EUROPEAN
OUTDOOR
GROUP

Single Use Plastic Project

Industry Report

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Single Use Plastic Project

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1. Executive Summary

Introduction and Background

Started in 2018, The Single Use Plastics Project is an initiative of the European Outdoor Group with over 30 brands and retailers primarily from the outdoors industry. Participating organisations in the project work together to significantly reduce the impacts of their single use plastic packaging. The project was initiated by, and primarily designed to meet the needs of the business models found in the outdoor industry, and this narrowed scope has allowed the group to move more quickly towards testing and iteration while still operating at a large scale and including several interconnected organisations. Members of the project group researched the single use plastic footprint of their organisations and the industry and determined that overwhelmingly the largest proportion of single use plastics was found in protective garment poly bags, and as such our work has focused on this specific application of single use plastic packaging.

This report is a summation of the research which underpins the findings and recommendations of the project, highlights the results of the recycling trials undertaken during 2019, and summarises the feedback of consumers, recyclers, retailers and brands. Other outputs of the project include a Poly Bag Standards document for wider industry use (Appendix 1), a functioning poly bag collection and recycling network (based in Germany and the UK) and a product shipping tool for use by the project team. Our key recommendations for European Outdoor brands, retailers, and value chain participants are: 1) to proliferate and standardise best practices which reduce and eliminate poly bags, and 2) to produce bags deemed absolutely necessary from only 100% recycled plastic and then recapture the bags before they enter the municipal waste system and ensure their appropriate return to the resource stream.

The Project Team

A wide range of outdoor brands and retailers, from SMEs to large global groups, based across Europe were invited to be part of the project. All added contributions of time, resources, and expertise to the subject matter, and often provided the project management access to their facilities or systems in order to create a detailed mapping of the industry and the role that poly bags play.

Project Outcomes

Throughout 2019, research was undertaken to:

1. Quantify the scale of the problem
2. Review the ecological impacts of our plastic packaging against several material alternatives (see section 2. The Science)
3. Evaluate the end-of-life scenarios for our poly bags (see section 3. The Systems)

Towards the end of that year, a new system for managing our poly bags was tested and measured for impact.

Included in this report are references and data from multiple LCA's, adjacent studies, analogous examples, and quotes from experts. The material we present does not necessarily include the multitude of hours of discussion and dialogue with packaging experts, external industries, alternative materials providers, government bodies, adjacent projects, academics, solutions providers, and internal project members – all of which helped to guide and shape the direction and thinking of the project team.

Importantly, we learned that plastics do some things better than alternatives, and that during their production, transport, and use phases, they may have a superior ecological performance than initially thought. The life cycle assessments and impact comparisons we reviewed frequently agree that plastic is a superior packaging material in terms of ecological impact along almost every single segment of its lifecycle except at end of life. Alternative materials tend to shift rather than mitigate or even lessen environmental impacts, and often present new and increasingly problematic negative externalities which are equally difficult to control or eliminate. We also learned that in their end-of-life, plastic poly bags such as the ones used in our industry are particularly challenging, and the current data suggests the majority of recycled films still end up in landfills or incinerators[1].

For those reasons, we chose to directly target the systems and end-of-life problems associated with our poly bags, and many of the key outcomes we have explored still rely on **recycled plastic** as a substrate rather than any other alternative material.

Single use plastic is a systemic issue, not a materials issue

Within the Poly Bag Standards document, developed as part of this project, a new poly bag design is proposed. This is an improved version of conventional polyethylene polybags which allow for reduced impacts in manufacture and use, and enhances circularity. Polyethylene (virgin and recycled) is compatible with existing polyethylene film recycling technologies, is resource-efficient in terms of the small volume of material required to create a poly bag, and can leverage the existing systems used by product manufacturers and their supply chain partners. As such, one of the primary systems we tested has the potential to divert as much as 86% of used recycled plastic bags away from landfills or incinerators and back onto the recycled plastic market.

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Proposing the continued use of polyethylene for poly bags should not be considered as maintenance of the status quo. There is significant potential to reduce waste, decouple from fossil feedstocks, reduce greenhouse gas emissions and revolutionise the sustainability profile of poly bags when brands, retailers, warehouses, distribution centres and recyclers work collaboratively to capture and/or eliminate poly bags before they reach consumers, alongside using the maximum possible percentage of recycled materials to manufacture a fully-optimised poly bag design. We readily acknowledge that to some this might be viewed as insufficiently addressing the wider plastic problem. We do not claim that our outcomes are the solution or panacea to the plastic problem, but rather a very significant collective step in the right direction.

Project Deliverables

The project has produced the following key deliverables:

1. Poly bag recycling system - a brand and retailer collaboration removing poly bags before they enter a municipal system, and sending the bags to be recycled in a dedicated and controlled stream.
2. Industry poly bag standards - a guide of better and best design principles to be used in poly bags throughout the European outdoor industry. The standards include a prototype designed in collaboration with brands, retailers, 3PLs, and recyclers to meet needs of all stake holders without sacrificing optimum recyclability.

3. Product shipping matrix - a list of product lines organisations are able to ship without plastic along key segments of the value chain. Provides a network for assistance, and examples of success to further encourage widespread adoption.

Implementing a collaborative recycling stream

Optimising poly bags and creating standards

100%

Getting to 100% recycled plastic in poly bag manufacturing

Creating a matrix of products able to ship plastic-free

These focuses are interconnected and, we feel, represent a compelling unified step as an industry.

2. The Science

Life cycle analysis (**LCA**) is a method used to evaluate the environmental impact of a product through its lifecycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

Journal of Environmental Management, 2010[2]

Life cycle assessment (**LCA**) is a cradle-to-grate or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use.

Environmental Management, 2017[3]

What is a poly bag

First, to place context and scope around this report, it is essential to note that in our industry, the survey results from our project team in 2018 indicated that the largest proportion of single use plastics comes from our garment poly bags. The definition set out by the report developed by Fashion For Good and the Sustainable Apparel Coalition describes these bags as, "A clear, typically low-density polyethylene (LDPE) based plastic bag which protects a garment, during transit from manufacturing sites to distribution centres and onwards to retail stores and consumers' homes (through ecommerce)." Notably, this excludes poly bag mailers used for shipping products as well as peripheral plastic packaging implementations sometimes found on products such as hang tags, strapping, kimbles, etc. All of these were deemed out of scope as they were found to be a very small proportion of the value chain's single use plastic with highly accessible and suitable alternatives already available in the market.

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For more information on what a poly bag is, see report by **Fashion for Good**[4] .

Research and Measurement Methodology

By narrowing the scope of the project to focus directly on garment poly bags, we were also able to begin researching the environmental impacts of our current materials in circulation versus several proposed alternate materials. Where possible, we used Life Cycle Assessments to evaluate and compare the impacts of plastic and alternatives, and we supplemented this research by consulting experts, academics, scientific articles, and adjacent studies. To understand why we have evaluated the particular LCA's, reports, and whitepapers detailed in this report, it is beneficial to chart how the project has evolved from its inception and through its development.

Our first objective was to bring together several organisations from across the industry that would represent the broader value chain. Rather than working in isolation, together we could evaluate potential poly bag alternatives and their ramifications up- and down-stream. We sought to challenge the functions and purposes of the poly bag and explore alternative materials or elimination strategies.

1 – bring everyone together
2 – research the problem
3 – narrow in on potential alternatives, test, and iterate

Given the predominant narrative around plastic packaging, and its tactile and precursory relationship to the products it protects, it is worth putting the environmental impact of garment poly bags into context. The environmental footprint of the poly bag is extremely insignificant when compared to the product it is protecting - an early H&M report[5] indicates packaging as a whole only represents 5% of a product's impact, Kering group's 2019 EP&L figures[6] peg packaging as 1.2% of product environmental costs, and data from HIGG suggests similar figures for our product mix. Direct feedback from a small number of EOG members gave us an overview of what proportion packaging has on the overall carbon footprint of their products. This data, although varied[7], mirrored the wider figures, with brands providing data on poly bag packaging only, combined packaging (polybags and cardboard), and where appropriate their exclusion of poly bags. Overall, we surmised that the impact of packaging depends on the type of product (e.g. hardgoods or apparel), product weight (e.g. leather boots vs. lightweight t-shirt) and the packaging material (cardboard vs. poly bag) and that, within our industry, packaging accounts for <1% - 7% of the carbon footprint (Figure 1). Despite these figures, with regards to the garment poly bags used in the outdoor industry, the predominant end of life scenario is a landfill, an incinerator, and in extremely rare cases the natural environment, and these issues are significant and worth tackling.

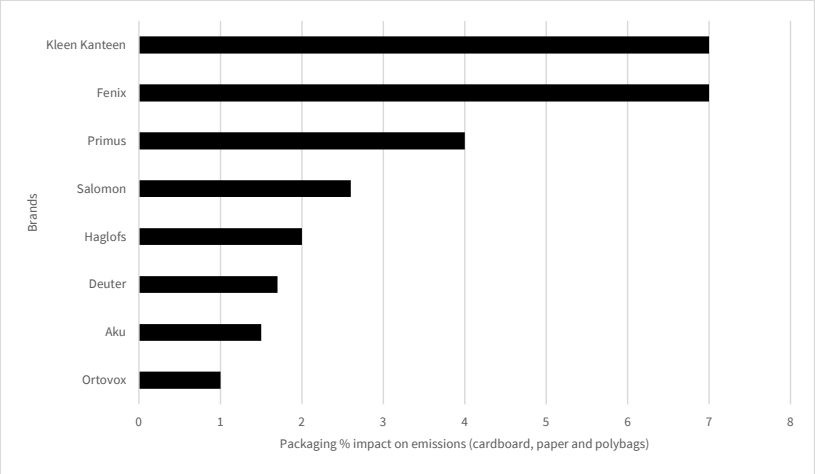

FIGURE 1 - PACKAGING % IMPACT ON EMISSIONS

We initially sought to remove single use poly bags entirely from the value chain, from manufacturing facilities predominantly in Asia to distribution and retail locations across Europe. Initial tests indicated that this frequently results in substantial product loss, as reported by Patagonia[8] following a trial wherein 30% of garments going through their shipping system without a polybag were damaged, rendering them unsellable. When the product represents such a significant environmental cost, any damage to products quickly offsets the minute gains from poly bag elimination efforts. The least sustainable packaging is the one in which the product is damaged.

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These tests, and our own research visiting multiple distribution centres across Europe, highlighted the very real need for product protection; in transit to protect products from dust and moisture; in warehouses to protect products from damage during transport and storage; in distribution centres and retail outlets to preserve product cleanliness on handling. Currently, there remains a necessity to continue using protective packaging in circumstances where the environmental conditions cannot be controlled, facilities cannot ensure reliable passage, or for particular product lines which are more prone to damage or discolouration (Figure 2).

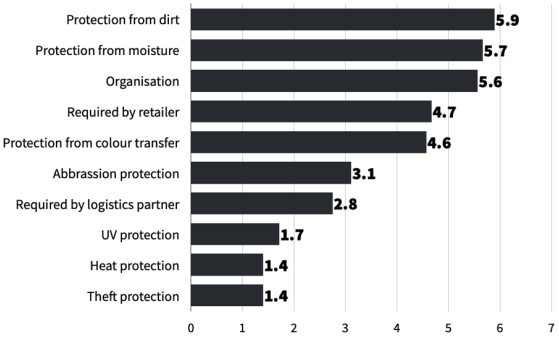


FIGURE 2 – PRODUCT PROTECTION REQUIREMENTS

Following this feedback, the EOG collaborated with the **Sustainable Packaging Coalition, The Retail Industry Leaders Association** and **Fashion for Good** and, as detailed in the report[9], this feedback on the necessity for, and requirements of, polybags was confirmed (Figure 3).

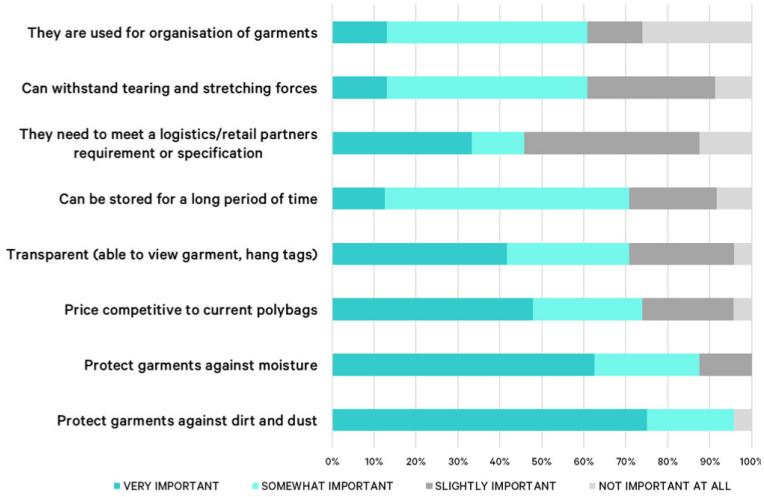


FIGURE 3 - IMPORTANT CHARACTERISTICS OF POLYBAG PACKAGING

Sustainability concerns associated with plastic packaging are well documented and present in many of the concerns brought forward by end user of our products. The project initially turned to the burgeoning alternative material innovations, and the possibility of substituting the material most commonly used to create single use plastics. The potential to replace oil-based polymers with an alternative material was investigated and research was undertaken to determine the viability of several of the existing options including bio-based, bio-degradable, compostable, pro-degradable, soluble, etc.

The outcomes and impacts of the alternative materials, as analysed in the LCA's, was not as initially anticipated. Although there are benefits to using paper or cotton packaging in terms of littering or human toxicity, in comparison to traditional plastic packaging, the overall consensus on the use of plastic alternatives is that there are not clear net environmental benefits from substitution. This is especially evident in terms of the production stages as well as end-of-life treatment which can also be problematic. These material alternatives are not a panacea and can frequently be a step in the wrong direction in terms of ecological impact.

"In many cases plastics are actually better for the environment than the alternatives. It is surprising until you look closely at it."
Susan Selke, Director of the School of Packaging, Michigan State University[10]

Plastic and alternative materials

Plastics, that is thermoplastic polymers, are made from the fossil fuel petroleum and include polymers such as Polyethylene Terephthalate (PET), Polyethylene (PE) and Polypropylene (PP), with low density polyethylene (LDPE) being the material most commonly used for transparent flexible poly bags used in the outdoor industry. In the LCA's reviewed for this report, a range of materials used for (shopping or protective) bags were assessed for their sustainability and durability, including polyethylene, cotton, paper and various bioplastics. For an overview of the materials referenced in the LCA's, see table 1.

Bioplastics (or biosynthetics, or bio-based plastics) is an umbrella term for materials which are either based on biological matter, are biodegradable, or feature both properties, and there is a huge variety of materials available, all with differing raw material sources, properties, and end-of-life options.

Not all bio-based plastics are biodegradable, and not all biodegradable plastics are bio-based. And even biodegradable plastics might not biodegrade in every environment.
Anja Krieger, GreenBiz[11]

As bioplastics are still emerging materials, there is a lack of cohesion across the industry on how to quantify their end-of-life environmental properties. In Table 1, both biodegradability and compostability are included, however the Sustainable Packaging Coalition[12] counter the concept of biodegradability as a meaningful sustainability attribute, believing that "compostability is the only attribute that conveys environmental benefits derived from biodegradation" and acknowledge that compostability depends on the design[13] of the package.

Absent from this table is recycled conventional plastics, as these materials were not listed within any of the LCA's which are referenced in this report, however it is important to note that the conventional plastics listed are capable of being recycled within most existing municipal recycling streams and/or using conventional recycling equipment and technologies.

Conventional plastics				
Low Density Polyethylene (LDPE)		Derived from fossil fuels, low strength-to-density ratio, commonly used for polybags, film	Non-biodegradable / compostable	Recyclable
High Density Polyethylene (HDPE)		Derived from fossil fuels, high strength-to-density ratio, commonly used for grocery bags, detergent bottles	Non-biodegradable / compostable	Recyclable
Bioplastics[14]				
Bio-based PE, PP or PET		Materials made/partly from renewable resources such as bioethanol, chemically identical to conventional plastics	Non-biodegradable / compostable	Limited recyclability[15]
Polylactic Acid (PLA), (PHA), (PBS) **Starch blends**		Materials (partly) derived from biomass e.g., corn, sugarcane, or cellulose, or thermo-plastically modified starch and biodegradable polymer blends	Biodegradable / Compostable under specific industrial environmental conditions	Limited recyclability
PBAT, PCL		Biodegradable random copolymer plastics based on fossil resources	Biodegradable, Compostable	Non-recyclable
Natural materials				
Cotton		Typically woven from 100% cotton and designed to be reused multiple times.	Biodegradable	Recyclable
Paper		Produced by mechanically and/or chemically processing cellulose fibres derived from wood, rags,	Biodegradable	Recyclable

		grasses or other vegetable sources.		

TABLE 1 COMMON PACKAGING MATERIALS ASSESSED IN LCA'S

Apart from their measured ecological impact using the common markers measured by the LCA, we also used the following points of discussion to assess or understand alternative material proposals in context of their broader or systemic impacts:

- **Scalability** - Does the material represent an actual global solution, or can it only meet the demands of a few organisations or specific regions? What type of infrastructure will need to exist in order to produce the material and what does the timeline look like to deploy? How much existing capital expenditure would be rendered obsolete if implemented?
- **Feedstock** - Are we pulling from waste sources or from agriculture that could/should be used as farmable land? Are there substantial considerations to be made with regards to introducing agriculture into the supply chain of poly bags? At scale, and if deployed across other industries following our material decisions, what negative externalities could manifest from switching poly bags to this new material?
- **Microplastics** - In instances of biodegradability or solubility claims, does the material fragment into smaller, equally challenging pieces, or does it degrade into base components in a timely manner?
- **Claims of biodegradability/compostability -** Is the material certified, what does the certification mean, is it tested outside of a laboratory, has there been any third-party verification of claims? What do experts and academics say about the real-world performance of these materials?
- **Hazardous to recycling systems** - What happens if the material is introduced into a municipal recycling stream? Does it damage the adjacent plastics en-route to become a resource? Is it obvious to the end user that it should not be recycled? Does the material require a consumer behavioural change, and is the substrate material change sufficient to compel those behavioural changes?
- **Waste mindset** - Are we actually contributing to solving the root issue, or merely addressing the symptoms of a larger problem? Do we perpetuate the culture of waste? Are we assuming accountability for the proper care of the bags or continuing to pass that responsibility to the end user?

These further discussion topics were used in tandem with the life cycle assessments outlined below as a further filter for our considerations of alternative materials.

The problems with alternatives to plastic

LCAs of traditional vs. alternative single use and reusable shopping bag materials were evaluated for this report as they most closely reflected the use and type of material the project was centred around. They share similar production means, substrate material compounds, and end of life treatments. There is recognition that there has been some discussion over the validity of comparing bioplastics with traditional plastics using LCA methodologies[16], and this has been taken into consideration within the findings of many of the LCA's cited.

A meta-analysis of seven LCA's, carried out by **The United Nations Environment Programme**[17], indicated that whilst "Biodegradable bags decompose and contribute less to the impacts of littering, compared to conventional SUPBs; however, the LCA results indicate they might be the worst option when it comes to climate impacts, acidification, eutrophication, and toxic emissions". The study found that, although the single use plastic bag (SUPB) fared poorly in terms of littering and microplastic shedding, the environmental benefits of the starch-based (biodegradable) bag did not exceed those of the conventional SUPB, as the method of producing fossil-based co-polyesters has a significant climate impact and the waste bags produce methane when degrading in landfills. A similar conclusion was drawn for conventional HDPE bags with a prodegradant additive (oxo-biodegradable) in comparison with conventional SUPB, whereby the improvement in littering was countered with the lack of plastic degradation in landfills and the effects of the prodegradant on the recycling process. This report also concluded that paper bags performed poorly in comparison to fossil-based single use bags in terms of climate change, eutrophication and abiotic resource depletion, and that they might only perform comparably against heavy single use bags, or if they were

produced in renewable energy powered efficient mills, reused several times, or recycled at their end-of-life. Similarly cotton bags would need to be reused 100+ times in order to make it environmentally competitive to single use plastic bags (Table 2).

		Bags considered in study				
		Single-use HDPE bag	**Reusable LDPE bag**	**Paper bag**	**Biodegradable bag (1 use)**	**PP (20 uses)**
Indicators	Climate Change					
	Acidification					
	Eutrophication					
	Photochemical ozone creation (POCP)					
	Abiotic Resource Depletion (ADP)					
	Water use					
	Littering potential					

Performance key	
	Best
	Better
	Worse

TABLE 2 - SUMMARY TABLE FOR CIVANCIK-USLU ET AL. (2019)

"The SUPB (single use plastic bag) is a poor option in terms of litter on land, marine litter and microplastics, but it scores well in other environmental impact categories, such as climate change, acidification, eutrophication, water use and land use"
The United Nations Environment Programme

An **Environment Agency, UK**[18] report on carrier bags reached similar conclusions in relation to starch-polyester blend bags, stating that they "have a higher global warming potential and abiotic depletion than conventional polymer bags, due both to the increased weight of material in a bag and higher material production impacts". The study also found that when using an HDPE bag with prodegradant additives, environmental impacts (such as global warming potential, abiotic depletion, and marine aquatic ecotoxicity) were higher than those of the conventional HDPE bag, additionally noting that these types of bags should not be recycled as they can damage or reduce the quality of the plastics with which they are being recycled. The reuse LDPE bags was highlighted as a potential solution to reducing the global warming potential in comparison to HDPE bags, and the manufacturing geographies of LDPE contributed to lower acidification and aquatic ecotoxicity performance. The report concluded that paper bags would need to be reused 4 or more times in order to compare favourably to fossil-based HDPE bags, due in part to the effect of paper production on human toxicity and terrestrial ecotoxicity, which brings to mind issues of durability. Despite the high number of reuses of the cotton bags, they were found to have a greater environmental impact compared to the LDPE bag in terms of global warming potential, acidification, eutrophication, human toxicity, ecotoxicity and oxidation as a result of the energy used to spin cotton yarn and the chemicals/fertilisers used to grow the plant (Figure 4).

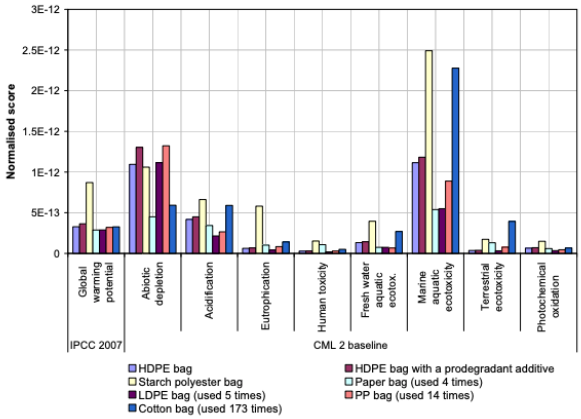


FIGURE 4- THE NORMALISED RESULTS OF THE IMPACT ASSESSMENT WHEN THE IPCC 2007 AND CML 2 BASELINE METHODS WERE USED.

"The conventional HDPE bag had the lowest environmental impacts of the lightweight bags in eight of the nine impact categories. The bag performed well because it was the lightest bag considered. The lifecycle impact of the bag was dictated by raw material extraction and bag production..."
Environment Agency, UK

Carrefour[19], the French retailer, commissioned a study assessing shopping bags from which it was deduced that "Paper carrier bags have a bigger environmental impact than lightweight plastic bags in all categories apart from risk of litter." (Table 3[20]). The results score the materials against the disposable HDPE bag, which is scored 1.0 as a reference. When considering the environmental impacts of water consumption, greenhouse gas emission, atmospheric acidification, eutrophication and solid waste generation, the paper bag and the biodegradable bag performed worse than the disposable polyethylene (HDPE) bag. In this study, the majority of environmental impacts are generated during the raw material extraction and manufacturing process (e.g. fossil fuel extraction and refining, paper manufacture), followed by the end-of-life treatments of the bags, with the bag manufacture and transport impacts having a negligible effect[21].

	HDPE (virgin polymer)	**Reusable LDPE (virgin polymer)**				**Recycled fibre**	**Starch-based**
Indicator	**Disposable PE bag**	**Used 2x**	**Used 4x**	**Used 5x**	**Used 20x**	**Paper bag (single use)**	**Biodeg-radable bag**
Consumption of non-renewable energy	1	1.8	0.9	0.7	0.2	1.0	0.9
Water consumption	1	1.6	0.8	0.7	0.2	3.3	1.0
Greenhouse gas emission	1	1.6	0.8	0.7	0.2	1.9	1.4
Atmospheric acidification	1	1.8	0.9	0.7	0.2	1.8	1.6
Formation of photochemical oxidants	1	0.9	0.4	0.3	0.1	0.9	0.4
Eutrophication	1	1.8	0.9	0.7	0.2	12	11
Solid waste generation	1	1.7	0.8	0.7	0.2	1.8	1.1
Relative risk of abandonment of used bags	Strong	Medium low			Low	Medium-Low	

Legend	
	At least 20% poorer performance compared to disposable PE bag
	At least 20% better performance compared to disposable PE bag
n	Number of uses of shopping bags

TABLE 3 - RELATIVE PERFORMANCES OF THE BAGS STUDIED (FRENCH CONTEXT OF WASTE TREATMENT)[22]

"The disposable PE bag is therefore rather better than paper and biodegradable bags on most indicators, except for the risk of abandonment which is the main weakness of this bag"
Carrefour[23]

In common with the above LCA's, and particularly those specifically related to shopping bags, The 2017 **Danish Environmental Protection Agency**[24] cradle-to-grave study of grocery carrier bags concluded that "In general with regards to production and disposal, LDPE carrier bags, which are the bags that are always available for purchase in Danish supermarkets, are the carriers providing the overall lowest environmental impacts for most environmental indicators". This conclusion was based on their findings that ranked the LDPE bags as showing the lowest impacts over paper, polypropylene (PP) and composite bags in environmental indicators such as ozone depletion, acidification and ecosystem toxicity. The results of this study scored unbleached paper and LDPE bags as having the lowest impacts in terms of climate change, human toxicity (cancer effects) and fossil resource depletion, when compared to the alternative bag materials, with the paper performing better than LDPE in terms of climate change regardless of end-of-life treatment (reuse or incineration). The LDPE bag scored the lowest on 8 other environmental impacts, with the heavier reusable bags (made from polyester, polypropylene, recycled polyester, composite and cotton) providing the highest climate change impacts and the organic cotton bag providing the highest impacts overall. Although not included in Table 4, results presented for recycled LDPE bags presented lower emissions than for those made from virgin material.

Environmental indicator	Carrier bags providing lowest impacts
Climate change	Paper unbleached, biopolymer, LDPE
Ozone depletion	LDPE
Human toxicity, cancer effects	Paper unbleached, LDPE
Human toxicity, non-cancer effects	Composite, PP, LDPE
Photochemical ozone formation	LDPE
Ionizing radiation	LDPE
Particulate matter	LDPE
Terrestrial acidification	LDPE
Terrestrial eutrophication	LDPE
Freshwater eutrophication	LDPE
Marine eutrophication	PP, LDPE
Ecosystem toxicity	LDPE
Resource depletion, fossil	Paper unbleached, LDPE
Resource depletion, abiotic	PP, LDPE
Water resource depletion	LDPE, biopolymer

TABLE 4 - CARRIER BAGS PROVIDING THE LOWEST ENVIRONMENTAL IMPACTS FOR ALL THE ENVIRONMENTAL INDICATORS CONSIDERED. THE ORDER IN WHICH THE BAGS ARE LISTED CORRESPONDS TO THE RAKING OF THEIR LCA RESULTS STARTING FROM THE LOWEST IMPACT. ONLY THE THREE LOWEST SCORING BAGS ARE LISTED.

"In general with regards to production and disposal, LDPE carrier bags, which are the bags that are always available for purchase in Danish supermarkets, are the carriers providing the over-all lowest environmental impacts for most environmental indicators."
The Danish Environmental Protection Agency

The investigation to determine whether bio-based materials were more environmentally friendly in comparison to plastics, conducted by academic researchers **Khoo, Tan and Chng**[25] in 2010, arrived at the conclusion that "Although bio-based products have been mostly regarded as a sustainable solution for replacing petroleum-based polymers, in most cases, the amounts of resources and energy required to produce them have not been taken into account...The main issue lies in reducing the energy used in the life cycle production of the bio-material from crops". Their data showed that the bio-bag had greater impacts in terms of photochemical ozone, eutrophication and global warming potential than conventional plastic bags, and that the type of energy used in production significantly affects the environmental impact of material production, citing a 69% increase in production impacts on making bio-bags compared to polypropylene bags, and a 5-fold increase when using coal-power, whilst also noting that bio-bags are more environmentally friendly than polypropylene bags when clean renewable energy is used (Figure 5). At their end-of-life, the highest impacts were generated by land-filled bio-bags, followed by bio-bag incineration and least impactful was bio-bag composting, but for all materials their end-of-life impacts were only a fraction of their production impacts.

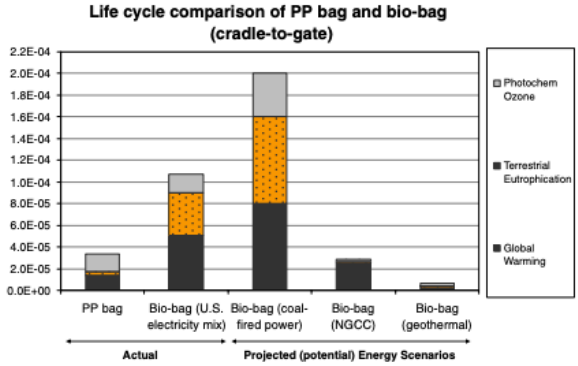


FIGURE 5 – FINAL NORMALIZED AND WEIGHTED IMPACT RESULTS

"It was concluded that the life cycle production of bio-bags can only be considered as environmentally friendly alternatives to conventional plastic bags if clean energy sources are supplied throughout its production processes."
Khoo, Tan, Chng

As well as the LCAs listed above, relevant research reports and scientific articles which assessed both the environmental credentials of bioplastics, and their end-of-life performance, were critically evaluated in order to inform our decision on how best to proceed.

The biodegradability, or otherwise, of bio-derived polymers is deemed insignificant according to the 2019 **WRAP**[26] report which commented on potential issues in the recycling bio-based plastics, concluding that "Any plastic however derived (bio or petroleum), that is manufactured/ altered in order to degrade at end of life could present a significant problem to conventional plastic recyclers." This is at odds with the recent increase in plastic packaging collection for recycling (in the UK) and the benefits associated with recycling plastic, such as avoiding oil extraction and refining which accounts for over 95% of energy used in plastic manufacture.

Concerns regarding numerous aspects of bioerodable bags, including recycling, shelf-life and storage, were outlined by the **Scottish Executive**[27] whose report state that, in terms of recycling, although conventional bags such as HDPE and LDPE can be recycled into new products, there is an issue if they are mixed with bioerodable bags (for composting) as they contaminate the recyclate, lowering the functional properties of the recycled materials.

"Bioerodable bags are designed to decompose through the action of sunlight, water, stress and, ultimately, the enzymatic action of microbes in an aerobic environment. Where degradable bags are simply disposed of alongside other 'household waste' and then landfilled (like most household waste in Scotland [SEPA]), then the necessary conditions to allow degradation may well be absent and thus the environmental 'benefits' lost."
Scottish Executive

A report by **KPMG**[28] in 2019 highlighted the issues raised around growing plants used for bioplastics (e.g., corn) and questioned whether the associated pollution caused by fertilisers, or the diversion of land use away from food production, was acceptable. It also touched upon the issue of disposal, citing that unless sufficient intense heat is available "the bioplastics won't degrade in a meaningful timeframe. If they end up in marine environments, they will have exactly the same harmful effects as petroleum-based plastic".

A group of leading scientists from **EASAC**[29] (the association of the National Academies of the EU Member states, Norway and Switzerland) see limited potential for bio-degradable plastic alternatives due to their actual, rather than theoretical

recyclability, as well as their somewhat misleading name whereby "'bio' does not equate to reduced environmental impact since alternative feedstocks to fossil fuels can be associated with high greenhouse gas emissions, competition with land for food, or driving land use change."

When comparing the environmental footprint of conventional plastics and other materials, a **Northern Ireland Assembly**[30] report stated that "It takes more than four times as much energy to manufacture a paper bag as it does to manufacture a plastic bag. For paper bag production, forests must be cut down (trees are absorbers of greenhouse gases) and then the subsequent manufacturing of bags produces greenhouse gases". The report commented on the use of toxic chemicals to produce paper, leading to air and water pollution, stating that paper bags generate significantly more air and water pollutants than plastic bags. Due to the increase thickness of cotton bags, in comparison to plastic bags, there would be an expected 80-fold increase in transport vehicles required to transport the same number of products, contributing proportionally to the amount of fuel used and greenhouse gas emitted. The report also highlighted the benefits of recycling polyethylene, including the reduction in energy consumption, sulphur and nitrous oxide gas production, water consumption and carbon dioxide generated.

"Research demonstrates that paper in landfills does not degrade or break down at a substantially faster rate than plastic does. In fact, nothing completely degrades in modern landfills because of the lack of water, light, oxygen and other important elements that are necessary for the degradation process to be completed."
Northern Ireland Assembly

The alternative materials analysed in the LCA's referenced are not the only ones being used currently to create packaging. Glassine paper, made from wood pulp, has formerly been used for food products and archival materials, but is now being used for apparel products by brands such as Asket[31], who have used this material to replace PE poly bags. This material can be derived from renewable sources (i.e., FSC certified materials) and be mixed with standard cardboard/paper for recycling at EOL. A few key limiting factors still under consideration are the substantial production impacts from the processing of the paper fibres, the ability of the material to adequately protect product over a trans-Asiatic supply chain or through more humid and wet conditions, and the decentralised retailer standards around bag transparency. Production impacts could be offset by purchasing from suppliers linked into renewable energy sources, but these options are still highly inaccessible in Asia. Brands with manufacturing in Europe, fewer or no 3rd party retailers, and sufficient quantities to meet MOQs would most immediately benefit from the potential gains seen in glassine paper. Deployment of this material as a global resolution to the single use plastic poly bag is still less tenable given the dearth of infrastructure to support reducing its production footprint, unknown performance along the trans-Asiatic shipping rails, and lack of wider retailer capabilities to support semi-transparent material applications in their distribution centres.

Conclusion

Although we continue to maintain that plastic substitutes should be explored and deployed in certain applications, we did not find the research to indicate that this was the case for single use plastic poly bags in the outdoor industry at this time. In fact, we found that our initial position of sourcing an alternative material to be misaligned with the predominant findings within the research community, the LCA's, reports, and scientific articles reviewed. Subject matter experts seem to agree that the problem is not simply plastic as a material, but systemic in nature.

The overriding finding from the LCAs was that, although there were some environmental benefits to bio-based materials in terms of reduced littering potential and biodegradability under specific environmental conditions, these alternatives could also be problematic and are not an adequate solution nor are we wholly confident in their declared benefits. Their wider deployment may be a step in the wrong direction, particularly when taking in to account their inability to be recycled when inadvertently mixed with conventional plastics. In fact, according to the New Plastic Economy Oxo Statement[32], over 150 organisations across the globe have called for the banning of oxo-degradable packaging worldwide as, according to the signatories "...compelling evidence suggests that oxo-degradable plastics take longer than claimed to degrade and that they fragment into small pieces which contribute to microplastics pollution."

In the Sustainable Packaging Coalition's 2015 position paper[33], they also outlined their stance against biodegradability (prodegradant) additives for petroleum-based plastics, finding "these additives do not offer any sustainability advantage and

they may actually result in more environmental harm" given that they do not enable compostability, have an adverse effect on recycling, promote the concept of 'litter friendly' material, and that biodegradation of oil-based materials releases carbon into the atmosphere. And in a 2016 report compiled for the European Commission DG Environment[34] on the impact of oxo-degradable plastic concluded that "The evidence suggests that PAC [Pro-oxidant Additive Containing] plastic is not suitable for any form of composting or Anaerobic Digestion process and will not meet current standards for packaging recoverable through composting in the EU (EN 13432)" due to the slower degradation timeframe of these materials being incompatible with industrial composting.

"We feel strongly that the most ideal end-of-life scenario for petroleum-based plastics is recycling. There are ample opportunities for the sustainable usage of petroleum-based plastics, and we need solutions that help realize those opportunities. Unfortunately, biodegradability additives are not one of them."
Sustainable Packaging Coalition

Aside from bioplastics, paper and cotton were commonly assessed as alternative for plastic bags. There is a general perception that paper is better than plastic, however the environmental impacts of paper production are well established in terms of deforestation[35] and the water resources required to make paper, making it a less sustainable option than commonly assumed. The pulp and paper industries produce nitrogen oxides, sulphur oxides (which contribute to acid rain) and carbon dioxide (greenhouse gas), whilst during paper production harmful wastewater may be discharged from mills, potentially polluting the water. When not recycled, paper and cardboard is either sent to landfill or for incineration, it is subsequently broken down, and methane (a greenhouse gas) is produced, and even during the recycling process, the removal of ink generates chemical emissions, as does the bleaching of wood pulp.

Cotton is an especially challenging substitute for single use plastic polybags, given that an uncoated 100% fabric would fail to meet all of the required performance requirements (e.g. moisture protection) and the addition of a waterproof coating would increase the weight of the product, the price per bag, and affect the biodegradability at the end-of-life. Cotton is a water resource intensive material to cultivate, with the growing of cotton accounting for 69% of the water footprint of textile fibre production (1kg requires 10,000-20,000 litres)[36] and it is often grown in countries already facing water stress. Cultivating cotton also requires the use of pesticides and fertilisers which are at risk of leaching into water and soils, causing problems for humans and animals, and can lead to soil degradation and erosion alongside the loss of forests and other habitats.

"Growing cotton uses 18% of pesticide 25% of total insecticide worldwide"
Greenpeace[37]

The production of cotton is responsible for the emission of 220 million tonnes of carbon dioxide annually[38] and although organic cotton has a lower environmental impact, there are associated higher costs which outdoor brands would need to factor in to pricing. Although cotton fibre is naturally biodegrable, according to the LCA's, packaging made from cotton would need to be reused several hundred times to make its impacts comparable to reused or recycled LDPE packaging.

The key finding of our research indicates that, when compared to a variety of materials against a range of environmental indicators, plastic is the preferred material choice when considering the lifecycle of a material. More specifically, given the potential to:

- Reduce the use and extraction of raw fossil resources to make virgin plastic
- Reduce the energy consumption and greenhouse gas emission involved in producing recycled plastic (compared to the extraction, refinement and manufacture of virgin plastic)[39]
- Reduce the amount of plastic waste sent to landfill or incineration
- Meet the needs of a circular economy

Recycled plastic is therefore our current preferred material.

"Using 30% recycled content in PE films has been <u>estimated</u> to reduce energy consumption by a quarter and reduce greenhouse gas emissions by over a third during manufacturing."
Sustainable Packaging Coalition

"It is not as simple as 'plastic is bad' so let's use something else. It will require a complete change in the way we use product packaging at the moment. Most packaging is now used just once and thrown away. We need to move away from that."
Eliot Whittington, University of Cambridge's Institute for Sustainability Leadership[40]

"Plastic, as a material, isn't the enemy. ...is just one example of a well-thought solution that isn't just looking to replace one product with another. It is an attempt at changing a system. When it comes to plastic, I believe the solution will come from doing as CupClub does: tackling the whole journey of plastic pollution rather than just the product.
Deniz Gülsöken, Forbes[41]

"Biodegradable" plastic doesn't do what you think it does. Your paper or metal straw takes only a tiny sip at the problem of plastic pollution. And your supposedly eco-conscious cloth grocery bag is more damaging to the environment than conventional plastic bags—unless you reuse it literally thousands of times. In other words, many of our ideas about plastic and the environment are confused. And that may be getting in the way of the fight against global warming.
Wade Roush, Scientific American[42]

"Householders continue to see plastic as wicked and paper based goods as benign. But when considered over the entire life of the packaging, paper and cardboard embody far more greenhouse gases than their plastic equivalents"
Carbon Commentary, The Guardian[43]

"Biodegradable, oxo-biodegradable and conventional plastic formulations remained functional as carrier bags after being in the soil or the marine environment for over three years."
Alan Williams, University of Plymouth[44]

"It treats the symptoms, not the disease," he says. "If the disease is our throw-away society, making packaging biodegradable only encourages people to throw more away."
Anthony Ryan, University of Sheffield[45]

"Generally, recycling things is a good thing to do because you recapture the value of the material and you incorporate it into new products again."
Ashley J. Holding, LimeLoop[46]

"Industrial composting may add additional cost and transportation dimensions to the disposal of compostable products that make composting more comparable to a landfilling scenario which may further decrease any GWP benefits that were achieved."
Hottle et. al

"Since significant benefits are shown from recycling plastic films, additional resources should be dedicated to improving the overall recycling rate. There are still technical barriers for film recycling. Tailored equipment is needed for films recycling. However, to make the equipment investment economically variable, sufficient volume of plastic film waste is required. This requires the cooperation of multiple stakeholders."
Hou et al

"The ideal target of a plastic which breaks down naturally in the environment remains elusive since most applications of plastics require durability. It is a basic premise that a material which can degrade in the environment should not degrade during its shelf life. There are only a limited number of products which can meet biodegradation tests in the marine environment and even those still maintain their integrity for months, during which time the risks of entanglement and ingestion remain."
Anne-Christine Albertsson of the Swedish Academy, The European Academies of Science

3. The Systems

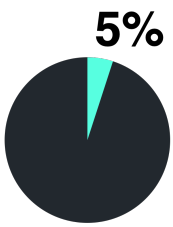
To be viable, plastic should and can be designed for recycling and, importantly, be mechanically recycled wherever that is possible.
Breaking the Plastic Wave, The Pew Charitable Trusts and SYSTEMIQ[47]

The case for recycling plastic film

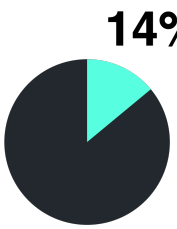
The reality of the current plastic recycling landscape is sobering. After a short first-use cycle, 95% of plastic packaging material value, or $80–120 billion annually, is lost to the economy[48]. A staggering 32% of plastic packaging escapes collection systems, generating significant economic costs by reducing the productivity of vital natural systems such as the ocean and clogging urban infrastructure. In the UK, a quarter of consumer plastic packaging is flexible films, however only 6%[49] of this is currently recycled due to issues with collection, sorting and recycling technologies. The cost of such after-use externalities for plastic packaging, plus the cost associated with greenhouse gas emissions from its production, is conservatively estimated at $40 billion annually – exceeding the plastic packaging industry's profit pool.

2x

Most recycled plastics are only recycled only once or twice before final disposal.



Material value retained for use as further materials due to costs of sorting and reprocessing.



Estimated plastic packaging globally ***collected*** for recycling.

Sources[50] [51]

Commented [DT3]: First caption repeats 'only'

An LCA by **Hou et al**[52] on the end-of-life treatments for plastic film waste surmised that there are significant advantages in recycling materials. The study assessed the environmental impacts of sending plastic films to landfill, incineration and the recycling of mixed and sorted waste, concluding that the main environmental benefit gained from the recycling of plastics is due to the reduction in use of virgin plastic materials. Additionally, the recycling of mixed or sorted waste delivers greater benefits in terms of eutrophication, water intake than incineration or landfill, as shown in Figure 6 (wherein positive values indicate an environmental burden and negative values denote an environmental benefit).

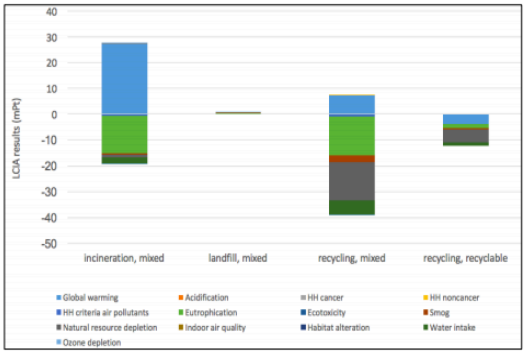


FIGURE 6 – ENVIRONMENTAL IMPACTS OF DIFFERENT PLASTIC FILM END-OF-LIFE TREATMENT SCENARIOS

In this study greater environmental benefit was attributed to the recycling of mixed waste, as compared to sorted waste, due to the higher mass fraction of plastic films in (standard post-consumer) mixed waste compared to sorted film waste which is not commonly collected. Were there to be a system wherein plastic film could be separated from other plastic waste prior to collection and/or recycling, the environmental benefits of recycling will be vastly improved.

These results are backed up by the **Sustainable Packaging Coalition**[53] who state that "Glass, aluminium, steel, and plastic production processes typically incur lower greenhouse gas emissions when recycled feedstocks are used instead of virgin feedstocks, owing to the fact that the recycling systems that produce those recycled feedstocks are less carbon-intensive than conventional raw material extraction processes and/or the manufacturing processes are less carbon-intensive when recycled feedstocks are used." They also acknowledge, however, that plastic film reprocessing can be complex, due to the different technologies available (dry or wet processing) and how they affect the end market for the films, and the need to develop new specifications for each batch of recycled PE content on account of the different melt indexes of HDPE, LDPE and LLDPE which may all be present even in a pre-sorted PE film stream and require different processing considerations.

The problem is plastics' end-of-life

Research and life cycle assessments indicate that from a materials perspective, the primary issue is not plastics themselves, but rather what happens with plastics once we are done using them. As we sought to follow our own plastic poly bags to their terminus, we discovered several systemic issues that increasingly view the bags as waste rather than a potential resource. This is partly a consequence of the drive to minimise production costs by choosing the lowest cost option rather than the most sustainable - and in the case of polybags, plastic is the cheapest material. This then leads users along the supply chain to devalue the polybags made from this material, right the way through warehousing, distribution and retailers, to the consumer who receives it.

To further investigate this, we reached out to members of the Single Use Plastic project group and asked them to contact their recyclers directly and question them on the issues they face when recycling materials from the outdoor industries. Their feedback indicates that without significant intervention, plastic packaging in the outdoor industry is nearly always given over to municipal waste collectors, where it will end up almost entirely in a landfill or an incinerator; very little evidence supports the notion that poly bags used in the outdoor industry end up the natural environment. We view all of these end-of-life options as unsustainable, overly linear, and contributory to the wider environmental crisis.

"Incinerators are giant furnaces for burning waste, and they cause air pollution, noise, smells, litter and traffic as waste is trucked in and smoke pours from the chimneys. Some also goes into landfill, where it can leach toxic chemicals into the environment."
Greenpeace

In our view, the only correct usage of plastic is one where we avoid pulling from virgin sources, use the bag as efficiently and as many times as possible, and upon reach its terminus it is verifiably returned to the resource stream (Figure 7).

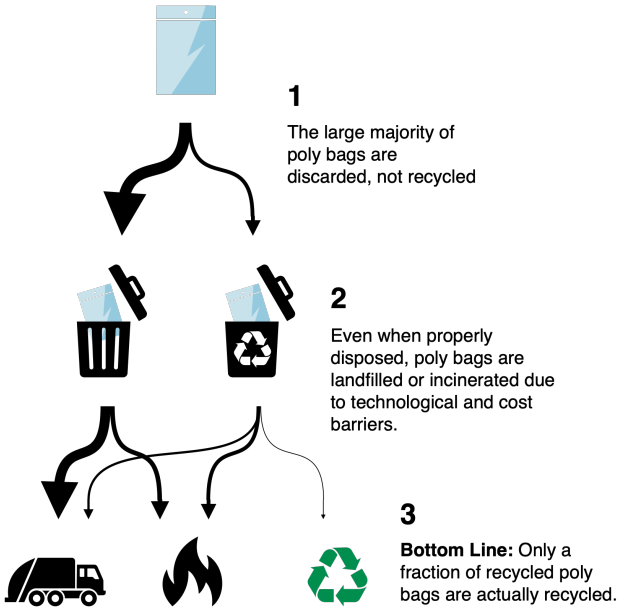


FIGURE 7 – END OF LIFE ROUTE OF OUR POLYBAGS

The realities of our plastics' end-of-life point to larger problems with an overdependence upon municipal waste management, and this is a major problem. The technology and infrastructure to mechanically recycle the plastic film used in our poly bags is widespread, relatively inexpensive, and highly efficient. But the costs of sorting and cleaning our film from a municipal waste stream is untenably prohibitive, meaning that MRFs (material recycling facilities) often treat film as waste. When sent en-masse to a municipal waste facility, sorting, cleaning, and extracting value from plastic film quickly becomes economically untenable.

Traditionally, plastic packaging has been designed with functionality and marketing display in mind, while its end-of-life management has been disregarded.
RecyClass[54]

Casepak[55], a UK-based MRF, commented on recycling plastic bags, saying that "When these thin plastic films enter a conventional materials recycling facility (MRF), they can seriously harm the efficient operation of plant and machinery. The composition of films and their high tensile strength means that such materials can quickly become wrapped or tangled around moving or revolving machinery". Even a small percentage of unwanted plastic film can potentially affect the efficient running of recycling operations - requiring the use of costly and time-intensive hand-sorting at beginning of the process and potentially affecting the quality of the recycled material produced. In the instance of Casepak, "each tonne of material contains approximately 1.95% of unwanted plastic film contaminant. While that figure may seem small, it has a huge impact on operations. As a result, we have had to employ a series of counter-measures to mitigate contamination at the MRF. At the start of the sorting process, plastic film is handpicked out of the recycling stream. While the additional labour is costly, particularly as the recovered film is of little value, it is vital to remove such material as early as possible." Added to these technical issues is the fact that there is huge variation both within, and between, countries on how they are able to deal with thin-film plastic waste. With reference to the UK system specifically, Casepak makes the point that "The UK also needs more advanced secondary market infrastructure in place to deal with hard-to-recycle items such as plastic film. Some supermarkets do offer film and plastic bag recycling at their stores, and widespread adoption of such schemes should be encouraged to help reduce the volume of plastic film entering the recycling stream."

Flexible packaging is also considered to be one of the "most problematic waste streams" according to **Municipal Waste Europe** given that it is sometimes multi-layered, lightweight and frequently not recyclable. Their position paper[56] on the EU Strategy on Plastics in a Circular Economy recognises that "Plastic waste causes difficulties to resource and waste management as there are problems with lifespan, repairability, reusability and recyclability which need to be addressed, particularly with packaging, due to the diversity in plastic packaging materials and the number of plastic packages entering the waste stream on a daily basis."

Collection is not recycling…and without the appropriate technology at the appropriate capacity, to recover the materials from flexible packaging, recycling targets and a circular economy for this material will not be achievable.
Vanya Veras, Municipal Waste Europe[57]

The **OECD**[58] recognised the barriers to plastics recycling as being economic, technical, environmental and regulatory. The economic issues faced including the vulnerable markets for recycled plastics, and the relatively high costs of collecting, sorting and processing waste plastics due to; the widely distributed and diverse nature of sources of plastic waste; the costly and difficult separation of polymer types at recycling plants; and the contamination of post-consumer plastic. In terms of technical barriers, the inconsistent collection systems for waste, waste contamination, problematic additives and problems arising from the presence of biodegradable plastics in the waste stream were noted.

The **European Environment Agency**[59] agree that "Another issue is that the quality of materials collected for recycling can vary, meaning that recycling plants cannot count on streamlined inputs of materials with a specific quality. Recyclers cannot count either on pan-European end-of-waste criteria for all recyclables. The combination of these factors explains the weak demand for some recyclables from processing and recycling plants." This issue, when combined with the barrier of low market prices for virgin raw materials and the complex composition of some waste products, it is unsurprising that the reuse and recovery of waste materials is challenging when left to the municipal facilities to identify, sort, and reprocess.

An unfortunate side-effect of this waste of resources is that frequently our plastic waste is shipped thousands of miles to Asia or other developing nations to be dealt with. In 2016, the EU exported about 1.4 million tonnes of plastic waste to China[60] and, until 2018 when China introduced its National Sword policy, which prohibited 24 types of waste from entering the country, China was still the main trade partner for plastic waste. That ban led to other countries, such as Malaysia, Turkey and Indonesia, being the main receivers of EU plastic waste exports, however they have pushed back against this by implementing similar bans.

"It's really a complete myth when people say that we're recycling our plastics. It all sounded good. 'It's going to be recycled in China!' I hate to break it to everyone, but these places are routinely dumping massive amounts of [that] plastic and burning it on open fires."
Jim Puckett, Basel Action Network[61]

A 2021 **Greenpeace** report highlights how the UK export of plastic waste to Turkey resulted in "plastics dumped in rivers, on beaches and in illegal waste mountains", prompting Turkey to announce that most plastic waste imports will be banned in June 2021, leaving Europe with little choice but to start dealing effectively with its own waste.

Figures from **Plastics Recyclers Europe** indicated that "Roughly 10.000 trucks of plastic waste leave Europe every day. This waste is then exported to developing countries and processed without quality standards and under poor conditions. Developing countries provide a high supply of cheap labour force, ergo plastic waste is exported rather than processed by the European recyclers." This has the effect of limiting the expansion of the European plastics recycling market and their suggestion is that by limiting exports, Europe's dependency on imports of natural resources would consequently be decreased.

Similarly, a report from the **European Environment Agency**[62] estimated that "In early 2019, the EU exported around 150.000 tonnes of plastic waste per month. This figure was about twice as high in 2015 and 2016 - up to 300.000 tons monthly - when exports went to China and Hong Kong primarily. Import restrictions are the reason for the decrease and shift in exports of plastic waste to other countries in Asia." The report suggests that this lack of recycling infrastructure is one of the reasons that the EU's capacity to reuse, recycle and recover its plastic waste is still not yet fully realised.

Each European municipality has a different way of collecting post-consumer waste and, in the UK, different councils have differing guidelines on which plastics can be recycled, causing confusion for consumers.

"In the UK, recycling rates have stagnated in recent years, while National Sword and funding cuts have led to more waste being burned in incinerators and energy-from-waste plants... Westminster council sent 82% of all household waste – including that put in recycling bins – for incineration in 2017/18."
Oliver Franklin-Wallis, The Guardian[63]

In the **CEFLEX** (A Circular Economy for Flexible Packaging) Designing for a Circular Economy Guidelines[64] they state that "Today (2020), only two-thirds of European countries collect flexible packaging with other dry recyclables despite approximately 70-80% of all consumer flexible packaging being reported as mono-material polyolefin- based materials which can be readily identified, sorted and recycled" indicating that there exist significant barriers to the collection and recycling of post-consumer plastic materials. Their solution, as set out in their position paper[65] is that "A well functioning collection system for recycling flexible packaging requires the collaboration of industry, legislators, local authorities and consumers."

Plastic Recyclers Europe have identified a number of challenges related to the recycling of plastic materials, particularly that the "Unstandardized and unharmonized collection and sorting schemes across Europe pose a problem when it comes to supplies delivered to and by the recyclers. These fluctuations impede the recyclers' ability to provide the market with the required constant supply of recyclates with homogenous quality level." They suggest that issues such as these can be overcome by creating a strong secondary raw materials market, developing a fully functional and transparent market for recyclates to improve the collection and recycling rates, eventually reducing Europe's dependency on imports.

The disconnect between municipal solid waste (MSW) streams and the preferred end-of-life scenario is highlighted in a **McKinsey**[66] report, which states that **"**Recyclers' dependence on industrial sources suggests that the flow from MSW (the largest stream of plastic waste) to the recycling industry is not yet working well. A range of reasons could help explain why this might be the case, including lower feedstock quality or higher contamination compared to industrial plastic waste, as well as existing alternative waste treatment routes with less complexity, such as waste-to-energy or incineration." Their proposed solutions to this problem include improving the collection and sorting of feedstock to improve the quality of the input material, creating a common marketplace for raw materials and recyclates to increase supply and demand for recyclers.

Legislative considerations

The above opinions and research on the complexities and barriers related to plastics, and plastic film, recycling point to the need for a wholesale improvement in the waste management stream. Progress is being made; however, it is slow due to the fragmented nature of the waste collection and recycling network across Europe and the individual legislative procedures in place within different countries and regions.

There are at present efforts underway at a **European Parliament and Council** level to address the end-of-life of plastic materials, as set out in Directive (EU) 2019/904[67] wherein they propose that specific legal frameworks are created in order to address and reduce the "significant negative environmental, health and economic impact of certain plastic products" including the introduction of "extended producer responsibility schemes to cover the necessary costs of waste management and clean-up of litter" specifically related to single-use plastic products.

"The European Strategy for Plastics is a step towards establishing a circular economy in which the design and production of plastics and plastic products fully respect re-use, repair and recycling needs and in which more sustainable materials are developed and promoted.
European Parliament and Council

Whilst in the UK, the **HM Government Strategy for England**[68] "will contribute to the delivery of five strategic ambitions to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025" by prioritising the use of resource efficient product/packaging design and reforming the Packaging Waste Regulations to ensure the production of recyclable packaging, incentivise the reduction of difficult to recycle packaging, and increase the recycling of packaging back into the same or similar products.

Additionally, in the UK, the **UK Plastics Pact**[69] is a collaborative initiative to create a circular system (for post-consumer waste) that keeps plastic in the economy and out of the natural environment. Led by the charity WRAP and set up in partnership with the Ellen MacArthur Foundation, it is a coalition whose members cover the entire plastics value chain and its ambitious targets for its members by 2025 include the elimination of problematic or unnecessary single use plastic and the use of 100% reusable, recyclable or compostable packaging, alongside targets on plastic recycling rates and minimum recycled content of plastic packaging. The group has created a separate work stream specifically for films and, as of May 2021, has issued guidance for supermarket retailers allowing them to collect and recycle a greater range of plastic bags and product wrappers through the promotion of in-store recycling.

That these high-level strategies, legislations and initiatives exist demonstrates the need for more harmonised waste management systems across Europe, as the recycling industry is primed for significant opportunities when connected directly to producers.

Conclusion

In light of the research and legislative directives emerging across Europe, we view our most immediate and pressing work as improving or supplanting the systems which fail to move our poly bags back into the resource stream. Our focus is to create poly bag standards which improve the recoverability of the packaging, and then facilitate the collation and direct delivery of poly bags to recyclers. The subsequent segment of this report explores the efforts and pilots deployed by the Single Use Plastics Project as they explore potential actions for targeting the largest proportions of single use plastic poly bags in the outdoors industry. These initiatives were undertaken while acting within the legitimate understanding of the systems and materials research noted to this point by the report.

"The issue we see, is that plastic is problematic at its end of life. This is caused by a variety of reasons. The bags end primarily at retail stores and with consumers, and in both situations the only option is to dispose of the plastic using local municipal waste systems. These systems often cannot process, or do not process plastic films owing to the economics."
Faye Flam, Bloomberg Opinion[70]

"Some councils have debated giving up recycling altogether. And yet the UK is a successful recycling nation: 45.7% of all household waste is classed as recycled (although that number indicates only that it is sent for recycling, not where it ends up. In the US, that figure is 25.8%."
Oliver Franklin-Wallis, The Guardian[71]

"Plastic film and bags are among the most frequent causes of contamination. Each of these items jeopardises the percentage of material the recycling sector can recover, as contaminated batches are frequently rejected or need to be resorted."
Lee Bradbury, Recycling & Waste World[72]

"So we've got these companies producing this new packaging and new materials and new plastics in such a scientific- and business-driven way, and then [they] rely on the disjointed network that is recycling to get it back. And [recycling] is not robust."
Keefe Harrison, NPR[73]

"To reduce plastic pollution, action should be taken in line with the waste management hierarchy...and the circular economy approach..., to minimize plastic waste generation first of all, improve the state of solid waste collection services, strengthen the recycling industry and ensure safe disposal of waste to controlled landfills."
United Nations Environment Programme

"Flexible plastic represents a quarter of all UK consumer plastic packaging, but only 6% is currently recycled. Complex challenges underpin this: poor design, collection infrastructure, inconsistent communications, sorting challenges, reprocessing technology, capacity, and unstable end markets."
WRAP

"Ultimately, there is no single, one- size-fits-all solution to the plastics issue. Governments, businesses, and individuals all play major roles in exploring data-driven pathways for improving how we manage the plastics economy."
Rachel Meidel, Rice University's Baker Institute for Public Policy[74]

"A reduction of plastic production— through elimination, the expansion of consumer reuse options, or new delivery models—is the most attractive solution from environmental, economic, and social perspectives. It offers the biggest reduction in plastic pollution, often represents a net savings, and provides the highest mitigation opportunity in GHG emissions."
The Pew Charitable Trusts and SYSTEMIQ

"Strategic partnerships that increase the length of contracts between MRFs, recycled plastic recyclers, converters, and brand owners can be used to negotiate stable, lower prices on recycled content."
Sustainable Packaging Coalition

"Each European collector has his/her own rules and requirements to sell the waste to recyclers. These varying standards make it very hard for recyclers to comply with any European schemes."
Plastic Recyclers Europe

"However, the processes and infrastructure required to collect, sort and recycle post-consumer flexible packaging are not yet widely established across the whole of Europe, nor is it uniform or harmonised. So, while the materials can be considered as being 'Designed for Recyclability', this flexible packaging can only be considered 'recyclable' in those countries where the infrastructure, capability and end markets are already in place."
CEFLEX

"The voluntary commitments submitted to the Circular Plastics Alliance in the European Union provide a first attempt at creating more transparency, but their first assessment published in 2019 illustrates the gap between committed supply and demand and falls significantly short of formulated ambitions by stakeholders along the entire value chain, highlighting the need for more actionable mechanisms."
McKinsey & Company[75]

"The trend in decreasing exports of plastic waste is likely to result in an increase in incineration and landfilling in the short term, because of the current lack of capacity to increase recycling and reuse in the EU."
European Environment Agency

4. The Proposal

Collaborative efforts, scaled up, can have a meaningful impact

Design, test, iterate

The initial remit of the Single Use Plastics Project was to work collaboratively to reduce the impacts of single use plastics across the entire value chain. As noted previously in this report, the material inputs and systems surrounding these plastic poly bags are complex and varied. Our project team readily acknowledges that we are not experts on the advancing materials solutions present or forthcoming in the marketplace, and we observe that even the subject matter experts and research are rarely unanimous in their support for, or scalability of these alternative materials along our existing value chain. On a systemic level, however, the assessment and optimisation of operational challenges were in fact well within our existing capabilities. While we may not possess certainty around bio-degradables, pro-degradables, compostables, water-solubles, etc., we do hold subject matter expertise on the relevant implications of systems changes and their knock-on effects to our supply chains and sales channels.

Key to the Single Use Plastics Project was an ambition to move quickly to testing and iterating, leveraging the overlapping businesses models and scale present in our single value chain context. After spending most of 2018 and 2019 researching the problem, scale, proportion, flow of plastics through our industry, and alternatives proposals, we worked to select promising alternatives and test them on an industry scale. The project team felt that critical to the successful outcomes of the joint effort was a move away from only the theoretical and into the practical applications. As such, we selected three key ambitions to test, measure, and where progress was evident, improve. After researching the potential alternative materials and the flow of our poly bags, we chose to move forward with pilots around a digital platform for shared best practices and reduction strategies, re-usable packaging, and an industry recycling stream.

Collaborative Platform

Share best practices among participating orgs. of successful elimination

Industry steer on items shippable without a poly bag and elimination of common poly bag contaminants

Reusable Packaging

One bag, multiple uses, targeting parts/subsets of the supply chain

An ambitious trial to combine reusable packaging with poly bag elimination to ship a product fully devoid of all single use plastic

Industry Recycling Stream

Dedicated recycling stream for outdoor industry poly bags and more

Evaluated potential to remove poly bags from products displayed in retail stores and prior to e-commerce sales

All three tests were run in multiple countries using a mixture of brands and retailers. Although all three tests produced useful outcomes and direction for the project, one pilot which was very successful, both in terms of quantifiable achievements and industry perception, was our collaborative industry recycling stream trial. This trial was continued into an implementation project, and we will attempt to condense the key learns or takeaways from below.

Industry Recycling Stream trial

The recycling concept came from an understanding of the flow of poly bags through the industry and to their terminus. The final points at which we controlled the poly bag packaging were just before shipping directly to consumers via e-commerce orders, and at the retail store just before they are discarded. In either instance – with the retail store or the consumer – the poly bag is then sent to a municipal waste collector (via recycling or general waste), where, as described in detail above, the likely outcome is to be landfilled or incinerated. The recycling concept with designed around capturing the poly bags at the last instance within the value chain wherein we were in control of the packaging. To this end, we sought to retain the poly bags sent to retail stores, and simultaneously identify product lines which could have the poly bags removed just before shipment and could safely transport the final mile without the plastic film protector. The resulting poly bags would, if combine with other actors in the industry, represent a large, relatively clean, pre-sorted, homogenous film with tremendous potential value to the recycled plastic market.

One of the key features of this systems redesign proposal centred on a potential "market to market" form of circularity. With the vast majority of our manufacturing taking place in Asia, the ability to move used plastic back from Europe is increasingly complex and often untenable. Making poly bags out of our poly bags was a compelling story but neglected the inherent challenges. Even if there were no associated carbon implication from a return trip to Asia, the logistics behind returning the plastic to its appropriate location within a widely distributed sourcing chain was administratively unmanageable with minimal or no real-world climate gains. However, we saw an opportunity to manufacture our poly bags using material from the recycled plastic market in Asia – a widely accessible commodities market – and then return the poly bags back to the recycled plastic markets in Europe, thus reducing material degradation, assuming responsibility for the material, and ensuring its appropriate return to the resource stream. We do not promote this as the solution to all single use plastic, but a substantial collaborative step in the right direction.

Near the end of 2019, the project completed a series of tests where participating organisations collected poly bags a) removed from outgoing e-commerce orders just before being shipped, b) from retail stores backhauled to distribution centres, and c) from any returned e-commerce orders. This system allows the poly bags to protect key product lines up to the last mile, but ensures they are not sent to the municipal waste stream via the retailer or consumer (Figure 8). As we learned, plastic which ends up at a municipal waste facility will likely be sent to incineration or landfill – both unacceptable outcomes in the view of the project team.

These three streams of poly bags were combined from brands and retailers across 8 countries, and 3.2 metric tonnes were jointly sent for reprocessing by a dedicated recycling partner. Poly bags gathered came from multiple retail stores, thousands of e-commerce orders and returns, and as such were not selected for their purity or quality. The batch was intentionally not pre-sorted or cleaned to ensure that the quality would reflect the actual quality present across the industry. The value, quality, and contamination were measured by the recycler and feedback was provided. We simultaneously surveyed nearly 900 consumers across Europe who received orders that were part of these tests. This survey was used to measure NPS (satisfaction), order condition, neatness, damage, general reactions and more. We also measured operational impacts to the participating organisations including costs, labour challenges, return rates, etc. We asked participating organisations to provide feedback around operational impacts including costs, procedural obstacles, and changes to product return rates. Our feedback and data collected could be divided into three key areas: recycler feedback, consumer feedback, and to a much lesser extent operational feedback.

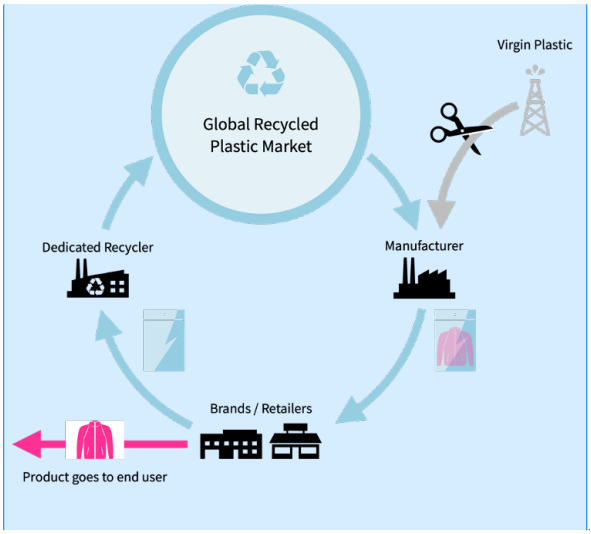


FIGURE 8 ROUGH CONCEPTUALISATION OF THE MODEL

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1. Recycler feedback

The dedicated recycling partner selected for the project received the trial poly bags for processing and gave feedback on the quality of the reprocessed material, stating that "The efficiency/yield of the materials was at ~75%". The recycler had to remove packaging, impurities and obstructing 'byproducts' including polypropylene flexibles, clothes hangers, silica gel bags, printing, glues, stickers, paper and cardboard. A yield of 75% for a clean stream is deemed to be sufficient, according to the recycler, and is above average[76] when compared to five other European processing facilities receiving packaging waste from EPR (Extended Producer Responsibility) systems including film waste.

"Value of the feedstock in the current state of play would be comparable with 95/5 market quality"

The term 95/5 relates to the grading method of scrap plastic (especially LDPE Film) and is "a reflection of material to contamination and/or colour" [77]. Therefore, this 95/5 quality assignation means that the content of the films in that particular stream was 95% natural PE films and 5% other PE films. Accordingly, the long-term aim would be to reach a quality of 98/2 or 99/1 on arrival at the recycling depot, essentially close to a mono stream with hardly any sorting needed, which would require the elimination or further reduction of impurities (paper, stickers etc.). Achieving these levels of purity would significantly augment the stream yield and value.

The outcome of this trial indicates that when we as an outdoor industry recycled poly bags collectively, we achieved a 95/5 plastic grade - without any optimisation. Together, we have the ability to achieve a commodity grade plastic that has value on the recycled plastic market. That means it can be made into new bags, or into transparent applications, rather than down cycled into black garbage bags. It's the second highest PCR grade our recycler produces and if the bags are optimised, we can make that even better (98/2).

2. Consumer feedback

As part of the research undertaken in the recycling system trial, consumer responses and feedback were collected to understand how end users would connect to, understand, and react to the proposed changes. Several thousand e-commerce orders were selected to be sent out with product which had its protective poly bag removed just before shipment. Inside, consumers would find the product(s) without poly bags, and a small note (Figure 9) drawing attention to the lack of protective film and providing a QR code and website consumers could visit. The website provided visitors with the opportunity to learn more about the proposed measures and provide their feedback. In total, 866 responses were collected in two languages, German and English. The questions asked consumers covered NPS (satisfaction), order condition in comparison to similar online purchases, neatness, damage, proclivity towards sustainable packaging topics, and general reactions. The combined NPS was a very encouraging 76.1, and nearly all areas of the survey indicated a supportive position from the end user. The open comment s section also provided candid reactions and constructive critiques which can be used to improve and revise the system and its implementation. A further analysis of the responses from end users provides a more in depth understanding of the way in which the system resonates with outdoor product consumers.

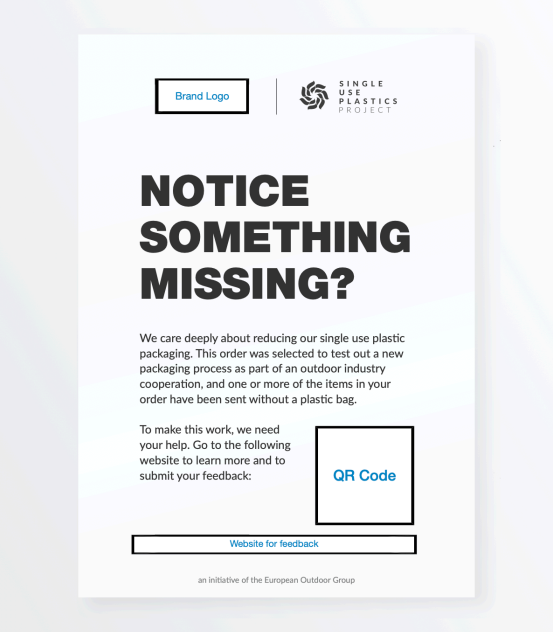

FIGURE 9 CONSUMER NOTE IN BAG-FREE DELIVERY

The consumer feedback was overwhelmingly positive, with the overall consensus being that consumers were happy to receive products un-bagged, that the packaging wasn't missed, and that they were pleased to see cooperative initiatives as such undertaken by the industry (Figure 10).

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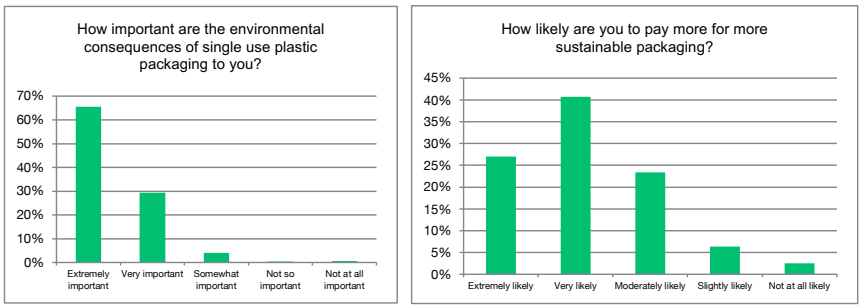


FIGURE 10 – FEEDBACK FROM CONSUMER SURVEY – Q2, Q3 (ENGLISH AND GERMAN COMBINED)

"Happy" "Positively surprised" "Good impression"

"I didn't even realize until I saw the flyer! I would definitely say it's a very positive impression- no need for

"I was positively surprised and found that so unusual that I told several members of the family and a friend. A

me to deal with the bags, which can't be recycled where I am."

"Many producers of organic clothing have been providing packaging without single use plastic for years, so I could never understand why outdoor clothing suppliers didn't do the same thing. Finally they've caught on! Well done!"

package without plastic bags is such a rare finding that I will most certainly try to order more from that vendor whenever possible."

"I realized it the second I opened the package and it felt really good to not waste plastic for my order! I strongly take care of it and prefer companies without plastic packaging from now on"

There was little indication that products were delivered in a damaged, dirty or wrinkled state, and no indication that these rates were significantly greater than orders with poly bags. In some instances, the perception of order quality was noted as improved, or more personalised, by the end user when the poly bag was removed. Further research, exploring whether the positive impact of a poly bag-free delivery outweighs the negative effect on consumer perception of receiving wrinkled items in an order, would be valuable (Figure 11).

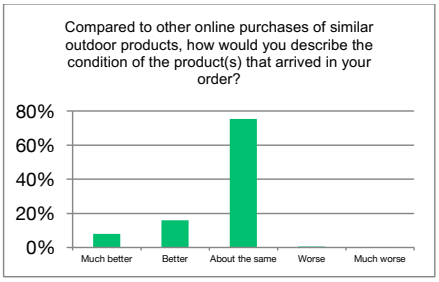


FIGURE 11 – FEEDBACK FROM CONSUMER SURVEY – Q5, Q6, Q7 (ENGLISH AND GERMAN COMBINED)

"Good condition" "Perfect" "Keep going"

"The products were absolutely OK, neither better nor worse than those I am used to receive in plastic bags. Just my conscience was better!"

"I perceived the goods in the package as having been packed very lovingly."

"Interestingly, seeing it folded neatly inside the cardboard box made it feel more like a human was on the other side of

Condition of items was perfect. Delivered during very heavy rain period in Ireland with no damage to garments inside!”

"Product seems more valuable.”

the purchase. Whereas a plastic-wrapped item has something almost robotic about it. Maybe I’m looking into it too deep but that’s how it came across! Really pleased.”

“It would make me buy from those organisations more readily.”

“It‘s a good reason to order from that company again.”

Ultimately, we received some highly thoughtful and informed responses, indicating that our consumers are both interested, and invested in finding solutions to the issue of decreasing and/or recycling single use plastic. The most common word found in the open responses was “keep” attached to some level of encouragement to carry the initiative forward.

“Keep going” “Please continue” “Keep up the good work”

“I think it’s a brilliant thing to be doing and should be expanded as much as possible to remove as much plastic from the processes and failing that recycle what you can’t remove from the surplus chain.”

“A positive tendency to receive products with less plastic waste at home and the possibility to centralize plastic for recycling.”

“You are the ecological role models of our society. Please continue your path!”

“It was perfect, and definitely leads me to preferably consider manufacturers and retailers that try to avoid plastic as far as possible. Actually, there are already (small) manufacturers with direct retail that completely avoid plastic packaging!! (At least to the end consumers).”

3. Operational feedback

The primary focus of the initial trials was not operational optimisation or improvements, but rather understanding potential value of the stream and proof of concept of the system. Nevertheless, we did seek to gather anecdotal feedback from the participating organisations in an effort to improve upon the system in subsequent tests or system designs. The impacts of the trial varied across the participating brands and retailers, depending mostly on the particular operational set up of each organisation, however there was general agreement around some issues. Participating organisations included national and multinational brands, large and medium sized retailers, and participants were based in multiple countries across Europe. The sample size was still considerably low, and no pre-emptive measures were set in place to control for the varying processes and business models deployed at an operational measure by the participating organisations. Crossover was almost non-existent, and each organisation was almost its own singular data point. Shared challenges and workouts were limited by the variability of participants. Regardless, several insights emerged relevant to both the participants as well as potential future members of the project. Perhaps of especial note from our limited data would be the reality that most assumptions are functionally incorrect and worth challenging. Broad, declarative statements around costs, space limitations, impacts to product cleanliness/neatness/damage, or efficiency reductions were often both evidenced in some organisations, and then completely absent in others.

The only pieces of feedback which were consistent across all participating organisations were 1) removing poly bags before shipping e-commerce orders had no impact to return rates in any instance, and 2) employee reactions were regarded as generally positive.

Some qualitative statements around operational impacts from the trials are included below. Our recommendations for secondary trials or implementations would be to prioritise investigating more closely the gap between organisations which were

able to handle the removal of the poly bag with minimal efficiency impacts versus those who were greatly affected by increased time requirements.

+

"Return rate didn't seem to be affected"

"All persons involved were eager to contribute to this pilot project, I encountered a lot of goodwill."

"Very positive emotions towards tackling the SUP problem within our own logistic processes from employees all over the company."

"No extra work for employees or storage space."

-

"Performance within our shipping processes of single item orders (textiles) dropped."

"The biggest challenge was the economic transport of the poly bags."

"In general there would be a storage space issue."

"Organising and preparing the shipment was very time consuming."

Key findings

This was a successful real-world pan-European, multi-organisation industry trial. The testing delivered tangible results and gave us an insight into MRF and recycler requirements, brand and retailer operational considerations for implementation, and consumer satisfaction on receiving un-bagged products.

The feedback from the recycling trial testing indicates that our plastic is commodity-grade and valuable when recycled collectively. When we recycle together, we achieved a 95/5 plastic grade - without any optimisation. That means it is sufficiently high-grade for use in further transparent applications (e.g. capable of being remade into another poly bag), rather than down cycled into black garbage bags. It's the second highest PCR grade our recycler produces and, if the bags are optimised, we see achievable gains in optimising the input material. Our system targets the largest proportion of plastic moving through our industry estimated at over 86%.

Consumer feedback showed substantially elevated NPS scores, encouraging feedback, and an elevated perception of the order condition and value.

Organisational feedback showed no impact to return rates, and we sent off tens of thousands of orders without poly bags, however, efficiency improvements needed to be made to meet long term sustainability.

95/5

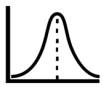
Quality of plastic from recycled poly bags when reprocessed collectively. If optimised, stream could potentially achieve 99/1.

86%

When implemented, percent of the industry's poly bags this system can divert from landfills, incinerators, and the natural environment.

76.1

Net Promoter Score (NPS), or customer satisfaction, of consumers who received orders without poly bag protectors.



0%

Average change in return rates for orders sent out without poly bags protectors across all organisations.

Our proposal

The least sustainable packaging is the one wherein the product is damaged. Especially in the outdoors industry, where our technical products cost the environment substantially more than the poly bag. The early efforts of the Single Use Plastics project was to investigate the potential for broad substitution or elimination of single use plastic used to protect garments in transit/storage. However, our research revealed that there are compelling reasons why certain products need to be protected from dirt, dust and moisture (white or pale coloured garments, delicate items, garments prone to surface damage etc.) which necessitate, or at least justify in the interim, the continued use of poly bags for select product lines.

We then considered the option of replacing conventional oil-based polymers (such as polyethylene) with innovative bio-based polymers, natural packaging materials such as paper or cotton, water-soluables, compostables, pro-degradants, etc. We were surprised to find out that these materials are not inherently superior in terms of their sustainability credentials in comparison to recycled LDPE, particularly given the resources required and GHG emissions generated during their production, the very specific heat intensities required to induce degradation of bioplastics, and the problems associated with mixing bioplastics with conventional plastics during the recycling process. Alternative materials are problematic owing to issues with their feedstocks, frequently caustic manufacturing processes, inability to provide the necessary benefits during use, or problematic end of life scenarios.

This led us to consider the option of making the best use of the material already available on the market in a way that reduced waste transported to landfill or incineration, and which ensured that the material retained much of its value on the global market: **recycling**. By creating a separate and specific route for our poly bags, one where they are collected in distribution centres (and not sent directly to e-commerce customers) or in retail outlets and sent back for collection by specialist recycling partners, we can capture poly bags before they enter municipal waste streams and thereby minimise the issues associated with contamination of the poly bag waste, the contamination of household recycling waste streams, and produce reprocessed material which can be sold back into the European market.

Systems change over materials change

What is important is that the poly bags are returned to the resource stream with the smallest degree of material degradation and loss as possible. The recycling system we have tested and are implementing allows the material to be reprocessed at a very high grade, capable of further transparent applications. Although we do not compel our poly bags to become the next generation of poly bags, we wanted to ensure that was the level of material preservation we were sustaining. We see intrinsic value in pulling from global recycled plastic markets, and then pushing our poly bags back onto the recycled plastic market.

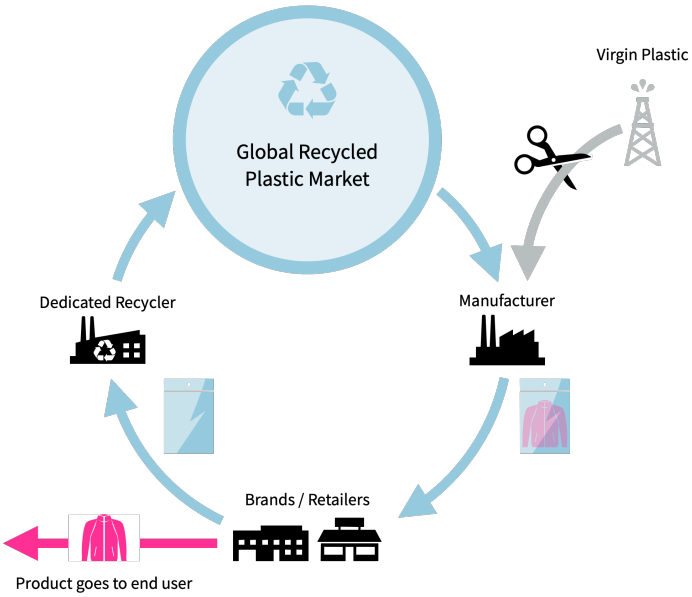


FIGURE 12 – ILLUSTRATION OF POLY BAG MARKET CIRCULARITY

The Ellen MacArthur Foundation[78] advocates that "Shifting from linear to circular requires systemic solutions" through the implementation of a system which changes the way plastics are designed, used (or avoided where possible), re-used (if applicable) and recycled or composted to ensure no loss of economic value. This requires innovation in reprocessing technologies and effective collection infrastructure.

For plastic to become valued and never become waste it's imperative that everybody from those producing it (brands, retailers, food service businesses, packaging suppliers and plastic producers), collecting it (local and city authorities), sorting it and recycling it (waste management and recycling sector), to those using it (citizens) as well as Government, NGOs and media are involved. Everyone in the UK can and should engage.
Ellen MacArthur Foundation

These sentiments are echoed in the **Fashion for Good**[79] report, in which the suggestion is for brands to "Focus on the system as well as the material" by considering collection and recovery points of any poly bag waste generated (e.g., DC, retail outlets, households), investigating the potential to eliminate plastic use altogether, and exploring the use of reusable systems for e-commerce shipping. This report also focuses on the design of poly bags, citing the need to address recyclability contaminants such as inks and labels, assessment of collection as well as innovations in the recycling process and techniques.

The advantages of creating a circular economy for plastics are also highlighted in a **Recoup**[80] report, by way of maintaining a valuable resource, leading to positive environmental gain.

In **A European Strategy for Plastics in a Circular Economy**[81] the aim is that "Packaging placed on the market in the EU should be either reusable or recyclable by 2030" and this will only be achieved with a greater integration of recycling into the plastics value chain. The report highlights that there already exist, on the continent, successful commercial partnerships between producers and plastics recyclers which prove that quantity and quality issues can be overcome with sufficient investment.

Some of the goals of the above-mentioned EU Strategy were informed by **The European Academies of Science**[82] who assessed the entire plastics value chain and formulated seven recommendations to EU policymakers. These included a ban on exports of plastic waste (which ties in with our aim to return reprocessed material to the local plastics market), targeting zero plastic waste to landfill and extended producer responsibility. They also touched upon the subject of advanced recycling technology, stating that "If, as EASAC recommends, export from the EU and landfill are to be stopped, it is essential to develop integrated recycling systems which can deal with all plastics waste."

"To be viable, plastic should and can be designed for recycling and, importantly, be mechanically recycled wherever that is possible. Each metric ton of mechanically recycled feedstock offsets 48 per cent in GHG emissions relative to virgin plastic product, reduces the need for the extraction of virgin materials, and helps achieve a circular economy"
The Pew Charitable Trusts and SYSTEMIQ

Research conducted by **Milios, Davani and Yu**[83] posited that in order to increase the re-use and recycling of plastic waste to create a resource efficient circular economy in Sweden, there was needed "(1) appropriately established schemes for the separate collection of plastic waste, (2) steady supply of plastic waste in adequately high volumes, (3) well-functioning markets for plastic waste with clear signals of secondary raw material demand, and (4) quality guarantees by the recycling industry for uptake in plastic manufacturing processes." In doing so the researchers theorised that a large portion of polybags could be diverted away from incinerators, landfills, exporting, and the natural environment. We find this to be very encouraging, and a significant step in the right direction for creating systemic improvements that shift the responsibility back to us, the producers.

"...the studies recognise that the low production costs of new plastic disincentivises the collection and transformation of used plastic and highlights that in recent months, the price of recycled plastic flakes has surpassed the price of manufactured 'virgin' plastic."
Cambridge Institute for Sustainability Leadership[84]

"It is not only greater levels of capacity that are required, but also improvements in sorting technology and a wider range of processing technology including non-mechanical recycling. It is likely that the latter will be critical to enabling the use of recycled content in flexible plastic packaging."
WRAP

"European legislators should adopt rules and incentives to speed up the move towards a Circular Plastic Waste Economy. We have to reuse plastic goods and packaging, drastically improve our recycling and above all see that no waste is leaked into the environment."
Prof. Michael Norton, Recycling Magazine[85]

"'Extended producer responsibility' (EPR) is a powerful environmental policy approach through which a producer's responsibility for a product is extended to the post-use stage. This incentivises producers to design their products to make it easier for them to be re- used, dismantled and/or recycled at end of life."
Sandra Laville, The Guardian[86]

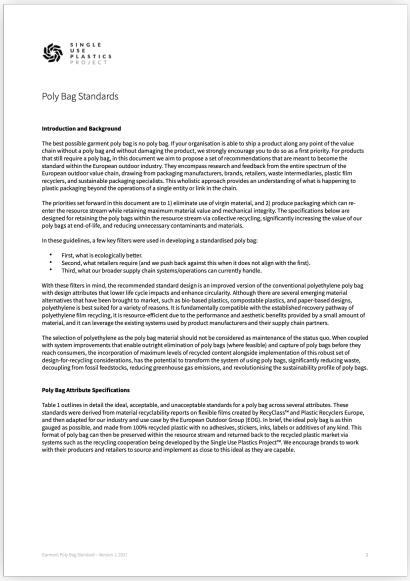
5. Discussion

The issue of single use plastic packaging within the outdoor industry value chain is complex and requires clear context to make the best steps in mitigating impact.

The reality is that poly bags amount to a fraction of the ecological impact when compared to the product they protect, and most end their life in a landfill or incinerator. Plastic, especially recycled plastic, does some things very well compared to the alternative materials available on the market, and in other ways it can be very problematic. Our efforts have been concentrated on collaborative efforts that target the areas where plastic is most environmentally caustic – the end of life. One of our feature outputs of the project has been the testing run on a joint recycling system which seeks to capture poly bags before they are discarded into a municipal waste system. The represents the largest potential gains to be made in terms of percentage of poly bags within the outdoors industry. Although the recycling tests and system proposal is largescale and resource intensive, it is one of several measured and targeted outputs of the Single Use Plastics Project.

Our other efforts currently underway also include: an industry poly bag standards document which was developed with input from poly bag producers, manufacturers, brands, retailers, waste intermediaries, recyclers, and sustainable packaging specialists; and a product shipping survey which is undertaking the task of identifying which product lines can be successfully shipped across key segments of the value chain without a poly bag. These two initiatives are designed to motivate a shift towards decoupling from all virgin inputs, challenge assumptions around necessary poly bag features, design the bags with end of life in mind, and create resources and momentum around fully eliminating poly bags from stable product lines.

Industry Poly Bag Standards Document



SINGLE USE PLASTICS PROJECT

Poly Bag Standards

Introduction and Background

The best possible garment poly bag is no poly bag. If your organisation is able to ship a product along any point of the value chain without a poly bag and without damaging the product, we strongly encourage you to do so as a first priority. For products that still require a poly bag, in this document we aim to propose a set of recommendations that are meant to become the standard within the European outdoor industry. They encompass research and feedback from the entire spectrum of the European outdoor value chain, drawing from packaging manufacturers, brands, retailers, waste intermediaries, plastic film recyclers, and sustainable packaging specialists. This wholistic approach provides an understanding of what is happening to plastic packaging beyond the operations of a single entity or link in the chain.

The priorities set forward in this document are to 1) eliminate use of virgin material, and 2) produce packaging which can re-enter the resource stream while retaining maximum material value and mechanical integrity. The specifications below are designed for retaining the poly bags within the resource stream via collective recycling, significantly increasing the value of our poly bags at end-of-life, and reducing unnecessary contaminants and materials.

In these guidelines, a few key filters were used in developing a standardised poly bag:

- First, what is ecologically better.
- Second, what retailers require (and we push back against this when it does not align with the first).
- Third, what our broader supply chain systems/operations can currently handle.

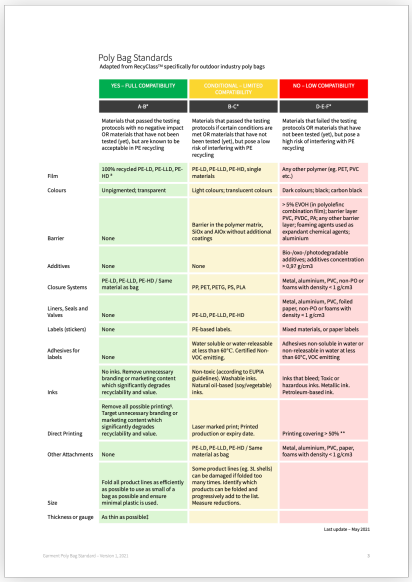
With these filters in mind, the recommended standard design is an improved version of the conventional polyethylene poly bag with design attributes that lower life cycle impacts and enhance circularity. Although there are several emerging material alternatives that have been brought to market, such as bio-based plastics, compostable plastics, and paper-based designs, polyethylene is best suited for a variety of reasons. It is fundamentally compatible with the established recovery pathway of polyethylene film recycling, it is resource-efficient due to the performance and aesthetic benefits provided by a small amount of material, and it can leverage the existing systems used by product manufacturers and their supply chain partners.

The selection of polyethylene as the poly bag material should not be considered as maintenance of the status quo. When coupled with system improvements that enable outright elimination of poly bags (where feasible) and capture of poly bags before they reach consumers, the incorporation of maximum levels of recycled content alongside implementation of this robust set of design-for-recycling considerations, has the potential to transform the system of using poly bags, significantly reducing waste, decoupling from fossil feedstocks, reducing greenhouse gas emissions, and revolutionising the sustainability profile of poly bags.

Poly Bag Attribute Specifications

Table 1 outlines in detail the ideal, acceptable, and unacceptable standards for a poly bag across several attributes. These standards were derived from material recyclability reports on flexible films created by RecyClass™ and Plastic Recyclers Europe, and then adapted for our industry and use case by the European Outdoor Group (EOG). In brief, the ideal poly bag is as thin gauged as possible, and made from 100% recycled plastic with no adhesives, stickers, inks, labels or additives of any kind. This format of poly bag can then be preserved within the resource stream and returned back to the recycled plastic market via systems such as the recycling cooperation being developed by the Single Use Plastics Project™. We encourage brands to work with their producers and retailers to source and implement as close to this ideal as they are capable.

Garment Poly Bag Standard – Version 1, 2021 2



Poly Bag Standards

Adapted from RecyClass™ specifically for outdoor industry poly bags

	YES – FULL COMPATIBILITY	CONDITIONAL – LIMITED COMPATIBILITY	NO – LOW COMPATIBILITY
	A-B*	B-C*	D-E-F*
	Materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PE recycling	Materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PE recycling	Materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PE recycling
Film	100% recycled PE-LD, PE-LLD, PE-HD *	PE-LD, PE-LLD, PE-HD, single materials	Any other polymer (eg. PET, PVC etc.)
Colours	Unpigmented; transparent	Light colours; translucent colours	Dark colours; black; carbon black
Barrier	None	Barrier in the polymer matrix, SiOx and AlOx without additional coatings	> 5% EVOH (in polyolefinic combination film); barrier layer PVC, PVDC, PA; any other barrier layer; foaming agents used as expandent chemical agents; aluminium
Additives	None	None	Bio-/oxo-/photodegradable additives; additives concentration > 0,37 g/cm3
Closure Systems	PE-LD, PE-LLD, PE-HD / Same material as bag	PP, PET, PETG, PS, PLA	Metal, aluminium, PVC, non-PO or foams with density < 1 g/cm3
Liners, Seals and Valves	None	PE-LD, PE-LLD, PE-HD	Metal, aluminium, PVC, foiled paper, non-PO or foams with density < 1 g/cm3
Labels (stickers)	None	PE-based labels.	Mixed materials, or paper labels
Adhesives for labels	None	Water soluble or water-releasable at less than 60°C. Certified Non-VOC emitting.	Adhesives non-soluble in water or non-releasable in water at less than 60°C, VOC emitting
Inks	No inks. Remove unnecessary branding or marketing content which significantly degrades recyclability and value.	Non-toxic (according to EUPIA guidelines). Washable inks. Natural oil-based (soy/vegetable) inks.	Inks that bleed. Toxic or hazardous inks. Metallic ink. Petroleum-based ink.
Direct Printing	Remove all possible printing! Target unnecessary branding or marketing content which significantly degrades recyclability and value.	Laser marked print; Printed production or expiry date.	Printing covering > 50% **
Other Attachments	None	PE-LD, PE-LLD, PE-HD / Same material as bag	Metal, aluminium, PVC, paper, foams with density < 1 g/cm3
Size	Fold all product lines as efficiently as possible to use as small of a bag as possible and ensure minimal plastic is used.	Some product lines (eg. SL shells) can be damaged if folded too many times. Identify which products can be folded and progressively add to the list. Measure reductions.	
Thickness or gauge	As thin as possible!		

Last update – May 2021

Garment Poly Bag Standard – Version 1, 2021 3

In our view, the best possible poly bag is no poly bag, and we encourage and support aggressively prioritising elimination strategies. Where poly bags are still necessary, however, we have developed a set of standards to minimise contaminants and ensure the maximum value of the material is retained. This is not the solution to all single use plastics, but a collective step in the right direction.

The standards found in this document were created with input from the entire value chain - producers, manufacturers, brands, retailers, waste intermediaries, recyclers, and sustainable packaging specialists. Working together, we can critically evaluate the

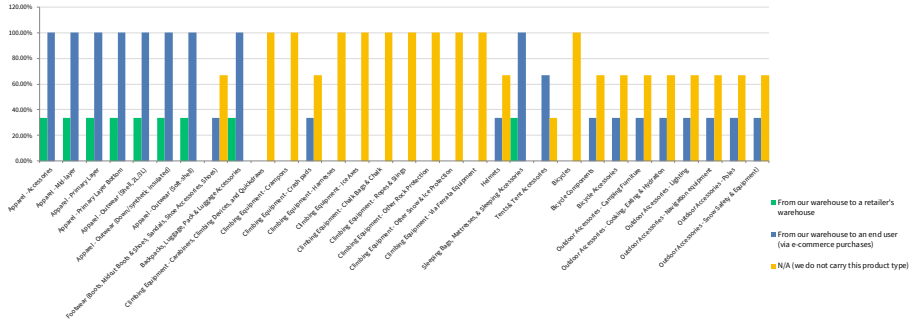
fragmented standards currently in play and facilitate broader alignment on packaging requirements in the context of their impact.

Our ultimate objective is return poly bags to the resource stream, and by designing for end of life, we can prioritise specific attributes which have the largest net impact on the bags' value after use. If these bags are deemed an invaluable, critical resource for protecting certain products, then they need to be treated as such and not readily discarded. We also present in this document a new poly bag design for increased reusability, recyclability, and minimal/no virgin material requirements. By working together, we can standardise the poly bag, design for recovery, and limit contaminants which devalue the material at end of life.

Product shipping matrix

We have built and will continue to improve a digital intra-project platform for shared ideas on quick/ existing plastics elimination or reduction strategies. By connecting with each other, brands and retailers can ask questions and be network with other organisations who have already tested initiatives such as reducing poly bag sizes and gauge, roll packing, best suppliers for recycled plastics, etc. We can also use our collective knowledge to create optimal poly bag standards, and open-source higher recycled content for poly bag manufacturing in Asia.

In addition, we have commenced developing a product shipping matrix which identifies which product lines can be shipped by which organisations across their respective segments of the value chain – without a poly bag. Using this information, we can identify low-hanging fruit, and create a network of organisations which can support each other in transitioning away from poly bags across certain stable product lines. These organisations can act as exemplars or advisors to other members of the project group as they seek to eliminate poly bags from similar product lines in their own organisations.



Recycling network

As discussed above in this report, our group is currently in the process of implementing an industry-level recycling stream of relatively clean, homogenous, and pre-sorted film that can be reintroduced into the resource stream with maximum value retention and minimal down-cycling.

We are building an industry specific recycling stream starting with the U.K. and Germany/Benelux regions, but with the intention of growing to include other key geographies within Europe. When implemented correctly, this system can capture an estimated 86% of the poly bags moving through the industry. We have the ability to create a stream of high quality recyclates that require minimal sorting and cleaning yet produce a better-quality pellet than when disposed of through traditional means. At current mixed quality levels and when recycled together, our poly bags can be recycled into 95/5 grade PCR or higher and sold to the commodities market. This means they have substantial value, but only when properly managed and sent collectively.

Implementation and invitation to join

This project is an ongoing commitment, and the publishing of this report is not an end, but more a summation of the progress we have made and a reflection on what we have learned. The impacts of the COVID-19 pandemic were especially acute with regards to where the largest proportions of our plastic end up before being discard – physical retail stores. But with the gradual re-opening of retail, subsequent to the continuing relaxation of lockdowns across Europe and the UK, we are resuming our recycling network trial, our polybag standard has recently been released and is in use by brands, and we are continuing to receive data for our product shipping matrix.

So far 30+ brands and retailers have already joined as project participants, without whom we wouldn't have made the progress we so far have, but there's always room for more to stand behind this project so that we can achieve the best outcome for our industry. If you are interested in joining or learning more, please contact the European Outdoor Group.

Commented [VH5]: To be updated when report complete, ready to be published

APPENDIX 1 – Poly Bag Standards

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ENDNOTES

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Kleen Kanteen	6%-7% (paper-based packaging only, transport and product packaging)
Fenix:	<1% (hardgoods), 7% (lightweight product) (transport and product packaging)
Primus	4% (Scope 3), 3-4% (overall), 1-8% (LCA) (mainly cardboard, polybag use negligible)
Salomon	2.4%-2.6% (road running shoes, cradle to cradle, mainly cardboard and paper)
Haglofs:	2% (Scope 1, 2, partial 3 (production & logistics)
Deuter	1.7% (children's rucksack study, poly bag, cradle-to-customer + waste)
Aku:	0.7% (raw materials packaging) 1.5% (leather footwear packaging, mainly cardboard)
Ortovox:	<1% (pre- and post-consumer recycled poly bags only)

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