Liner Kraft is made of corrugated lined board, which has a much higher impact per tonne than the pulpwood. The factor used to model this[1] includes the linerboard, fluting medium, inks and glue, even though 95% of the board used is recycled brown board.

- **Manufacturing** impacts are related to energy consumption. Impacts associated with hydro operation include emissions of methane, operation and maintenance activities and materials of the power plant, such as lubricating oil or mass of water passing through the turbines.

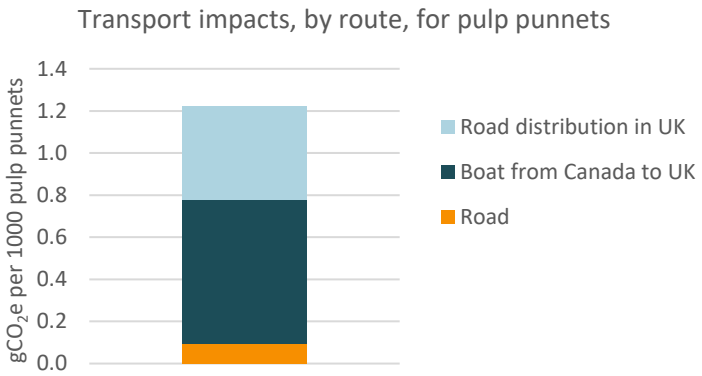
- The plastic bags are much more important than the boxes for **packaging**. A second scenario with the plastic packaging removed is below.



Removal of plastic packaging from the pulp-based punnet life cycle lowers the per-punnet impact from 14.7 gCO_2e per punnet to 10.7 gCO_2e per punnet.

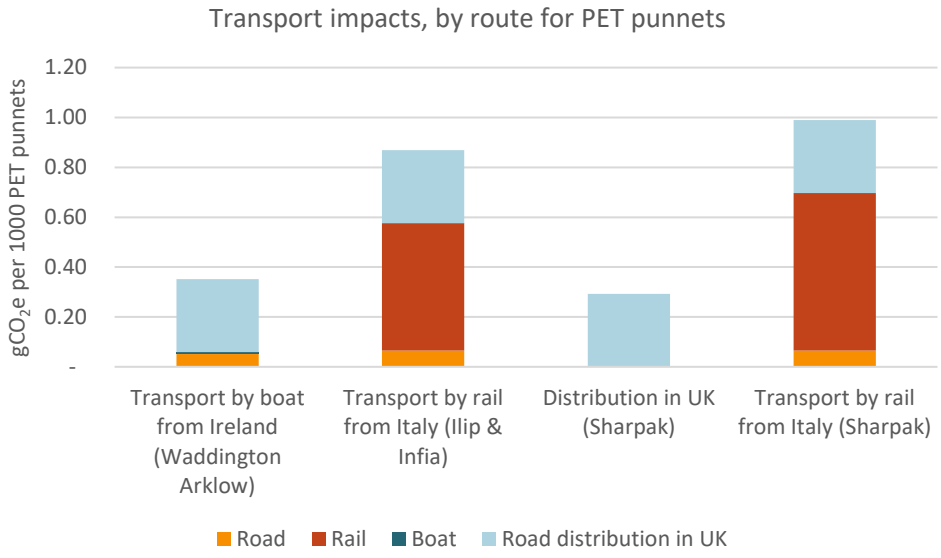
Transportation impacts are dominated by the longest-distance element, ocean shipping. Impacts are shown here for 1000 pulp punnets.

[1] corrugated board box production; kg; CA-QC; EI3.4 (Ecoinvent 3.4, 2017)



PET punnet impacts

- Raw material impacts are entirely associated with PET production. Punnets are assumed to be 70% rPET, and 30% virgin materials.
- Manufacturing involves extrusion of plastic sheets and thermoforming into punnets.
- Packaging impacts are based on a carton and a pallet, as well as a plastic bag liner. The pallet has a greater impact than the carton (per punnet), but overall packaging is not significant.
- Transport routes to the UK are modelled based on an assumed equal split between Arklow in Southern Ireland, Ilip & Infia in Italy, and Sharpak (UK and Italy). Transport impacts are small in comparison to other impacts. Impacts per route are shown below, per thousand punnets.



3 Focused sustainability evaluation

A focussed sustainability assessment was undertaken, using both quantitative methods where data is available and qualitative methods, to compare wider environmental impacts of a moulded pulp punnet with a standard PET punnet. This has focussed on key elements that differ between the two punnet types; raw materials and manufacturing process.

Qualitative assessment

A qualitative assessment has been made to develop a scoring for impact areas where quantitative scoring is less available. This was carried out through desk-based research.

Results

Results are presented in the table below. The score represents a score out of 10, which allows comparison between Pulp and PET impacts within that category. It is worth noting that the PET scores here are not based on particular PET manufacturers; average industry factors are assumed as per the ecoinvent dataset.

	Pulp	PET	Source
Deforestation	7	NA	Lexeme for REDD+; WWF & RSPB; WWF
Biodiversity	5	10	WWF, CBD, UN Global Compact, UNEP, WBCSD
Water consumption	6	8	WWF, UNEP
Waste	3	7	EAA, UNEP, PlasticsEurope
Water toxicity and pollution	4	10	Ecoinvent, WWF
Natural capital	3	10	UNEP, NCC

Impact area	Comments
Deforestation	One of the biggest drivers for deforestation globally is the wood and timber industry, which provides the feedstock for the pulp industry. However the Forest Stewardship Council (FSC) is considered by independent NGOs to be the most credible mainstream timber, pulp, and paper standard. No data found for direct impact of plastic on deforestation.
Biodiversity	Timber, **pulp** and paper industries are identified as one of the key drivers of biodiversity loss worldwide, and these are a priority commodity for WWF. Bad logging practices can lead to degradation of habitat. However, WWF notes that well-managed production in natural forests can potentially maintain many of the biodiversity values of a forest over time, and the FSC certification for pulp is regarded as having rigorous requirements on maintenance of High Conservation Values. Risks of **plastic** for marine biodiversity are considered high, as marine life is vulnerable to entanglement and ingestion of plastic.
Water consumption	Both punnets consume water in their upstream raw material impacts. Use of **pulpwood** from certified sources carries low physical water risks, though deforestation and illegal logging result in adverse impacts on the surrounding ecosystems and quality of water resources. Water is an important input to **plastics** production - notably from the fossil fuel supply chain, where water impacts can be significant.
Waste	**Plastics** are wasted at a high rate whereas **paper-based** products experience higher average recycling rates. Further, plastic is the most common type of marine litter.
Water toxicity and pollution	Water effluent from pulping mills can result in pollution and eutrophication of local waterways. Plastics pellets from the supply chain may enter the waste stream, as well as the downstream water pollution impacts of plastics.

Natural capital	**Pulp** industry negative impacts on natural capital are primarily in wastewater pollution. Significant pulp industry dependencies include: biodiversity, water provisioning, climate regulation (see NCC p. 44). **Plastics** industry impacts on natural capital are primarily in greenhouse gas emissions released upstream in the supply chain from the extraction of raw materials and manufacturing of plastic feedstock.

Quantitative assessment

The end-of-life indicators developed by Ecoinvent are a comparable set of metrics which have been applied to the materials and processes involved in the production of the two punnet types. They allow us to compare the relative impact in each area of interest. The units are an arbitrary score which has been scaled out of 10.

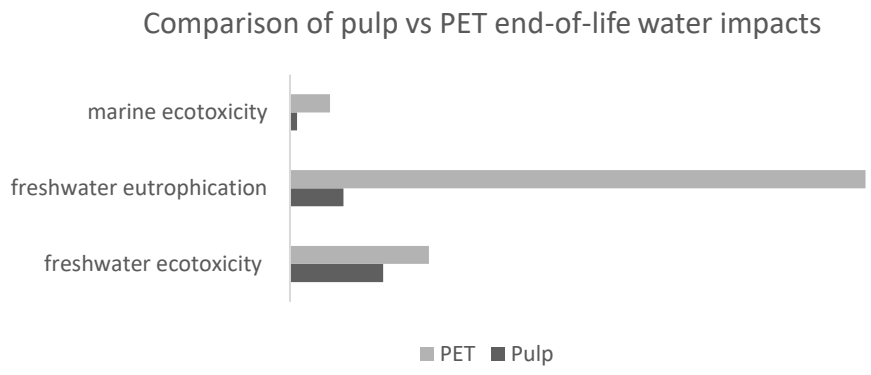
Results

As the table below shows, the two most significant impacts from the two punnets are in fossil depletion and climate change, where the PET punnet performs much less well.

Air quality is measured by particulate matter formation (this refers to PM10 and other airborne particles), and photochemical oxidant formation, which contributes to smog.

	Pulp	PET	Source
agricultural land occupation	1.85	0.42	Ecoinvent 3.4
natural land transformation	0.17	0.08	Ecoinvent 3.4
human toxicity	0.03	0.16	Ecoinvent 3.4
fossil depletion	3.3	10	Ecoinvent 3.4
particulate matter formation	0.25	1.55	Ecoinvent 3.4
photochemical oxidant formation	0	0.12	Ecoinvent 3.4
climate change	1.77	7.57	Ecoinvent 3.4
freshwater ecotoxicity	0.00014	0.00021	Ecoinvent 3.4
freshwater eutrophication	0.00008	0.00088	Ecoinvent 3.4
marine ecotoxicity	0.00001	0.00006	Ecoinvent 3.4

Water impacts of both punnet types are less important in terms of their overall environmental impacts, but a comparison between the two shows that the pulp punnet consistently performs better.



4 Conclusions

The results presented in the carbon footprint demonstrate a lower carbon footprint from the pulp-based punnet. However, impacts of packaging are not insignificant, primarily driven by the plastic bag which punnets are packaged in for distribution. Raw material impacts for the pulp punnet are heavily weighted towards the double liner Kraft used despite the fact that this makes up only 20% of the pulp mix.

The wider sustainability impacts of the pulp punnet presented, both qualitative and quantitative, also support the conclusion of better overall environmental performance of the pulp moulded punnet manufactured by CKF over a PET equivalent. Plastic risks are particularly relevant to impact on climate change and marine biodiversity. Despite water risks inherent in the high water consumption of the pulping industry, quantitative analysis of the overall water impacts of the two punnets shows that the fossil depletion, climate change impacts, and land occupation impacts are more significant globally on a per-punnet level.

5 References

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Appendix: Summary of scope and approach

The focused sustainability evaluation is designed to provide an evidence-based comparison of the two alternative packaging options, to support decision-making by customers and to enable communication of the impacts and benefits of each alternative. It is not intended as a substitute for a full LCA evaluation takes account of the major environmental impacts.

The evaluation compares two alternative standard fruit punnets, one PET based and the other pulp based, with the following components:

- Quantified Carbon footprint, using a database of GHG emission factors drawn from Ecoinvent and other sources
- Semi-qualitative scored assessment of other key environmental impacts, including:
    - water consumption
    - freshwater and marine pollution
    - airborne pollution
    - waste and pollution to land
    - use of natural capital
    - biodiversity impacts

The scoring is based on research and published information on these impact categories for these two packaging materials and Anthesis databases, and quantitative indicators are used where data is available.

The following data was used for the evaluation :

- Weight of punnets
- Supply source and location of materials
- Transportation data, including weight of material carried per truck from the supplier
- Available data on energy and water consumption used in processing of inputs to form the packaging material
- Energy and water consumption and waste resulting from manufacture of a punnet by CKF
- Estimated distances from CKF manufacturing to customer locations

Where specific primary data was not available, the Anthesis databases were used.