Re-Designing Waste

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A scoping study for the Design Council

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Redesigning Waste

Waste and design.

This paper is about the way in which design connects to the current problems of the public management of waste. The connection is not obvious. We cannot talk of designer waste in the same way as we do designer clothes. Waste is not a positional good. People do not want to be seen with their waste. If anything they are embarrassed by it. Recently an Italian citizen went to the high court in Italy to object to being made to use a transparent plastic bag for his weekly rubbish on the grounds that it conflicted with his human right to preserve his privacy. Far from wanting to draw attention to ones waste, the priority is to hide it. Waste is the shadow side of commodities.

At the level of the object, therefore, waste strives for anonymity. The 'things' involved in waste and its management - the dustbin, the waste collection lorry, the landfill site, and the incinerator - are not the stuff that designer's dreams are made of. They are paid for out of council taxes not sold on the market. They don't have to be made attractive. For municipal waste managers who sign the cheques for waste services, the prime considerations are utilitarian not aesthetic. Function dominates form.

Some containers are a part of 'street furniture' – particularly wheeled bins and bottlebanks – and as such there is an issue of the aesthetics of appearance (bottlebanks in particular are too often case studies in bad design). Recently there has been some use of 'architecture as public relations' in order to increase the public acceptability of incinerators - the designs emphasising modernity and safety as a means of public re-assurance (one incinerator in Taiwan has been built with a revolving restaurant at the top of the chimney). For the most part, however, design has been sidelined.

Systems design

Design is not of course just about objects and the aesthetics of form. From the 1980s there has been a renewed interest in the design of systems and in the process of design. In a piece called 'Beyond the Object in Design' John Thackara put it like this:

> "designing is no longer concerned with individual products but with whole systems; it is not just about experts solving problems, but about collective participation; along with new science it is not a rules-based game but a creative process, which can make products and places unique"

This was written in 1988, at a time when not only design theorists, but social scientists were trying to come to terms with the nature and implications of the new flexible manufacturing systems that had emerged during the decade. The key elements of the change analysed by Thackera were similar to those identified by the theorists of the post industrial economy - the simultaneous fragmentation and globalisation of markets, the shift in innovation from hardware to software, the increasing interpenetration of

production and consumption, the diffusion of just-in-time production and opening out of organisational systems. Thackera's called his book 'Design after Modernism. The economists used the term 'post Fordism'. All agreed that the era of mass production and its reflection in modernism had come to an end. What had replaced it was less certain . Hence the use of the 'post' suffixes, and the tentative sketches of the new.

Two things about design were clear from this literature. First design – particularly the design of objects – played an increasingly central role in the 'new competition.'[1] Secondly, the changes involved not merely the multiplication of product design but the redesign of systems, understood to include not just technical systems but the social and institutional structures in which production was embedded. Productive systems and their design became one of the key concepts for understanding the depth of the change and of the central policy issues of a post industrial economy. In the transition to this economy, design therefore had a particular importance.

In the UK the changes had been pioneered in retailing. In Japan it was in manufacturing. The Japanese production model (with its parallels to the industrial districts of continental Europe), transformed branch after branch of manufacturing over the next decade.

Introducing such changes into the public infrastructural services was more complex. The shape (and the physical networks) of these services had been determined by the early 20th century and were consolidated as the century progressed. Electricity, water, liquid and solid waste, land transport, and communications, were organised on a similar pattern, and by the second half of the century the public sector was at the centre of them all.[2]

The different configurations opened up by post Fordism included the the re-organisation of services around the avoidance of production rather than its expansion, the introduction of new switching systems for telecommunications and freight transport, the development of distributed service networks, of distance learning, and of micro power, and micro water systems. They were all difficult to introduce within the institutional structures (and interests) of the Morrisonian public corporations that had been established to organise the services as rationalised national industries. Privatisation allowed some redesigning of the systems– particularly in telecommunications. But too often it involved the transfer of responsibility from one form of centralised organisation to another.

There has been an increasing tension between the old forms of organisation of public services and the potentials of the new technologies, between the tradition of mass service production and the scope for the user oriented delivery of differentiated services. For many of these services the adequate design of the new systems is still obscure. The debate around it has been at the heart of British domestic politics. What is evident in each of the branches of the traditional infrastructure is that the old systems cannot continue as before.

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[1] The New Competition was the title of an influential book analysing the nature of flexible manufacturing systems, written by the American economists Michael Best, and published by Polity Press in 1990.

[2] An excellent discussion of the structuring of telecommunications out of the 19th century postal and telegram services can be found in Andrew Davies Telecommunications and Politics, Pinter 1994.

During the 1990s, a second pressure gathered strength for system change in public infrastructural services. It came from the environment. What are now recognised as environmental imperatives can be read as further symptoms of a crisis of the old industrial order, as the juggernaut of mass production collided with the external and internal worlds. The first wave of environmental policy was focussed on the control of pollution, and a tempering of the destruction of 'natural capital' – the seas, the forests, and the soils. But from the late 1980s there was a growing awareness that quite new energy and material systems were required, that the rivers, sea and air could no longer serve as sinks, and that transport networks had to be redrawn.

This is the context for the renewed significance of system design in the current period. As in all periods of long wave transition from one industrial era to the next, the economic prize goes to those best able to manage the system transitions. In the sphere of infrastructure the new systems have commonly appeared first at the margins (such as the telecommunications system in Finland), or in regions which have been leaders in the new industrial technologies (like the West Coast of the United States). In countries, such as Britain, where the inherited structures of Fordism are strong, the birth of the new is more difficult and traumatic.

The design profession has an important potential role in this context. Its traditions of systems thinking, of combining innovation and practise, and balancing imagination and cost, are all too often absent among the makers of public policy. It is no accident that some of the most striking innovations in municipal services have been led by designers (the architect mayor of Curatiba in Brazil is one example).

This paper argues that design in this sense is of central relevance to the transformation of public services, and specifically to changes in the management of waste. Waste raises a multiplicity of issues of system design – from how waste is managed in itself, to the wider questions of the design of products, materials, and modes of consumption that are the sources of waste. The very scope of these design questions suggests that the potential link between waste and design is a two way street. On the one hand waste management needs design to help it reshape itself. On the other hand, the issues posed by waste hold the mirror up to the industrial design process itself.

The old waste system

The traditional problem with waste has been how it can be contained. In the pre-industrial era, the majority of waste went back into biological and technical cycles. In the towns most human faeces were put into cesspools, and the nightsoil collectors sold the residues as fertiliser for the land. Food followed a similar cycle. For many years the pigs of East Anglia were fed on the food waste from London, just as the fields of Hertfordshire were fertilised by London's excrement. Inorganic waste passed through a descending cycle of re-use before being re-worked for new products.

The system was rough and ready. Waste overflowed its makeshift containers. Town streets were in part middens, and the rivers were sewers. Prior to the 1830s the most notable feature of urban life to the modern visitor would have been its smell. As late as 1858 Parliament was on the point of closure because of the smell from the Thames.[3] By this time the great movement of Victoria containment was well under way: first water closets and sewers for excrement; and by the 1890s dustbins and weekly municipal collection for daily refuse.

This was the basic system of waste management throughout the twentieth century. As far as dustbin waste is concerned, collection vehicles became larger and more automated, and the distance travelled for disposal got longer. But the characteristics of the system remained the same:

- waste was aggregated into a single stream of mixed waste; mass production was mirrored in mass waste
- the basic household container was the dustbin, or for blocks of flats the paladin.
- the movement was linear, from the dustbin to the landfill or incinerator for final disposal
- the open dumping of waste in land or in rivers and the sea was superceded by the containment of waste (or ash from the incineration of waste) in landfills
- the system was designed to make waste invisible.

From the viewpoint of design, the task was to keep waste out of sight. Dustbins were black and opaque as were the plastics sacks and wheeled bins that gradually replaced them. In high rise estates, waste was put into chutes. In some blocks of flats, a Le Corbusier-like arrangement known as the Garchy system allowed householders to deposit their dustbin waste down the sink.

When the growth of consumer durables required some new way of handling waste that was too large for dustbins, civic amenity sites were set up on the margins of towns or in obscure areas of the city where large items could be deposited. There was little contact between householders and dustman. The collectors cleared the streets with a minimum disturbance. Like street sweepers and night cleaners they were the service sector's untouchables.

Design was not required to make waste attractive, but to make waste management cheap. The economics of collection depended on the volume of waste carried by collection vehicles and the degree of compaction. Industrial designers worked at how to automate a labour intensive process – through attaching lifting mechanism and automatic arms. They increased the power of compaction with more advanced hydraulics. Modern collection

[3] See S.Halliday, The Great Stink of London, Sutton, 1999.

lorries are now equipped with complex machinery, and can carry upto 12 tonnes of waste. Their size is limited only by the space in the streets which they service.

Where the sites of disposal were far away, large transfer stations were constructed, at which the waste was further treated and/or compacted into containers and shipped by barge, rail or road to the landfill sites. The logistics were simple: radial feeder flows of homogeneous waste into a node, with further linear shipment where necessary.

The fate of household and commercial economies did not hang on the slow productivity gains made in waste management. It costs on average £80 to collect and dispose of the 1.2 tonnes of waste produced by each household per annum, paid for through the Council tax. For most firms, waste costs are no more than a tenth of 1% of total costs, and have occupied even less of senior management's time. At the level of the macro economy, the waste industry has an annual turnover of only £4 billion. It is a marginal sector, for growth, employment and the balance of payments. In spite of its history as one of the principle public services at the local level, it has remained on the organisational margins of local government. The path to political and professional advance has not passed through the committees and departments of solid waste management.

Pressures on the old order.

Over the past 15 years, this century long system of containment has come under increasing pressure. There are three main reasons:

- waste overspill
- increased toxicity
- climate change and resource depletion

Waste overspill.

The growth of consumerism means that per capita waste quantities have risen (in line with GDP growth) and its composition has changed, challenging the traditional means of containment. The growth of plastics (now 30% of the volume of dustbin waste) is one example. The expansion of consumer durables (and their packaging) is another. Each has been met with a response that has brought its own problems. The civic amenity sites for bulky waste have been significant generators of traffic (0.7% of all car traffic in London is made up of journeys to and from civic amenity sites). The 120 or 240 litre wheeled bins, which have replaced the 100 litre dustbin for nearly half UK households, have done their job of containing waste almost too well. They have increased the quantity of waste managed in the formal sector by at least 20%, (and the space taken up by waste storage in front gardens or back alleys) mainly by providing room for garden waste and for the left-overs from home improvements.[4]

[4] A good study of an early wheeled bin scheme is that produced for the Borough of Bury in Lancashire in 1986. By analysing collection rounds it found that more than doubling the size of the container led to a

Elsewhere, however, the new waste has not been so easily contained:

- on high rise estates, the chutes have become regularly blocked. Rubbish is thrown out of windows (so that on some estates cleaners have to wear hard hats) or collects in public spaces. In some cases, such as the Holly Street estate in Hackney, the waste problem became so endemic that buildings had to be demolished because of the impossibility of controlling waste fed vermin.[5]

- waste in the streets has increased as a problem. The most pressing immediate issue is abandoned cars – up to 300,000 p.a. as a result of the fall in scrap prices. But in many areas the problem goes much wider than this. In the old industrial towns in the North waste collects in the back alleys – black sacks, bedsteads, cardboard boxes. In Preston, nearly a tenth of all household waste is collected as street litter. In the inner cities, it is all too common to see sofas, chairs, or old TV sets abandoned on the pavement - or in front gardens and the crannies of building sites. These are the durables which never make it to the civic amenity sites, and where councils do not provide free pick up services. Worse still, the increasing cost of waste disposal has led to an increase in fly-tipping by small shops and cafes, with rubbish piling up round litterbins and on the kerbside.

- parks have also had to deal with waste overspill. First and foremost is the problem of dog excrement. While an estimated half a million tonnes of animal litter finds its way into dustbin waste, substantial quantities of dog excrement are deposited on pavements and in parks. In spite of municipal efforts at creating 'dog toilets', the majority of the excrement is uncontainable. Many councils have given up, and instead have tried to create no-dog reserves: excrement free zones where children can play freely. Less tangible has been the overflow of packaging in parks – tins, bags, plastic cups and bottles that miss out on the litter bins (and too often are caught by the giant mowing machines).

All these are examples of the defiling of public spaces. In daily life we tend to screen them out, but analyses of deteriorating urban neighbourhoods have found that the accumulation of waste is a major factor in depressing the quality of living in those areas. It can of course be countered with money. Wealthy areas can finance more services to keep the streets clean. Westminster for example has bi-weekly refuse collections and daily street sweeping in many parts of the borough. It spends £97 million p.a. on refuse collection and street cleaning compared to the £7 million p.a. spent by neighbouring Southwark.

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permanent increase of 25% in the weight of waste, with some parts of the Borough registering 30%. The report concludes that 'householders are understandably using their wheeled bins to dispose of bulky and garden wastes that would previously have been taken to the Civic Amenity site. There is also the strong possibility that additional wastes are entering the collected waste stream which previously might have been burnt, left as litter, fly tipped or possibly recycled through bottle banks or waste paper schemes." Many councils saw the wheeled bin as the answer to the uncontrollable overspill of waste.

[5] For the problems of waste management on high rise estates in London, see Ecologika, Re-Inventing Waste, London , 1998, Chapter 9.

But for poorer areas the costs of keeping public spaces clean are increasingly prohibitive. In one London borough, it was found that two thirds of the time of estate cleaners was spent in dealing with the consequences of 'waste overspill'. In another, upto two thirds of the parks budget was identified as being spent on the management of waste. What lies behind these figure is the labour intensity of the 'cleaning up afterwards'. The average costs of managing waste on estates is ten times that spent on ordinary street collections. One London borough spent more on special teams for unblocking chutes than on its total waste disposal.

Collecting mainstream waste has in real terms become progressively cheaper. But as more escapes from the mainstream, the cost of clearing up these peripherals becomes ever more prohibitive. Tight budgets set limits to clean cities. For many areas, keeping streets clean is an augean task that can no longer be afforded.

Urban design and the structures of public sector finance has paid too little attention to the containment of waste. The old high rise blocks are replaced with imaginative new build housing, whose paladins (and their inevitable overspill) are placed either side of the main entrance. Redevelopment of the urban fabric – whether housing, or street improvements, or new public service buildings – takes place with little connection to the complementary expenditure in street cleansing. The problems arising from the distinction in public finance between capital and revenue expenditure is never more evident than in the deterioration in the cleanliness of public space. Large quantities of capital are sunk into physical buildings, with little connection to the cost of its continuing upkeep.

Policy has largely focussed on subjective campaigns to change public behaviour. This places the onus (and the blame) on the shoulders of citizens. But it obscures the role of design –both of built form and of public administration – in the failure of containment.

Toxicity.

A second long term trend in waste has been the increase in toxicity. There are over 6 million tonnes of 'special' i.e. hazardous waste produced in the UK p.a. and the quantities are rising. The new EU Directive covering hazardous waste has widened the coverage, increasing the number of registered producers of special waste in Britain from the current 200,000 to a forecast 600,000, with hazardous waste shipments set to treble to 1.5 million p.a. This does not take accounts of the solvents, pharmaceuticals, pesticides, batteries, paints, acids, propane tanks, aerosols, anti-freeze and cylinders found in the domestic dustbin stream. Nor of those materials which emit carcinogens and heavy metals when incinerated (notably PVC) or which react with decomposing organics in landfill to produce hazardous particulates and leachate.

In part the growing hazardousness of waste is the result of the post war development of new materials – notably chemicals and plastics. But the environmental sensitivity to toxicity is also a consequence of the improved technology of measurement. The impact of landfills on methane generation can now be measured, as can their effect on water tables

and surrounding neighbourhoods. The recent British studies of the association of hazardous waste landfills with cancer clusters and birth defects in the neighbourhoods around them serve only to reinforce the findings of similar studies elsewhere.[6] Similarly, improved measurement has alerted public opinion to the dangers of dioxin production and the emission of other pollutants from incinerators.[7]

The evidence of the past twenty years on the environmental and health hazards associated with waste disposal is now incontrovertable. Landfills are still the source of more than a quarter of methane emissions in this country (for Europe as a whole the figure is a third). Up until the early nineties municipal waste incinerators were found to be responsible for a third of all dioxin emissions in the UK. The hazardous effects of waste were clearly not being contained, which only the new technology of measurement was making visible.

As a result there has been a decade of regulations aiming to 're-contain' these emissions. Landfills are required to have extensive linings to prevent leachate, and incinerators from 1996 have had to install expensive scrubbing equipment to remove pollutants. Both these measures have reduced pollution but not eliminated it. Landfills leak. Incinerators transfer the emissions from the air to the ash, and as the scandals at Byker in Newcastle and Edmonton in London have shown, there have been serious breakdowns in the handling of toxic residues.

One consequence has been that disposal facilities have been increasingly hard to site. Both landfills and incinerators have been the subject of major local campaigns that have matched in their intensity opposition to nuclear plants. The most acute part of the crisis of the current system of waste management is now the political resistance to its disposal.

Climate change and resource depletion

Two further factors driving change in the waste sector are the environmental imperatives of climate change and resource depletion. It is not just a question of reducing methane emissions (which are conservatively estimated to account for 5% of the UK contributions to global warming) but of increasing the productivity of primary resources in order to reduce the CO_2 emitted during their production. One quarter of all greenhouse gas emissions are estimated to stem from the life cycles of materials. Increasing the life of products, and recycling materials are among the ways to conserve the 'grey energy' embodied in them and to reduce demands on primary processing. Researchers in the Netherlands have estimated that materials reduction in Western Europe – following increases in penalties for carbon use - would contribute emission reductions of 800 million tonnes of CO_2e, one sixth of all European emissions.[8]

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[6] For a survey of health impact studies for landfills see Peter Montague, Landfills are Dangerous, Rachel's Environment and Health Weekly no 617, 24th September 1998.

[7] see M.Allsopp, P.Costner and P.Johnston, Incineration and Human Health, Greenpeace 2001

[8] D.Gielen, T.Kram and H.Brezet, "Integrated Energy and Materials Scenarios for Greenhouse Gas Emission Mitigation", paper for the IEA/DOE/EPA workshop, Technologies to Reduce GHG Emissions: engineering-economic analyses of conserved energy and carbon, Washington, May 1999.

These are only the most immediate environmental factors driving new waste policies at the European level. Also significant are the urgency of paper recycling to reduce pressure on natural forests, and of the composting of organic waste to counter soil loss and reduce CO_2 emissions by sequestering carbon in soils.

The new waste management system.

There have been two responses to this crisis in waste. One is to modernise the existing system of waste management without changing its structure. In addition to improved containment of landfills and the burning of at least part of the methane they generate, there has been a move to reduce the amount of waste going to landfill in untreated form. The traditional form of pre-treatment has been incineration, and one path of development has been to raise the temperature of combustion to try and destroy hazards that are produced at lower heat levels. There are also new chemico-energy technologies being developed (such as pyrolysis) which use methods drawn from the electricity and chemical industries to 'mine' the waste for elements which can be used for energy or as a chemical feedstock. In each of these cases, the collection system remains in tact. Some energy or material may be salvaged from the 'treatment' processes, but they remain processes of destruction rather than the retention of the embodied value of waste materials for the purpose of recycling.

The second response is that of 'eco-modernisation'. It involves the introduction of a post-Fordist system of collecting and reprocessing waste that stands in sharp contrast to the existing system of mass waste management. Its key features are the following:

- *circular flow of materials*. The guiding principle of eco-modernisation is to restore the pre-industrial biological and technical cycles using post industrial means. The established linear 'cradle to grave' system of material use is replaced by a circular 'cradle to cradle' one. This means separating out the organic fraction of waste and using it either for compost or, depending on its composition, as a biomass energy feedstock. For other materials the goal is 'upcycling' – maximising the retention of the embodied energy and economic value, and adding to it by its application in its original or new uses (for example using recycled crumb rubber for the surfaces of sports halls, or crushed recycled glass as a filtration medium). Those materials which cannot be recycled or composted for technical or economic reasons should be phased out. [9]

- *separate streams*. In the new systems niche waste replaces mass waste. Waste is no longer analysed and handled as an aggregate but broken down into components suitable for recycling. Waste composition analysts sort waste into as many as 60 materials. Kerbside boxes in Canada collect upto 20 materials. Different containers are provided for garden and food waste. Each of these materials has its own

[9] For a good statement of the need to restore biological and technical circuits see the article by two leading eco-designers, William McDonough and Michael Braungart (1998).

requirements for collection and processing, and its own destinations. This opens up new spaces for innovative design.

- *increased visibility.* Instead of the wheeled bin, recycling uses open plastic boxes. Instead of black bags, householders are issued with transparent bags for food waste and residuals. The civic amenity sites (and in New Zealand many of the landfills) are no longer organised as places for disposal, but as reception centres for recycling, re-use and repair. The Phoenix Transfer Station in Arizona was re-designed to make the quantity and the process of handling of waste visible; the civic amenity site – with its large flow of visitors, was brought from a separated back area to the front of the facility, and integrated into the other functions of the site; viewing windows to see the waste were put into the ramp area, and the courtyard; there is now an interpretative section of the building for schools to learn about waste, a library and a reception area for parties and weddings. As the artists who designed it said their aim was to take waste out of its hiding place, to make it transparent. As a result the transfer station has become a community centre and the site a destination for waste tourism. This is only one example of a more general trend, which has seen the reclamation of waste as a source of education and entertainment, and the establishment of waste museums.[10]

- *reversals.* Intensive recycling is a looking glass economy, that reverses the normal flows of the production process. Its activities are described by words that reflect the return section of the cycle and the prevalent use of the suffix 're-'. Collecting recyclates involves reverse logistics (collecting directly from households rather than delivering to them), reverse packaging, and reverse retailing (through take-back agreements, or goods covered by returnable deposits)[11]. For durable goods, there are new systems of repair and remanufacturing, of re-covering or 're-skinning', as well as re-fining. Product design now has to take on board the requirements of post-use 'reversals' as does the planning of sales and distribution.

- *new time.* In the past the regularity of collection of waste was determined by the speed of decay of the putrescible fraction. The weekly pick up was set by the time it took for flies' eggs to hatch during the hot weather. Other waste had no time structure other than the working day of the waste services: it could be taken to the CA site or picked up through special collections at any time. Once waste is broken down into separate streams, new routines can be established. While food waste may need to remain weekly, residual waste can be picked up fortnightly or even monthly (depending on the volume). Some places, like the village of Wye in Kent, have monthly waste exchanges in the village hall. A new waste calendar is emerging: a Christmas tree collection in January, a spring cleaning collection in April, the visit of

[10] For the history of how two artists came to redevelop the engineering designs of the Phoenix Solid Waste Management facility, see Glatt, Singer and Jensen, (2001)

[11] One striking instance of reverse retailing in waste is the arrangements in Curatiba, Brazil, where householders are paid for delivering their waste in food tokens that can be exchange for food from local farmers. Such a principle could be applied to recycling, using public smart cards and paying for the delivery of source separated materials by giving access to public facilities at low marginal cost to the local councils.

a mobile chipping machine at pruning time, summer garden waste collections, and textile or hazardous waste clear outs every quarter.

The new scheduling allows a greater utilisation of existing vehicles and equipment, it increases the densities of special collections, and provides incentives for channelling waste into the appropriate streams for recycling and composting.

- *new space*. Circular flows of materials enjoy economies of proximity. The points of consumption are at the same time points of secondary materials supply. The waste paper of cities has become known as an urban forest; their waste metals as urban mines; their demolition wastes as urban quarries. While manufacturing has fled the cities over the past thirty years, recycling provides a reason for it to return. Mini urban paper mills have expanded, the extra costs they incur through their small size, being outweighed by the savings in the cost of transport relative to large out of town mills and in their access to existing infrastructure. The same is true for the small scale specialised production processes for the multiple uses of recycled glass and tyres, for plastics and construction waste, and for a wide range of repair, refining and remanufacturing. In each of these cases the economies of proximity challenge the dominance of economies of scale as the determining factors of industrial location. Global linear production chains can be reconfigured as local loops.

- *new types of equipment*: The separation of waste into streams provides the opportunity for waste management to move away from standardised, inflexible plant, to specialised equipment geared to the requirements of the particular waste stream, which is at the same is flexible enough to accommodate multiple uses and fluctuations in waste flows. The central concepts of innovation in waste equipment design are modularity, flexibility, de-scaling to micro units, low CO_2 emissions and ease of switching between transport modes. They are in the process of being applied to household containers and waste packaging, collection vehicles, sorting machinery, as well as compost containers and compost processing plants.

- *consumer as producer*. As with many modern production systems (from energy efficiency and transport to health and education) so in intensive recycling, the consumer is also a producer. The effectiveness of recycling programmes (and the quality of the recyclates) depends critically on the readiness of householders to participate and the effectiveness of their source separation. The challenge for system design is that householders are being asked to take more trouble, at (initially) increasing cost, and undertake tasks some of which, like home composting, involve skill and space. In these circumstances, there is a premium on household advisory services (such as compost 'doctors') on the techniques of social marketing ((including the user friendly design of the collection system) and on the design of the containers used within and around the home.

- *new types of labour and organisation*; The starting point for successful recycling schemes (reflecting the change in perspective on public services more generally) is the quality of the front line service worker and their relation to the householder. The

planning of tasks, training, incentives and organisation are focussed around that. The new green collar recycling workers combine the roles of household advisers, data analysts, local promoters, and multi-material collectors. In the best schemes they are given considerable autonomy in the organisation and operation of their rounds, with a central organisation supplying technical support, machinery purchase and maintenance, material bulking/sorting facilities, and standardised management information systems.

- *information intensity.* The main data collected in the traditional waste industry related to tonnages of mixed waste entering disposal sites. The environmental impact of waste management is resulting in a new range of performance indicators being collected[12] But for the viewpoint of managing the more complex flows of materials involved in intensive recycling, there is a need for much more sophisticated collection and analysis of data. Recycling and residual bins are now being fitted with bar codes, which allows a more careful tracking of recycling participation rates and the use of data based marketing techniques. On board weighing has been introduced to provide data on waste quantities by household (allowing for the introduction of charging for residual waste by weight). Computerised round planning provides greater flexibility to adjust rounds in accordance with changing weights resulting from increased capture rates in recycling. The weekly rounds provide an opportunity for regular information being passed to householders (with some recycling boxes being made with a slot to carry regular newsletters).

  When these improvements in operational data are added to the investment required in social marketing, training and householder support, and contrasted with the savings that can be made in vehicles and other plant and equipment, it is clear that there is a shift in the pattern of investment required in the industry from fixed capital to information .

- *shift in responsibility* There is change in the finance of municipal waste with responsibility shifting from local councils funded from council taxes to consumers and producers. On the one hand there has been an expansion of 'user pay' or 'pay as you throw' for the collection of residual waste. This has not yet been implemented in the UK because of legal requirements to provide a free collection service, although there are some experiments of providing discounts for householders according to the amount of recycling they do; there is also scope for charging for ancillary services like special collections, green waste collections, and the provision of wheeled bins.

  Equally far reaching is the requirements on firms in a particular 'product chain' to be responsible for diverting a certain (and growing) proportion of the waste derived from that sector. The costs of recycling are thereby switched from municipal authorities to firms. The first sector covered by regulations was packaging, but this is now extending to tyres, newspapers (voluntary code), batteries, electrical and electronic

[12] For the outcome of a project to develop a set of performance indicators for the waste sector see Green Alliance, Indicating Right; environmental performance indicators for the waste management sector. November 2001

goods and end of life vehicles. These changes can be described as the privatisation of responsibility for waste (in line with the principle of 'polluter pays'). They create a new set of incentives to change the way waste is managed, and how products are designed in the first place.

The features of the new recycling systems have not all appeared in one place, as part of a coherent 'post Fordist' system of waste management. This is not how transitions take place. The old organisational structures mean that systems for recycling and composting often mimic the practises and technologies which they replace. Some recycling trucks are multicomparment versions of the traditional refuse vehicle, but even larger and more complex (one such built in Britain was so large it had difficulty in getting round street corners). The German system of recycling (which has produced a national recycling rate of 43% with many Lander now well over 50%) is based on parallel traditional collection systems for organics, packaging waste, paper and residuals, often involving three or four wheeled bins, large vehicles and centralised sorting and processing facilities. As a system it is expensive and faces limits in effectiveness.

On the other hand, the outlines of the new system are emerging, bit by bit and place by place. Where the technologies and practices follow the paths outlined they tend to improve performance and reduce costs. The Italian organics collection system, which uses small, one-person operated vehicles to collect food waste set out in 30 litre buckets, is a case study of the new model public service and has led to budget savings for many of the 1000 municipalities that have adopted it. The same is true of the micro-biological closed vessel composters, (that have dramatically reduced composting costs), the reverse logistics of some of the major 'zero waste' firms in New Zealand and the dry recycling collection systems in parts of Canada and the UK.

Some of these technologies are still in the process of development. They remain unintegrated with other parts of municipal waste management for institutional and contractual reasons. Because the system design paradigm underlying eco-modernisation is so different to that which has governed the management of 'mass waste', the traditional industry has found it easier to promote the chemico-energy path to modernisation which remains within the old paradigm. As technologies of material destruction, they allow waste to remain in an economic ghetto, largely unconnected to the rest of the economy. If waste is to be re-integrated, as a junction rather than a terminus within re-established biological and technical material circuits, then 'fifth wave' production systems thinking is required. This is where the design sector has a central role to play. With its experience of post Fordist system and industrial design, it could become a critical transmission mechanism for these ideas into the management of waste.

From recycling to eco-design - the wider materials revolution.

Once the principles of pollution reduction and recycling are applied to waste they lead to questions about why and how waste is produced in the first place. Waste is a symptom, the point at which problems appear whose roots are in the wider economy of material use

and product and process design. There have been three main design issues which have been opened up by the shift towards a recycling economy:

- clean production
- restoring the circuits
- material productivity

Clean production

The pressure for end-of-pipe pollution control from the 1970s, and the increased measurement of pollution that went with it, led to investigations that proceeded back up the pipe to identify the causes of pollution so that they could be stopped at source. There has been a growing movement for clean production, with its own specialists, conferences, and journals. Scientists have been gradually assembling a map of industrial toxicity, tracing the sources and pathways which led to the emissions of dioxins, heavy metals, ozone depleting substances, and so on, that were accumulating in the environment.

A primary focus has been on the chemical industry, which accounts for a majority of the hazardous waste produced (70% of 300 million tonnes p.a. in the case of the US). One approach has been to identify key toxic chemicals which are prevalent throughout the economy, and develop alternatives that would allow them to be phased out. An example is chlorine which is used in a wide range of products – from solvents to pesticides, plastics, CFCs, bleaches, pulp and paper, water treatment, metal production and many intermediate products. The very qualities of chlorine which make it so widely used in industry are also at the root of its environmental dangers. Many organochlorines resist natural degradation and therefore build up in the environment over time (so called persistent organic pollutants). Many of them are more soluble in oils and fats than they are in water, so that they bioaccumulate, moving from the environment into the fatty tissues of living organisms. As a result, the disruptive impact of organochlorines on the brain and nervous system, on the immune system, on the reproductive process, and as carcinogens, is concentrated at higher levels of the food chain. It has caused widespread concern in relation to human health and is the reason for the banning of CFCs, and of the 12 POPs in the Stockholm Treaty, all of which are organochlorines. The design challenge this poses is to find alternatives for such everyday products as PVC, flame retardants, pesticides, and refrigerants, and for processes such as dry cleaning, water treatment, and bleaching.[13]

A second approach has been to concentrate on alternative organic processes which are less toxic than those currently in use. The focus has been on the processes of nitration, halogenation, alkylation, isomerisation, sulfonation, nitration, and amination, developing

[13] On the issues of product re-design in the chlorine industry see the study by Thornton (2000).

environment-friendly catalysts, new cleaner engineering approaches, novel reaction media, and bio-synthesis.[14]

A third approach starts from the product and works backwards to identify non polluting chemicals and materials which can be used in its re-design. Braungart and McDonough have done this for a number of products, including furnishing fabrics and footwear. In the case of the fabrics, their project team identified more than 8,000 chemicals used in the textile industry and eliminated 7,962 of them. The fabric that was developed used only 38 chemicals. It was fully compostable, and its processing acted as a filter for water so that, much to the surprise of the official inspector, the waste water coming out of the factory was as clean as that which went in.[15]

All these are elements of an emerging 'green chemistry. In each case, the primary task of re-design is in the hands of chemists. But product designers, as well as architects and engineers, have an important role to play in incorporating clean materials (and processes) into their work. Now that the costs of waste disposal and pollution are being passed through to the producers, supplemented by materials bans, there is a further incentive for manufacturers and systems designers to take on board the life cycle impact of materials, and if necessary phase out whole technologies (such as nuclear power generation).

Restoring the circuits

A strategy that aims to re-establish the material and biological circuits soon highlights blockages that result from existing material and product design. Studies of the composition of domestic dustbin waste, for example, find that some 15% of the materials pose major problems for recyclers. The most difficult items include disposable nappies, household batteries, plastic film, multi-layer packaging, drink boxes, engine oil and various kinds of dense plastic. There are many other things to add to the list once waste consumer durables are taken into account – such as plastic composites, or the coatings of cathode ray tubes. The technical difficulties of recycling in each of these cases has provided an agenda for innovation in industrial design.

With some materials, such as waste oils, the innovation required is in methods of refining which allow the oils to be re-used. In others it is a question of simplifying materials or changing them to ease recycling. Already there have been substantial strides made in developing plant based plastics to replace oil-based ones. The founder of tetrapak has recently unveiled a new bio-degradable packaging material based on chalk. Disposable nappies could be composted if the synthetic plastics and some of the chemicals are substituted. All these signal a shift of materials from technical to biological cycles, from exhaustible to renewable materials, and more particularly from a hydrocarbon to a carbohydrate economy.

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[14] For a summary see S.K.Sikdar and S.G.Howell, "On developing cleaner organic unit processes", in Journal of Cleaner Production Vol 6, no.3-4, 1998 pp 253-259.

[15] See McDonough and Braungart, op. cit. (1998)

Similar changes are taking place in the design of products which are difficult to recycle for economic rather than technical reasons. Design for disassembly addresses the need to cheapen the process of recycling. A number of auto companies have set up disassembly lines, and the same thing is now happening in the electrical and electronic equipment industry. In both cases, the original product design is now taking on board the question of simplifying disassembly, adopting new kinds of binding agents, for example, like glues and solders, that are easy to crack open after use, and using fewer composite materials that are difficult to separate..

Materials productivity

Once the principle of designing for recycling is established, it is only a short step to the question of how the environmental efficiency of the circuits can be improved. The current focus is on increasing the productivity of materials, meaning expanding the output of the virgin materials that enter production to begin with. Recycling is clearly one way of doing this, but it is only one step in a much wider 'green materials revolution'. Significant advances that are being made in all of the following fields:

- **improved materials and feedstock efficiency** (e.g. less waste in production)
- **extended product life** by the remanufacture of worn parts, by providing a face lift for still-operational commodities ('re-covering'), and by promoting re-use. There is also a growing interest in transforming the process of repairs. Repair costs can be cut by automating fault diagnosis, by modularising of components, and by designs that allow for the upgrading of sections of the product as technology develops ('dynamic modularisation').
- **increased product utilisation**: through the extension of product leasing, consumer sharing as in car pools schemes, or the provision of public services such as public libraries (which have been promoted in Finland as a means of waste reduction).
- **extended material life** not only through recycling but the use of more durable materials and the phasing out of planned obsolescence.
- **production avoidance** by reducing the consumption of such things as water, energy and transport as the result of housing or urban design, or by new processes like ploughing at night that reduces the need for herbicides)

A new stage for industrial design

For many designers the goal of improving the productivity of materials and reducing waste is not new. It was part of the modernist design ethic of mass production. Henry Ford put waste reduction at the centre of his production philosophy. He sought to cut waste in all its forms, in the use of labour, materials, and machine capacity, though not in final consumption. Manufacturers since then have cut down on the 'material intensity' of

products through light-weighting. They have reduced stocks by adopting the methods of just in time production, and there has been a dramatic fall in the number of re-works and discards as the result of 'zero defect' processes.

But the introduction of 'eco-efficiency' policies within firms during the 1990s, marks a new stage in industrial and productive system design. The alarm bells that have rung over climate change, pollution, and material depletion, have led to a re-assessment of all stages of the economy from an environmental perspective. Extended producer responsibility programmes, together with environmental regulations and fiscal incentives, are forcing manufacturers to review all aspects of their design approach and production processes.

Those who have been rethinking their production strategies in the context of waste reduction and material productivity are no longer accepting the existing economic structures which separates production from the use of products and their ultimate disposal. For such separation means that it is not worth manufacturers incorporating long-life materials into their products if they lose control over their life cycle. Nor does the fact that the risk of the performance of durable goods is born by the consumer rather than the manufacturer, encourage industrial interest in long term performance.

One response has been to expand long term guarantees and product leasing. Another is to incorporate take back clauses into the terms of sale. Some manufacturers are going further, redefining their business as providers of ***commodity services.*** They are selling a service on long term contract, retaining ownership of the commodities which become an input to the service. The trend has advanced fastest in the business sector (with the growth of fleet management, of leased and serviced buildings, and of manufacturing services like spray painting or commercial services like Xerox's copiers). But it is also extending into consumer services. Washing machine and detergent manufacturers are offering 'cleaning services' instead of washing machines and washing powder. Unilever is considering offering house cleaning and gardening on the same principles. Ford are developing a package of 'travel services' to include 60,000 miles of a leased car, with the costs of repairs, petrol, and insurance included in the leasing fee.

A recent survey of these developments estimated that 10% of European GDP now comprises products sold as services (as against 15% in the US), with the leading companies expecting to double or quadruple their share of services rather than products by 2010. It concluded that on current trends the US would be leaders in the change of manufacturing to selling performance rather than goods, that the Japanese would be leaders in reverse manufacturing systems, and that Europe would remain tied to high class material recycling systems.[16]

In short, the internalisation of environmental considerations within business and government policy is not merely adding a factor onto the many which designers have to take into account. It is prompting a change in the way in which the economy is

[16] Product Life Institute, The Shift from Manufacturing to a Service Economy 1998-2010, Geneva, 2000

conceptualised, in the purpose of production and the materials that are used. This is the challenge to traditional industrial design. The challenge is not confined to the question of waste, let alone municipal waste, although the reduction of the hazards and quantities of waste has been a significant part of the pressure for change. But municipal waste – as a public service – has had a particular role, since it is the point at which the dark side of industrial production is revealed through the shadow side of consumption. The development of a new municipal waste economy is therefore important not just in itself, but as a way into the wider question of industrial systems and their design.

Potential projects.

A number of possible projects suggest themselves from the above discussion. Their aim would be:

- to exemplify the way in which contemporary design thinking can aid the diagnosis of problems in the operation of public services, and contribute to the redesign of the productive systems of which the public service forms a part.

- to undertake a number of strategic interventions as an exploration of the process of redesign, and as a means of contributing to the changes required

- to illustrate through the interventions the various ways in which Thakara's call for collective participation in the design process could be realised in practice.

The projects fall under four headings:

i) increasing public awareness of the issues which redesigning has to address, and the means/capacities that enable effective participation

ii) the design of smart systems for the recycling and reduction of waste

iii) the design of key components of the new systems

iv) the redesign of product chains to take account of environmental imperatives, including the development of new materials, new uses for old materials, material substitution, longer life products, and more intensive use of products.

Public awareness and participative design skilling.

1. Information and design.

For those responsible for public decisions – both locally and nationally – there is always the problem of accurate information about problems and the alternatives, no more so than in waste where statistical data is so poor. There are many obscure areas in the analysis of waste – from its material composition, the rate of growth of different materials in the

waste stream, the cost of managing particular wastes and their overspill, the health impacts of various kinds of waste and so on. The issues in each of these cases is on the one hand how the state finds out, and on the other how citizens can find out. Much of the current politics of waste turns on these issues of information, and what Ulrich Beck calls 'contestable science'.

This project would explore how designers in other fields of system design have sought to address these questions, and how a new 'economy of information', with the relevant insttutional structures and resource bases could be established to allow a greater participation in the creative redesign of waste systems and their subsequent operation.

2. Photography.

Much 'expert' discussions is conducted verbally, through written reports, mathematical modelling, and specialist discussion. Less use has been made of other more open media, such as performance, video and photography. This project would use photography to explore the impact of waste on the 'degeneration' of urban public space. Schools, colleges, adult education classes, local environmental and community groups would be asked to study the appearance of waste in their locality using the lens. It would be an exercise in re-examining the urban landscape from the perspective of waste. It would aim to show the social and geographic distribution of filth, and to use the evidence of photography to initiate local discussions of the causes.

There would be a common brief for all who participated in the project, but towns and groups would be encouraged to adopt their own approaches to process. Among the possibilities are the staging of exhibitions in the local library, museum or council offices; the making of a local TV programme; the use of oral history methods for recorded voices to accompany the photographs; and the engagement of students in the research and execution of the project and a subsequent tour of local schools to present their findings. One option would be to issue 1000 disposable cameras (part funded by Kodak) and generate an exhibition from that (a method that has produced striking results in the case of war photography).

3. A waste museum.

The best modern museums have become creative spaces for individual and collective learning. They operate as 'open systems' drawing on an extensive inventory of materials, objets trouve, and photographs. These materials are not limited to their own archive, but often contributed by the communities of interest engaged in the topic of the museum. In this instance the museum acts as a 'shop window' for the artefacts and ideas of multiple groups, retaining the key role of curator and presenter of the assembled material.

In part museums of this kind are defined as a space for direct experience and learning. Many of them have set apart educational rooms where schools can visit for a day to use the resources of the museum. They use multi-media and interactive methods to engage the critical faculties and imagination of those who come to the museum investing in the

preparation of content and forms of presentation to a level which is far beyond the resources of general education institutions.

At the same time their presentations are not confined to a single place. Rather the museum acts as a node, distributing the substance of an exhibition through multiple means – from CD Rom, to the web, and travelling exhibitions.

A museum of this kind devoted to waste and the green material economy would represent an innovative intervention in the field of waste awareness. There is common agreement on the need for awareness programmes, since the new economy of waste requires the direct involvement and understanding of householders. Yet the programme and campaigns have been remarkably limited in scope.

A waste museum could act as a hub for the production and distribution of creative material on the issue, in turn stimulating the development of specialist museums (devoted to such issues as paper, organics, and packaging). The museum should aim to become a national centre of expertise on the 'new waste', of discussion, education and the multi-media production of content. A waste museum has recently opened in Bolton, which has a narrower focus than the one proposed here – being primarily concerned with incineration. But it shows the scope for an initiative of this kind.

The design of smart systems for recycling and waste reduction

4. A Zero Waste competition. There is a potential project for the design of a zero waste system for any relevant unit – a street, a workplace, an institution, a district or town. This would be open to competition. One model for a competition of this sort was that run by the Architecture Foundation for the design of a new transport system for London. The competition was widely advertised (inter alia on the tube) and had a low entry fee. The Foundation established a resource centre (with key articles, videos, and material on overseas experiences) accessible to all those entering the competition. Of the 900 who entered, most were groups – school and college students, young practitioners, some community groups. There was an initial exhibition of the entries, and a short list was prepared, with all those short listed being funded to work up their ideas for presentation in a major exhibition on the South Bank.

5. The design of an intensive recycling system. There are eleven intensive pilot projects for intensive recycling currently operating in Britain (three in Lancashire, four in Essex, one each in mid Sussex, Suffolk, Kent and in Daventry, Northamptonshire). Most have been launched with minimal resources, but all have rapidly reached recycling levels of 40%-60%. There is an opportunity for the Design Council to design an innovative intensive municipal scheme, calling on the system design expertise of those from other sectors as well as the best international recycling experience. The project would be an exploration of the contribution that the design sector could make to public sector system design. It would reflect the broad approaches to design underlying all these projects (system thinking, participation, creative process as against rule based blueprint), and would seek to be fully operational within three years.

Given that most of the pilots to date have been in suburban or country town areas, it would be best to target an urban area, with a range of housing types. This would allow the project to feed back into discussions of urban regeneration and the design of public sector housing and run down public space. One possible place would be the City of Newcastle-on-Tyne, where there has been a strong community campaign stemming from pollution from the incinerator at Byker. The campaign was last year awarded a substantial grant by an American foundation for its work in democratising environmental decisions. With the funds they held a public inquiry, and now plan to develop an alternative waste strategy for the city. Another possibility would be Trafford or Salford to the West of Manchester, or any of the former mill towns to the North, notably Oldham, Rochdale, Bury or Bolton. In all these cases, there is a Government recycling fund that could finance the start up of such a scheme in 2003/4.

Key components of the new material circuits.

6. Micro technologies. The separation of waste into distinct streams opens up possibilities for changes in the way these streams are handled. In particular there is the potential to develop new micro technologies, that would enable a more dispersed geographical distribution of facilities and the reduction of conventional waste and primary material transport.

Initial versions of some of these technologies are already in operation, but it would be valuable in building an economic basis for the production of such equipment, if design teams could assess the existing models and suggest improvements. One or more projects could be developed round the following:

- the use of small, electric *pedestrian controlled vehicles (PCVs)* for the collection of recyclables and organics. These vehicles travel on the pavement (thus reducing the time between the collection point and the vehicle). They act as feeders to a 'parent' vehicle which collects the builders sacks once they are filled with recyclate. The PCVs can be parked overnight in local garages or yards without having to return to central depots and are run by a single operator. The fact that they do not need a driving license to operate, means that they can be run by young people on New Deal schemes, as in North Manchester and the London Borough of Haringey.

  There are currently three firms that produce version of the recycling PCV. All are aware that the models need to be further improved, not least through the feedback from operatives who have been using the vehicles.

  The PCV system is an example of appropriate technology, which would have widespread application in barrios in the Southern hemisphere, as well as in the centres of those European towns where streets are too narrow for conventional refuse vehicles.

- the development of 'designed' *household and workplace containers and litter boxes* for public areas to accommodate the source separation of discards. Northern European countries (Germany, Scandinavia, Holland, Austria and Switzerland) produce a wide variety of such containers. It would be valuable to review those that are already produced in the context of the development of source separation schemes in the UK.

- the development of a UK version of the *food waste collection system.* This would involve a design review of the system as it currently works in Italy, both in terms of household containers, and the lightweight vehicles which carry between 1 and 5 cubic metres of food waste. The vehicles have equipment at the back to lift a wheeled bin, as well as a tipping mechanism to allow them to offload onto a long distance carrier truck. They are also designed to receive volumes of dry recyclables if and when required. The food waste collection system has spread rapidly in Italy over the past four years and would be particularly appropriate for dense urban areas, particularly terraced properties in the North, Scotland, and Wales.

- a consideration of the principle of *containerisation and low cost 'switching' for handling multi-stream waste.* There are example of mixed waste vehicles with removable containers that can be detached and switched without the need for further waste transfer and compaction. Some of the recycling vehicles comprise standardised wire cages which could in principle be adapted as containers for later transfer to vehicles to take them to processing plants. It would be valuable to have experts in the design of container systems to review current waste vehicles and logistics to see if the containerisation principles could be extended.

- the design of a *door-to-door source separation collection system for high rise buildings.* A number of pilots are in operation, notably one for three high rise blocks in Brentford (the London Borough of Hounslow). The London Borough of Tower Hamlets which has 70% of its housing stock in high rise buildings is planning to introduce a system of this kind throughout the Borough in the next two years. Given the problems of waste management in high rise estates, and the fact that no clear alternative system has yet been developed internationally, there is a particular opportunity for innovation in this field in the UK.

- the design of micro *closed vessel compost systems*, that can process putrescible waste economically from neighbourhoods, institutions or isolated rural areas. Of particular promise are those systems which have been designed by micro-biologists, (originating from New Zealand, Australia and Quebec) which avoid the need for costly electronic control mechanisms and hydraulic movement. Since vertical composters would be highly visible, and widespread throughout the country, it is important that they incorporate the best design features to improve visual impact and reduce nuisance.

- the design of enclosed *garden composters and wormeries.* 1.3 million home composters were distributed by local authorities in England and Wales between

1996/7 and 1999/2000. Over the next five years this number is likely to treble. The task in this case is to review the large number of bins already available on the market, consider their design, and the economics of production and suggest improvements.

- the design of *management information systems* to handle the greater complexity of multistream recycling systems.

In each of these cases the technology involved is relatively simple. What is important is the design of the systems which combine the technologies.

7. reverse packaging.

Packaging has four functions in conventional consumer commodities:

- it maintains hygiene
- it stops cross contamination between goods when they are put together in a shopping basket
- it carries information on it
- it makes the commodities within the package more attractive

This project would involve packaging designers considering how far these functions are relevant for the packaging waste for high diversion and what other functions have to be taken into account in designing 'reverse packaging' for waste.

It is clear from successful recycling schemes that the form of waste packaging is a critical question. In the Italian food waste system the 6 litre bio degradable transparent plastic bags contain the odours of food waste; they make food waste easier and more hygienic to handle; they could in principle have instructions written on them. They account for more than a quarter of the annual costs of running the food waste system (26% in the case of Bolton). The Italian system also raises the question of the sizing of the small bio bins in the sink (called compostainers in North America) and the food waste bins for collection.

Bag schemes have been less successful with dry recyclables. There have been various pink bag/blue bag schemes which allow materials to be commingled and then separated at the MRF, but they have had lower capture rates than open 45-60 litre plastic boxes. They involve debagging – an extra process. But in Australia there have been interesting experiments with 'tag bags' whereby the plastic bag of recyclables is closed with a bar coded tag, and the tag is then used as a ticket for weekly prize draws. One of the questions raised by bag systems is how far different coloured bags could be used more effectively than they have been to date, for example for storing and setting out particular items (such as hazardous waste and batteries, or nappies).

There is also a question of whether the design of commodity packaging could have integrated in it the function of packaging discards (for example by getting supermarkets to offer plastic carrier bags designed to serve as a reverse package for used paper.)

8. The on-line design assessment of available technologies. For public sector procurement – generally carried out by public and private sector waste managers – there is no independent international search and assessment of the rapidly developing technologies in this field. The purchasers are confined to trade waste literature (which is limited in its coverage in the UK) to site visits, and to UK trade fairs (again limited because of the low level of development of recycling and composting in the UK). The function of the Italian 'real service centres' which is to provide such specialist international advice to small and medium firms in particular industries, is a model for improved technological choice (and best value) in the public sector in waste.

The project should be set up as part of a network of similar institutions in Europe, North America, and Australasia. The initial task would be to undertake an assessment of the existing information economy as experienced by municipal waste managers, government and quasi-public officials, community enterprises and small and medium firms in the waste and recycling field. This would include an assessment of the professional organisations , training programmes and private sector information diffusion including the trade press, conferences, and consultancies. Effective diffusion of new technological information is a critical factor in industrial transition, not least if the design of the new systems is to involve participation from community groups and those working in the sector. The design issue here is partly the circulation of information about design, but it is also the meta question of how to design a distributed information system which can perform this function effectively.

Waste minimisation, resource productivity and eco-design.

9. Designing for the use of secondary materials. In many sector recycling has been difficult to establish because of restricted markets or prohibitive standards in the recycling of waste. Many of the sectors producing materials for household consumption (newsprint, glass containers, tin and aluminium cans) are oligopsonists (few buyers) for the purchase of secondary materials, which has depressed prices paid for secondary materials. There may be technical restrictions on their take back and re-use of materials (like green glass, or plastic coating on steel cans) or restrictive regulations as in the construction and composting industry.

One of the principle tasks in strengthening the biological and technical circuits is to research new uses for secondary materials, preferably those which retain and add to the 'grey' energy and economic value already embodied in the material (upcycling). A number of institutions overseas have done extensive work on this subject, working with users of materials to diversify their material purchases to include recyclates. They have produced manuals for the principle recycled materials, some of which are becoming available in the UK through the Waste Resources Action Programme.

One potential project for the Design Council programme would be to identify, in consultation with WRAP, a field where less international work is available and develop high value uses for discarded materials.

10. The design implications of producer responsibility. Increasing numbers of products are being subject to producer responsibility arrangements, either voluntary or mandatory. These include packaging, electrical and electronic goods, end of life vehicles, household batteries, tyres, and newsprint. Elsewhere extended producer responsibility (EPR) has been extended to manufacturers of solvents, lubricating oil, pharmaceuticals, paint, and domestic pesticides, all of which are candidates for further EU regulation, along with PVC, baby's nappies and (in the UK) junk mail. Initially EPR schemes involve the financing of the recycling of these products or their disposal in hazardous waste facilities, but the consequent increase in costs gives a strong incentive for the redesign of products and choice of materials to facilitate recycling.

The project would involve working with manufacturers in one of these sectors to develop product designs that would increase resource productivity.

11. Creating a UK Centre of Design for the Environment.

As an initial starting point, it would be useful to survey existing work in the UK on Design for the Environment, its institutional bases, and how the UK arrangements compare to programmes to promote DfE overseas. Depending on the results of this survey, consideration could then be given to establishing a UK Centre to act as an animator of eco-design.

12. Environmental design and the use of materials and waste in construction.

The Greater London Authority in its role as a planning authority for London is drafting guidance on Sustainable Design and Construction. There would be a clear role for the Design Council to work closely with the GLA from the perspective of resource productivity and waste minimisation , with a view to developing a policy that could inform the commissioning of public sector capital projects and planning guidance throughout the country.

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