Institute for European Environmental Policy

An IEEP Report for INCPEN

PACKAGING FOR SUSTAINABILITY:
Packaging in the context of the product, supply chain and consumer needs

Claire Monkhouse
Catherine Bowyer
Andrew Farmer

27 Sept 2004

CONTENTS

EXECUTIVE SUMMARY

When the EU Packaging and Packaging Waste Directive was adopted in 1994 (94/62), its aims were outlined as preventing or reducing the impact of packaging and packaging waste on the environment, and ensuring the proper functioning of the internal market. Ten years on, the European Commission is evaluating the Directive with a view to setting out the future direction of packaging policy. A number of studies have been commissioned to feed into this evaluation, covering implementation of the Directive, assessing options to strengthen prevention and reuse and an analysis of the single market aspects. Whilst these are important, it was felt the role that packaging plays in a broader context also warrants attention. Without a clear understanding of the different drivers for the production and use of packaging, it will not be possible to take policy to the next stage. This study seeks to fill that knowledge gap.

Packaging can be seen in two ways. Firstly, packaging prevents waste. Packaging is not a product in itself: it is a means of delivering a product to a customer in good condition and is designed to ensure that the product passes through the supply chain without being damaged.
Secondly, however, packaging becomes waste at the end of its useful life. Despite the prevention objectives of the Directive, the amount of packaging waste continues to increase. Over the period 1997 to 2001 the amount of packaging waste generated increased by 7 percent across the EU as a whole. The EEA[1] estimates that this trend is set to continue, and the amount of packaging waste could increase by 18 percent from 65 million tonnes in 2000 to 77 million tonnes in 2008. Much of this increase is due to demographic and lifestyle changes and is therefore outside of the influence of the packaging chain. However, businesses can help compensate by continuing to design lighter weight packaging and by offering consumers a wider range of pack sizes so that wastage of goods and food is also reduced.

In many instances, under-packaging can cause more waste than over-packaging, in terms of both energy and raw materials. The negative impact of product wastage due to inadequate packaging is substantially higher than the impact of using more packaging to protect the product. Research has indicated that in one sector alone, damage in the European supply chain costs an estimated €3.5billion per year. This not only represents a great loss of financial resources but also a loss of the natural resources that have gone into manufacturing and transporting the product.

The role that packaging plays in preventing the loss of resources therefore needs to be emphasised. Reducing the amount of packaging with the sole objective of reducing the amount of packaging waste we discard risks increasing the amount of goods which are thrown away because they become damaged or spoiled as they pass through the supply chain to the final consumer and therefore place more pressure on natural resources.

It is generally agreed that in the absence of additional policy measures, waste generation in the EU is likely to increase for the foreseeable future[2]. In determining the next steps for packaging policy, there needs to be a full understanding of the role that packaging plays in society. This study identifies a vast array of drivers which impact on the amount of packaging placed on the market. Changing demographics and lifestyles, including the trend towards smaller households, an ageing population, an increase in the number of people living alone,

[1] EEA (2004): Presentation to the conference: Packaging our Futures, 1-2 March 2004
[2] COM(2003)301 op cit

and demands for convenience, all have an impact on the type of products demanded by the consumer. Industry needs to respond to these changes but itself has no control in determining demographic trends. Where industry does have control is in the designing of packaging that is ‘fit for purpose’. Packaging needs to fulfil a number of criteria to ensure that the product is delivered to the consumer in good condition. Industry is faced with a number of trade offs, balancing the need to reduce the environmental impact of packaging with the need to ensure that it performs well and prevents wastage of products in the supply chain. The specific demands placed on the packaging by the end-user may be relatively limited compared with those demanded by production, distribution and storage processes. These demands and trade offs are rarely evident to the final consumer.

There are clearly a number of factors that influence the amount of packaging and packaging waste placed on the market. What is not clear, however, is where attention now needs to be focused to achieve the objectives of the Directive. Policy measures to date have focused on preventing waste through packaging minimisation and encouraging reuse, recovery and recycling by the setting of targets. Whilst there has been success in the achievement of targets for recovery and recycling, it is widely acknowledged that preventing waste remains a major challenge. This is true of waste in general and is not confined to this particular waste stream alone.

The EU is committed to tackling this challenge and is currently developing two closely related Thematic Strategies: The Thematic Strategy on the sustainable use of natural resources and the Thematic Strategy on the prevention and recycling of waste. The former focuses on the need to reduce the environmental impact of resource use and decouple environmental degradation from economic growth, whilst the latter will identify the most efficient combination of measures and targets necessary to promote more sustainable waste management. The issues being discussed during the development of these Strategies have many overlaps with the debate on packaging. Consequently, it is essential that policy relating to packaging be developed in this context, not in a separate piecemeal fashion.

Conclusions

- Industry has taken a number of steps forward in terms of packaging minimisation. However, the amount of overall municipal waste generated continues to increase and more needs to be done to reduce it.
- In formulating policy it needs to be acknowledged that many drivers for increased packaging are outside of industry’s control, such as changing demographics and lifestyles.
- There are a number of factors to take into consideration when designing packaging to be ‘fit for purpose’ and industry has to make a number of trade-offs.
- It needs to be emphasised that packaging has a role to play in the prevention of product and resource wastage.
- The challenge is to design packaging systems to get goods from production to consumption without damage using the minimum amount of resources and generating the least amount of waste.
- The Essential Requirements Regulations are enforced only in the UK and France. Other Member States also need to enforce them

Policy Recommendations

- Packaging policy needs to be developed within the context of overall strategic sustainability policy.
- Policy needs to promote and support activities which result in environmental benefits.
- Taking an overall resource use approach, attention needs to be focused where most environmental impact is taking place.
- There is a need for a mix of policy measures, which could include:
  - Best practice guidelines.
  - Sector or product working groups aimed at sharing good practice and problem solving.
  - Better enforcement of the Essential Requirements.
  - Further use of standards.
- Commercially viable markets need to be further developed for recycled materials.
- UK policy needs to address the issue that basing targets on weight alone provides a disincentive to increasing recycling rates for lightweight recyclable materials.
- Policy needs to be flexible, whilst maintaining common high environmental standards, so that it can be applied to the different local contexts of 25 Member States.
- More needs to be done on making consumers aware of their impact on the environment

INTRODUCTION

When the Packaging and Packaging Waste Directive was adopted in 1994 (94/62), the aims were outlined as preventing or reducing the impact of packaging and packaging waste on the environment and ensuring the proper functioning of the internal market. The environmental objectives were to prevent the production of packaging waste, reduce the hazardousness of packaging waste and to encourage reuse, recycling and recovery.

At present, waste is more than ever at the forefront of EU policy as policy-makers strive to meet the challenges of reducing the amount and hazardousness of waste generated and ensuring that it is better managed. Total waste quantities continue to increase in most European countries. The amount of waste generated is equivalent to approximately 3.5 tonnes per capita per year[3]. At the same time, the negative externalities of managing and treating waste are being realised and there is a continued drive to divert waste away from landfill, which accounts for two-thirds of total European municipal waste disposal.

Although a waste stream approach, for packaging and other streams has resulted in some benefits, there is growing recognition of the need to take a holistic approach to resource use and waste management. With the development of Thematic Strategies on waste prevention and recycling and on natural resource use, the debate on where the focus of EU waste policy should be looks set to stay high on the policy agenda.

Against this policy context, the European Commission is taking a closer look at the Packaging Directive, ten years after its adoption and has to present a report to the European Parliament in June 2005. To inform this, DG Environment has commissioned a study to evaluate the implementation of the Directive and assess options to strengthen prevention and reuse, for completion by October 2004. DG Enterprise has commissioned a separate study to cover the Single Market aspects of the Directive.

Whilst these discussions are important, it was recognised that there is a need to take a more comprehensive look at packaging, including its role and the factors that drive companies' choice of packaging and consumers' choice of packaged goods. DG Environment encouraged INCPEN to carry out research in parallel with the Commission's research programme to explore this issue further. The findings will feed into the decision-making processes on the review of the Directive.

This study therefore seeks to demonstrate the role that packaging plays in society. The report is structured as follows:

- **Section 1 - Packaging and the environment:** Packaging has an important role to play in preventing waste before itself becoming waste. This section identifies where packaging prevents product loss through the supply chain and in the home. It also places packaging in the context of overall waste generation and environmental impacts.
- **Section 2 – Drivers for packaging:** This section forms the main body of the report. It looks at the extensive range of factors which influence the amount of packaging placed on the market. Section 2.1 analyses the social and market drivers for packaging, such as changing demographics and lifestyles. These drivers are largely

[3] Towards a thematic strategy on the prevention and recycling of waste, COM(2003)301, 27.5.2003

outside the control of industry. Section 2.2 identifies the many factors involved in designing packaging that is 'fit for purpose', including the need to protect the product through the supply chain, production efficiency, cost effectiveness, etc. These factors are largely within industry's control. Case study examples are used throughout this section. This information has been obtained from interviews with selected industry representatives. It is not intended to be a comprehensive review of experience; rather it provides indicative examples to bring to life the points raised.

- **Section 3 – Environmental innovation and evaluation:** Even before the Packaging Directive, there was a business imperative to minimise the amount of packaging used from a cost perspective. This section provides examples of how industry responds to all the drivers in section 2 through innovation. It also looks at how packaging is continually improved by testing and ongoing evaluation.
- **Section 4 – Packaging in the waste policy context:** This section discusses the current policy context within which packaging needs to be seen. It looks at what waste policy is aiming to achieve and provides details of the current Thematic Strategy approach.
- **Section 5 - Conclusions and Recommendations**.

Acknowledgements

IEEP and INCPEN would like to thank all the people interviewed for the study, and those who provided valuable information for the case studies.

1. PACKAGING AND THE ENVIRONMENT

The Packaging and Packaging Waste Directive defines packaging as all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the end user or consumer. It consists of (a) primary packaging - the individual sales unit to the final user or consumer; (b) secondary or grouped packaging – packaging which groups a certain number of sales units together but is not part of the product itself and (c) tertiary or transport packaging – packaging which facilitates handling and transport. In simple terms, its role is to ensure that the product gets from the end of the production line to the final consumer in good condition. Packaging therefore plays an important role in preventing waste in three respects:

- Preventing wastage of the product itself as it passes from producer to the consumer
- Preventing wastage in the home
- Preventing wastage of all the resources that go into making the product, transportation, selling and using it

Perhaps the most obvious of these points is the prevention of product waste, and section 2.2 explores in greater depth the role that packaging plays in the preservation and protection of products. The business imperative is obviously to reduce product loss, thereby maximising profit levels. Companies will often set an acceptable wastage rate, dependent on the product properties and value then design packaging to perform at or better than this rate.

It has been commented that whilst much is known about performance within the manufacturing process, once the product passes beyond the factory boundary little feedback is provided about the performance of packaging as it passes through the supply chain. Kooijman (1995)[4] found that surprisingly little data on loss rates for foodstuffs from distribution to retailing has been published.

UK CEED (1995[5]) also carried out research and found that companies were conducting extensive in-house testing and distribution/storage trials to see how well the packaging prevented product loss and damage but little information was collected on packaging performance and product loss once a product had left the production line. This made it difficult for the companies to determine the relative effectiveness of existing packaging designs and so achieving the right balance between packaging use and product loss was often a result of trial and error. It concluded that one of the main reasons why monitoring has not been carried out systematically is that many producers rely on independent distribution companies to move their products from the production line to final users. The information flow between these companies has, in the past, been limited.

More recent research by PIRA[6] supports this – see the box.

---

[4] Kooijman, Dr J M, 1995: *Environmental impact of packaging – performance in the food supply chain.*
[5] UK Centre for Economic and Environmental Development (UK CEED), 1995: *Packaging in a Market Economy*.
[6] *PIRA (2003) Realising Profit Improvement through Reducing Damage in the Fast Moving Consumer Goods Supply Chain.*

'Much of the data relating to shrinkage goes unrecorded and insufficient information passes along the supply chain, making attempts to resolve the issues difficult. It was found that most companies fail to think in terms of the supply chain, instead they tend to tackle those issues relating to their own business in isolation'.[7]

Damage in the fast moving consumer goods supply chain

As part of its International Strategic Futures research programme, PIRA produced a report[8] investigating damage in the fast moving consumer goods (fmcg) supply chain. The research examined the costs associated with damage looking at data from existing studies and carrying out new qualitative and quantitative research. The report concluded that:

- The **cost of damage is not truly known** at individual company and industry level and losses in general are not well recorded, evaluated, quantified or managed.
- Best estimates are that fmcg damage in the European supply chain costs as much as **€3.5bn each year**, with the total supply chain loss figure (including theft) placed at €18bn, **equating to over 2% of the whole sector value.** The real cost of damage would be far greater than €3.5bn, taking into account indirect costs.
- **Manufacturers are driving much of the damage reduction work** and currently **retailers are not prioritising the issue**, but are passing pressure back up the chain, rather than collaboratively involving themselves in improvement.
- The main **cause of damage was manual handling, primarily associated with order picking at regional distribution centres, in roll cage use and manual shelf filling**.
- To reduce damage, the **balance between packaging performance level and the physical hazards of supply needs to be redressed**. On the one hand, packaging could be upgraded, resulting in an increase in packaging. This runs contrary to environmental legislation and likely future consumer pressure, which is driving industry to minimise packaging. Under some circumstances increasing packaging would result in an overall saving for manufacturing, if the balance between pack spend and savings generated through damage reduction were favourable. On the other hand, changes could be made to handling systems at the wholesaler and retailer stages and this is increasingly being considered.
- There are significant drivers for both manufacturing and retail to work collaboratively to resolve supply chain damage and that **collaboration is critical to progress.**

[7] PIRA *(2003) Realising Profit Improvement through Reducing Damage in the Fast Moving Consumer Goods Supply Chain*
[8] *PIRA (2003) op cit*

Preventing wastage in the home

Koojiman (1995)[9] found that even less information is available for the consumer-controlled part of the food chain. Losses at this stage include:

- Fresh or prepared foodstuffs which never reach the kitchen or consumption stage because they have deteriorated during storage
- Food which clings to the wall of the packaging and is thrown away with it
- Discarding of inedible parts of fresh foods such as fruit skins and cores, and animal bones and fat
- Discarding of suspending liquid or syrup from canned foods
- Food left uneaten on the plate and subsequently discarded.

A study completed in 2004 for the Department of Environment, Food and Rural Affairs (DEFRA) in the UK estimated that 3%-6% of purchased food is discarded and food waste is 10%-20% of the food consumed[10].

Using milk as an example, Kooijman (1995[11]) estimated that far more energy would be saved if consumers reduced the amount of milk wastage at home, rather than changing the type of packaging used:

Maximum UK energy saving from changing from one type of milk container to another (glass refill bottle, carton, plastic bottle or pouch)	168 kJ
Minimum energy saving by reducing milk wastage at home by buying the right amount	250 kJ

A Swedish study[12] has recently looked at the influence of packaging on product losses in the home. It was considered that, to a large extent, the environmental debate has focused on packaging and its environmental impact, without much consideration of the environmental benefits of packaging in protecting the product and preventing waste.

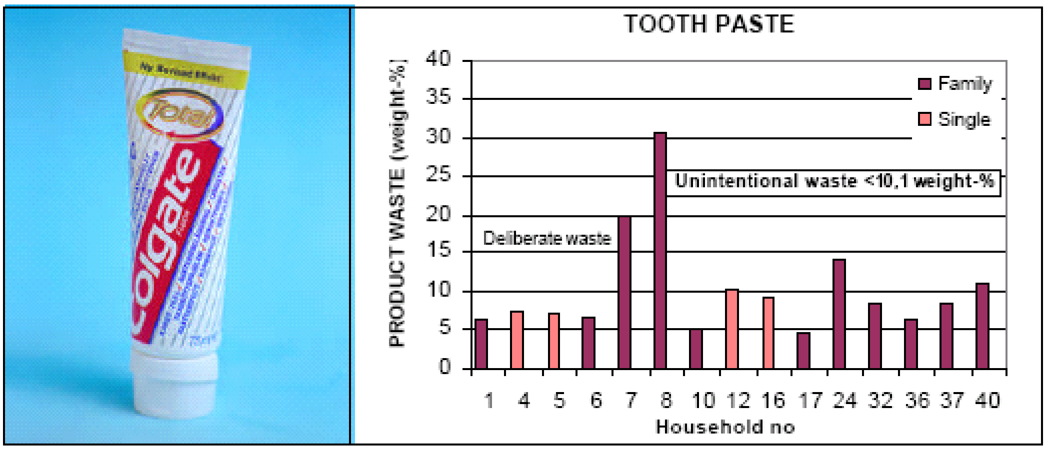
'Both product and packaging cause environmental impact and if the package cannot fulfil its protective function, for instance because its material contents have been reduced, the total environmental impact from the product-packaging systems increases due to increased product waste'.

The study looked at what is termed 'deliberate waste', that which occurs when the product has become unusable and 'unintentional waste', that which is left in the packaging when the consumer considers it emptied. The aim of the study was to find combinations of package and

[9] Kooijman, Dr J M, 1995: *Environmental impact of packaging – performance in the food supply chain.*
[10] Enviros et al (March 20004) Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes, DEFRA
[11] Kooijman, Dr J M, 1995: *Environmental impact of packaging – performance in the food supply chain.*
[12] Johansson, B, (June 2002) The influence of packaging on product losses in the households – A study performed by means of a test group, Report No 204. STFI-Packforsk AB

product that cause product waste, to highlight where efforts can be focused on minimising loss, as opposed to minimising weight. A test group of 40 households was established to look at unintentional product waste. Earlier studies had indicated that consumers have great difficulty in estimating how much of the product is left in the package when it is thrown away and usually under-estimate the amount being wasted. The study took twenty of the most common everyday commodities, including yoghurt, bread, toothpaste, ketchup, milk, margarine and shampoo and analysed the product content of discarded items. It found that unintentional product waste was as much as 5-10 percent, the range depending on the product. Toothpaste in a plastic tube, for example, gave the highest unintentional product waste (average 10.1 percent). The study also highlighted that another for product waste is pricing, when consumers buy more of a given product than they need, because of the lower price per unit of larger packs, and promotions which offer, for example, '3 for the price of 2'.

Figure 1: The level of toothpaste wastage in the home



Reproduced with permission from STFI-Packforsk AB

The level of wastage not only represents a loss of resources but also a loss of money for consumers. For example, product loss from yoghurt pots is relatively small at 2.8 percent of weight. However, based on this level of loss, the volume of sales and price, consumers in Sweden lose an estimated €100,000 every year on yoghurt

The study recommends that to minimise unintentional product waste, a package should have as many of the following properties as possible: large opening, transparent appearance, ability to be placed upside-down and easy to re-close. The contents should be easy to pour, press or scrape out and have a long shelf life. Furthermore, it argues that unintentional product waste could be reduced if better information is given to the consumer about the packaging. To prevent deliberate product waste, it suggests that consumer behaviour needs to be influenced.

Preventing waste of resource inputs

The need to prevent wastage of products is not only due to the economic value of the goods but also to prevent the wastage of resources that have gone into making the product and transporting it to the point where damage occurs. In many instances under-packaging can cause more waste than over-packaging, in terms of energy and raw materials.

Kooijman (2000)[13] demonstrated that in the UK, the amount of energy locked up in the production of goods is at least ten times that used for the packaging (see table 1). When considering energy consumption the negative impact of product wastage due to inadequate packaging is substantially higher than the impact of using more packaging to protect the product. This represents a significant loss of resources to society, not to mention the implications of increased waste.

Table 1: Comparison of Selected Energy Requirements (GJ/year, UK)

	Food & drink	**Clothing & Personal care**	**Home & Interior**	**Education, leisure, transport**	**Total**
For goods production	21.0	26.0	24.0	38.0	109.0
For packaging production	4.6	1.0	0.7	0.8	7.1
For transport from factory/farm to shop	1.6	0.2	0.1	0.2	2.1
For heating, cooling and lighting shops	1.3	0.1	0.1	0.1	1.6
Used by consumers at home and for transport	14.0	1.0	80.0	43.0	138.0
Total energy consumption	**42.5**	**28.3**	**104.9**	**82.1**	**257.8**

Research from Packforsk shows that taking overall resource use into account, the negative impact on the environment is higher if a product is under packaged rather than over packaged.

Packaging also has a role in preventing the use of other resource inputs in the home. For example, some packaging enables food to be stored without refrigeration. However, there is also a trend in the opposite direction in that lifestyle changes which reduce the time spent on shopping and cooking leads to an increased demand for chilled or frozen ready-meals.

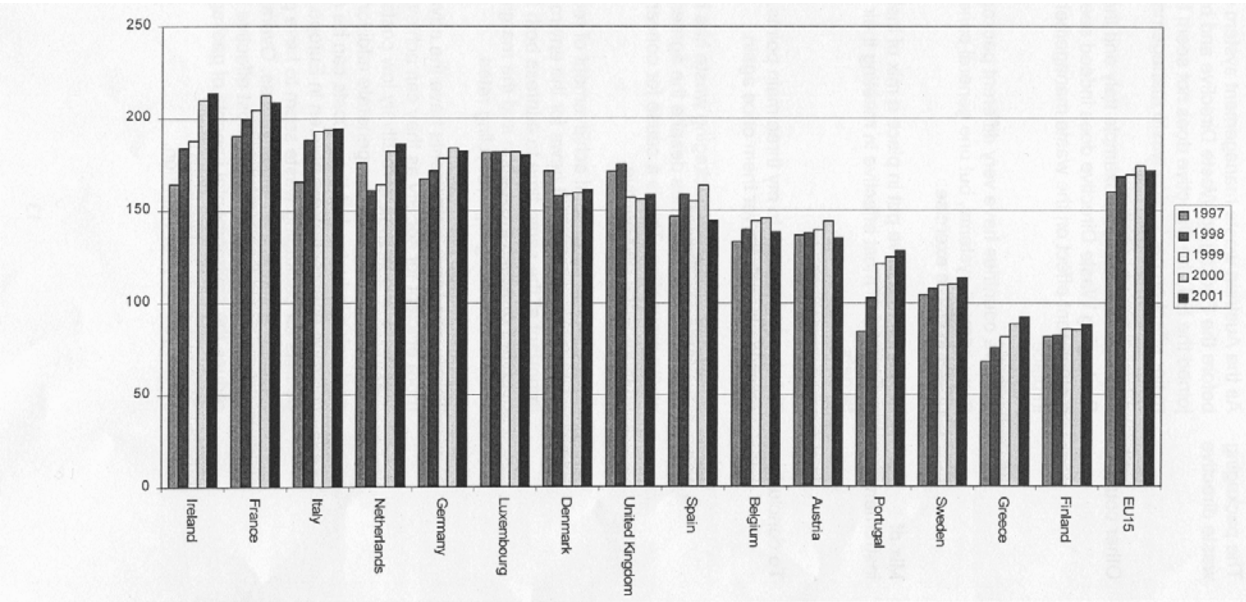
Why is packaging an issue?

The role of packaging in preventing waste has been outlined. However, packaging also generates waste and it is here where most attention has focused in terms of policy and consumer awareness.

[13] Kooijman, Dr J M (2000) *Environmental impact of packaging – performance in the household.*

Despite the prevention objectives of the Directive, the amount of packaging waste continues to increase in most European countries mainly because of lifestyle and demographic trends (see Figure 2). On average, across the whole of the European Union, the amount of waste packaging generated per head of population increased from 161 kg in 1997 to 169 kg in 1999[14]. The total amount of waste packaging generated within the European Union (15 Member States) in 1997 was around 60 million tonnes[15], and over the period 1997 to 2001 the amount of packaging waste generated increased by 7 percent across the EU as a whole. The EEA[16] estimates that this trend is set to continue, and under a business as usual scenario the amount of packaging waste could increase by 18 percent from 65 million tonnes in 2000 to 77 million tonnes in 2008. A paper presented to the Informal Environment Council meeting (14-16 May 2004) noted that it is clear that even in the packaging sector, the waste stream that has received significant attention, there are trends in society that necessitate the use of more packaging.

Figure 2: Packaging waste generation in the EU15 (kg/capita)



The generation of packaging waste is closely related to production and consumption in society. There is therefore a major challenge to decouple the generation of waste from economic growth in a society where disposable incomes are increasing. A more specific factor for packaging is that a large percentage of packaging waste is related to food consumption. As section 2.1 highlights, demographic and lifestyle changes mean that consumers are demanding more imported foods, pre-prepared foods, and smaller portion

[14] Report from the Commission to the Council and the European Parliament on the implementation of Community waste legislation: Directive 75/442/EEC on waste, Directive 91/689/EEC on hazardous waste, Directive 75/439/EEC on waste oils, Directive 86/278/EEC on sewage sludge and Directive 94/62/EC on packaging and packaging waste, for the period 1998-2000, COM(2003)250, 11.7.2003

[15] COM(2003)250 op cit

[16] EEA (2004): Presentation to the conference: Packaging our Futures, 1-2 March 2004

sizes. All of these factors contribute to an increase in the amount of packaging required but reduce product waste.

Packaging in the context of overall waste generation

According to figures presented in the Commission's proposal[17] to amend Directive 94/62, packaging waste represents about 17 percent of the municipal solid waste by weight and 3 percent of the total waste stream. For some materials, such as glass, plastics and paper/cardboard, packaging waste represents a high share of the total material waste, about 70 percent for glass, 60 percent for plastics and 40 percent for paper and cardboard. The sources of packaging waste vary from material to material. Households generate most of the used glass and roughly one-third of paper and cardboard waste. The rest comes from industrial and commercial sources. Plastics are more or less evenly split between household and non-household sources and metals originate slightly more from household than from non-household sources.

Total waste generation in the EU is approximately 1.3 billion tonnes per year (excluding agricultural waste) and total waste, including municipal and industrial amounts to approximately 3.5 tonnes per capita per year[18]. According to the European Environment Agency, five major waste streams make up the bulk of waste generation in the EU: manufacturing waste (26 percent), mining and quarrying waste (29 percent), construction and demolition waste (22 percent), municipal solid waste (14 percent) and agricultural and forestry waste[19]. Together these waste streams account for 90 percent of waste generated.

It is generally agreed that in the absence of additional policy measures, waste generation in the EU is likely to increase for the foreseeable future[20].

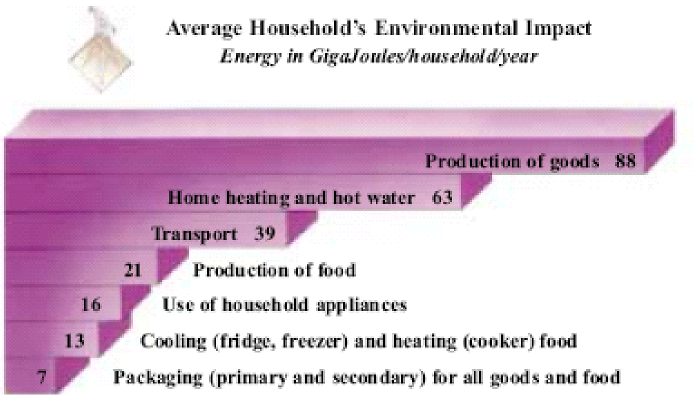
Packaging in the context of other environmental impacts

Packaging also needs to be considered in comparison to other activities which have an environmental impact. For example, research by Kooijman (1995) showed that packaging is responsible for only 7% of the annual energy use a typical household[21]. The figures also demonstrate the loss of energy resources when products are damaged or wasted in the household. For example, the average household uses food that has been produced using 21 GJ of energy and other goods produced using 88 GJ per year. It is essential therefore that these resources are not wasted as a result of, *inter alia*, poor packaging.

---

[17] Proposal for a Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste, COM(2001)729
[18] Commission Communication '*Towards a Thematic Strategy on the prevention and recycling of waste*' COM(2003)301, 27.5.2003
[19] COM(2003)301,op cit
[20] COM(2003)301 op cit
[21] Kooijman (1995) op cit

Figure 3: Average household environmental impact



Looking at the environmental impacts associated with waste in particular, a recent report for the UK Department for Environment, Food and Rural Affairs (DEFRA)[22] investigated the environmental and health effects of different municipal solid waste (MSW) management options and compared them to impacts from other sources. It concluded the following:

- CO_2 has significant global warming potential –MSW management accounts for around 2.4 percent of total UK emissions of CO_2, transport accounts for 21 percent;
- Benzene may cause cancer – emissions of benzene from MSW operations account for less than 0.2 percent of total UK benzene emissions, transport accounts for 47 percent;
- Dioxins and furans are associated with effects on human development, reproduction, damage to the immune system and are probably carcinogenic. Emissions of dioxins and furans from MSW operations account for around 1 percent of total UK emissions, divided roughly equally between incineration and emissions from burning landfill gas, transport accounts for about 3 percent of the UK total
- Nitrogen dioxide affects air quality in urban areas and contributes to acid rain – MSW management accounts for less than 1 percent of the UK total, road traffic is responsible for around 42 percent.

Speaking at a recent conference[23], Catherine Day stated that there were a number of challenging questions to be addressed regarding where the EU should focus attention on environmental policy. For example, is it better to have an overarching goal of combating climate change or reducing the depletion of resources? The answer to this question needs to guide future policy development.

In conclusion, packaging plays an important role in reducing waste and minimising the loss of resources involved in production and transport. But packaging also generates waste. Therefore, the challenge for policy makers is to identify the requirements on packaging which allow for an optimal balance between its positive and negative outcomes.

[22] Enviros et al (March 20004) Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes, DEFRA
[23] Packaging our Futures, 1-2 March 2004

2. DRIVERS FOR PACKAGING

The total amount of packaging placed on the market is a function of both the amount of material per pack and the total number of packaged goods on the market. The amount of material used per pack is largely under industry's control. However, the number of packaged goods on the market depends on factors such as the economic climate, demographics and consumer preferences.

This section explores in detail the different driving forces behind packaging, using case study examples from industry to illustrate the points raised. Firstly, the market forces influencing packaging will be explored, before looking at the functional 'fit for purpose' characteristics of packaging.

2.1 Social and Market Drivers for Packaging

There are various social and economic factors that can drive packaging demand. These range from changes in Gross Domestic Product (GDP) and disposable income, to more subtle changes in lifestyle such as changes in shopping behaviour, living arrangements and time availability. A good summary of some of these issues and their interaction with packaging, is provided by work completed by the Packaging Stakeholder Forum (brought together by INCPEN). The Forum identified various factors that may influence packaging demand. Table 2 highlights the social and socio-economic factors considered to be an issue by the Forum. These are further expanded upon in the following sections.

Table 2: Selected socio-economic factors' impact on packaging[24]

	Reduced Packaging	More Packaging
The economy	Recession	Economic growth
Increasing number of one-person households		More goods, more smaller portions to avoid food wastage – more packaging
Ageing population		More easy-open features & clearer type size for instructions, require more material per pack
More women working full-time outside the home; Families tending not to eat together		More ready-meals which need more sophisticated packaging; Small portions avoid food wastage, but need more packaging
More meals eaten away from home	Catering packs mean less packaging per serving	

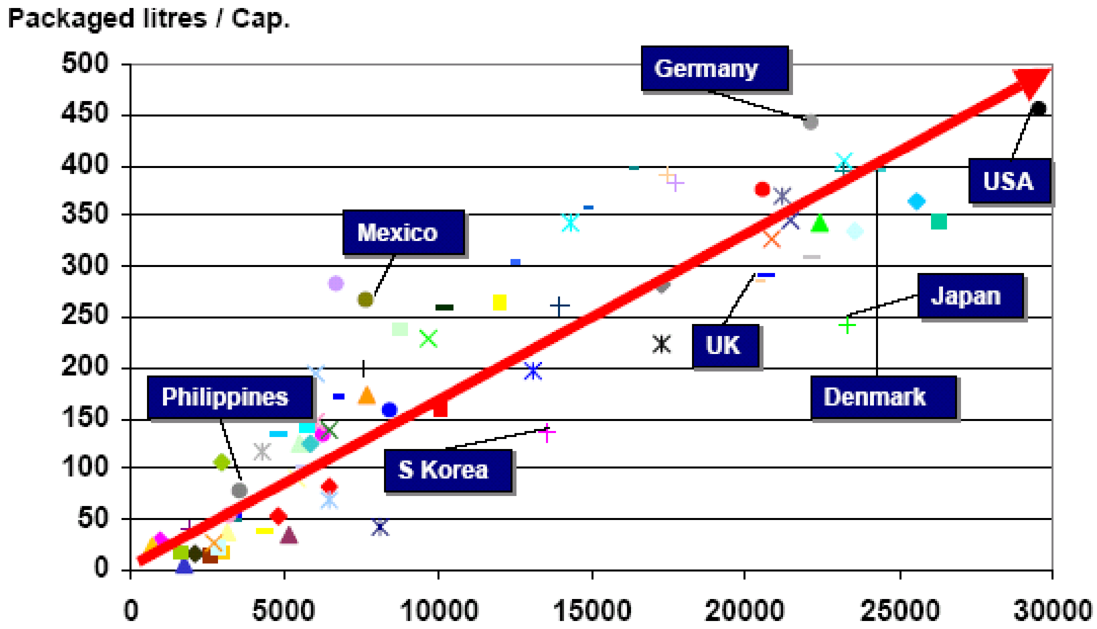
[24] Packaging Stakeholder Forum, 1997

Health concerns		Demand for fewer preservatives, means more packaging to provide same shelf-life; Encouraging children to eat fruit – small portions packaged to appeal; Increased demand for tamper-evidence and child-resistant closures, means more material per pack

Economic Drivers

Several studies have shown that as wealth increases, so too does consumption of goods and services. Though, in the most affluent societies, expenditure on private health care, education and leisure activities increases and these do not involve the use of additional resources. In some areas, the amount of packaging placed on the market also increases with GDP. The example below shows an increase in the sale of packaged drinks linked to increasing GDP (see figure 4)

Figure 4: Packaged beverages versus GDP/capita[25]



GDP/CAP (PPP$)*

* Gross national product per capita converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNP as a US dollar has in the United States.

Source: World Drink Trends, Zenith International, Canadean, The World Bank, Rexam Estimations.

[25] World Drink Trends, Zenith International, Canadean, The World Bank, Rexam Estimations*. Provided by REXAM (2004)

Though there are significant differences in the levels of wealth between and within countries, and there have been economic difficulties in many major economies since 2001, in general it continues to increase. Table 3 demonstrates the rising levels of GDP in the EU, the US and Japan. At the Lisbon European Council in March 1999, it was decided that 3% economic growth per annum was a sustainable level, and that the EU should seek to maintain this[26].

Table 3 – GDP Growth in the EU15, New Member States, the US and Japan
(constant prices where 1995 levels = 100). Figures expressed as % change on previous year.

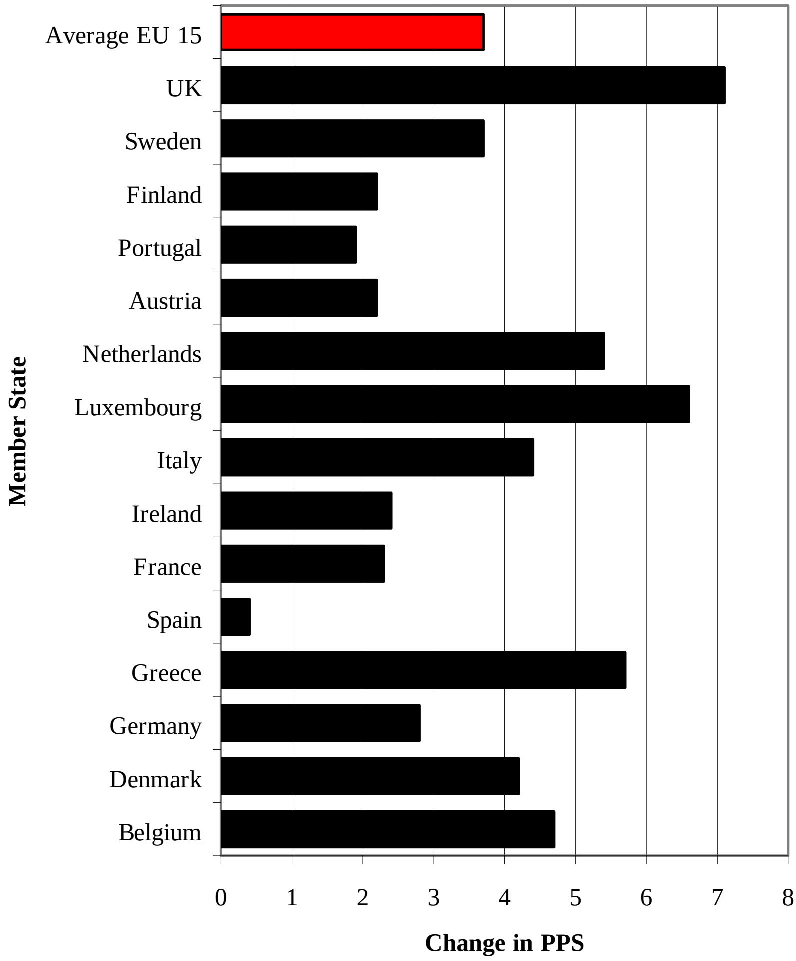
Country	**1994**	**1995**	**1998**	**2002**	**2003**
EU 15	2.7	2.4	2.9	1.0	0.6
EU new Member States	-		-	2.4	3.1
US	4.0	2.5	4.2	2.2	3.1
Japan	1.1	1.9	-1.1	-0.4	2.6

Source: Eurostat

Furthermore, average household expenditures are also increasing. As they do, consumption increases above the levels needed to survive, with products increasingly being used to demonstrate status or fulfil emotional needs. There may also be an increase in purchasing luxury items. Figure 5 shows that the purchasing power in Member States and across the EU as a whole increased over the period from 1994 to 1999.

[26] Presidency Conclusions, Lisbon European Council, 23-24 March 2000:
http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/00100-r1.en0.htm

Figure 5 – The change in household expenditure between 1994 and 1999 in the EU15
Values based on Purchasing Power Standard of which every unit can buy the same amount of products across the countries in the specific year.



Source: Household Budget Survey 1994 and 1999 (Eurostat).

Globalisation

As trade barriers are broken down, allowing markets to expand and manufacturing to be out-sourced throughout the Member States and beyond, the distance that goods must travel is increasing. In addition, the emergence of consumer classes as countries develop creates demands for goods to be transported to new destinations. This has implications for wider environmental and social policies but also for packaging, as it must withstand increased levels of transportation and survive different conditions, though there has been little investigation of the relationship between international trade and packaging. Within the packaging and retail industry this has led to an increase in the level of transit packaging required, and attempts to innovate in order to develop systems of packaging which maximise logistical efforts.[27]

[27] British Retail Consortium interview 2004

Demographic and Lifestyle Drivers

Reducing average size of households

The average number of people per household is declining (see Table 4). This has considerable implications for packaging and is a trend which can be observed across the all Member States, although to a varying degree. The trend towards smaller households has been driven by a number of factors including: couples having fewer children, fewer and later marriages, an increase in divorce and increased life expectancy. These trends have led to an increase in the number of children living with one adult and an increase in the number of single person households.

Table 4: Changing household size, 1993 - 2002 in Selected EU Member States

Member State	**1993**	**1997**	**2002**	**Change 1993 - 2002**
Greece	2.8	2.6	2.6	**-0.2**
Spain	3.3	3.2	3	**-0.3**
France	2.5	2.4	2.4	**-0.1**
Italy	2.7	2.7	2.6	**-0.1**
Luxembourg	2.7	2.6	2.5	**-0.2**
Austria	n/a	2.5	2.4	**n/a**
Portugal	3.1	2.9	2.9	**-0.2**
United Kingdom	2.4	2.4	2.3	**-0.1**
Czech Republic	n/a	2.7	2.6	**n/a**
Slovenia	n/a	2.9	2.6	**n/a**
Slovakia	n/a	n/a	3.1	**n/a**

Source: Eurostat

In particular, life expectancy has an important impact on packaging. This has risen by approximately 10 years over the last 50 years. In addition to the increase in single occupancy households, this has implications for packaging in terms of the need to consider issues such as openability (see 2.2).

Work by Kooijman (1995) has demonstrated that the environmental impact of household consumption varies significantly with household size. Reduced household size means that individuals generally consume more resources as the ratio between a resource and the users is reduced, ie. in larger households cooking, cleaning, entertainment and other equipment may be shared. In terms of packaging it means that people generally buy smaller packs to meet the needs of the household which means more packaging but potentially less product waste. Table 5 illustrates the point that smaller households tend to consume more per person. The difference between the figures is greatest when it relates to resources that could be shared if the household were larger, as opposed to items which are more generally for individual use, ie food and home and interior products versus clothes and personal care products.

Table 5: Number of items purchased per year by household size and per person

Consumable category	Number of items purchased per year			Average number of items purchased per person per year		
	1 person household	**2 person household**	**3+ person household**	**1 person household**	**2 person household**	**3+ person household**
Food and drink	2200	2900	3300	2200	1450	<1100
Clothing and personal care	290	460	630	290	230	<210
Home and interior	175	180	185	175	90	<62
Education, leisure, transport	650	840	960	650	420	<320
Total	***3315***	***4380***	***5075***	***3315***	***2190***	***<1658***

Source: Kooijman 1995[28]

The influence of household size on packaging

A manufacturer of canned fruit offers pineapple in a range of can sizes in each European country. It finds that in southern Europe, where family sizes tend to be larger and it is common for extended families to live together, the largest size of can is the most sold. However, in northern Europe, where household sizes are shrinking and many more people live alone, the smallest size of can is the one most commonly sold. As household sizes gradually shrink in southern Europe, smaller sizes of canned pineapple are becoming more popular there too. The company feels that, given a choice of sizes, consumers naturally buy the size that is least wasteful for their particular situation.

Change in Shopping Patterns

Shopping habits can have a significant influence on the type of packaging required. Shopping habits are changing - increasingly people's lifestyles do not allow them to shop for perishable goods on a daily basis. Therefore, goods must be packaged to allow longer-term storage. Another change in the way people shop is the increasing use of internet ordering and delivery of goods. Online ordering can reduce some environmental impacts such as traffic emissions. However, its impact on packaging is still unclear and dependent on the application of packaging to the situation.

Convenience and Fitting into Hectic Lifestyles

Peoples' eating and food preparation habits, along with their shopping habits, have altered due to the shift in the way in which people organise their time. For example, more women now work outside the home and people often eat on the move. According to a recent speech

[28] Kooijman, Dr J M, 1995: *Environmental impact of packaging – performance in the food supply chain.*

by the EEA, the average time spent in the kitchen preparing a meal is 6 minutes[29]. This means that people are increasingly allowing less time for food preparation and want food to be presented in a form that is easy to prepare and cook and hence fit into their lives. Retailers have to take these drivers into account. The amount of pre-prepared food is on the increase as are smaller single person portions. This also has to be considered in the design of the packaging and can often mean that the amount of packaging needed per product is increased.

Another aspect of eating habit change is that rising disposable incomes have led to an increase in the tendency to eat out. Eating out can be spontaneous and therefore people need food products which they can store for longer periods to deal with this unpredictability. This is a particular issue in smaller households, where food consumption patterns can be particularly unpredictable.

Meeting the demands of 'on-the-move consumers'

"I eat my breakfast, put on my make up and talk on the phone on my way in"
(Atlanta car commuter)

The increased demand for convenience is one of the main drivers for new packaging. Convenience could simply be smaller sizes for smaller households but also purpose-made packaging of any kind to make it functional and more appropriate for an occasion or a location.

Consumers across the developed world are increasingly consuming 'on-the-go' to save time. This is a growing and profitable segment with a flow of new products and packaging.

According to a study made by Datamonitor, Europeans make 540 billion journeys/year, 4 trips on average per day, which means that we spend 1 hour every day on the move. The European 'on-the-move' market for food and beverages is estimated to be worth around €70 billion. The challenge is to develop packaging that functions on the move.

2.2 The need for packaging to be 'fit for purpose'

According to the Packaging Directive packaging is used 'for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer'. Packaging is not a product in itself it is a means of delivering a product to a customer in good condition. Before its ultimate disposal by the final consumer it has been used by the manufacturer, wholesaler and retailer to protect the goods while they are being transported, stacked, stored and displayed.

The product, its packaging and the various processes to which it is subjected form part of an integrated product supply system. The selection of packaging is dependent not on discrete choices made in isolation but on a number of often complex trade-offs and compromises being made between the different supply chain demands. These trade-offs are rarely evident to the final consumer. The specific demands placed on the packaging by the end-user may be relatively limited compared with those demanded by production, distribution and storage

[29] EEA presentation: Packaging our futures conference, 1-2 March 2004.

processes and this may lead the consumer to assume that any packaging not required for final consumption is over-packaging.

The following explores in depth the many functional roles that packaging needs to perform, including:

- Cost effectiveness
- Containment of the product
- Preventing waste - protection and preservation of the product
- Production efficiency
- Logistics issues, such as transport, warehousing and handling
- Product presentation and marketing
- Information provision
- Safety requirements
- Usability of the product
- Tamper and theft prevention.

In addition, packaging must comply with the Essential Requirements of the Packaging Directive.

Cost effectiveness

It makes good business sense to reduce the cost of producing a given product, enabling manufacturers to increase profitability and compete on price. Packaging spend within industry can be significant. One UK industry representative commented that typically a fast moving consumer goods company (fmcg) company with annual sales of, say, £1000m and profit of £100m will spend around £50-70 m on packaging. Thus there is a huge internal cost pressure to reduce packaging and hence spend.

The proportion of the cost attributable to packaging varies (see table 7). For some goods, such as toiletries, packaging represents a significant proportion of the overall product cost, whereas for others it is much smaller. In an increasingly competitive market economy, the business imperative is to reduce these costs. UK CEED (1995[30]) concluded that market incentives discourage over-packaging:

'Barring market imperfections, market forces should encourage all participants in a supply chain to minimise production costs, including the costs of packaging. If the market works effectively, only those amounts of materials necessary to fulfil the various demands made of packaging will be used.'

[30] UK Centre for Economic and Environmental Development (UK CEED), 1995: *Packaging in a Market Economy*.

Table 7: Packaging as a Proportion of Product Value
Source: UKCEED

Selected Products	Percentage of product value attributable to packaging
Books	Less than 1%
Beer	5%
Paint	8%
Foodstuffs	10 – 12%
Toiletries	20 – 25%

The level of spend on packaging will depend on whether the product is high or low value and what levels of wastage may be tolerated. For example, if you are producing low value baked beans it may be more cost effective to accept a given level of wastage in the supply chain and keep packaging costs to a minimum, rather than package the product in fail-safe packaging at higher expense, given the relative cost benefits of doing so.

There are also indirect cost drivers. For example, the fact that retail space is at a premium is currently a significant driver encouraging retailers to reduce the amount of space taken up by each product. Store formats are becoming increasingly small and reducing size allows a larger number of different products to be put on shelves.

Containment of the product

Perhaps the most obvious function of packaging is its need to contain the product. Packaging needs to contain the product from its point of production to its point of use, for example a bottle for shampoo or a drink, or a box to hold washing powder. Awkwardly shaped or sized products may need to be specially packaged to aid handling and retailing. Packaging can also facilitate the handling and sale of small items (e.g. screws), which might otherwise be difficult to retail.

Protection

Packaging needs to respond to the need to reduce wastage, by ensuring that it protects the contents inside and where relevant, preserves them. UKCEED[31] (1995) lists possible dangers to the integrity of the product from:

- Damage by shock and impacts, vibration, abrasion, compression, deformation, dropping piecing or tearing
- Spoilage through changes in temperature, moisture, humidity and pressure and/or exposure to light, radiation or oxygen, ingress of micro-organisms (fungi, moulds, bacteria), rodents, vermin or insects as well as dirt, dust, odours, magnetic forces, or contamination by other products whose packaging has failed
- Malicious actions (tampering).

[31] UK Centre for Economic and Environmental Development (UK CEED), 1995: *Packaging in a Market Economy*.

The Thai Packaging Centre was set up in 1984 when the Government realised the importance of packaging for export promotion. Its main responsibility is to improve the standard of packaging used for Thai products in both local and export markets. At that time, fruits and vegetables were typically packed in traditional woven bamboo baskets, plastic boxes and wooden boxes made of para-rubber wood. There were tremendous losses from mechanical damage since the packaging did not effectively protect the produce during transportation. In addition, these packs are uncompetitive in the world market, in terms of appearance, ease of handling, use and disposal and strength properties (Maneesin, 2003[32]).

To ensure that packaging meets these challenges, many companies carry out extensive testing on packaging before placing their goods on the market and also in response to bad experiences (see section 3 on testing and evaluation).

Often a manufacturer chooses a number of layers of packaging in different materials deliberately to reduce the *total amount of* packaging required, with each layer serving a different need. For example, a wine box has a cardboard outer box for rigidity, an inner bag made from layers of polyethylene and an aluminium-coated plastic to provide a barrier against damage from air. An example from Dixons, a major electrical manufacturer and retailer, highlights this point.

Dixons explained the reason for different layers used to package television sets. A television is placed in a plastic bag in a box, with expanded polystyrene (EPS) inserts and plastic covers on the plug. Though some may view this as excessive, each layer has an important role to play, especially when packaging a high-value product:

- The EPS protects the television from damage by preventing movement inside the box
- The plastic bag protects the television against paintwork damage that EPS can cause
- The plug cover prevents the plug damaging the product during transit
- The box is for overall protection and logistics

Active packaging is increasingly being utilised to protect and preserve goods, thus reducing wastage. The term 'active packaging' refers to a method of slowing down quality-impairing processes within the packaging itself, by creating a controlled atmosphere. By binding oxygen, condensation or carbon dioxide or by incorporating anti-microbial substances via smart-foils, packaged foodstuffs are able to retain a maximum level of quality with an extended shelf life. For example, in the past, the durability of carbonated drinks was reduced when packaged in plastic as opposed to glass bottles. However, oxygen-absorbing layers were developed and are now in use in multi-layer PET bottles. Whereas passive barriers delayed the ingress of oxygen into the bottle, the active barrier layer actually binds the oxygen, and as a result the shelf-life of beer in PET bottles has been increased from six to nine months[33].

Active packaging has also been used to enhance the quality of a product, rather than simply protecting or preserving it. The most common example is the development of the 'widget' in

[32] Maneesin, Dr P (August 2003) *Post-harvest Packaging*, Asian Packaging Federation Congress, Colombo.
[33] TRpackaging.com

canned drinks, which is only activated upon opening. The widget is a capsule which when activated causes the beer to foam. Other specialist uses include temperature-changing properties, for example the development of self-heating or self-cooling drinks.

Preservation

Packaging must ensure that the product contained within reaches the consumer in a good condition. This is especially true of food products, for which there are strict guidelines on the materials that can be used and the conditions which it must be kept in during its journey to the consumer. For example, refrigerated lorries are used to transport fresh produce, such as meat, and the temperature must be kept at a certain level throughout transportation.

In 1983 the World Health Organisation (WHO) estimated that in parts of the developing world, 20%-50% of food is wasted and does not reach the consumer because of inadequate distribution and packaging systems[34]. In Western Europe, only 2%–3% of food fails to reach the consumer.

Producers and retailers are also concerned about the shelf life of products, due to the need to prevent wastage and loss of sales. Packaging also has a role to play in preserving goods once in the home. Industry has responded by, for example, developing resealable bags for fresh and dried products and vacuum packing products to extend their use-life.

Setting an appropriate loss rate

Packaging could be developed to protect against all eventualities and ensure that products were never damaged or wasted. However, this would not make economic sense, nor would it be the best environmental option. Companies therefore often set a level of product wastage that will be tolerated. This level varies from company to company and is largely dependent on the value of the product (eg computer versus tomato) and its potential for causing injury or damage (eg bleach versus mineral water). Leakage in aerosols, for example, is not acceptable at all.

Levels of wastage tolerated: Selected examples

Dixons - According to Dixons, 0.02% is an acceptable rate of loss for television sets.

PIRA International - The level of wastage tolerated varies and depends on the product and sales volume. For example, if you had an expensive piece of medical equipment which a company sells ten of per year, tolerance would be very low, whereas if you are selling high quantities of low value goods you would accept higher levels of damage. The consumer tolerance of damage is also an important factor, for example satisfaction levels if you have bought a damaged watch versus a dented can of baked beans.

[34] Maneesin, Dr P *op cit*

Loose versus pre-packed foodstuffs: the myth of the unpackaged tomato

'The arguments for packaged foods must be seen in the context that there is still wastage, for example peelings, it is just not as obvious to the consumer as this takes place before they see the product. If you are going to address the issue of packaged versus unpackaged, you need to consider the whole life cycle of each option. From a retailer perspective, consumers have shown that they want pre-packaged goods, especially in urban areas.' (Sainsburys)

Shoppers can buy some items without any packaging, such as loose fruit and vegetables from market stalls. Supermarkets also sell loose fruit and vegetables and unwrapped goods, for example from the delicatessen counter. Though many customers prefer to buy ones which have been pre-packed. Consumers may assume, rightly or wrongly, that the loose product is a better environmental option, given that there is no packaging at the point of sale.

However, this fails to take into consideration the packaging that has been used in transporting the product from grower to the retail outlet. It would be a mistake to assume that 'loose' goods do not need any packaging: melons or oranges, lettuces or runner beans, could not be shipped from the grower to the shop or market stall without any packaging at all in this chain.

The difference is that we do not see the crates and trays used to deliver these because they are removed before the goods are displayed. Taking into account the fact that goods that are not pre-packed are more likely to be damaged or bruised, there may be as much or more waste from 'loose' goods as from packaged ones. This is not a result of globalisation or long-distance trade in general – it applies even to produce from local growers.

Kooijman (1995[35]) supports this, finding that food preparation close to the beginning of the supply chain – for the manufacture of packaged foods – generates less waste than food preparation in the home. One reason for this is that markets exist for trimmings and peelings, which, if collected in bulk, can be economically processed into animal feed.

Study Assessing the Environmental Impacts of Different Packaging Systems for Apples

In 2003 Marks and Spencer commissioned a Streamlined Life Cycle Assessment (LCA) of its different apple packaging systems[36]. The study quantified the energy and waste footprint resulting from the production of raw materials and energy, manufacture, transport and sale, and the use of the packaging, and identified the levels of waste that could be attributed to the packaging or failure of the packaging at each stage of the life cycle.

It assessed three packaging systems – loose apples, a non-biodegradable pack of four apples, and a biodegradable pack of four apples – and found that an increase in point-of-sale packaging does not necessarily result in more waste or in higher energy consumption across the life cycle.

The results of the life cycle analysis in relation to waste and energy are given in the tables below. When apples are sold loose, the consumer has far less to discard (9.2 kg per 1000 apples as opposed to 17.5 kg with packaged apples). However, overall waste generated

[35] Kooijman, Dr J M, 1995: *Environmental impact of packaging – performance in the food supply chain.*
[36] ERM (January 2003) *Streamlined LCA Study of Apple Packaging Systems*, Marks and Spencer Plc

throughout the system is higher (185.9 kg as opposed to 135.0 kg per tonne). Loose apples involve more waste at the packaging production, packaging plant and retail stages, and the waste arising on these business sites is far more significant than the small amount of packaging thrown away by the consumer.

When looking at energy, the biodegradable four-pack is the most energy-efficient of the three systems, based on data from the supplier of the material, Novamont S.p.A., consuming 2419 MJ per tonne. Loose apples require 16 percent more energy (2818 MJ), and the non-biodegradable four-pack 28 percent more (3104 MJ).

It is also worth noting that the production of the packaging consumes less than half the energy consumed in the production of the apples which the packaging protects.

Table 6: Life Cycle Profiles for the 3 Packaging Systems per Tonne of Apples Purchased

	Life Cycle Waste Profiles (kg)		
Life cycle stage	**Loose**	**Non-Biodeg 4 pack**	**Biodeg 4 pack**
Packaging production	18.4	4.4	3.9
Transport to packaging plant	0	0	0
Packaging plant	79.9	55.6	55.6
Transport to distribution centre	0.0	0	0
Distribution centre	0.0	0	0
Transport to retail outlet	0.0	0	0
Retail	89.9	51.1	51.1
Transport by customer	0	0	0
Customer use	9.2	17.51	17.5
Other		2.46	2.5
Burden associated with production of wasted apples	4.9	3.9	3.9
Total	202.2	135.0	134.4
Recycling benefit	-16.4	0	0
System total	**185.9**	**135.0**	**134.4**
Non-biodegradable waste	*5.7*	26.7	13.5
Packaging waste	*66*	*25*	*25*

	Life Cycle Energy Profiles (kg)		
Life cycle stage	**Loose**	**Non-Biodeg 4 pack**	**Biodeg 4 pack**
Packaging production	2342	2060	1408
Transport to packaging plant	5	35	2
Packaging plant	85	122	122
Transport to distribution centre	5	35	35
Distribution centre	8	63	63
Transport to retail outlet	7	75	75
Retail	108	49	49
Transport by customer	21	79	79
Customer use	0	0	0

Other		0	0
Burden associated with production of wasted apples	730	587	587
Total	3310	3104	2419
Recycling benefit	-492	0	0
System total	**2818**	**3104**	**2419**
System Total Excluding Allocation Concerns (Distribution Centre, Retail and Customer Transport)	*2681*	*2913*	*2229*

The different performance of the three packs in relation to energy and waste makes it difficult to decide which is the 'best environmental option' and demonstrates the complexity of choosing a 'one size fits all' solution to packaging. If the overall objective is to reduce energy consumption, for example, then the type of packaging chosen would be different to that chosen if the priority was to reduce waste. Policy can also have an impact on this decision, for example the existence of economic instruments on energy and waste and making trade offs to obtain the least cost overall option.

<u>Production efficiency</u>

When considering packaging design, one of the main considerations is whether it can be manufactured easily and cost-effectively. To run along the production line, packaging needs to be of appropriate dimensions, strength, material and design specification. The efficiency of a filling line may be largely determined by packaging design specifications. For example, when lightweight PET bottles were first used for carbonated soft drinks in the early 1980s, a relatively heavy base cup was needed to prevent them falling over on high-speed filling lines. Within a few years, filling machinery had been adapted to plastic rather than glass bottles, the base cup was no longer needed and the weight of a two-litre PET bottle was reduced immediately from 75g to 55g.

A confectionery manufacturer sells chocolate sweets in plastic bags. Consumers occasionally complain that these bags seem a little large compared to the amount of sweets contained in them. However, the bags are designed to be the smallest that they can be without sweets jamming in the seal when the bags are sealed. Bags of various heights were trialled on the production line until the bag height that gave an acceptable reject rate of one per cent was determined. A bag 8mm shorter gave a 14% reject rate and so was not put into production because of the product wastage that would have resulted.

There can be inertia in technological developments due to the level of investment in existing machinery, and its expected lifetime. The expense of setting up new production lines to accommodate wholly new packaging is not incurred lightly, although in the longer term market success may make such changes justifiable.

Packaging manufacturer - Most production lines are custom designed, so if there is a change in the packaging, it means a lot of expense to automated filling lines. For example, the caps provided by an injection moulding company are applied automatically and machinery and production lines would need modifying accordingly if any changes were made. New machinery costs in the region of £150,000 – £400,000 and is expected to last for 15-20 years.

These two factors many inhibit change, especially in cases where companies have a standard range of products.'

Major food manufacturer - Investment in existing production processes is a factor in delaying changes being made to packaging. For example, for a sizeable food manufacturer to change a modern packaging line it could cost millions of euros. You therefore have to be certain that the changes would be beneficial financially, especially when shareholders are involved. Some changes can be made, however, without having to undergo significant process changes.

In the case of refillable bottles, developments can be delayed as a result of the existing bottle population. For example, to run down the same filling line as the bottles already in circulation, new refillable bottles have to be of the same external dimensions. If they are to hold the same quantity of product, they also have to have the same internal dimensions. Thus refillable bottles are the prisoner of history – the gradual improvements that are common in the development of non-reusable packaging are not possible and changes take place in large and infrequent steps, when the existing population lags so far behind the state of the art that it becomes cost-effective to withdraw and replace all the bottles in circulation.

Logistics

Packaging needs to be designed in such a way that it will protect the product through the supply chain and can be handled efficiently throughout the distribution system. Packaging that is used to transport the product from the production line to the consumer is often overlooked when considering the environmental characteristics of product packaging because it is not 'visible' to the final consumer. Transport packaging is usually removed before the consumer sees the product, unless used by the retailer to facilitate bulk display or if the consumer is making a bulk purchase. For this reason, its functional importance is often either unknown or underestimated.

The logistics of the product supply chain have many implications for the way in which packaging is designed. Packaging needs to withstand the pressures of the transportation system chosen, including transportation by road, rail, sea or air, or indeed a combination of all of these modes. This varies according to the market for the product and whether the packaging first goes to a separate packer-filler before further distribution.

One of the functions of packaging is to consolidate sales items into larger units for efficient transport and distribution from production line to distribution warehouse or retailer and on to the final consumer. To enable large quantities of a single product to be handled, a pallet or tray based distribution system may be used and this imposes particular demands on the shape and size of the packaging.

A pharmaceutical retailer developed a system for re-using the plastic transit trays for the delivery and display of its sandwiches without the need for alteration or redesign. The trays are no longer used just once, but are re-used at least three times. Broken trays are returned to the supplier for recycling. As a consequence the retailer saves over €180,000, approximately 200 tonnes of plastic and 270 tonnes of cardboard annually.

Source: British Retail Consortium

There is increasing retailer pressure to reduce transport packaging, as this becomes a problem that they have to deal with. However, if transit packaging were to be reduced, more primary packaging would be needed. Retailers are also calling for packaging which is easier to get to the shelves. This is a problem if you supply a number of retailers who each have their own, different, requirements. By definition, if supply requirements aren't standardised there will be inefficiencies in the system.

Source: Major food manufacturer

Transport efficiencies can be maximised by designing packaging so that the sales packaging is the minimum needed for the product, the sales packs fit snugly into the transport packaging whose dimensions fit the pallet exactly and the pallet fits into the vehicle with no wasted space (unless weight rather than volume is the critical factor for vehicle loading).

Packaging for distribution needs to take into consideration a number of factors, including:

- Containing and protecting the products
- Ability to withstand pressure from stacking
- Resistance to conditions throughout distribution, such as vibration, vertical impact and climatic conditions
- Ease of handling and transport
- Avoidance of the use of more than one packaging material wherever possible, for ease of recovery
- The ability to carry information for safe delivery and rapid identification of the packaged product, for example bar coding or new RFID technology
- Providing effective space utilisation during storage, handling and transportation. This involves modular designs which can fit onto international standard pallet sizes or which can maximise the dimensions of an air-freight container. Packaging height is not standardised but varies in accordance with the fragility and weight of the contents
- Secondary packaging can also assist with sales promotion, for example where pallets are used at the point of sale

The Need for Packaging to Withstand Pressure in Warehousing and Distribution

Dixon's warehouses stack boxes up to around 6m high and there are plans to increase this to 8, or 10m for more efficient use of space. To do this, however, the boxes need to be able to withstand the pressure and therefore need to use more materials for strength. The cost of packaging will increase but this will be offset by the reduced costs of warehousing.

Containers are used to transport packaged goods, which have the advantage of no wasted space in comparison to the use of pallets. Clamp trucks are used to move the goods and these can lift, for example 8 x 28" television sets at once. The packaging therefore needs to withstand the force of the clamp truck. By not using pallets, tertiary packaging is not needed but more primary packaging has to be used to protect the product.

Commercial purchasers may specify 'export packaging'. This is basically a pallet that bolts the product in place using v-board or timber planks up the sides. Instead of packaging for protection, Dixons focuses on reducing damage during transportation. For example, lorries with air suspension are used in preference to transport by rail (shunting problem). It is interesting how this conflicts with another environmental policy objective of reducing road transport in favour of rail.

Most damage occurs when the goods are delivered to customer's homes and packaging to prevent this is very difficult. Some developments include putting handgrip holes on bigger items – but polystyrene is needed behind the handles, therefore increasing the packaging used.

Reducing damage in the supply chain: An example from industry

Research by Kraft on their own product range found that the main reason for products not selling was crushing during distribution and handling. Three basic solutions were implemented: packaging improvement, distribution practice and policy change, and pallet configuration change. Packaging improvement included upgrading of corrugated board specifications, upgrading from paper wraps to corrugated cases and improving the sealing process on selected pack formats. Distribution practice and policy change involved improving truck loading and load protection methods, eliminating clamp handling for selected products and development of an internal policy for packaging and pallet design.

The results demonstrate the scope for improvement through pack re-design and through technical evaluation of pack specification:
Bull's-Eye BBQ Sauce – case redesign and upgrade – damage down by 22%
Capri-Sun fruit drink – improved sealing process – damage down by 30%
Kraft shredded cheese – case upgrade – damage down by 14%
Digiorno Sauces – new gluing methods to secure case – damage down by 15%.

Source: Grocery Headquarters, February 2001

The effect of manufacturing and logistics on choice of material

Policy and other driving forces, such as image and cost, have sometimes encouraged a move to using recycled in preference to virgin materials. However, the decision to switch to using recycled materials for environmental reasons needs to be balanced with the other functional requirements that packaging needs to perform. The over-riding factor is that the packaging needs to get the product from the end of the production line to the consumer in an acceptable condition.

Some companies have found that using recycled board, for example, means that an increased weight is needed to achieve the same strength properties. In almost all Member States, the Packaging Directive is implemented in a way which bases obligations on weight. In the UK for example, the Producer Responsibility Obligations (Packaging Waste) require producers to take ‘reasonable steps’ to recover and recycle specific tonnages of packaging, calculated on the basis of a number of factors, including the tonnage of packaging handled by the producer in the previous year. This may discourage companies from using recycled materials, though because the price of Packaging Recovery Notes is quite low, it is more likely that the cost of extra fuel needed to transport the extra weight will be more significant. The selected examples below demonstrate the decisions involved in choosing recycled or virgin materials.

Dixons - The company was getting higher damage levels in its Scandinavia depot. On average, one television set in every ten container loads is damaged, but in Scandinavia they were finding that it was 4 or 5, and sometimes as many as 14. Typically there are 400 televisions in a container. The average set costs £200 so this represents a high loss. An investigation showed that these high rates of damage were due to the use of recycled materials for boxes. Due to humidity and condensation, the strength of the boxes was reduced in comparison to boxes using virgin materials. As a result, it was necessary to switch back to using virgin materials (at this location only).

A soft drink manufacturer – The company aimed to reduce the weight of its glass bottles. New glass bottles that were almost 20 per cent lighter were developed. Trial batches of these bottles were filled and tested to ensure that they survived typical lorry trips and general distribution stresses. Then the bottle was launched on the market. However, it was soon discovered that the bottles were breaking when subjected to sea transport to the Continent. In addition several consumers reported that the bottle had shattered around the neck as they twisted off the cap. So a product recall was undertaken, involving recalling several hundred thousand bottles from retailers, at considerable cost in terms of money and product wastage.

Marks and Spencers - All cardboard boxes, excluding those that come into contact with food, are made from recycled board. However, to do this a higher tonnage of board is needed to obtain the same level of strength, which runs against the requirement to reduce the weight of material used.

A major food manufacturer – Some products pick up properties from materials. Fat based products, for example, are very sensitive to picking up odour and taste. There are therefore limitations to using recycled materials for packaging that comes into contact with food.

Product Presentation and Marketing

Along with providing protection to the product and performing other practical supply chain functions, the primary packaging, can influence its commercial success. From the consumer perspective it can attract them as potential buyers by adding value to the product or triggering understanding or a connection. From a retailer or manufacturer perspective it is a ‘permanent expression of the brand’, or as one retailer put it, it is the ‘part of the company that the consumer takes home with them’. Packaging has a significant role to play in the marketing of a product, particularly in an increasingly competitive retail environment.

Research has indicated that a pack on a supermarket shelf has less than three seconds to grab a shopper’s attention. In the average supermarket there are in excess of 10,000 different packs to choose from across both food and non-food items. In this short space of time, packaging has a role in making a product stand out in communicating its key benefits through the use of shape, colour, illustration and brand name (Design Council[37]). Research at the Henley Centre has shown that 73 percent of purchase decisions are now made in the store. In this environment only one brand can sell itself by being the cheapest - the rest must compete on design (Fitch Design Consultants). Therefore companies are now looking for their packaging to work harder.

Examples of Effective Design and Packaging in Marketing

A cosmetics company marketed a skin cream in a white plastic bottle but sales were slowly declining. Investigation revealed that the type of plastic used was causing dust to be attracted electrostatically to the bottle while it was on display in retailers. This made the bottle look dirty, causing consumers to reject the product. The company reacted by repackaging the bottle in a white cardboard carton with a cellophane wrap. This made the product look clean and more ‘upmarket’. Sales increased tenfold, providing a compelling example of the power of presentation. However, the company recognised that the carton did not perform a product protection function, and so several months later a more fundamental redesign of the packaging was undertaken. A new, lightweight, clear plastic bottle was introduced which enabled the carton to be eliminated while maintaining the required upmarket look of the product. Sales remained buoyant.

Effective food packaging[38]
In 2002 Williams Murray Hamm won the DBA Design Effectiveness Award Grand Prix (an award which rewards outstanding examples of commercially successful design) for the redesign of Hovis bread packaging. As a result of the change in packaging design, Hovis was identified as the fastest growing non-alcoholic grocery brand, increasing its brand value by 31 percent and becoming the number one in both brown and white bread sectors for the first time in its 115 year history.

The best/most effective packaging design will vary according to the product with which it is associated. However, it should always convey an understanding of the product to the consumer. In some cases it is not the most ostentatious and impressive options that is the most effective. For example, some brand owners use plain packaging to reinforce the image of a

[37] Sands, Jonathan (2004) *About: Packaging Design*, Design Council
[38] DBA design effectiveness awards http://www.dba.org.uk/home.html

lower price to the consumer. Others, use transparent packaging for food products to convey the quality of their products to the consumer.

Packaging can also be designed to be an integral part of the product. This is particularly true with gift or luxury items, where the packaging forms an important part of the product. Easter eggs are perhaps the most well cited example of this. Others include the use of heavier bottles for quality wines and spirits than would be required for logistical and other reasons, as a way of conveying the message of quality to the consumer. Marks and Spencer, for example, is well known for its range of products in the gift market.

The marketing driver for packaging is arguably the most difficult aspect to reconcile with the Essential Requirements of the Packaging Directive, where the imperative is to minimise.

Safety

The risks associated with packaging need to be minimised to prevent injury during manufacture, through the supply chain and to the final consumer. Nestle switched from using glass packaging to plastic packaging for a coffee whitener product, due to safety reasons. This change also had a positive effect on the weight of packaging used. Where previously they had used 3000 tonnes of glass, the change resulted in using 250 tonnes of plastic for the same number of jars.

Safety considerations also apply to the use of the product once with the consumer. For example, consignments of meat may be rejected if instruments show that it hasn't been kept within the correct temperature range throughout transportation. At present, the development of 'Intelligent Packaging' (see below) includes a number of safety functions, for example warning of sell-by and use-by dates, reminders to put the milk back in the fridge, etc.

Safety requirements are also closely linked with the need to contain the product (eg. bleach) and prevent tampering. Hazardous products need to be packaged to prevent inappropriate use. In the case of medicines, or cleaning materials, the packaging may incorporate specially designed opening devices for protection. However, there is always a conflict between being child-resistant and being easy to open, particularly for the elderly.

Some types of material may not be feasible for certain types of pack, for instance due to an inability to guarantee the safety of recycled material for food contact or skin contact applications.

Consumer Information

Information presented on the pack may be the sole point of contact between the manufacturer and the end-user. This is sometimes a legal requirement (ingredients lists, sell-by dates and quantity declarations on foodstuffs, for instance) but even when it is not, it is important in helping consumers make choices before purchase (e.g. the features of an electrical product) or in providing instructions for storage, use and disposal.

Over the years, packs have had to provide more and more information. The development of the Single Market has exacerbated this, by creating a greater need for multilingual labelling. Some of the information on the label – allergy warnings in particular – is of no interest to most consumers, but absolutely essential to a few. This means that ‘white space’ around the relevant declarations is needed so that the consumer can easily identify information of interest. In the case of medical products, the amount of essential information is such that a tube of ointment may have to be packed in a carton purely for the purpose of containing an accompanying leaflet.

Aside from the quantity of information, that needs to be provided, most of which is in response to legal requirements, there is also an issue of quality and clarity. According to the UK National Consumer Council, information on packaging is poor and it is sometimes difficult for consumers to differentiate between what concerns the product and what concerns the packaging itself. In a recent interview, they reinforced the fact that labelling must be simple and focus on what the consumer needs to know.

Intelligent Packaging – Revolutionising the way packaging communicates

Packaging can communicate with manufacturers, retailers, etc though the use of radio frequency identification (RFID), which allows goods to be monitored throughout the supply chain. Whereas this function has been provided in a more limited extent by bar codes to date, RFID technology allows items to be scanned individually, in grouped/secondary packaging and up to the level of whole container loads. Unlike bar codes, RFID picks up a radio signal so single units do not need to be scanned directly. The benefits that this will have throughout the supply chain, particularly through transportation and storage, are clear. Intelligent packaging can also communicate changes in conditions, for example temperature changes during storage or transportation, drawing attention to things that may have an adverse effect on the quality or safety of the goods.

Packaging designers are also developing packaging that will communicate with the consumer. Though still in its infancy, ideas for future applications were showcased at the UK Total Processing and Packaging Exhibition (March 2004). For example, milk cartons that tell you to put them back in the fridge if left out, to prevent wastage. Packaging that provides health messages, for example recommended daily allowances of a certain food; or simply marketing messages from the producer.

Furthermore, intelligent and active packaging is now used to alter the characteristics of the pack or product, for example oxygen-absorbing layers in food packaging or ‘widgets’ in beverages (see protection).

Demonstrating the Need for Packaging to Provide Information: Blister Packs

In pharmaceuticals, the move to provide tablets in blister packs, instead of glass bottles, has happened because of the need for more information which must to be supplied to the consumer. At the time the Labelling & Leaflet Directive was being developed, industry pointed out that its provisions conflicted with the packaging prevention requirements of the Packaging and Packaging Waste Directive. Since that time, some life cycle assessments have shown that blister packs actually have marginally less environmental impact than glass bottles. Though being driven by the need to provide information, the packs have also been found to have other benefits, such as allowing the consumer to keep track of the amount of medicine taken.

The packaging used in the case study example consists of a foil lidded blister tray, comprising 7 or 10 tablets, with a leaflet wrapped round the tray and packed in a tuck-end carton

Code of practice requirements: The dimensions of the blister tray are governed by the need to provide an adequate seal around the tablets. The dimensions of the blister are determined by BS7236:1989 'British Standard Code of Practice for Non-Reclosable packaging for solid dose medicinal products'. Part of the code concerns the need to provide a degree of child resistance and to prevent the dose being released due to mishandling. The code describes tests to determine seal strength, seal integrity and resistance to bending. As an example, the resistance to bending test requires that packs should be able to be bent along both axes through 180 degrees without signs of rupture. Obviously the seal area must be sufficient to withstand this.

Patent Pack Initiative: This encourages the provision of tablets in quantities relative to the course of treatment. Blisters also have the advantage that the number of tablets taken can be seen by counting the open cavities - a useful reminder to show how far the user has completed a course of tablets.

Information requirements: The Community Code relating to medicinal products for human use (2001/83/EC) requires an 'original' leaflet to be supplied with every medicine. 'Original' means the current MCA approved version of the leaflet. To ensure this happens, pre-packing the leaflet with the tablets is the preferred option, rather having to ensure that there is an adequate supply of the current version of the required leaflet available at point of sale. An alternative could be to print all the required information on pack but this would require a larger carton taking into account minimum type size recommendations.

Usability and acceptability of the product

Usability

> ***Improving openability***
>
> Liquid food cartons are often criticised as being difficult to open. Some now include a plastic opening mechanism, which is also resealable. This has improved the openability of the package but also acceptability by consumers who were concerned at leaving products open in their fridge.

Packaging must be easy for all consumers to use. Two important elements of this are openability and facilitating use. Openability is a major issue that is of particular importance in relation to older people, although it also impacts on all consumers. A package that is difficult to open can lead to spillage and waste or more seriously to people endangering themselves by, for example, attempting to open a package with a sharp knife.

Research by the Design Council[39] indicated that there are three main elements that must be considered in order to ensure that all consumers can open packaging:

- Muscular – a typical 70 year old has the strength of a 10 year old, therefore packaging must not require more force to open than they are able to generate
- Visual – it is important that instructions are printed at a size legible to all consumers
- Cognitive – packaging is not always intuitive to use, and it should be as simple as possible.

Packaging can also enhance the product, with primary packaging potentially facilitating use in various ways. Examples include:

- Mechanisms for dispensing the product – a tissue box or washing-up liquid bottle is a convenient way of dispensing the product
- Increasing ease of use - blister packed medicines help ensure that the consumer takes the right dose at the right intervals, foodstuffs can sometimes be cooked in the pack previously used to get the product to the consumer and for storage at home.

Acceptability

The type of packaging consumers will accept can vary considerably depending on the individual's priorities and an important consideration for the packaging industry is how to juggle these varying positions. An example of differing consumer acceptance is the use of PVC by a major consumer goods manufacturer in the US but not in the rest of the world where PET is used. The use of PET, a more expensive alternative, is due to perceived environmental concerns. However, consumer preference has to be balanced with other practical concerns, as consumers may not fully appreciate other consequences and impacts that packaging is trying to minimise. For example consumers sometimes complain that supermarkets stock milk in plastic and not in rather than refillable glass bottles. This is however safer for staff and consumers, and has reduced the weight of packaging significantly which has led to lower transportation costs.

---

[39] Design Council (2002) the Helen Hamlyn Research Centre, Opening up: packaging that can be opened by everyone

Lack of consumer support and acceptance can lead to innovations in packaging being abandoned. For example Sainsburys attempted to reduce packaging on its muesli from a bag and a box to just a box. As a result they received increased complaints about the quality of the cereal and reverted to the original format.

Tamper evidence and theft prevention

For safety reasons, in some instances packaging needs to ensure that the product contained cannot be tampered with. Food products, for example, often have a protective seal around the opening to prevent tampering. This has an important role to play in consumer acceptance, by allowing the consumer to see that the product they are buying has not been opened.

A toothpaste manufacturer was forced to add aluminium tear-off seals to toothpaste tubes in Germany when it was found that consumers were tasting the toothpaste in supermarkets (that is, removing the caps and licking the toothpaste, then replacing the caps and putting the tubes back on the shelf!)

Producers and retailers also want to reduce the risk of a product being stolen, either at the point of sale or whilst it is further back in the supply chain. High value goods which are small and would be easy to conceal, such as a memory stick for a computer, are often placed on larger pieces of card and covered in a transparent plastic box. Whilst this may appear to the consumer as over-packaging, in this case the packaging plays an important role in theft prevention.

Dixons tried to move away from using black shrink-wrap on cages when transporting high value electrical goods to stores. However, they found that in addition to its known functional role of keeping products together, it also served an important theft prevention purpose at the back of stores. The use of black shrink-wrap therefore continues.

SUMMARY OF DRIVERS

In conclusion, there are a large number of drivers involved in influencing the amount of packaging placed on the market and the type of packaging chosen. These can be summarised as:

Social and market drivers

- Smaller households and an increase in the number of people living alone
- An ageing population;
- Increasing GDP and purchasing power of consumers
- Changing lifestyles demanding convenience – smaller packs, pre-packaging, frozen goods
- Demand for consumer choice

'Fit for purpose' drivers

- Cost effectiveness
- Containment of the product
- Preventing waste - protection and preservation of the product

- Production efficiency
- Logistics issues, such as transport warehousing and handling
- Product presentation and marketing
- Information provision
- Safety requirements
- Usability of the product
- Tamper and theft prevention.

3. ENVIRONMENTAL INNOVATION AND EVALUATION

Innovation

Innovation occurs in response to a combination of factors, including the market, fit for purpose drivers, policy drivers and environmental concerns. Innovation results in improvements to packaging, some of which are targeted at or have the effect of reducing the environmental impact. The examples below demonstrate such changes and illustrate the benefits gained.

Minimisation of Packaging

There has always been a cost imperative to reduce the amount of materials used to produce a pack. However, minimisation is also an objective of environmental policy. Reducing packaging means fewer natural resources are used, reductions in weight and size can result in resource savings at the distribution level and the less packaging that is placed on the market means less packaging waste. There are many examples where industry has pursued minimisation objectives, with positive end results. For example, the average weight of a glass container has been decreased by approximately 30 percent since 1980 and the thickness of supermarket carrier bags has reduced by approximately 45 percent over the last 15 years.[40] It is critical, however, to consider the functional requirements of packaging and to ensure that minimisation does not result in the adverse effect of increased resource waste.

Minimisation in the Can Industry

The principal image of a can as a metal cylinder with two ends has remained similar over its history. However, the quantity of raw materials used to make comparable cans over the decades has continuously reduced, at the same time ensuring that its fitness for purpose is maintained. Lightweighting has been made possible through technological advancements, which have allowed the thickness of materials to be reduced and innovative changes in the production process.

- Between 1983 and 2003 the tonnage of metal used to produce 1 billion cans reduced by 30 percent.
- Between 1980 and 1997 the body thickness of a 850ml vegetable can reduced from 0.26mm to 0.19mm and its weight reduced from 125g to 50g.
- A new body manufacturing process (where by cans are composed of two pieces rather than the original three) has resulted in a further weight reduction from 50g to 35g.

Reducing Void Space in Cereal Boxes

Sainsburys led an initiative to reduce over packaging of cereals. It had been perceived for some time that customers would select larger boxes over smaller equivalents containing the same amount of product, as they felt they were getting better value for money. This prevented

[40] GG360 Packaging Design for the environment: reducing costs and quantities

brands making the first move, due to fears that sales would drop.

Sainsburys decided to experiment by reducing the size of one of its cereal packets and the sales figures remained stable. They then decided to reduce the size of three other boxes and again sales of these other cereals also held. They approached other companies to suggest that they do the same. Eventually other suppliers took on board the change, as their packs attracted attention for being over packaged. The whole process from the initial change in the first cereal pack to a change across the board took approximately two years.

The benefits of reduced pack size include the obvious material minimisation benefits, hence cost savings and improved environmental performance. However, there are also less obvious benefits such as being able to fit more boxes into secondary packaging, increasing the number of packs it is possible to transport per lorry load so reducing distribution costs, and reducing the shelf space required for storage and stacking – particularly important in light of the increasing trend of opening smaller stores in urban areas.

For Sainsburys, the volume of its own brand packs reduced by 24 percent, materials costs were reduced by 2 percent and there was an annual saving of 7.2 tonnes of cardboard. Furthermore, it allowed more units to be packed per case, thus reducing transport overheads.

Shift in materials used

Changing the materials used for packaging can reduce the environmental impacts. Changing materials (or their combinations in layers) can, for example, facilitate recycling, etc.

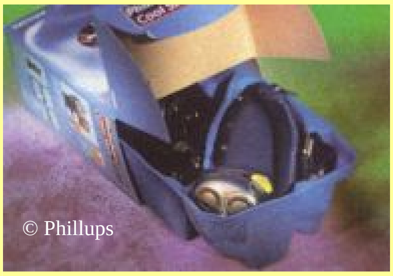
Removing layers of packaging

The new design of Duracell's battery packs has eliminated the need for blister packaging and enabled batteries to be packaged in a single material - cardboard.

At Marks and Spencer, garlic bread used to be sold wrapped in film with an outer box providing the product information. It was recognised that the outer box had no benefit for the consumer or the product and so the company moved to printing on the wrap. This removed an entire layer of packaging.

Changing materials

Egg boxes were traditionally made of pulp. Plastics took a major share of the market in the 1970s/80s because they were cheaper and reduced egg damage. There was a swing back to pulp in the late 80s as its price dropped and because of consumer perception that pulp was better than plastics but today the market is moving back towards plastic.



The packaging for Philips shavers used to comprise a plastic inner pack and a cardboard cover box. The inner pack is now made from moulded cardboard so the whole pack can be recycled with used paper. Now 10 percent less material is used and savings are made on storage and transport, as a result of the stackable nature of the inserts.

Using Biodegradable Materials

In the UK, Sainsburys has been trying to introduce biodegradable packaging as a substitute for conventional plastics for marketing reasons. It began this initiative in the packaging of its 'organics' range. The packaging also has to be GM free, and costs in the region of two to three times that of traditional packaging. Despite the additional cost, Sainsburys decided to implement the packaging. The decision was also influenced by the large number of local authorities proposing to supply composting bins to households.

In another initiative, Sainsburys attempted to address the problem of complaints about carrier bags by trialing the use of biodegradable carrier bags in three stores (two in London and one in Durham). However, the trial was not a success. The bags looked like plastic bags and despite in-store advertising interest levels from customers were low, and there was a low level of understanding of the meaning of biodegradable. As a result of the lack of interest and the high cost of the bags when compared with standard carrier bags (approximately two to three times higher) the bags were not rolled out in stores.

Designing for Resource Efficiency

In some circumstances it makes sense to change packaging to reduce the number of materials and make recycling easier. In others, it is a more efficient use of resources to use a mixture of materials, which may reduce overall use of resources throughout the supply chain, even if it is more difficult or nor worth recycling.

Recycling is a systematic process and cannot happen if one of the links is not fulfilled. For example, it will not happen if there is no market for the recycled material. Various retailers have indicated that they are keen to encourage materials recycling from packaging, and one way they are trying to encourage this is by using recycled materials in their own packaging (provided it is not used in food contact), hence providing a market for the recycled material.

Packaging Designed for Reuse

In the same way that packaging can be designed to encourage recycling it can also be designed for reuse. As pressure to minimise packaging increases retailers are increasingly looking for ways to protect their product but minimise waste. One way of doing this is to make the packaging part of the product. The packaging can then be kept and reused by the consumer increasing their enjoyment of the product and at the same time serving a functional purpose. Another way of doing this is by creating a system, which allows packaging to be used again.

It is often assumed that the only types of packaging which are sent back to the factory and used again are beer and soft drink bottles. This is not the case. There is extensive use of reusable packaging in business-to-business trade: reusable wooden and plastic pallets, drums for chemicals, plastic crates (which are sometimes collapsible for the return journey to the factory), bread trays and others.

One of the main factors in determining whether a reuse system is cost-effective is the return rate achieved. Where return is built into business routine a high return rate can be expected; when it is left to private consumers to return the used packaging, their willingness to do so will depend on how readily this fits into the way they live.

Thus the number of return journeys (the "trippage") achieved by a refillable bottle falls into three distinct bands:

- a *high* trippage rate for beer and soft drink bottles in the pub trade, where the bottles do not leave the landlord's possession and can be put back into the empty crate after use to be returned when the next delivery is made

- a *medium* trippage rate for milk bottles, which are simply put out on the doorstep for collection when the next delivery is made, and for beer and soft drink bottles bought by the crate and taken home

- a *low* trippage rate for beer and soft drink bottles bought individually

Buying beer and soft drinks by the crate has never been UK practice but is done in Denmark, Germany and some other countries. The deposit on the crate and its contents is in effect a once-and-for-all investment, since no new deposit is paid if the empties are exchanged for a full crate at the time of the weekly shopping expedition.

However, the use of refillable bottles is in long-term decline. In an increasing number of British households, nobody is at home during the day and consumers prefer to buy their milk from the supermarket and put it straight into the fridge rather than have it left on the doorstep. Shops and bars need more storage space if they are to accept deliveries of reusable bottles in bulky plastic crates, and with a wider and wider selection of products for sale, they just do not have the space.

German supermarkets have traditionally set aside an area where crates are stacked ready for sale, but even there – and despite the introduction of legislation to protect the reuse system – sales of refillable containers have steadily fallen. For impulse buys, or purchases where the consumer does not want a large number of bottles of the same product, German consumers buy individual bottles just as they do in the UK and they find it more convenient to put them out for recycling rather than return them for a deposit. When German law imposed a deposit on non-refillable bottles and cans which was much higher than the deposit charged on reusable bottles, the effect was that a significant number of consumers brought the cheaper refillable bottles but did not bother to return them.

Systems Designed to Enable Reuse of Packaging[41]

In response to damage in the supply chain and the need for retailers and suppliers to reduce the volume of packaging waste, Omega Express (a distribution company) and their customer Macmillan Distribution Ltd (a book distributor) decided to work together to design a custom built, reusable tote box to replace cardboard cartons. As a consequence Waterstones (a book retailer) no longer has to deal with waste cardboard, has increased the speed of handling goods, and has eliminated waste storage and disposal costs. An initial pilot scheme involved 3000 omega boxes, replacing 21,270 cardboard cartons. The success of the pilot scheme meant it was rolled out and by 2001 96,000 Omega boxes had been introduced replacing an estimated 5 million cardboard boxes.

Barriers to Innovation

The extent of innovation and its success is constrained by a variety of perceptions and factors. Firstly, there are significant cost constraints as the packaging and associated industries are highly competitive markets with few margins of error. Innovation can be inhibited by fear of failure and the wastage of valuable economic resources. In particular, where there are a number of brands competing in the market, there is a feeling that no one wants to be the first to change their packaging fearing loss of sales. For example, it was commented that smaller boxes with the same content may appear to be less value for money to the consumer. It is arguably easier to innovate when competition is reduced, for example in the case where retailers only stock their own brand products.

Another aspect that may be a barrier is the knock on effect that changing packaging could have on the whole chain. Changes to packaging design may demand changes in machinery or in the case of primary packaging, changes to the secondary and transit packaging. For example, it has been estimated that for a sizeable food manufacturer to change a modern packaging line it could cost millions of euros.

Lack of understanding and communication through the supply chain can lead to limitations in innovation, as little information is fed back to packaging designers. It has been commented that companies are very good at monitoring losses within the confines of their own activities, but that there is limited feedback as the product passes through the supply chain. There may also be a lack of understanding of all the issues involved in packaging innovation by sectoral staff. As a result some retailers undertake training for packaging technicians in relation to environment and innovation and industry generally supports best practice guides to improve understanding.

[41] Envirowise leaflet – CS332 –2002 – retail supply chain distributes cost savings from improved packaging.

Materials properties can also act as a limit to innovation. For example, several UK companies highlighted the disincentive to use recycled materials when it results in increased weight, as in some cases more material is needed to give the same strength of package.

Testing and Evaluating Packaging Performance

The performance of packaging can be improved by undertaking testing and through ongoing evaluation and continual improvement. The extent to which this happens varies, and can be scientific and/or evidence based.

Dixons carries out simulated tests, which involves dropping the box on all sides to see whether the structure withstands pressure, and simulated transportation. It has a specification for packaging, which is given to all suppliers and a lot of testing has been done to reach this point. It is now at the point where breakages and losses are minimal.

A major consumer goods manufacturer undertakes transport testing as they supply goods worldwide. To test the packaging they either actually send it on a ship for weeks or simulate conditions, including transport by ship, road, storage in the warehouse and climate conditions (frozen, ambient, tropical). Damage is assessed again each time the pack is changed.

The decision to carry out testing is occasionally in response to a bad experience. For example, companies may have had to recall products that have been damaged in the supply chain when packaging has not been fit for purpose. This exercise can entail excessive costs, loss in sales and damage to image.

Continual improvement to packaging can also occur as a result of consumer feedback and benchmarking. Complaints received from consumers can be a significant driver. A detergent industry expert commented that complaints are usually the tip of the iceberg,: ‘for every consumer that takes the trouble to complain, probably fifty others are also unhappy but instead of complaining they will show this in the marketplace by choosing another product. Complaints are therefore used as a barometer’.

Dixons received a complaint from Trading Standards[42] regarding excessive packaging. The complaint concerned the packaging of a computer component, which was attached to a large piece of card and covered by a plastic box. Dixons investigated the case and as a result it has been agreed that the amount of packaging used should be addressed when the range is changed, though it will still be large enough to deter theft.

Benchmarking allows companies to compare their performance with competitors. By doing so, it is possible to see how others are packaging similar products and lessons can be learned from this. Though this information may not be shared freely, it is possible to test packaging to ascertain its properties, such as materials used, weight and to compare this with what you have in place.

[42] In the UK the Essential Requirements are enforced by Trading Standards

4. DISCUSSION AND CONCLUSIONS

It is clear from the study that the issue of packaging is not as clear-cut as one may initially perceive. There is a range of complex factors involved in determining the amount of packaging placed on the market and its properties. Some are these factors are within the control of industry, whilst others, such as demographic and lifestyle changes, are not. While there remains scope to further reduce the environmental impact of packaging, the way that this is done needs to take into consideration the real life situation in the packaging sector.

Taking an overall view of the impacts of packaging, both positive and negative, is important. Packaging is a very visible part of household waste and because of that, packaging is often considered to have *only* a negative environmental impact. When a manufacturer chooses the packaging for a particular product, there is a wide range of factors which influence that decision, only some of which are environmental considerations. It is necessary to recognise the balance that has to be struck between these. Safety requirements, for example using more packaging to ensure the product cannot be tampered with. The requirement to provide information to the consumer, making the product easy to use, production efficiency, and ensuring that the packaging can withstand the various pressures in the supply chain. These factors are often not visible to the end consumer, who is usually unaware of the logistics involved before the product reaches the retailer's shelves.

Packaging waste from households accounts for just 3 percent by weight of all waste disposed of in the EU. Arbitrarily reducing the amount of *packaging* with the sole objective of reducing the amount of packaging waste we discard risks increasing the amount of *goods* which are thrown away because they have become damaged or spoiled as they are moved through the supply chain to the final consumer. Research has indicated that in one sector alone, damage in the European supply chain costs an estimated €3.5billion per year. This not only represents a great loss of financial resources but perhaps more worryingly, a loss of the natural resources that have gone into manufacturing and transporting the product. The role that packaging plays in preventing the loss of resources therefore needs to be acknowledged. In this respect, simply advocating packaging minimisation may not always be the best environmental option.

Since packaging fills a wide range of different functions, basing the decision of which packaging material to be used for a product on the *single* criterion of making the packaging suitable for re-use or recycling is also likely to be environmentally unsound. For example, the use of factory-refillable bottles may be advocated but to be strong enough for refilling they need to be made thicker and being therefore heavier, transporting them consumes more fuel.

This study has demonstrated the fact that different solutions will apply to different situations. One type of packaging cannot be advocated as being the best environmental option in all scenarios. A case-by-case approach needs to be taken to ensure that in each instance the environmental impacts of packaging use are minimised. Given this, how can policy best meet the objective of preventing or reducing the impact of packaging and packaging waste on the environment?

This question comes at a time when EU waste policy is at a crossroads. The amount of waste generated in the EU is rising and it is widely considered that in the absence of additional policy measures this trend will continue. Though existing policies have always advocated prevention as the most preferable approach, experience shows that this has not delivered. At the same time, it is recognised that the different methods of managing waste all have negative environmental externalities.

Policy makers have started to re-evaluate what it is that we want to achieve. Instead of focusing on ‘waste’, attention is now placed on the environmental impacts of resources use throughout the whole life cycle. The Sixth Environment Action Programme highlighted ‘natural resources and wastes’ and one of four key environmental priorities to address over the period 2002-2012, with the objective of:

‘better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns, thereby decoupling the use of resources and the generation of waste from the rate of economic growth and aiming to ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment’.

The Programme objective is primarily being taken forward by the development of two Thematic Strategies. The first on the sustainable use of natural resources and the second on the prevention and recycling of waste. The strategies are being developed in parallel given their obvious synergies. While the former focuses on reducing the environmental impact of resource use, with the ultimate goal of decoupling economic growth and environmental damage, the latter specifically addresses waste prevention and recycling. The issues being discussed during the development of these Strategies have many overlaps with the debate on the revision of the packaging Directive. Consequently, these processes cannot be seen in isolation. This study highlights a number of these issues.

Minimisation and the prevention of waste

At present packaging is perceived only as a waste stream that needs to be addressed, rather than acknowledged as playing an important role in preventing waste and the loss of resources. In many instances under-packaging can result in more waste than over-packaging if the product is not sufficiently protected through the supply chain. This includes the resources used in the packaging and transporting products from manufacture to retail but more significantly the resources that go into the product itself. Some studies have placed the amount of energy locked up in the production of goods at ten times that used for the packaging. This represents a significant loss of resources, not to mention the implications of increased waste. Moving to a focus on reducing the environmental impact of resource use throughout its whole life cycle should help to address this. Whilst it is important to continually look for ways of reducing packaging, it is vital to consider the functional requirements of packaging and to ensure that minimisation does not result in an adverse effect of increased resource waste.

Re-use

When considering the relative merits between re-use and recycling, environmental impacts of whole systems need to be taken into account. Though reuse systems may reduce the resources needed for, say, the production of one plastic crate versus multiple corrugated boxes, transportation is needed to return crates to a given point and detergent and water are used to clean the crates. Reuse systems also rely on a high level of participation. Where return is built into a business routine, particularly closed loop systems, a high return rate can be achieved. However, when it is left to private consumers to return the used packaging, their willingness to do so will depend on how readily this fits into the way they live. Cultural differences are extremely important in determining the level of participation, and an approach used in one Member State cannot necessarily be transferred to another, or introduced Community wide. There cannot be said to be one ‘best environmental option’. In deciding whether reuse systems are preferable to one-way systems with recycling, each individual situation needs to be assessed.

Recycling

Waste policy, including the Packaging Directive, has to date placed a strong emphasis on setting targets for recycling. Whilst mandatory targets play an important role by ensuring due attention is given to waste throughout the Community, this needs to be approached with some caution. The potential side effects of policy instruments need to be considered. For example, simply increasing targets for recycling may discourage prevention of waste at source and reuse. Basing targets on weight also has implications, in that it can provide a disincentive to using recycled materials in instances where a higher density of material is needed to obtain the same strength.

Recycling targets need to be part of a broader package of measures, amongst which are mechanisms to encourage the development of markets for recycled materials.

Designing for Resource Efficiency

EU policy is increasingly being targeted earlier in the life cycle, moving from traditional end-of-pipe solutions to preventing environmental impacts from the outset. This includes Integrated Product Policy (IPP) and integrating environmental considerations into product standardisation. The packaging industry has been aware of environmental considerations for a number of years. Over the years this process has become more systematic and this is being further encouraged by the use of the Essential Requirements and the development of best practice guidelines. Again, in designing for resource efficiency, preventing loss of the product by using effective packaging needs to be considered.

The role of the consumer

Perhaps the greatest challenge to bringing about sustainable patterns of production and consumption is dealing with consumption itself. There are a number of existing policy instruments addressing the environmental impacts of production, for example Integrated Pollution Prevention and Control (IPPC). Consumption, however, is harder to tackle. Economic growth, rising living standards, changing lifestyles and demographics all create new and increasing demands on goods and services. In addition, there is variation in the degree of action that society is prepared to take and this is critical in determining the level of success of any measures introduced that require participation. Consumer awareness has been identified as a key issue that needs to be addressed. This is not only true of waste but is something that is raised time and again in relation to all environmental policy.