



incpen



ENVIRONMENTAL IMPACT
OF PACKAGING IN THE UK
FOOD SUPPLY SYSTEM

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INCPEN – The Industry Council for Packaging and the Environment

Preface

INCPEN was founded over 22 years ago as a forum for all industrial parts of the packaging chain, i.e. from the farm or factory to the ultimate consumer. Members include raw material suppliers, packaging manufacturers, converters, packers/fillers and retailers.

Whilst keen to show the positive side of packaging, this work, as with all INCPEN activities, attempts to research our industry’s environmental work and to take a responsible view on behalf of the public.

Packaging has become a visible issue for politicians and various interest groups. We have found that the public do recognise some benefits of packaging but are often misled by unsubstantiated claims of “over packaging” even though other INCPEN research shows industry has no incentive to over package and has an excellent record on minimisation.

We hope this booklet will help those willing to listen and understand that there needs to be a more balanced view on the environmental aspects of packaging and we should be working to identify and correct the areas where action is needed.

INCPEN will continue to play a major role in supporting the introduction of a UK scheme in keeping with the requirements of the 1994 EU Directive on Packaging and Packaging Waste. We also believe the public has a right of choice. We aim to give that choice coupled with responsible action.

Bill Jones
Chairman INCPEN Technical Committee 1996

Key Findings



Recommendations

Overall

- To identify areas for improvement the combination of contents and packaging has to be evaluated.
- Environmental gains in other parts of the food chain are often achieved by increasing packaging which itself has a relatively small environmental impact in relation to that of food production and distribution.

Responding to demographic change

- Households are getting smaller and therefore more people need to buy smaller portions and this will mean a 4% increase in food packaging by the year 2000. (*page 7*)
- Consumer choice should not be restricted by unrealistic packaging reduction measures that will conflict with demographic trends. (*pages 7–8*)

Waste in perspective

- The nearer food preparation waste is generated to the beginning of the supply chain, the less energy is used and hence the lower the environmental impact. Waste from food preparation in the processing plant is often not “waste” but becomes a by-product for use in another process. (*page 10*)
- Packaged foods generate less total waste than fresh foods. (*page 11*)
- If it takes more of the earth’s resources to re-use or recycle an item than to make it from new materials, use and dispose of it, then it is environmentally better to use new materials. (*page 17*)
- Large households generate less waste per person. (*page 12*)

Energy use

- The energy used for packaging is 11% of the energy used by the whole food supply system. (*page 14*)
- Energy used by consumers in shopping, storing and cooking food is over 3 times the energy used for its packaging. (*page 14*)
- It is more important to reduce energy use than solid waste because the consumption of fossil fuel energy has environmental effects that are far more significant than the disposal of solid waste. (*page 14*)

to industry:

- Make portion size match consumer needs.
- Recycling should be encouraged only when the environmental benefits justify the costs.
- Design processes and packaging to reduce food wastage throughout the chain.

to legislators:

- Demographic changes need to be considered before designing measures to reduce packaging.
- Material and energy use along the entire food chain should be taken into account.

to consumers:

- Buy the right amount of what you need – to avoid the product being wasted, and buy it appropriately packaged – unwrapped for immediate consumption, large bulk quantities for a party, single portions if you plan to eat alone, long-life if it’s not going in the fridge, decorated for a gift.

Why the Study was done

Packaging for food and drink is used to make sure the contents get from the farm or the sea to people's plates in good condition. It is just one part of the food supply system and cannot be considered in isolation. Over two thirds of packaging is used for food but the same principles apply to packaging for all items.

Many different foods make up the total diet. Packaging and other technological developments have provided huge improvements in food quality and have extended the choice of foods over the seasons. People now have a choice of over 15,000 different product lines in a typical supermarket.

The total consumption of food depends on people's nutritional requirements and has hardly changed over the years:

- the range of types of food we eat is still fairly traditional,
- limited by our digestive capabilities, we continue to eat roughly 10 times our body weight each year.

What has changed is people's lifestyles and demographics, particularly the number of people who live in smaller households.

It is obvious that the amount of food consumed per household depends mainly on the number of inhabitants, and it is also obvious that larger households can buy bigger portion sizes than single people who tend to rely on smaller portion packs. However, it is not always appreciated that this has a significant effect on the environmental aspects of the food supply system.

The environmental aspects are also affected by the food inside the pack and people's needs. Once opened, the quality of food deteriorates, so pack sizes have to be appropriate to the number of people who are going to eat the food at any one time. Even if the food does not deteriorate, most consumers like a variety of foods, so again smaller portions are desirable.

To get a better understanding of the relationship between packaging and the whole supply system, including the effects of demographic trends, INCPEN commissioned Professor Jan Kooijman of the Netherlands, who has spent many years studying the food supply system, to carry out a year-long study.

We did not set out to decide if the status quo was right or wrong, but to identify, in the current situation, where improvements could be made.

The main source of information was the Government's National Food Survey which has provided continuous information on weekly shopping and food consumption, split by size of household (number of inhabitants) since 1940.

This was supplemented by information from UK companies and retailers, information from Professor Kooijman's more extensive study of the Dutch food supply chain and some actual "kitchen sink" research carried out by a number of volunteers.

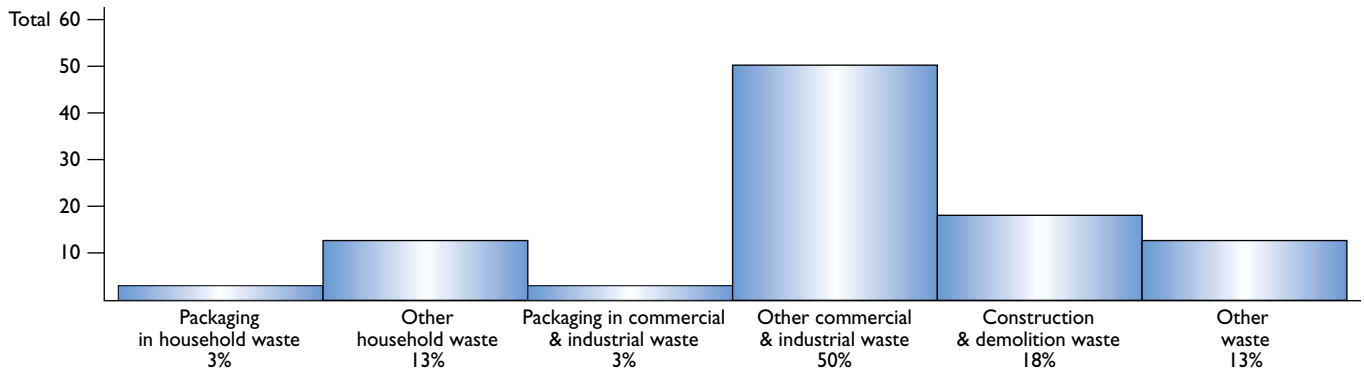
The study was overseen by a Steering Committee, which included representatives of consumer and environmental organisations. The initial results were reviewed by a group of 50 experts at a meeting in September 1995.

This booklet reports on the results. Additional information from the National Food Survey and other government publications is included.

Background

Ask any group of British people what's in their dustbin and they will tell you "packaging". In terms of volume, they have a point – a corn flake box or a large bottle takes up a lot of space. But in terms of weight, packaging is less than a third of household waste, and by the time the rubbish has spent a few weeks in a landfill site, it is squashed so flat that all packaging (and that includes industrial and commercial packaging), whether it is measured by weight or volume, is around 6%–7% of total landfilled waste (120 million tonnes per annum).

Waste going to landfill (million tonnes per annum)



Source: DOE, INCPEN

By focusing too much on packaging and household waste, we tend to ignore other wastes such as food waste. A typical family might throw away just over 3 kg of packaging in a week but it also throws away approximately the same amount of food. Consumer surveys show that people think of packaging as a necessary evil and ignore, take for granted or are unaware of its positive contribution in such areas as allowing them to have foods out of season, saving food preparation time in the kitchen and actually helping to reduce waste.



Packaging has been under challenge on environmental grounds for a number of years and the industry has responded, not only by putting significant resources into recycling schemes, but also by continuing to reduce the use of resources in packaging.

Much of the criticism of packaging is based on emotion or a lack of information but even that has stimulated research and development by industry and has helped to identify areas for continuous improvement.

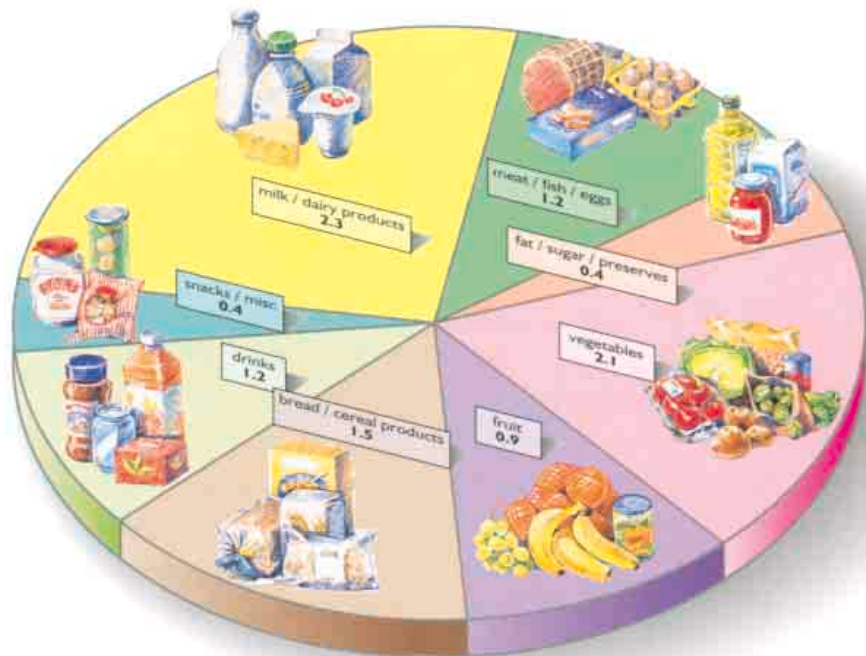
Legislators have also responded to challenges to packaging but their input has not always been beneficial because they have not taken account of the total production and supply chain or consumers' needs. There is a real danger that, far from helping the environment, current EU and UK legislation on packaging could drive us into wasteful practices.

“Legislation can take too narrow an approach. Far from helping the environment, poorly thought out laws will produce wasteful practices.”

Food Consumption and Demographics

The UK has a population of 58 million. In 1994 we spent just over 11% of our income on household food – an estimated £47 million. The average person spends £15 each week on food and drink for consumption at home (10 kg–12 kg) and another £6 on snacks and meals eaten out. This provides about 18 kg of food and drink which gives the average person 13,300 calories of nutritional energy each week.

Food brought by the average person for eating at home *kg / person / week*



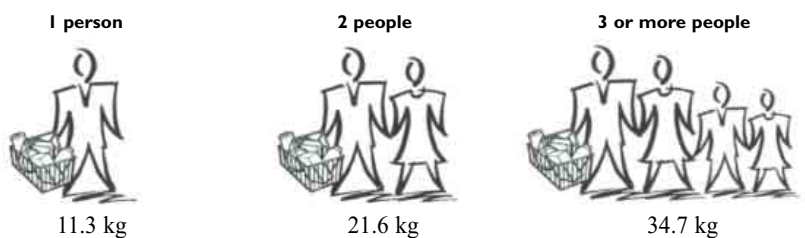
“Large households eat more and so buy bigger packs which use less packaging.”

The purpose of the food supply system is to provide the population with sufficient quantity and variety of food in good condition. Packaging is an essential part of this process.

Household size

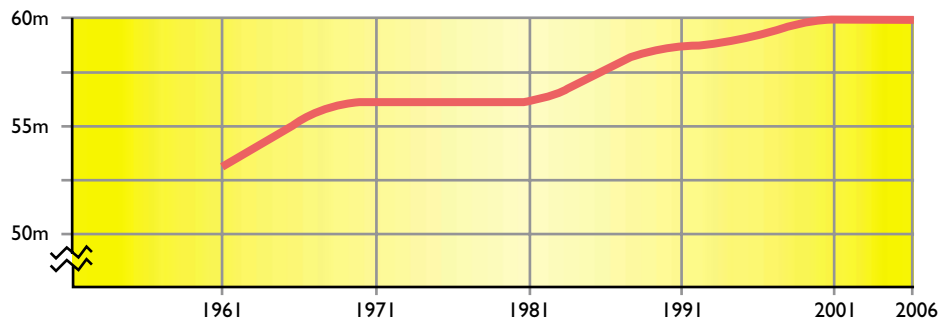
The purchase of food and the resulting waste stream of food and used packaging depends very strongly on the size of each consumption group. This also determines the size of the pack bought.

Food and drink bought for consumption at home in different sized households *kg / week*

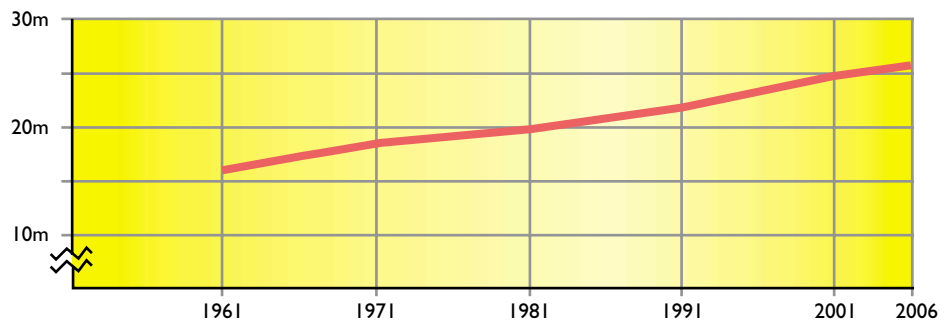


The importance of the influence of household size becomes even more significant because of the increase in the number of people living in smaller sized households. This is due not only to people living longer but also to the the increase in divorce rate, single parent families and even more people choosing to live alone.

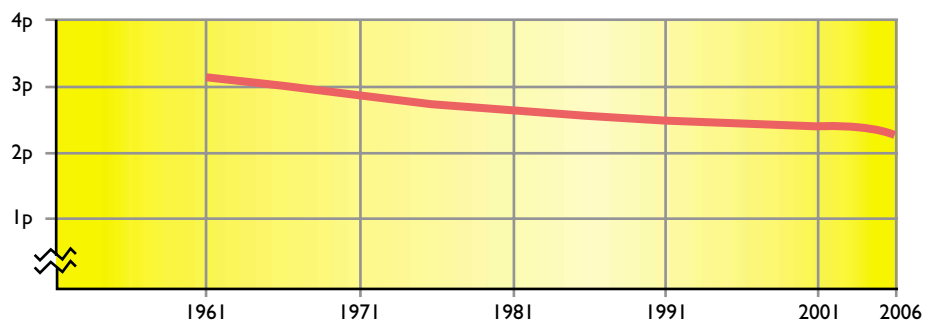
Population



Number of households



Average household size



These demographic changes in the UK have many social and environmental consequences. The forecast rise in population will lead to the need for more food but coupled with the trend to smaller sized households this doubles the expected increase in food.

To cope with this, Professor Kooijman estimates there will need to be a minimum 4% increase in food packaging by the year 2000 compared with 1993. In reality, the increase will probably be more than that because of the additional trends towards more frequent meals, separate family meal times and other lifestyle changes.

“More people need to buy smaller portions because households are getting smaller and this means more packaging.”

Lifestyle changes



Other changes in society are also having an effect on the food supply system and packaging.

- different members of the family eat at different times of day – therefore they need more, smaller portions
- increased demand for ready-to-cook prepared meals – these need more sophisticated packaging protection but they reduce the amount of food preparation waste that is transported through the distribution chain
- increased demand for fewer preservatives in food – therefore more protection from packaging to provide the same shelf life e.g. modified atmosphere packaging for fresh meat and fish
- despite greater equality of the sexes, women still do 80% of the shopping, yet an increasing number of them also do full time jobs outside the home. As a result, time-saving, convenient products are increasing in demand, e.g. ready-to-cook meals, easy-to-use household cleaners
 - older, retired people may have more time to shop, prepare meals from scratch, grow their own food and may generate less used packaging
 - more meals are eaten outside the home (in 1994, 20% of our total food and drink was eaten “out”) – food eaten in a restaurant is bought in catering sizes which means less packaging
 - other food bought to eat out needs to be available in individual portions. Sandwiches, in particular are a rapidly growing market – 1250 million are sold annually, contributing 0.2% of our diet (2 kg of food per person per year – protected by 0.3 kg of packaging)
- demand for child-resistant closures and the need for tamper-evident features on packs means more packaging
- for older people, the need for clearer type size for instructions and easier opening can mean using more material per pack

All these factors must be considered by policy makers before they design measures to encourage the reduction of packaging. It is not for industry to decide if these trends are right or wrong – the reality is that they are happening and industry needs to be able to respond.

“All these changes need to be considered before designing measures to reduce packaging.”



Food Consumption and the Supply Chain

The National Food Survey gives quantities of food purchased but there are no published sources of information on portion sizes or the associated weight of packaging. This data was obtained by analysing the results from volunteers' shopping records and spending many hours emptying, cleaning and weighing the packaging. Over 200 foods, packed in a variety of pack size, were included.

Volunteers were from a range of types of households – students, older people living alone, one adult with children, couples and families. These volunteers kept a record of the weight of food and packaging bought over a two week period and the weight of peels, rinds, skins and bones, scraps on the side of plates and packaging thrown away, composted or recycled.

Not all people need the same amount of food and the total amount of food and packaging depends on:

- an individual's nutritional needs which in turn depends on age, sex, body weight and type of work
- the total population and the size of each "consumption group" i.e. how many people eat the food at the same time
- the portion and pack sizes available – larger groups can buy bigger packs
- the efficiency of food use i.e. how much food is lost during storage, preparation and cooking

Packaging and portion size

Large packs use less packaging per gram of product than small packs.

Packaging is not just the pack we take home. Protection for a product is designed as a total integrated system made up not only of the packaging containing the goods (primary) but also the cases, trays and wrapping used to group the primary units (secondary) and the larger boxes, crates and pallets used to transport them (transport). There is no point assessing the primary pack without taking account of the other forms of packaging.

*“Products need adequate packaging throughout the supply chain; provided by the **combined** properties of primary, secondary and transport packaging.”*



Small pack needs 1 1/2 times more packaging to protect a serving.



Small pack needs 6 times more packaging a serving.



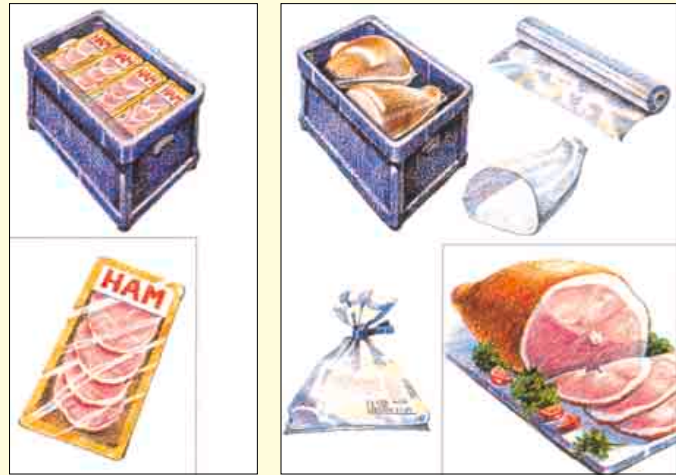
A small loaf needs twice as much packaging per slice.

Waste and losses along the food chain

All along the food chain losses occur or some form of waste is produced.

This study did not look at agricultural waste, and it also stopped short of following the food all the way through people's digestive system. It did, however, take account of all the stages in between.

For many people "fresh food" means little or no packaging. This may be the impression we are given when we buy foods from a delicatessen counter or help ourselves to loose fruit and vegetables but the shop or supermarket is at almost the end of the food chain. At all previous stages in the chain, fresh foods still need protection and they tend to need more secondary or transport packaging than foods that are pre-packed. Fresh foods also generate an additional flow of potential food waste along the whole food chain.



Losses from farm or factory to shop



Prepared "stabilised" food
0.1%–1% wastage



Fresh "perishable" food
10%–20% wastage

Some losses in the chain also arise from inadequate packaging. This is not just a waste of resources but is also costly. If a 1 kg bag of flour bursts in a distribution depot, it costs on average £5.00 to clear up and causes an additional £1.00 worth of damage to other goods.

"Environmentally, it is better for food preparation waste to be generated at the beginning of the supply chain.

Waste from food preparation in the processing plant is often not 'waste' but a by-product for use in another process."

Waste at home

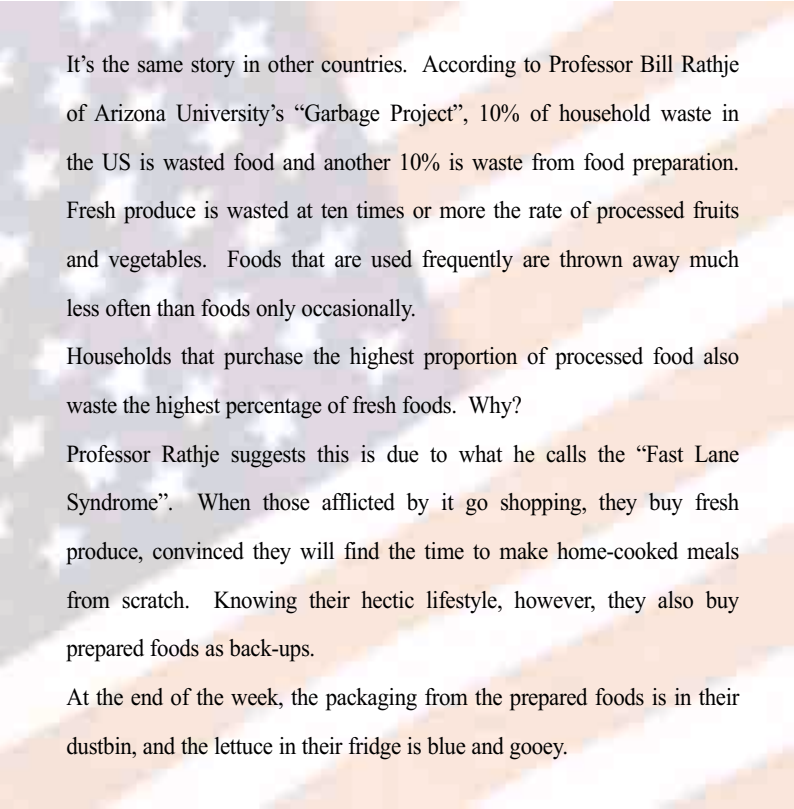
People use only some of the food that they buy. As some food is wasted, the system has to deliver more food than is actually eaten.

Some food deteriorates because it is stored too long. Preparing fresh food produces waste – rinds, peels, bones. For some foods such as lean meat or tomatoes there is very little waste, for others such as cheaper cuts of meat or cauliflower there is much more.

With ready-to-eat meals or drinks a varying amount of foods will stick to the packaging and liquids such as brine are sometimes discarded. Some people do their best to get the last bit out of a container, by adding a drop of vinegar to ketchup, hot water to a savoury spread or chase the last baked bean round the can but inevitably some gets left. This can be as little as 1% but in some cases (such as brine) as much as 20%.

Finally, we do not always eat everything on our plate and this too becomes waste.

Overall, between 3% to 6% of the food we buy is thrown away during preparation and between 10% and 12% of what we could then eat is thrown away.



It's the same story in other countries. According to Professor Bill Rathje of Arizona University's "Garbage Project", 10% of household waste in the US is wasted food and another 10% is waste from food preparation. Fresh produce is wasted at ten times or more the rate of processed fruits and vegetables. Foods that are used frequently are thrown away much less often than foods only occasionally.

Households that purchase the highest proportion of processed food also waste the highest percentage of fresh foods. Why?

Professor Rathje suggests this is due to what he calls the "Fast Lane Syndrome". When those afflicted by it go shopping, they buy fresh produce, convinced they will find the time to make home-cooked meals from scratch. Knowing their hectic lifestyle, however, they also buy prepared foods as back-ups.

At the end of the week, the packaging from the prepared foods is in their dustbin, and the lettuce in their fridge is blue and gooey.

"Packaged foods generate less waste than fresh foods."

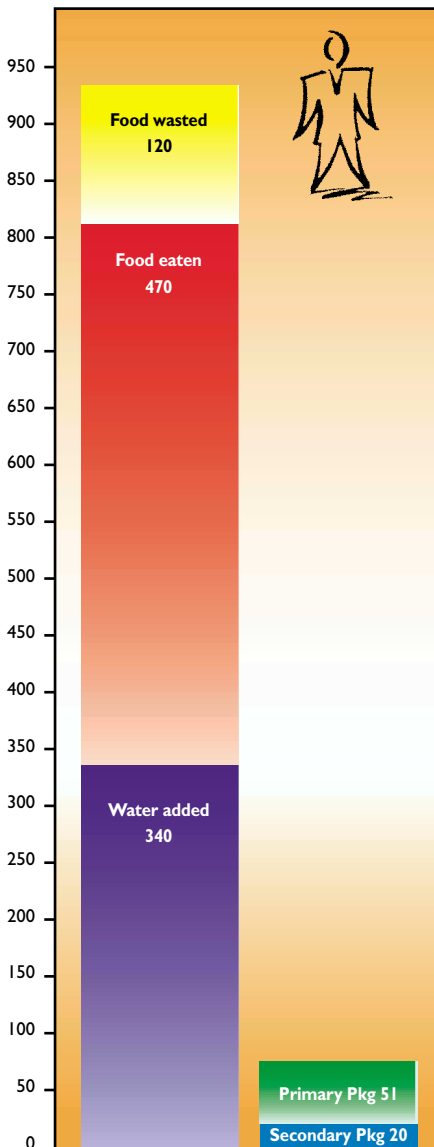
Used packaging

Packaging is often criticised on environmental grounds mainly because it is so visible in the waste stream; and naturally enough, attempts to reduce the amount of household waste tend to focus on the visible fractions – packaging, and newspapers.

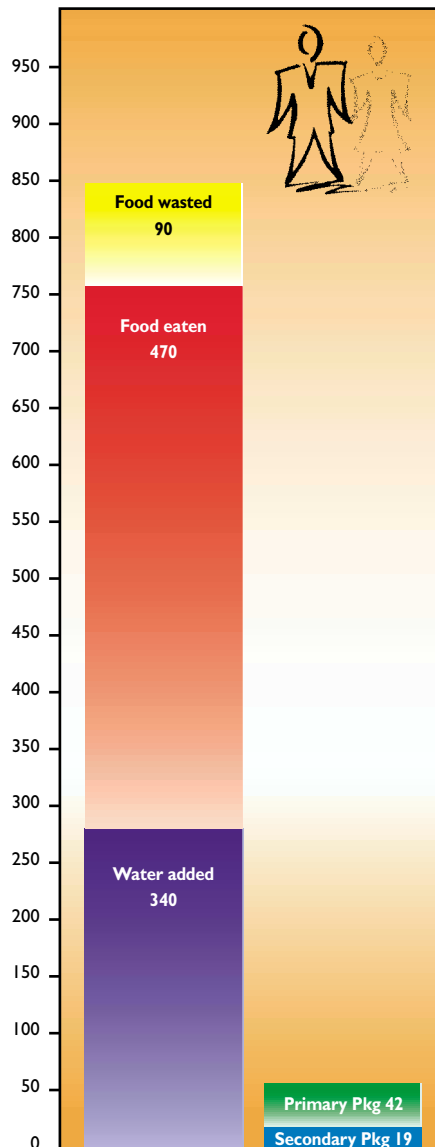
Waste food is seen as inevitable and beyond anyone’s control, whereas used packaging is seen as a problem which can be blamed on industry. In fact, waste food is a much greater waste of resources, not just in terms of weight but more importantly, in terms of energy.

Food and packaging quantities per person in different sizes of households

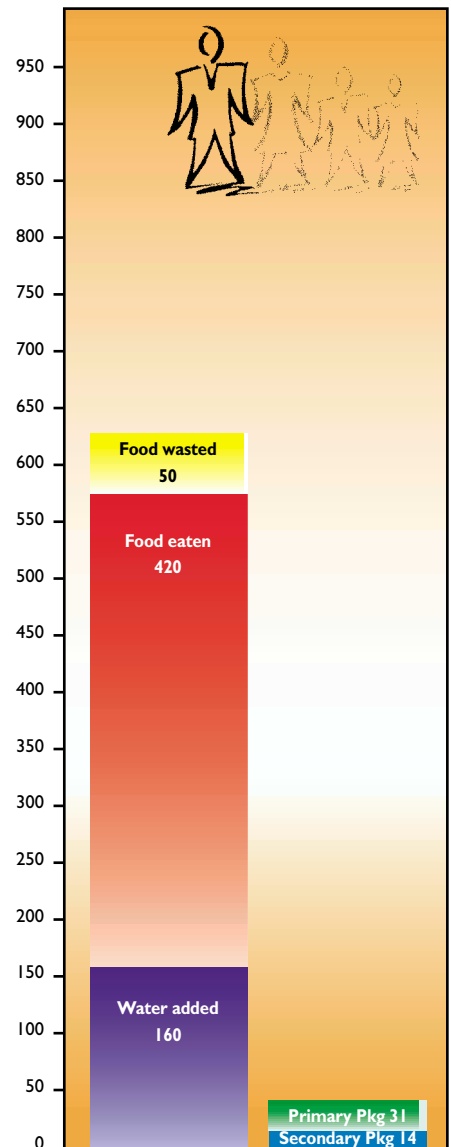
Food and drink used at home in single person household kg / person / kg



Food and drink used at home per person in 2 person household kg / person / kg



Food and drink used at home per person in 3 or more person household kg / person / kg



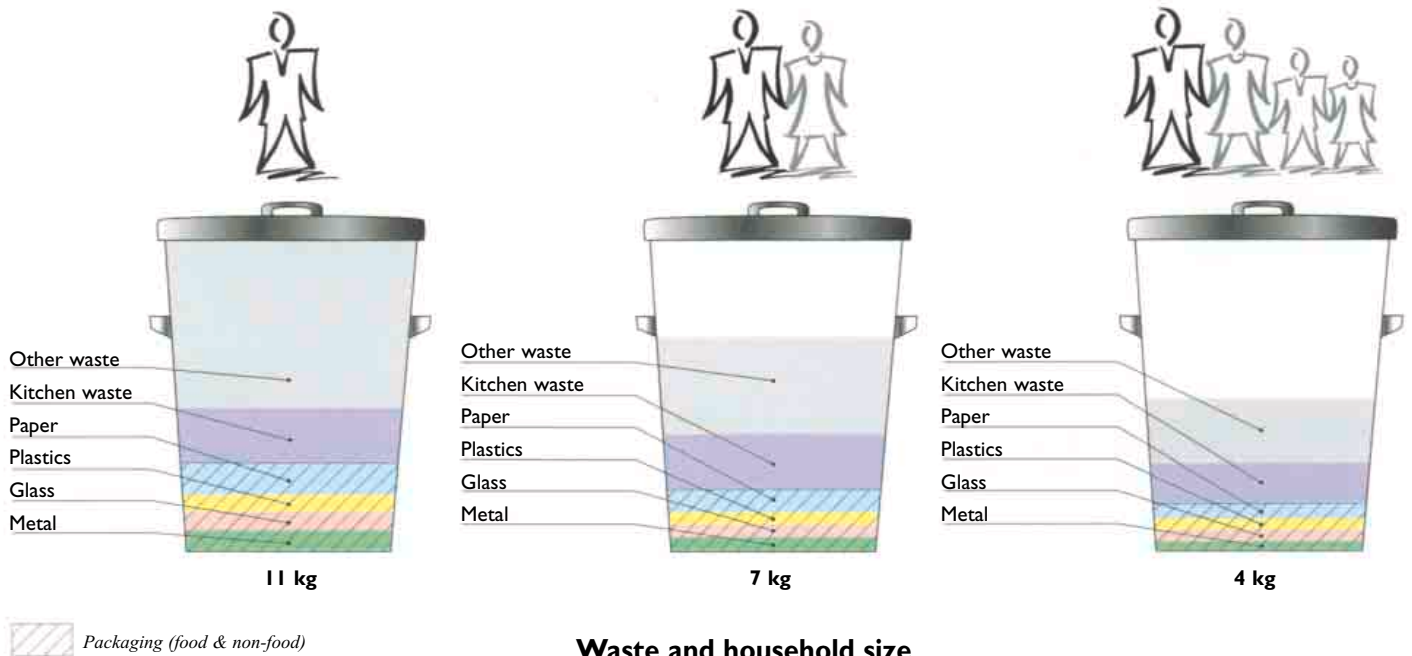
“Packaging protects 10 times its weight of food.”

For the average consumer, the ratio of weight of food bought to its total packaging is 10:1. In other words the materials in packaging protect 10 times their weight of food – with a range between 1 and 200 times depending on the food. As only 2% to 3% of our food is wasted in getting it to the consumer, compared with as much as 50% in developing countries, the packaging is not only a cost effective way of helping to feed a nation, it actually reduces waste.

Taking the lid off the dustbin also confirms the comparative efficiency of living in larger households and shows the relatively smaller amount of used packaging and food “kitchen” waste generated per person.

Household dustbin waste per person in different size households

kg / person / week



Waste and household size

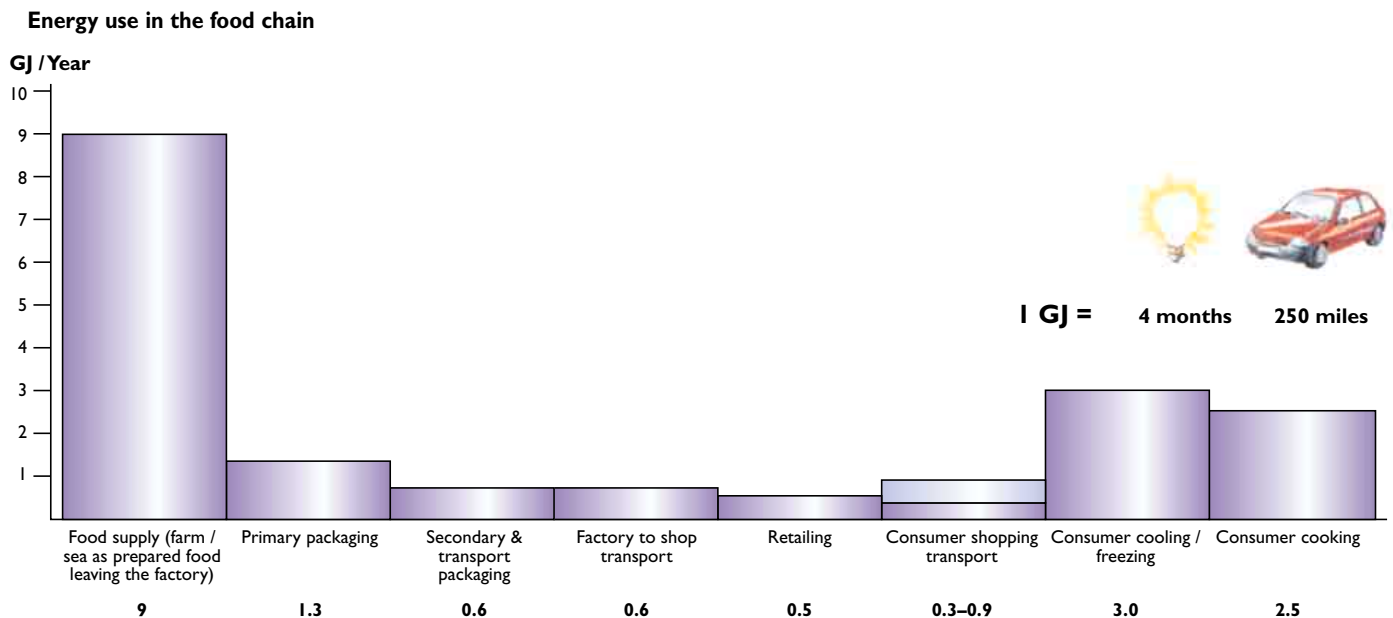
Large households are relatively efficient. They buy larger sizes and eat more meals together, generating less used packaging and less food waste per person. The higher level of food wasted per person in small households would be even greater if they could not purchase the small portion sizes to suit their consumption needs. Industry needs to have sufficient flexibility to continue the development of packaging materials and designs to make packaging more efficient, in particular, using less material to give better protection to help counter the forecast increases in packaging.

“Industry needs flexibility to be able to give consumers value for money and an environmentally responsible packaging.”

“Consumer choice should not be restricted by unrealistic packaging reduction measures that will conflict with demographic trends.”

Energy Use Throughout the Supply Chain

The energy used to grow, pick, farm or fish and prepare the food is by far the largest amount of energy in the system. Packaging has a critical role to play in making sure this energy is not wasted on its journey along the chain. To decide how to reduce energy, we need to know how it is used at the moment.



“Many people would argue that it is more important to reduce energy use than reduce solid waste because the consumption of fossil fuel energy has environmental effects that are far more significant than the disposal of solid waste.”

“Energy used for primary and secondary packaging contributes 11% to the total.”
“energy used by consumers is about 3 times the energy used for packaging.”

Energy use in packaging, distribution and retailing

About 5% of food is delivered directly from the manufacturer to shops. All other food is delivered in large quantities to distribution depots and then sent in smaller quantities to the stores.

In the last 10 years, there has been a shift in shopping habits and now about two thirds of all food and drink is sold through large superstores. In all stores, energy is used to cool some foods and for heating and lighting. It was difficult to find any published information on retail energy use, so data from the Dutch survey was used.

Consumers' use of energy

Consumers have a large effect on energy use. The change from shopping in small town centre shops to out-of-town supermarkets means that there is a wider choice of goods, more variety of sizes and prices are lower but it also means that most people now have to use a car to go shopping.

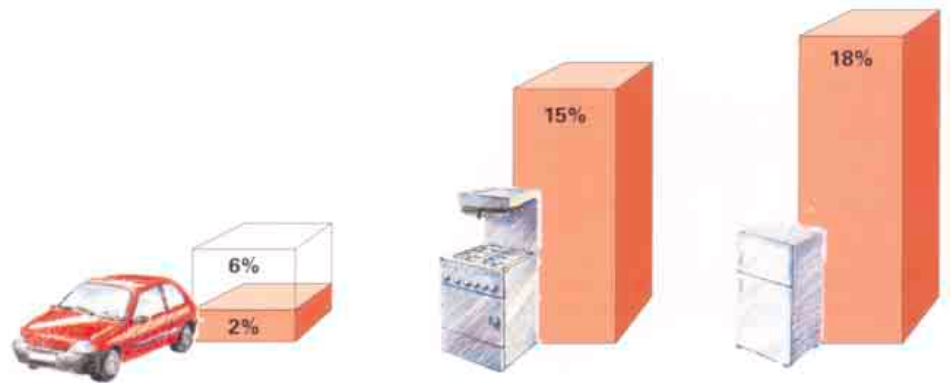
In this study we assumed that 70% of weekly shopping trips are made by car travelling 8 km to the edge of town. For high street shopping, between 25% and 70% of people use a car and travel 3 km. The energy use was apportioned to each food based on the weight of food purchased, with a correction made for door step delivery of milk.

The average person using a car to do the weekly shopping contributes a minimum of 1.8% to the total food chain energy. This assumption is likely to be at the low end – if people make more than one trip a week or travel further, consumer transport could be as much as 3 times higher.

“The environmental impact of packaging is small compared to that caused by the primary purpose of the system – production and delivery of the food itself.”

Much more significant, though, is the energy used to keep food chilled or frozen at home – 99% of homes have a fridge and 47% have freezers. Use of fridges and freezers contributes 18% to the total energy and cooking at home contributes another 15%, assuming 40% of homes use electricity and 60% use gas.

The energy used by people in their homes may seem surprisingly high but home fridges and freezers and kitchen cookers are very small and inefficient compared with industrial sized equipment. And the smaller the household size, the more energy it takes to provide each person with sufficient food.



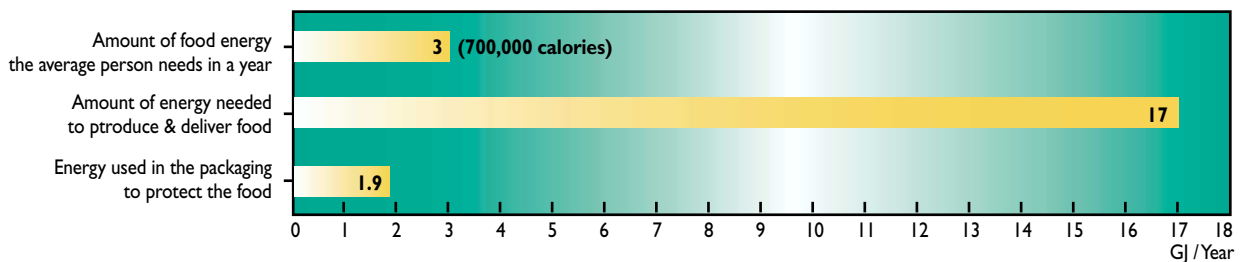
Energy use in the home, percent of the total food supply chain energy.

Nutritional energy – calories

In theory – but not very practical – the most energy-efficient way to feed ourselves would be to visit a food processing plant for meals. As the food travels further down the food chain more and more energy is used. This is not an issue that industry can make a decision about but something that society as a whole needs to consider.

The energy used to grow and produce food and get it on to people’s plates is on average 6 times greater than its nutritional energy.

Food energy



“If we did not have packaging, up to twice as much energy would be needed to feed people because much more food would be wasted during distribution.”

Solution:
**How to reduce the
environmental impact of
packaging and the food supply chain**

*“Make portion size
match consumer needs.”*



From the packaging point of view, the most important action is to match packaging with what people need.

Most companies are constantly seeking ways to cut down on the packaging they use and trying to make it easier to recycle. This is fine provided they do not ignore the more important areas, such as:

- providing small portions for people who live alone and bulk sizes for large families reduces food wastage
- developing packaging systems that keep food fresher longer
- helping people reduce their energy use. For example, a company changed the instructions on rice to encourage people to boil it in just the right amount of water for the rice to be cooked when it has absorbed all the liquid. This reduces the energy needed to boil surplus water which would then be strained off and thrown away. A little action like this helps cut down people's cooking energy and saves them money. To have a positive impact on the environment, we are much better off concentrating on designing efficient packaging that preserves appropriate quantities of food, instead of focusing on how to reduce packaging on its own or reach arbitrary recycling targets set by EU and UK laws.

The small environmental impact of packaging compared to the whole food chain means that it can sometimes be better to use additional packaging or processing in order to get a big environmental gain in other parts of the chain. For example, heat processed and aseptically processed foods may need more packaging or processing energy initially but do not need to be kept chilled or frozen further down the distribution chain.

Ready-to-eat meals need more packaging but generate next to no waste in the distribution system and save on transport energy because only the edible portion is transported.

*“Solutions: Get a lodger, join a
commune, invite the neighbours round
to eat, buy food that can be kept at
room temperature or, more practically,
buy the right size portion.”*

The environmental movement for years has encouraged people to buy the biggest pack size to reduce waste. It is true that this reduces the amount of packaging per gram of product but it is far from certain that this will reduce waste because for small households it will simply increase the amount of food that they waste.

In real life both large and small packs depending on circumstances can play a part in minimising environmental impact.

“Recycling should only be encouraged when the environmental benefits justify the costs.”



Recycling in perspective

Legislators around the world have placed increasing emphasis on recycling used primary packaging, based on the idea that recycling will conserve resources and improve management of waste.

In reality, recycling some things some of the time does help the environment but there is a level above which it does more harm than good. And that level depends on a host of factors that need to be decided at local level. These are different for different materials and change over time.

Neither recycling nor “return for re-use” systems are environmental virtues in their own right – they are both industrial processes that use energy and have their own environmental burdens.

Current UK and EU law, however, sets a minimum 15% recycling target level for all packaging materials by 2001, regardless of where they end up or the state they are in. No one knows if this is a sensible level and it is quite likely that we will end up collecting some materials for recycling even when there is no environmental gain.

“If it takes more of the earth’s resources to recycle old materials or re-use an item than to make, use and dispose of it from new materials, then it is environmentally better to use new materials.”

The “right” amount of packaging

The vast majority of packaging already uses resources sensibly as a result of commercial competitive pressures.

Telling people to avoid excessive packaging or over packaging is meaningless because:

- people only see the primary pack, so they do not know how much secondary packaging is needed to protect the goods when they are being transported to the shops. They are therefore unable to make a judgement about what may be excessive;
- it depends on what people want – a bottle of whisky in a decorated box is not over packaged if it is intended as a gift; it might be if it is for one’s own use.

“Buy the right amount of what you need – to avoid the product being wasted; and buy it appropriately packaged.”



Telling people to avoid over packaging is meaningless.

Much more practical advice that could help people reduce food wastage as well as used packaging, would be:

“Buy the right amount of what you need – to avoid the product being wasted; and buy it appropriately packaged – unwrapped for immediate consumption, large bulk quantities for a party, single portions if you plan to eat alone, long-life for storage, decorated for a gift.”

Dr Kooijman concludes:

To optimise the environmental effects of food packaging, it is essential to analyse a system that covers its main purpose “food”, the total production chain and the varying demands of the consumer.

Legislators involved in reducing the environmental impact of packaging should take mass and energy performance along the food chain into account.

Industry needs to have sufficient flexibility to continue the development of packaging materials and designs to meet consumers needs **and** to make packaging more efficient – using less materials to give better protection.

“People can help if they are given practical advice – let’s put packaging in its place and focus on real environmental improvement.”

Biography: Jan Kooijman

Jan Kooijman is currently a consultant to the food and packaging industry at “Food Technology Consulting” in Gouda, the Netherlands. After working in academia and industry in the field of physics and chemical engineering, he spent a number of years as Director of Research and Technology in product, packaging and process development for dairy, baby and dietary foods.

As visiting Professor at Wageningen University from 1988 to 1995, he carried out extensive research on food packaging in relation to preservation, shelf life and quality, and on the interaction between food and its effect on the environment along the food chain.

He is the author of over a hundred publications including a recently published textbook on packaging of food, *Verpakken van voedingsmiddelen een ketenbehandeling*, Kluwer 1996.

Dr Kooijman’s full report, *Environmental Impact of Packaging Performance in the Food Supply System*, November 1995, 44pps, is available from INCPEN at a cost of £95.00.

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Acknowledgements

**INCPEN is most grateful for the valuable help and guidance given by
members of the Steering Committee:**

John Newman *Biscuit Cake Chocolate Confectionery Alliance*

Belinda Howell *Boots*

Ted Richards *Courtaulds*

David Bellamy *Food & Drink Federation*

John Mortimer *Going for Green*

Mike Hancock *Pira International*

Mike Pratt *J Sainsbury*

Elizabeth Allen *Waste Watch*

Thanks also go to the Food & Drink Federation for a financial donation

Edited by Jane Bickerstaffe

with expertise, advice and additional assistance from

members of the Technical Committee:

Bill Jones *Sonoco Europe*

Gerry Elms *Ancor*

John Sale *British Polythene Industries*

Adrian Myers *British Steel Tinplate*

Simon Paul *BT*

Lindsay Fortune *Courtaulds*

Derek Lewton *Mars Confectionery*

Ann Stirling Roberts *Pira International*

Geoff Hammond *Reckitt & Colman Products*

Dave McFarlane *Smurfit*

Peter Singleton *United Biscuits (UK)*

Derek Wade *United Distillers*

Steve Anderson *Unilever*

Peter Harrison *John Waddington*



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November 1996 Price £12.00