BEYOND RECYCLING

The longer life option

TIM COOPER

Recycling is widely considered to be positive for the environment. People instinctively believe that re-using materials from products which might otherwise end up in a landfill site must be environmentally beneficial. The idea that recycling is intrinsically 'green' is promoted widely – by politicians, local authorities, manufacturers, journalists and, indeed, most environmentalists. It has come to symbolise good environmental practice.

The fact that recycling allows raw materials to be used repeatedly might appear to suggest that no environmental damage need be caused by ever-increasing consumption in industrial countries. Yet the recycling process, like all physical activities, affects the environment. Energy is consumed as waste products are collected, sorted, cleaned and separated into their constituent materials. Pollution is caused, both as a by-product of this energy consumption and, more directly, by materials reclamation processes. The subsequent manufacture and distribution of products made from recycled materials also has an impact on the environment.

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Energy and Materials Conservation Research

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Executive summary

The growing volume of waste in industrial countries, linked to high levels of consumption, is increasingly recognised as a key environmental issue. In Britain alone 6 million kitchen appliances, 3 million vacuum cleaners and 2 million vehicles are discarded each year. Many have lasted for less than a decade.

Until now, the focus of attention by government, industry and environmental campaigners alike has been on recycling. Yet recycling is coming under increasing scrutiny as awareness grows that it, too, has an impact on the environment.

Attention is now turning – notably in the Government's recent sustainable development strategy – to the possibility of reducing waste and pollution through the manufacture and sale of products with longer life spans.

This report argues that increased product durability should be the key element of a new environmental strategy to minimise waste: *the longer life option.* A new focus in the debate on consumption and waste is needed because the environmental benefits of longer lasting products have not been fully appreciated. The longer life option is not only environmentally beneficial but commercially realistic. For example, Swedish car manufacturers have thrived while increasing the average life span of cars from 9 years to over 17 years since the mid 1960s. By comparison their average life span in Britain is 11-12 years.

The report concludes that

- *there is a widespread awareness of the benefits of recycling over waste disposal in landfill, but there has been too little analysis of the environmental downside to recycling*
- *concern is mounting at the possible net commercial cost to manufacturers of recycling consumer durables and potential problems raised by contaminated secondary materials*
- *there is a need to distinguish 'technical life', 'service life' and 'replacement life', and the aim should be to optimise rather than maximise product life spans*
- *in addition to the environmental gains, increased product life offers potential benefits to consumers (who would gain better value for money) and manufacturers (who could improve their competitive edge)*
- *whilst action is needed by Government and industry to develop and promote longer lasting products, many consumers, too, need to change their attitudes.*

The influences upon product life are complex and deeply rooted in our contemporary industrial culture. Even so, there are many practical measures which would encourage the manufacture and sale of longer lasting products, including:

- *a shift in taxes from labour to energy and raw materials in order to encourage repair and reconditioning*
- *significantly longer guarantees, free at the point of sale, covering labour as well as parts, and lasting for at least ten years for most household products*
- *mandatory labelling of products with their normal expected life span, so that consumers can more readily assess their value by taking account of the anticipated length of service which they will provide*
- *action by central and local government to promote waste reduction and reuse, with clear policies and targets to complement those for recycling.*

It is increasingly evident that an environmental strategy is needed which goes *beyond* recycling, based on longer lasting products. Only such a strategy could achieve the reduction in the volume of energy and materials passing through industrial economies necessary if sustainable development is to be achieved.

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The focus in the recycling debate has, so far, been on packaging rather than products. This new culture of recycling is now being extended, however, and a trend is emerging towards the promotion of products such as cars, washing machines and electronic goods as recyclable. There is a prospect that products which malfunction will increasingly be recycled rather than repaired.

'White goods' delivered to a recycling centre

This report takes a hard, critical look at recycling. Its focus is on consumer durables – defined here as vehicles, kitchen appliances, audio-visual equipment and other domestic electrical products, furniture and floor coverings, hardware and garden tools.[1] It questions whether recycling is the best environmental solution to the increasing volume of discarded consumer durables. Is it, perhaps, diverting attention from more radical responses? Rather than increasing society's capacity to absorb waste, should the priority instead be to reduce the flow of energy and materials through the economy (its 'throughput') by encouraging longer lasting products?

Such questions point to a need to consider an environmental strategy which goes *beyond* recycling. The relatively low position of recycling in the widely used 'hierarchy of waste management options', which prioritises different measures for dealing with waste according to environmental impact, is significant. As the reduction of waste by encouraging longer lasting products is at the top of this hierarchy, the current priority given to recycling needs to be questioned. The report thus analyses recyclability in relation to durability. Such a comparison is useful because choices have to be made in public policy, design and marketing. Public sector bodies have to decide where to concentrate their limited resources, while in the private sector designing products for recyclability and durability is likely to push up costs, forcing companies to decide what the market will bear. In addition, the use of particular materials or methods of construction to achieve durability may make recycling impossible or more difficult.

The aim of this report, therefore, is to:

- describe recycling and durability in the context of the debate on sustainable development and, specifically, the throughput of energy and raw materials in modern industrial economies
- consider the relative attention being given to recycling and increasing product life by government and industry
- identify and explain the position in the waste management hierarchy of reduction, reuse and recycling
- analyse the complementarities and conflicts between recyclability and durability in areas such as design, marketing strategy and public policy
- make practical recommendations for action to encourage the manufacture and sale of longer lasting products.

At the outset, it is necessary to state two caveats. First, this is not a treatise *against* recycling. Once products no longer function and cannot be repaired, any component parts that can be reused or reconditioned should be separated and those that cannot should (where appropriate) be recycled. In other words, there are benefits from operating at different levels of the waste hierarchy at different stages during a product's life cycle. Second, the report makes occasional generalisations, although it is recognised, of course, that environmental impacts vary according to the type of product and geographical location.

The issues raised in this report have a wide-ranging significance. Public sector decision makers, for example, are required to assess the relative environmental impact of various waste prevention, minimisation and management policies. They have to evaluate different responses to environmental problems caused by the substantial volume of waste generated in industrial societies. There is also a traditional macro-economic concern that resources be allocated efficiently: neither Treasury policy nor policies on waste should inadvertently encourage manufacturers, local authorities or consumers to squander finite reserves of energy and raw materials. Understanding the relationship between recycling and durability will help to inform decisions on waste-related policies such as recycling credits, a landfill levy, and other fiscal reforms and spending options.

Likewise, the issues are important to the private sector. Manufacturers are increasingly confronted with a need to make decisions based on the total environmental impact of their products, from 'cradle to grave' (i.e. from extraction of raw materials to final disposal). This need has arisen in part through pressure to substantiate promotional claims made in attempts to attract the 'green consumer', who increasingly demands firm evidence of a product's environmental performance. The main reason, however, is the prospect of legislation to make industry responsible for products at the end of their lives. Proposed 'take-back' legislation in Germany will soon require manufacturers of vehicles and electronic goods to accept responsibility for them once discarded. Similar legislation is likely to be introduced throughout the European Union within two or three years.

Ultimately, the debate on recyclability and durability demands consideration of more fundamental issues relating to the shape and direction of our economy. The goal of sustainable development is accepted by politicians of all parties. Making a bold assumption that economic and environmental policy decisions will, *to some degree*, be integrated, two alternative future scenarios may be identified.

In one, economic output is maximised, but more and more of the ever-increasing output is devoted to clearing up environmental damage created in the process of achieving it. Recycling is encouraged on the basis that the repeated use of finite reserves of energy and raw materials will help to sustain a fast 'throughput' in the economy into the long term. Products are recycled rather than repaired. No ultimate limits to consumption are accepted.

In the other, the economy is managed on the basis that the aim is to maximise people's well-being and improve the environment while *reducing* this throughput, the flow of energy and raw materials. As products are designed for durability the level of manufacturing output is, relatively, low; it may even fall. On the other hand, repair and reconditioning work is far more common. Recycling takes place only after products, or their components, no longer function.

Such a dichotomy exposes the controversial territory which underlies this debate. This report thus starts by considering the broader economic and environmental context, before examining in detail the extent to which the second scenario is realistic.

1 Sustainable resource use

All economic activity depends upon and influences the physical environment. In seeking to explain the interaction between economic activity and environmental change, economists have sometimes utilised the basic laws governing the behaviour of matter and energy, the laws of thermodynamics.[2] Recently, for example, in *The Green Economy* Michael Jacobs highlighted the fact that the first law, which states that matter and energy cannot be destroyed or created, is a reminder that in production processes nothing fundamentally *new* is created; what happens is that materials and energy are transformed from one state to another (Jacobs, 1991, p.11). Thus each quantity of materials and energy which enters a productive process will eventually end up as the same quantity of waste; an initial part comprising residual waste and the remainder, the discarded product.[3]

This gradual process of transformation from resources into waste is dictated by the second law, which states that in the absence of external sources of energy the amount of available matter and energy is always in decline. Resources which were once concentrated and thus in a useful form become dissipated and unavailable for use – the measure of unavailability being termed 'entropy'. It follows that just as the sun enables natural cycles to take place in the living environment (where waste matter becomes food for other organisms), the use of solar technology in an industrial economy could slow down the rate at which entropy is increasing.

These physical laws shed light on the process of environmental change which results from economic activity. Research by the Wuppertal Institute in Germany has highlighted a strong inverse correlation between the environmental sustainability of an economy and the volume of energy and raw materials passing through it (Schmidt-Bleek, 1993a). Meanwhile, a related research development concerns the concept of 'industrial ecology', through which, as a means of developing a sustainable manufacturing strategy, a parallel is drawn between the processes in an industrial system and those in a biological ecosystem.[4]

A helpful model for differentiating the dynamics within contemporary industrial economies from those of an environmentally sustainable economy distinguishes a 'linear' economy from a 'circular' economy (Figure 1) (Jackson, 1993; Jacobs, 1991). The typical economy in industrial economies takes a linear form, in that it is assumed that at one end of the industrial system there is an unlimited supply of energy and raw materials, while at the other, the environment has an infinite capacity to absorb pollution and waste. The overriding policy goal is to expand the total amount of economy activity which, recorded as economic growth, is commonly regarded as a proxy for human wellbeing.

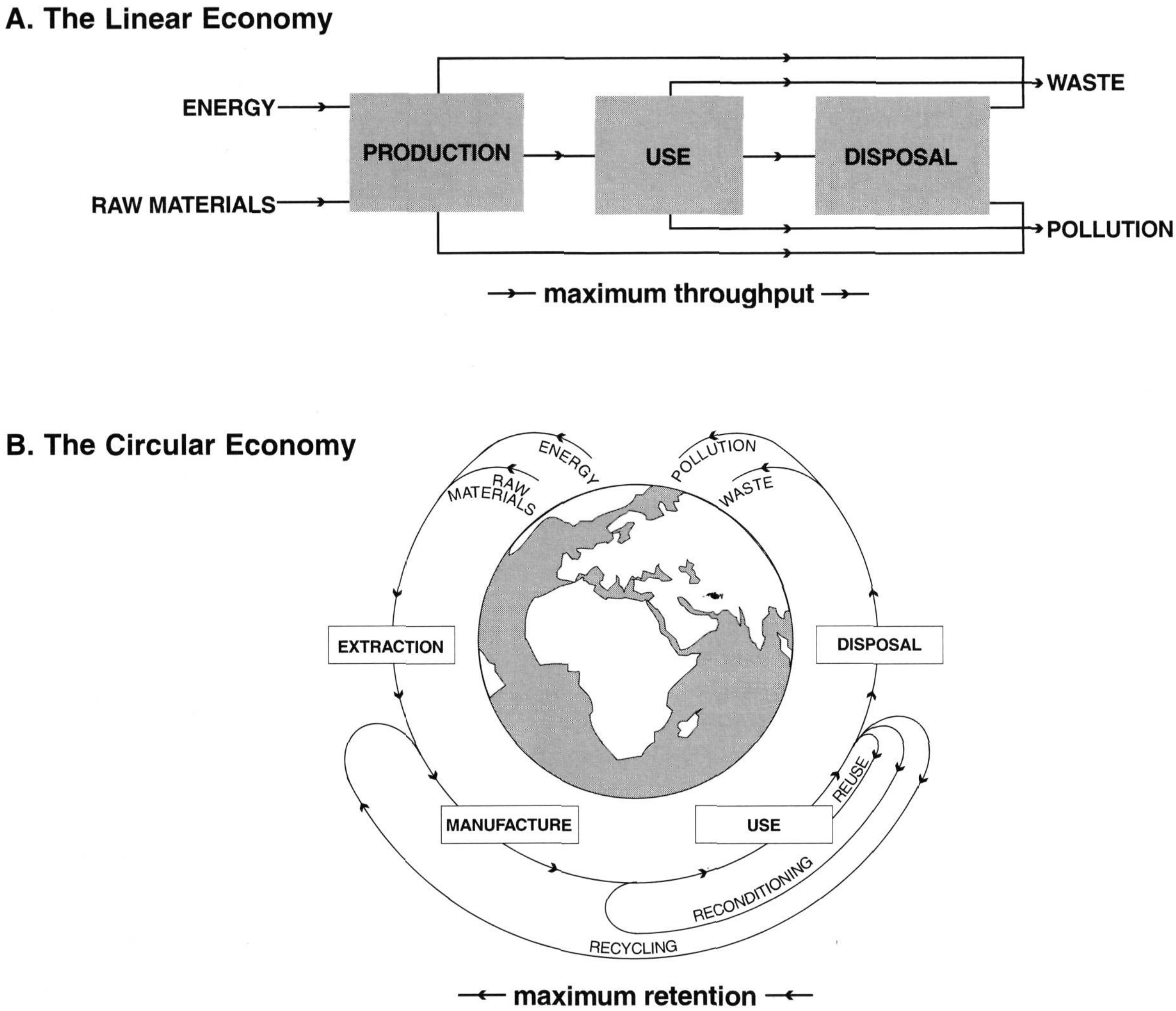
In a circular economy, by contrast, the aim is to minimise the throughput of energy and raw materials in the economy without sacrificing wellbeing. As throughput is determined both by the volume of energy and raw materials entering into the productive process and by the amount retained within the system (e.g. through waste reduction, reuse and recycling), both inputs and outputs are addressed: the production system is based on "minimum input, maximum retention and minimum output" (Kemball-Cook, Baker and Mattingley, 1991, p.2). In such an economy 'efficiency' is defined in terms of the effective use of physical resources rather than purely financial criteria. Of course, even in a circular economy finite resources are depleted and waste created, in keeping with the laws of thermodynamics, but, unlike a linear economy, the environmental impact is minimised.

If the goal of sustainable development is to be reached, industrial countries must move towards developing circular economies, which will involve integrating economic and environmental policies. The strength of these policies will determine exactly how quickly this move towards circularity takes place and sustainability is achieved.

Excessive throughput?

Recent environmental reports detailing the input of energy and raw materials and the output of pollution and waste in industrialised economies give an indication of the impact of current levels of throughput (e.g. World Resources Institute, 1994). As the case for recycling and lengthening

Figure 1: LINEAR AND CIRCULAR ECONOMIES



Source: NEF.

the life span of products is based on the premise that this level of throughput is excessive, this section sets out some of the evidence.

The report *World Resources 1994-95* pointed to human ingenuity and the prospect of materials substitution in arguing that "the world is not yet running out of most non-renewable resources and is not likely to, at least in the next few decades" (World Resources Institute, 1994, p.5). However, the fear of shortages of energy and certain raw materials expressed some twenty years ago in reports such as the Club of Rome's *The Limits to Growth* has not entirely disappeared (Meadows, Meadows, Randers and Behrens, 1972). A recent study in *Scientific American* warned that reserves of petroleum, copper, nickel and molybdenum are below 70 years and would fall "perilously low" if less developed countries were to match consumption levels in the industrialised world (Frosch and Gallopoulos, 1989, p.96). Energy raises the most concern, as at present most comes from non-renewable sources. Energy consumption worldwide has quadrupled since 1950 and is growing even faster in developing countries.

Even so, since *The Limits to Growth* was published it has become apparent that the greatest threat is not that energy and raw materials will run out, but that the natural environment will no longer satisfactorily act as repository for all the pollution and waste associated with their use (Pearce, Markandya and Barbier, 1989). The World Resources Institute has warned that "virtually all industrialised countries continue to release to the environment a massive quantity of toxic material – heavy metals, hazardous chemicals, and acidic gases" (World Resources Institute, 1994, p.4). Pollution crosses national boundaries and threatens people's health and livelihoods by causing climate change, destroying forests, lakes and other ecosystems, and damaging the ozone layer. Many problems arise even before raw materials are exported to manufacturing nations: dust from mining, acidic gases from smelting and refining, and emissions of fine particles of toxic trace metals which can enter animal and human food chains. Although serious pollution incidents and the dirtiest factories often attract the most attention, as the authors of *Beyond the Limits* (the follow-up report to *The Limits to*

Growth) have pointed out, "all use of materials, at each stage of the production process, leaves trails of pollution" (Meadows, Meadows and Randers, 1992, p.80).

In addition to environmental threats such as resource depletion and pollution, the amount of solid waste generated in industrialised countries is rising. In the member countries of the Organisation for Economic Co-operation and Development (OECD) municipal waste per head rose by 26% between the mid-1970s and late-1980s. In many countries, including Britain, the prospect of tighter development controls and more stringent licensing requirements for landfill sites is likely to create upward pressure on waste disposal costs. A vast number of consumer durables are discarded annually in Britain: around 2 million vehicles, 6 million large kitchen appliances, 3 million vacuum cleaners, a substantial quantity of audio-visual equipment, and millions of small appliances such as kettles, toasters and irons. In addition, a considerable amount of furniture, carpets and other bulky household waste is discarded. Estimates suggest that kitchen appliances account for 400,000 tonnes of waste each year and audio-visual and telecommunications equipment for a further 100,000 tonnes.[5]

Even so, it might appear as if, statistically, consumer durables constitute only a small fraction of the 20 million tonnes of household waste generated each year – perhaps no more than 5% – and an even smaller part of the total annual waste stream of 400 million tonnes. This would be a false impression, however, because the household waste stream and industrial and commercial waste streams interconnect. As consumer durables are discarded, a considerable amount of additional waste is generated through the production processes for replacement goods. Equally important, waste streams interconnect internationally, as many of the raw materials used are extracted overseas. A rule of thumb cited in *Beyond the Limits* is that every tonne of waste at the consumer end of the stream has also required the production of 5 tonnes at the manufacturing stage and 20 tonnes at the site of initial resource extraction (Meadows, et al., 1992, p.83). Thus, for example, in 1991 1,000 million tonnes of copper ore were extracted worldwide to obtain less than 10 million tonnes of metal (World Resources Institute, 1994, p.9).

Reducing throughput

How should environmental problems of such magnitude be addressed in industrial countries?

The environmental impact of production in a circular economy is reduced by increasing product life spans and by intervening at various points in the life cycle so that products (or their components) are reused, reconditioned or recycled. Recycling and increasing product life spans thus both represent means by which the throughput of resources can be slowed down. The value of recycling is not just the conservation of natural resources; indeed where the resources are renewable, such as the trees used in manufacturing paper, this may not be particularly significant. More important is the reduction in energy consumed. The most striking example is the typical 95% energy saving in the production of aluminium by recycling scrap compared with the process using the primary raw material, bauxite (Table 2).

An increase in the life span of consumer durables would likewise reduce the throughput of resources. This could be

RECYCLING

Recycling involves *the conversion of recovered scrap materials into a form suitable for use as a secondary material for the manufacture of marketable end-products.* The secondary (i.e. reclaimed) materials are mixed in various proportions with virgin materials. This may involve no loss of performance (as is normal with ferrous scrap), but a degree of downgrading may be necessary, resulting in products of lower specification (as with most plastics).

It is sometimes possible to use secondary materials in the manufacture of products similar or identical to those from which the scrap originated; this is known as 'closed loop' recycling and is intended to minimise the amount of residual waste.

Historically much scrap used to be collected door-to-door by 'rag and bone' merchants, but today most large discarded items are delivered by householders to civic amenity sites or 'traded-in' to retailers.

The term 'recycling' is sometimes confused with 'reuse', which more accurately describes the secondary use of *products* or *components*.

Table 1
AMOUNT OF POST-USE SCRAP RECYCLED AS A PROPORTION OF CONSUMPTION, 1992, UK

	Estimated home consumption *(Thousand tonnes)*	Scrap
Ferrous metal	13,420	45%
Aluminium	645	39%
Copper	391	45%
Lead	302	64%
Zinc	237	21%

Source: Department of the Environment, (1994). *Digest of Environmental Protection and Water Statistics*, London: H.M.S.O.

Table 2
ENERGY SAVED THROUGH RECYCLING

Ferrous metal	74%
Aluminium	95%
Copper	60-96%
Lead	77%
Zinc	61%

Source: NEF, based on Ogilvie (1992).

DURABILITY AND PRODUCT LIFE

Durability is *the ability of a product to perform its required function over a lengthy period under normal conditions of use without excessive expenditure on maintenance or repair.* This translates into several definitions of life span and, to complicate matters further, different measurement units may be used (e.g. years of existence, operational cycles, hours of use).

A product's 'technical life' is the maximum period during which it can physically function (i.e. irrespective of repair costs which might reasonably be considered prohibitive).

A more practical definition is its 'service life', the product's total life in use from the point of sale to the point of discard. Such a definition is of greater use to waste disposal authorities seeking to assess future waste streams. Retailers, however, are mainly interested in the 'replacement life' of a product, the period after which the initial purchaser returns to the shop for a replacement, irrespective of whether or not the original product still functions (it may have been sold as a second hand item, given away to friends or children, or kept as a spare).

Depending on the strength of the second hand market, there may be a considerable difference in product life according to which of these latter two definitions is used.[6]

Table 3
PRODUCT LIFE SPANS

	(average service life)
Cars	11-12 years
Cookers	10-15 years
Washing machines	7-10 years
Refrigerators	10-12 years
Microwaves	8-10 years
Radio cassette players	10 years
Telephones	3 years
Televisions	10 years

Sources: Sarson, 1992; Poll, 1993; Nieuwenhuis and Wells, 1994.

achieved by designing products for greater durability and through activities which have been collectively termed 'product-life extension': the reuse of products (passed on as gifts or sold in second hand markets), repairs and reconditioning (the latter perhaps involving upgrading such as inserting a faster microprocessor into a computer) (OECD, 1982).

The precise *scale* of reduction in throughput required in industrial economies for environmental sustainability is difficult to quantify. An indication, however, is given by the minimum 60% reduction in greenhouse gas emissions suggested by leading scientists as required, immediately, to stabilise the current concentration of carbon dioxide in the atmosphere and prevent the threat of climate change increasing.[7]

Since the oil crises in the 1970s many countries have sought to improve the energy efficiency of their economies (i.e. the amount of energy consumed per unit of output, or Gross National Product). Germany's Wuppertal Institute prefers a broader measure. On the basis that "a drastic reduction in per capita resource consumption... is ecologically imperative" (von Weizsäcker and Jesinghaus, 1992, p.7) it is developing a conceptual tool called MIPS (Material Intensity Per unit of Service) to explore the possibility of radically 'dematerialising' industrial economies, i.e. reducing the consumption of resources generally for a given output. Schmidt-Bleek argues that to move onto a sustainable course industrial countries may need to dematerialise their goods and services by an average factor of ten (Schmidt-Bleek, 1993b, p.487). Such a transformation would clearly demand a smaller output of material goods, not merely less residual waste.

In order to achieve such change, some key economic influences upon resource use would need to be addressed. The fact that there is no *market* for 'environmental assets' such as unpolluted air, clean rivers and seas, unspoilt landscape and so forth means that no economic value is attached to them. The result is the linear economy, where such assets, being under-priced, are over-exploited and society as a whole bears the cost of remedying environmental degradation rather than the companies and individuals responsible for causing it.

Likewise, the market for waste is distorted. The fact that much waste is unmeasured and unpriced means that resources of potential value wrongly enter into the waste stream and a 'throwaway' culture is encouraged. One reason for this is that individual households do not directly bear the 'marginal cost' of increased domestic waste. Consequently a household has an inadequate incentive to minimise waste through, say, taking care to avoid over-packaged items or products with unduly short life spans.

In effect, when people buy consumer durables they are not paying the full cost, the sum which earlier this century the economist A.C.Pigou identified as the 'social cost' – the private cost of transactions plus indirect effects on society such as environmental damage (i.e. 'externalities'). As a result, although some consumers may be better off in the short term, the welfare of society in general is lower than if production and consumption decisions had incorporated the environmental impact.

One response would be to attempt to internalise all the wider effects into the product price so that from the customer's perspective there is no *economic* incentive for purchasing a product with sub-optimal environmental performance. This approach has limitations, however, in that economic instruments cannot correct all market failures: aesthetic and disturbance costs, for example, are difficult to quantify. It would be more realistic to influence the relative cost of the 'factors of production' which shape production processes and after-sales services (i.e. labour, energy and raw materials, and plant and equipment) through ecological tax reform: transferring tax from labour to energy and virgin raw material. Such reform would encourage environmentally sound practices through which, in general, the use of natural resources is reduced and employment increased: repairs, reconditioning and recycling tend to be labour-intensive rather than resource-intensive.

2 Current priorities

In the last few years industry and all levels of government – European, national and local – have shown increasing interest in recycling, whereas little attention has been paid to the life span of products. Thus manufacturers proudly pronounce that their products are 'recycled' or 'recyclable', but most are hesitant about stating how long they are likely to function. Likewise, the Government has introduced a national recycling target for domestic waste, but has yet to take practical steps to encourage the manufacture and sale of longer lasting products.

Industry

Many products with a high metal content, including vehicles and kitchen appliances such as washing machines and cookers, have traditionally been recycled. The suggestion that manufacturers are now making them with an unprecedented capacity for recycling therefore represents something of a myth. Indeed, far from there being any improvement in the recyclability of cars, for example, they are currently *less* recyclable than in the past because of a growing plastics content. This has increased to roughly 12%, compared with 2% in the early 1960s. Fears have even been expressed recently that it has become less economic to recycle cars because around 25% of each car (the plastic, plus rubber, foam, textiles and fluids) cannot now be recycled (Ogilvie, 1992, pp.50-1; Williams, 1991, p.4).

According to a report from the Warren Spring Laboratory, formerly the Government's environmental technology centre, around 75% of 'white goods' (i.e. kitchen appliances) are fragmentised in shredders to recover metals for recycling (Poll, 1993). In the 'brown goods' sector (i.e. audio-visual equipment and telecommunications equipment) only telephones have been extensively recycled. Most brown goods end up as landfill, as do most non-electrical consumer durables. Now that the manufacturers of vehicles and brown goods are faced with the prospect of 'take-back' legislation, however, which would make them responsible for their products after being discarded by consumers, many are exploring ways to increase the recyclability of products, such as using designs which make them easier to disassemble so that materials can be separated for recycling.[8]

Fear of 'take back' regulations has prompted the formation of two trade bodies which aim to create effective voluntary schemes in the hope of staving-off stricter legislation. The Automotive Consortium on Recycling and Disposal (ACORD) was set up in 1992 to improve vehicle recovery and aims to increase the average percentage of materials recycled in scrap cars from the present 77% to 82% by 2015.[9] Virtually all major car manufacturers in Europe have taken initiatives such as setting up vehicle disassembly plants where products can be dismantled and the separated parts either reused (perhaps after reconditioning), recycled, incinerated or landfilled. BMW, for example, has established a plant in Sussex and plans further plants sufficient to handle all BMWs scrapped in Britain. In the electronics sector the Industry Council for Electronic Equipment Recycling (ICER) has been set up to develop a national waste strategy for electronic goods. Companies such as IBM, DEC, Hewlett Packard, Rank Xerox and Grundig are already taking back used equipment, while Toshiba and Hitachi have research programmes to reduce dis-assembly times (Bashford, 1993; Clegg and Williams, n/d).

In contrast to the increasing commitment of manufacturers to recycling, for most types of consumer durable there has been no significant or sustained trend towards the development of products that last longer. Although no comprehensive historical data on product life span is available, the general trend appears to have been in a downward direction. Independent studies suggest that modern cookers, vacuum cleaners, kettles and irons are less durable than in the past.[10] The influences upon product life are discussed in detail later, but one important factor is that technological advances have made it possible to replace metal with plastic and to reduce the precious metals content in electronic equipment. Costs have been reduced but quality has often suffered. Such changes have sometimes been forced upon manufacturers by competitive pressures.

For a few products, however, there has been an upward trend in life span. Televisions, for example, appear more reliable than in the past due to improved tube technology, while corrosion prevention measures are likely to result in cars that will last longer.[11]

For some products customers have a reasonable degree of choice, with durability greater at the top end of the market. However, most volume manufacturers have given little attention to the possibility of increasing their products' life spans and tend to focus their marketing on price, cosmetic appearance and additional functions (some of which are rarely used). Moreover, the boundary between durable goods and disposable goods is becoming blurred. Items such as biros and razors have for many years been manufactured for a 'single use', but the area of overlap between durables and disposables has expanded through the development of single use cameras and the promotion of fashionably-designed spectacles, telephones and watches.

Apart from fear of legislation, why is industry choosing a strategy based on recycling rather increased life spans? In an article in *The Ecologist,* Simon Fairlie offered a provocative explanation: "Recycling offers business an environmental excuse for instant obsolescence" (Fairlie, 1992, p.280). Recycling, he argued, can be seen as part of a calculated strategy by industry to sustain sales in a world where markets for many consumer durables are reaching saturation. Though clearly controversial, his claim merits further investigation.

The public sector

Public sector bodies have, like manufacturers, shown more interest in recycling than durability. The most substantive piece of research on product life, an OECD report entitled *Product Durability and Product-Life Extension*, contained several recommendations for governments, but these were not taken up in Britain or most other member countries (OECD, 1982). Even the European Union's Ecolabelling Scheme, which is intended to promote products with a low environmental impact, does not include durability among the eco-label criteria. Inclusion was explicitly rejected when the terms for assessing washing machines were drawn up, although this decision is due to be reconsidered in any future review of the criteria (UK Ecolabelling Board, 1992, pp.44, 53).[12] A significant exception to the general lack of interest is the British Standards Institution's *Guide to durability of* *buildings and building components* (BS7543), which contains some useful definitions and recommendations, but this is not generally concerned with movable consumer durable items.

It is only very recently, in its major environmental policy document *Sustainable Development: the UK Strategy*, that the Government appears to have started to pay closer attention to the benefits of longer lasting products (H.M. Government, 1994). This important breakthrogh is considered later. By contrast, prompted by an amended EU Directive[13] on waste which stipulated that member states must encourage recycling, the Government has set a target level for household waste recycling, published a Waste Management Paper specifically on recycling, provided various forms of financial assistance for recycling (including grants to industry and voluntary organisations), initiated a system of 'recycling credits', and entered discussions with key industrial sectors on increasing recycling and recovery (Department of the Environment, 1991; H.M. Government, 1994).

'Brown goods' arriving in a skip

In seeking to explain such priorities, the political expedience of recycling is perhaps significant. As the OECD report noted, recycling has an early effect on the waste stream and recycling volumes are readily quantified (OECD, 1982, pp.62-3). Any new recycling initiative has an identifiable impact within a normal electoral cycle. It is also a visible, photogenic activity which politicians can personally participate in. By comparison, the benefits of durability are far less transparent to the general public and take effect more gradually.

At the local authority level, household waste strategies have mainly focussed on newspapers and disposable packaging rather than consumer durables. They are very frequently based on the 'dustbin' alone and not total household waste. Significantly, many recycling officers are employed by district councils rather than the county councils which oversee civic amenity sites (where the bulkier consumer durables end up).

Awareness is increasing, however, of the need for local authorities to pay attention to the destiny of consumer durables as well as packaging, and to promote reuse as well as recycling. Different solutions are required according to what has been discarded: compared with packaging, consumer durables tend to have a complex construction and more materials, are bulky, and sometimes have component parts which contain hazardous substances.

Finally, the priorities of businesses and the public sector may partly be explained by the fact that surprisingly little attention has been paid to durability by environmental or consumer organisations, despite much rhetoric about our 'throwaway society'.[14] Their focus has instead been on recycling. Consequently there has been little pressure on decision makers to move towards the longer life option.

Figure 2: ESTIMATED POTENTIAL FOR RECYCLING / INCREASED PRODUCT LIFE SPANS

	PRODUCT TYPE										
	White goods *large*	**White goods** *small*	**Brown goods**	**Vehicles** *cars*	**Vehicles** *bicycles*	**Furniture**	**Floor coverings**	**Hardware** *plastic*	**Hardware** *metal*	**Garden tools**
LEVEL OF RECYCLING	2	4	4 R	1-2	2	4	4	4	2	2-3
POTENTIAL FOR INCREASE	3	2	2	2	3	4	3-4	3	3	3
SATISFACTION WITH LIFE SPAN	V	3-4	2-3	3 R	1-2	V	V	3	V	2-3
POTENTIAL FOR INCREASE	2	1	2	1	3	2	2	3	2	3

Key: 1=VERY HIGH, 2=FAIRLY HIGH, 3=RATHER LOW, 4=VERY LOW/NIL, V=VARIABLE, R=RISING

Note: The 'potential for increase' rows are for illustrative purposes only, being dependent on technical and economic factors. Recycling, as defined in the report, excludes reuse.

Source: NEF.

3 The limits to recycling

There are many benefits to recycling compared with the disposal of products in landfill. Obviously the waste stream is reduced and thus waste disposal costs are lowered. In addition, there are the energy savings noted earlier, while from industry's perspective recycling scrap metal is profitable because secondary materials can be produced at a competitive price. However, concerns relating to environmental impact, commercial potential and technical limits need to be taken into account in assessing the future of recycling.

Environmental uncertainties

The overall environmental impact of recycling is inadequately documented, especially in relation to the transportation of materials, but it will by no means invariably be positive.

Steven Ogilvie's appraisal of the environmental effects of recycling for the Warren Spring Laboratory, though in general sympathetic towards recycling, concluded that "it is quite possible that the burdens created as a result of the collection of materials for recycling could outweigh any environmental benefits accruing from the recycling process itself" (Ogilvie, 1992, p.14). No other significant research has been carried out to quantify the environmental hazards which are involved, but there is sufficient anecdotal evidence to suggest that recycling is by no means environmentally benign.[15] For example, the break-up of products into their constituent materials, which is the basic process involved in recycling, means that hazardous materials are no longer 'locked up'. Consequently various forms of pollution are possible during recycling: dust and noise from shredders, emissions from the processes used in reclaiming metals, a toxic final residue.[16] For example, old appliances may still have capacitors and transformers with toxic PCBs (polychlorinated biphenyls) and may contain heavy metals such as cadmium, which is used as a colouring medium and as a stabiliser in plastics.

According to available research, pollution from recycling processes appears not to be a particularly serious concern, although many companies have hitherto not monitored their emissions and are only beginning to do so because of the introduction of integrated pollution control regulations in 1995. It is, however, known that in copper recycling the control of lead emissions can be difficult and air emissions from secondary aluminium smelters, caused by the combustion of contaminants (i.e. oil, paint, polymers), can be a problem. Emissions when ferrous scrap is used in making steel are thought to be below the level when only primary metal is used (although here, too, exact figures are unavailable), while emissions from plastics recycling processes are considered insignificant (Henstock, 1988; Ogilvie, 1992).

The residual waste which remains after recyclable materials have been recovered can cause problems because it may contain a high concentration of hazardous matter. Around a quarter of shredder feedstock is currently non-recyclable and discarded as landfill. Shredder waste from white goods is less hazardous than in the past, especially as fewer capacitors with PCBs are present, but shredder waste from vehicles (which accounts for 70-80% of feedstock in shredders) is more problematic due to the possible release of various acids and mineral oils, heavy metals and hydrocarbons. In addition, one of Ogilvie's main concerns related to the use of salt fluxes in aluminium recycling to prevent oxidation, as some 450-600kg of slag is produced for every 1,000kg of aluminium and its disposal is becoming unacceptable as landfill due to high levels of soluble fluoride (Ogilvie, 1992, p.85).

Above all, however, it is the net consumption of energy in recycling which raises most concern regarding its overall environmental impact. As noted above, less energy is used in obtaining raw material inputs by processing scrap than extracting metal from primary sources. However, as Jacobs points out: "Wastes can't turn back into resources unless there is some external source of energy. 'Recycling' doesn't just happen on its own... it has to be powered by an energy source" (Jacobs, 1991, p.112). At each stage in the recycling process – processing scrap materials, manufacturing, transporting discarded products, secondary materials and replacement products – energy is used. This in turn results in pollution and waste (e.g. carbon dioxide from burning fossil fuels or radioactive waste from electricity generated by nuclear reactors). In other words, recycling waste reduces one environmental problem only at the cost of increasing others. Moreover, if the amount of recycling is increased, the energy required will rise as more dispersed and intractable wastes are handled.

Figure 3: POTENTIAL CONTAMINANTS IN RECYCLED MATERIALS

Recycled Material	Residual contaminants	Non-residual contaminants
Iron and Steel	Copper, tin, nickel	Zinc
Aluminium	Iron,silicon	Lithium, glass, siliceous dirt, magnesium, zinc, tin, lead
Paper	Flexographic inks (>10%), water-resistant coatings	Adhesive wire staples, plastics
Glass	Iron and chromium colourants	Metals, ceramics
Plastics	Fillers, colourants	Other polymers, bacteria, inks labels, adhesives

Note: *Residual contaminants* are not removed during pre-treatment and processing operations and impair the quality of the recycled material or product.
Non-residual contaminants can be removed by processing but removal reduces the yield of the reclaimed product, extends processing times to allow contaminants to be reduced to acceptable limits, or leads to the discharge of toxic fumes, effluents or solid waste.

Source: Department of the Environment (1991).

Commercial obstacles

As consumers and taxpayers may increasingly be required to pay for recycling, perhaps at the expense of other environmental measures, it is important to consider the economic implications of recycling consumer durables.

The fact that vehicles and large appliances such as washing machines and cookers have traditionally been recycled is evidence that recycling *can* offer a commercial return. The recovery of most types of discarded products which have not previously been recycled appears to be uneconomic, however, and manufacturers have been charging a levy. In Germany, where manufacturers are preparing for 'take back' legislation, Grundig have charged DM37 (around £15) to dispose of a television and DM15 (£6) for a video.[17] In addition to these extra costs for consumers, taxation to fund public expenditure on the promotion of recycling is, in effect, a subsidy on the waste generated by a 'throwaway' production system. This expenditure may well increase: there is pressure from industry for more public investment to support the attainment of recycling targets. The car recovery and recycling organisation, ACORD, for example, has stressed that its targets could only be met if the Government invests in incinerators to burn the shredder waste.

Whether a significant increase in the recycling of consumer durables is a realistic commercial proposition is uncertain. A major expansion might bring the commercial benefit of economies of scale, but on the other hand, the marginal cost of recycling is liable to rise sharply as waste becomes more dispersed and intractable.

The main influences on the profitability of recycling are the volume and quality of recyclable materials, the extent to which discarded products are geographically dispersed, and the available market for recyclate (i.e. secondary materials recovered from scrap). The cost of producing this recyclate is, in turn, determined by factors such as disassembly times and the degree of contamination.

Cars, for example, are worth recycling because they contain a large amount and relatively high proportion of recyclable scrap metal, for which there is a ready market. Plastic housewares represent the opposite extreme; they are widely dispersed, each contains little material and the market for that material is very weak. The variety of materials in products is important. Recycling is most cost effective when there is a large volume of homogenous material. Thus scrap steel from demolished buildings or shipbuilding is even more desirable than that from cars and large appliances, while the scrap value of most small appliances, which contain a large number of different materials in relation to their volume, is insignificant.

Perhaps the most fundamental problem affecting profitability is that recycling preserves only the value of materials in products, which represents a relatively small proportion of the total 'value added' in the production process. A major report on end-of-life electronic equipment concluded that for nearly all items the cost of recovering materials would exceed the scrap value (Roy, 1991). Another report suggested that in a hypothetical piece of electrical equipment weighing 10kg, not too dissimilar in composition from a television, the value of scrap materials would be only £1.71 (Bashford, 1993, p.68). According to Wim Bruens, Environmental Manager at Philips, recycling a television set will always be unprofitable and the best that can be hoped for is to reduce the loss by redesigning sets.[18] The company has estimated that, in contrast to the DM38 (around £15) typically charged for collecting televisions, the actual cost is DM100 (£41). The main problem, Bruens argues, is that raw materials are too cheap.[19] Another company, Noell, which has operated a pilot scheme in Germany for recycling telephones, claims that a scrap telephone is worth 30 pfennigs (around 12p) but costs DM3 (£1.20) to recycle.[20] In the vehicle sector Horst-Henning Wolf, the head of BMW's recycling programme, has described the programme's costs as 'frightening' (Nieuwenhuis and Wells, 1994, p.156). The amount of time involved in the manual disassembly of cars results in labour costs which may (at least for plastic) exceed the value of materials recovered. In other words, the problem is not simply that raw materials are too cheap, but that they are too cheap relative to labour. One solution might be automation in order to reduce the labour costs involved in disassembly, but this involves major investment expenditure and the benefit of increased employment is lost.

Although products are increasingly being designed to improve their recyclability by, for example, making disassembly more easy, other trends in design are not so positive. Like many economic activities, the profitability of recycling improves as volumes increase, but lightweighting and miniaturisation reduce the flow of materials and make them more dispersed. Materials substitution is another factor which makes recycling less promising. The substitution of gold in electronic equipment with nickel-on-palladium or silver reduces the value of discarded products.

The trend towards substituting plastics for metal is even more significant. Reference has already been made to cars. Whereas once vacuum cleaners were mostly metal they are now typically over 70% plastic. The trend is similar for other products, from washing machines to personal stereos. Given the absence of a healthy market for polymer recyclate, this trend presents an obstacle to sustaining – let alone increasing – present levels of recycling. At present less than 1% of post-consumer plastic waste is recycled. A key problem is the need to separate the many different types of plastic. Consequently secondary material generally costs more than virgin material of the same quality.[21] For some products the different plastics could be standardised to facilitate recycling, but this would involve over-specifying, which increases the cost to the consumer.[22] Only when there is a very high volume waste stream of a standardised product does recycling plastic become commercially realistic. However, even recycling telephones, of which over 2.5 million are recovered annually, is apparently not profitable (Roy, 1991, p.33).

One final factor affecting the commercial equation which ought to be noted is that scrap markets tend to be volatile. Without a strong and growing demand for new recycled *products*, matching the supply of secondary materials arising from increased recycling, the price of scrap material is liable to fall and make the whole exercise uneconomic.

Technical limits

No comprehensive study has yet been carried out of the potential implications of an industrial system in which recycling is the norm for most products, but one concern would be the contamination of materials and the possibility that there might be absolute technical limits to recycling.

The performance of materials depends on a certain minimum level of purity, which can obviously be affected by the use of scrap (Figure 3). The effects of contamination are complex, but excessive residual elements can render material unusable, or at least reduce its value. For example, copper in ferrous scrap in excess of 0.2% can cause steel to be brittle. Residual elements of tin and nickel can also be harmful. Zinc from galvanised steel oxidises in steel-making, creating voluminous dust that causes problems in furnaces and increases the residual waste.

The implications for the quality of products of a gradual and sustained increase in impurity levels are largely unknown. In *Design for Recyclability,* Michael Henstock has at least addressed the threat: "Scrap is a recirculating load; each time that it is recycled it can introduce fresh contamination, cumulatively raising the impurity level of the basic steel scrap. Such stock, when eventually it forms scrap, is of ever-diminishing acceptability" (Henstock, 1988, p.27). He points out that the purity of steel fell after the first world war, because of copper and tin impurities resulting from recycling scrap during the war, and notes that it has never returned to pre-war levels. One report has suggested that the average copper content of fragmentised scrap steel has risen from 0.2% to about 0.3% since cars and white goods began to be processed in shredders (Poll, 1993, p.29).

The current technical obstacles to recycling plastics have been well documented (e.g. Ogilvie, 1992; Roy, 1991; Sarson, 1992; Williams, 1991). There are a large number of different types of plastic and many cannot be recycled together. Either separation or over-specification (both of which add to costs) is required. Fillers and additives, used to colour plastic, make it electrically conductive or change its density, may inhibit or prevent recycling. There are, in any case, limits to the number of times which plastic can be recycled because its properties degrade after a few cycles.

More generally, the current state of technology is such that a substantial number of materials cannot be recycled, including thermosetting plastics, ceramics, composites and coated materials. Thermosetting plastics include polyesters (used in furniture and, for heat resistance, in items such as toasters and circuit boards) and formaldehyde (used in saucepan handles), and account for around 40% of plastic used in cars. Nor can important components such as CRTs (cathode ray tubes) in televisions, which contain heavy metals, or, indeed, the LCD (liquid crystal display) components which are superseding them.

In summary, it is likely that large consumer durables made primarily of metal will remain recyclable but it is unlikely that recycling will be profitable for many other items of electronic equipment and most small electrical appliances without a significant change in raw material prices. Henstock issued a stark warning: "A general trend is observable towards the use of smaller quantities of metals in consumer goods, and their replacement by polymers and other non-metallics (and) the use of complex materials or mixtures of materials...Taken to its logical conclusion, this trend could lead towards the virtual cessation of the recovery of secondary materials from post-consumer scrap and a corresponding increase in the amount of materials discarded in irrecoverable form" (Henstock, 1988, p.5).

Most non-electrical consumer durables – such as sofas and carpets (which represent a considerable proportion of bulky domestic waste) and any products made predominantly of plastics, wood or natural fibres – are unlikely to be commercially recyclable in the near future. The ultimate fate of a discarded carpet, for example, will probably still be use in cellars, garages or keeping rain off compost heaps – in other words, some form of product-life extension – rather than a recycling bin.

4 The longer life option

The previous section suggested that recycling does not represent the 'ultimate' green solution to our throwaway culture. In assessing the means by which to cut the amount of waste generated in modern industrial economies, the standard model used is the 'hierarchy of waste management options', which prioritises different measures for dealing with waste (Figure 4).[23] The order in this hierarchy suggests that increasing the durability of products and improving after-sales services, in order to extend their use, ought to take precedence over recycling, which is rated third.

Recycling reduces waste but does not *minimise* it – an important distinction. It is essentially an 'end-of-pipe' response (although recyclability may require modifications in design at the start of a product's life cycle). As such, it barely affects the inherent flaws in a production system which make manufacturers dependent upon ever-increasing throughput for their profitability. By contrast, increased durability requires more radical change at the point of production. It represents a 'front end' response.

In its major report *Sustainable Development: the UK Strategy*, the Government suggests that the hierarchy of waste management options mirrors the requirements of sustainable development. Acknowledging past flaws, the report then states: "It is salutary, therefore, to consider the extent to which current waste management practice in the UK operates towards the bottom of this hierarchy." (H.M. Government, 1994, pp.150-1)

Most significantly, having identified waste minimisation as at the top of the hierarchy, the report continues: ***"Effective waste minimisation is not just a question of reducing unwanted outputs from the manufacturing process. It also involves producing... longer lasting products"*** (ibid). This recognition is welcome, but it now needs a Government led initiative to encourage appropriate action.

This section thus explores the potential environmental impact of a strategy to encourage longer lasting products, the benefits to consumers, and the implications for industry and government. It should be stressed that any such strategy should be to *optimise* rather than *maximise* life span. Durability should not be treated as an end in itself. There must be allowance for the fact that the gradual replacement of outmoded models may bring environmental gains,

Figure 4: THE WASTE HIERARCHY FOR CONSUMER DURABLES

REDUCTION IN ENERGY AND MATERIALS USE
less material in products
less waste in manufacture
lower energy consumption in production and use
longer lasting products

↑

REUSE OF PRODUCTS
extending product-life through secondary transactions
reusing components once original product is discarded
repair and reconditioning of malfunctioning, underperforming or broken products (perhaps upgrading)

↑

MATERIALS RECYCLING
converting scrap products or components into usable secondary materials

↑

ENERGY RECOVERY
producing energy by burning waste or using landfill gas

↑

LANDFILL
landfill without energy recovery

Source: NEF.

especially if the environmental performance of products is improved through technological advance. For example, Porsche established a research programme on the potential for a 'long-life car' and studied cars designed to last 25-30 years but concluded that the optimal life span would be 18-25 years (Nieuwenhuis and Wells, 1994, pp.160-1). Before considering the implications of increasing the life span of consumer durables, it will be helpful to highlight some of the main influences upon it.

Influences

Three of the key influences upon the life span of consumer durables may be summarised as fitness, functions and fashion.

The failure of a product to work effectively, a loss of *fitness*, is the most obvious explanation for the discarding of products. Whereas a century ago products were manufactured to last as long as possible, most now have a predetermined 'design-life'. The ease with which a product can be repaired is an important factor. The increased complexity of products sometimes makes them more difficult to repair, especially with electronic devices such as printed circuit boards. A product's life span is also affected by the quality of care given to it by the owner and the owner's expectations of future reliability and service life (Figure 5).

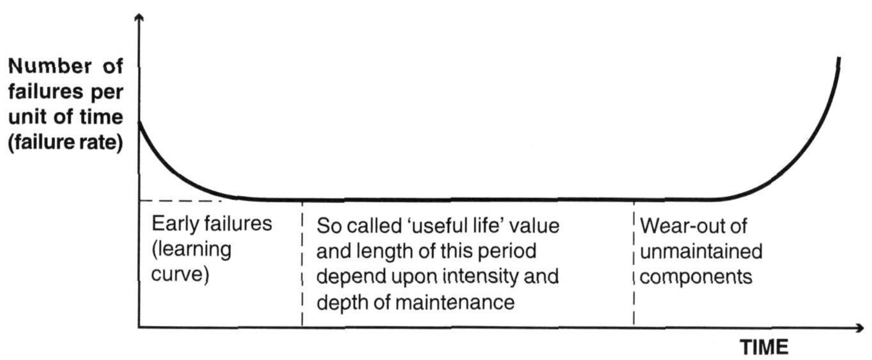
People's ability to get products repaired may well depend on the availability of spare parts. Although trade associations have codes of practice, recommended periods for stocking parts are sometimes below the average life span of products. For example, AMDEA (the Association of Manufacturers of Domestic Electrical Appliances) recommends to its members that parts for refrigerators and freezers are stocked for eight years even though such appliances typically last for ten to twelve years. Some companies vary from the industry norm: the Consumers Association found that appliance manufacturer Miele keeps functional parts for 15 years, whereas Haden stocks parts for only 2-4 years.[24]

Another important influence is technological change, which leads people to replace ageing products with new models which may appear of higher quality or offer more extensive *functions*. For example, computers have become more powerful with each generation of microprocessor, washing machines have faster spin speeds, telephones contain new features such as last number redial, and televisions have remote control and stereo sound. Occasionally genuine environmental improvements are offered, such as increased energy efficiency.

Some products are upgradable and consequently there is less pressure to replace them. Personal computers can be upgraded with faster microprocessors, for example, and in Germany well over a million cars have been retrofitted with catalytic converters (Nieuwenhuis and Wells, 1994, p.167). Currently, however, few consumer products are designed to be readily upgraded.

Thirdly, replacement sales are stimulated through the influence of periodic changes in design which are essentially concerned with *fashion*. Superficial changes are made to the appearance of, say, electrical goods for no purpose other than to make past models appear out of date and encourage people to replace them as quickly as possible, even if they still function effectively. Annual or seasonal 'face lifts' are also applied in order to inspire sales staff to appear eager and excited about products to customers, in the hope that this might increase sales.

Figure 5: BATH TUB CURVE SHOWING THE RELATIONSHIP OF NUMBER OF FAILURES AGAINST TIME



Note: More frequent maintenance lowers the bottom of the curve subject to diminishing returns. Taking more components into maintenance prolongs the flat portion. Scheduled preventive maintenance correctly carried out acts on *components* to reduce average failure rate of the *system*.
Source: BS5760: Part 0: 1986.

The cultural context

The main obstacles to increased product life are not technological. As the OECD report concluded, citing a leading scholar, R.T. Lund: "From a technical point of view there is no question that longer-lived appliances could be made. This is freely agreed upon by manufacturers of these products" (OECD, 1982, p.15). More important are the cultural and economic pressures which generate the throwaway mentality which has become so prevalent in society. In short, society has become more acquisitive, individualistic and profligate, each of which has an impact on product life.

As society has become increasingly acquisitive, people have come to *expect* that certain consumer durables will need to be regularly replaced, whereas once they were regarded as long term investments and lasted for several decades. Sofas, which are replaced on average every 8 years, are an example. Demand for innovative products such as microwaves and portable telephones tends to grow rapidly. In addition, people have a strong preference for products which are new and for these there is an extra 'virginity value'. This is reflected in the heavy depreciation in the price of second hand goods: the sales value of a car, for example, drops by 50% after the first three years – barely 25% of its expected life span.

This trend is long established – R.H.Tawney's *The Acquisitive Society* was published in 1921 – and is reinforced by a shift in our political culture towards individualism. Market pressures have been used to steer people towards private ownership. The relaxation of credit controls a decade ago, for example, enabled the purchase of consumer durables without a deposit. In contrast, shared or communal facilities, such as launderettes, tend to be held in low esteem. Moreover, it often costs little more to purchase than to rent items such as televisions.

At the same time, despite this individualism, people do not live or act in total isolation. Each individual's behaviour in buying products and services is influenced by that of others, which is in turn affected by societal aspirations. In other words, the overall level of consumption is not simply the sum of isolated choices, but may partly be explained by social psychology.

In economic debate there is acceptance across all political boundaries of 'consumer sovereignty', the idea that social welfare is maximised when the demands of individual consumers are treated by Government and industry as of paramount importance. This can be criticised on at least two grounds. Firstly, it depends on a false assumption that consumers are autonomous, able to be viewed and understood outside of a social or environmental context. Secondly, it implies that people have an unqualified 'right to consume', which in effect represents a denial that there are absolute environmental limits to consumption. There are also philosophical and, more specifically, ethical objections to reducing people to mere 'consumers'.

The third dimension which needs to be touched upon briefly is profligacy. People often criticise the economic 'system' or blame others for our throwaway culture, but many do not themselves keep products for as long as they could. One survey, albeit modest in scale, found that around a quarter of electrical appliances discarded at civic amenity sites were still functioning and a further quarter could be repaired for a minimal cost.[25] It would certainly be wrong to depict people in general as reluctant victims of fashion. Fashion serves as a means by which many people can display affluence to others and possession of a 'latest model' is an important influence on purchasing behaviour. This is nothing new – Thorstein Veblen defined it almost a century ago, in *Theory of the Leisure Class*, as 'conspicuous consumption'.

Not surprisingly, then, there is an inverse correlation between income and the average life expectancy of consumer durables. Relatively expensive products are replaced less frequently during economic recessions. From a global perspective, they tend to be maintained for much longer periods in the poorest countries. This international dimension is highly significant. Many consumer durables are imported into affluent, high-wage countries from countries where labour costs are relatively low. One of the consequences is that people in the richer industrialised countries are able to afford to purchase consumer durables, but when they need to be repaired this is relatively – perhaps prohibitively – expensive because repairs are carried out with higher paid domestic labour.

Environmental implications

The overall impact of these powerful and complex influences upon consumer behaviour has led to an economy in which many products have sub-optimal life spans. What advantages, therefore, are offered by seeking to change this?

First, the potential for environmental gains. A general increase in the life span of consumer durables would reduce the throughput of energy and materials, resulting in less use of finite resources, lower emissions of pollutants (including greenhouse gases), and a smaller amount of residual waste to dispose of as landfill.

Comprehensive data is not available, but a rough, common sense estimate would suggest that doubling the life span of

Figure 6: LIFE-CYCLE ASSESSMENT MATRIX FOR WASHING MACHINES

	Production +	Distribution +	Use +	Disposal	= TOTAL
ENERGY (MJ)	2,072	146	48,000	33	50,251
CRITICAL AIR VOLUME (1,000m³)	37,025	1,654	2,457,000	705	2,496,384
CRITICAL WATER VOLUME (dm³)	11,763	2,132	307,000	240	321,135
SOLID WASTE (kg)	51	4	622	36	713
WATER GENERATION (l)	6,152	154	280,000	0	286,306

Source: UK Ecolabelling Board (1992).

products should halve their net environmental impact. In the late 1970s the study by Porsche of long-life cars concluded that if cars were built to last for 18-25 years there would be a 55% saving in materials, while research by the Batelle Research Centre in Geneva found that increasing the average life span of cars from 10 to 20 years would almost halve the consumption of energy used in production (Nieuwenhuis and Wells, 1994, pp.160-1; OECD, 1982, p.58; Stahel and Reday-Mulvey, 1981, p.75). More recently, a hybrid cool storage facility, combining the features of a traditional kitchen cupboard and a refrigerator, has been designed at the University of Wuppertal; this is intended to last as long as the house and to need seven times less material than the ten conventional fridges which it would replace during its life span.[26]

Environmental benefits from increasing the life span of products by improved design and appropriate after-sales care would normally exceed those from recycling, not least because most of the components remain physically intact. In addition, the various methods of extending the life of products can usually be carried out locally, whereas the processes involved in delivering discarded products to recycling sites and in manufacturing and distributing replacements involves considerable transportation.

The main argument on environmental grounds *against* increased product life concerns the possible sacrifice of improved energy efficiency in new electrical products such as washing machines and personal computers.

Such research as has been published suggests that for major electrical appliances the scale of most environmental impacts is greatest in the use phase of product's life cycle, rather than during the production, distribution or disposal phases (e.g. UK Ecolabelling Board, 1992). Even so, it is extremely doubtful that improved energy performance could justify replacing a functioning product: the extra energy involved in replacing a car, for example, is likely to offset any benefit in terms of improved fuel efficiency in newer models according to Sweden's vehicle testing authority (Nieuwenhuis and Wells, 1994, p.166).

It should also be noted that environmental improvements in new models of products are sometimes offset by other innovations. In cars, for example, the weight of extra features such as electric motors for windows and sunroofs often cancels out gains in basic fuel efficiency. Moreover, technological change may *increase* the environmental impact: frost-free refrigerators, for example, have a higher energy consumption than conventional models, and the average new vacuum cleaner uses more energy than those being replaced. In any case, it should be emphasised that in most new ranges the products are *not* improved in terms of environmental impact.

Another concern about increasing a product's durability is the possibility of increased materials consumption for thicker surfaces or add-on diagnostic parts, and the use of non-recyclable materials, coatings and fillers. Such concerns may occasionally be valid. A more likely requirement for increased durability, however, is better quality materials, fixtures and fittings, which would not necessarily have a greater environmental impact.

In summary, therefore, the effects on the environment of longer lasting products will almost invariably be positive.

LIFE-CYCLE ASSESSMENT

At the level of the individual product, there remains a multitude of unanswered questions concerning the relative merits of recyclability and durability. In determining priorities and making choices, an immediate problem is that adequate technical data for quantifying environmental impacts does not yet exist. The most promising methodology is 'life-cycle assessment' (LCA), through which various environmental impacts are identified and quantified at each different stage in a product's life: production, distribution, use and disposal.

An estimate of product life is essential for accurate LCAs, as this determines the appropriate multiplication factor for the 'use' phase (the annual impact in use is then multiplied by the total number of years of service provided by the product). In determining optimum life, the production, distribution and disposal impacts avoided per year of additional life would need to be compared with any reduction of annual impact in use achieved through, say, greater energy efficiency.

The methodology is evolving and demands more research, but it should eventually enable the impact of products which are recyclable and durable to different degrees to be compared; for example, a product designed to last five years, one that will last ten years, one that is recyclable and one that is not.[27]

In a report on washing machines commissioned by the UK Ecolabelling Board, PA Consultants carried out an LCA and concluded that "for nearly all environmental impact measures, replacement with a more efficient model would seem to be clearly preferable to increased longevity" (UK Ecolabelling Board, 1992, p.36). However, their LCA (Figure 6) did not include the impact of raw materials extraction (which was deemed unquantifiable) and the calculations were based on a somewhat optimistic claim by manufacturers that the average washing machine lasts for 14 years. In addition, there is no certainty that consumers will choose the more efficient models as replacements, as they tend to be more expensive.

Consumer benefits

As a nation we spend around £36bn annually on consumer durables, a sum equivalent to over £140 per month for each household. Almost a half of this is accounted for by the purchase of vehicles.

It is obvious that many people enjoy shopping for new products. On the other hand, many find shopping a chore and have little interest in fashion. They simply want good service from products and would prefer *not* to have to replace items so frequently. Yet they have little choice, because for many types of product the main differences between models aimed at the 'mass market' relate to function and cosmetic features. Increasing the availability of longer lasting products would thus give consumers the benefit of greater choice.

An understandable concern for consumers is that such products might be too costly. It is possible that products designed for increased durability will be more expensive, but any increase in price may well be offset by the longer service life. One difficulty is in identifying which models are likely to be the most durable and whether a premium price represents good value. A survey by the National Consumer Council found that 80% of consumers considered accurate information on product life expectancy and reliability to be 'essential' or 'very important', while 40% thought that information actually provided was 'fairly poor' or 'very poor' (National Consumer Council, 1989, p.20). Often they have little to guide them about a product's likely life span other than vague claims or manufacturers' reputations. Guarantees do not last long enough to act as a guide and extended warranties, often marketed as providing long term security, have been severely criticised by the Consumers Association for their poor value.[28]

At present, consumers are aware of the 'point of sale' price. In order to enable them to identify the products which genuinely offer the best value for money, however, they need to know the annual cost of getting the service provided by the product (i.e. the *cost per unit of service*). For example, a toaster costing £25 which lasts for six years provides better value than one costing £15 which only lasts for three. Charles Ware, author of *Durable Car Ownership*, has calculated that the costs of a Morris Minor maintained over 20 years would be roughly half those of a less durable car purchased and replaced every 3 years over the same period (Ware, 1982, pp.23-4). Such information should accompany any increase in price in order to reassure customers. Awareness of true costs would be particularly useful to poor people, who can least afford to keep replacing low quality items which appear cheap but are not durable. In practice. however, they might need low interest loans as well as information in order to afford more expensive products.

If there is to be a substantial move away from our acquisitive, individualistic and profligate culture, perhaps more fundamental change is needed. A leading specialist in product life, Walter Stahel, has argued that it is imperative to replace the current 'fast replacement' production system with one based on the 'optimal utilisation' of products. In the latter system, people would explore the best means of utilising the services which products provide rather than merely maximising their consumption. Stahel concludes that instead of acquiring and owning products households would increasingly hire or lease services (Giarini and Stahel, 1989; Jackson, 1993). It is, after all, the service which provides true value to the consumer – the clean clothes, mobility, heating and television programmes – not the hardware. The products would be owned and maintained by suppliers (either manufacturers or retailers) who would have an incentive to increase their durability.

Over the past fifty years people's expectations of durability have, for many products, fallen. However, just as they now expect products to be safe, there is no reason why they should not expect them to be durable. Product liability legislation was developed to protect consumers as individuals against unsafe products. The risks from a lack of durability are more diffuse, affecting the collective wellbeing of people on the planet, but this is no excuse for ignoring them.

ALUMINIUM CARS: THE BEST OF BOTH WORLDS?

An example which highlights some of the complexities in seeking to minimise environmental impact through recyclability and durability is the prospect of increased aluminium in cars (Henstock, 1988, pp.119-24; OECD, 1982, pp.61-4). Some forecasts predict that the aluminium content in cars is likely to rise from around 5% to 20% (Henstock, 1988, p.121). Aluminium, like steel, is recyclable and an executive car made predominantly of aluminium, such as that recently launched by Audi, could last for 20 years, a considerable increase on the current norm of 11-12 years.[29] It would also have improved energy performance because of reduced weight.

Processing primary aluminium from bauxite is very energy-intensive, but producing secondary aluminium cuts energy consumption by 95%, and so the environmental impact of an aluminium-based car relative to a typical steel-based model would depend heavily on the proportions of primary and secondary material used.[30]

A further complexity is that primary and secondary materials are not always perfect substitutes. Most reclaimed aluminium, because it contains impurities, is believed to go into casting alloys rather than wrought alloys.[31] However, on the basis of American evidence, Henstock suggests that casting alloys account for a mere 20% of aluminium consumption (Henstock, 1988, p.120). Moreover, any increase in demand for aluminium from the car industry is likely to be for *wrought* alloys (because of the performance required for structural parts). As wrought grades cannot currently be made from recovered castings, increased aluminium in cars and consequent recycling could result in an excess of castings relative to wrought, threatening serious disruption in the aluminium market and the possibility of *increased* open-cast mining of bauxite.

More secondary material could, in principle, be used for wrought, but this would require better identification and segregation processes. Until then, different aluminium body parts must be recycled separately.

Opportunities for industry

The potential benefits of increased product life spans to the environment and to consumers are reasonably self-evident. Industrialists, on the other hand, may be concerned that their companies would suffer from reduced sales.

Manufacturers and retailers are well aware that the markets for televisions, refrigerators and vacuum cleaners are saturated, and that few households are now without washing machines and telephones (Table 4). Dependent on replacement sales, they fear that longer lasting products would reduce their future income. Another worry is that the higher price of longer lasting products would reduce consumer demand. Many manufacturers of consumer durables tend to be instinctively conservative and most compete on similar terms, with a strong emphasis on price and style rather than durability. Where demand is elastic (i.e. sensitive to changes in price), a high-volume manufacturer which increased its products' durability and thereby incurred higher costs would take a significant risk.

Such concerns are understandable. However, it has been pointed out that the extra cost involved in increasing the design life of products can be exaggerated and can in any case be passed on to consumers to the extent that they are convinced that the product represents good value (Jackson, 1993, p.272). A practical example of the success which can be achieved by developing longer lasting products is the Swedish car manufacturing industry. Volvo and Saab, which enjoy strong reputations for the durability of their vehicles, have nearly 40% of the domestic market where, even with a severe winter climate, the average life expectancy of cars is now over 17 years. They have performed well despite a period of rapid growth in the average life span of cars, from 9 years to 16 years between 1965 and 1982 (Nieuwenhuis and Wells, 1994).

Aside from cost and price considerations, manufacturers which increase the design life of their products and offer comprehensive after-sales services such as repairs and upgrading are likely to be rewarded with increased customer loyalty and thus would strengthen their position in the market. An association with the higher quality end of the market could benefit them, although they would need to assess their market position and the prospect for growth in the premium sector. Another advantage is that it might be possible to lengthen design cycles and thus spread development costs over a longer period. Such changes would enable companies to shift the source of their profitability from maximising sales volumes and benefiting from economies of scale to increasing the 'added value' of products through improved quality.

The planning involved in a strategy to increase product life spans could lead businesses to extend their 'environmental foresight', preparing them for future trends, legislation and breakthroughs in environment-friendly technologies. One trend already underway is towards a 'product stewardship' business culture, in which manufacturers accept responsibility for products throughout their complete life cycle, including the point at which they are discarded, the principle of 'extended producer responsibility'. The initial response of many manufacturers to this trend, reinforced by the threat of 'take back' regulations, has been to investigate the recycling potential of their products. It might be more advantageous to increase their life spans, thereby reducing the return flow of discarded products.

One of the concerns for industrial designers is the extent to which recyclability and durability are complementary. Designing products for recyclability and durability might involve similar requirements. For example, ease of disassembly makes separating materials easier at the end of a product's life, thereby improving recyclability. It also makes repair and upgrading work more practical and cheaper. In addition, the use of high value materials, either for electronic circuitry or structural parts, can make a product both more recyclable (as its scrap value will be greater) and more durable (being more hard wearing).

There may, however, be potential conflicts. For example, the type of materials or method of construction used to improve durability may inhibit recycling. Ceramics, composites and plastics may be more durable than the materials which they replace, but, as noted earlier, tend not to be recyclable. Use of galvanised steel inhibits rust in cars, thus lengthening life spans, but the zinc makes recycling more problematic. In assembling products with plastic casing the use of screws makes access for repair work easy, thus facilitating a lengthier service life, whereas plastic snap lock fittings can have a tendency to break. At the end of such a product's life, however, screws hinder recycling if it is shredded (rather than disassembled manually), because the output will be a mix of plastic and metal.[32]

Thus there may be occasions when industrial designers may have to make choices. According to Paul Burall, author of *Green Design*, if conflict *does* arise durability should normally take priority, as suggested by the waste hierarchy: "It is wrong to see recycling or ease of disposal as the only, or even the most important, concern for the green designer. The first consideration should be the life of the product itself" (Burall, 1991, p.53).

In practice, it is the marketing department of companies rather than the design department which is more likely to determine strategic priorities. Here, too, a company that wishes to communicate a clear and simple message will need to choose carefully. Selling recycled or recyclable products is an obvious way to give a company a 'green' image. On the other hand, durability could well be more easy to market, as it is self-evidently in the consumer's personal interest, whereas recycling depends on a degree of environmental altruism.

One of the constraints upon increased product life noted earlier concerned technological advance. Industry could prepare for this by designing products to be upgradable (although there are obviously limitations). Products could be designed with distinct functional modules (i.e. structural elements, the 'skin', wear and tear components, and control components), standard interfacing and low interdependence of components. Manufacturers are often aware of potential future improvements, such as increased energy efficiency, through unexploited research or by observing higher quality products not yet widely available in the domestic market. A Government commissioned report, *Energy Efficiency in Domestic Electric Appliances*, for example, has described likely improvements in the energy efficiency of refrigerators, freezers and televisions, while suggesting that little technological improvement can be expected in washing machines, cookers, dishwashers, kettles and irons (March Consulting Group, 1990).

Table 4
WHO OWNS WHAT

	% households 1964	1992
Refrigerator	34	99
Television	80	99
Telephone	22	89
Washing machine	53	88
Deep freeze/fridge-freezer	n.k.	85
Video	0	72
Car	37	68
Microwave oven	0	59
Tumble drier	neg.	49
CD player	0	33
Home computer	0	23
Dishwasher	neg.	16

Note: n.k. = not known (the earliest available figure, published in *Regional Trends 28*, is 47% in 1980/81).
neg. = negligible.

Sources: Central Statistical Office, (1993). *A report on the 1992 Family Expenditure Survey*, London: H.M.S.O. ; Central Statistical Office, (1994). *Social Trends 24*, London: H.M.S.O.; NEF estimates.

Manufacturers may have to consider more fundamental change. On the basis that the economic system must ultimately change from the contemporary 'fast replacement' production system, Stahel and Jackson argue that "commercial innovations are necessary to decouple the profitability of commercial enterprises from the throughput of goods for consumption" and that the source of future profitability could be the sale of services rather than products (Jackson, 1993, p.288).

A related idea is suggested by Paul Nieuwenhuis who, in a rare academic paper on product life, speculates that in future "car producers might make their money not primarily by making and selling new cars, but by selling spares, repair and afterware through their dealer networks to keep their own products on the road for a long time" (Nieuwenhuis and Wells, 1994, p.170). Such a transformation might appear rather dramatic, but manufacturers with foresight will be responsive to new market conditions. Nieuwenhuis highlights the fact that the status of used car sales has been raised in Sweden (where car life spans have increased dramatically), with strong marketing, high profile display areas and, in the case of Volvo, used car brochures.

Already a small number of manufacturers stress durability. For example, ASKO, the Finnish white goods manufacturer, states that its washing machines are designed to last for fifteen years with daily use and offers a unique five year parts and labour guarantee. Linn, the Scottish hi-fi manufacturer, claims that its products are designed for long term upgradability. The cars of top range manufacturers such as Rolls Royce, Mercedes-Benz and Porsche have always had to be durable, as have Land Rovers, which last, on average, for 30 years.

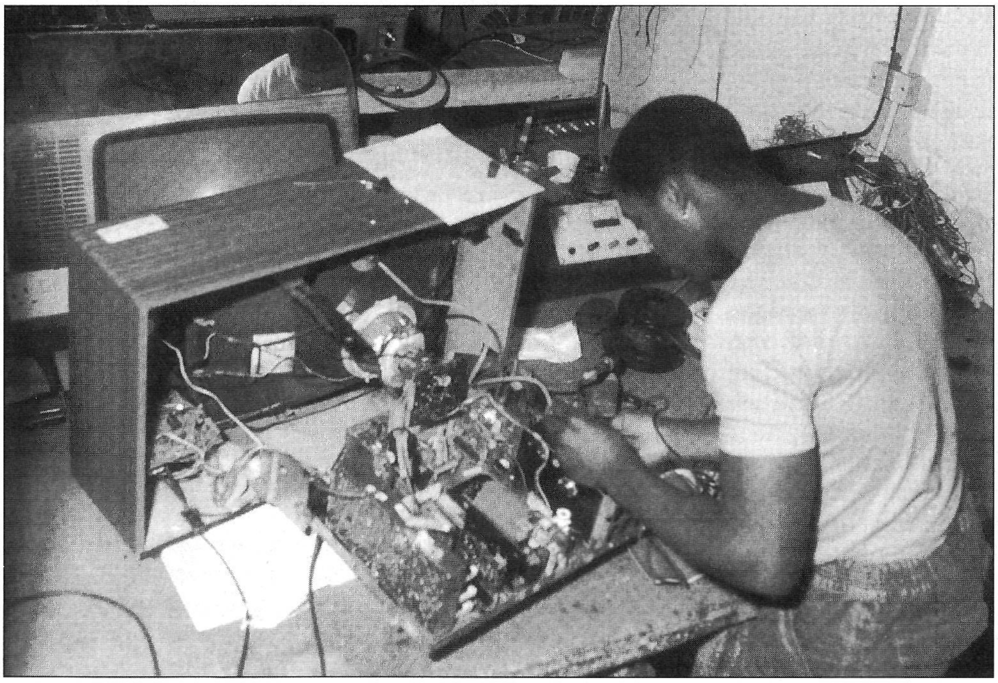
Companies which manufacture products intended for above average life spans have tended to be found at the premium end of the market. Significantly, though, volume manufacturers such as Philips, Braun and Miele have stated publicly in recent years that they intend increasing their products' life spans. They have evidently concluded that there will be net benefits from such a strategy, and that gaining a competitive advantage through increasing quality will outweigh any loss of replacement sales. John Cridland, the CBI's Director of Environmental Affairs, considers product durability to be one of the key issues emerging on the environmental agenda for businesses.[33] Even so, if there is to be a widespread shift towards increased durability much will depend on the extent to which the Government changes the commercial climate in order to encourage environmentally sound practices.

Issues for governments

Contrary to the fears sometimes expressed that increasing the life span of consumer durables would harm the economy, such a trend would, in fact, bring advantages in terms of traditional economic goals such as a healthy trade balance and increased employment. Repairs, reconditioning and other service work would nearly always be carried out in Britain, whereas many new consumer durables are imported – around a half of all cars and domestic electrical appliances. Thus there would be a beneficial impact on the balance of trade. Another positive effect would be on employment, as such work tends to be relatively labour-intensive. This would have the added advantage of being geographically spread and weighted towards people with manual skills.

There could be other social gains, some of them not immediately apparent from the traditional economic indicators. If products are readily repaired and people are less frequently faced with the need to purchase replacements, the pressure for ever higher incomes might ease. In addition, the 'informal' sector of the economy, upon which socially deprived groups often depend, should gain. Second hand transactions often benefit charity shops, while a growing number of community based organisations repair old appliances and furniture and provide them at a discount to local people suffering from poverty. Repair work is also carried out in the expanding number of Local Exchange Trading Systems (LETS), through which people exchange skills outside the formal 'money' economy using community based local currencies.

Man repairing television



Perhaps the most fundamental conflict of all, however – and one which at some point the Government must resolve – is between the alternative economic scenarios described at the outset of this report. Is the aim an economy in which recycling is promoted as a means by which the throughput of energy and raw materials in the economy can best be sustained and, indeed, maximised? Alternatively, is it an economy in which there is a reduction in this throughput on the grounds that this is necessary for sustainable development?

Governments must ask whether recycling can satisfactorily absorb the volume and variety of waste generated in a modern industrial economy. The key question is not whether recycling is *required*, but whether it will *suffice*. Is sustainable development possible with an economy in which products are recycled but no attempt is made to reduce final consumption?

It is hard to predict the effect of increased product life spans on economic output (GNP), the key indicator which politicians use to judge the performance of governments. Whatever the statistical outcome of a strategy promoting longer lasting consumer durables, however, it is important not to confuse the level of GNP with human welfare. As Jackson and Marks point out, expenditure on consumer durables cannot necessarily be equated with the value of services which they provide: "short term obsolescence of durable goods tends to inflate consumer expenditure without contributing to welfare, whereas improvement in the durability of goods increases the service value (welfare) associated with those goods without increasing personal consumption" (Jackson and Marks, 1994, p.12). The present use of output growth as a key economic indicator thus conveys an impression of ever-increasing affluence which is false, in part because it records the productive activity generated when consumer durables wear out prematurely. Any reduction in such activity would matter less if governments made a concerted effort to differentiate output from welfare and made use of new indicators of economic progress, such as the Index of Sustainable Economic Welfare, which the New Economics Foundation and other organisations are developing to complement GNP statistics.[34]

5 Conclusion and recommendations

Consumer durables all too often end up prematurely in landfill. The available evidence suggests that many do not last as long as in the past, most could be designed and manufactured to last longer, and some are discarded which still function. Far too little attention has been paid to durability by politicians, environmentalists, manufacturers and retailers in recent years, while many consumers are guilty of somewhat profligate behaviour. What, therefore, can we conclude?

First, despite increased environmental concern, *the British economy is not being steered onto an environmentally sustainable path*. For example, the Government has effectively rejected scientists' arguments that greenhouse gas emissions must immediately be reduced by at least 60%; its policy is to 'return' the level of emissions in 2000 to that prevailing in 1990. Little attention has been paid to possible medium term energy scarcities. The need for people in affluent industrial countries to reduce their consumption is barely on the political agenda, despite the implications for a world where population is rising fast and billions of relatively poor people aspire to the life styles of the rich. Many people in modern, liberal industrialised societies simply believe that they have a right to consume to their maximum potential. Politicians have not dared to deny their claim.

Second, *the move towards increased environmental sustainability will necessitate a substantial reduction in the throughput of industrial economies*. This requires a radical change in the relative price of labour and natural resources. As long as the full cost of extracting and using energy and raw materials is not included in the price of consumer durables (i.e. the environmental impact is not incorporated), there will be an undue economic incentive to replace items instead of repairing or upgrading them.

Third, *a strategy which merely improves society's capacity to absorb waste will not suffice*. It is a fallacy that there is no environmental impact involved in recycling. In order to overcome environmental problems created by the volume of consumption and waste in industrial economies it is necessary to take action which goes *beyond* mere recycling. Ultimately, it is more important to create longer lasting goods than to make them recyclable.

If pressure to move up the waste hierarchy is to be increased, some radical change is required. The following are proposed as recommendations to Government, local authorities, manufacturers, retailers, environmental and consumer organisations, and individuals.

Recommendations

(i) Action at all levels of government

Ecological tax reform is necessary to achieve the right balance in the use of labour and natural resources and thus a prerequisite for sustainable development. In Britain it should take the form of phasing out employers' national insurance contributions and phasing in higher taxes on energy (excluding domestic heating) and raw materials. It should be revenue-neutral. As a 'front end' solution it would be a far more effective means of reducing waste than proposals such as a landfill levy.

Changes to VAT should be made to provide an increased incentive to the sale of longer lasting products, preferably throughout the European Union (EU). The zero rating of repair work might encourage people to repair rather than throw away serviceable products. In Britain, the Institute of Wastes Management has proposed the reduction or elimination of VAT on products made entirely from post-consumer waste. Similar treatment should apply to products sold with significantly longer and more stringent guarantees than current industry norms.

In the EU Ecolabelling Scheme durability should in future be included among the criteria used in assessing relevant products.

Any EU proposals for 'take back' legislation should be carefully scrutinised to ensure that the reuse of products and components is encouraged rather than threatened.

Having publicly acknowledged the need for longer lasting products, the UK Government should, in developing its national waste strategy, outline the practical measures which it regards as necessary to encourage their manufacture and sale.

The Government should promote the new economic indicators which are being developed. These provide a more credible measure of progress than GNP, which only measures the level of economic activity.

Since the publication of the OECD report the available information on product life, far from being improved, has become out of date. The Government should therefore initiate a comprehensive research programme on product life to obtain the following:

- adequate data on product life
- improved understanding of the factors influencing life span, including consumer attitudes and behaviour
- independent life cycle assessments of recycled and longer lasting products
- an evaluation of the net employment impact of a strategy to increase product life
- an assessment of the potential for new forms of environmental innovation associated with longer lasting products.[35]

The Department of Trade and Industry is currently reviewing consumer guarantee legislation. If manufacturers (as distinct from retailers) assume more responsibility for guarantees, they might take more interest in long term product performance and have greater incentive to improve product durability. Reform might also help to pre-empt retailers from profiteering through the sale of extended warranties, which offer poor value for money.

One of the major obstacles to increased consumer demand for longer lasting products is the lack of information to enable them to judge whether to pay a premium price. Manufacturers and retailers should therefore be required by law to disclose the normal expected life span of consumer durables on the basis of reasonable conditions of use.[36] Manufacturers should be required to keep spare parts throughout this period.

In order to encourage more repair and reconditioning work and thereby extend the life of products, the Government should promote the development of second hand shops and markets, although it should examine regulations to ensure that consumers are confident that second hand products such as electrical appliances are safe and obtained honestly.

Local authorities should develop strategies higher up the waste hierarchy. These should include targets for waste reduction and reuse, to complement their recycling targets, and a programme to promote community awareness of their importance.

Waste disposal authorities should improve the data available on discarded products at civic amenity sites and elsewhere, as a first step towards recovering a higher proportion of usable products and components. Obtaining such information has been made harder as a result of the contracting out of such sites to private sector operators.

Waste collection authorities should explore ways of ensuring that small appliances and other household goods are recovered rather than lost amongst other rubbish in large wheelie bins.

(ii) Action by manufacturers and retailers

Industry should assess the marketing potential of durability as well as recyclability. One of the main reasons why in many product sectors competition is based so heavily on price and cosmetic appearance is that consumers lack adequate information on the design life of products. They would be more likely to buy higher value products if they had greater certainty that the benefits of an increased service life would outweigh the extra cost. Irrespective of any legal requirements, therefore, manufacturers and retailers should improve the quality of 'point of sale' information on the anticipated life span of their products.

Manufacturers should offer much longer life guarantees within an overall context of developing a stronger commitment to providing service and not simply hardware. This was a key suggestion of the OECD report. Such guarantees should be offered free of charge at the point of sale and cover labour and parts for at least 10 years for most household products.

Spare parts should be available for longer periods than current practice. Trade associations should amend their codes of conduct accordingly and manufacturers who guarantee parts availability in accordance with them should encourage retailers to display the appropriate information. Parts should be standardised where possible, which would be in the interest of consumers as this would increase their availability and make them cheaper.

Excessive delays for repair work is not unusual. One means of improving current practice might be for more companies to have computerised databases for repair and maintenance. Manufacturers ought to act more efficiently when supplying parts to independent service engineers and DIY repairers. They currently appear to lack an incentive because of the relatively small cash flow involved.

Regular servicing, together with high quality repairs, can make a significant contribution to extending product life spans. Service contracts should be encouraged, with explicit information given to the consumer as to the nature of servicing work carried out.

Industrial designers should apply the principles of 'eco-design' to their work, designing products for durability, ease of repair and upgradability wherever possible.

Manufacturers should evaluate the potential for a pilot scheme for leasing to households a comprehensive range of consumer durables designed for durability and ease of repair.

Consumers are often dissuaded from carrying out even basic repairs by manufacturers, who are concerned about product liability and aware of the profits to be gained from repair work. Products should be designed to be repaired by owners wherever possible and sold with comprehensive repair manuals.

(iii) Action by environmental and consumer organisations

Environmental organisations should devote more of their resources to campaigning for movement up the waste hierarchy. Now that the momentum for recycling has been generated, they should develop more comprehensive proposals to achieve 'reduction' and 'reuse', within a context of waste minimisation.

Organisations such as the National Consumer Council and Consumers Association should be more active in responding to consumers' concern about durability and to the greater value for money offered by longer lasting products. Consumers should be encouraged to pay less attention to the 'point of sale' price and more to the anticipated 'cost per unit of service provided'.

The Sale and Supply of Goods Act was passed in November 1994 and durability is now one of the aspects of quality determining whether certain types of product are acceptable for sale. The interpretation of 'durability' by the courts should be carefully monitored by environmental and consumer organisations.

Such organisations have an important role in educating their members and the general public about the benefits of longer lasting products.

(iv) Individual action

Individuals must also play a part. As potential customers, they should demand better information about the durability of products and raise their expectations about the life expectancy of products.

Where there is no evidence from technical data that products have been substantially improved, consumers might do well to purchase end-of-range models, which are often heavily discounted.

Some manufacturers argue that the high incidence of returns to retailers results in substantial unnecessary waste. People should avoid returning undamaged products to shops, which is often a consequence of impulse buying.

Owners should understand the environmental significance of taking good care of their possessions. Periodic servicing can help to extend product life. Whenever possible products which stop functioning should be repaired, preferably locally, rather than discarded.

Fundamental change to our throwaway culture will be possible only if people resist the pressure to consume. Evidence that products which still function are being discarded suggests that many could make a greater effort to resist the temptation to buy replacement products prematurely.

Conclusion

The greatest of the environmental challenges which lie ahead is our need to adopt sustainable patterns of production and consumption. It is difficult to predict with certainty the speed at which a major transformation will be forced upon us, but the evidence is clear that change is imperative and it would be a great mistake to think that we have already done enough.

The development of recycling in recent years is welcome, but it will prove an obstacle rather than a stepping stone if it detracts attention from the more fundamental changes that are now required to reduce the excessive throughput of energy and materials in our economy. There is a longer life option which must now be chosen.

Footnotes:

1. Some definitions of consumer durables also include clothing and footwear, household textiles, recreational goods, and DIY goods.

2. The leading exponent in modern times is N.Georgescu-Roegen (see, for example, his essay 'The Entropy Law and the Economic Problem' in Daly (1980)).

3. Robert Ayres has calculated that 94% of all material (including ores, but excluding inert materials such as stone, sand and gravel) is converted into waste residuals as fast as it is extracted and only 6% is added to the stock of durable goods (Ayres, 1989, p.26).

4. This concept was the subject of a symposium at the American National Academy of Sciences in 1991. Research on a similar theme, 'industrial metabolism', linking the transformation of materials in the biosphere to that in industrial economies, is being carried out by (among others) Robert Ayres. See, for example, Ayres (1989) and Frosch and Gallopoulos (1989).

5. The sources for this data are Department of the Environment, 1992, p.162; H.M.Government, 1994, p.148; Poll, 1993, pp.8, 19, 33; Sarson, 1992, pp.2, 13. Data from another Government-commissioned study suggests that 600,000 tonnes of electrical appliances and a similar tonnage of other waste (mainly furniture and rubble) is taken to civic amenity sites (Environmental Resources Limited, 1992, pp.3, 5, 6, 147).

6. Manufacturers have claimed that the average service life of a washing machine is fourteen years, during which the first buyer keeps it for eight years and 'second hand' buyers for a further six years (UK Ecolabelling Board, 1992, p.27).

7. This was the majority view of the world's leading scientists on the InterGovernmental Panel on Climate Change. The minimum 60% figure was calculated on a global basis; Anderson has calculated that if international equity considerations are taken into account Britain should cut its emissions by 84% (Anderson, 1993, p.24).

8. 'Take back' legislation ends the traditional division of roles by which the private sector produces and consumes while the public sector disposes of the waste thereby created. Obligations for avoiding, recycling and disposing of waste are transferred to the private sector, thus giving industry an incentive to produce waste minimising products.

9. According to its proposal a further 13% would be incinerated (with energy recovered in the process, to heat buildings or generate electricity), whereas none is at present.

10. For example, according to a report on cooking appliances by market analysts Euromonitor: "Preoccupation with shortening product life is especially important in this market, particularly as the freestanding sector consists largely of replacement sales. Manufacturers are speeding up the rate of innovation and style changes" (Euromonitor, *Market Research Great Britain*, April 1992). A report commissioned by the Department of Energy noted declining life spans for vacuum cleaners, kettles and irons (March Consulting Group, 1990, pp.60, F7). Other independent authorities have similarly identified a trend towards shortened product life spans (e.g. *The ENDS Report*, No. 215, December 1992, p.14; Roy, 1991, p.16).

11. The durability of cars declined in the early post war years and they appear to have around the same life expectancy, 11-12 years, as they did in the early 1970s (Nieuwenhuis and Wells, 1994, p.157; OECD, 1982, p.42).

12. This contrasts with the Dutch national scheme, which in the criteria for chairs it is specified that they should be designed for ease of repair and that the availability of spare parts should be guaranteed.

13. Council Directive 91/156/EEC, amending Directive 75/442/EEC on Waste.

14. This fact has not gone unnoticed by more radical thinkers (e.g. Fairlie (1992) and Sandy Irvine, 'Recycle? Not if You can Help It', *Real World*, Autumn 1992, pp.4-6). For example, Friends of the Earth used to employ a Recycling Officer and have promoted returnable bottles, but have not yet actively campaigned on the life span of products. The Consumers Association has on several occasions covered recycling in *Which?* magazine, but has not yet given similar attention to product life.

15. A recent U.S. Environmental Protection Agency report has noted the lack of data to assess the nature and significance of such hazards, although like most publications on recycling, it unfortunately excluded coverage of consumer durables (U.S. Environmental Protection Agency, 1993b, p.1-4). The Department of the Environment is shortly to carry out a research project on the externality effects associated with recycling.

16. The two most important techniques used in recovering metals from scrap are pyrometallurgical (where scrap is heated until the metal fraction melts) and hydrometallurgical (where scrap is treated with a chemical which selectively removes some of the materials for recovery from solution). The latter is more environmentally friendly according to Sarson, as the solutions can be recycled and only small emissions to the atmosphere arise, but it can only be used to dissolve exposed material such as precious metals on circuit boards (Sarson, 1992, pp.28-9).

17. *The ENDS Report,* No.215, December 1992, p.14.

18. *New Scientist*, 4th September 1993, p.20.

19. Other problems relate to the large number of components, around 2,000, and the fact that a major component, the cathode ray tube, cannot be recycled. The dismantling time, often thirty minutes, is also significant (*New Scientist*, op. cit.).

20. *WARMER Bulletin*, May 1994, p.41.

21. Recycling vacuum cleaners, for example, is currently not feasible because recycled ABS plastic cannot compete in price with virgin material. *The ENDS Report*, No.223, August 1993, p.15.

22. For example, up to ten different types of plastic are used in television cabinets. These could, in theory, be replaced by polypropylene.

23. The term 'management' is unfortunate and unnecessary, as the context should be *minimising* rather than *managing* waste.

24. *Which?*, September 1991, p.521.

25. Tim Hunkin, 'Things People Throw Away', *New Scientist*, 24th December/31st December 1988, pp.38-40.

26. Wuppertal Institute leaflet, *Ecodesign*.

27. Comparisons between the environmental impact of manufacturing packaging from virgin materials and from recycled materials have already been made (Ogilvie, 1992, pp.105-6). Two difficulties raised with LCAs are determining the exact boundaries of studies and the method of aggregating environmental impacts. For example, a particular type of product might reduce the volume of solid waste but increase energy consumption: ultimately there is a need to determine whether reducing pressure on landfill or the threat of global warming is the greater priority.

28. *Which?*, September 1992, p.493. The Office of Fair Trading launched an enquiry into the sale of extended warranties in 1994. Criticism of the inadequacy of information for consumers is nothing new (see, for example, Packard, 1961, p.259).

29. *The Times*, 21st June 1994. A report on materials substitution in car manufacturing, cited in the OECD report, warned that increased longevity of cars with a greater aluminium content would depend crucially on the quality of design and manufacture (OECD, 1982, p.61).

30. A study of aluminium and steel cars comparing the energy consumption in both the manufacturing and use phases was carried out by the International Iron and Steel Institute, the findings of which were disputed by Audi and the aluminium industry (*The ENDS Report*, No.233, June 1994, p.25).

31. Virtually all aluminium used in manufacturing products is alloyed and these are classified commercially into 'wrought' alloys and 'casting' alloys according to the fabrication process used (Ogilvie, 1992).

32. The extent of conflict in design is thus influenced by whether the discarded product is to be shredded or disassembled manually, and more likely in the former case. It also depends on the added cost of making a product recyclable or durable.

33. Personal communication.

34. The Index includes an adjustment designed to take account of changes in product life, separating expenditure on consumer durables from the value of services flowing from the stock of durables (Jackson and Marks, 1994).

35. The ESRC Global Environmental Change Programme (Phase IV) invited research proposals on upgradability, which represents a welcome step in the right direction.

36. More information on this proposal is available from NEF. Manufacturers are already aware of the likely life span of products. Various techniques of accelerated life testing are available (e.g. use of higher loads, increased duty cycles, operation at higher than normal temperatures, assessing failure rates for components) and are already used in, for example, the aircraft and white goods sectors.

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