X **Beyond Recycling**

I have argued that municipal waste is the first step for a Zero Waste policy. It is centred on householders, (who have a key role in the post-waste order as recyclers, voters and consumers) and local authorities (who are the local public interpreters of environmental imperatives). It is a segment of waste more open to direct government influence than other parts of the waste flow, and at the same time connects to small firms and local institutions and their waste practices via the municipal trade waste service.

But even a radical transformation of municipal waste policy can only take things so far. The next step is to promote increases in recycling and composting in the commercial, industrial, construction and agricultural spheres. Alongside that, policy has to reach back to promote reduction of waste in the first place. Recycling in this sense is only a staging post. It is new production processes, material substitution, materials efficiency and design for extended product life that will be necessary to carry Zero Waste further.[103]

One estimate of the relative impact of different Zero Waste measures on greenhouse gas (GHG) reduction has been made for Western Europe by the Delft Group using the Markal model. Table 8 presents its results based on several hundred case studies in the second half of the 1990s.[104] The Delft Group was not able to analyze product reuse and product substitution in any depth, and its recycling category (accounting for less than a sixth of potential reductions) is narrowly defined to refer primarily to plastics recycling.

What these results show, nonetheless, is the importance of moving beyond recycling. Recycling is part, but only a part, of a wider green materials revolution. As the 1998 USEPA study confirms, while there are major GHG savings to be made from recycling and composting, GHG reduction will always be greater if waste is prevented rather than managed.[105] The Delft research highlights the

Table 8 The significance of different elements of Zero Waste strategies to GHG emissions reduction

Design for Environment Strategies	Emission reduction potential ($MtCO_2e$)
Increased feedstock efficiency (less energy intensive processes, reduced losses during materials production)	50 - 100
Increased material efficiency (high strength materials, new alloys, composites, improved quality control to reduce variations in materials quality, reduced waste of materials during production, higher design strength, less material intensive design, materials standardisation)	100 - 200
Increased product efficiency (such as new packaging concepts, car sharing, increased product life, multi functional products)	50 - 150
Materials recycling/energy recovery (mainly plastics recycling)	100 - 200
Product reuse (renovation of buildings, design for disassembly)	25 - 50
Feedstock substitution (biomass feedstocks for plastics, solvents, fibres)	50 - 100
Materials substitution (renewable materials, less CO_2 intensive materials, materials with improved physical characteristics, recyclable materials, material innovations and substitution leading to emission reductions in the use phase of vehicles and buildings)	200 - 300
Product substitution (product service concepts, less material-intensive products, products requiring less maintenance, long life products)	100 - 200
Total	675 - 1300

Source: Gielen, Kram and Brezet (1999)

major savings that can be made from changes in the resources used in industry, the efficiency with which they are used, and the types of goods – their durability and level of performance – that are produced to service consumption needs.

Policies to promote the new green materials economy are more complex than those involved in the expansion of municipal recycling. The changes required are pervasive. They reach throughout the economy, covering multiple facets of production and consumption. They have necessarily to work with industry for it is the producers who have to introduce the new paradigm. Policy is therefore directed at re-shaping the terms under which the market operates in order to provide the framework, the incentives and the information to encourage change.

In addition to the traditional government instruments such as regulations, generalised tax breaks and standardised grant programmes, three innovative approaches to environmental policymaking have had relevance for the encouragement of waste minimisation and materials efficiency:

- extended producer responsibility;
- innovations in public finance;
- knowledge economy instruments.

Together these provide the means to speed up changes already underway.

1. Extended Producer Responsibility

The concept of private property has from its inception had to identify the rights of 'quiet enjoyment' conferred by ownership, and the limitations on the use of that property if it harms others. The principles of environmental liability and 'polluter pays' marketise the infringement of these limits, expressing damage in monetary terms so that it can be internalised in the accounts of the polluter.

This has been effective when pollution can be traced to an identified source, such as a large factory, and its impact quantified. But what if the pollution has multiple sources? Are the harmful effects of CFCs from a discarded refrigerator the responsibility of the manufacturers of CFCs, of the fridge maker, the retailer for selling it, or the user for discarding it? Who is responsible for the pollution caused by nappy waste – Proctor and Gamble for producing the disposables, or the baby for using them? For issues such as resource productivity and waste, there are many points of responsibility in any product chain. We can speak of the socialisation of responsibility.

Extended Producer Responsibility (EPR) addresses this problem in an original way. It shifts the focus away from production facilities to product systems and design. In the words of Gary Davis, a leading contributor to the ideas and practices of Clean Production:

"Extended Producer Responsibility as a broad principle states that producers of products bear a significant degree of responsibility for the environmental impacts of their products throughout the products' life cycles, including upstream impacts inherent in the selection of materials for the products, impacts from the manufacturer's production process itself, and downstream impacts from the use and disposal of the products. Producers accept their responsibility when they design their products to minimise the life-cycle environmental impacts and they accept legal, physical, economic or informational responsibility for the environmental impacts that cannot be eliminated by design."[106]

He then outlines a set of principles to use in applying EPR, which include the following:

- schemes should create effective feedback to product designers to stimulate clean production;
- they should take a life cycle approach and be directed at producing life cycle benefits;
- there should be a clearly defined locus of responsibility;
- policies should be tailored to specific product systems;
- they should increase communication between producers throughout the product chain;
- policies should stimulate innovation by concentrating on improved outcomes not processes;
- there should be means of assessing the environmental and economic results of the policy, particularly where schemes are voluntary;
- policy should be framed with stakeholder involvement.

From this it should be clear that EPR is a policy instrument that reaches right back into product design and to issues that are at the centre of any industrial Zero Waste Strategy. How directly it does so will depend on the design of any particular scheme and the target levels set.

In the case of the EU's Packaging Waste Directive, targets are primarily set in terms of recycling and recovery levels, but the fact that the cost of meeting these has to be paid for by those in the packaging chain means that there is an increased monetary incentive for each of them to reduce the amount of packaging and improve its recyclability. The impact of the Directive, and of earlier national packaging measures, is reflected in the technical changes that are already taking place in the packaging industry, partly through light-weighting and partly through the substitution of biodegradable materials.

The EU has taken the lead in reducing the quantity and hazardous nature of waste through sectoral Directives. It is requiring producers to take responsibility for meeting graduated recycling targets for batteries, end of life vehicles and electrical and electronic equipment, as well as adopting 'design for recycling' and the reduction or

phaseout of heavy metals and other hazardous substances. The use of EPR to control and reduce hazardous waste in British Columbia is summarised in inset 5.

As an instrument, extended producer responsibility can be tailored to specific products and substances, it is flexible in its application, and encourages collective responsibility within a product chain for the environmental impact of that chain. It can be used to reduce or phase out a wide number of substances, and substitute them with alternatives, from chlorine based materials like PVC and solvents, to non biodegradable plastics and chemicals in babies' nappies.

In the UK, the government has relied primarily on encouraging voluntary producer responsibility arrangements. By the late 1990s schemes existed in vehicles, batteries, tyres, newspapers and electrical and electronic equipment, but in most of these cases the advances have been limited, and less effective in changing the course of the sector and developing new technologies than the legislative programmes on the continent.[108]

The one legislative scheme has been in packaging in response to the EU Directive. In this and other forthcoming Directive-led programmes, the principal question remains how to shift government policy from being a passive implementer of EU Directives (and in some cases a force for diluting their terms) to being a proactive promoter of EPR as a means of achieving environmental goals and of stimulating new technology. In practice, the dominant emphasis of UK policy in EPR, as in other waste-related directives, has been on minimising costs rather than on maximising environmental outcomes.

In this regard it is striking that the recent assessment of EPR in Packaging in the UK by DEFRA's Advisory Committee on Packaging began by stating that 'one of the key objectives for the UK has been to achieve its environmental targets at the lowest possible cost to industry', without any assessment of the environmental impact or the priorities that should be set in implementing the Directive. It was unclear at the time the report was written that the UK would meet its targets, which would anyway leave it 'below the level of many other Member States'. What the Committee was certain of was that the scheme had minimised the cost.

The report reflects all that is weakest in the 'old order' approach to recycling in the UK. It sets incineration in direct competition with recycling in its recommendations on targets, resisting the EU Commission's proposals to replace 'recovery' tonnages by recycling. It warns against any attempt by the Commission to reduce the amount of packaging, and against any attempt to introduce reuse rates, and argues against high targets for individual materials. Rather it proposes that glass is given priority over paper and cans since paper would involve kerbside collection and, like cans, would be a lighter material when the targets are set by weight. There is no mention of the relative contributions of each of these materials to resource conservation and GHG reduction, which is one of the prime purposes of the Directive in the first place.[109] The predomenantely corporate Task Force represents a product chain which is not taking full extended responsibility for its environmental effects.

Rather than this approach, the government should outline a programme of EPR which leads rather than follows EU Directives. This is the policy which has been followed so successfully in Germany, and to a lesser extent in Sweden and Holland, and which has placed those countries in the lead in new recycling and waste reduction technology. The programme should be developed out of the joint waste minimisation and materials efficiency initiatives discussed below, and cover products as well as materials that have been difficult to recycle or that cause hazards in disposal.

Inset 5

Producer Responsibility and Household Hazardous Waste in British Columbia

During the 1990s the Government of British Columbia targetted the removal of hazardous waste (accounting for 1%-2% of household waste) from residuals sent for disposal. Initially in 1990 they established 8 pilots depots for households to deposit hazardous items, but these were only partially successful and were later closed. They also provided recycling incentives for tyres and batteries, which led to the recycling of 20 million tyres and 5 million vehicle batteries between 1991/2-1998/9.

But from 1992 they adopted a producer responsibility approach, putting the onus on manufacturers to administer and fund the waste reduction programmes:

- Used lubricating oil. Sellers of oil either had to take back used oil at no charge or arrange for agents to accept it. Each year this diverts more than 40 million litres of used oil.

- Paint. Paint brand-owners were required to take responsibility for the safe disposal of used paint. They established a not for profit company to do so for paint, aerosols and empty containers. The company has 103 depots throughout the province, and is financed by a small eco fee per can, which is paid by producers. In four years they collected 11 million litres of paint. Oil based paints are shipped to hazardous treatment/disposal facilities; latex paints are recycled into construction products; paint cans go to steel mills; and some paint is re-used.

- Pharmaceuticals. In 1996 the industry established a voluntary stewardship programme, for hazardous drugs to be returned to 650 pharmacies for safe collection and disposal.

- Solvent/flammables, domestic pesticides, gasoline and pharmaceuticals. The Government required producers to establish stewardship programmes for waste products. They jointly opened 35 depots, financing them either by an eco fee or through producer subscription.

These schemes have to be independently audited. In some, such as paint, there are reuse and recycling targets. The long term aim is to encourage the switch by consumers and producers to less hazardous materials and products (from water based to oil based paints for example.)

2. Innovations in public finance

Green tax proposals aimed at encouraging the closed loop economy have focussed on raising taxes on material inputs and waste. We have already discussed waste taxes. At their current levels, they are not a significant enough cost for most industries to encourage a radical redesign of the product chain. Similarly, there is limited scope in the UK to pursue the proposals considered elsewhere for raw material charges and subsidy reduction, or virgin material import ceilings.

The exception is the construction sector, whose use of materials can be significantly influenced by taxes on primary aggregate and waste disposal. The tax of £2 a tonne on inert waste taken to landfill introduced in 1996 has led to a fall in landfilling of this class of waste by a third (more than 12 million tonnes) in the two years between 1997/8 and 1999/2000.[110] This has led to some increase in recycling, which will be reinforced by the introduction of an aggregates tax in 2002 at a level approaching 50% of the ex-works value of virgin stone.

For commercial and industrial producers, reliant on material imports and for most of whom waste costs are trivial, the measures that promise to have a significant effect on resource productivity are those introduced in Britain to reduce CO2 within the context of the Kyoto targets. There are five elements here:

- the climate change levy (CCL), taxing electricity, gas and other non-renewable energy sources used by business;
- the exemptions to the levy granted to energy intensive businesses which sign energy efficiency agreements;
- the earmarking of part of the levy to finance a Carbon Trust to take the lead in energy efficiency (and waste reduction) advice and in low carbon innovation;
- the earmarking of another part of the levy to provide capital allowances for energy saving technology;
- the provision of start-up finance for an emissions trading scheme, through which firms which have exceeded their CO2 emission reduction targets can sell the excess to those who have fallen short.

There are a number of innovations here: the primary resource tax, which partly reflects the carbon intensity of fuels; the use of tax explicitly to change business behaviour with the tax revenues hypothecated to further the same goals; the use of negotiated agreements with firms to change corporate behaviour in return for tax reductions; the establishment and funding of a not-for-profit Trust to act as an animator of innovation; and finally the marketisation of target performance through emissions trading. In the history of public finance this package would qualify for a chapter on innovative instruments. Many have been advocated by environmental economists, but few in the mid-1990s could have expected they would be introduced so rapidly.

The above measures have been put in place to increase energy efficiency. The question is how far they can be developed to improve material resource productivity. As the Dutch research suggests, the two are closely related and a major impact on energy reduction can be made through improved material productivity. It is not just a question of getting heavy energy users to improve their energy efficiency, but of changing manufacturing production so that it uses less of the energy-intensive primary materials and/or extends their life through reuse and recycling. This is the reason why Zero Waste is important for Climate Change policy.

There is a parallel here between pollution control and emissions reduction. The first stage in both is to cut down the emissions of the major polluting plants and processes. In each case, the plants and their emissions can be readily identified (and for this reason they are likely to be the early core of players in the emissions trading market). The

challenge comes when the cause of the emissions cannot be ascribed to a single plant but to the product chain as a whole. Can the UK climate change measures be widened to take in such product chain issues and waste reduction/resource productivity more generally?

The question can be posed first in relation to emissions trading. For such trading to work, firms have to register current emission levels and agree targets for their reduction. There have been 44 agreements in the UK to date, and there is a view that the existing criteria of eligibility that allows firms to trade reduction targets for tax concessions should be widened. Under the likely terms of the international trade in permits, once a reduction target is agreed a firm (or country) will have the option to meet it by emissions reduction, sequestering carbon or by buying credits. As a result major GHG emitters in North America are already preparing for the new trading regime by investing in projects that will promote sequestration or large emissions reductions (such as forestry and agriculture) and hence offset their own shortfalls.

With respect to waste and materials, it should be possible in principle for firms, either individually or as a product chain pursuing the Design for Environment Strategies outlined in Table 8, to register their current CO2 emission levels and reduction targets and to generate surplus certificates for sale. Given that the price of the certificates when they are internationally traded is forecast to be substantial, this would provide a major incentive for the adoption of industrial Zero Waste policies. The issue is whether the registration and target regime in the UK can take such policies into account. How could the benefits of substituting biodegradable plastics for oil-based plastics be included in the scheme; or the production of a fully recyclable car with a thirty-year lifespan?

Similar questions could be asked of other parts of the UK's fiscal package: could such material productivity initiatives be granted the Climate Change levy reductions in return for an agreement covering material efficiency as well as energy efficiency improvements? Could firms that provide lifelong guarantees on products with take-back agreements qualify for the extra capital allowances? Could those firms which agree to standardise components to ease remanufacture and repair receive funding from the Carbon Trust?

The answers to these questions must in principle be yes. Waste minimisation and materials efficiency agreements could be replicated on the model of those for energy efficiency, and indeed would overlap. But, as with the producer responsibility approach, the challenge comes when no one firm can make the necessary changes on its own. In such cases, the agreements and incentives need to be collective.

Instruments of the information economy

A third approach sees the generation, interpretation and distribution of information as the critical point of entry for Zero Waste policy. The starting point for any re-orientation of productive practices, it argues, is to make their current environmental impact visible. Where economists have sought to marketise environmental costs and benefits which have been hitherto outside the market, so in parallel the same thing needs to happen with environmental information, to make visible what has hitherto remained unseen.

In relation to Zero Waste this entails the qualitative and quantitative study of the impact of different types of product and productive system on the environment and an assessment of how they can be improved. In the past thirty years this has generated a wide range of new ways of looking at the material flows of the economy and their effects. (The ex post quantification of material flows is one example, along with life cycle analysis and dynamic ex ante estimates of flows and processes to judge the impact of alternative paths of technical change.) It has also generated new ways of counting (through the development of environmental reporting and performance indicators) and a new level of scientific testing of hazardous effects.

For some writers the project of increased environmental knowledge is parallel to that of increased social knowledge which accompanied the expansion of government social policy in the nineteenth century, with its extended apparatus of statistics, inquiries, inspectorates and institutional controls.[111] For others it represents an endless task of trying to control (carry on business in spite of) the uncontrollable effects of modern technology, where each new attempt produces its own hazards.[112] Much of the debate has centred on the identification of risk and how its potential impacts are assessed and distributed.[113] For all these writers the role of science and information about the environment has become the pivotal point of environmental politics. It is also the starting point of any project of ecological modernisation. In this context government policy towards the production of information, its interpretation and circulation becomes the critical instrument for environmental reform.[114]

This informational economy feeds into the process of Zero Waste production in six ways:

- as the stimulus for action by civil society;
- as the basis for subsequent development of government policy and regulation;
- as an input for ecodesign and new environmental technologies;
- as productive information for re-oriented producer strategies and practices;
- as a source of data for public monitoring and surveillance;
- as information to consumers to inform purchasing decisions.

These represent the political, governmental and economic dimensions of environmental transition and each can be strengthened through government support.

A starting point for considering a policy on information and Zero Waste are the conclusions of the Cabinet Office report on Resource Productivity. Although the report raises the possibility of extending the principles of environmental taxation to the field of materials, its prime recommendations reflect the knowledge economy approach. The list of recommendations includes the following: the development of Material Flows Analysis and environmental accounts, further research on the role of natural resources in the economy and the barriers to improved resource productivity, the development of resource productivity proxies and measurements, an assessment of existing information providing bodies (and by implication a strengthening of the function), a programme of awareness-raising around resource productivity issues, an extension of environmental reporting by major companies, a connection of sustainability issues across departments and their internalisation into Treasury assessments, possible indicative targets, and support of conversion initiatives through advice, finance, public procurement and improved training and education.[115]

These are all necessary elements for a new resource productivity policy, but as a programme they need more specificity and scope. The impact on waste minimisation of the proposals for self-monitoring through the publication of environmental reports, for example, will depend on the nature of the reporting: what is covered, how far it extends into the issues covered in Design for the Environment and so on. As we noted earlier there is pressure for environmental reporting from insurance companies and pension funds, which have an interest in the real progress being made rather than its presentation. Thus, much rests on the degree to which the format and substance of reporting reflects the wider perspectives of Zero Waste.[116]

Self-reporting needs to be supplemented by enhanced rights and resources for independent environmental

auditing bodies, and by schemes such as eco-labelling, or the successful environmental league tables in Indonesia in which a ranking of the environmental performance of major firms is published, with those at the bottom given notice before publication to provide them with an opportunity for improvement. In an era when major companies are more than ever dependent on the integrity of their brands, the opening of the environmental books becomes a powerful policy lever that works through the market, via the impact of both green consumers and ethical investors.

Secondly, the data on industrial and commercial waste needs to be regularised and extended. Waste Strategy 2000 set a target of a 15% reduction on 1998 levels for commercial and industrial waste going to landfill by 2005, which is some five million tonnes. The way in which this might be measured is by data from landfills, but this does not allow the targets to be made firm or sector specific. As far as data on the latter is concerned, the Environment Agency carried out a National Waste Production Survey of 20,000 firms in 1998, the first of its kind for many years. But this is not being repeated, it is said, because of a shortage of finance. Yet it has to be recognised that information of this kind is as critical for effective policy and industrial change in this field as it is in the macro control of the economy.

Thirdly, the proposals for further research and for technological support need to be brought together and responsibility for them placed in a Clean Production Centre. This is an idea proposed by the OECD and implemented in a number of OECD member countries. The main purpose of such centres is to act as an entrepreneurial driver of the new materials policy. The Centre would promote clean production research, design for the environment initiatives, and the extension of Zero Waste advisory services, and in particular would:

- undertake and/or sponsor sectoral, material and process specific research;
- provide a link between independent research institutes and firms on the model of the successful Steinbeis foundation in Germany;
- produce manuals and provide advice on waste reduction, feedstock substitution and materials efficiency;
- supply relevant market and technical information to small and medium firms.

Above all it would be charged, like the Carbon Trust, with animating change.[117]

One option would be to attach it to the Carbon Trust, whose terms of reference already include advice on waste reduction. As we have seen there is a strong interconnection between advice on energy, water and waste reduction, and between their effects. The scope and resources of the trust could be expanded to take in the promotion of innovations for increased materials productivity as well as energy efficiency.

Even if established separately the trust should remain closely linked to the Carbon Trust (and to WRAP) and would be funded in a similar way with resources drawn from the Climate Change levy and from increments in the landfill/disposal tax.

A policy package

The three approaches outlined here are not alternatives. Nor are they mutually exclusive. Each provides an innovative entry point for policies that promote the changes necessary for Zero Waste. They also provide a range of instruments, which largely complement each other, and which can be further linked to more established policy tools such as regulations and public purchasing. As can be seen in the case of energy efficiency, once the goals are clear, a variety of tools can be drawn on to change the course of production and the nature of innovation in any industry.

The central point again, as in the case of municipal waste, is a clarity about goals. There may be strengthening independent pressures upon the corporate world to improve environmental performance, but these need to be contextualised within a clear government perspective. The government alone can provide leadership and purpose on issues that span the range of particular interests.

Business itself recognises this. The Advisory Committee on Business and the Environment gave priority to its recommendation that: 'government makes clear to business the broader goal of resource productivity in its policies on waste minimisation and reducing waste to landfill'.[118] The role is one of intellectual and policy leadership.

In the case of energy and climate change the ground has been well set, and the work of translating it into immediate policy was undertaken by a small task force led by Lord Marshall.[119] In the case of materials productivity and materials substitution, the new perspectives are less widely known.

- **The government should establish a Design for the Environment Commission.**

The Commission should identify the potential of these innovations in the UK context, draw up a programme for conversion, establish a set of targets and develop the policies needed to achieve them. The Commission would be made up of leading international specialists in the field of the green materials economy together with their equivalents in the UK. Their report should set out the new paradigm of green production. The policies to promote it should provide the incentives and make the sources of advice and information available for those who choose to pursue the approach. A report of this kind would provide the basis for synthesising the work of government and industry in this field.

This is a first step. At the same time, an immediate start should be made on extending the idea of industry agreements introduced as part of the Climate Change levy. In this instance the agreements should not be negotiated solely with firms, but with groups of firms engaged in a particular product chain or production of materials.

One initiative of this kind which has been in operation for more than a decade is taking place in Holland. In 1989 the Dutch Parliament established a waste minimisation target of 10% by 2000 which was applied (flexibly) to 29 priority waste streams. For each of the streams, waste minimisation plans were drawn up through consultation between industry and government, and these were then translated into individual company environmental plans. The sectoral plans were embodied in covenant agreements between the industries and the government, and all companies in the sector or chain were issued with a handbook setting out the goals of covenant and a list of possible minimisation measures. Headway was made most rapidly with sectors which already had integral environmental tasks, such as the chemical industry, paper and paper goods and the dairy industry, but the work was then extended to other groups.[120]

Processes of this kind are already taking place in the UK around producer responsibility programmes, but there is a strong case for widening their scope and extending them to other sectors within the framework of national waste reduction targets. In particular sectoral working groups should consider how actions taken in the field of materials efficiency, product performance, product life extension and feedstock substitution could be linked to the CO2 reduction targets and future emissions trading.

National and local

The emphasis of industrial Zero Waste policy has been on actions to be taken by national government. But within a new policy framework there is much that local and regional government can also do. The national Clean Production Centre should be established with a network

of regional sub-centres. Local and regional government, and the regional development agencies, can play a role as a link between existing environmental research institutions and local industry. There is scope for using public purchasing to encourage Zero Waste companies, and to work with them and other institutions on local reuse and CO2 reduction schemes.[121] Above all, they can use their central information and material role as recyclers and disposers of municipal waste, to connect into the wider project of Zero Waste.

XI **Conclusion**

The environmental critique of modern production has advanced on two fronts: sources and sinks. One has highlighted industrialism's devastation of certain natural resources and ecosystems, the other the pervasive pollution from its wastes. There have been attempts in each case to provide remedies in isolation: to develop sustainable forestry at one end, for example, or to install pollution control equipment at the other. Both have had an impact – but both find themselves holding back the growing demands for new resources, and the growing quantity of wastes, as a sea wall holds back the pressures of a rising tide.

If the relentless growth of global material production is to be outpaced, the problems of sources and of sinks cannot be solved in isolation. They have to be seen as parts of a wider chain of production and consumption that must be reconfigured as a whole. The issue is one of changes in productive systems – how products and processes are designed, how they operate and how products and materials, once used, return again to the circuit of production.

The major transformation now being demanded in agriculture, where intensive farming is both depleting the soil and leaving residues – whether in the area of nitrogenous run-off or toxic middens – illustrates the point, as do the shifts taking place in the energy sector and in transport. In each case, the critique has broadened from an identification of particular environmental problems to a challenge to the economic architecture of the productive system as a whole. Whether for food, power or mobility the movement for reform is now being framed in terms of how needs are being met – and how they could be met differently in ways which would work with the grain of social and natural ecosystems rather than against them.

Beyond the waste ghetto

Zero Waste should be seen in this light. Much has been done since the early 1970s to reduce the pollution stemming from waste disposal and to encourage the reduction of waste. Yet the volume of waste and the problems resulting from it have continued to increase. This is how Joke Waller-Hunter, the OECD's Director of the Environment put it in 1999:

"Despite nearly 30 years of environmental and waste policy efforts in OECD countries, the OECD-wide increase in waste generation is still in 1:1 proportion to economic growth. A 40% increase in OECD GDP since 1980 has been accompanied by a 40% increase in municipal waste during the same period …Consumer spending also follows these trends. According to our colleagues in the Economics Directorate, there is expected to be a 70%-100% increase in GDP by the year 2020 in the OECD area. I would personally not like to imagine a world where municipal waste generation is also 70%-100% higher than the already high levels of today".[122]

What was initially conceived as a confined policy problem had by the late 1990s become a gathering environmental nightmare, which led to waste being named as one of the 'red light' issues in the OECD's Environment Strategy in 2001.[123]

The first policy focus has been to improve the safety of the waste disposal sinks, the second to reconnect waste to industrial production through recycling. These have both been advanced from the end of the pipe – through the conduct of waste management. Yet, in Britain at least, the connections between recycling and the processing industries have been weak. Municipal recycling has been treated first and foremost as an 'option' for waste management. Its main perceived significance has been as a means of reducing the quantities of waste for disposal rather than providing high quality feedstock for industry. Only now, with the establishment of WRAP, are the connections between the recyclers and industry being systematically constructed so that the market for materials becomes not a problem but a raison d'être of municipal recycling.

'Low road' recycling has always faced difficulties as long as it remained primarily a waste disposal option. The various attempts to recycle or compost mixed waste have been gradually abandoned, in favour of a policy of source separation. Once waste materials are examined separately, the problems of quality and marketability are continually posed. What is the market for municipal compost if it contains high herbicide residues in garden waste, or contaminated meat in putrescible scraps? What is the value of plastic lined steel cans and plastic composites? What is it in the construction of a toaster that makes it difficult to repair? What are the economics of glass and plastic bottles that makes the industry so reluctant to reuse?

In each case, waste managers may conclude that the materials are unrecyclable, or that it makes no economic or even environmental sense to do so. But the problems of disposal push the question back on the table and pose it the other way round, namely: what would be required to make such a material technically and economically recyclable? Such a question takes waste managers beyond the end-of-pipe boundaries. It leads necessarily to questions about waste production, and waste production in turn leads on to issues of industrial design and manufacturing processes.

This is the first connection. The second is that between recycling and the other great arena of environmental concern – the sustainability of resources. Composting comes to be recognised as important not simply as a means of diverting bio-degradable waste from landfill, but of contributing to soil restoration and the fight against desertification. Or take paper. Recycling one tonne of waste paper preserves 17 trees. A modern recycling mill therefore saves five million trees a year. That is a measure of the importance of recycling. It shows how the problems of sinks and sources are linked and how they both, in their own way, flow into the wider questions of production.

The argument of this book is that waste cannot be treated in isolation. Attempts to do this whether using old or new technologies are necessarily limited for three reasons: first, the landfilling and incineration of mixed waste has been unable to eliminate the hazards associated with each. They can confine and attempt to manage them, but as regulations tighten, costs increase and the problems of everyday operation – of accidents, fires, malpractice, material failure, seepage and the scattering of toxic residues to air and water – continue to reappear.

Secondly, the disposal of waste removes materials from their cycle. Modern forms of disposal and pre-treatment are designed to generate some energy or material from the waste stream they deal with. Landfills produce harvestable bio-gas. Incinerators generate energy and extract low grade metal from their ash. Mixed waste composting produces a grey compost high in heavy metals which is sometimes used for landfill cover or land reclamation.But these represent no more than the salvage of resources during a process of destruction and bear no comparison with the resource savings from source separated recycling and composting.

Thirdly, restricting the problem of waste to that of its disposal is to sacrifice its role in the environmental transformation of industrial production. Landfills and incinerators ask no questions. They take what comes to them. They are driven by the requirement to operate within regulations at least cost. There are few prizes given for the cleanest landfill or the lowest emission incinerator. They have no incentive to hunt out the batteries in a consignment of mixed waste. If a load of PVC arrives at an incinerator, the issue is how to phase in its combustion in order not to exceed emission limits, rather than whether or not to divert it elsewhere. Far from having an interest in reducing hazards, disposers stand to benefit from them, hazardous and clinical waste disposal being at the top of the waste price hierarchy.

Much the same can be said of 'low road' recycling, whether its aim is to divert from landfill or to meet government targets. It, too, is passive. Its dynamic is not to connect back to the industrial circuit to recover high value material or pre-empt toxic waste. Rather the effort is put into contesting regulations, and once they are set, into finding ways to meet their formal requirements at least cost. In this context a target or regulation is seen as a burden, not as an invitation to innovate.

Zero Waste has a different perspective. Waste is a sign of failure of industrial design. It is a symptom of wider issues. While waste has to be managed, the aim of Zero Waste is prevention, and the development of circuits that slow down the entropy of energy and materials and enhance nature's metabolic process. As Michael Braungart remarks, waste must equal food:

"The amount of organic waste produced by ants is more than four times higher than that produced by the six billion people in the world. But ants are not an ecological problem – they return all products of metabolism to various cycles. Nature knows no waste. All products of metabolism are recycled as 'food' for other organisms.[124]

Zero Waste seeks to understand why these circuits have broken down and how they can be restored. Whereas traditional waste management was geared to making waste invisible, Zero Waste aims to increase its visibility. Recyclers undertake waste audits and follow material flows. When they collect, instead of the closed wheeled bin, they use open plastic boxes. Instead of black bags, the new Italian collection systems provide transparent bags for food waste and residuals. The civic amenity sites (and in New Zealand many of the landfills) are no longer organised as inaccessible places for disposal, but as reception centres for recycling, reuse and repair – extensions of the car boot sale. The last few years have seen the reclamation of waste as a source of education and entertainment. Schools establish wormeries and include waste in their curricula. Communities ask for transparency in the monitoring of waste facilities and finance their own

testing. Never has waste been so closely inspected, watched, tested and discussed.

The reason for this renewed visibility is so that all those involved in producing and handling waste can distinguish those parts of it that can be returned to production, from those parts which should not have been produced in the first place. I have argued that one of the important things about waste is that it is a vantage point for assessing the sustainability of modern industrial processes. Waste and its management serve as a stage of quality control for the whole system, tracing back defects (bad waste) to their source. To confine waste management to disposal or to passive recycling is to neglect its role as a point of innovation for clean production.

A similar point applies to waste management's new role as a link in the biological and technical circuits. It is no longer a terminus but a critical interchange in the process of material circulation. As such it needs to be integrated with the producers of waste on the one hand, and the users of the reclaimed materials on the other. Modern recycling no longer acts solely as collector and merchant, but as an active player in the system of knowledge production. Its starting point may be the channelling of unwanted material back into useful production, but it then acts as a promoter of new uses for old materials and of new materials (and products), both of which serve to increase the resource productivity of the system as a whole.

The most innovatory institutions in the new waste management have played this intermediary role, with engineers, material specialists and market researchers working alongside local industry on secondary material use. They have combined technical advice and research and advised regulators on new standards. In parallel, producer responsibility legislation encourages industries to assume these functions on their own behalf – sub-contracting the collection and sorting function – while undertaking their own programme of research and re-design to improve the life cycle of products and materials.

Zero Waste is not simply a form of waste management. It is a programme for innovation and industrial transformation. The construction of an incinerator or any of its chemico-energy variants undercuts this dynamic. It rests on the proposition that waste can be dealt with on its own terms, without venturing into the territory of how it is produced, or how materials could be reused most effectively. It poses its own set of questions – to do with economies of scale and how to control pollution – and maps its own political territory (covering planning permissions, local opposition and the terms and enforcement of regulations). It is inward looking, defending its interest politically against external pressures, rather than outward looking with a focus on wider industrial change.

As a result, while the construction of a new incinerator claims to answer some immediate issues of waste disposal, it sidesteps the association, in Waller-Hunter's words, 'between waste generation and climate change, deforestation, toxic substance releases, biodiversity loss, increased soil erosion and other problems.'[125]

It also fails to connect to the social and economic potential of Zero Waste. Waste prevention and recycling offer scope for local and regional industrialisation, urban regeneration, a range of 'green collar' jobs, and a means of improving environmental equity. One of Walter Stahel's main points is that lengthening product life entails a major substitution of labour for energy and materials, requiring as it does the development of regional repair workshops and the development of local loops for dematerialised fashion goods, and the taking back of goods for remanufacturing.[126]

Productive systems

Through waste, as through the pressures on natural resources, the environmental imperatives have forced a redefinition of the categories used to analyse the economy. Instead of the segmentation of linear production – primary

materials, manufacturing, distribution, consumption and waste – environmental economists distinguish between different productive systems. They classify by sector or by material or social need, within a wider environmental system, and speak of an industrial metabolism and of material circuits, rather than the monetary flows of macro economic analysis.[127]

Zero Waste is therefore at root a productive systems perspective. As such it deals with complexity and multiple connections. It is also centrally about change. In terms of economic thought it speaks the language of Schumpeter rather than Smith, of destruction and innovation rather than market equilibrium. In its mainstream form, its analytical dynamic comes from the tension between the material demands of modern industrial production and the ecological limits of the natural world. Out of this tension comes the problematic of alternatives. Zero Waste is about different paths of development of productive systems.

New approach to policy

I have suggested that Zero Waste also involves a new approach to policy. This is necessary for three reasons. First, attempts by a central body – whether state or corporation – to manage a complex system by means of traditional forms of centralised command and control are bound to fail. As corporations have grown they have faced this core organisational problem, and the history of the current industrial era is one of experiments in organisation which combine decentralisation and synthesis in a way that allows innovation to flourish. States have faced a similar problem, one that is at the centre of discussions on the shape of a new regime for waste.

Secondly, waste and the green materials revolution pose questions of interdependence that cannot simply be solved by market instruments based on individualised property and responsibility. As Ulrich Beck puts it, technology has advanced to the point where individualised liability breaks down. This is true both of environmental effects and of changes in productive systems that are needed to minimise these effects. Policy therefore has to find new ways of dealing with socialised responsibility and interdependent production.

Third, the reduction in waste and changes in material production – because of their systemic character – have multiple impacts which demand a rewiring of traditional departments of the state. Joined up government is a way of talking about the need for new means for governing productive systems. An initiative may not meet the economic criteria in terms of the desired outcomes of a single department, but would pay its way if multiple outcomes were taken into account. Zero Waste produces multiple dividends, and this poses a challenge to existing structures and forms of assessment within government.

The discussion of British policy has explored some of the issues and innovations in the instruments of government in relation to waste and materials productivity, with the following conclusions:

- there is a central place in modern environmental policy for government leadership and a clear vision of the long term alternative. This provides the synthesis of perspective which is necessary for systemic change. Without it both government and industry will fragment into particularistic policies;

- producer responsibility is an innovative way of dealing with interdependence. Policy identifies groups of actors – in this case firms in a product chain – who can be collectively held responsible for a set of environmental effects, and asks them to develop alternative solutions. Government sets the parameters and targets and the group of actors decides how to meet them;

- fiscal policy can be used to support the process of environmental transition by recycling funds through hypothecation, or other tax/benefit packages, from one set of practices (or actors) to another. to another.

- Central government intervenes in the process of these financial flows, and may negotiate directly with large firms or groups of firms as to the terms on which the financial benefits are forthcoming. The energy efficiency agreements are an example of this and instruments of this kind could have wide ranging application in the field of materials and municipal waste, in the latter case through an expansion of public service agreements. They are a form of collective contract or, as the Dutch put it, a covenant;

- considering the conversion of industry towards Zero Waste through the lens of the knowledge economy places information and its circulation at the heart of new systems of government. How information flows within the system, particularly to those governing the system from the centre (whether government, industry or civil society) becomes a central issue, as do the sources of knowledge of those with responsibility for production (from households which compost, to large scale manufacturers). Zero Waste is information-intensive both as a system of production and a system of government;

- a key role is played by institutions that mediate between the three main spheres of the economy – the private market, the state and the household. These may be non profit companies carrying through entrepreneurial public functions on behalf of the government (as in the case of WRAP or the Carbon Trust), or community recyclers working at the interface between households, local government and material markets. The new form of governance has a central role for the third sector;

- finally there is the issue of the role of the market and regulation. My conclusion here is twofold. First markets and regulations are not alternatives. They are inter-dependent. The issue is not market versus regulation, but what kind of market and what kind of regulation. Second, Zero Waste requires more of both; on the one hand a greatly expanded use of market instruments adjusted to provide the necessary incentives; on the other a strong environmental state to provide direction, to structure the market and administer a limited range of regulations. The market cannot do these things on its own.

As far as waste in the UK is concerned, the post neo-liberal period in the 1990s simultaneously weakened government in a sphere of environmental policy that required strong public leadership, and failed to structure a system of incentives which would encourage markets to work towards ends that were commonly agreed. This is the reason why British waste policy has failed in its own terms, and has left the UK so far behind in the progress towards a waste minimising economy.[128]

At the same time a range of policy instruments were developed, which, if reformulated, have the potential to create the economic climate, the incentives, the intermediary institutions and the social knowledge necessary for the programme of conversion which Zero Waste entails.

I have suggested that there are multiple outcomes from Zero Waste. There are also multiple paths towards it. An immediate one is the recycling and composting of municipal waste. The targets for this should be set high, both because of the urgency of the environmental issues at stake, and in order to focus the attention of all those engaged in municipal waste management on the central issues of transition. But industry itself should advance in parallel. It, too, should have ambitious targets, not just for each firm individually, but for the product chains of which they form a part.

For all those engaged in this work, Zero Waste should be understood, in a pragmatic sense, both as a target and a methodology. But it also represents a wider project - the redesigning of the system of industrial production and consumption to meet the imperatives and desires of a post-industrial age.

Endnotes

[1] For a brief summary of the scientific evidence, see P.Montague, 'Landfills are Dangerous', Rachel's Environment and Health Weekly no 617, 24th September 1998. This includes British cases.

[2] P.Elliott et al, British Medical Journal, August 17th 2001 and the Department of Health website. This study was commissioned in 1998 after the results of a major European study which looked at 21 sites, 10 of them in the UK, and found an increase of foetal malformation for women living within 3 km of a landfill site. Other UK government studies are now attempting to measure the air emissions and leachates from landfill sites.

[3] M.Ritter and B.Gugele, 'Annual European Community Greenhouse Gas Inventory 1990-1999', European Environment Agency April 2001.

[4] 'NIMBY' is an acronym for 'not in my back yard'.

[5] Among recent major campaigns against landfills in the UK, particularly notable have been those preventing the expansion of major landfill sites in Belfast, Cornwall, Kent and West Lancashire, and the closure of the Nant-y-Gwyddon landfill in the Rhondda.

[6] For Europe see European Environment Agency, 'Environment in the European Union at the turn of the Century', Copenhagen 1999 and J.Schmid, A.Elser, R.Strobel, M.Crowe, 'Dangerous Substances in Waste', Technical Report no 38, European Environment Agency, February 2000.

[7] A good recent survey of the scientific evidence on incinerators and pollution can be found in: M.Allsopp, P.Costner and P.Johnston, 'Incineration and Human Health', Greenpeace 2001.

[8] In the case of the largest UK incinerator, at Edmonton in North London, it was found that highly toxic mixed fly ash and bottom ash was being landfilled in Essex, stored in open heaps in East London, and used for road construction and as housing materials. Tests of the East London heaps found dioxin levels ranging from 241 to 946 nanogrammes (ng) per kg, in line with the 735 ng per kg level established by the incinerator operator in its mixed ash, and well in excess of the 50 ng per kg levels judged acceptable by Germany for ash levels in soil or public places such as children's playgrounds. Even higher levels were found in samples from the 44 allotments on which 2,000 tonnes of ash had been deposited from the Newcastle incinerator at Byker, in one case the level reaching 9,500 ng per kg. The Byker tests also found high lead contamination, with 19 of the allotments tested showing levels above those (331 milligrammes per kg) that led to closure of the nearby City Farm. In the light of the findings from Edmonton and Byker, the Environment Agency launched an investigation into the fate of ash from all 11 municipal incinerators.

[9] Among UK plants that have been shut for reasons of fire and explosion in recent years have been the municipal incinerator in Dundee, and SITA's tyre incinerator in Wolverhampton. On the Wolverhampton plant see the ENDS Report no. 313, February 2001.

[10] The Edmonton incinerator, which was upgraded in 1996, registered nearly 1,800 exceedances with the Environment Agency between 1996 and 2000, exceedances being defined as emissions of 150% over the legal limit for at least an hour. It was only prosecuted once.

[11] The controversy over the operation of the Byker plant and its residues is only one of many waste scandals to have occurred internationally in the 1990s, in spite of modern regulatory structures being in place. In the case of Byker, the problems of ash contamination were first raised by the local allotment holders who funded their own tests, and together with the trade union at the plant, have had to engage in an 18-month dispute over the conduct, results and interpretation of official tests and the action stemming from them. This has culminated in a two-month 'citizen's inquiry', chaired by Andrew Bennett M.P., that has widened the issue into an investigation of Newcastle City Council's waste management strategy and the alternatives. On the centrality of contested science and information in contemporary environmental politics see Ulrich Beck, Ecological Politics in an Age of Risk, Polity Press, 1995.

[12] A survey of 4,000 UK landfill sites in 1993 found that 230 had suffered a major pollution incident, one third of them being modern 'containment' sites, and 10 of them having been started after 1990. 'The Waste Manager', March 20th-22nd 1994, cited in Williams P.T, Waste Treatment and Disposal, Wiley 1998 p.267.

[13] US Environmental Protection Agency 'Greenhouse Gas Emissions from Municipal Waste Management' September 1998 ES-1. This is the final draft which was modified to take on board a number of contested arguments by proponents of incineration: even so the greenhouse gas savings from recycling exceeded those from 'energy from waste' incineration by a factor of four.

[14] D.Gielen and T.Kram, 'The MATTER project on integrated energy/materials strategies for Western Europe', Paper to the ETSAP

workshop, May 1998, Berlin.

[15] USEPA 1998 op.cit.

[16] The model was developed by the Canadian consultancy firm REIC on the basis of waste composition and recycling studies in the UK. The results are reported in R. Murray, 'Creating Wealth from Waste', Demos 1999, p.39.

[17] The link between reducing and recycling waste and global warming has still to be recognised between (and even within) ministries in the UK. The DETR White Paper 'Climate Change: the UK Programme', published in November 2000 contained only three brief references to waste and gave it only marginal importance in the overall Strategy (pp 38, 81 and 184). The same Department's 'Waste Strategy 2000' treats the overall climate change impact as contingent on the specific circumstances of material and place, and suggests (on the basis of a report by the incineration-associated consultancy AEA Technology) that the new Strategy and the impact of the Landfill Directive will have only a marginal impact on carbon emissions (a reduction of 0.1-0.4 million tonnes). See Department of Environment, Transport and the Regions, 'Waste Strategy 2000', HMSO, Vol. 1 p.18.

[18] R.Lal 'Soil conservation and restoration to sequester carbon and mitigate the greenhouse effect', III International Congress, European Society for Soil Conservation, Valencia 2000.

[19] E.Favoino, 'Composting: a backbone of intensive recycling schemes' in: Ecologika, 'The Potential for a Recycling and Composting Led Strategy in Greater Manchester', Technical Papers, Greater Manchester Waste Disposal Authority, December 2001, p.5.

[20] D.J.Gielen, 'The MARKAL systems engineering model for waste management', paper prepared for the workshop 'Systems engineering model for waste management' Gotteborg, 1998.

[21] The arguments on the environmental benefits of recycling as against incineration, in particular with respect to plastics and paper, are more fully discussed in the London recycling plan prepared by Ecologika for the London Planning Advisory Committee and the Environment Agency, 'Re-Inventing Waste: Towards a London Waste Strategy', London 1998, Chapter 4.

[22] P.Hawken, A.B.Lovins, L.H.Lovins, Natural Capitalism, 1999, p. 3.

[23] European Environment Agency, 'Environmental Signals 2000', Copenhagen 2000, p.102.

[24] This is the argument of much footprint research, which calculates the ecological footprint of contemporary modes of production. One example of this work, which looks inter alia at waste in the UK, is a study of the Isle of Wight funded by the waste company Biffa, which showed that the per capita footprint of the islanders was 2.4 times the size of the island, marginally less than the 2.5 ratio for the UK as a whole. See Best Foot Forward and Imperial College, 'Island State: an ecological footprint analysis of the Isle of Wight', Biffaward, 2000.

[25] A.Adriannse, S.Bringezu, A.Hammond, Y.Moriguchi, E.Rodenburg, D.Rogich and H.Schultz, 'Resource Flows: the Material Basis of Industrial Economies', World Resources Institute, Wuppertal Institute, Netherlands Ministry of Housing, Spatial Planning and the Environment, National Institute for Environmental Studies, Tsukuba, Japan, April 1997.

[26] Performance and Innovation Unit, Cabinet Office, 'Resource Productivity: Making More with Less', November 2001.

[27] For accessible versions of the argument see E.von Weizsacker, A.B.Lovins and L.H.Lovins, Factor Four, Earthscan 1997, P.Hawken, A.B.Lovins, L.H.Lovins, Natural Capitalism, op.cit.

[28] G.Gardner and P.Sampat, 'Mind over Matter: Recasting the Role of Materials in Our Lives', World Watch paper 144, December 1998, p.26.

[29] 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.

[30] On the expression of social identity through things, including the old and the new, see the work of Pierre Bourdieu,and in particular his remarkable book Distinction: a Social Critique of the Judgement of Taste, Routledge, 1984.

[31] This definition came from the Commission's 1992 Report. It is quoted in J.Thornton, 'Pandora's Poison: Chlorine, Health and a New Environmental Strategy', MIT, 2000, pp. 347-8.

[32] Many examples of clean production initiatives are contained in the Journal of Cleaner Production, Elsevier Science. See also Thornton op.cit. Chapter 9.

[33] See E.Favoino, 'Trends in the Treatment of Organic Waste in Europe', in: Ecologika, 'The Potential for a Recycling and Composting Led Strategy in Greater Manchester', part

1, Greater Manchester Waste Disposal Authority, December 2001.

[34] These points echo a number made by two Cranfield design engineers, Chris Sherwin and Tracy Bhamra, in their paper 'Beyond Engineering: Ecodesign as a proactive approach to product innovation' in 'The Proceedings of Ecodesign 99: First International Symposium on Environmentally Conscious Design and Inverse Manufacturing', Tokyo, February 1999, pp 41-6. Their concern was with the product-centred, incremental use to which LCA has been put, rather than its use for designing new products and systems.

[35] M.Braungart and W.McDonough, 'Design for Reincarnation', Resource, April 2000. See also their article 'The Next Industrial Revolution' in Atlantic Monthly, October 1998.

[36] Op.cit.

[37] For North American and UK evidence see R.Murray, 'Creating Wealth from Waste', op.cit. Chapters 4 and 5.

[38] There are reports of some US recycling programmes being cut back for these reasons, losing their momentum, their political support and in the end their budgets. See Institute for Local Self Reliance, 'Wasting and Recycling in the United States', 2000, Grass Roots Recycling Network, Athens GA, 2000.

[39] Flexible specialisation is a term coined by C.Sable and M.Piore in their book, The Second Industrial Divide, Basic Books 1984, which was one of the first to recognise the character of the new paradigm. The new paradigm has also been referred to as Just-in-Time Production, Post-Fordism and Flexible Manufacturing. See also a key early work on the subject, M.Best, The New Competition, Polity 1990.

[40] Two of the most successful recyclers have been the Salvation Army and Oxfam – though neither has yet ventured into multi-material kerbside collection. The 250 members of the Community Recycling Network together are the largest kerbside recycler in the UK.

[41] One example arose when it was discovered that the Audit Commission and the DETR, under pressure from industry, had classified the reuse of toxic incinerator ash for construction as recycling, with the result that the best way of meeting the government's recycling targets would have been to incinerate all combustible waste in order to maximise the residual ash. This ignores (as do many other definitional disputes) the issue of the quality of recyclate discussed earlier.

[42] This is recognised in the EU working document on a future Bio Waste Directive, where separate biowaste collections are proposed for all towns and cities with more than 100,000 population within three years of the Directive coming into force, and all towns and villages with more than 2,000 inhabitants within five years. The collections should be planned for household waste, as well as for biowaste from restaurants, hotels, canteens, schools, public buildings, shops, markets, food businesses and shops. See: European Commission, Working Document, 'Biological Treatment of Biowaste', 2nd draft, Brussels February 12th 2001.

[43] One of the UK's leading recyclers, the community enterprise ECT, uses acorn group marketing data, gathered by postcode, to estimate the composition and quantity of waste from any particular locality – on the basis of which it plans its rounds, forecasts its quantities of captured recyclables and estimates performance.

[44] The UK system of collection and disposal credits provided for such transfers between separated authorities, although collection savings have often been difficult to capture because of the lack of flexibility in contracts. In 1999/2000 Disposal Authorities paid an average of £23.87 for avoided disposal on 1.1 million tonnes of recycled or composted material, but only £0.92 for avoided collection on 32,000 tonnes diverted.

[45] G.Gardner and P.Sampat, 'Mind Over Matter: Recasting the Role of Materials in Our Lives', Worldwatch Paper 144, December 1998, p.15.

[46] L.D.Simone and F.Popoff, 'Eco Efficiency', MIT, 1997, p.3. The authors were at the time Chairman of the Minnesota Mining and Manufacturing Co. and of the Dow Chemical Company respectively, and chaired the WBCSD working group on eco-efficiency. See also N.Nemerow, Zero Pollution for Industry, John Wiley, 1995.

[47] For examples of waste reduction see L.D.Simone and F.Popoff op. cit., and the United Nations University Zeri Project for example of zero emissions.

[48] The problems of extending 'environmental management systems' (EMS) to product design and development is discussed by G.Ries, R.Winkler and R.Zust in 'Barriers to successful integration of environmental aspects in product design', in: 'EcoDesign '99. Proceedings of the First International Symposium on Environmentally Conscious Design and Inverse Manufacturing', Tokyo February 1999 pp 527-532. The discussion relates to experience in Switzerland. Although they highlight the difficulties, it is clear from their paper that the push for effective integration between EMS and product design is

strong, and that increasing numbers of firms are internalising environmental issues in their research and development (60% of 250 firms surveyed were integrating in this way in 1997/8, up from 20% two years earlier).

[49] For a remarkable analysis of the chlorine industry from this perspective, see J.Thornton, 'Pandora's Poison', op. cit. MIT 2000.

[50] See W.R.Stahel, 'The service economy: wealth without resource consumption?', Philosophical Transactions A, Royal Society, London 355, (June) pp 1,309-1,319. See also O.Giarini and W.R.Stahel, The Limits to Certainty, 2nd edition, Kluwer Academic Publishers, 1993.

[51] The auto project is one on which Michael Braungardt has been working as an exemplar of the new low resource economy.

[52] The Product Life Institute, 'The Shift from Manufacturing to a Service Economy 1998-2010', Geneva, p.165 (the report is available for US$/Euro 5,000 from the PFI, PO Box 3632, CH 12ll Geneva 3).

[53] See David Morris 'Building a new carbohydrate economy', Renewable Energy World, Vol 4 no 5, September-October 2001.

[54] Franklin Associates estimates that the new material 'Ecolean' has between 30% and 70% less environmental impact than the glass, laminated cardboard and aluminium it is designed to replace.

[55] Henry Ford made some trenchant observations in his autobiography on the old engineering order who dismissed his initiatives as unworkable, see My Life and Work, Heinemann, 1924.

[56] On the early development of the opposition to incineration in the US see B.Commoner, Making Peace with the Planet, Gollancz, 1990, Chapter 6.

[57] Sweden in 1990 relied on landfill and incineration in broadly equal proportions (44% and 41%) with recycling and composting accounting for 16%. In that year they amended their Solid Waste Act to set out the principles of Producer Responsibility and encourage dry recycling. Producer Responsibility legislation and subsequent ordinances were introduced in 1992-4, covering packaging, tyres and waste paper. By 1997 recycling and composting had reached 33% and they are presently in line to rise much higher when the ban on organics to landfills comes into force in 2005. In France, recycling was overshadowed by incineration until 1999, when the Environment Minister ordered the closure of 20 high polluting incinerators (with a further 40 on probation) and ordered waste plans to be redrawn to given greater emphasis to recycling.

[58] The Dutch programme was in part a response to dioxin scares in the late 1980s, when high dioxin levels in cows' milk and dairy products were traced to incinerator emissions. It was found that none of the incinerators were complying with the required standards. After the rebuilding programme, there have been regular surveys which are still finding that not all the new generation of incinerators comply with the strict standards the Dutch have introduced.

[59] The Bio-Waste Directive was planned as a compliment to the Landfill Directive (for details see footnote 42 above).

[60] See the Commission's proposals for the sixth EC Environment Action Programme, published in February 2001 (ENDS Report 313, pp 46-48) and the speech to the European Waste Forum on June 21st 2001 by the Environment Commissioner Margot Wallström, which hinted at a possible shift away from product-based EC producer responsibility initiatives to a broader, materials-based policy.

[61] The Italian Decree no 22, which implemented a number of EU Directives, included a provision that all non-hazardous waste must be disposed in the region where it is produced.

[62] See Roger Crowe, 'Green finds a primary role in the boardroom', Financial Times April 12th 2001.

[63] The nuclear industry, for example, found itself beached in the 1970s as the result of concern about emissions, the disposal of nuclear waste and the cost of decommissioning. The phaseout of PCBs, CFCs and asbestos threatened firms dependent on these materials. Pesticide producers have found themselves attacked from four directions – the impact of pesticides (particularly those based on organochlorines) on workers in pesticide factories, on the farmers applying them, on water quality and on consumers of food with pesticide residues. In some instances the compensation claims for pollution incidents made on manufacturers (notably Union Carbide at its Indian Bhopal plant) have been so large that they have led to the rapid collapse of firms internationally.

[64] The pressure on major companies in the UK to incorporate environmental considerations into their decision making has been increased by the recent conclusions of the Turnbull Committee on corporate governance, which establishes guidelines for the management of environmental risk.

[65] R.Slater, 'State of Composting in the UK', Materials Recycling Handbook, Emap, 2001.

[66] John Gummer, for example, overrode the advice of his civil servants in allocating £12 million Capital Challenge funds to London boroughs because the Boroughs had produced detailed plans that promised a significant expansion of recycling in London. There are many similar examples from the period of office of Michael Meacher.

[67] Merrill Lynch, 'Pollution Control', September 1998 p.7

68 The system of recycling credits applied a parallel principle within the public sector, with provisions for arms length inter-authority transfers (according to disposal costs saved) that served as a price supplement.

[69] See the controversy surrounding the report by the Environment Agency Board member Paul Dalton on the inadequacy of the EA's regulatory practices on the ground, 'Just Who Does the Environment Agency Protect?', August 2001. A summary of the controversy appeared in an article by Paul Brown in the Guardian, September 12th 2001.

[70] John Turner in evidence to the House of Commons Select Committee on 'Delivering Sustainable Waste Management', op, cit. 'Minutes of Evidence' p.89.

[71] There are 15 compliance schemes, the largest of which, VALPAK, represents 3,000 of the obligated parties and accounts for 60% of the compliance 'market'.

[72] The Environment Agency estimates are contained in their nine regional strategies published in 2001. The results of the waste strategy model and a summary of the Landfill Directive RIA model results are contained in Annex B of 'A Way with Waste', DETR, 1999, Volume 2 pp 148-160.

[73] Manchester Waste Limited and the Manchester Waste Disposal Authority have been in dispute with the Environment Agency over the classification of the organic output from their mechanical treatment plants, which at the moment is classed as non-inert waste and subject to the landfill tax. See the House of Commons Select Committee Report, Environment, Transport and Regional Affairs Committee, 'Delivering Sustainable Waste Management, Minutes of Evidence', March 14th 2001, p.62.

[74] The collection authorities are bound to deliver their waste to such facilities under the terms of the Environmental Protection Act 1990 which gives disposal authorities first claim on any waste or recyclate in their area for which contractual provision has been made.

[75] PFI contracts have sought to introduce some sharing of these risks with the contractor, recognising that this will lead to higher gate fees. A study for the DTI reported that gate fees in the initial PFI waste contracts, all of which were centred round incinerators, were 19%-26% above those of cost-plus contracts. See Impax Capital Corporation Ltd, 'The Influence of the PFI on Waste Management Pricing', Report for the New and Renewable Energy Programme, ETSU B/WM/00549/REP, 2000.

[76] That this conflict is a real one is shown not just by the low recycling rates of UK authorities served by incinerators but also by the recycling programmes in countries like Holland and Denmark which have had to fit in with the volumes and priority materials required by each country's stock of incinerators.

[77] There has been a recent shift in view in some parts of the waste industry. A recent document from Biffa commented that 'most in the industry agree that that at least 60% is a realistic target for diversion from landfill into biodegradation and recycling.' See Biffa, 'PFI Update', July 2001. Biffa has been an exception within the mainstream waste industry in re-assessing the role of waste management in the light of the need to re-establish biological and technical cycles.

[78] For a statement of this position see J.Rifkin, The Age of Access, Penguin 2000.

[79] The DTI consultation paper on renewable energy strategy emphasised EfW as a significant potential contributor to the renewables programme ('New and Renewable Energy for the 21st Century', DTI March 1999) and the 1999 Waste Consultation Paper took this up, concluding that 'the Government will continue to encourage the recovery of energy from waste, where this is the BPEO, as part of its renewable energy strategy.' 'A Way with Waste', DETR, 1999 vol 1, p.21. Nevertheless, in terms of climate change strategy, waste was given only marginal importance chiefly because the AEA report estimating the CO2 savings from recycling omitted all energy saved from avoided virgin production (see footnote 13 above).

[80] 'Making Waste Work', DETR, 1995, p.53

There have also been controversies over toxic ash from the Sheffield plant and pollution in Dundee. In Sheffield tests of bottom ash showed dioxin levels at 150 ng/kg. In Dundee, a Friends of the Earth survey found high levels of contamination around the incinerator, which led to calls for medical screening of those living in the area. See Sunday Times, July 15th 2001.

[81] There were substantial delays in delivering WISARD, caused, it was said, because its designers had found it difficult to get it to produce results

supportive of the 'integrated option'. This was eventually solved, but after less than a year, the Scottish Environmental Protection Agency decided to end its compulsory use on the grounds that it always produced results favouring incineration.

[82] In the first half of the 1990s there was a small Supplementary Credit Approval programme to assist local authority recycling; and later individual awards were made under Capital Challenge and Single Regeneration Budget (SRB) programmes. The total was probably less than a tenth of the amount by which the UK remaining incinerators were subsidised.

[83] In a Parliamentary answer the Minister Michael Meacher said that this was not necessarily the case, but the Guidance continues to carry weight nonetheless.

[84] Op.cit p.58

[85] 'A Way with Waste', op.cit. vol 1 p.25 The wording was kept in 'Waste Strategy 2000', vol 2 p.77

[86] Op.cit. vol 2, p.19 'Waste Strategy 2000' in re-affirming this point said that EfW plants should be 'appropriately sized' and not crowd out recycling, but no geographical limits were set for the catchment areas so that EfW applications are being considered for areas where their capacity equals the whole MSW stream. See Vol 1, p.23 para 2.23.

[87] In September 2000, after Ministerial intervention, it was announced that priority in the allocation of PFI funds should be given to recycling, but the PFI terms and process still favour capital intensive projects and promote wholly inappropriate long-term contracts. As for the £140 million for recycling, none was earmarked for 2001/2.

[88] Proceedings of the Welsh Assembly, May 10th 2001, Cardiff.

[89] The data is for dry dustbin recyclables and is derived from DEFRA, Municipal Waste Management 1999/2000, July 2001, Tables 8 and 9, and from estimates made for UK waste composition by the Canadian waste analysts REIC. Target capture rates are from best practice programmes in the UK and Canada.

[90] The levels of organics found in residuals in the integrated food waste collection systems operated in Italy average 15%-20%. In the best schemes they fall to 10%. In Austria and Germany the levels average 40% and in the Netherlands 50%, partly because of the high diversion levels in dry recyclables in all these countries, and partly because of the widespread use of wheeled bins for residuals, which attracts a higher levels of organics than the Italian system (see inset 2).

[91] The Environment Agency issued a Consultation Paper 'Guidance on the Waste Treatment Requirements of Article 6(a) of the Landfill Directive' in late 2001. It defines 'treatment' narrowly, so that all residuals after source-separation for recycling would be considered as 'treated' in spite of the fact that their fermentability would be in no way reduced. This is another example of the UK's environmental minimalism, and is in line with British opposition to the EU's Bio Waste Directive.

[92] MBT has been largely ignored in the UK. Two plants are currently at the planning stage, but MBT has been scarcely considered in the waste plans of disposal authorities or the RTABs. Waste Strategy 2000 mentions MBT only briefly, noting its widespread use in Austria and Germany, and highlighting issues of pollution control found in some of the plants there. It is not included as an option in the models that informed Waste Strategy 2000, nor in the proposed 'integrated' option, in which incineration with energy recovery is put forward as playing 'a full and integrated part in local and regional solutions'. See Waste Strategy 2000, vol. 2, pp 78-85.

[93] A recent report by AEA Technology for the EU Commission 'Waste Management Options and Climate Change', ED 21158, 2001, estimated that MBT produced the lowest GHG flux (a negative flux of 340 kg CO2e/per tonne of MSW) of the various options for treating mixed waste prior to landfill. The principal reason is the sequestration of carbon through the landfilling of the stabilised organics following the MBT process.

[94] See Peter Jones of Biffa in his evidence to the Select Committee in October 2000, Environment, Transport and Regional Affairs Committee, Fifth Report, 'Delivering Sustainable Waste Management, Minutes of Evidence', March 2001 pp.7-8. There has been growing pressure from industry to increase the landfill tax in ranges from £25-£40 a tonne, but this is in part driven by the high cost of methods of residual treatment rather than the cost of recycling. The lower range estimate is based on the extra cost of moving to intensive recycling in all sectors of the economy, with the financing of recycling increasingly shifting to the market through producer responsibility legislation.

[95] In Italy three-stream systems have been introduced close to (or below) the costs of traditional collection. This has been in part due to the low cost methods of food waste collection and in part because of the scope for savings from the large number of regular collections (three or four per week in many Mediterranean countries) once food waste is separated out (see inset 2). An application of the Italian food waste model to Greater Manchester forecast that waste system costs would fall for

all nine boroughs. See M. Ricci, 'Guidelines and Costs for the Management of Food Waste in Greater Manchester' in Ecologika, 'The Potential for a Recycling and Composting-led Strategy for Greater Manchester', Greater Manchester Waste Development Authority, December 2001.

[96] The Essex High Diversion Programme, 'Prospectus', Chelmsford, June 2000. The local authority share of new fixed investment is estimated at £35.5 million. If this was publicly financed, it would lower the revenue support to £18 million, and require an overall sum of £53.5 million to fund the transition.

[97] The estimate does not include the recycling credits provided by Essex County Council (reflecting the costs of disposal and the landfill tax) nor of any increase in the costs of CA sites. Including recycling credits in funding requirements would add a further £3 million p.a., giving a total of £18 per household p.a.

[98] The transitional costs depend in part on the level of disposal costs. In a study for Greater Manchester similar to that undertaken for Essex, capital costs were £4.5 million and transition costs £25 million for a population 50% greater than that of Essex. The main reasons for the lower costs were the higher level of disposal costs (a saving of £36 for each tonne diverted from disposal was assumed for the nine Greater Manchester boroughs) and the use of the low-cost Italian food waste collection systems. By comparison, in Toronto, where disposal costs are high because of the need to export waste to landfills in Michigan, the Council recently announced its plans to achieve a 60% diversion target by 2006, with an incremental cost of only £5 a tonne.

[99] It might well be less in the event that a shift to four-stream systems would produce more packaging waste from the estimated 4.6 million tonnes in the domestic waste stream than the 1.2 million tonnes forecast as required for the 60% target. Supply would exceed demand and put downward pressure on PRN prices in the process.

[100] If the 50% target for the recovery of packaging waste in 2001 is met, it will have cost the 'obligated parties' some £100 million, little of which has gone to the municipal sector. The £100 million figure is given in the government's September 2001 consultation paper on 'Recovery and Recycling Targets for Packaging Waste'.

[101] The government is currently undertaking a five-year review of the performance of the Environment Agency. The draft report of this Review was summarised in ENDS no 320, September 2001. The report does not address the main issue that has emerged in the conduct of the Environment Agency, which is the problem of getting a rule-based organisation to take a proactive role in environmental protection, coupled with the issue of regulatory capture.

[102] The New Opportunities Fund has developed fruitful methods of managing the bidding process, including joint seminars for applicants and individual specialist advice.

[103] The OECD has made waste minimisation, extended producer responsibility and changes in the mode of consumption the prime focus of its work on waste since 1994.

[104] Gielen,Kram and Brezet op.cit. (see footnote 29).

[105] USEPA, September 1998 op.cit (see footnote 13).

[106] G.A.Davis, 'Principles of Application of Extended Producer Responsibility' Proceedings of the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy, Paris March 2000, Part 1, pp.102-8. Gary Davis is from the Center for Clean Products and Clean Technologies, University of Tennessee.

[107] For other products and substances the EU has used bans – as in the case of the landfilling of tyres and the phasing out of CFCs in fridges and air conditioners, and of halons in fire protection systems.

[108] This was notably the case in the electric and electronic goods sector, where UK firms showed a marked reluctance to expand recycling in spite of the forthcoming EU Directive and the advances made in electronics recycling on the continent.

[109] Report of the Task Force of the Advisory Group on Packaging, DEFRA, November 2001.

[110] For a more detailed discussion see ECOTEC, 'Effects of Landfill Tax – Reduced Disposal of Inert Waste to Landfill', January 2000.

[111] See E.Darier (ed) Discourses of the Environment, Blackwell 1999, particularly the introduction by Darrier, and the chapter by T.W.Luke, 'Environmentality as Green Governmentality', pp 121-150.

[112] This is the position of Ulrich Beck in a succession of books on risk and modernity. Beck is a professor of sociology in Munich, one of the international centres of the re-insurance industry. See particularly his book Environmental Politics in an Age of Risk, Polity Press 1995.

[113] For a review of the problems surrounding scientific knowledge and its treatment within conventional risk assessment see M.O'Brien, Making Better Environmental Decisions, MIT

Press, 2000. The book also outlines a different approach termed 'alternative assessment'.

[114] A recent study that highlights the issue of information, hazards and governance is by the European Environment Agency, 'Late lessons from early warnings: the precautionary principle 1896-2000' which was published in January 2002. In light of the historical experience of hazards such as asbestos and BSE, the study considers how more accessible, science-based information and stakeholder governance in economic activity could minimise environmental harm and maximise innovation. The proposals have particular relevance to the issue of information and governance in relation to Zero Waste.

[115] Performance and Innovation Unit, Cabinet Office, 'Resource Productivity: Making More with Less', November 2001, op.cit.

[116] The former DETR has produced guidelines for business on reporting waste, which were aimed at helping companies measure the waste they produce, how waste management could be improved and achieve savings. These need to be extended to the materials productivity strategies outlined here.

[117] On alternative experiences of quasi-public institutions to provide technical support and advice to industry, see H.Rush et al, Technology Institutes: Strategies for Best Practice, International Thompson Business Press, 1996

[118] The Advisory Committee on Business and the Environment, 'Resource Productivity, Waste Minimisation and the Landfill Tax' August 2001. Another of its recommendations was to raise landfill costs and to use the extra tax revenues to fund resource productivity initiatives in the business sector.

[119] Lord Marshall, 'Economic Instruments and the Business Use of Energy', Treasury, November 1998.

[120] For a description of the programme see P.Hermens and T.van Roemburg, 'Dutch Perspective on Waste Prevention Target Setting', OECD Joint Workshop on Extended Producer Responsibility, op.cit. Part 2, pp 41-49, March 2000.

Proceedings of the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy, op.cit. March 2000, Part 1, Introductorary speech.

[121] On reuse and the ways in which consumers and local authorities can influence its expansion see N. and D. Goldbeck, Choose to Re-use, Ceres Press, New York, 1995.

[122] Proceedings of the OECD Joint Workshop on Extended Producer Responsibility op. cit.Part 1, Introductorary speech, March 2000.

[123] OECD, 'Environmental Strategy for the First Decade of the 21st Century', adopted by OECD Environment Ministers May 16th 2001, and the accompanying 'Environmental Outlook'.

[124] M.Braungart, 'Waste Must Equal Food' Green Punkt Scheme Annual Report 2000, 'Recycling as a Source of Raw Materials', p.78. He continues 'natural processes are not eco-efficient but rather eco-effective. Nature does not save, it "wastes" – however with suitable resources (just look at a cherry tree in spring – what a "waste" of energy and raw materials.)'

[125] J.Waller-Hunter,op.cit.

126 For a good recent summary of his ideas see W.R.Stahel, 'From Design for Environment to Designing Sustainable Solutions', in: UNESCO, Our Fragile World: Challenges and Opportunities for Sustainable Development, EOLSS Publishers, 2001, pp 1553-1568.

[127] A summary of the industrial metabolism approach, based on ex post material flows, is given in R.U.Ayres, 'Industrial metabolism: theory and policy' in: R.U.Ayres and U.E.Simonis (eds), Industrial Metabolism: Restructuring for Sustainable Development, United Nations University Press, 1994.

[128] On the shift in environmental policy from centralist regulation to market instruments and the issues arising see M.R.Chertow and D.Esty (eds), Thinking Ecologically: the next generation of environmental policy, Yale 1997.

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