

PRODUCTS TO SERVICES

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1.0 INTRODUCTION

1.1 Aim

This report explores the way in which products supply particular functions to consumers and the proposition that products should be regarded as 'deliverers of services'. It identifies various options for reconfiguring the relationship between products and services in order to meet people's needs while reducing the consequential environmental impact. These new 'product-based services' could form the basis of a trend towards a more sustainable 'functional economy'.

1.2 Methodology

A case study approach was used as this is well suited to exploratory work, especially where areas of perceived complexity exist. At the outset, a search of material relevant to the theme of the project was undertaken using electronic media. Contact was then established with other specialists working in this area and we subsequently participated with several other researchers in a seminar at Cranfield University. Face to face interviews with semi-structured questionnaires were carried out with experts on the rental sector, energy service companies, and the white good and brown good industries. Telephone interviews and desk research supplemented the findings from the interviews. The case studies were framed around a typology based on earlier research and discussion structured around the three domains of environmental, economic and social sustainability.

1.3 Key definitions

The following definitions are used in this report:

Products

Products are 'tangible objects that exist in both time and space' (Shostack, 1982, p.49). Manzini (1996) describes them as artefacts that supply the consumer with benefits, noting that production is usually separated by time and place from consumption.

Services

Services 'consist solely of acts or process(es), and exist in time only' (Shostack, 1982, p.49). They are intangible (i.e. they do not occupy space) and, as such, they cannot be possessed; they can only be experienced, created or participated in. There is direct interactivity between supplier and customer, and the process of production and consumption is simultaneous (Hoogerwerf, 1996).

Product-Service mix or Product-Service combinations

The relationship between products and services is complex. In practice the provision of services involves a number of tangible and intangible elements, while the supply of products relies on the culmination of a long chain of services. Products and services are therefore intimately and symbiotically linked.

The idea of service-less products or product-less services is thus flawed (Shostack, 1982). In reality there is a spectrum from product-dominant entities (e.g. salt) to service-dominant entities (e.g. teaching). The configuration (quantity and quality) of products and services supplied to meet the demand for well being may be described as a product-service mix (Manzini, 1996) or product-service combination (Te Riele et al, 1999).

1.4 Altering the product-service mix

Rationale

There is a growing body of international research on the potential to achieve environmental benefits by altering the product-service mix (e.g. Giarini and Stahel, 1993; Oosterhuis et al, 1996; Schrader, 1996; Rocchi, 1997; Elsen, 1997; White, Stoughton and Feng, 1999).

Manzini (1996, p.3) argues that the transition towards sustainability will require 'a mix of products and services in which the major role is played by a new generation of services.' These 'new services' will be characterised by 'low environmental intensity and high user participation.' Their development may require a 'leapfrog' rather than 'incremental' approach.

Such change requires the design of suitable product 'hardware' (e.g. increased durability) allied with appropriate application 'software' (e.g. an effective interface with users). The shift in the product-service mix might take the form of additional services which

- **offer a 'valued-added' to products**
- **reduce the need for as many products**
- **displace products, or**
- **take away the desire for products.**

It might be assumed that there would inevitably be environmental gains from a change in the mode of consumption from buying a product for ownership to purchasing the function of their services. In reality, such gains are probable, but not certain. The assumption is intuitively sound but needs to be substantiated with firm evidence. Documentation on the environmental effects of services is currently inadequate (Te Riele et al, 1999; White and Feng, 1999). It is clearly not necessarily true that services are environmentally benign (e.g. travel and tourism, defence). Ellger and Scheiner (1997, p.568) conclude that 'the intrinsic environmental problem of services...seems to be the transport problem' and it is therefore especially important to address transport-related aspects of service provision.

Recent developments

There are some signs that a trend towards reconfiguring the product-service mix is emerging. For example, some mobile phones are now given to consumers in a deal through which payment is made only for the service that they provide. Likewise 'set-top' boxes enabling conversion from analogue to digital reception for television, initially marketed at around £200,

are now offered without charge to subscribers to ONdigital (which costs from around £84 p.a.).

The trend has been most notable, however, in business-to-business services. A growing number of companies have marketed themselves as service producers, including Xerox (photocopiers), Interface (carpets), Electrolux (industrial cleaning), IBM (computers), and Wilkhahn (furniture).

There is increasing public interest in the environmental product policy and, specifically, the potential for 'market transformation'. However, the Government has also recently expressed an interest in issues relating to the product-service mix. Responding to a Select Committee report on the environmental impact of consumer products, it stated: 'The Government believes there are potential gains for the environment in moving away from the direct consumption of certain goods and towards the use of services which meet the same need. It is keen to capture these gains, and will monitor and contribute to research in this area as it develops' (DETR, 2000a).

1.5 Categories of change

There are several ways of categorising movements along the product-service spectrum. Table 1A synthesises the work of several authors (Oosterhuis, 1996; Rocchi, 1997; White, Stoughton and Feng 1999) to identify six main transitions which can deliver environmental benefits. These are then described in further detail.

Table 1A: Service types

No.	Focus	Service transformation
1	Design	From planned obsolescence To sustainable product design
2	After-sales support	From short term guarantee To comprehensive after-sales support
3	Form of contract	From ownership To eco-leasing
4	Mode of consumption	From individual consumption To collective consumption
5	Need	From dependence To reduced need
6	Sales revenue	From output maximisation To least cost supply

1) Sustainable Product Design

Any product-service mix has to be designed. Application of the principle of sustainable product design (in which the environmental, economic and social requirements of sustainable development are integrated into the design process) enables the service life of products to be increased and may thereby alter the product-service mix. Products are designed for durability, ease of repair and upgradability and in new product development full account is taken of the wider sustainability implications of product use and disposal. Sustainable product design is not yet commonly practised. The rather more narrow approach of eco-design (or 'design for the environment') is more common, through which the environmental impact of products is reduced. This approach is most evident in product sectors in which environmental labelling is common or a legal requirement.

2) Comprehensive After-Sales Support

As noted above, all products provide and are supported by services to one degree or another. At the pre-sales stage, for example, retailers offer information. Once sold, a product will require a certain level of support in order that the service that it provides is maintained

effectively. The kind of support required will depend on the type of product: some are more reliable than others. Evidence from the National Consumer Council (1996, 1997) suggests that the quality of customer service currently offered by retailers is highly variable. A charge may be made for these additional services, as with extended warranties. However consumer organisations have concluded that these often represent poor value for money (Which? Online, 1999). Retailers appear to have adopted a strategy of reducing product prices and seeking relatively high margins on sales of warranties to compensate.

There appears to be scope for improving the quality of after-sales services by providing longer guarantees, supplying parts more cheaply and for longer periods, or offering better value extended warranties. Better after-sales support could offer considerable environmental benefits -by increasing the service life span of products and by increasing the efficiency of their use. Retailers should be open to this kind of change in the product-service mix, as market analysts have found that the quality of after-sales service is highly influential in determining the store chosen by consumers.

3) Eco-Leasing

Historically people have been able to purchase the services provided by products through rental. This market has been in decline, but a revival appears possible due to recent developments in European waste policy in the form of 'take back' legislation on cars and electrical or electronic products. For example, the proposed EU Directive on Waste Electrical and Electronic Equipment (WEEE) would make producers of household appliances responsible for their collection, treatment, recycling and disposal and would establish targets for recycling and re-use, and in due course, collection (ICER, 2000). Producers considering the implications of being made responsible for end-of-life products when discarded may conclude that it would be preferable in future to rent or lease products rather than sell them (particularly if they want to retrieve their own branded products rather than be part of a pooled collection system). Thus in the foreseeable future it is conceivable that private ownership of household appliances, which is so characteristic of modern consumer society, may no longer be the norm (Ellger and Scheiner, 1997; Schrader, 1996).

Radical changes in the current rental market would be required. Two companies currently dominate leisure rental, each claiming 1m-1.5m customers, Thorn (which owns Radio Rentals and Crazy George's) and Granada. The sector is largely sustained by two types of customer, low-income customers unable to obtain credit for outright purchase and early acquirers of new technology (initially colour television and more recently widescreen television). After around 15 years of decline, following the removal of credit controls and increased reliability of televisions, the market appears to have stabilised. Companies now offer a broader product range (television rental accounts for less than one half of Radio Rentals' business and only 15-20% of Crazy George's). Rent-to-own contracts, which require no deposit (unlike traditional hire purchase) and offer swap or cancellation without penalty and free repairs, became common during the 1990s. American evidence shows that such contracts typically result in total payments two to four times greater than retail prices, but low income customers value the ability to make regular structured payments and to withdraw from contracts (Zikmund-Fisher and Parker, 1998). The benefit to suppliers is that under such contracts they are not left with a large stock of second hand products with relatively low resale value.

Waste arises from people's desire to own an increasing number of products and the ability of producers to reduce product life spans in order to maximise replacement sales. In the past, it would appear that rental has not offered significant environmental benefits. Indeed it could be argued that as it often introduces consumers to expensive products based on new technology it increases the pace at which new products are transformed into perceived necessities and thus promotes consumption. In addition, there is anecdotal evidence that rented products are liable to be misused. Nonetheless, there are potential environmental benefits depending on the frequency and intensity of use of the product. For example, access to short rentals for products used infrequently (e.g. DIY tools) may prevent people from unnecessary purchases; it thus reduces the number of products required to meet social needs. More important, although products for the rental market have not hitherto been designed differently from products for sale, the fact that rental suppliers are responsible for the cost of maintaining and replacing products should provide an incentive for products that are durable, reliable and cheap to repair. More generally, rental could allow people to test their need for particular products.

The concept of 'eco-leasing', which represents a form of rental with environmental constraints, has recently been developed in the context of linking services with environmental benefits (Oosterhuis et al, 1996; Schrader,1999). It is distinguished from traditional rental by at least two preconditions. First, there is no option of final purchase, in order that the producer retains responsibility for discarded products. This contrasts with the current trend: the new and relatively successful chain Crazy George's only offers rent-to-own contracts. Second, there must be a direct contract between the producer and the customer in order to create a close relationship to deal with repairs and any other service requirements. There may also be a need for penalty clauses to deter customers from regular product (cf. component) upgrades. Eco-leasing is not yet practised to any significant degree in the consumer sector.

4) Collective Consumption

Another means of altering the product-service mix is for the services provided by products to be based on 'collective consumption', which embraces how they are used and in some instances, how they are owned (Table 1B).

As affluence in society has increased, so too has individualism. People own more products than ever before. Some are only used infrequently. Often they are used by individuals rather than in group situations, an obvious example being televisions.

There are several forms through which collective consumption could take place, notably rental, sharing and pooling, and there is considerable overlap between them. The key differences relate to the length of contract, the degree of formality and the nature of transactions and use. Collective consumption can provide greater transparency with regards to the true cost of buying the service provided by products, as fixed costs are integrated and attributed to each period of use.

Rental is the more formal and traditional approach, characterised by a financial transaction through which the consumer obtains short-term possession of the product for a given charge (paid either once or at regular intervals). The product is often used by a number of different consumers in succession.

The second form of collective consumption is product sharing. This approach is often more

informal and involves the shared use (and sometimes shared ownership) of a product amongst several consumers. These consumers may use the product simultaneously or in succession. The use of products in 'sharing' situations is usually for a much shorter time scales than rental or leasing, but often involves long-term commitments to the group of people with whom the product is shared. Sharing may not necessarily involve a financial transaction.

A third form is referred to as product pooling, a term which tends to be used where there is more than one product type being shared at any one time. For example, in Heidelberg, Germany a voluntary pooling system for household products and office equipment operates through a registered society. People who join offer at least one product for the pool and are then allowed to use products owned by other members. Members pay an annual membership fee and a fee for wear and tear depending on the value of the product and period of use (Oosterhuis et al, 1996). LETS schemes, in which people offer products and skills in exchange for payment in a local currency, provide a further example of pooling.

Collective consumption, in whatever form, enables products to be used in such a way that their utilisation value is maximised. Products can be used more intensively, which reduces the number of products required to meet people's needs (and thus the throughput of energy and materials in the economy). In addition, intensive use means that higher efficiency standards can be exploited more quickly, as products are less likely to become technologically dated before they are physically worn (e.g. energy efficient washing machines, rechargeable tools). There may also be economic benefits to the consumer, particularly in situations where fixed costs are high relative to costs in use (e.g. through depreciation), or where costs in use are high for a lone individual (e.g. cars). There are also other potential benefits. Pooling systems, for example, may provide members with a wider choice of products.

Characteristics of collective modes of consumption include a preference of function over form and a move away from individual desire to own products and towards a collective or group loyalty. Community use and collective ownership remain marginal activities at present, although significant progress is being made in some parts of Europe, where there are a growing number of car share and car pool schemes.

Table 1B: Summary of some key options

Product use options	Examples
Owned individually Used individually	The current norm of private ownership
Owned individually Used collectively	Ride sharing, home television
Owned collectively Used individually	Car sharing/pooling, community launderette
Owned externally Used individually	Eco-leased car or appliance, commercial launderette, internet café, library computer
Owned externally Used collectively	Public transport, laundry service, pub television

5) Reduced Need

Various services could directly replace the need for specific products or substances. They might either take the form of a 'low technology' alternative to prevailing norms (e.g. washing lines instead of tumble driers), or be educational in nature (e.g. Government information campaigns on waste which promote repair or reduced packaging). In the case of mobility they may require changes in physical infrastructure or social behaviour (e.g. telecommuting). In

general, low technology solutions will not be provided by the product supplier due to the conflict of interest.

6) Least Cost Supply

The business rationale behind most market transactions for products is 'to maximise output in order to maximise profit'. The philosophy underlying least cost supply inverts this to 'minimise output in order to maximise profit'. This reversal of traditional business strategy is achieved by moving away from a narrow product focus to addressing how the customer's long term 'needs' or 'goals' could be achieved with fewer resources and at lower cost. Least cost supply therefore simultaneously offers environmental and economic benefits.

Pest management services in practice. Suppose a farmer buys a pest service rather than a pesticide from the supplier. Suppliers then have an incentive to remove the pest whilst minimising pesticide use, thereby reducing their material costs and potentially increasing their profit. The farmer achieves the required result without the problems associated with handling pesticides. This idea works on the basis that the customer (i.e. farmer) no longer buys the chemicals but instead buys the desired result. He or she has an incentive to use a service provider who is able to reduce pesticide use the most while maintaining an acceptable result, as a more efficient use of chemicals should result in the lower prices.

Least cost supply is currently primarily operational in industrial sectors, notably chemicals and energy. For example, in the chemical industry management services are offered to their clients on a unit-price basis (i.e. solvent is sold per tool cleaned with the fixed incentive to reduce rather than increase chemical use for both supplier and consumer). The chemical company's service may include the entire chemical-handling programme in their price (e.g. training, legal compliance and waste disposal). Companies currently offering such programmes include Ciba AG Division pigment (who sell colour services instead of dyes and pigments), Zeneca (integrated pest management services instead of pesticide) and Chrysler Corp and Dow Safechem (solvent services instead of solvent).

The potential for movement to a least cost supply approach is also apparent in the energy sector, moving away from the sale of energy products to a sale of energy services, such as warmth. This approach has been pioneered in the USA; its application in Britain has so far largely been limited to business to business deals.

2.0 CONTEXT

This section places the proposed alteration of the product-service mix into an economic, cultural and political context. The requirements for the design and management of the proposed new 'functional economy' are then explored and a series of case studies introduced.

2.1 Economic trends: from manufacturing to services

The second half of the twentieth century has witnessed a significant shift in the structure of economy, characterised by a decline in manufacturing and significant growth in services such as banking and insurance. The proportion of the total workforce employed in the service sector rose from 45.4% in 1950 to 71.3% by 1992 (Illeris, 1992).

The reasons for this transformation to a new service-based economy have been explored and critiqued by several researchers (e.g. Gershuny, 1978; Silver, 1987). The explanations are numerous, complex and sometimes contradictory (Cowell, 1984; Illeris, 1992; Lovelock, 1996). Early explanations for the growth of services built upon a 'three-sector theory' of economic

development (e.g. Fisher, 1935), relating the increase in services to the accumulation of wealth in advanced industrialised nations. Poor countries were initially limited to meeting their basic absolute needs. As their wealth accumulated they were able to manufacture products and when their need for products was largely met, surplus wealth was available for investment in services and luxuries. The theory was later enhanced by incorporating the role of labour productivity (e.g. Clark, 1940). As time passed, a decreasing proportion of the labour market was required to meet primary and secondary product needs, and therefore more employees were available to the service sector. This led to the visions of a post-industrial society characterised by increased time devoted to leisure, tourism, education and health (e.g. Bell, 1973).

These ideas were contested by Skolka (1976) and Gershuny (1978), who offered a different interpretation. They argued that rather than moving to a society dominated by purchased services, advanced economies were gradually replacing traditional 'collective' services with personally owned labour-saving appliances and a 'self-service' society was evolving; hence the movement away from launderette to washing machine, from cinema to television, from train to car and so on. These transformations were attributed to economic pressures. Product manufacturers were able to increase their labour productivity whilst the service sector was not, and therefore the cost of supplying products relative to services declined. The price differential increased further when taxes were added to the equation (Gershuny, 1979; Gershuny and Miles, 1983).

Gershuny's hypothesis has not been unchallenged. Criticism has been directed at the omission of several critical factors that explain an increase in the use of services by consumers (e.g. Cowell, 1984; Silver, 1987). These include

- increased female representation in the work force resulting in more affluence but less time
- weakened connections to family and community
- increased proportion of elderly consumers through improved life expectancy
- the need for specialised skills and externally sourced knowledge to maintain products
- improved service quality and flexibility
- greater wealth and higher expectations.

These interpretations of products and services as competing with each other are now recognised as rather naïve. Several commentators (e.g. Illeris, 1992) highlight the interconnectedness, compatibility and complexity of product-service systems. Recent economic trends indicate that there are significant differences between service types and that elements of each of the earlier theories are operating simultaneously (Illeris, 1992). For example, Driver (1984) and Delmas and Gadrey (1987) both found that whilst the Gershuny model was applicable to some services industries, it could not be used as a foundation for future forecasting of the whole service sector, as other trends indicated that the sector was expanding.

Meanwhile, the demand for product ownership has continued to rise whilst the volume of products under rental agreements and the amount of repair work undertaken has declined in most product groups. This is the result of the low price of products relative to services caused by a combination of increased manufacturing productivity and the influx of cheaper goods imported from less advanced countries with lower manufacturing costs and less stringent environmental and social legislation.

At the same time current trends suggest a significant increase in the volume of services that supplement core products either directly through 'added value' (such as warranty services) or indirectly through channels such as retailing, marketing, financial services and transport. In saturated consumer durable markets, the provision of these supplementary services is increasingly important to gaining competitive advantage (Lovelock, 1996). As noted above, some corporations that previously defined themselves as manufacturers of a particular product range are re-thinking their corporate identity as service providers.

The growth of innovative services through digital technology is becoming increasingly significant in the development of the economy. The improved communication provided by such systems enables the rapid transmission of data and offers new opportunities for service innovation, such as telephone and Internet banking.

2.2 Cultural trends: affluence and ownership

The growth in affluence has led to an expanding range of public and private services such as leisure, tourism, health, education and transport. Meanwhile the relative decline in the cost of many products has made them more accessible to a wider range of income groups. Consumer durable ownership has increased dramatically (Table 2A), taking preference over other forms of product possession such as rental and leasing.

Despite the record levels of product ownership now attained, evidence suggests that people do not necessarily consider themselves content, and expectations are now greater than ever (Lansley, 1994). The trend towards increased product ownership and material intensive lifestyles is driven by a complex interplay of technological and socio-economic factors (Box 1).

The motivations behind the desire to own, possess and consume have been linked in recent sociological thought to complex cultural processes (e.g. Dittmar, 1992). Product ownership provides more than the sterile utility of a particular product. Ownership and consumption are recognised as vehicles for individual identity construction, being used to express values, construct rituals and indicate affiliation with a particular group or lifestyle (e.g. Belk, 1991; Heiskanen and Pantzar, 1997). Product ownership offers autonomy, privacy and security, and gives the consumer freedom to customise products as they wish. Ownership also provides the rights to control use of possessions (Furby, 1978). Schrader (1999) suggests people strive for 'symbolic self-completion' through material possessions and that, for some, ownership is a form of compensation for their perceived inadequacies. They accumulate and use products in order to expand their sense of control over their environment and increase their perceived power (Schrader, 1996).

The urge to own an increasing number of objects results in 'hyper-consumption', in which the division between needs and wants becomes progressively blurred (Kilbourne et al, 1998). Human desires once largely defined by spiritual beliefs and value systems are increasingly socially constructed, their needs and wants shaped by producers through advertising and the media. This has led to a situation in which people consume beyond their needs and dysfunctional forms of consumption, such as 'revenge' and 'compulsive' shopping habits prevail.

Table 2A: Consumer durable ownership

% households	1964	1992
Refrigerator	34	99
Television	80	99
Telephone	22	89
Washing machine	53	88
Car	37	68

Source: Central Statistics Office, 1993.

Box 1: Factors encouraging widespread consumer durable ownership

(i) Technological Changes

Structure / Materials

The development of new cheaper synthetic materials such as plastics initiated considerable changes in structural composition and lowered costs.

Diversity

The diversity of products available expanded rapidly and innovations attracted consumer attention.

Complexity

The nature of products became more complex, offering advanced functions and increased utility, especially through the advent of electronics.

Efficiency

The products became increasingly specialised in order to achieve certain tasks more efficiently, which increased the number of products people felt they needed.

Fashion / Novelty

The variety of product categories subject to the vagaries of fashion increased (e.g. from textiles to kitchen utensils, electrical appliances and sports equipment) as did the consumer desire to test and try new products and the availability of cheap novelty items and free gifts.

(ii) Socio-economic Transformations

Income rises

Rising average income provided consumers with the opportunity to buy increasingly cheap mass-produced products.

Social emulation, status and identity

The desire to emulate others and to improve social status increased as possessions became important vehicles for self-expression.

Rising expectations

As products became more widely available expectations grew, with ownership of an increasing range of products becoming 'normal' or 'necessary', rather than 'luxury'.

Acceptance of disposability / rejection of thrift and repair

The move towards cheaper, less durable products was accompanied by a gradual acceptance of disposability, and a stigma became attached to second hand products, repair and thrifty behaviour (with the notable exception of antiques).

Time famine

Real and perceived time famine led to the rapid uptake of labour saving and convenience products.

Improved communication and marketing

Improved communication and more sophisticated marketing and advertising led to the generation of new perceived needs and priorities.

Dependence on product system infrastructures

As the physical infrastructure (transport, water, electricity etc.) and the production and consumption frameworks (international purchasing and distribution, advertising, marketing, acquisition, use and disposal etc.), developed their mutual interaction resulted in a society locked into prevailing production and consumption patterns.

Sources: Bocoock, 1993; Cooper, 1994; Kilbourne et al, 1997; Olshavsky, 1980.

The current economic system is dependent on the continued social construction of consumer desire (Thompson and Holt, 1997). In saturated markets for consumer durables, producers are reliant on replacement purchases and modifications to existing models to induce sales by expanding perceived necessities. Manufacturers operating in this environment are positioned in an ambiguous state, their role of supplying durable products to meet consumer needs conflicting with that of maintaining high levels of demand in order to continue production.

2.3 Political trends: a change in strategy

The growth of mass consumption has led to enormous transformations in the social fabric, challenging traditional structures of work, the family and religion. Social interaction in community and family situations has been displaced by increasingly individualised lifestyles.

In industrialised countries key economic, demographic and cultural trends threaten to increase levels of consumption further over the next decade, thereby amplifying environmental threats (MINTEL, 1998a; Nijkamp et al, 1998). They include

- rising numbers of single person households (e.g. due to divorce, decline in marriage), each consuming almost the equivalent of former shared households
- growing numbers of retired and elderly people with disposable income, an abundance of leisure time and greater health needs
- more dual income households through increased female representation in the work force
- higher expenditure on products per person.

The social and environmental consequences of unsustainable consumption have attracted mounting scientific scrutiny and recognition. This has led to a general political consensus at a global level that there is a need to pursue a course of sustainable development in order to alleviate environmental damage while ensuring social equity (e.g. Carley and Christie, 1995).

Early policies by the European Union (EU) to alleviate the environmental degradation caused by unsustainable patterns of consumption were predominantly focused on the role of manufacturers at the point of production. Regulatory frameworks mainly took the form of legislative 'end of pipe' controls formulated to mitigate pollution through technological innovation. These addressed specific environmental impacts of production processes, leading to short-term solutions and substitutions but neglected the pollution and waste associated with the use and disposal phases in the product life cycle. During the past decade much emphasis has been placed on eco-labelling, launched in 1993 and intended to encourage the design and manufacture of less environmentally-damaging products. In contrast to several national schemes (e.g. the Nordic Swan), the EU scheme has failed to become properly established.

A more sophisticated approach is now being adopted. Current policy is aimed towards creating a comprehensive framework for 'product systems', incorporating a more holistic approach to production and consumption. The two main elements in this new approach are Integrated Product Policy and Producer Responsibility.

Integrated Product Policy (IPP) is a strategy intended to enable a more comprehensive approach towards environmental policy. The aim of IPP is 'to modify and improve the environmental performance of product systems' (Ernst and Young/SPRU, 1998). It encompasses the whole life-cycle of the product, from extraction of raw materials through to disposal. Several European Union countries had already devised product policies and product management strategies at national level and the Ernst and Young/SPRU report, which was commissioned by the Environment Directorate, called for an IPP for Europe (ENDS, 1998). Significantly, however, the report maintains that the IPP should focus solely on products and that services should be omitted until more information becomes available. It concluded that 'the debate over 'products' and 'services' is not sufficiently mature for conclusions to be drawn about the need for, or benefits of a generic shift from products to services' (Ernst and Young/SPRU, 1998, p.9).

The EU and several national governments are also developing policies based on Producer Responsibility. By making producers responsible for the environmental impact of their output the aim is 'to encourage producers to prevent pollution and reduce resource and energy use in each stage of the product life cycle through changes in product design and process technology' (Thorpe and Kruszewska, 1999). Lindhqvist (1992) identifies four forms of responsibility (Box 2).

The ultimate form of producer responsibility is a system of product leasing, in which the producer maintains responsibility for the product's manufacture, maintenance and disposal whilst the consumer only purchases the products' services. Examples of current producer responsibility policies being developed include the proposed Directive on Waste Electrical and Electronic Equipment (WEEE) and that on End-of-Life Vehicles.

Box 2: Forms of Extended Producer Responsibility

Liability responsibility

The producer is responsible for environmental damages caused by the product

Economic responsibility

The producer is responsible for covering the costs of end of life actions (i.e. collection, recycling or disposal)

Physical responsibility

The producer (where applicable) is responsible for the physical management of the product

Informative responsibility

The producer is responsible for fulfilling informative requirements of the product

Sources: Lindhqvist, 1992; Thorpe and Kruszewska, 1999.

2.4 The 'Functional Economy': an integrated solution

The need to reduce pollution, waste and resource depletion demands a more holistic approach to the consumption and production of products and services, involving a different kind of economy. The alteration of the product-service mix is one means of increasing eco-efficiency in order to make a transition from our present 'transactional economy' to a goal-orientated 'functional' economy. This transition recognises that people are viewed as users of functions

and services rather than consumers of products (Manzini, 1996; Rocchi, 1997; Stahel and Jackson, 1993, White et al, 1999). In contrast to the current transactional economy, in which products and services are viewed in isolation, the new strategy, orientated around carefully designed product-service mixes, could be used to meet consumer needs more effectively, whilst increasing resource efficiency and reducing pollution. This new, 'functional' economy may in addition offer cultural benefits providing opportunities for local business, enhanced community spirit, better employment prospects, and improved social welfare and quality of life.

However, in order to establish whether revised product-service combinations will provide environmental, economic and social improvement, it is necessary to evaluate the process of service design and management. Increasing the service element in any product-service mix is not a panacea for environmental management. Objectives such as resource efficiency and pollution minimisation need to be integral to the design phase of any product-service combination. Manzini (1996) has called for 'sustainable product-services development' (SPSD), a strategic design activity for developing an intrinsically sustainable mix of products and services, which would form the basis of the proposed new functional economy. Such a strategy would need to involve representatives of all stakeholder groups with an interest in new product development.

The process of de-industrialisation and growth of the service economy has already led to considerable academic interest in the marketing of services (Lovelock, 1996). In contrast, service design has received only meagre attention (Brown et al, 1996). Thus processes of service design, known as 'blueprinting' and 'mapping', are still in their infancy. Unlike a product's characteristics, which are tangible, quantifiable and can be replicated, services (or the service elements which accompany products) are intangible, personal and variable and therefore far more difficult to design and measure. Most attempts at service design have followed the pioneering work of Shostack (1984, 1987) who introduced the concepts of 'molecular modelling' and 'service blueprinting'

2.5 Altering the product-service mix - a case study approach

Most previous work on transforming the product-service mix that has sought to demonstrate the benefits of this strategy has related primarily to the business sector. The remainder of this report aims to provide examples of product-service alterations that occur or could be developed in the domestic sector, highlighting the applicability of this concept to consumers as well as businesses.

The report considers whether rethinking products as deliverers of services which fulfil needs might lead to new options to meet these needs with the least possible environmental impact. This will be done through a series of four case studies, which aim to

- Identify and define possible transformations in the product-service mix for washing machines, energy, transport, and televisions and personal computers.
- Assess the scale of potential environmental, economic and social benefits and opportunities provided by such transformations.
- Highlight the major barriers to product-service mix alterations.
- Identify possible solutions for tackling these obstacles.

Finally, the case studies are analysed collectively, so that conclusions can be drawn regarding the potential of product-service mix alterations to provide environmental, economic and social

benefits. The key obstacles are identified and recommendations suggested for overcoming them.

3.0 WASHING MACHINES CASE STUDY

3.1 Introduction

The relatively small size of many kitchens in Britain has not been persuasive enough to prevent households from aspiring to own a washing machine, nor, in many houses, a tumble drier. Most people now regard a washing machine as a necessity (Lansley, 1994).

The current generation of washing machines is far more efficient in terms of energy and water consumption than in the past. The average consumption of water and energy has declined by factor of two in the past 10 years (van den Hoed, 1997). At the top end of the market, 'fuzzy logic' technology links the wash programmes automatically with the size of load. Electronic programmes are becoming a standard feature.

Market context

Around 2 million washing machines are sold in Britain each year (AEA Technology, 1997). Production is increasingly centralised in Europe and around two-thirds of washing machines sold in Britain are imported, although most of those made by Hotpoint, the market leader with 30%, are manufactured here. There has been a divergence in the quality of washing machines sold in recent years. Demand for budget range products has risen in response to falling prices and there has also been significant growth at the premium end of the market.

Just over 90% of households now own a washing machine and 51% own a tumble drier (Boardman, 1997). In the middle of this century there was a growth in the use of launderettes, but these have been in decline. There are currently around 6,000 launderettes, compared with a peak of 11,000 in late 1950s. The growth in washing machine ownership resulted in low profits, which in turn led to low investment. Laundry services, which used to provide a door-to-door service for households, are now largely restricted to the commercial sector, although nappy cleaning services have emerged in a few areas.

Current intensity and longevity of product use

The frequency with which washing machines are used varies considerably, but is on average four to five times each week (Group for Efficient Appliances, 1995). Usage is largely influenced by household size. The average service life span of washing machines has been estimated (perhaps conservatively) at 8 years (AEA Technology, 1997).

3.2 Transforming the product-service mix

The essential function of washing machines is to provide a service of cleaning clothes. Washer driers in addition dry the washed clothes. Launderettes provide the same cleaning service by another means, shared machines, and may provide an additional optional service in the form of 'service washes', where the labour element is provided by staff. A laundry service

goes further and offers the latter, plus a collection and delivery service. There are a range of complementary products and services to be taken into account, such as tumble driers or (more cheaply) washing lines, and irons and ironing services. An overview of possible future changes in the product-service mix is shown below (Table 3A).

Option 1: Sustainable Product Design

There have been some improvements in the environmental performance of washing machines, as noted above, but manufacturers have paid less attention to durability. Although premium range products have normally been designed to provide a reasonably lengthy period of service (at least 15 years), the life span of cheaper models is often relatively short. This may be influenced by the fact that repair costs often appear relatively expensive when contrasted with budget-priced replacement products. The proposed WEEE Directive is intended to promote product designs which enable ease of repair and upgrading and thus reduce waste.

There is considerable potential for increasing the service life of washing machines in the mass market. Now that technological advance appears to have stabilised in this product sector, it may be easier to convince consumers to buy products designed to provide a lengthy service life. It will, however, require a change in attitudes. For example, many consumers today have limited expectations of product life and expect prices to be cheap; buying kitchen appliances is no longer regarded as a long term investment. Although technology of washing machines may have stabilised there are two other developments worthy of note: the development of wash balls, designed to replace washing powder, and the potential use of electronic chips in clothes that enable washing machines to select appropriate programmes and warn users of potential problems with mixing different clothes types.

Option 2: Comprehensive After-Sales Support

Pre-sales information about washing machines is variable in quality. Energy labels are mandatory, but information on the design life of products is rarely available except in sales booklets. These are rarely on display and manufacturers' warranty information is often not provided at the point of sale. Whether such services will be improved will largely depend on pressure from consumers for more detail.

After-sales services are similarly variable, with critics pointing to unduly expensive extended warranties and the risk of repairs being dealt with by incompetent service engineers. Extended warranties have in the past provided retailers with high profit margins. It is not always clear to consumers for how long an extended warranty can be taken out and whether they can be renewed indefinitely. Future improvements in after-sales services may take place, but appear unlikely to be substantial.

Option 3: Eco-Leasing

Washing machines manufacturers are known to be considering the potential for eco-leasing washing machines, an interest stimulated by the prospect of the aforementioned EU Waste Electrical and Electronic Equipment Directive. If approved, this would require washing machines producers (i.e. manufacturers or importers) to recycle or re-use 90% of all discarded items from 1 January 2004.

One manufacturer, Electrolux, is actively developing a strategy of selling the product function rather than the product, which it terms 'functional sales', although at present this appears likely

to be targeted at professional users rather than households (White, Stoughton and Feng, 1999). The prospect of this opportunity being open to private households will depend on whether domestic consumers can be convinced that rental costs are not excessive.

Option 4: Collective Consumption

Collective consumption may take the form of launderettes, either in high street locations or integrated into housing developments, and laundry services. Launderettes allow washing machines to be used more intensively, but to achieve this investment must be increased. This has happened in Germany, where Öko-Express Waschsalons has worked with Miele to modernise launderettes by reducing the environmental impact of machines and creating a more pleasant atmosphere.

The potential for new laundry services is less clear, but they may conceivably become more viable if the home delivery of other products, such as food, becomes common, a trend already evident. An alternative collection and delivery method is that used by ECOMAT in America, who collect and deliver laundry to and from apartments through a deal with United Parcel Service and thereby minimise the use of vehicles.

Option 5: Reduced Need

A more radical solution is to develop services that reduce the need to use washing machines. This could be through changes in social custom (e.g. the acceptable frequency with which clothes are washed or trends in the 'formality' of clothes). Fabric manufacturers might develop innovative materials that require less frequent washing. The use of driers could be reduced through the use, wherever possible, of washing lines. However not all options are beneficial: the use of disposable nappies has substantially reduced the need to clean cotton nappies, but this merely replaces some environmental impacts with others (i.e. solid waste disposal). These services may be promoted through information from Government and environmental organisations; clothing retailers could also play a role.

3.3 The scale of potential benefits (environmental, economic and social sustainability)

Environmental benefits

Each year around 2 million washing machines are discarded, together with half a million tumble driers and spin driers and several million irons, together weighing over 170,000 tonnes (Poll, 1992). Washing machines typically comprise 45-60% steel, 20-30% concrete and 5-15% non-ferrous metals. They may contain environmentally dangerous substances in their electronic components, plastics and wires (Nordic Council, 1997). An increase in the average service life of washing machines and a reduction in the number of households who own them would reduce this flow of waste.

Wet appliances overall (i.e. washing machines, tumble driers and dishwashers) account for 16% of UK electricity consumption - equivalent to 12TWh in 1996. New tumble driers are two or three times as energy intensive as washing machines. It has been estimated that total consumption could be reduced by 17% through changes in household behaviour such as use of lower temperatures and more efficient loading (Boardman et al 1997).

In addition, millions of disposable nappies are discarded each year, accounting for 3-4% of all household waste. This could be substantially reduced through increased use of cotton nappies, which might be encouraged through nappy cleaning services. Finally, account should be taken of irons in addressing the environmental impact of the whole process of cleaning clothes.

In order to explore the key options, a study was recently undertaken by van den Hoed (1997) (Box 4). Van den Hoed considered the options for centralising the washing process, and concluded that a commercial laundry service had the greatest potential for reducing environmental impacts. The perceived benefits of collective provision depend on which environmental impact is accorded the highest priority; collective provision could involve an unexpectedly high energy cost.

Table 3B: Predicted environmental impact of washing machines

	1995	2025 (forecast)
Energy consumption	8.5MJ/kg	3.3MJ/kg
Water use	25 litre/ kg	7 litre/load
Detergent use	45 gram/kg	15 gram/kg

Source: Van den Hoed, 1997

Box 4: The van den Hoed study

Van den Hoed's starting point was that technological innovation in domestic washing machines had the potential to reduce environmental impact by a factor of 2.5-3.0 (Table 3B) but that further improvement was limited by

- consumer behaviour (e.g. 70% loading, high temperature washes, over-dosing with detergents)
- 'natural' limits (i.e. the need to wet clothes)
- the nature of technology (e.g. an inability to upgrade machines, the use of 'batches' rather than a continuous process).

He thus contrasted this 'business as usual' scenario with two alternatives: (i) a neighbourhood service created by the integration of small professional laundries within housing developments in populated city areas, and (ii) a wash service created through diversification of the current large commercial laundries (hospitals, hotels) into the domestic sector. In each case the consumer would not be personally involved in wash activities (cf. launderettes). Continuous washing would make recycling of water and detergent feasible and enable machines to be used intensively during their life-span. On the other hand, collective washing would require higher temperatures (in order to meet hygiene requirements and be acceptable), mechanical drying (for fast throughput), and some form of distribution to and from customers (which may involve packaging to protect clean clothes ~~them~~ from damage).

His research drew the following conclusions about the use of energy, water and detergent (although there were no conclusions on materials use):

- Energy use is greater in each case due to the need to dry clothes, wash at high temperatures and to transport clothes. The potential for lower energy use through innovation is similar to that for domestic washing (equivalent to a factor 3 reduction).
- Water use would be substantially lower for commercial laundries than domestic washing or neighbourhood laundries, due to filtering and cleaning water for recycling. Neighbourhood laundries offer only a very slight reduction compared with home washing. Commercial laundries have the potential for further reductions compared with domestic washing (equivalent to factor 10, i.e. 2.5 litres/kg).
- Detergent use would be significantly lower in each case due to better recycling technologies and expert dosing systems, with the commercial laundry option offering the greatest potential for savings. Commercial laundries have the potential for further reductions compared with domestic washing (equivalent to factor 16).

Source: van den Hoed, 1997

Economic and social benefits

No research has been identified on the macroeconomic implications of moving to a service-based approach to cleaning clothes. The manufacture of washing machines is now highly automated. By contrast, rental services and repair work are relatively labour intensive. The transfer of the labour involved in cleaning clothes from the householder to launderette staff or laundry employees would lead to increased employment.

The process of cleaning clothes in washing machines at home is a private, sometimes lonely activity. In contrast, the use of community facilities such as laundrettes - and even the social contact made through the use of laundry collection services (including nappy laundering) - can offer a social benefit by bringing people together.

3.4 Barriers to change

Economic

Cost is clearly an important factor in determining the viability of options for altering the product-service mix. For example, at present, it is often so expensive to rent a washing machine (around £16 per month, £192 p.a., in Sheffield) or use a launderette (around £5 to wash and dry a 26lb load) that purchasing a washing machine is the most economically rational choice.

The kind of laundry service suggested by van den Hoed would need to cover a densely populated area or achieve very high participation rates in order to offset the cost, both economic and environmental, of delivery.

Nappy laundry services appear to be rather more expensive than using a washing machine (and perhaps marginally more expensive than using disposables). At present, the typical charge in Sheffield is £30 per month for each baby.

Cultural

People have become accustomed to owning washing machines, which gives them the ability to wash clothes at whatever time they choose. They may be reluctant to allow people outside of their family to handle their clothes. Laundrettes have a poor social image and are often not easily accessible without a car (which may also be considered necessary to carry a load for a family).

People enjoy the convenience of disposable nappies compared with using cotton nappies. Even if the latter are washed through a service company they may need to be transported back to the home and will need to be stored.

The culture of ownership brings certain expectations about financing. Many people are used to paying the initial relatively large capital cost of new appliances and are then content to take a risk with reliability (although some purchase warranties despite the concern about value for money).

Technical

Increasingly people lack technical knowledge of products, and precise information such as

their design life is rarely available.

There could be planning objections if there were proposals to site laundries or launderettes within some residential areas in order to minimise transport.

3.5 Solutions

There are a variety of policies that can be used to overcome the barriers to transformations in the product-service mix for washing machines.

Regulatory

- Stronger EU legislation on waste to encourage more re-use when producers become responsible for discarded washing machines (e.g. separate re-use and recycling targets in the forthcoming WEEE Directive).
- Statutory requirement for washing machines to be labelled with their anticipated service life.
- Statutory requirement for retailers to display manufacturers' warranties at point of sale.
- Re-introduction of credit controls requiring a minimum deposit on purchase of consumer durables.

Fiscal

- Ecological tax reform to provide a greater economic incentive to design for longevity and improved after-sales support.
- Variable charging for household waste, with a tax on disposable nappies to encourage the use of nappy cleaning services.
- Zero-rating VAT on repair and maintenance work.
- Preferable tax treatment to encourage manufacturers to offer eco-leasing.

Voluntary

- Environmental education resources which promote the use of non-disposable nappies and washing lines.
- Government signals in economic statements that it does not wish to reinforce the acquisition and ownership culture.
- Improvements in the quality of product information and after-sales support by retailers.
- Modernising launderettes and better marketing to highlight their potential advantages.
- Launderettes offering complementary services such as child care or office equipment (to enable people to work while waiting), perhaps through partnerships.

3.6 Conclusion

The case study demonstrates that although there are a range of alternative approaches to washing clothes, those that involve outside agencies have drawbacks as well as benefits. Research suggests that if the impact of energy use is of greater concern than waste and detergent use, then higher priority should be given to policies to promote sustainable product design, eco-leasing and reduced need than a strategy of collective provision.

In summary, key factors that are crucial to ensuring the success of a service of cleaning clothes are:

- strict regulatory and fiscal measures to deter the generation of product waste

- product information to direct consumers to models designed for durability, ease of repair and upgrading
- new initiatives to develop laundry collection services
- public encouragement for the use of cotton nappies and washing lines.

Table 3A: Possible transformations in the product-service mix for washing machines

P2S type	Driver	New product-service mix	Mode of delivery to consumer	Form of practical benefit
implications	Possible level of benefit	Environmental implications	Social implications	Economic
SUSTAINABLE PRODUCT DESIGN	Industrial designers, Government	Longer lasting products	New products	Increased longevity ***
	Fewer products and less waste	Initially costlier but cheaper in long run		
COMPREHENSIVE AFTER-SALES SUPPORT	Dissatisfied consumers, customer service departments	Enhanced service quality after product sold	Product information, improved warranties, long guarantees	Products maintained for longer, parts available * Employment in repair sector, cheaper repairs
ECO-LEASING	Rental firms	Consumer pays for product use time	Product supplied via rental store	Supplier responsible for all servicing ** Potential feedback into design No capital cost but costlier in long run Stigma
COMMUNITY LAUNDERETTE	Tenants association, local authority	Product is in pooled facility in flats, village hall	Visit to location required	No purchase of appliance *** Fewer appliances, possible use of car Costlier to consumer Opportunity to meet neighbours, stigma
COMMERCIAL (HIGH STREET) LAUNDERETTE	National firms / local individuals	Product is pooled in high street facility	Visit to high street required	No purchase of appliance *** Fewer appliances, possible use of car Costlier to consumer Stigma
LAUNDRY SERVICE	Companies operating in non-domestic sector	Product not needed, or used less, as service undertaken centrally	Regular door-to-door collection	Household avoids time/ effort **** Fewer appliances, reduced energy consumption Commercially uneconomic, potential employment
NAPPY WASHING SERVICE	Environmental entrepreneurs	Purchase of serviceable (re-usable) nappies	Regular door-to-door collection	Product re-used ***** Reduction in nappy waste Employment Opportunity to discuss child care
USE OF WASHING LINES	Educational campaigns	Purchase / use of tumble driers avoided	lines for tumble driers	No purchase of appliance **** Possible prior use of faster spin speeds, fewer appliances
NEW FABRICS OR DETERGENTS	Designers, material and detergent manufacturers	Washing requirement reduced	Purchase of new product	Less frequent washing *** Less frequent use of appliances

4.0 ENERGY CASE STUDY

4.1 Introduction

In changing the product-service mix for energy, the traditional sales approach is transformed. The energy industry and energy product businesses move from an approach based on maximising sales of energy supplies to one based on selling the services provided by energy in the form of warm homes, cooked food, efficient appliances and so forth. Selling energy services provides energy suppliers with a greater incentive to increase efficiency. This transition in the corporate culture of companies within the energy sector thus enables the provision of 'energy solutions' that meet current needs whilst minimising resource consumption.

Current environmental trends indicate a requirement to reduce energy use substantially. The resources extracted, distributed and consumed for energy production are vast. Energy production, provision and use is primarily responsible for one of the dominant global problems, climate change, with major environmental, economic and social implications. Households currently account for around one quarter of Britain's total carbon dioxide emissions, a key contributor to climate change. The Government has established targets for reduction of carbon dioxide emissions, at 20% below 1990 levels by 2010.

Although Britain is currently a net energy exporter, known supplies of oil and natural gas will only last a few decades and coal is relatively costly and polluting. Renewable energy sources make up less than 1% of total energy production, although there are plans to increase its share (IEA, 1999).

The energy sector has experienced profound change in recent years through the process of privatisation. Institutions once publicly owned and structured in mostly vertically integrated supply chains (providing production, distribution and supply of power) have been split up and separated into function-based private sector companies. The electricity sector, for example, is divided into

- generators (competition is encouraged amongst a number of producers)
- transmission (maintained as a monopoly, controlled by the National Grid)
- distribution (maintained as a monopoly, controlled by Regional Electricity Companies)
- suppliers (competition is encouraged amongst electricity suppliers)

There has been a similar 'unbundling' of functions within the gas markets. There are currently 28 licensed suppliers of gas and 13 licensed electricity companies competing for customers to expand their market share.

4.2 Transforming the product-service mix

There are two paths that transformations in the product-service mix for energy may take. The first is to make supply side alterations, the second to influence consumer demand (Table 4A).

Option 1 - Change Corporate Culture

Supply side alterations in the energy sector will require changes to corporate culture, through which companies adopt the general principle that energy should be supplied as a service to the consumer at minimum economic, environmental and social cost. This would lead to the more holistic management of energy in which, prior to investment in extra productive capacity, the cost of supplying additional energy is compared with the cost of reducing the need for energy by providing energy saving measures. In circumstances where it is more efficient to invest in the latter, energy companies would provide funds or incentives to their customers to install conservation measures (providing the 'service' element). Companies operating with this form of management would measure their market power by the customer base rather than the volume of energy transferred.

There are several different terms that have been used to describe this model of energy management, including Least Cost Planning, Demand Side Management and Integrated Resource Management. Von Weisacker et al (1998) describe it as the transition from 'mega' watts to 'nega'-watts.

Historically, energy policy in Britain has encouraged the utilities to focus on increasing sales

through investment in supply rather than promoting energy conservation (McEvoy et al, 1999). Examples of supply-driven conservation efforts are scant; where projects have been operated (e.g. through the European Union SAVE project) it was concluded that the competitive nature of the liberalised UK market does not lend itself to this form of management (Jackson, 1997). Other nations have been more proactive in this area (Box 5).

Box 5: Changes in corporate culture

There are several examples of American and Canadian companies making this transition during the 1980s. Pacific Gas and Electric were one of the first companies to appreciate the business potential of managing electricity demand. They recognised that it made greater commercial sense to increase the efficiency of existing facilities and to advise their customers on improving energy efficiency than to invest in new generators and plant. By 1994, there were 3,000 programmes managing electricity in this way across the USA (OECD, 1994). Several European companies are similarly exploring the potential for transforming their business management structures. In addition, energy companies in developing countries, notably in the Asia-Pacific Region, are applying this management method to cope with the challenge of rapid growth in energy demand.

In 1993 the UK Government established the Energy Savings Trust (EST) to co-ordinate projects directed at improving energy efficiency. In addition, the Energy Efficiency Standards of Performance (SoP) scheme for electric utilities was initiated (the first scheme took place from 1994 to 1998 and the second is due to expire in March 2000). This scheme effectively obliges the regional electric utilities to spend £1 per customer in their region on energy saving measures to meet a specified energy saving target. The EST monitors the scheme to ensure that the targets are met cost effectively. It encourages change in the corporate culture of energy suppliers by stimulating the provision of a service element to energy supply. It is probable that the SoP scheme will be extended to gas utilities following the recent union of the gas and electricity regulators (OFGEM).

The form of energy service associated with this form of management strategy can occur with little participation from consumers. As such it differs from the range of further options discussed below, which encourage more long-term co-operative approaches to the business-customer relationship.

Option 2 - Energy Service Companies (ESCOs)

A second supply based product-service transformation for energy is the creation of 'Energy Service Companies' (ESCOs). ESCOs would replace the traditional format of selling energy products in their raw state (e.g. kWh of electricity) to the sale of the service that energy provides, such as 'a warm home'. There are different forms that ESCOs could take.

- Utilities as ESCOs
- Independent companies

Utilities appear to be the best candidates to take on the role of an ESCO as they currently manage the energy supply to the home. In this form they could provide customers with an energy audit, technical advice coupled with the installation of energy efficiency measures, as well as an energy supply. They could then recover their costs from the consumer over an extended period (i.e. in the form of the fuel savings generated from the efficiency measures).

Independent companies could also become ESCOs, providing customers with an energy audit, technical advice coupled with the leasing or loan finance of installation of energy efficiency measures, and advice/management of the energy supply. They would need to impose a charge, but consumers would gain by knowing that the company had no potential conflict of interest in energy supply.

Some forms of ESCO are already operational in Britain, though mainly in the industrial sector, where third party independent companies have been providing this form of service since the late 1970s under the title 'contract energy management services' (CEM). CEM provides a combined package of technical services for the energy management of a building or process

and the provision of finance for energy management investments. Following privatisation, many of the electricity utilities set up ESCOs to serve their industrial clients. ESCOs for industrial and commercial sectors have been more successful than their domestic counterparts. Owen and King (1997) warn that there is a need to be cautious; to date industrial ESCOs provide services to only a tiny part of the overall market, and most investment has been in consumption monitoring and Combined Heat and Power (CHP) rather than the provision of energy efficient equipment and building work.

Within the domestic sector there has been some progress with ESCOs in collective housing projects. Several local authorities and housing associations have expressed interest in the concept and are taking an active role in establishing this form of partnership with suppliers. Attempts to establish ESCOs for owner-occupied housing have led to pilot projects, but profitable schemes have yet to evolve. The development of ESCOs elsewhere in the European Union has followed a similar pattern (Butson, 1998).

The Energy Savings Trust plays a central role in promoting ESCOs in the domestic and small users sector in Britain. An ESCO programme has been running since 1996 and to date has supported 29 different projects (including 15 feasibility studies), run by a variety of organisations including utilities, local authorities, housing associations and private companies (examples of trials are on the EST web site).

Option 3 - Home Service Companies (HSCOs)

Home Service Companies (HSCOs) represent another possible option for transforming the product-service mix. These would provide both a home and most forms of servicing to its residents, for which a monthly fee would be paid. This fee would include a variable rate for energy, water and communication provision (which would be guaranteed at a competitive rate) and a fixed rate for the building, its maintenance and general services such as security, laundry and cleaning. If clustered together, the properties could be provided with recycling and composting facilities and have access to a number of pooled resources (e.g. IT equipment, work tools, exercise equipment). In blocks of flats or housing estates there might be the potential for HSCOs to incorporate Combined Heat and Power (CHP) or renewable energy generation into the service provision, although there is uncertainty as to whether it is legal to tie consumers down to one supplier in this way. Such companies would most probably be developed by entrepreneurs in the property development sector working in partnership with building societies, property owners, construction companies, utilities or tenants. An HSCO project is currently being developed and piloted by the University of Hannover (Box 6). Researchers there are using a specially constructed pilot housing development, which forms part of the EXPO 2000 event, to explore the potential for combining a series of relevant projects, including heat services, water services, cooling services, washing services, mobility services and short term tool leasing (Schrader, 1996).

HSCOs' properties could also be fitted with 'smart' meters positioned strategically to display real time information on the household's monthly energy, water and communications use, including projected costs. Cost structures could be banded to make peak loads more expensive. The information could be downloaded onto a home computer, where it could be used with software packages designed to improve home management. For example, the data could be inserted into Going for Green's Eco-Cal programme that identifies potential environmental improvements, or into finance management software to enable good household budgeting and facilitate appropriate investment decisions. The smart meters could be linked to a central computer that would calculate itemised monthly bills; these could contain advice on

how to reduce consumption whilst maintaining comfort, thus providing effective feedback to consumers.

These kind of interactive services would enhance the potential for direct energy savings achievable through an Energy Service Company. An HSCO would profit from optimal resource use and householder satisfaction and would therefore have an incentive to increase resource efficiency, providing services at minimum cost. The visibility of consumption and costs to the consumer adds a vital element.

Option 4 - Design Solutions

The above options offer significant potential to reduce energy consumption, by more efficiently delivering energy to meet needs. An alternative approach is to provide product-service mixes that eliminate or reduce the need for energy.

One option is to focus on design solutions for products or buildings. Design is a service that adds value to products. Product design solutions can be introduced alongside other energy services or independently. Many products can be designed to fulfil needs adequately, whilst minimising energy use (Boardman, 1997). Over recent years considerable advances have been made in improving the energy efficiency of domestic appliances such as washing machines and refrigeration equipment. There are also examples of products for which energy requirements have been more dramatically reduced or eliminated via design solutions, such as the wind-up radio and torch, the development of very low energy refrigerators, the redesign of the energy-less larder, and solar operated products.

Similarly energy conscious building design can considerably reduce the demand for energy by making optimal use of passive solar energy, conservation measures and high efficiency. Since 1995 it has been compulsory that all new domestic buildings comply with the Standard Assessment Procedure (SAP), ratings which provide an indication of the energy use efficiency of space and water heating.

It is important at the design phase to consider the energy requirement (and other environmental impacts) of products used for improving the energy efficiency process (e.g. in insulation materials), in order to ensure that proposed solutions are indeed optimal.

Option 5 - Eco-Leasing of Energy Products

A final option is to develop eco-leasing for energy products such as boilers, central heating systems, solar panels, community wind generators, cookers and refrigerators. This could allow advances in energy efficiency and technology to be adopted more rapidly and in the most environmentally beneficial way. Companies would compete to provide the consumer with the most effective technology, while minimising changes to products through advances in modular design and improved repair and recycling technologies.

Eco-leased energy generating products would enable each household to create its own energy supply. The eco-leasing of solar panels may be a particularly attractive option as they have a long life span, are becoming increasingly efficient, and in financial terms are viewed as a 'safe' investment. Japan and the USA (especially California) have been pro-active in offering subsidised solar finance packages, although there are not yet known to be companies offering an eco-leasing service. Within Britain, one company, Solar Century, offers customers financial

services in conjunction with National Westminster Bank through the re-mortgaging of the property. Advances in fuel cell technology that allow energy to be stored are being made which, if successful, will make solar power more attractive.

4.3 The scale of potential benefits (environmental, economic and social sustainability)

Environmental benefits

There are potentially considerable sustainability gains and win-win scenarios to exploit by transferring to a service-based energy system. The environmental impact associated with the energy production chain is minimised, including climate change contributions, other emissions, resource depletion, and waste. There remains much potential for improvement. Recent research suggests that almost 75% of homes are 'poor' or 'very poor' in terms of energy efficiency; out of 15 possible conservation measures the average home had only 8 in place (LEAC, 1996). An earlier report (MINTEL, 1992) indicated that there was potential to reduce the annual total expenditure on energy in the average home by roughly 41% through conservation measures, equivalent to £278 p.a. The EST estimated in 1997 that the domestic sector could make annual energy savings of over 85TWh by 2010 by investing a mere 2% of the total amount spent on domestic energy consumption each year.

It is not possible to calculate with any accuracy the potential contribution of a new product-service mix to reduced energy consumption, as this would depend on a multitude of complex factors such as uptake and technological progress. There is, however, little doubt that more effective energy service provision could raise the efficiency of domestic energy use to a considerable degree.

Economic and social benefits

There are also economic benefits. The consumer gains as most energy saving services will provide financial rewards. Industry benefits as many of the options provide a closer knowledge of the consumer, the development of new business partnerships, and opportunities for growth. Suppliers gain competitive advantage resulting from enhanced reputation and greater profit where rewards are higher from efficiency measures than supply. Distributors also gain, as the pressure on the production and distribution network is reduced. The national economy is improved as dependency on energy imports is reduced and susceptibility to energy price fluctuations minimised. In addition, unnecessary power station and distribution network construction is avoided. There may also be positive employment implications, as providing energy services often involves greater labour intensity (especially at the customer interface) and requires local trades-people (e.g. for fitting energy efficiency equipment).

There may also be social gains, as the energy generators will less often have to construct new plant and face the threat of contentious planning disputes. Energy services generally have wide-ranging applicability. As ESCOs arrange for all efficiency measures to be installed and enable repayment over extended periods, they are appropriate for all consumers, including those who are less educated or on low incomes and thus need greater support. The information-based approach provided by HSCOs will provide customers with real time billing and thus enable them to manage their household services efficiently.

4.4 Barriers to change

The limited progress made to date in transforming the product-service mix for energy in the domestic sector can be attributed to the following factors.

Economic

The separation of the utility from generators and distributors in Britain has produced a situation in which there is little financial incentive to reduce total energy consumption, as the generator has no contact with the supplier. The only exception to this is that the distributor could benefit financially from improved supply management.

Energy Service Companies setting up in the domestic sector face a number of financial obstacles. Setting up such a company is a potentially lengthy and expensive process, requiring high level investment, innovative thinking, flexibility and creative marketing (Home Service Companies face similar, perhaps even greater, problems). Domestic contracts do not provide the economies of scale offered by industrial contracts and the margins of profit per unit are currently low (and so do not in themselves represent a viable business proposition). ESCOs must therefore operate as a tool for attracting new customers or retaining existing customers on the basis of offering 'value added' services. As they operate with high initial overheads (assuming measures are installed with finance packages) and these are only recouped over an extended period, suppliers may experience a high level of initial risk relative to the rate of return. Non-supplier based ESCOs have to cover additional overheads.

In particular, the cost structure faced by energy suppliers is unhelpful. They currently pay the distributors a combined 'fixed' and 'variable' fee for the use of the energy distribution network; the fixed fee element is disproportionately large and unrelated to the amount of energy supplied. This arrangement means that suppliers have less incentive to reduce the total energy purchased from distributors because such a reduction will not result in a proportional reduction in cost.

The financial viability of ESCOs is also hindered by energy prices that are too low to encourage consumers to have energy efficiency measures installed. The deregulation of the electric and gas markets has led to increasing competition and prices are being lowered further, exacerbating the situation. Consumers are thus receiving mixed messages - falling prices imply abundance and yet they are encouraged to 'save' energy. In addition, current VAT arrangements continue to favour energy consumption compared with energy efficiency. Moreover, fluctuations in energy prices make it difficult for companies to calculate the payback period when investing in both energy supply and energy efficiency. Managers of businesses involved in product-service transformations must therefore anticipate carefully and build flexibility into their plans.

The private rented sector raises particular problems, as landlords currently have little financial interest in the installation of energy savings measures, while tenants are usually unwilling to invest in such measures as tenancies are often shorter than the payback period of the investment.

Eco-leasing arrangements for energy generating and saving products require businesses to think differently about the way in which they operate and the method by which profits are accrued. They also require pre-investment by suppliers. Smaller businesses in particular may not have the financial resources to invest in such a transition.

Cultural

It is anticipated that the volume of energy consumed in Britain could rise by as much as 6 TWh by 2010 (Boardman, 1997). In general, people do not believe that there is any kind of major energy crisis. The fact that the energy efficiency of household appliances is improving may give them the impression that there is no need to be concerned. This may act as a barrier to the realisation of product-service transformations.

Research by Northern Electric suggests that a lack of demand from consumers for energy services is one of the central barriers to the establishment of domestic ESCOs. Consumers lacked awareness of the direct relationship between energy consumption and environmental damage, and showed little enthusiasm for energy conservation. Market research commissioned by the EST found that energy saving measures had to offer significant savings before they were deemed 'worth the hassle'. In order to appreciate the value of energy services, households need regular feedback on their consumption. Current domestic metering arrangements do not provide the level of sophistication required (Owen and King, 1997).

Short-term thinking is a particular problem. MINTEL (1997) found that only 23% of those interviewed would be prepared to wait more than three years for a return on their investment in an energy saving product. There were 17% of respondents who simply did not know what sort of time period to expect. The report concluded that consumers want more independent advice on energy efficiency and information on selecting energy efficient products (although even when energy information labels are provided these are often ignored).

People give high priority to home ownership; owner-occupied housing accounts for over two-thirds of housing. It may be difficult to attract customers to Home Service Companies when properties are leased or rented.

Finally, consumers may well be cynical about the motive of utilities that provide energy efficiency as part of their added value services and thus be wary of any offer.

Technical

The current regulatory framework allows consumers to change supplier every 28 days. Utilities are therefore under pressure to attract new customers, which has led to strong price competition and the use of gimmicks (such as air miles and mobile phone points) rather than the promotion of long-term energy efficiency. Energy suppliers have highlighted the 28-day rule as the key regulatory barrier to ESCOs. An ESCO cannot afford the risk of losing customers to competitors after installing efficiency measures into their homes and this explains why financial packages in most ESCOs are limited to personal loans.

Current legislation does not make clear whether local authorities have the power to develop ESCOs and trade in energy efficiency. Even so, several local authorities are developing imaginative partnerships with energy suppliers for housing projects and other similar schemes. This uncertainty is a critical obstacle to the development of ESCOs in a potentially receptive market.

The EST anticipates that a reduction in price differentials will, in due course, lead suppliers to compete for new customers using more substantial added value services such as ESCOs. It believes that the current lack of suppliers piloting ESCOs can be attributed to short-term

thinking rather than lack of interest.

It is unclear how the institutional arrangements of HSCOs would operate but, in theory, problems could arise if companies were unable to require a minimum length of service contract in order to cover their initial investment costs.

4.5 Solutions

Many opportunities to improve energy efficiency are well documented, and yet the perceived level of benefit is often not regarded as sufficient to take action. Strategies to overcome the barriers to product-service transformations in the domestic energy sector are documented below.

Fiscal

- Taxation on energy should be increased and that on energy efficiency equipment reduced
- Additional public funding should be provided to promote the aims of the EST and to support the development of ESCOs and HSCOs
- A range of financial incentives to encourage energy services should be considered

Internalising the external costs of energy supply would alter the framework in which energy suppliers operate. This approach is currently being developed in the form of the climate change levy. Broadening its scope to encompass domestic users and reducing the tax burden on energy efficiency equipment are two of the more obvious ways to increase the viability of domestic energy services. This would clearly have considerable social and political implications, and safety nets must be provided to ensure that fuel poverty is alleviated. Low income households would need financial compensation, and projects such as the Home Energy Efficiency Scheme (HEES) - which provide them with advice and grants for insulation and energy efficient products - would have a vital role in ensuring social sustainability. Timing issues are crucial here, to avoid adverse effects on vulnerable households (Boardman et al, 1999).

The EST needs increased public funding to improve its work in stimulating the market for energy efficient products and the development of ESCOs, including increased advertising. As the ideal 'blueprint' for the domestic ESCO does not yet exist, exploration of various formats and financing arrangements must continue. Direct financial support for the development of future ESCOs through the EST is essential, as energy suppliers and other parties such as local authorities are unlikely to be in a position to initiate pilot projects because of the financial risks. Similarly, public funding for pilot studies of HSCOs would enable the feasibility of this option to be tested.

Energy regulators need to consider how change could be made to the current situation in which suppliers give bulk energy buyers discounted prices. The potential for a reverse strategy, with energy prices gradually lowered as use decreases, needs to be explored. One possibility is to establish benchmarks for various business and building classifications. A German scheme currently puts an additional levy on domestic consumers using in excess of 6,000 kWh per year.

Various other financial incentives could be offered to encourage energy services in the domestic sector. Examples include low interest loans for energy efficiency investments,

sponsorship for research, and rewards for companies who supply less electricity per household than their competitors (perhaps in the form of a tax relief or a lump sum). Third party financing and co-operative partnerships are other possible instruments for overcoming investment barriers (Hennicke, 1998).

Regulatory

- A more stable market for ESCOs should be provided by amending the 28-day rule
- Product information on energy needs to be improved and minimum standards introduced for a wide range of products
- The SoP levy should be increased to encourage suppliers to spend more on energy efficiency

ESCOs require a more stable energy market and the opportunity to build long-term relationships with their customers. In order to achieve this the problems raised by the 28-day rule need to be addressed. The safeguards for energy supply debts that exist in current licensing arrangements should be extended to cover debts for energy efficiency services supplied. Consumers should not be able to switch supplier until outstanding debts are paid, whether for energy supplied or energy efficiency investments.

In order to make ESCOs more attractive, OFGEM should require energy distributors to terminate - or at least reduce - the 'fixed' fee element, so that such companies would pay primarily for the amount of energy supplied. This would make it more economically rational to reduce the flow of energy through the network.

Improved information on energy for consumers is necessary. New regulatory measures should require mandatory energy labels for more domestic appliances and designate minimum energy efficiency standards for products in addition to refrigerators and freezers. The existing regulations on energy labelling should be better enforced. Consumers could also be entitled to receive independent information at the point of sale on the estimated life cycle cost of household appliances.

The Standards of Performance (SoP) scheme should be continued, to ensure that improvements in energy efficiency are maintained and, with the recent union of the two regulators, extended to gas. The Government should use its power to propose energy savings targets and increase the levy per person.

The Government should clarify legislation with regard to the power of local authorities to invest in the energy efficiency of their housing stock. Some improvements are drafted into the current Local Authority Bill, but further clarification is needed. Regulation could also be extended to allow local authorities to ensure that privately rented housing has a minimum level of energy efficiency.

Voluntary

- High quality public information campaigns on the environmental impact of energy should be introduced to promote consumer awareness
- Retailers should provide information with appliances to enable consumers to understand payback periods and potential savings
- ESCOs and HSCOs need to develop convenient and informative billing systems, expand their activities, and market their services effectively

Measures to improve consumer awareness of the impact of energy consumption and waste are needed alongside the internalisation of these costs in the price of energy. Better national advertising and education campaigns promoted by independent bodies, such as the EST or DETR, are required. These should aim to raise awareness by addressing the direct relationship between energy use and environmental damage, and seek to generate more response from consumers.

Consumers also need a better understanding of payback periods and potential energy cost savings over specified time periods. These could then be given greater transparency in retail outlets. It is also important to prevent a rebound or substitute effect once energy use has been reduced. Technological advance and consumer awareness must be thus raised simultaneously.

Advertising that emphasises the positive aspects of a service package such as convenience and comfort is likely to be better received than the suggestion that energy services require some form of sacrifice (OECD, 1994).

The success of ESCOs is reliant on the stimulation of market demand for energy efficiency services, but they must also seek to create a market for their services. They need to inform consumers of their motive for improving energy efficiency in order to avoid consumer mistrust. They should offer consumers a comprehensive and flexible package of services, perhaps combining efficiency measures with safety checks and a convenient single billing system (with exact details of expenditure in order to ensure transparency and accountability). Bills could in due course include information regarding the source of the energy and the environmental impact of its production and consumption, in order to improve consumer awareness and provide consumers with benchmarks for setting their own efficiency targets. Likewise HSCOs need to develop a market development strategy.

The work of the Energy Efficiency Best Practice Programme (EEBPP) and other programmes that support energy efficiency are important. The expansion of the EST into a new 'Sustainable Energy Agency', advocated by the Green Alliance (ENDS, 1999) could facilitate a more comprehensive approach to energy efficiency and energy services, incorporating renewable energy, industrial energy efficiency, transport efficiency and CHP. This might benefit energy service providers as their work would be better integrated into the wider energy sector.

4.6 Conclusions

The case study indicates that there are viable alternatives to the current product-service mix for energy that could generate economic, environmental and social benefits. In theory, companies could gain profitability from selling energy efficiency services while providing more long-term stability to the energy market. However the potential for success for many of the options is limited in the current financial climate, as real energy prices fall and efficiency measures become less viable.

In summary, key factors that are crucial to ensuring the success of energy services are

- increased co-operation between previously isolated business enterprises based on mutual support and reward
- the need to introduce measures to ensure that the company profitability from energy

- efficiency exceeds that from energy supply
- the introduction of revenue-neutral carbon tax on domestic as well as industrial consumers with a safety net for low income households
- improved visibility in price and cost structures, eventually to include the increased use of visual displays of metered energy use in households and billing disaggregated by appliance type

Table 4A: Possible transformations in the product-service mix for energy

P2S type	Driver	New product-service mix	Mode of delivery to consumer	Form of practical benefit
Social implications	Level of benefit	Environmental implications	Economic implications	
CORPORATE CULTURE CHANGE	Utilities	Review of investment priorities	Business	Efficiency
measures considered in plant investment decision making	**	Improved sense of responsibility	Increased efficiency; fewer new plants	Long run economically rational decisions
ENERGY SERVICE COMPANIES (ESCO)	Utilities, entrepreneurs, local authorities	Consumer		
provided with energy service based on combined supply and efficiency measures; sale of energy service rather than kWh	Housing Associations, industry contracts	Distribution and use efficiency. Improved housing stock; Utilities avoid unnecessary expenditure on plant and grid.	***	Increased energy use efficiency; reduced depletion of non-renewable energy sources and reduced air emissions; fewer new power stations and associated infrastructure
	Lower bills once investment pay back completed;	employment increase		Better temperature regulation and reduced draughts
HOME SERVICE COMPANIES (HSCO)	Entrepreneurs, property developers	HSCOs provide all required home services to customers (home, water, electricity, gas and possibly cleaning, laundry and security etc.)	***	
	Business contract	Corporate incentive to provide all services using least resources		Increased efficiency in the provision of all home services
	Employment increase	Improved awareness of environmental impacts		
DESIGN SOLUTIONS	R&D managers	Needs met without use of energy or by reducing energy requirement of products	Via service sector	Less energy used; products more efficient
	****	Increased energy use efficiency; reduced depletion of non-renewable energy sources and reduced air emissions; energy metering on products may lead to behavioural change	Consumers benefits from lower running costs	
ECO-LEASING OF ENERGY PRODUCTS	Entrepreneurs	Consumer pays for eco-lease of products	***	Closed materials loop and reduced waste through servicing
	Business	Producer maintains responsibility		Relationship with customer over life time of product; opportunity to encourage loyalty; employment

5.0 TRANSPORT CASE STUDY

5.1 Introduction

The product within the transport system is the vehicle, together with the track infrastructure, but the desired need that is fulfilled is access, through mobility. This is in turn generally required for a further, unrelated goal in another place (e.g. employment, shopping or social events). Transformations in the product-service mix for transport are directed at achieving these goals more efficiently, reducing the mobility requirement or eliminating it altogether.

Transport is a contentious issue within the sustainability debate. The use of private cars is a particular concern. A quarter of all households now have access to two or more cars. In the forty years up to 1996 the average number of passenger-kilometres driven by car per year increased from 91bn to 620bn. During the same period rail travel decreased from 40 to 38 billion passenger kilometres, and bus and coach from 89 to 44 billion passenger kilometres (DETR, 1998b). The Environmental Transport Association (ETA) estimate the external cost of motoring to be £51bn per annum, £2bn of which relates to road damage and £49bn to

environmental damage (ETA, 1999).

The transport infrastructure is owned and operated by different bodies. The Government currently pays for most road construction and maintenance through taxation; in 1998 this amounted to £1.3bn on the trunk and motorway network and £3bn on local transport networks. The rail track networks are partly subsidised by Government. In addition public transport carriers are partly subsidised; in 1998 subsidies amounted to around £1bn for bus services and £1.6bn for rail services (DETR, 1998a).

The proposed European Union End-of-Life Vehicles Directive, currently still in draft form, would introduce the principle of producer responsibility for vehicles and set targets for recycling. However Britain appears to be following Germany's lead in seeking to weaken the requirements.

5.2 Transforming the product-service mix

There are a multitude of possible product-service options to mitigate the current environmental impacts of transport. These include measures to improve the efficiency of vehicles and close the 'materials loop', enhancing existing services operating in the transport sector, and other options which may reduce the demand to travel (Table 5A).

Option 1 - Enhanced Maintenance and Repair Services

In order to operate efficiently and with minimal environmental impact, vehicles require regular maintenance and, when necessary, appropriate repair. Routine maintenance work ensures the vehicle's optimum performance and prevents premature deterioration. Normally, the manufacturer specifies the frequency and nature of maintenance service requirements. These services could be enhanced to improve the general performance of the current vehicle fleet.

Currently the state of vehicles on the road is controlled in two ways, by the general observation of traffic police authorities and by the requirement for cars over three years old to undergo an annual MOT. There is currently no legal requirement to undergo the service schedule advised by the car manufacturer. In the UK the total market for servicing and repair of cars in 1997 was estimated to be worth £8,975 million (MINTEL, 1998b), although statistics on vehicle repair work are problematic as many garages operate car sales alongside repair and therefore are not included in DTI retail trade statistics for repair. Vehicle maintenance and repair services are operated by a variety of businesses ranging from large garages (which may hold a franchise with a manufacturer) to garages specialising in specific services, small family run garages and self-employed mechanics. Some consumers undertake their own vehicle servicing.

There is a uncertainty over the size of the DIY or 'self-service' market. Whilst some reports identify it as a growth market, on account of the increased sales of parts from 'spares' shops, others suggest that DIY servicing is in decline and more car owners are using independent garages and franchised dealers for the maintenance of their vehicles. The proportion of motorists who have not had their car serviced has fallen, suggesting that the vehicle fleet as a whole is being better maintained. There is, however, concern that British consumers are relying too heavily on service professionals for the simplest car maintenance. A study (for *Motor Trader* magazine) found that 36% of cars surveyed were running light on oil and 13% were on the minimum level.

It is also important to conduct regular maintenance and repair work of transport

infrastructures, which contribute significantly to the environmental impact of the mobility process.

Option 2 - Eco-Leasing of Vehicles

The leasing of vehicles by companies and individuals is common, as is short-term rental. Traditional forms of vehicle leasing are conducted via third party financial service companies. Most companies operating traditional lease agreements restrict their services to vehicles under five years old and with a fixed mileage. Vehicles exceeding these limits are either sold to the customer or auctioned.

This form of leasing may well encourage wider ownership of new and 'nearly new' cars by making such vehicles more affordable; for example, the 'nearly new' car leasing market in the UK grew 51% from 1996 to 1997. In addition, new finance products including personal leasing and deferred purchase schemes reduce the short term finance costs and are encouraging a higher proportion of motorists to buy new cars rather than nearly-new cars. It is likely that these forms of leasing speed up material flows and contribute to greater environmental damage - as at present car technology is improving only slowly and is largely outweighed by increases in vehicle size and power.

This trend is not just applicable to cars. The flight company Lufthansa currently leases its fleet in order to maintain up to the minute technology. Although this means that they can take advantage of efficiency gains, there are considerable waste implications.

As noted above, 'eco-leasing' is somewhat different to a traditional vehicle leasing arrangement. In particular, the manufacturer retains ownership and is therefore responsible for the vehicle's ultimate disposal. This is particularly significant in the context of the EU Directive on End-of Life Vehicles, which from 2006 will require producers to recycle cars manufactured after 2001 at the end of their lives. Eco-leasing is suited both to domestic and business users, and could operate for all forms of transport (i.e. from bike to boat).

Several companies are starting to test a few ideas relating to eco-leasing, such as replacing vehicle sales with the sale of 'tens of thousands of kilometres driven' (Box 6). Companies such as Volvo, Vauxhall and Ford are beginning to consider themselves as sellers of mobility services rather than vehicles. Although this approach is still in its infancy, it indicates recognition of a movement towards producer responsibility and the potential business value of a service provision ideology.

Box 6: 'Charter Way'

Since 1992, Mercedes Benz has been running a scheme for truck users that is trade marked 'Charter Way'. It takes the form of a long term leasing arrangement allowing consumers to purchase individual packages of 'transportation capacity' (defined by time or mileage) instead of buying and owning the truck / hardware. This means that customers do not have to think about the insurance, taxes and maintenance and can concentrate on their business. In addition, because the fixed costs of the vehicle are reduced, economic comparison with alternative transport arrangements becomes easier, encouraging more efficient resource use.

Source: European Partners for the Environment, 1996

Option 3 - Collective Vehicle Services

There are several manifestations of collective vehicle services. Whilst this is a relatively new

area of interest and some concepts are still in their infancy, the following definitions have been chosen to reflect the potential services provided, in the light of work carried out to date in this area. The assumption underlying collective vehicle services is that ownership or long term possession of the same vehicle is not necessary as long as a person can have access to the use of a vehicle when mobility is needed (Box 7).

The first of these services is short term '**vehicle rental**', the traditional form of collective vehicle service where a vehicle is available for use by a number of different users in succession. Vehicle rental is conducted via a single transaction, a one-off payment providing the consumer with short-term use of a vehicle (typically up to 30 days).

The second is '**vehicle sharing**', where a vehicle is available for use by a number of different users in succession. Vehicle sharing involves the consumer either sharing the cost of ownership with family or friends or becoming a member of a vehicle share organisation. Most schemes involve the shared use of a car - however the concept could be equally applicable to other vehicles (e.g. lorries, vans).

The business format of current 'car share' schemes are varied; they include small-scale shared ownership and use of a single vehicle amongst friends, local co-operatives or non-profit organisations, and large-scale commercial organisations offering a range of services and vehicle types. Most car share schemes operate by charging members a fixed membership fee and a variable fee for the use of the organisation's vehicle based on time and/or mileage. Bookings are made by telephone or through the Internet. The cars are parked at 'car stations' in central locations for easy access. Entry into the vehicle is gained either by keys stored in a security box near to the car station, or - where technology is more advanced - 'smart cards' are used to operate onboard computers that calculate billing and report this and other information to a central computer.

Vehicle rental and vehicle sharing offer the consumer different services. Vehicle rental companies often operate larger businesses from out of town locations, catering for tourists, accident replacement cars and business use, with fees paid per day of rental, while vehicle share schemes offer customers a local service providing short-term use of vehicles for smaller journeys (often available at an hourly rate). This differentiation is becoming less pronounced as many car share organisations are forming partnerships with car rental companies, for example both AVIS and Hertz participate in schemes in Germany, and Willhire and Budget are involved with schemes in the UK.

A third service is '**ride sharing**', where the consumer is either the passenger or the driver of a vehicle in which any spare seats are made available for others to use via a booking service. The business format of ride sharing schemes is varied. They include informal ride sharing between friends, works organised ride sharing between employees and formal services operated by ride sharing companies. These latter businesses operate a controlled pricing scheme currently set by National Car Share at £1 per journey flat rate plus 10p per mile. Members have to undergo a security vetting process and are able to specify which gender they are willing to share rides with. Ride shares are arranged for both regular travel (such as work lifts) and one-off, possibly long distance, journeys.

Box 7: Examples of 'Collective Vehicle Services'

Vehicle rental

The car rental market is a global business, with many companies operating large scale international franchises. In the UK the vehicle rental market is growing, experiencing an increase in turnover from £2,643 million in 1992 to £3,745 million in 1996 (ONS, 1996). The key players are AVIS, Republic and Hertz, who share 42% of the total UK market (MINTEL, 1998d). Many vehicle rental company fleets seek to optimise business opportunities by establishing themselves in the proximity of other transport providers, e.g. airports.

Vehicle sharing

The concept of Vehicle / Car Sharing has evolved gradually in various countries since the 1970s. One of the most successful Car Sharing Organisation (CSO) is the Swiss scheme 'Mobility Car Sharing' based in Zurich, which has developed from a small grass roots operation into the world's largest CSO with 700 locations, 1,200 cars and 25,000 members. CSOs now operate in Germany (e.g. StadtAuto GmbH in Berlin have a total of 4,000 members sharing 170 vehicles of nine different models), the Netherlands (e.g. Call-a-car which offers doorstep delivery), Denmark (Hertz Delebelin), Austria (Easydrive CarSharing GmbH), Singapore (e.g. Car Co-op), the US and Canada (e.g. AutoShare, CommunAuto), France, Ireland, Italy, Norway, Sweden and the UK.

The CSOs operating in the UK are still in their infancy, located in Leeds, Milton Keynes and Edinburgh. The Leeds and Milton Keynes schemes are currently running on a single car basis but are looking to expand. Cranfield University successfully operated a car-share scheme from 1997 to 1999. A new project in Sheffield linked to a housing estate was announced in late 1999.

The company Smart Moves was launched in 1998 as a not-for-profit organisation facilitating car-share scheme projects within UK communities (Smart Moves, 1999). They are developing eight different working models of car-share groups, exploring which business frameworks operate most effectively.

Ride sharing

There are organisations co-ordinating 'Ride Sharing' services at national level in many European countries; Mitzfahrzentralen in Germany arranges over 1.5 shared lifts each year, Autostop operates in France, taxistop in Belgium, Sharcom in Switzerland, and in the UK there are two ride share schemes called Freewheelers and (rather confusingly) National Car Share. The UK schemes currently operate via the Internet. National Car Share is currently setting up a sophisticated telephone system to increase the flexibility of this service.

Sources: Various Internet sites

Option 4 - Integrated Transport Services

Improving the efficiency of transport systems is a global priority. There is currently substantial research and development effort directed towards developing more sophisticated infrastructure and transport systems. Eco-leasing and collective vehicle services may reduce the current excess of vehicles and the environmental problems associated with their use and disposal. However their use in isolation will not be adequate. It is necessary to look beyond individual vehicle use to alter the format of supply by providing Integrated Transport Services (ITS), which offer the same level of mobility with greater efficiency and hence less environmental impact. Integrated Transport Services enhance existing transport systems by improving the 'chain of mobility', making the linkages between and within transport systems more efficient and increasing the flexibility and attractiveness of public transport service options. At the same time, the comfort, access and reliability of current public transport services need to be addressed for maximum impact.

Current examples of ITS are in operation throughout Europe (Box 8). Transport Service Companies (TSCs) are potential providers of ITS, although the concept is still in the design phase and further research is needed to gauge its financial viability (McLaren, 1999). A TSC would offer its customers access to integrated transport services in a one-payment package. Customers would pay a monthly fee for a complete transport service which would incorporate access to shared vehicles, a monthly season ticket for all forms of public transport in the local area, discounted rates on national travel, and occasional free or discounted access to the facilities of other Transport Service Companies or transport providers operating in other regions (via partnership agreements). Customers of a Transport Service Company would be supported by access to a 24-hour telephone and internet information service which would

provide advice and booking services and would have complete insurance, recovery and rescue cover. To be viable, the cost of membership to the scheme would need to be competitive with the average cost of monthly vehicle lease arrangements.

Box 8: Examples of 'Integrated Transport Services'

The 'Combined Ticket'

The first step towards integrating transport systems and increasing their convenience is the combined ticket, which allows several journeys to be taken using different modes of transport. The most common form of combined ticketing is for bus and train journeys in a stated area over a week or month. Other examples include train tickets with the taxi fare to and from the final destination included. Combined ticket systems are available in most European cities; there are also a number of examples of regional level schemes.

The 'Station Car'

In an increasing number of major cities CSOs and/or car rental companies have formed partnerships with railway companies to integrate rail and car networks. For example, the car rental group AVIS Europe plc have established partnerships with SNCF and Deutsche Bahn, and the CarShare company (Swiss) have cars available at several stations. This 'station car' concept is also being tested in the USA, with field trials at the Dublin/Pleasanton BART in San Francisco station.

The 'Mobil-card'

The German CarShare company StattAuto in Berlin have taken the above ITS concepts a step further. Their customers purchase a 'Mobil-card' which allows them access to the shared car fleet, cash-free payment in taxis, free cycle hire and free monthly use of all public transport such as buses, city trains and subway.

This organisation is among the most advanced in its use of electronics - in co-operation with Mercedes Benz, a microchip ("touch-key") is being developed which will allow the access to shared-cars without users first having to go and get the keys at a special safe. Additionally, it will allow automatic, electronic, invoicing of miles driven and time used. It also has good links with other organisations. At several train stations in Germany the Bundesbahn provides parking spaces for car-sharing organisations and allows the setting up of information and publicity stands within the train station's buildings. Overall, car-use by StattAuto members is down 50%, and car-ownership is down 80%.

Sources: Various Internet sites

Option 5 - Need-related Service Solutions

Integrated Transport Services could provide considerable environmental savings in comparison to individual vehicle use, but the objective is mainly supplying in order to meet demand. By contrast, the most environmentally effective product-service options for transport are those that eliminate or reduce transport demand.

There are two product-service options in particular that could successfully substitute transport services

- Information Technology Service Solutions
- Local Service Solutions

Information Technology Service Solutions can either operate with transport services or independently. When operating in conjunction with transport services, information technology can be used to manage - and thereby reduce - demand by ensuring the optimal use of transport carriers. For example, freight and public transport companies can use advanced information services to improve the efficiency of their logistic and distribution activities. Information databases could also be useful for a variety of transport reduction services such as sourcing local suppliers, setting up green commuter plans (which both encourage ride sharing and stagger work start and finish times), and providing access to real time information on public transport. When operating independently, information technology services can offer

direct competition to transport services. For example, teleworking and teleconferencing avoid commuting and business travel but can achieve the same overall goal.

Local Service Solutions eliminate the need to travel by changing the infrastructure that makes transport services necessary. This form of strategy does not represent a direct substitute to transport but a substitute to the further goal which transport is used to achieve. For example, integrated community planning can be used to ensure that the majority of consumers have safe pedestrian and cycle access to frequently used facilities (e.g. clinics, schools, leisure centres), therefore allowing the goals of health, education and leisure to be achieved without the need for transport. Urban planning within many European countries is now changing to accommodate these principles. For example, plans for 'out of town' shopping and entertainment centres are being blocked and in several German, Dutch and British cities, car-free communities have been developed. These provide a housing area free from traffic, which can only be purchased (or rented) by those who either have no car or are willing to give their car up.

5.3 The scale of potential benefits (environmental, economic and social sustainability)

Environmental benefits

There are many potential sustainability gains and win-win scenarios to exploit from transforming the product-service mix for transport. Environmental improvements accompany each of the possibilities discussed, with options 4 and 5 likely to be most advantageous. Improved maintenance and repair services should ensure that vehicles operate safely and at optimal efficiency, which extends the possible life span of the vehicle. If linked with eco-leasing, the resource gains increase further, as this would encourage more component standardisation that should facilitate easier repair work and the closure of material loops. Collective vehicle services such as car and ride sharing encourages greater intensity of vehicle use, which facilitates optimal use as the vehicle wears out more rapidly and therefore does not fall too far behind improvements made in energy efficiency). Integrated Transport Services are likely to reduce unnecessary journeys, while need-related solutions offer the potential for even greater environmental gains. Each of the options is associated with reductions in pollution and waste and the prevention of unnecessary infrastructure developments. This provides new opportunities to develop land previously required for parking, roads and other transport-related developments into more useful community areas.

It is important to ensure that the energy and resource requirements of transport alternatives are given consideration (e.g. energy use, resources and waste associated with transport avoidance strategies). The need to evaluate the environmental effects of alternatives to current transport options has been argued by Te Riele (1997), whose research highlights the deficit of information available on the environmental impact of services. For example, teleshopping can reduce shopping trips but may increase the number of journeys per individual product transaction, as with the growth in sales of individually packaged and transported books and CDs from the US to the UK home market. It is therefore imperative that the distances between service interactions are reduced and the volume of freight minimised (Ellger and Scheiner, 1997).

There is limited quantitative research on the environmental benefits of the transformations in the product-service mix for transport. It is difficult to estimate the overall environmental savings without considerable further research to look in depth at each of the options. One

exception is car sharing. Car sharing schemes have been evaluated and results indicate that they have a significant impact on reducing vehicle numbers and decreasing car mileage per year (e.g. Muheim, 1992; Baum and Pesch, 1994; Meijkamp, 1998). Steininger (1996) found that car sharing organisation members who were previously car owners reduced their total annual average use from 5075.4km to 3931.9km. The number of cars per person in most car-sharing organisations is 1 vehicle per 15 members. Even if only a small percentage of the UK had operational car sharing organisations, the environmental savings could be substantial.

Economic and social benefits

In economic terms all options have the potential to be operated profitably for varied markets (freight, business and domestic use), offering new business opportunities for both existing companies and entrepreneurs. The changes in business structures could also lead to employment opportunities, as the service element requires greater human interaction (administration, co-ordination and technical inputs). Increased contact between business and consumer may facilitate greater customer awareness, with potential for improved customer loyalty and competitive advantage. By offering more flexibility between transport options, there may be business benefits to other transport service providers. For example, car share members use public transport more frequently than car owners do. In addition, improvements in the competitiveness of public transport options would open up new markets to innovative service companies operating at transport interchange locations.

All of the product-service transformations have social benefits. Car and ride sharing will encourage social interaction at community level. Investment in alternatives to the private vehicle will improve the social equality of mobility, as all income groups thereby benefit from increased accessibility and efficiency. There are also indirect benefits to society in the form of an improved urban environment and better life quality (via reductions in accidents, noise and parked cars). On the negative side, tele-commuting may result in people undertaking much of their work in isolation from colleagues.

In addition, these options can provide individual consumers not only considerable financial savings (purchase, repairs, tax, etc.) but also increased convenience, as they avoid time consuming activities which accompany car ownership (cleaning, insuring and taxing, etc.). Car share schemes also provide more flexibility than ownership, as the consumer can choose the vehicle - large or small - which best suits their requirement for a specific journey. Tele-working offers the potential to prevent daily long distance commuting, but stimulates residential dispersal.

5.4 Barriers to change

Economic

Companies that wish to establish themselves in businesses that provide new transport options face a number of financial obstacles. The most pertinent of these is the issue of cost to the consumer. For any of these options to appeal to the consumer and work successfully their cost must not be greater than the current cost of owning and operating a private vehicle. The price of buying a vehicle does not incorporate the full social cost of car ownership and is

therefore unrealistically low. In addition, the cost of purchasing a vehicle is actually in decline and therefore - despite the rise in running costs through higher fuel tax - the attractiveness of alternatives to the car is being reduced.

Companies that operate leasing, rental or car share schemes also face greater financial risk than those involved in simple 'sell-buy' transactions as they must pre-finance the investment. The replacement of a lump sum payment at the outset by payment through installments may possibly act as a commercial barrier.

The current financial framework does not provide the consumer with enough information to compare the costs of one form of transport with another. Many consumers find the contrast between private and public transport costs difficult to assess, often simply comparing their fuel costs against public transport prices and deeming the latter too costly. The daily costs of running and maintaining a car therefore need to be made more transparent.

The high cost of labour and parts may inhibit the potential of enhanced maintenance and repair options. Some consumers may continue to operate vehicles that are unsafe or inefficient due to repair cost barriers, a problem that would be avoided in an eco-lease or collective vehicle service scenario.

Car Sharing Organisations in the UK experience a number of finance-related barriers. For example, unlike their European counterparts, UK insurance companies operate by insuring 'drivers' rather than 'cars'. This arrangement impedes the financial viability of small car-sharing schemes, as they have to become companies before they can buy insurance. In addition CSOs lack adequate investment, as there appears to be reluctance among investors to take risks before the profitability of CSOs can be demonstrated.

Finally, shortfalls in the taxation process send the wrong signals to the consumer, blocking movement towards environmentally preferable product-service mixes. For example, the current taxation system places a duty on public transport travel cards but not on most public parking spaces. This essentially penalises those who use public transport rather than private vehicles.

Cultural

One of the most significant difficulties facing those wishing to transform the product-service mix for transport is the obstacle of a car ideology in Western cultural development. Industrial societies have become so reliant on the private vehicle that the 'right' to own a car is a dominant belief. The historical development of private vehicle ownership over the past fifty years has led to a society whose infrastructures are so dependent on this mode of transport that people without access to a car are physically and socially excluded.

In addition to the provision of flexible mobility, the car has a number of supplementary roles. It has become a vehicle for self-expression (i.e. status symbol / identity aid) and has created its own cultural rituals (cleaning, brand loyalty, etc.). Many drivers enjoy the privacy, security, flexibility, sense of control over the movement and customisation that car ownership provides, and feel intimidated by public transport. They are therefore reluctant to test alternatives such as car and ride sharing and unwilling to forfeit the functional and supplementary roles that their car plays. The value given to privacy and personal freedom in the individualist culture currently prevailing creates a significant barrier to all forms and concepts of shared travel.

Security issues are likely to concern people and possibly inhibit them from participating in ride share schemes. UK scheme organisers have tried to alleviate this by processing photo-membership cards and stringent security checks on new members.

There may be concern that members of pool schemes and people who lease or rent vehicles may take less personal care of vehicles. Car Share Organisations reported that car exteriors are sometimes neglected, but car interiors are maintained in good condition through social pressure, as most scheme vehicles display the name of the last user. The car rental companies did not offer any specific comment on this issue.

One cultural barrier to keeping up maintenance needs and repair of their vehicles may arise from a widespread suspicion that many garages will not carry out work in an honest and competent manner. Most consumers are in a position of vulnerability when having maintenance and repair work conducted on their vehicle, as they lack the technical expertise to know whether or not they are receiving a fair service; some consumers may not have adequate knowledge of the most simple car maintenance requirements. Various independent reports by interest groups have revealed a consistently poor track record across the UK and Europe (European Consumer Law Group, 1997). The shortcomings identified are varied and include the conduct of unnecessary work, charging for materials and services not used, large price differentials between garages for similar work and lack of thorough checks leading to the neglect of work required. This lack of competence has implications for safety of vehicles and for their environmental impact.

Alternatives to car ownership and use have become stigmatised to a significant extent. Local public transport in particular is perceived as a service for 'the poor' rather than an acceptable and feasible alternative to the car. In addition, public transport in the UK has a reputation for being unreliable, late and poorly timetabled.

The industrial sub-culture is also relevant. Companies often appear unwilling to diversify away from conventional business structures and approaches and try something innovative, such as insurance companies being unwilling to test the feasibility of insuring the person rather than the vehicle, and the lack of interest by car rental companies in car-share schemes. This inertia may act as a hindrance to product-service transformations.

Technical

The lack of routine travel patterns constrains the potential success of ride sharing especially amongst work colleagues. This issue was highlighted by National Car Share, who hope to overcome this problem by building greater flexibility into the data bases of organisations running these schemes.

Car sharing and Integrated Transport Services are more likely to operate successfully where there is an efficient public transport network, offering members a feasible alternative to the private vehicle for most journeys. The number of participants is also important, as levels of flexibility increase proportionally with the number of participants.

The lack of adequate information on the size of the repair and maintenance sector acts as a barrier to improvement, as it prevents benchmarking and projects to assess the potential for expansion.

It is important to the potential success of product-service transformations for transport that

they are carefully designed to ensure that economic, environmental and social goals are achieved. For example, a potential technical barrier to the optimal implementation of an eco-leasing strategy is that its growth and acceptability may inadvertently encourage wider vehicle possession, by reducing the initial capital investment required for car use. Reduced costs may encourage a rise in the number of vehicles available per household and increase car use amongst people who might otherwise use public transport (e.g. young adults, low-income groups).

An additional concern is the effect of manufacturers gaining a monopoly on all aspects of car use. For example, if eco-leasing is encouraged, manufacturers may prioritise recycling above durability (although this may be acceptable where efficiency gains are rapid). Another concern raised is that the closure of the materials loop via eco-leasing could eliminate the market for the non-manufacturing service providers (local garages, second hand sales businesses, component suppliers, etc.) and drive independent repair and maintenance businesses out of the economy. Manufacturers could opt for economies of scale and operate a few large centres for car maintenance, servicing or dismantling and reproduction, damaging local economies in the process. These concerns require further research.

5.5 Solutions

There are a number of strategies that can be used to overcome the barriers to transformations in the product-service mix for transport

Fiscal

There is a need to make prices reflect the comparative environmental impact of transport options more clearly. From the perspective of ecological economics, the prices of virgin materials and energy and the costs of disposal are currently too low. They could be raised by a variety of means, primarily through ecological tax reform. This could be revenue-neutral with funds directed into establishing relevant product-service transformations in the sector.

The following measures are suggested

- Fuel tax that reflects the full cost of its production and consumption
- Parking charges and taxes to ensure that public land use is paid for
- Explore further the potential for levies on road congestion
- Variable transport taxation reflecting externality costs of vehicles. The changes to Vehicle Excise Duty, Company Car Allowances and Road Fuel Duty for cleaner fuels in the last Budget were positive incentives to encourage cars with less environmental impact, although they were implemented in a way that has cut the cost of motoring
- Reducing the use of public resources for road building and maintenance by making users on motorways pay a track charge (as currently happens with rail infrastructure)
- Make public sector grants to transport operators conditional upon progress towards developing ITS, and extending the package approach

In addition, a number of fiscal measures should be introduced which encourage insurance companies to offer fully comprehensive 'car' based insurance as well as 'person' based variable insurance. Ensuring that all cars are insured with fully comprehensive policies would assist the development of car sharing organisations by lowering the cost of their collective service in comparison to that of private ownership.

Special arrangements could also be made to make sustainable transport options more

attractive than the car. Collective vehicle services and integrated transport services could be given tax relief to encourage further investment. For example, Buses currently pay road tax, which could be reduced or eliminated. Additionally, although some tax on fuel is currently rebated, bus companies could be made exempt from all fuel tax, and improved capital allowances for investment in public service vehicles could be investigated.

Further, the provision of special facilities for participants in car share, car pool and ride share schemes, such as special lanes and free or reduced parking costs, could make these options more attractive

An examination of the current system of global manufacture and distribution is needed. Transport costs currently allow the passage of parts from all over the world to be manufactured or serviced and repaired at one location and then redistributed again. From an environmental, perspective local products and services should be sourced and used where possible.

There is concern that some of the fiscal solutions could have deleterious social implications. In order to ensure that policies restricting private vehicle use do not create social exclusion, it is important to ensure that 'risk' groups are identified (e.g. the disabled and residents of rural areas) and specific attention is given to ensuring that their needs are taken into account. The inequality impacts of all policies should be assessed and addressed, as recommended by the Acheson Inquiry (Acheson, 1998).

Regulatory

The following regulatory solutions would help facilitate environmentally beneficial product-service transformations

- Extended producer responsibility for all vehicles (through the current proposed Directive) and associated infrastructure (including oil exploration, petrol stations etc)
- Improved land-use planning controls, preventing out of town and urban fringe developments
- Providing local authorities with greater legal powers to implement measures to mitigate congestion and apply parking charges as they deem necessary at the local level

Other beneficial changes include:

- Improvements in information provision to make costs transparent and ease comparison between different forms of transport
- Obligatory vehicle servicing on a regular basis as specified by an independent body (cf. the manufacturer)
- Coverage of routine maintenance and efficient driving techniques as a part of the driving test

Voluntary

In order to encourage businesses and consumers to consider various transport options more carefully it is necessary that

- Entrepreneurs or businesses should establish and sponsor trials for key ideas (e.g. set up a scheme with an insurance company to trial insuring the car rather than person for a CSO;

- pump-prime new car share or ride share initiatives)
- Vehicle industries should stock spare parts for purchase throughout the vehicle's life
- Public/private partnerships should develop in order to facilitate expansion and development of product-service transformations for transport
- Through its public information campaigns, Government should be bolder in challenging use and ownership of cars and more vociferous in promoting the benefits of public transport and non-ownership schemes

5.6 Conclusions

The case study demonstrates that there are numerous feasible alternatives to the current product-service mix for transport that could provide environmental, economic and social benefits. In theory, industrial, public and voluntary organisations should be able to establish and operate viable transport service enterprises. The potential success of many of these options is however thwarted by the public obsession with the private vehicle, which makes efforts to internalise its true costs (and therefore compete fairly with alternatives), or replace it, politically difficult.

In summary, key factors that are crucial to ensuring the success of transport services are:

- the internalisation of the external costs for all forms of transport and associated infrastructure
- the provision of public and private financial support to pilot transport service enterprises
- improved urban planning to facilitate reduced car demand and prevent car-dependent out of town developments

Table 5A: Possible transformations in the product-service mix for transport

P2S type	Driver	New product-service mix	Mode of delivery	Form of potential benefit
Level of benefit	Environmental implications	Economic implications	Social implications	
ENHANCED MAINTENANCE SERVICES for all vehicles	Manufacturers Company contract	Improved efficiency of existing stock with effective maintenance servicing	Improved maintenance and repair services	
*	Well maintained cars operate more efficiently and produce less pollution.		Economic benefits to local communities if work carried out in local garages, increased employment in maintenance	
ECO-LEASING SERVICES	Manufacturers	Company maintains ownership of vehicle and sells consumers use of vehicle for specified time period or agreed mileage	Company contract	Longer and more intensive product use. Improved maintenance and recyclability
	**	Avoids firms having capital in fixed assets, economies of scale for end-of-life waste management, employment transferred from manufacturing to service provision	Encourages new approach to product design; closes materials loop and avoids waste	
COLLECTIVE VEHICLE SERVICES (RENTAL, CAR AND RIDE SHARING)	Entrepreneurs			
Environmentalists	Individuals	Rental and car-share offer consumers successive use of vehicle; ride sharing involves use of vehicle by owner and several other users	Individual contract, collective agreement, personal arrangements	
Demand met more efficiently by intensifying vehicle use; reduced vehicle fleet; consumer given greater flexibility	***	Greater material and energy efficiency. reduced emissions and fewer end-of-life cars		
Employment in administration, fixed costs per user reduced		Improved urban air quality provides health benefit		
INTEGRATED TRANSPORT SERVICES	Politicians	Contracted Company provides vehicles and operators; consumer shares product simultaneously with others	Contract with PTE	Demand met more efficiently using an optimal integrated set of transport carrier options
****		Greater materials and energy		

efficiency, reduced emissions, fewer end-of-life vehicles, less traffic congestion
 information provision, public transport, but fewer jobs in manufacturing
 convenience and comfort for public transport users
 NEED-RELATED SERVICE SOLUTIONS) Environmentalists / IT companies Demand for vehicles is
 reduced or avoided by IT or local service solutions. Via service sector Needs met more efficiently
 without need for transport ***** Resource use and pollution minimised Increased local activity enhances
 local economy and improves quality of life Fewer accidents, reduced congestion, less traffic emissions, and
 more cycling and walking improves public health

6.0 TELEVISIONS AND PERSONAL COMPUTERS CASE STUDY

6.1 Introduction

Television has exerted a huge influence upon contemporary culture and technological innovation is increasingly changing its form and use. Colour television was introduced in the 1960s after which technology stabilised, apart from the emergence of VCRs and NICAM stereo. Recently, however, the pace of change has increased. Widescreen televisions are readily available, plasma or LCD screens not far off. At the luxury end of the market, large-screen, sound enhanced (Pro-logic) televisions are promoted as in-home cinema. The most significant trend, however, is towards digital technology. This offers electronic programme guides and Internet links, the latter providing the basis for home-based e-commerce (e.g. banking, shopping) and e-mail. Industry analysts found that 26% of households expect to have digital televisions by 2001 and predicted that one half of these would have web access (MINTEL, 1998a). In 1982 just four television channels were available. New forms of delivery such as satellite and cable now provide access to more than 160. Digital terrestrial television can now provide access without the need for a satellite dish or cable (the ONdigital system). Sky satellite is already offering digital services and cable service providers will soon. New integrated digital televisions (iDTVs), with integrated set-top boxes, are being sold with 'free' digital services.

Meanwhile, personal computers are used at home for an increasing number of activities, such as word processing, information acquisition (especially via the Internet), communication (e-mail and e-commerce) and entertainment (e.g. games, including gambling). The areas in which growth in computer use is greatest in the home remain unclear. In 1999 the Government announced a target that there should be a national network of 1,000 computer learning centres in schools, colleges, libraries, Internet cafes and other high street locations. Several companies in the private sector are offering new venues for Internet use; these include easyJet, with its new Internet cafe venture, easyEverything.

Since the introduction of the first IBM personal computer in 1981 computer technology has advanced rapidly. The processor speed and memory capacity of the latest personal computers far exceed those of earlier generations. Developments in advanced sound and graphics systems are increasing their potential for multimedia use. The voice recognition capabilities of the latest software are primitive but improving. Real time television transmitted through personal computers (PC-TV) is on the horizon.

There remain many uncertainties as to how audio-visual and information technologies will in future relate, including whether the computer and television markets will converge or diverge and the potential for sharing equipment such as monitors and speakers. For example, the market for games appears to be moving from video games consoles played through televisions, such as the Sony PlayStation and the Nintendo N64, to games devised for the powerful capabilities of multimedia personal computers. It is also unclear whether e-

commerce will develop primarily through television or personal computers. In October 1999 Sky launched an interactive television shopping service operated by remote control units, e-mail is possible with keypads, and games will be available in due course. Some observers argue that the impetus to move from the Web to Web-like television channels for e-shopping may be very powerful (Allen, 1998). Already Microsoft has launched NetChannel, a Web-for-TV service that enables access to the Internet without a computer through use of a set top box.

Such convergence is not the only option. Graham and Davies (1997) conclude that the Internet is at the opposite end of the spectrum from multimedia broadcasting; the former is personally addressable, usually received in private, low cost and frequently low quality, while the latter is broadcast to a mass market, often received in public and, if it is of high quality, expensive.

Market context

Each year around 4 million televisions are sold in Britain. The market is saturated: 98% of households now own a colour television. Over one half of all households (57%) now own a second set (LIRC, 1998). Consequently sales are either replacements or purchases made by households in order to 'trade up' and acquire models with the latest features.

The television market has seen a severe cost reduction curve. According to industry sources this is the result of the globalisation process (e.g. access to global capital, rationalised production sites, increased demand worldwide), well-established production facilities, and lower labour costs. Over the past 10-15 years EU firms have transferred production to the Far East to cut costs (although conversely Japanese and Korean firms have built new plants in Europe in order to avoid tariffs). As a consequence, premium quality televisions are now around the same price as standard televisions were five years ago. The industry is currently anticipating a divergence in product quality, with a new trend towards large-scale supermarket sales causing traditional specialist retailers to move up-market.

People are increasingly spending less on the 'hardware' of television sets and more on gaining access to the services which televisions offer (Table 6A). Thus new televisions cost from around £200, and increased reliability has led to a decline in spending on television repairs (from £203m in 1992 to £61m in 1997, including VCR repairs) (LIRC, 1998). Meanwhile, subscribing to Digital services costs from £84 p.a. to £480 p.a. and pay-per-view services adds further costs. The provision of set-top boxes free of charge (once priced at almost £200), in exchange for a one year subscription to a service provider, reflects the same trend. It has also been suggested that although consumers may be willing to pay for convenience, such as the ability to view programmes at convenient times, they appear less willing to pay for higher quality pictures or sound (Allen, 1998).

At the same time, there has been a long-term decline in the television rental market. People may be willing to pay for the services received in the form of programmes, but they prefer to own the hardware, the equipment through which such services are provided. According to the industry trade association BREMA, rental currently accounts for 8.5% of the market for new televisions, compared with 12% five years ago (table 6A).

Table 6A: Consumer spending on televisions, 1997

Set purchases	£1,050m
TV (and radio) repairs	£61m
Set rentals	£708m
TV licences	£1,989m
Satellite TV	£1,459m
Cable TV	£466m
<i>Total</i>	<i>£5,733m</i>

Source: LIRC, 1998

Table 6B: Computer sales, 1997

Systems	£1,275m
Add-ons and software	£639m
<i>Total (excludes games)</i>	<i>£1,914m</i>

Source: LIRC, 1998

Meanwhile, ownership of personal computers by households is rapidly increasing, with annual sales currently around 2 million units. Around 40% of households now own personal computers, compared with only 22% in 1992. Some analysts anticipate that the figure will exceed 50% by 2002 (LIRC, 1998), although the Henley Centre recently concluded that ownership of personal computers with Internet access will peak at 48% in 2006 (Allen, 1998). Spending on 'add-on' equipment and software appears likely to rise in the next few years, while spending on systems is predicted to decline due to falling prices (LIRC, 1998) (Table 6B).

The Internet, to which over 6 million households now have access, is an important influence on the personal computer market. In recent years companies such as Freeserve have offered free Internet access, although there are charges for use, normally at off-peak telephone rates. The largest service provider in Britain, AOL, charges a £9.99 monthly subscription and 1p per minute for calls. Recently there has been pressure for an end to call charges in order to promote use of the Internet; in America AOL charges £12.50 per month for unlimited access.

Intensity of use and longevity of product

Despite suggestions that people's lives are busier than ever, on average they watch television for 25 hours each week, equivalent to 14% of each day (DTI, 1996). As working patterns have changed and programming has been extended towards a 24-hour service many televisions are in use for a large proportion of each day, although the number of hours watched per person is the same as it was in 1980 (Graham and Davies, 1998).

There is currently no firm data on the service life of televisions, although it appears that on average they last around 13 years before being discarded (AEA Technology, 1997). The period during which the television is the primary set in the household may be rather shorter, depending on technological advance. When such advance occurs, televisions may be stored or used very infrequently for several years before being discarded. As noted above televisions are very reliable; a recent *Which?* survey found that only 5% had broken down in the past year, compared with 11% in 1992.

The intensity with which personal computers are used in the home varies considerably according to the extent to which they are used for work, Internet access, games, and other functions. The average life span of personal computers has been estimated at 5 years (AEA Technology, 1997), although this is limited by technological advance rather than functional obsolescence. Indeed, their 'primary' working life may be as little as 2 or 3 years, whereas the

technical design life of components is around 10 years (Bayley, 1995; Nordic Council, 1997). Technological change has meant that there are millions of computers now being stored in people's homes which could provide a limited service, such as word processing, but which are not powerful enough for other functions.

6.2 Transforming the product-service mix

This case study focuses on how to maximise use of the services embodied in the television and computer hardware, rather than exploring how services delivered through televisions and computers (i.e. entertainment, information, education, etc) might be provided in other forms. The options are summarised in Tables 6C and 6D.

In the past, the primary service provided by televisions has been the provision of audio-visual entertainment (defined broadly to include education). However in recent years the number and range of services available through televisions has started to increase very rapidly. Many of these new services are characterised by a need for more active engagement by the user with the hardware, such as seeking information about e-commerce (Allen, 1998) The product-service mix for televisions is thus already changing dramatically, as each individual product offers many more services than in the past. One outcome is that such change may reduce the need for transport. People who get entertainment primarily by watching television travel less to live entertainment venues, while those who use e-commerce will travel less to shops and banks. When personal computers were first launched, the services offered were primarily word processing and the use of spreadsheets. As the hardware has evolved, together with associated software, the services that they are able to provide have increased dramatically. However, the pace of technological change has left many consumers dissatisfied, as they see products that are expensive - relative to many other consumer durables used in the home - depreciate in value over a very short period. In theory personal computers can be readily upgraded, enabling them to provide significantly increased services, but in practice the potential is often limited. Consequently consumers might find attractive the ability to purchase the service supplied by personal computers, as distinct from the product hardware, especially if they feel that they have not had good value from purchasing products in the past.

Option 1: Sustainable Product Design

The potential for sustainable product design has yet to be fully realised. Innovation in the design of televisions and computers, together with other electrical appliances, is being influenced by the prospect of EU waste regulation that is intended to create a feedback mechanism to design. The current proposal would require producers to re-use or recycle 70% of discarded televisions and computer monitors, by weight, by January 2004. In theory, this should result in increased product life spans. Already there has been a trend towards increased recyclability in new products and reduced standby energy consumption.

The potential for sustainable product design is, however, inextricably linked to technological development. The extent to which the hardware may have a long service life depends largely on whether audio-visual, IT and telecommunications products are compatible and designed to be upgradable. Bayley (1995) concluded that upgrading personal computers is relatively easy, as modular design makes them easy to disassemble and the majority of components are easily identified. He also argues that the energy performance of repaired and refurbished equipment may be relatively poor, while pointing out that software upgrades can reduce energy consumption. Retailers claim that upgradability is being integrated into new digital television

technology, with set-top boxes able to receive software updates and having interfaces for future computer or telephone connections and other add-on modules.

Option 2: Comprehensive After-Sales Support

Televisions are generally reliable, and become obsolescent through technological change as much as functional breakdown. Excessive repair costs can, however, curtail their life span. The cost of after-sales support is partly determined by the market structure. The recent debate on extended warranties has revealed how high street chains have exploited service contracts, in the form of extended warranties, as a highly profitable activity. Their ability to do so arises from the decline in the number of small, local electrical stores and their position of relative strength over manufacturers at the point of sale. This enables them to sell a service contract before consumers open the box, which may contain a manufacturer's warranty offering better value.

One problem inhibiting repair work is the importance attributed to brand identity, which has resulted in too few standardised parts and thus unduly high costs. In the past there appears to have been a lack of innovation in developing upgradability, although there are substantial limitations because of the product architecture of televisions compared with computers.

Personal computers have traditionally attracted considerable consumer demand for after-sales support. Although the hardware computers is generally reliable, the perceived vulnerability of purchasers leads some to purchase hardware warranties, while users with limited computer skills often purchase a software support service to meet their need for a sense of security. These forms of after-sales support are not cheap. For example, an after-sales package from Time Computers, covering hardware and software, costs £2.50 per week (£130 p.a.) or 50p per minute. A service agreement for a personal computer system worth around £1,250 from Dixons, covering hardware only and based on 5-year cover, costs £95 p.a. The scope for significantly improving after-sales services appears limited, although the poor value of warranties needs to be addressed.

Option 3: Eco-Leasing

The potential advantage to the consumer of renting a product that is subject to rapid technological change is self-evident. If eco-leasing attracted interest from both producers and consumers there could be a greatly reduced environmental impact if it led to improved design and less waste. However, there could be a perverse outcome if consumers were able to upgrade frequently and their interest in new technology resulted in constant demand for the latest products.

Renting a television was common until relatively recently. Initially it was popular because televisions were not always reliable and expensive to purchase, especially when colour television was launched. The sector saw a decline brought about by cheap and reliable products, although there was a minor revival with the launch of widescreen television that coincided with the 1998 World Cup.

In the mid-1990s the rental market for personal computers was apparently growing (Bayley, 1995). However the economics of renting have not proved attractive and the domestic market

is currently very small. High street outlet Radio Rentals operated in the market for a while but withdrew as a result of the difficulty finding a cost-effective use for personal computers over 18 months old. Currently Dell offer rental to private customers, but only if sole traders. They offer customers the opportunity to purchase their rented products after three years for only £100 and offer the same service cover to private purchase as that provided to rental customers, so effectively there is little difference. Leasing in the commercial sector is more common, although some authorities warn against leasing except for short-term peaks of activity (Vincent, 1998)

There now appears to be a realistic prospect of a growth in rental, perhaps based on eco-leasing, as a result of the aforementioned EU legislation. Computer manufacturers in particular are aware of the substantial number of households who have old products for which industry may become responsible, a stock rapidly accumulating due to the products' relatively short life span. The legislation is likely to make them responsible for this 'historic waste'. One manufacturer, Philips, has been considering leasing televisions for several years (Bayley, 1995). Leasing will enable manufacturers to track their products and maximise the residual value of discarded equipment in the process of meeting statutory targets.

The fact that people have been used to renting televisions in the past may mean that they will readily accept a return to rental. On the other hand, it is possible that manufacturers will find consumers unconvinced, associating rental with a past era of relative poverty, high costs and untried technology. One key factor will be the ability of finance companies to offer rental packages that are attractive in comparison with purchasing new equipment.

The development of computer software leasing is another possibility. Market analysts MINTEL (1998d) have suggested that there could be a move towards on-line software, which users would rent rather than buy, receiving upgrades automatically loaded by the retailer free of charge. Some manufacturers are already selling PCs with no software on the basis that it will be downloaded.

Option 4: Collective Consumption

People often enjoy watching television together, as the service that it supplies is enhanced by a shared experience, and yet multiple ownership means that increasingly televisions are watched alone. Families that once had to make a choice as to which channel to watch, now simply use televisions in separate rooms.

Beyond the family, community use of televisions already takes place to a limited extent in pubs and clubs, and a significant increase in such activity appears unlikely. The opportunity to meet neighbours and friends is a positive factor, but one outweighed by the inconvenience of having to travel and purchase refreshments available far more cheaply at home. The fact that televisions are bulky and not readily transported precludes interest in sharing televisions except, perhaps, small portables.

The potential for community use of personal computers appears rather greater, particularly for functions such as accessing information. This is recognised by public authorities. Libraries clearly offer potential for shared use, although current provision is unimpressive due to funding constraints. There are limits, however, and personal computers in the home will continue to be valued for activities such as word processing and private entertainment.

Another possibility is the development of neighbourhood sharing schemes, in which people

agree to share personal computers and develop an arrangement to cover the costs fairly. For example, neighbours might agree to buy a personal computer alternatively every two or three years and share their use. This would allow them access to the latest technology when absolutely necessary, while halving the frequency with which they personally have to buy a new model.

Option 5: Reduced Need

Reduced demand for the services provided by televisions and computers appears very unlikely in the light of recent advances in communications.

Television is deeply embedded in modern culture. At most, a large and carefully positioned educational effort could conceivably stem the trend to multi-ownership, perhaps promoting community and family life and associating ownership of several televisions with profligacy (as in the growing criticism of 'second cars'). Reducing the perceived need for the services provided by personal computers appears equally unlikely, although there is potential for a far more sophisticated approach by equipment suppliers. Retailers often expect customers to purchase the most powerful piece of equipment with the greatest amount of pre-loaded software within their price range irrespective of need. Yet personal computers that are relatively old may often meet the functions required in many households, suggesting that the market for refurbished products could be more effectively promoted.

There is evidently a degree of mutual suspicion between television and computer manufacturers. Television industry representatives are apparently concerned that computer companies such as Microsoft are targeting the television market as an area for expansion. At the same time, the use of televisions to provide multimedia entertainment may curtail one of the potential services offered by personal computers. Consumer attitudes to televisions and personal computers differ markedly: whereas televisions are seen as user friendly, durable and associated with broadcast entertainment, personal computers are perceived as complex, vulnerable to obsolescence and associated with work. However Allen (1998) concludes that the digital television strategy is based on the expectation that most people will value televisions for entertainment and e-commerce rather than potential links to the Internet.

6.3 The scale of potential benefits (environmental, economic and social sustainability)

Environmental benefits

The waste stream from discarded televisions and computers is large and contains environmentally dangerous substances.

Each year in Britain around 3 million televisions are discarded, weighing some 60,000 tonnes (Sarson, 1992), most of which were not designed for ease of recycling. They include substances such as lead, cadmium, brominated flame retardant and chlorinated paraffin (Nordic Council, 1997). A more efficient use of the services provided by televisions would lead to a reduction in this waste stream. Televisions also have a significant impact in terms of electricity consumption. Brown goods, which include televisions and other audio-visual appliances such as video recorders and hi-fi systems, account for around one-eighth of total UK electricity consumption (Boardman, 1997); televisions alone account for 5% of total UK electricity consumed (DETR, 2000b). A reduction in the number of televisions in use thus

offers significant potential to save energy.

The waste stream from personal computers may be relatively small at present, but it is likely to grow very rapidly due to rapidly increasing household penetration. Personal computers contain environmentally dangerous substances similar to those found in televisions and as a higher proportion by weight. They also have a shorter life. The use of LCD or plasma screens replaces the problem of lead oxide in cathode ray tubes with new environmental concerns (not least a lack of publicly available information about their content). A more efficient use of the services provided by personal computers would thus lead to a reduction in the volume and toxicity of the waste stream.

Economic and social benefits

There would be marginal shifts in employment as a result of the changes proposed. There may be gains in the repair and maintenance sector, in eco-leasing, and in developing community facilities for computers, although these could be slightly offset by losses if product sales decline. There are potential social benefits for example from the use of computers in public situations, through neighbourhood sharing schemes or Internet cafes

6.4 Barriers to change

Economic

The pace of technological change has a major impact, with products incorporating recent innovations attracting a high premium price and a process of discounting thereafter.

Television rental costs are such that it is not normally a cost-effective option. One retailer recently visited was offering a new Philips television at £479 to buy or £23 per month to rent, a payback period for purchase of well under two years. Neither are service agreements in the form of extended warranties cost effective, according to the Consumers' Association. A 1998 survey revealed that the average bill for a television repair paid by its members was £44. However extended warranties cost between £55 and £200 for a typical policy covering five years. Even the cheapest ones cost at least four times as much as the average total outlay on repairs over five years, £12 (repairs are only needed infrequently due to reliability).

Producers face economic constraints. The cost of designing televisions to be upgradable is higher (Bayley, 1995). One leading manufacturer indicated that it is not currently involved with the rental market because design requirements and cost structures differ. More specifically, it perceived rental as a different kind of business activity, involving greater interactivity with customers and requiring a quick service. The latter would require parts to be readily available and cheaply installed whereas, by contrast, it used higher quality parts which might be more costly to install.

The pace of technological advance in the personal computer sector means that the price of new products is very closely linked to the service capability. In particular, CPUs (Central Processing Units) are frequently updated with the result that they are discounted very quickly.

At present rental is not cost effective. For example, research found that a Dell computer priced at £1,226 for immediate purchase would cost more to rent over 3 years (£1,598) than to purchase over the same period (£1,478). The same after-sales service package is offered

for each. At the end of the three years the rented product may be purchased for £100, adding to the difference.

Cultural

Corporate culture may be an important barrier to change. According to one television industry source, a significant obstacle changing the product-service mix is that they and their colleagues in industry find it hard to step outside mainstream business thinking. This may result from a perception that to do so involves unnecessary risk. It is also related to the fact that change cannot be instigated in one country alone due to the global nature of the electronics industry.

On the demand side there is a powerful obstacle in the form of the modern cultural norm of television ownership. People may therefore view eco-leasing negatively because they associate it with 'old fashioned' rental. In addition, the growth of multiple ownership means that each individual in a household now expects to be able to choose and watch their preferred channel at any time. Increased access to a growing number of channels as a result of satellite, cable and digital technologies will reinforce this problem.

There is similarly substantial social pressure for people to own personal computers, in particular because they are perceived as having the potential to bring revolutionary change into the home. People do not yet associate the personal computer with leisure, often choosing not to locate them in the main living room, and MINTEL (1998a) found consumers apparently reluctant to use the Internet to download films and music. This suggests that it may not be easy to merge the technologies.

People may prove to be resistant to e-commerce, preferring traditional modes of shopping and banking. Castells (1996) has argued that tele banking will only take off when people are pushed into it against their will.

Technical

The potential for designing televisions that are able to incorporate technological advance appears limited. Although digital televisions are being marketed as upgradable, current technology could become obsolete through changes in the display sub-system (i.e. picture tubes). According to Bayley (1995), the cathode ray tube acts as a closed system and cannot itself be upgraded, while it is unlikely to be cost-effective to replace such a fundamental part of the product. Thus, for example, televisions will not be upgraded to either widescreen or High Definition TV (HDTV).

As noted above, any potential development in changing the product-service mix is liable to be influenced by the technological uncertainty concerning the future of the television in relation to personal computers. As technology advances, the integration of audio-visual with information and communications technology may increase the number of pieces of equipment in demand, or it may lead to rationalisation. It is unclear which media will be preferred for e-commerce and whether separate television and computer monitors will be required for much longer. In addition, one potential application which could have a positive environmental impact by reducing transport is e-shopping, but this has not yet been established, partly because it can be slow to use the Internet as a shopping medium and, unlike conventional shopping, browsing incurs a financial cost. Castells (1996) concludes that e-shopping will only grow when virtual reality multimedia blossoms.

6.5 Solutions

The following strategies can be used to overcome the barriers to transformations in the product-service mix for televisions and personal computers.

Regulatory

- Statutory requirement for televisions to be labelled with their anticipated service life
- Statutory requirement for retailers to display manufacturers' warranties at point of sale
- Targets for the recovery of all computer components and higher targets for computer monitors and televisions in EU legislation on waste, to encourage eco-leasing
- Re-introduction of credit controls requiring a minimum deposit on purchase of consumer durables

Fiscal

- Ecological tax reform to provide a greater economic incentive to design for longevity and improved after-sales support
- Zero-rating VAT on repair and maintenance work
- Preferential tax treatment to encourage manufacturers to offer eco-leasing

Voluntary

- Government 'signals' that do not reinforce the acquisition and ownership culture
- A broader approach to environmental education resources which encourages communal and live entertainment within the context of social sustainability
- Private sector investment to improve the upgradability of computers
- Improvements in the quality of after-sales support by retailers

6.6 Conclusion

The case study demonstrates that for products such as televisions and personal computers there are already marked changes in the product-service mix due to changes in technical potential. Assuming that such products are regarded as essentials the focus is on how consumers can benefit from such change without resorting to purchasing new models very frequently.

In summary, key factors that are crucial to ensuring the success of services provided by televisions and personal computers are

- strict regulatory and fiscal measures to deter the generation of waste
- the design of products which are readily upgradable and customised to meet the needs of individual consumers
- the ability of producers to develop attractive eco-leasing options
- the development of adequate community computer facilities in order to minimise the need for individual ownership

Table 6C: Possible transformations in the product-service mix for televisions

P2S type Potential drivers New product-service mix Mode of delivery to consumer

Form of practical benefit implications	Possible level of benefit	Environmental implications	Economic implications
SUSTAINABLE PRODUCT DESIGN	Industry and prospective legislation into fewer units; upgradable needed **	New product/s Fewer duplicate items (monitors, screens, speakers), less space needed **	Integration of multimedia products Potentially expensive
COMPREHENSIVE AFTER-SALES SUPPORT	Enhanced service quality, especially after product sold; improved warranties, longer guarantees Appliances last longer, possible feedback into design More local shops	Dissatisfied consumers, customer service departments standardised parts Products maintained for longer, parts available for longer Employment in repair sector, cheaper repairs	Product information, *
ECO-LEASING	Rental firms Supplier responsible for all servicing possible	Consumer pays for product use time *** Initial capital cost met by producers, costlier to consumers in long run	Product supplied via rental store Potential feedback into design, but innovation take-up Possible stigma
SHARING - COMMUNITY TELEVISIONS	Pubs, clubs, tenant associations, local authority shared facility in pub, club Fewer appliances, possible use of car	Visit to location required No purchase of extra / spare appliances Free to consumer Opportunity to meet neighbours/ friends	Product is a **
REDUCED NEED	Live entertainment industry television per household * Fewer products	Less need for multiple ownership Reduced income requirement	Avoided Fewer Improved community life

Table 6D: Possible transformations in the product-service mix for personal computers

P2S type	Driver	New product-service mix	Mode of delivery to consumer	Form of practical benefit implications
SUSTAINABLE PRODUCT DESIGN	Industry and prospective legislation	New products Fewer duplicate items (monitors, screens, speakers), less space needed **	Multimedia integration of products Fewer duplicate items (monitors, screens, speakers), less space needed **	Potentially expensive
COMPREHENSIVE AFTER-SALES SUPPORT	Dissatisfied consumers, customer service departments	Enhanced service quality after product sold Products maintain function for longer Employment in repair sector, fewer new computers sold	Product information, improved warranties and capacity to upgrade Appliances last longer, possible feedback into design	*
ECO-LEASING	Manufacturers Supplier responsible for all servicing No capital cost but costlier in long run	Consumer pays for product use time ***	Product supplied by manufacturer Potential feedback into design, but innovation accepted	
NEIGHBOUR SHARING SCHEMES	Community sector Neighbours visit each other, possible use of LETS currency	Computer purchase and servicing is shared privately Purchase costs shared Fewer products Consumer costs minimised Opportunity to meet and share knowledge	Purchase costs shared **	
COMMUNITY FACILITIES	Consumer demand internet cafes, etc. Visit to location required	Products pooled and available for short use in libraries, internet cafes, etc. Purchase of infrequently used items avoided Employment, consumer costs minimised	Opportunity to develop friendships and share knowledge	****

7.0 SUMMARY AND CONCLUSION

7.1 Key issues

The four case studies show different issues to be tackled. Meeting consumer demand for mobility clearly causes considerable environmental damage and the transport case study showed that there are many alternative approaches to the traditional model of private car ownership and use. The case study on energy raised rather different questions, notably the need to engage energy suppliers and raise consumer awareness.

The two case studies on appliances provided contrasting insights because of the different potential for increased services through each product type. The case study on washing machines provided the clearest example of well-established alternative services for cleaning clothes. Televisions and personal computers provided rather different insights. Both are increasingly subject to changes in the product-service mix brought about through technological advance that are already broadening their role as service providers. In the case of televisions, the change is relatively new and is being introduced through the use of digital technology, whereas the increase in services provided by personal computers is a long established trend.

7.2 Overall advantages of a new product-service mix

The research has identified a number of benefits which have been classified into environmental, economic and social categories. The environmental benefits are associated with the reduction in throughput of energy, vehicles and household products. They include reduced use of materials, improved energy efficiency and less use of dangerous substances. The economic benefits may be described in relation to the whole economy or individual households. Nationally there should be more jobs, particularly as a result of the growth of after-sales services and community-based provision, and these are likely to more than offset any loss of jobs relating to manufacturing. There may also be beneficial trade impacts. Social benefits identified include the improvement in social relationships arising from the development of community and neighbourhood facilities, and health benefits associated with more active lifestyles and reduced pollution.

7.3 Main barriers to a new product-service mix

The barriers to a new product-service mix have been classified in this paper as economic, cultural and technical. The following are considered the most critical.

Economic

- Products are cheaper than services because of the relatively small labour element in large-scale manufacturing and consumer demand for a greater service element is therefore limited due to cost
- There is currently an inadequate financial incentive for product manufacturers to become service providers
- Government policy currently favours the traditional 'transactional economy' model of high economic growth through individual acquisition and ownership

Cultural

- The powerful influence of the trend towards individualism and ownership over the past twenty years encourages ownership
- Resistance within businesses and public institutions prevents the changes in corporate culture necessary to develop a new product-service mix
- The stigma attached to collective service provision would inhibit attempts to develop community facilities
- There is considerable political sensitivity on key issues such as energy prices, leading to Government inertia

Technical

- The current economic and social infrastructure has developed to reinforce individualistic

- lifestyles and routine activities based on private consumption
- The proposed measures currently lack a critical mass, or are not technologically advanced enough to meet rapid increases in demand (e.g. the personal computer/television interface, train infrastructure)
 - A lack of relevant information such as the lifetime costs of ownership restricts consumer understanding of product-service options

7.4 Key policy priorities

The Government is committed to the development of sustainable goods and services (DETR, 1999) and has pledged that it will monitor and contribute to research relating to changing the product-service mix (DETR, 2000a). In this context, the following recommendations are proposed.

Taxation measures

- The overarching requirement is a bold strategy of ecological tax reform. This is necessary in order to reduce the relatively high labour cost of after-sales service provision and rental or leasing. Increased taxation of raw materials and waste will encourage greater re-use, refurbishment and recycling.
- VAT on repair and maintenance services and on the supply and installation of energy efficient equipment should be zero-rated
- Adequate public funding for relevant pilot projects should be made available

Producer responsibility

- The proposed EU Directives on Waste Electrical and Electronic Equipment and End-of-Life Vehicles should be strengthened and, once adopted, introduced in the UK with firm conviction and resolve
- Producer responsibility should be encouraged with a focus on optimising product life
- The after-sales market should be better regulated in order to encourage repairs, servicing and upgrading where appropriate

Information provision

- Household appliances should be clearly labeled with their anticipated service life and average expected lifetime costs (per unit of use or per year)
- Component labeling should be encouraged in order to improve re-use, refurbishment and recycling
- Public information campaigns should address the benefits of new product-service options and the wastefulness of many product use patterns (e.g. those used infrequently)

Planning

- Infrastructure planning should be used to optimise product-service systems. Clear goals are required to help to promote local products and services, stimulate local economic development and avoid the need for long distance transport
- Alternatives to shopping as a leisure pursuit need to be encouraged

7.5 Conclusion

The debate on changing the product-service mix in order to gain environmental benefits has advanced significantly over the past ten years and is now attracting interest from Government and industry as well as academics. The current trend towards product-based services is modest in scale and mainly taking place in businesses-to-business markets. Environmental performance has not been the primary motive. This report has demonstrated many of the barriers to development in the household sector and suggested a range of fiscal and regulatory proposals through which they might be overcome.

In order to progress the debate more work is required. This will need to include both practical pilot projects and further research. The Energy Savings Trust is already running schemes for energy service companies and the results are used as a learning curve for future projects. The company 'Smart Moves' is similarly developing pilot projects for car-sharing schemes. Such exploratory projects are essential for highlighting potential problems, testing means by which they can be overcome and quantifying environmental benefits. However, greater momentum is needed. At the same time, policy research, too, needs to be undertaken. For example, the potential implications of the proposed EU Directives on Waste Electrical and Electronic Equipment and End of Life Vehicles for the leasing market could usefully be explored. In addition, more work is required on the means to overcome cultural obstacles such as the need for ownership. It is important to the marketing of product-to-services transformation that the move to a functional economy is perceived by the general public as a step towards a better quality of life.

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