



PACKAGING WASTE AND ITS MANAGEMENT OPTIONS

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GE0070 Waste Management

TABLE OF CONTENTS

1.0	Introduction	- 3 -
1.1	Sources of packaging waste.....	- 4 -
1.2	Recent data and changes.....	- 4 -
1.3	Environmental impacts of packing waste.....	- 6 -
2.0	Legislation of packaging waste	- 7 -
3.0	Waste management options	- 8 -
3.1	Prevention	- 9 -
3.2	Preparing for reuse	- 10 -
3.3	Recycling	- 11 -
3.4	Other recovery & Disposal.....	- 13 -
4.0	Conclusion	- 14 -
5.0	References	- 15 -

1.0 INTRODUCTION

Waste streams are defined as flows of specific waste from the source of the product through to its disposal, recycling or recovery (European Parliament, 2015). Waste streams are often split into two categories: waste streams made up of materials such as plastic or metal, and waste streams made up of certain products including electronic waste and end of life vehicles, which all require specific treatment before entering materials related waste streams (European Parliament, 2015). Packaging is defined as materials that are used to handle, protect, deliver and present goods (GOV UK, 2017), so is allocated into the waste stream category of product-related waste streams (European Parliament, 2015).

For packaging waste, it is split into three categories shown in **Table 1**.

Packaging Type	Description	Example for Pizza
Primary	Any packaging that contains the final/finished product. This packaging is used to contain, preserve, protect and inform the end user. Such packaging is usually referred to as retail or consumer packaging.	Pizza tray Film wrap Label
Secondary	Additional to primary packaging. Often used as protection and collation of individual units during storage, transportation and distribution. This packaging type is sometimes referred to as grouped or display packaging. These can include plastic bags and cardboard boxes.	Retail-ready packaging Outer carton
Tertiary	Other packaging including pallets, stretch wrap, and strapping labels, all of which are used for shipping and distributing goods. This packaging is usually not seen by the consumer so is referred to as transport or transit packaging.	Pallet Stretch wrap Strapping

Table 1 The 3 categories that packaging waste is split into, including examples of each category (Source: WRAP, n.d.)

1.1 SOURCES OF PACKAGING WASTE

Packaging is often found in everyone's day to day lives but recent data in Europe has shown that the majority of plastic packaging is derived from households, as they contribute to 64% of packaging

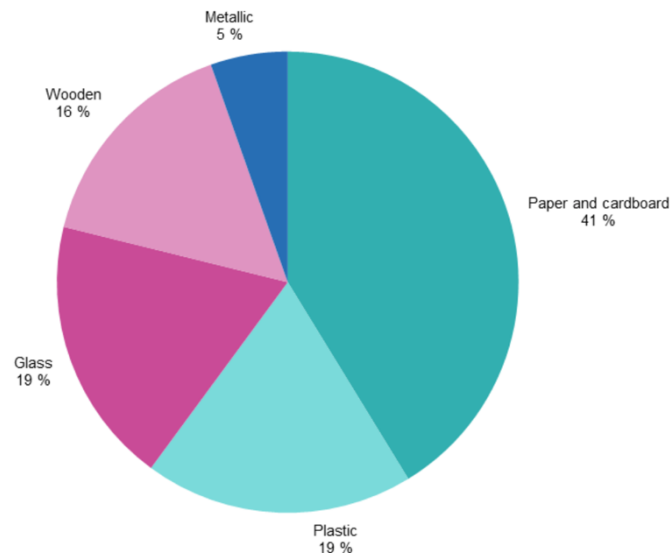


Figure 1 Packaging waste generated by packaging material in the EU, 2015 (Source: Eurostat, 2018)

waste whilst industry makes up the remaining 36% (Packaging Europe, 2018). It can usually arise from a wide variety of sources including supermarkets, hospitality, retail outlets, manufacturing industries, transport companies and households (Eurostat, 2018).

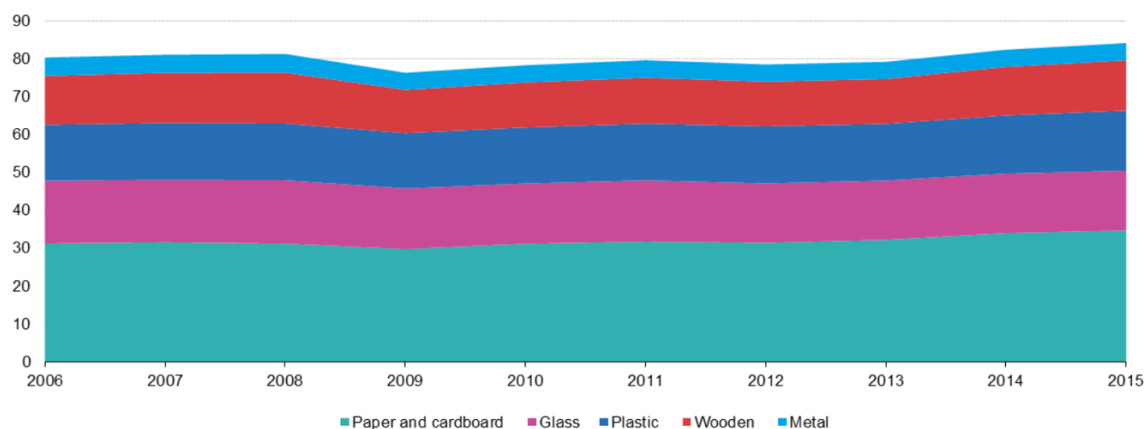
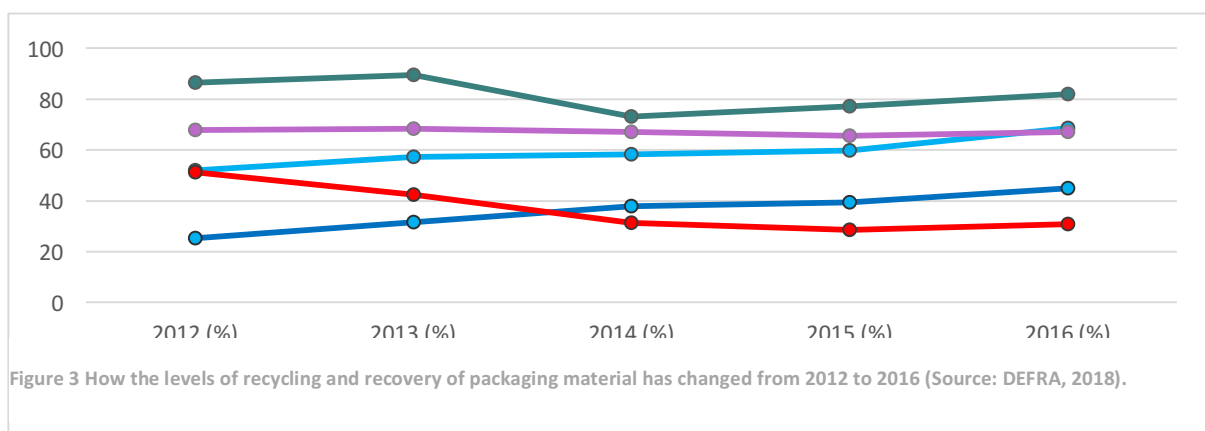
It is typically found in the UK and Europe that 41% of packaging waste is made up of cardboard and paper whilst plastic and glass account for 19% each of packaging waste materials. The other materials that are used are wood and metal, however these are substantially less than cardboard and paper (**Figure 1**).

1.2 RECENT DATA AND CHANGES

In 2015 73.7 million tonnes of packaging waste was created in households and industries (Eurostat, 2015) whilst 11.5 million tonnes of packaging waste was created in the UK alone (DEFRA, 2018).

Over recent years the UK has created specific targets for recycling. This in turn has impacted upon the amount of packaging waste that has been recycled and recovered, with 71.4% of packaging waste in the UK been recycled or recovered. This equates to 7.4 million tonnes of the 11.5 million tonnes created in the UK. Recycling rates since 2012 have changed for each packaging material.

Cardboard continues to have the highest recycling rate out of the five main materials, however this is a result of there been more packaging waste that is made from cardboard and paper. In 2014 recycling of glass, wood paper and cardboard all declined as there was an increase in the amount of waste packaging in these materials. This led to a larger proportion of material that needed recycling however current operations were not able to keep up, thus a decrease in the percentage of waste recycled (Eurostat, 2018). An increase in recycling and recovery rates has however occurred as awareness has increased across the UK. This in turn has led to the efficiency of being able to manage and recycle vast amounts of packaging waste in a suitable manner (Eurostat, 2018).



The development of the levels of packaging waste that's occurred between 2006 and 2015 throughout the EU has varied. In 2016 11.5 million tonnes of UK packaging waste was produced which was a slight increase from 11.47 million tonnes in 2015 and 11.43 million tonnes in 2014. From 2006 when packaging waste was 10.47 million tonnes the amount of packaging waste produced in

the UK has been steadily increasing until 2012 where it decreased to 10.36 million tonnes from 10.92 million tonnes in 2011 (Eurostat, 2018). From 2012 the amount of packaging waste has continued to increase to the 11.5 in 2016. Even though a large decrease of packaging waste was found in the UK, within the rest of Europe the same trend didn't follow, with the major decline in packaging waste occurring in 2009 (**Figure 3**), due to the major economic slump that caused GDP in Europe to turn negative (Eurostat, 2018).

1.3 ENVIRONMENTAL IMPACTS OF PACKING WASTE

Packaging waste has been seen to have many environmental impacts at the source and at its disposal. Packaging waste made from plastic materials often appears in the environment and landfills due to its single use disposable application. Most types of plastic that is used for packaging is not biodegradable (Andrady, 1994) and are often very durable, which therefore allows for polymers that are created today to last in the environment for decades (Hopewell et al. 2009). Even though there are now degradable plastics the problem still persists for a serious length of time as the degradation depends upon several physical factors including light exposure, temperature and oxygen levels (Swift & Wiles, 2004). Even when the plastic packaging has broken down as a result of weathering, it has to break down into smaller sections of waste, but the polymer included in plastic does not necessarily breakdown in a reasonable timeframe. This breakdown process results in plastic packaging debris accumulating in landfills and the natural environment, all of which cause problems for waste management systems as well as causing considerable environmental damage (Barnes et al. 2009; Gregory, 2009; Ryan et al. 2009).

Plastic is not the only form of packaging that effects the environment with the production on glass, cardboard and wood all having effects on air and water pollution. However, litter seems to be the largest source of harm to the environment with packaging waste being the third largest contributor to litter after cigarettes and food related waste, with mammals, birds and reptiles often ingesting or becoming entangled in packaging waste (Zerotape, 2016).

2.0 LEGISLATION OF PACKAGING WASTE

Legislation identifies the contents of labelling that must inform the end user on the contents of the packaging, materials, quantity, price, operating instructions, and warnings (GOV UK, 2017). Various legislation has been provided for waste management and waste packaging including legislation that helps to prevent more packaging waste from occurring. **Table 1** allows for the key legislation that the UK and its packaging producers must follow to be displayed.

Legislation	Description	Amendments
UK LEGISLATION		
The Producer Responsibility Obligations (Packaging Waste) Regulations 2007 (GOV UK, 2017)	This regulation effects organizations that own packaging, supplies it to other legal entities and has a turnover in excess of £2million per year, handles more than 50 tonnes of packaging per year and performs a relevant activity on any packaging that is handled (Valpak, n.d.)	2010- Technical changes
		2012- application of split target to glass
		2014- applies revised glass target
		2016- apply the revised glass and plastic targets retrospectively to 2016 and to 2017- 2020.
The Packaging (Essential Requirements) Regulations 2013 (GOV UK, 2017)	Aims to reduce the impact of packaging and packaging waste on the environment by minimizing weight and volume. Also requires for packaging waste to be reused, recycled or recovered, as well as introducing tolerances for the amount of toxic heavy metals (Valpak, n.d.).	Amendments made in 2013 to the definition of packaging and its forms whether it be primary, secondary or tertiary (Legislation GOV UK, 2013).
Landfill tax	Introduced on the 1 st October 1996. Encourages businesses and consumers to produce less waste, dispose of less waste at landfill and recover any value from waste (DEFRA, n.d.)	Number of changes to the scheme including landfill site operators are entitled to credit based on the contributions they give to approved bodies of objects concerned with the environment (DEFRA, n.d.)
Carrier bag charge	Implemented on 5 th October 2015 Aims to reduced single use plastic bags and encourage re-use (Gov UK, 2018) The 5p charge of carrier bags applies to companies who employ 250 or more staff (Gov UK, 2018)	N/A

EUROPEAN DIRECTIVES		
European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (GOV UK, 2017)	<p>The directive aims to limit the production of packaging whilst promoting the recycling reuse and other forms of waste recovery for packaging waste, with landfill been considered as a final resort (EUR-Lex, 2014).</p> <p>Member states of the EU have to ensure that packaging waste management systems are in place for collection, reuse, recycling and recovery in order for the most appropriate waste management alternatives to be observed, with prevention being the first priority to reducing packaging waste (EUR-Lex, 2009)</p>	Directive 2004/12/EC amends the directive of 94/62/EC on packaging and packaging waste (European commission, 2016)
		Directive 2005/20/EC amends directive 94/62/EC on packaging and packaging waste with the extension of deadlines for attaining recycling and recovery targets for the member states that accede the EU in 2004 (European Commission, 2016)
		Regulation (EC) No 219/2009 adoption of several instruments which are subject to the procedure referred to in Article 251 of the Treaty of Council Decision 1999/468/EC which regards to the regulatory procedure (European Commission, 2016).
		Commission Directive 2013/2/EU amendments to Annex I to Directive 94/61/EC on packaging and packaging waste (European Commission, 2016)
		Directive (EU) 2015/720 of the European Parliament and the Council of 29 th April 2015 to amend the Directive 94/62/EC in regards to the consumption of light weight plastic carrier bags (European Commission, 2016).

Table 2 UK legislation for packaging waste

3.0 WASTE MANAGEMENT OPTIONS

It is important to reduce the amount of waste packaging and improve the quality at which it is discarded. It is therefore important to follow the waste hierarchy system which is split into five categories as seen in **Table 3**. The waste hierarchy system ultimately allows for money, raw materials and energy to be saved as well as reducing the overall environmental impact of waste packaging as you move up the waste hierarchy system (WRAP, 2010).

Packaging policy	Description of policy
Prevention	Reduction of the quantity of material used in packaging (EEA, 2005)
	Reduction of packaging and packaging waste at production level (EEA, 2005)
	Reduction of packaging and packaging waste at the marketing, distribution, utilizing and elimination stages (EEA, 2005)
Preparing for Reuse	Any operation of packaging waste that allows for it to be refilled or used for the same purpose (EEA, 2005), with or without the need for checking, cleaning and refurbishing the packaging waste (DEFRA, 2011)
Recycling	Reprocessing packaging waste into other packaging or other lower quality products (EEA, 2005)
Recovery	The use of packaging waste for energy recovery and reprocessing materials back into fuels and backfilling operations (DEFRA, 2011; EEA, 2005)
Disposal	Landfill and waste incineration where no energy is recovered from the process, and the main purpose is to dispose of the packaging waste (DEFRA, 2011; EEA, 2005)

Table 3 Waste hierarchy explained

As seen in **Section 1.1** packaging waste it split into 3 separate categories. However, for the purpose of this report, waste management options are going to focus around primary packaging.

3.1 PREVENTION

Waste prevention is often defined as the the measures that are taken before the product or material becomes waste (Zacho & Mosgaard, 2016). Prevention of packaging waste is often the key aspect to encouraging the reduction of packaging waste amongst companies and households. As households tend to be the main producers of packaging waste it would be sensible to promote prevention at this level. Prevention management options include changing human behavior to packaging waste.

Prevention of packaging can also be instigated by reducing the amount of packaging used per item (Hopewell et al. 2009) as the over use of packaging is often used for aesthetics and marketing benefits, as well as little investment occurring towards new tools and production to decrease packaging (Hopewell et al. 2009). The design of products could also help to prevent increase packaging waste throughout the UK, as products which are designed so they can be re-used, repaired or remanufactured would result in fewer products entering into the waste stream (Hopewell et al. 2009).

Studies have found that prevention of packaging waste at household levels is not influenced by economic incentives (Cecere et al. 2014) or social pressure (Bortoleto et al. 2012; Cecere et al. 2014), but is in fact influenced by general environmental attitudes, thus enhancing environmental values between consumers is key to prevention (Bortoleto et al. 2012). Some examples of packaging prevention and its application to consumer goods can be seen in **Table 4**.

Company/Industry	Details of prevention method
Heinz Easy open can ends	Thickness of can ends was reduced by 10%. This resulted in a reduction in steel usage by 1400 tonnes whilst also saving 585 tonnes of carbon emissions each year.
Grolsch	Redesigned the shape of their glass beer bottles to reduce the amount of glass that was used by 13%. A second redesign allowed for the bottle to be an extra 15% lighter than the first redesign.
Duchy originals	Made changes to their packaging by changing the cartons to thinner cardboard without affecting the performance and strength. Overall 11% reduction was made.

Table 4 Case studies of changes made to packaging to help the prevention of packaging waste (Source: WRAP, 2011).

3.2 PREPARING FOR REUSE

By re-using primary packaging waste it reduces the number of raw materials used in manufacturing whilst also postponing the amount of waste that goes to landfill. However sometimes the costs of such implementations costs more than it would to use single use packaging, thus affecting the number of people that re-use packaging (WRAP, 2011).

Deposit schemes have proved to be beneficial in several areas of primary packaging waste as it gives incentives for retake and recondition of used reuse packaging (Golding, n.d.). By creating a packaging product that is reusable it reduces waste and environmental impacts at the production stage. Glass has often been re-used for the purposes of milk. Straus Creamery in the United States has been using reusable glass mottles since 1994 on a deposit based scheme. The returnable scheme encourages bottles to be returned but also allows the bottles to be washed and sanitized onsite and then reused. This process usually occurs 6-8 times before being recycled (EPA, 2014). Many companies do not promote re-use of their products due to the financial losses that are included. For the re-use of products to be beneficial they will have to set up a location to be able to clean and prepare items such as glass milk bottles for re-use. However, this results in more staff needing to be employed which comes at a large financial cost. This financial cost is often outweighed by the price that companies get for new products rather than re-used, which influences many producers and companies to not reuse packaging and instead create single use packaging (Bartl, 2014). To promote re-use amongst companies a global challenge of improving the economic challenge should be considered (Bartl, 2014), as lower labour taxes and higher taxes for energy and raw material use would promote the re-use of many packaging products (Cooper, 2011). However, the higher taxes for energy and raw material use needs to occur on a global scale for it to be effective (Bartl, 2014).

A management option for primary packaging waste is a packaging Levy also known as a tax on beverage containers (Haulotte et al. 2014), which is designed to encourage consumer behavior and promote re-use through deposit refund schemes (Eunomia et al. 2009). Such management has had success and failure when applied to beverage packaging as reports from Belgium suggested that the level of taxation was not significant enough to work as an effective individual incentive to change consumer behavior (Card, 2016). The difficulty that comes with the packaging levy is that it is often difficult to assess in terms of its effectiveness, as it often tries to target several goals including re-use but also reducing litter and CO₂ emissions (Green Alliance, 2008). Several studies conducted have found that the packaging levy as a form of management has not had a positive impact upon promoting reuse and reuse rates (Jansen, 1999).

3.3 RECYCLING

Majority of packaging waste that is produced can be recycled allowing it to become the most sought of option to reduce packaging waste, however recycling is found to have many costs including the cost to collect, sort and then recycle could possibly be outweighed by other waste management

options which provide less economical cost. Collection schemes have been put forward by local authorities to encourage the recycling of packaging has occurred (Alcalde et al. 2005). The success of these programmes varies across the different regions in the UK as these programmes can only be successful if individual participation is high (Bacot et al. 1993). The participation of individuals is often effected by the knowledge and awareness of the issues surrounding packaging waste and the consequences it has on the environment (Barr et al. 2001; Guagnano et al. 1995; Hornick et al. 1995), the availability of space in the home as recycling boxes often take up a significant amount of space (Boldero, 1995; Franco & Huerto, 1996), and the time that it takes to separate labels and different components of the packaging (Kok & Siero, 1985; Vining & Ebreo, 1990). As there are different materials that make up packaging waste it is important to treat each component separately through different recycling methods. To improve management of recycling several changes can be advised (**Table 5**).

Recycled content	Guidance on management
Glass	<p>Can be recycled indefinitely.</p> <p>Specifications of glass should be reviewed to allow for a greater amount of recycled glass to be used in all glass products.</p>
Paper & Board	<p>Paper cannot be recycled indefinitely-fibres get weaker and shorter each time they are recycled.</p> <p>To improve Paper and cardboard recycling the following should be considered:</p> <ul style="list-style-type: none"> recycled content board should be specified where appropriate, as the strength of the board is often reduced as a result of higher recycled content. Certain foods are recommended to not come in contact with recycled board. For recycling to be improved such issues should be resolved.
Plastic	<p>Plastics are not able to be recycled indefinitely due to losses in performance. For some performance to be maintained when recycled an additional virgin polymer should be added to the process.</p> <p>To improve recycling of plastic the following should be considered:</p> <ul style="list-style-type: none"> Specify the amount of recycled content per item
Metal	Cans are recyclable an infinite amount of times without loss of quality

	Recycling cans reduces the carbon footprint of the next can that is produced.
	Cans are made from materials produced with 50% or more recycled metal.

Table 5 Recycled content and what improvements could be made to recycling of each material (Source: WRAP, 2009).

3.4 OTHER RECOVERY & DISPOSAL

Energy recovery can be used for a variety of primary packaging waste including greasy pizza boxes, which are not suitable for recycling due to contamination. If such methods of management are used appropriately and encouraged amongst consumer and industries, it would be beneficial to helping reduce packaging waste. Although incineration and energy recovery have proved beneficial for products of wood, cardboard and paper, packaging that is made from plastic polymers becomes trickier to recover. There is often concerns over plastic waste in energy recovery due hazardous substances that may be released into the atmosphere. For packaging waste that is made from wood, paper or cardboard, energy recovery has proved to be beneficial in many parts of the UK (WRAP, 2011). However, issues do arise from this method including the high levels of greenhouse gases that are produced from plastics made from fossil fuels, thus sending this plastic packaging to landfill is more preferable than energy recovery methods (WRAP, 2011).

Landfill often seems like the most suitable approach to disposing of packaging waste, however this causes great environmental concern. There is currently limited space for landfills in many countries including the UK, which means that disposing of packaging waste in landfill should be a final resort. A landfill tax has been applied in the UK which aims to prevent the amount of waste taken to landfill and encourage companies and industries to try and recover value from their waste (DEFRA, n.d). The tax is split into two with inert or inactive waste being charged the lower rate of £2.70/tonne, whilst other waste is charged at £86.10/tonne (DEFRA, n.d.).

Although a landfill disposal should be avoided where possible, those landfills which are well managed often provide limited harm to the environment beyond transportation, however there are concerns regarding the long term effects of packaging waste in landfill, because as the packaging breaks down it can often release pollutants which cause soil contamination and groundwater pollution (Oehlmann et al. 2009). This results in landfill being the last management option of the waste hierarchy and should be avoided when possible.

4.0 CONCLUSION

Although many waste management options have been applied throughout the UK and Europe, issues occur due to the collection, transportation, sorting, treatment and the final disposal of packaging waste. Issues also arise due to the origins of waste which is often households, industry and hospitality and the key stakeholders within waste management such as local and national authorities, customers and manufacturers (Walls, 2005; Lavee, 2007).

As packaging is no longer limited to traditional functions of simply protecting a product, it is more often used as a form of promoting a product (Selva et al. 1998), with many companies providing unnecessary packaging to products that do not need protecting or conserving, but instead to provide information (Alcalde et al. 2005). Alternative uses of packaging have been linked to the rise in the accumulation of waste packaging at landfill with over packaging causing pressures on energy and natural resources, which in turn hinders economic development (Alcalde et al 2005).

To accelerate the transition of waste management it is essential for waste prevention to play a larger role in local, regional and national waste management. The UK's leading retailers all signed the Courtauld commitment in 2005, which including meeting three targets (WRAP, 2011):

1. Design out packaging waste by 2008
2. Make absolute reductions in packaging waste by 2010
3. Reduce the total amount of packaging waste over the same period.

Out of these 3 targets only targets 1 and 2 have been achieved, suggesting that current management options in place are not helping to achieve the reduced total amount of packaging waste produced. However, packaging waste is still likely to be high due to changes to packaging provided by retailers and businesses going unnoticed by the general public. Due to the lack of knowledge and information by consumers it is essential to improve the management option of prevention and use this as the main management, as it aims to reduce packaging waste from the start by the reducing the amount of packaging that is given to consumers in the first place.

Word Count: 2729

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