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The changing mindset in the management of waste

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There are strong drivers at all levels towards a culture of more sustainable waste management. These drivers include those at an international level, such as the Rio Earth Summit, at a European level, such as the Fifth Action Programme (1993–2000) and national drivers, such as the strategy for sustainable waste management in England and Wales. The business response to these drivers has led to an emerging interest in moving away from a waste disposal mentality towards a materials management mentality in which waste is reused, recycled, reduced and minimized. This is considered to be a fundamental shift which will create a huge challenge for the waste management industry, requiring a robust and flexible strategically driven approach at the household, local authority and business levels.

1. Introduction

For some time there has been the view that society inevitably produces waste for disposal, i.e. materials having no further utility. This paper identifies a significant number of driving forces which will change that view. In simplistic terms, this means that waste management is now moving towards materials management which is one of the most cost effective ways for companies to reduce their impact on the environment and to benefit from financial savings, improved corporate image, byproduct opportunities and much more. Evidence of this, as seen in the increasing number of waste minimization demonstration projects in the UK, is now available to the business community. It shows that taking a more rounded approach to waste management is increasingly being seen as central to operating an efficient business and relating directly to the 'bottom line'. There has been a cascade effect from international initiatives, such as the Rio Earth Summit in 1992, which has driven new European as well as national developments in the UK soon to have a significant impact. The key developments are the introduction of the landfill tax in October 1996 and the imminent UK implementation of the European Union (EU) Packaging Directive. The business economies available by taking this approach to the management of waste products will therefore become progressively more important.

A spin-off from this new approach is the creation of new opportunities in the development and provision of environmental technology and services (ETS) to satisfy

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the requirement to be less environmentally polluting and move towards cleaner technology. Indeed, the estimates which are now being made of the world market for these technologies and services is huge. At a recent Overseas Economic Council for Development (OECD) meeting of experts, the current world market for ETS was estimated at $250 billion (EIC 1996). Not only that, but the ETS sector, with the increasing uptake of cleaner technology for waste management, is expected to grow at a rate of between 5.5 and 8% per year (EIC 1996). Such a growth rate is rarely seen in any other sector, with the exception of information technology. As this sector strengthens and appropriate products and services come into the marketplace from the innovation which will inevitably occur, the ETS sector will itself provide significant impetus in establishing this new dynamic move away from waste management towards materials management.

While there are large opportunities within mainstream business created by this changing mindset, the waste management industry itself is faced with a huge challenge in the form of the inevitability of waste stream changes. As more types of waste are removed from the waste stream, such as packaging waste for recycling or energy recovery and organic waste for composting, landfill site and incinerator operators will be dealing with an unfamiliar beast. This issue is emphasized by the effect of the 'green' consumer on the nature of waste for disposal, in particular as local authorities implement kerbside collection schemes for the recycling of different household waste constituents. Will the changed composition of waste entering a landfill result in reduced methane emissions or unfamiliar leachate issues? Will the waste now sent for incineration have the required calorific value? These questions are the result of the changing mindset in the management of waste, which is the subject of this paper.

This paper will begin by introducing some of the key international and European developments relating to sustainable waste management, followed by an outline of the major national initiatives by which they have driven in the UK. The business benefits of moving towards materials management will then be covered, incorporating the results of specific initiatives undertaken at a local level in this field. Market opportunities within the ETS sector will then be considered, before moving on to discuss the implications for the waste management industry as a result of the changing volume and composition of waste generated.

2. The global perspective

The main international development in relation to sustainable waste management was the United Nations Conference on Environment and Development (UNCED), the Earth Summit, held in June 1992 in Rio de Janeiro, Brazil. 'The Earth Summit was an unprecedented event. It brought together more heads of government than any meeting in history. It effectively focused the world's attention on the most critical issues we face as a global community. And it adopted a global plan of action, Agenda 21, to address those issues' (Keating 1993). Within Agenda 21, certain national actions are called for, including actions towards more sustainable waste management. More specifically, 'national plans are needed to minimize the creation of waste, and to ensure that wastes are reused, recycled and safely collected and treated. Waste-control programmes should be developed in cooperation with local governments, businesses, non-governmental organizations and consumer groups. *Industrialized countries should have programmes to stabilize or reduce waste production by the year 2000*' (Keating 1993).

It was in response to Agenda 21 and the target highlighted above that the strategy for sustainable development in the UK evolved and subsequently the strategy for sustainable waste management in England and Wales.

There has also been a significant drive towards sustainable waste management at a European level. The Fifth Action Programme (1993–2000) sets out clear objectives in relation to the hierarchy of waste management, with the following strategic principles as the basis of the commission's policy: waste prevention; waste recycling and reuse; optimization of final disposal of waste; rational organization of all operations related to waste management; and remedial action (rehabilitation of contaminated sites, including old landfills).

The Framework Directive on Waste (75/442/EEC as amended by 91/156/EEC and 91/962/EEC) is also based on these principles of sustainable waste management, with much greater emphasis on waste reduction by the use of clean technologies, waste minimization during product manufacture, recycling, reuse or reclamation and the use of waste as an energy source (Articles 1 and 3).

3. National developments

The international and European developments already discussed have led to a number of significant developments in the UK driving business towards sustainable waste management, in particular the UK implementation of the EU Packaging Directive and the landfill tax. These developments are underpinned by 'Sustainable development: the UK strategy' published in January 1994 in response to the Earth Summit and the strategy for sustainable waste management in England and Wales, 'Making waste work'.

'This common inheritance: UK annual report 1996' outlines progress with the government's sustainable development strategy. For waste management, the report outlines national developments including the sustainable waste management strategy for England and Wales, the landfill tax and environmental trusts and producer responsibility and packaging legislation. It also contains a specific commitment, as in the previous year's report, with regard to waste management within the business community, to 'promote environmental management, with a target of 75% of firms with 200+ staff to have environmental policies for waste by 1999 and 50% to have management systems in place to achieve them (AR95 11.2)' (HMSO 1996).

'Making waste work' builds on the government's sustainable development strategy. It aims to: 'reduce the amount of waste that we produce'; 'make the best use of what waste is produced'; and 'choose waste management practices which minimize the risks of immediate and future environmental pollution and harm to human health' (DOE 1995).

Its primary targets are as follows: 'to reduce the proportion of controlled waste (non-radioactive household commercial and industrial wastes) going to landfill to 60% by 2005'; 'to recover 40% of municipal waste by 2005'; and 'by the end of 1998, to set a target for overall waste reduction' (DOE 1995).

The implementation of this waste management strategy, via such mechanisms as packaging legislation and the landfill tax, will inevitably push business towards more sustainable practices. However, the amount of waste produced will also inevitably reduce and its composition will change. While this may be obvious, the implications for the waste management industry are only just being recognized.

How big is the packaging waste problem in the UK? 9.9 million tonnes of packaging

waste is generated per year, of which 3.6 million tonnes is produced by industry and commerce (Durston 1996). In 1993, 32% of packaging waste was recovered, which is set to rise to 58% by the year 2000 (Durston 1996). The EU Packaging Directive, which came into force on 31 December 1994, aims to reduce the environmental impact of packaging. It covers all packaging waste and requires all member states to bring legislation into force by 30 June 1996. The directive sets the following specific targets to be achieved by June 2001: 50–65% by weight of packaging waste must be recovered; and 25–45% by weight of packaging waste must be recycled, with a minimum of 15% per material (ENDS 1995).

The UK implementation of this directive is based on the following shared legal obligation for the recovery of packaging waste: 5.5%, raw materials producers; 14.5%, converters (packaging manufacturers); 35%, Packers/fillers; and 45%, retailers/distributors (ENDS 1995).

By way of an example, let's consider a packer/filler using 170 tonnes of one packaging material per year. The company's targets will be as follows: recovery, 170 tonnes $\times$ 50% (UK recovery target) $\times$ 35% (sector obligation) = 29.75 tonnes; and recycling, 170 tonnes $\times$ 15% (UK minimum recycling target per material) $\times$ 35% (sector obligation) = 8.93 tonnes.

This system of legal obligations will be enforced by the Environment Agency (EA) and the Scottish Environmental Protection Agency (SEPA), via 'producer responsibility', and reviewed by the end of 1997. In the first year, just large companies with a turnover in excess of £25 million will be affected, then in the second year companies with a turnover greater than £10 million, and ultimately all companies with a turnover of £1 million or more, i.e. the majority of companies (Durston 1996). Currently, a company will be exempt if it handles less than 50 tonnes of packaging per year (Durston 1996).

The timescales associated with this significant change in the way in which packaging waste is dealt with are drawing closer, whereby packaging regulations are expected to reach the Statute Book by October 1996. At this point, companies must register to comply with their legal obligation either as an individual business or as part of a recovery scheme, such as VALPAK, which looks likely to become the national packaging waste recovery scheme in the UK.

It follows from these developments regarding packaging waste that companies' costs will rise through payments to recovery schemes. This will prompt them to consider ways in which they can reduce the volume of packaging waste generated as a result of their activities or products, encouraging them to think about more sustainable ways in which to manage packaging waste. Another result of the UK targets will be less packaging waste going for disposal, via landfill or incineration. Two clear issues arise from this for the waste management industry, one relating to the reduced volume of waste for disposal and the other to the changed composition of waste. What effect on landfill management will the partial removal of packaging waste have? Furthermore, will waste for incineration have the necessary calorific value minus a large proportion of its packaging waste content, in particular plastic packaging?

However significant, the packaging legislation affects just a proportion of waste generated in the UK, whereas the *landfill tax* affects almost all of it. The objectives of the tax are as follows: 'to ensure that landfill waste disposal is properly priced, which will promote a greater efficiency in the waste management market and in the economy as a whole'; and 'to apply the 'polluter pays' principle and *promote a more*

sustainable approach to waste management in which we produce less waste, and reuse or recover value from more waste' (DOE 1995).

There is a clear reference in the objectives of this tax to the promotion of the sustainable management of waste. This will be achieved via a two-tier tax and the introduction of environmental trusts, as follows.

(1) A lower rate of £2 per tonne will apply to the following inactive (or inert) types of waste: naturally occurring rocks and soils; ceramic or cemented materials; processed or prepared mineral materials, which have not been used or contaminated; furnace slags; certain ash, including bottom ash from incinerators; low activity inorganic chemical compounds; and gypsum (calcium sulphate) and plaster (HM Customs and Excise 1996).

Several wastes have been added to the list of 'qualifying materials', attracting the lower rate of tax via The Landfill Tax (Qualifying Material) Order 1996, as follows: brine and calcium hydroxide if deposited in brine cavities; refractories; aluminium hydroxide; zirconium dioxide; ferric oxide, including iron oxide; and calcium sulphate deposited in a containment cell (ENDS 1996).

(2) A standard rate of £7 per tonne will apply to all other taxable types of waste.

(3) Types of waste exempt from the tax are as follows: dredgings which arise from the maintenance of inland waterways and harbours; naturally occurring materials, arising from mining or quarrying operations (including extraction of minerals from the seabed) which have not undergone any separate process or had their chemical characteristics permanently changed; the burial of domestic pets at pet cemeteries (these are licensed as landfill sites); and waste resulting from the clean-up of historically contaminated land.

(4) The tax will be introduced on 1 October 1996 (HM Customs and Excise 1996).

Operators of landfill sites will be able to claim credit against their landfill tax payments by making voluntary contributions to approved environmental trusts. These trusts will have the following aims: the promotion of more sustainable waste management practices, for example recycling; education about waste management; restoration of old landfill sites or other damaged industrial sites; and the creation of wildlife habitats or conservation areas near a landfill site (HM Customs and Excise 1996).

Landfill operators will be able to claim a tax credit of up to 90% of contributions to environmental trusts, with a total claim in any 12 month period not exceeding 20% of its landfill tax bill in that period (HM Customs and Excise 1996).

The cost of waste disposal will therefore rise significantly with the introduction of the landfill tax, which is also likely to rise year on year, pushing companies to consider reducing the waste produced through a more sustainable approach to waste management. There are also indications that should a Labour government come into power, the landfill tax will be increased even more, thus exaggerating its effect on business. With packaging legislation about to come into force later this year, a double-edged sword is being created at a national level, driving companies to change the way in which they manage their waste.

Finally, the government recently published its 'Indicators of sustainable development for the United Kingdom', which incorporates waste as a key area. Specifically, in relation to industrial and commercial waste, it states that 'industrial and commercial waste is estimated to amount to around 85 million tonnes per year. Trends are currently uncertain, but the composition of the waste stream is likely to be changing as a result of changes in the structure of industry' (DOE 1996*a*, *b*). Ideally, this indicator would show trends in the volumes of waste being generated by different

industrial sectors against some measure of output. However, the difficulties associated with gathering this data are appreciated and commitments have been made in the waste strategy for England and Wales to improve the availability of data on industrial and commercial waste. The DOE and the EA will be working together to achieve this improvement.

4. Local initiatives

As well as developments at an international and national level driving a culture change towards the more sustainable management of waste in business, it is the initiatives being implemented at a local level which are resulting in the most direct impact. It is the business advantage to be gained from effective waste management which is perhaps the strongest driving force of all. As an increasing number of companies make a corporate commitment by joining Environment Business Fora and taking part in waste minimization demonstration projects in the UK, the evidence is mounting. This evidence demonstrates that companies are changing the way in which they think about waste, whereby a material is not a waste until it has no other possible use. It is at this point that a changing mindset is occurring in the management of waste, in favour of efficient materials management or total process efficiency.

'Business . . . is moving from a position of limiting pollution and cleaning up waste to comply with government regulations toward one of avoiding pollution and waste both in the interests of corporate citizenship and of being more efficient and competitive . . . It is the more competitive companies that are at the forefront of what we call "ecoefficiency" ' (Schmidheiny 1992). This quotation summarizes the direction in which the most competitive companies are moving. Within this framework of waste avoidance there are many options for the management of waste, summarized in the following hierarchy of waste, taken from The Fifth Action Programme (1993–2000) and now firmly part of 'Making waste work—a strategy for sustainable waste management in England and Wales': reduction; reuse; recovery (recycling, composting and energy); and disposal (DOE 1995).

Waste minimization, encompassed within the 'reduction' option at the top of the hierarchy, is the focus of much of the business activity via demonstration projects. It relates to the 'prevention is better than cure' principle, favouring process change for cleaner technology or raw materials substitution over end-of-pipe pollution control techniques. Optimizing the usage of raw materials through efficient materials management, sometimes referred to as total process efficiency, is inherent within this new waste management culture.

(*a*) *Waste minimization/materials usage improvements*

An example of efficient materials management is provided by Sterling Coated Materials Limited in Hollingworth, where a waste minimization programme resulted in materials utilization improvements in excess of £250 000 per year, a return on investment in excess of 250% (Department of Trade and Industry (DTI) 1992).

Another example, but of process change for total process efficiency, is provided by 3M's Riker pharmaceutical plant where medicine tablets were produced with a solvent-based coating that had the potential to cause substantial air emissions. After installing different spraying equipment inside the coating machine it was possible to use a water-based coating. Although the cost of this process change was $60 000, it

resulted in a saving of $180 000 in necessary pollution control equipment (Confederation of British Industry (CBI) 1993). The environmental benefits of this process change include the elimination of 24 tonnes of air pollution annually, as well as the total elimination of solvents from the process (CBI 1993).

It can be anticipated, however, that the business community will want to consider whether it is better to minimize a waste stream which has a revenue-generating potential as a treated or untreated valuable byproduct or, in fact, optimize its generation. Furthermore, market fluctuations or cyclic patterns can affect the feasibility of revenue generation from waste byproducts. For example, the price paid for recyclables is market driven and the price attracted by some materials, such as textiles, is more stable than others.

As already mentioned, there is a drive towards waste minimization demonstration projects in the UK. For some time there were just two key examples in the UK, namely the Aire and Calder Project and Project Catalyst, however there are now more than 20 such projects. There is also evidence that the number of companies taking part in these projects is increasing. The Humber Forum Waste Minimization Project, for example, is focusing on 11 participating companies initially but aims to reach and assist at least 145 companies in the region with a new approach to waste management (ETBPP 1995*a–c*).

But what is fuelling this drive? What is encouraging the increasing number of companies to take part? There are many business benefits driving this changing waste management culture, not least the potential to reduce costs in the following ways.

(i) Reduced volumes of waste generated, resulting in decreased waste handling, treatment, transportation/collection and disposal costs.

(ii) Reduced labour time spent handling waste, allowing valuable labour time to be channelled elsewhere.

(iii) Reduced wastage of raw materials, resulting in decreased raw materials costs.

(iv) More efficient usage of energy, resulting in lower fuel bills.

(v) More efficient usage of water, resulting in reduced water bills and a potential knock-on effect regarding effluent volumes generated and associated costs. At GE Plastics in Grangemouth, a waste minimization initiative resulted in a £480 000 investment in a reprocessing system for process water, which resulted in a 98% reduction in water effluent generated, with a payback period of less than six months (DTI 1992).

(vi) Minimized increases in environmental insurance costs.

There are numerous examples of the cost savings achieved through waste minimization, including the following.

(i) The Humber Forum Waste Minimization Project estimates £1 million per year cost savings for the 11 participants (ETBPP 1995*a–c*).

(ii) The West Midlands Waste Minimization Project expects to produce savings in excess of £2 million per year for participants (ETBPP 1995*a–c*).

(iii) The Leicestershire Waste Minimization Initiative identified potential savings of £3 million for the ten participating companies and after six months of implementation the actual savings were estimated at £0.75 million (Leicestershire County Council 1995).

(iv) The Aire and Calder Project saw financial savings of £2.1 million per annum for the 11 companies taking part within 17 months of project initiation, rising to

Table 1. *Savings achieved by the Aire and Calder Project*

	savings achieved				
	to 31 August 1993		to 31 August 1994		
source	£(thousands) yr^{-1}	%	£(thousands) yr^{-1}	%	% increase
water	185	9	512	15	177
effluent	197	9	462	14	134
raw materials	1308	61	1565	47	20
energy	112	5	327	10	192
others	351	16	484	14	38
total	2153	100	3350	100	55

£3.3 million per annum one year later (Johnston 1995). A more detailed breakdown of these cost savings is provided in table 1.

(v) Project Catalyst, which ran for 16 months with 14 companies, identified potential savings totalling £8.9 million per year of which over £2.3 million had been implemented before the end of the project (Atkins *et al.* 1994). Furthermore, almost £2.5 million of savings involved no cost and almost £3 million had a payback of less than one year (Atkins *et al.* 1994).

The huge proportion of cost savings attributable to waste management options relating to raw materials emphasized the fact that the changing mindset in the management of waste centres around the more efficient management of materials.

By picking the 'low hanging fruit' initially, i.e. those waste management techniques which have little or no associated cost, companies build up confidence in this new culture to invest in more capital intensive opportunities with longer payback periods. For example, of the measures for improved efficiency identified by the Aire and Calder Project, 12% were cost neutral, i.e. no cost was incurred in their implementation, and a further 60% had payback periods of less than one year (Johnston 1995).

The Centre for the Exploitation of Science and Technology (CEST) conducted an extensive programme of interviews during 1995 with all of the companies which participated in the following three demonstration projects, primarily to examine what motivated them to participate: Aire and Calder Project; Project Catalyst; and Leicestershire Waste Minimization Initiative.

With regard to cost savings, the following comments were typical: 'waste minimization is nothing to do with the environment, just a cost saving opportunity'; 'we strongly believe that the environment is a bottom line issue'; and 'cost is an environmental pressure because waste equals money' (Johnston & Stokes 1995).

These comments demonstrate a clear shift from the notion that waste management is related solely to 'the environment', towards the view that waste is an indicator of business efficiency. Therefore, unless companies manage their waste effectively, they will not be operating a lean business.

(*b*) *Cost savings through waste minimization*

Although business efficiency improvements via cost savings is perhaps the most powerful driver changing the way in which companies manage their waste, other key drivers exist. These include revenue generation through exploiting market opportuni-

ties to sell on waste for reuse, either treated or untreated. This driver is particularly pertinent in the food industry, where the opportunities for the generation of valuable byproducts from waste are expanding rapidly with advances in biotechnology.

Compliance with current and forthcoming environmental legislation is also a key driver for companies, again highlighted by comments such as the following from one CEST interviewee, 'if companies don't make moves on waste minimization now, then they'll have to do it by law' (Johnston & Stokes 1995). With the formation of 'one-stop-shop' national regulatory bodies, namely the EA and SEPA, compliance with environmental legislation is likely to become an even more powerful driver for sustainable waste management in business.

Compliance is a key factor within *corporate risk* whereby company directors, for example, are liable under the Duty of Care contained with §34 of the Environmental Protection Act 1990. Therefore, if a company is prosecuted for breach of the Duty of Care, its directors can potentially be imprisoned. However, the hidden costs of prosecution and the bad external publicity associated with it can be hugely damaging. This generates a *corporate fear* which is also an extremely valid reason for working towards sustainable waste management as a sound business strategy.

(*c*) *Marketing and communications in waste management*

Marketing and communications are also driving companies to look at more sustainable waste management, to secure competitive advantage through enhanced corporate image and improved relations with the following key stakeholders.

Customers: as customers become more environmentally aware, they will place increasingly stringent environmental performance requirements on their suppliers. This supply chain pressure looks set to be a major driving force for more sustainable waste management in the future. B&Q for example, primarily as a result of pressure from the environmental groups and the media, stated that by the end of 1995 B&Q would only purchase timber for its products from well managed forests (Knight 1996).

Employees: the importance of ownership and motivation throughout the workforce to make a waste management programme work is often underestimated. For example, at Walkers Snack Foods, 'the clear and visible benefits of the new culture mean that waste minimization is now staff-driven . . . the significant savings achieved by Walkers Snack Foods . . . could not have been achieved without the changed attitude and consent of the workforce . . . ' (ETBPP 1995*a–c*).

Pressure groups and the media: a key driver for B&Q to embark on its groundbreaking supply chain work was the pressure from non-governmental organizations (NGOs), campaigning against the sale of products made from tropical hardwoods; for example, insurers and investors (see below).

Insurers: it is becoming increasingly difficult for companies to obtain insurance for gradual pollution rather than sudden and accidental, resulting in such liabilities as contaminated land. This is especially relevant now that there is an environmental component to the financial due diligence process prior to land acquisition.

Investors: many banks are now considering the environmental impact of an organization before agreeing to lend.

Other stakeholders include: local community; shareholders; parent company; and sister companies.

Other business developments relating to improved corporate image are environmental management systems (EMS) and corporate environmental reporting. While the drivers for the former are similar to those for waste management, the achieve-

ment of one of the following EMS standards can act as a unique selling point, placing the company at the leading edge of environmental performance: British Standard for EMS, BS 7750—to which 36 companies in the UK had been certified by February 1995; Eco-Management and Audit Scheme (EMAS)–to which 15 UK companies had been certified by June 1996; and International Standard for EMS, ISO 14001—still under development.

The mere evolution of these standards is further evidence of the increasing importance of environmental management, encompassing waste management, to the business community and its stakeholders. In fact, BS 7750 suggests that companies consider the environmental performance of their suppliers, potentially generating a huge knock-on effect. BS 7750 states that 'the environmental probity of suppliers should also be considered, with regard to their products and activities. While in many instances it will not be possible to compile detailed registers of supplying organizations, it will often be possible to at least compare alternative suppliers in respect of their most important environmental effects' (British Standards Institute (BSI) 1994).

Corporate environmental reporting, the second business development highlighted as part of the move towards 'greener' corporate image, is also on the increase. Over 200 organizations have now published stand-alone environmental reports, in addition to their annual reports, such as THORN EMI, London Electricity, British Telecommunications, British Petroleum and Pilkington in the UK. These documents act as communicational tools for these companies to issue their key stakeholders. In some cases this may be employees, where motivation is the primary objective, and in others it may be customers or other stakeholders. Environmental reports outline corporate environmental performance, with waste management playing a central role. Reporting companies therefore want to make progress towards sustainable waste management practice in order to report good progress in subsequent reports.

The real reason, however, behind this clear move towards more sustainable waste management is a reduced impact on the environment. While companies focus on the business advantage to be gained and the minimization of corporate risk and corporate fear, there also is evidence that the ultimate objective is being achieved. Project Catalyst resulted in the following improvements in the environmental performance of the companies involved, in relation to waste reduction of the following proportions: waste to landfill reduced by over 12 000 tonnes per year; water consumption reduced by 1.9 million cubic metres per year; and effluent discharges reduced by 1.8 million tonnes per year (Atkins *et al.* 1994).

The measures needed to result in these reductions break down as follows: 55%, cleaner technology changes; 19%, good housekeeping; 23%, recycling/reuse; and 3%, product modifications (Atkins *et al.* 1994).

(*d*) *Environmental technology services: worldwide opportunities*

In part driving this changing business culture, but in part fuelled by it, is the increasing worldwide business opportunities for the environmental technology and services (ETS) industry. The ETS industry includes such areas of business as the development of cleaner technology, environmental management (including waste management) advice and the supply of end-of-pipe pollution control equipment. The world market for ETS is estimated at $250 billion, with market growth predicted at 5.5–8% per year, a rate of expansion experienced by very few other industries (EIC 1996). However, end-of-pipe technologies currently account for 80% of the total in-

vestment by business in ETS, leaving just 20% for clean technologies (EIC 1996). This indicates that there is still a long way to go in the uptake of cleaner technologies.

In the UK, however, we are not exploiting the increasing demand within the ETS sector. In fact, the UK has just 6% of the world's patents for ETS, with an ETS market of $11 billion in the UK in 1990, which is expected to grow to $28 billion by the year 2000 (EIC 1996). The UK ETS market also employs 100 000 people (EIC 1996). Therefore, while this rapidly growing demand is evidence that in the UK we may be taking part in the cultural change regarding waste management, we are not exploiting the ETS business opportunities which it brings hand in hand.

5. Conclusion: implications for the waste management industry

There is evidence that the composition of waste has been changing over recent years (Aspinwall and Company Ltd, 1992–1996, current key contributor to the National Household Waste Analysis Programme), prior to the increasing business waste minimization activity already discussed. Some examples of these changes in the waste stream include the following: significantly reduced fines (small particles of waste, such as ash) as households have moved away from solid fuel to electricity and gas; increased paper and plastics as the amount of packaging used has risen; and increased organic matter as less households have gardens for conducting composting.

However, with the advent of 'green' consumerism the above behaviour patterns look set to change, as over-packaged goods are boycotted and composting enjoys a revival.

Local authorities are also striving to reach their target of recycling or composting 25% of household waste by the year 2000 (HMSO 1996). In fact, Adur District Council in West Sussex was the first local authority to achieve this. Since April 1993, it has operated a multi-material 'blue box' kerbside collection programme alongside mini-recycling centres (MiRCs) (European Recovery & Recycling Association (ERRA) 1994). Almost 19 000 households were included in the 'blue box' programme, which involved householders putting dry recyclable waste materials into a dedicated receptacle for collection from the kerbside (ERRA 1994). Many other householders were able to use one of the 48 close to home drop-off facilities, MiRCs (ERRA 1994). The cost of this programme is the equivalent of £9.55 per household per year (ERRA 1994).

Couple these moves with regard to domestic waste with the intervention in the business waste stream and there are significant implications for the waste management industry.

Reduced volumes of waste will be generated by business as waste minimization becomes more widespread and waste management techniques are pushed up the hierarchy, away from disposal. The characteristics of waste generated will also change as packaging, for example, is recovered from the waste stream, along with waste attracting the higher rate of landfill tax. The resulting rate of change in waste stream volume and quality is unknown, which presents real difficulties for the waste management industry. The two main difficulties are: threats to the calorific value of waste, as materials such as paper and plastics packaging are removed from the waste stream, resulting in implications for energy recovery from incineration; and potential threats to bioreactive landfill, aerobic and anaerobic processes and gas utilization will result, as organic waste, paper and card are minimized in the waste stream.

These changes are rapid in relation to the planning/design and construction pe-

riods required for waste management facilities. Waste management companies are required to detail the types and volumes of waste which they will deal with at their landfill or incineration facilities within their applications for waste licences. These companies, as well as not being able to get a guaranteed waste stream from local authorities, are unable to specify the pollution controls to be used without definite knowledge of the types and volumes of waste to be dealt with.

In spite of these changes, it is crucially important that society recognizes that in the foreseeable future there will continue to be a need for the final disposal of material residues which have no further utility. Therefore, a new approach to the design philosophy of landfills needs to emerge possibly centred around the concept of a repository for materials which may have future utility as raw materials. What is wholly unrealistic is the view that committing materials to final disposal by landfill can be eliminated in the foreseeable future. In purist terms this will only be achieved, of course, when industrial processes and consumer use of products is 100% efficient, thereby closing the materials loop completely. It is essential, therefore, that local authorities work with the waste management industry to ensure that a responsible infrastructure of appropriate waste management facilities is in place. The government has recognized this by identifying the need for regional sufficiency in the management and disposal of wastes. 'We have made clear in the Strategy that planning authorities should aim for regional self sufficiency and plan for enough facilities to enable recovery or disposal of waste close to the place where it is produced—the proximity principle' (the Earl of Lindsay 1995).

The waste management challenge, therefore, for both domestic and industrial/commercial waste streams, is immense. Through responding to targets for more sustainable waste management, waste will change, both in quantity and quality. With the rate of change unknown, the waste management industry will find itself facing some significant issues. Therefore, in light of this changing mindset in the management of waste, the interested parties in business, the waste management industry, local authorities and the public, must work together to face the challenge. It is now becoming clear that future waste management strategies must be robust and flexible enough to accommodate these significant changes.

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