RECYCLING AND RECOVERY STRATEGIES

A Richard Horrocks

Introduction

The concept and practice of recycling has been a well-established part of the textile industry since the first industrial revolution. Historically, the waste reprocessing industries of Lancashire and Yorkshire, for example, reflected their respective interests in cotton and wool textile manufacture. Elements of these interests remain today but the impact of man-made fibres has introduced variety and blends to the industry. While basic textile and clothing manufacturing industries generate associated waste reprocessing sectors, there has been and continues to be a recycling industry associated with used clothing and other textiles or "used rags". In post-industrial EU, which has significantly reduced manufacturing sectors and hence associated "new rag" reprocessing industries, the growth in consumerism has assured that "old rag" recycling is or could be a large industry, often generated by charitable institutions and driven by exports to the less developed areas of the world. Table 1 lists and Figure 1 schematically shows the traditional and well-established recycling routes.

The strategy behind these traditional reprocessing industries was and still is purely one of wealth creation from waste and, as an industry, the textile and clothing sectors have always been able to demonstrate a degree of environmental sustainability in terms of fibre re-usage. In recent years there has been a shift to SE Asia of these traditional textile and garment-making waste reprocessing industries as the main textile manufacturing base has shifted to that region.

Of more recent importance to the European and US textile economies has been the emergence of new waste recycling technologies based on the values of waste synthetic fibres, high performance textiles and composite materials and recycled polymers as synthetic fibre precursors. The second half of Table 1 lists these. The often reversibility of synthetic fibre production sequences has enabled technologies based on depolymerisation and monomer regeneration to be developed; this has especial significance where sources of used textiles comprise large amounts of a single fibre type such as polyamide floorcoverings. Similarly, the usefulness of some synthetic fibre-forming polymers like polyester (PET) in other markets such as beverage bottles, has provided impetus for improved plastic recycling technologies in the packaging sectors because of their potential as raw materials for synthetic fibres.

Finally the complexity and value of many technical and industrial textiles has created opportunities for their effective recovering and recycling. Some companies like Gore, for example, (1) offer customers the service of accepting and disposal of used Goretex garments. This trend will probably increasingly occur for sophisticated garments and textiles in the contract and domestic sectors.

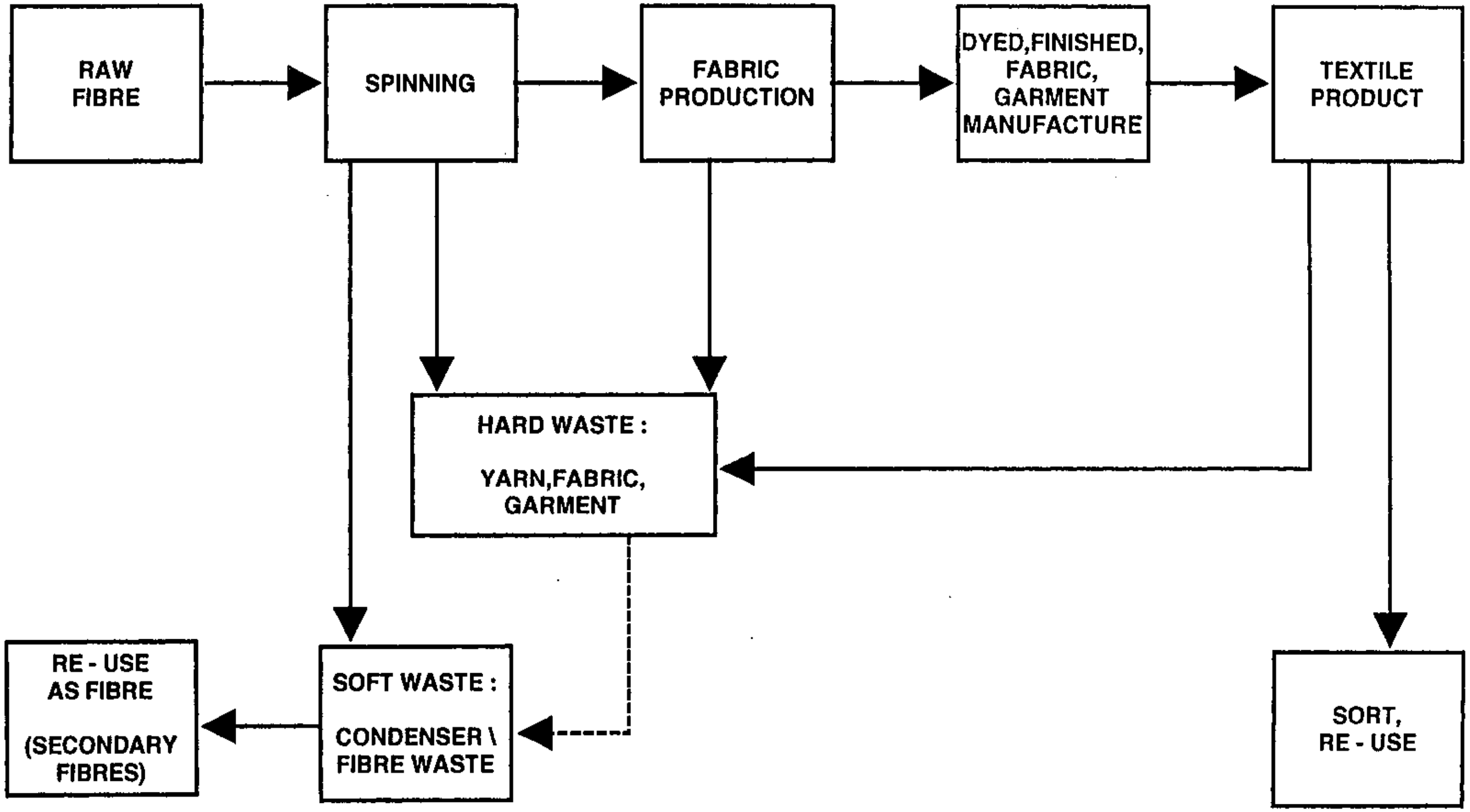

Figure 1: Traditional textile recycling pathways

Table 1: Textile recycling strategies

TRADITIONAL STRATEGIES	:	Soft and hard waste processing from spinning (condenser waste, noils, sliver, roving, yarn waste, etc.)
	:	Hard fabric waste from fabric production and garment manufacture
	:	New rags from unused textiles
	:	Old rags from used textiles
MORE RECENT STRATEGIES:	:	Synthetic fibre production waste (polymer, extruded and drawn fibre waste, etc.,)
	:	Depolymerisation of process and consumer waste (polyester, nylon 6 and 6.6)
	:	Synthetic fibre production from non-fibre polymer sources (PET bottle waste, blending of polypropylene waste with virgin polymer)
	:	Performance garments returned to manufacturers
	:	Technical fibre (and composite) recycling

Recycling Strategies beyond 2000

During the coming 21st century, the desire and need to recycle must be driven by ecological as well as economic forces, although in the end both are related in a finite world. In a world which

- took 10,000 generations to reach 2 billion population (1935) and the last 3 generations to reach 5.6 billion;
- is losing 12 million tonnes of topsoil, 12 thousand hectares forest and 20 species every 4 hours
- witnesses 80% of materials and wealth being consumed by 20% of its population; and
- needs to increase its environmental efficiency by a factor of 10 - 50 if it is to have sustainable human life

then recycling is only a part of an integrated waste management programme at local, regional, national and international levels.

The magnitude of the textile waste problem

Within the European context, for example, the question of whether there is an ecological need to recycle textiles and whether it should be a part of an EU integrated waste management programme might be asked.

Currently within the EU the main focus is on the management of plastic waste which finds its way into municipal solid waste (MSW) streams. Typically about 10% by weight of MSW comprises plastics which, while being non-biodegradable, offer recycling opportunities as valuable raw materials, and sources of energy because of their high fuel content (3). While industrial figures indicate an input of plastics packaging of about 20 kg/person per year, collected MSW data in Germany suggest disposal levels range from 9 - 17 kg/person per year.

The magnitude of this plastics waste problem should be set against the following background in Table 2 (4).

Table 2: Western Europe's Municipal solid waste - 1990

Waste type	Million tonnes	%
Textiles	4.8	4
Plastics	8.9	7.4
Metals	9.6	8
Glass	9.6	8
Misc (ash, etc.)	11.5	9.6
Paper, board	36	30
Organics	39.6	33
TOTAL EU	120	100

From these figures there is an indication that textiles, in terms of MSW are 50% the size of the plastics problem. These figures are consistent with textile fibre consumption figures in W. Europe of about 20 kg/person per year coupled with a reasonably high fraction being handled by the textile recovery sectors.

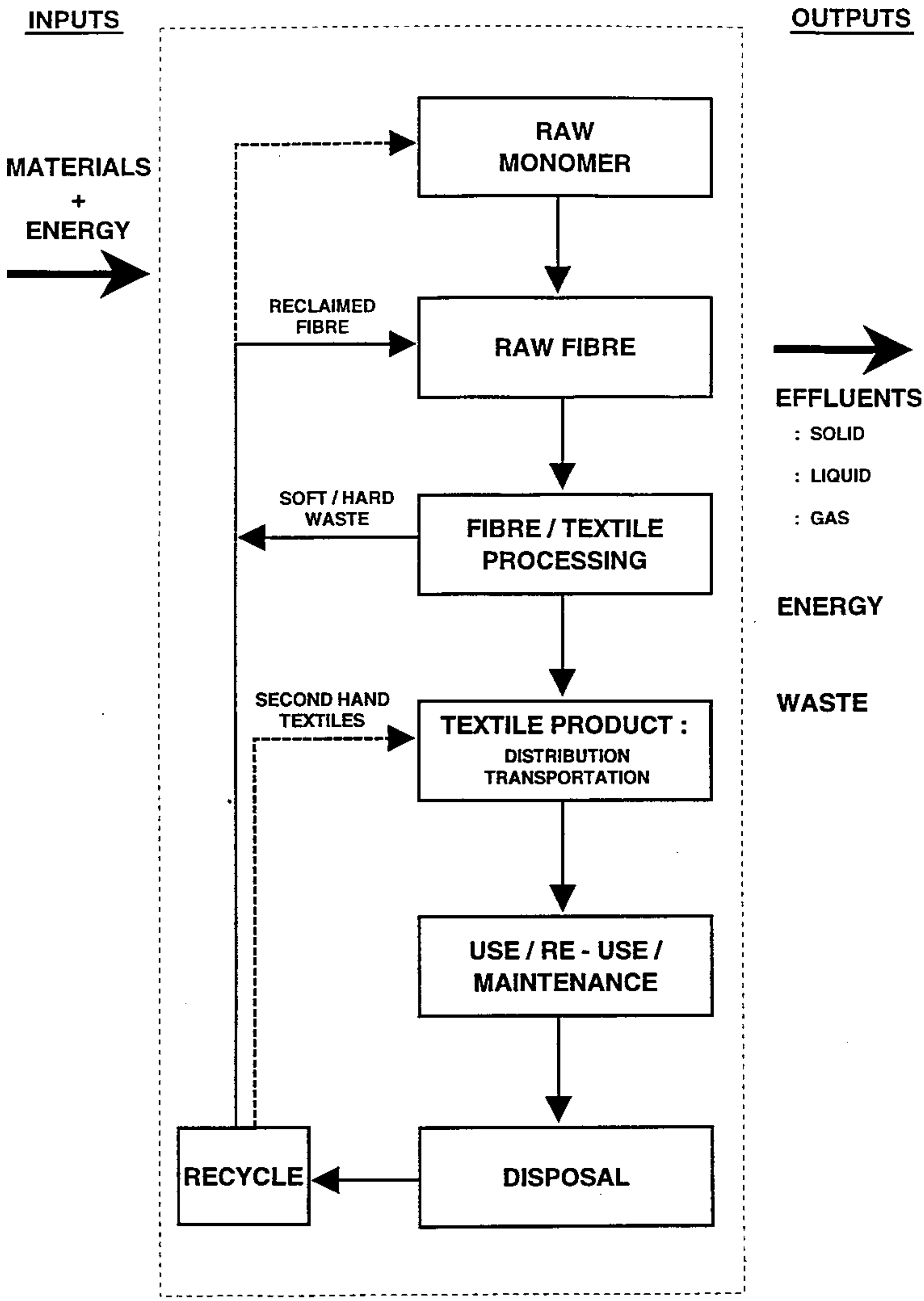

Figure 2: Textile recycling pathways with identified inputs and outputs

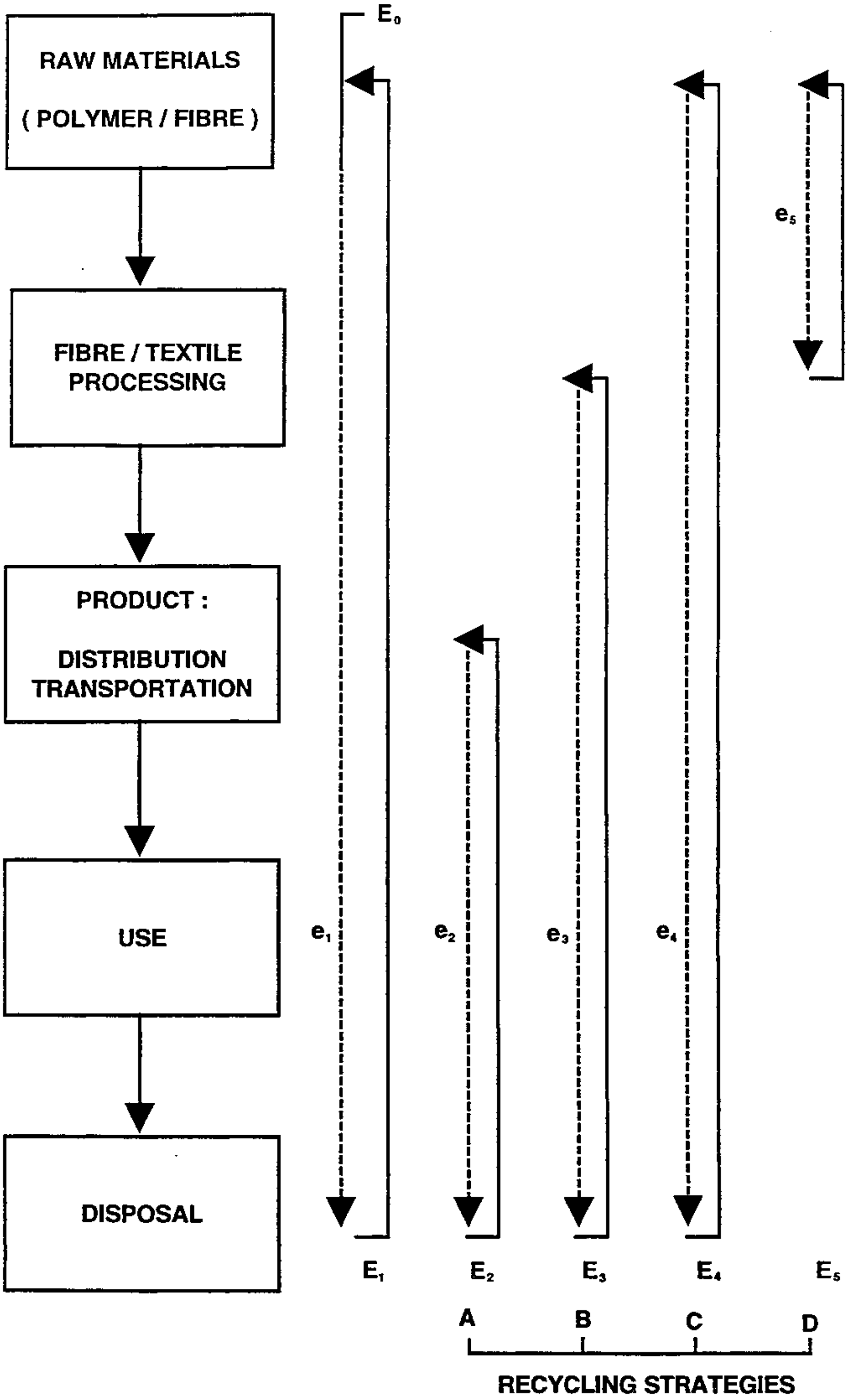

Figure 3: Energy input values for recovering/reclaiming (E_n) and reprocessing (e_n)

The EU Packaging and Packaging Waste Directive was finally adopted at the end of 1994 with the following targets:-

- minimum rate of recovery of 50%, maximum rate of 65%;
- minimum recycling rate of 25%, maximum rate of 45%;
- minimum recycling rate for each type of material of 15%;

This suggests that textile recovery and recycling could receive closer attention in the foreseeable future.

However, there is a current view that the traditional textile recycling sectors are very efficient and there is no need to give special attention to textile waste. In fact the energies expended in realising the value from PET bottles by converting a significant proportion into textile fibre is seen as a means of ultimately introducing this polyester source into an efficient, already existing, quite effective recycling process. The majority of the 4% textile waste figure in Table 2 comprises discarded carpets and household textiles - this is a problem, but one which is being partly addressed by synthetic fibre companies like BASF and DuPont which have developed pilot reclamation schemes involving fibre depolymerisation (eg for nylons 6 and 6.6) which regenerate monomers for reintroduction into the fibre production process.

Recycling targets - energy versus economics

The traditional textile reprocessing/recycling sectors have developed economically - efficient systems with their need to function as viable businesses. In both the developing textile recycling sector which includes synthetic fibre production from plastics waste and possible depolymerisation of carpet waste, for example and the composite materials recycling scenario, there could come a point where an increased level of recycling becomes energy inefficient.

In terms of cheap energy, this would not necessarily show as an uneconomical factor - energy costs and/or carbon taxation factors could force recycling levels to an optimum, equilibrium level. This would be acceptable on energy, economic and ecological grounds if textile recycling were part of a larger waste management programme.

Both Table 1 lists the newer textile recycling strategies and Figure 2 expands the traditional textile waste flows in Figure 1 and includes the emerging fibre depolymerisation and plastic waste-to-fibre routes. The figure also attempts to produce a more ecologically-balanced view. In order to address the economy versus energy question, the elements of Figure 2 can be simplified to give the flow chart in Figure 3 which introduces the energy factor.

If E_0 is the energy content of raw materials, e_1 is the energy to process raw materials into a product and E_1 is the total energy input and cost of recovering/reclaiming this same textile made from virgin raw materials, then E_2 to E_5 reflect the energy inputs of recycling textiles back to points of reprocessing exemplified by:-

- ROUTE A: Secondhand garment recycling (E_2)
- ROUTE B: fibre reclamation from "old rags" (E_3)
- ROUTE C: reclamation/depolymerisation (E_4)
- ROUTE D: fibre reclamation from new "soft" and "hard" wastes; chemical reclamation from textile effluents.

The full "energy cost" of recycling will be the recycling energy route value ($E_2,\ldots E_5$) plus a component of the original energy to process route, e_1, namely, e_n or $e_2 \ldots e_5$. However, against these "full energy" costs may be set the unit mass energy, E_0, for raw materials that recycling a similar unit mass saves plus the energy required to convert raw fibre into the process stages "saved" by recycling ie $e_1 - e_n$. Thus the true unit mass energy costs of recycling should be:-

Route A: $E_0 + e_1 - (E_1 + e_1)$ (i.e. Energy to convert raw materials to product - energy to recycle = energy saved)

Route B: $E_0 + e_1 - (E_2 + e_2)$

Route C: $E_0 + e_1 - (E_3 + e_3)$

Route D: $E_0 + e_1 - (E_4 + e_4)$

This gives rise to a general equation for any Route n of

Net energy saved by
Recycled system, $E_R = E_0 + e_1 - (E_n + e_n)$

To be energy efficient, recycling must save energy and so

$E_R > O$ (i.e. denoting a positive saving of energy)

ie $E_n + e_n < E_0 + e_1$

Energy input to recycle	Energy used in raw material costs and processing

Routes A and D on this simple model will have the smallest energy inputs and so perhaps offer greater energy savings and hence ecological efficiencies as well as economic efficiencies.

This simple model therefore suggests that for a given fibre or textile type there may be an optimum balance of recycling and disposal strategies which together create the highest level of ecological efficiency. In the far less complex but more important case of plastics waste disposal, it is considered that for a given plastic there is a maximum recycling level to be achieved which is balanced by an appropriate thermal recovery fraction. This simple model may be defined for plastics as:

		%
Plastic waste	Recycling	x
	Thermal recovery	y
	Other	z

may be expanded for textiles as:

			%
Textile waste	Recycling: Route	A	x_a
	"	B	x_b
	"	C	x_c
	"	D	x_d
		etc.	x_n
	Thermal recovery		y
	Other		z

Clearly this model is oversimplified but it does raise the question of the need to introduce an element of science into the whole area of waste recycling in textiles.

It is possible that given the correct model and data, efficient levels of recycling which are determined by both energy and economic efficiency criteria may be defined for each textile type. This is certainly the thrust of strategic developments for managing other material wastes. A further complicating issue is that for each process in Figure 3 which has been analysed more fully above, absolute values of E_n and e_n per unit mass of reclaimed textiles may vary as the total percentage of textile recycling increases. For instance, doubling a given level of recycling of a given textile type may more than double collection/transportation energy inputs because material is not dispersed uniformly in consumer societies. In other words, current recycling levels of textiles are determined by ease of finding and collecting which determines costs (and energy) of these activities. Figure 4 presents the outcome of such a model (5). In this figure, there is an energy efficient level of waste recycling where the total energy of the system is minimised (ie. energy saved, E_R) as a consequence of the recycling energy costs being less than the energy of using equivalent new raw material. However, for 100% waste recycling (using one or more routes) it is possible that the energy costs of collection, concentration and transportation will exceed the costs of producing and processing virgin product. At some level, a maximum economic fractional mass value of recycling, w_m, may be defined, with w_e being the most energetically and environmentally acceptable value.

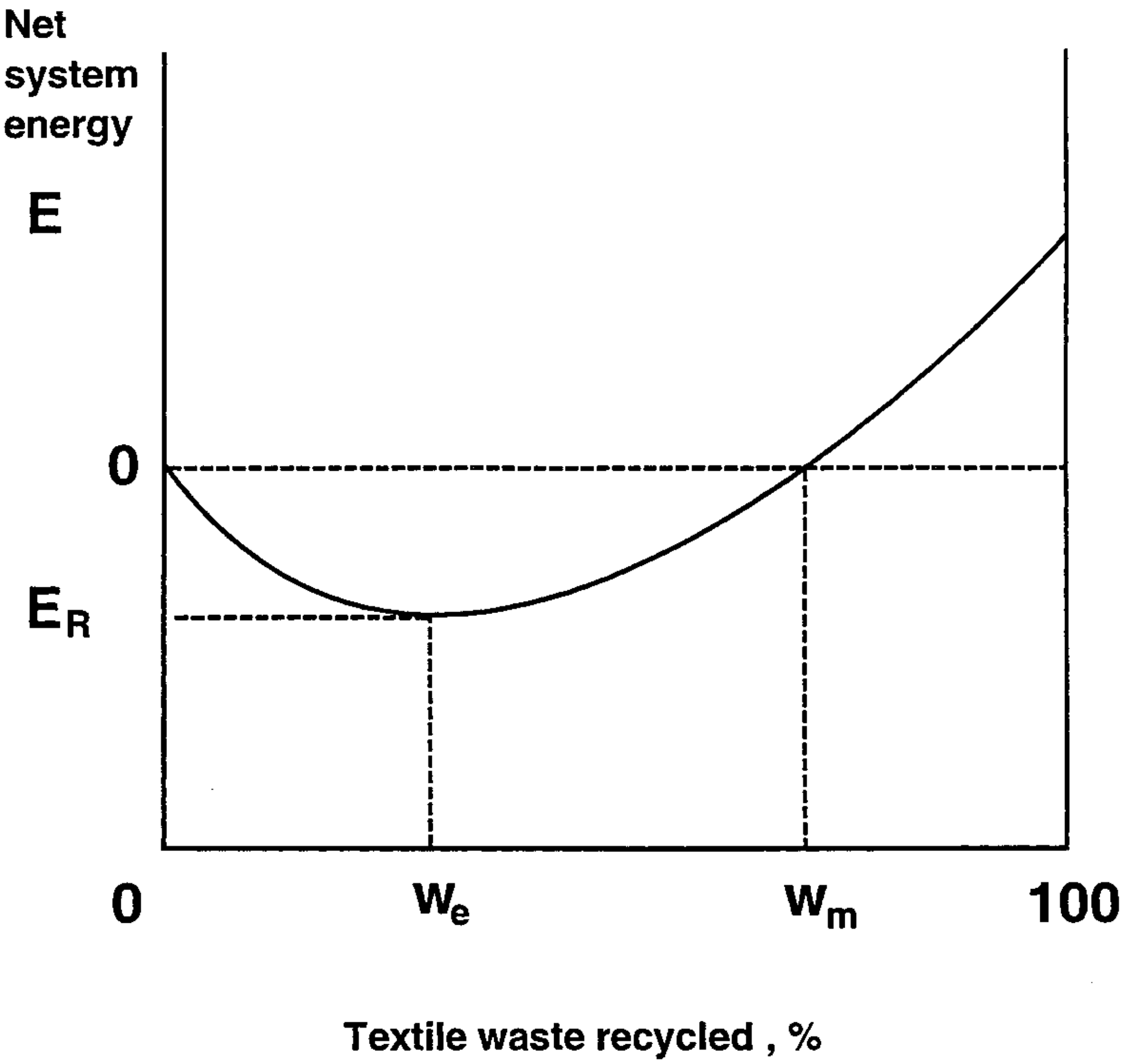

Figure 4: Net energy of recycling as a function of percentage waste recycled.

Current State of and Opportunities in Textile Recycling

Within the EU it is probable that in spite of the reduction in size of the traditional textile and clothing manufacturing sectors, there is still a sizable soft and hard waste reprocessing industry which is becoming more involved with recycling technical and industrial wastes. Because these and the remaining traditional industrial sectors are using in many instances, technical fibres of relatively high value, then the economic opportunities here will probably assure its efficient continuation. Coupled with this is a consumer-based population of about 300 million each consuming about 20-30 kg fibre/person per year equivalent to a total EU consumption of about 7 million tonnes (6). Unless the EU is accumulating textile products, it may be assumed that this figure is the same as the annual textile consumer waste quantity. However, Table 2 indicates an annual W. European MSW textile loading of 4.8 million tonnes.

The difference between these figures suggests that textile waste recovery/recycling within the EU is about 2 million tonnes per annum (see Table 3). This quantity will enter the traditional reclamation routes for used textiles (see Figure 1) which are accepted by those in authority as being efficient, even if a large part of this "efficiency" is determined by the needs of third world countries for exported garments. This market will not decline. Neither will the demand for "old rag" recycling into fibre for re-entry into the textile chain decrease as virgin raw material costs increase (as they are at the present time).

Table 3: W. European Textile consumption and waste production

Annual EU consumption of textiles (= total waste for steady state condition), tonnes	7 million
MSW textile loading (4%, see Table 2), tonnes	4.8 million
Shortfall = textiles recovered/recycled, tonnes	2.2 million

However, while OECD includes recovered textiles on its green list of materials, some 40 or so countries and potential markets for these products have yet to accept this designation (7). Thus markets for exported secondhand textiles and textiles comprising reclaimed fibres could be obstructed. With regard to the latter the need to distinguish between "waste" and "products containing secondary raw materials" is essential if export markets are to be fully opened.

The current value and potential value of the UK reclaimed textile market is shown in Table 4. Based on the above figures and assuming the UK consumption of textiles and waste production is about 1/6 of the EU figures above, then estimates of textile waste in municipal waste and recovered textile waste may be made. This shows an estimated 400,000 tonnes textile waste for reclaiming. (Note: Total UK household waste for 1992 was 20 million tonnes (8) which if 4% (Table 2) is assumed to be textiles, gives 800,000 tonnes-the same figure in Table 3).

The first half yearly figures for 1994 (9) in Table 4 suggest that about 200,000 tonnes per annum is exported outside the EU, leaving 200,000 tonnes within the EU from UK consumers/producers.

Table 4: UK textile waste production and reclamation

Total Textile Waste:

Table 3:	1/6 of 48 m tonnes (EU figures for 1990) = 800,000 tonnes for UK
Ref. 8 :	4% UK household MSW = 800,000 tonnes

6 months UK exports outside EC, Jan - June 1994 (9)

Secondary Fibres:

	tonnes	£k
Silk	22	140
Cotton (linter, yarn, fabric, garnetted stock)	2,127	3,315
Bast (jute, flax) seed (coir, loaf (sisal)	165	316
Man-made fibres (staple and filament)	49,136	64,989
Wool, animal hair	19,105	43,771
	70,555 (73%)	112,531 (87%)
Used textiles:		
Clothing, used textiles	25,753	16,385
1/2 year total	96,308	128,916
Annual Total (approx)	**200,000**	**250,000**

The estimated 800,000 tonnes of textiles "lost" in UK municipal waste might be considered as a lost resource, especially when landfill and incineration are the main disposal routes. If energy recovery was on the UK disposal or recovery agenda then the value of this would be partly realised. This "lost" quantity of textiles surely must offer a challenge and opportunity to UK reclaimers. Exploiting this opportunity and "lost resource" (having an estimated value of about £500 million at used clothes prices) requires consumer education, local authority co-operation and UK reclaimer partnerships bearing in mind, of course, the energy versus economy arguments or law of diminishing returns discussed in the previous sections (see Figure 4).

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MUNICIPAL WASTE - TRASH OR TREASURE

Jim Cunliffe

Municipal waste is produced by each and every one of us just by the act of living. It's the material that ends up in our dustbin - mainly packaging and food waste, or down at the local household dump - as old furniture, carpets, washing machines, fridges and the like, or as litter on our streets. Nationally in the UK we produce each year some 20 million tonnes of domestic, municipal waste, which is approaching a tonne per household per annum.

From the individual's point of view, once you have thrown your waste in the domestic bin it is a case of "out of sight out of mind" and this is where the problem starts.

Each local authority has a duty to collect and arrange disposal of this waste, and about 85% of it is dumped untreated into holes in the ground - landfill sites - as the cheapest way of disposal, typically £10-15 per tonne. However the availability of convenient holes is falling rapidly, especially in the south of the UK, so transport costs escalate and because holes are becoming scarce - just like any other commodity - price tends to rise. The net result is the rising cost of landfill disposal.

Increasing environmental awareness has focused attention on some of the problems associated with land filling such as landfill gas contributing to global warming, water and ground pollution due to leachate escape, restoration of the landscape and long term aftercare to ensure the integrity of the site after closure. Improved site management again pushes up costs of landfilling.

An alternative to landfill

There is an alternative - it can be burnt. Currently, there are about 30 municipal incinerators in the UK that do just that, accounting for some 8% of municipal waste.

The obvious advantage is that 90% of the material "disappears" and the remaining ash is only a third of the weight of that which went in - so making much less demand on final disposal to landfill. Unfortunately, incineration costs twice as much as landfill at about £30-35 per tonne. Furthermore, nothing really "disappears", it just changes into something else, and in this case, if one third of the weight remains as ash, two thirds has gone up the chimney as air pollution.

Again, increasing environmental awareness has focused on emissions to air, and more stringent controls are being introduced that will increase significantly the costs of incineration or even force plants to close down, putting even more pressure on landfill.

Table 1: **Typical composition of UK household (dustbin) waste and components commonly targeted for recycling - waste collected in Greater Manchester districts.**

Category	Concentration Weight %			Weight %	% Range		Sub Category	Related to GM Districts Waste	Recycled
					Minimum	Maximum		te.	te.
Paper and Card	21.6	54.1	33.2	11.40	7.7	18.7	Newspapers	73,600	} 19,111
				4.81	2.8	7.9	Magazines	31,000	}
				9.53	6.4	14.3	Other Paper	61,600	
				0.64	0.1	0.9	Liq. Containers	4,000	
				3.79	2.8	5.7	Card Packaging	24,500	
				3.10	1.8	6.6	Other Card	20,000	
Plastic Film	3.4	8.1	5.3	1.16	0.2	2.0	Refuse Sacks	7,500	
				4.18	3.2	6.1	Other Pl. Film	27,000	
Dense Plastic	2.7	10.1	5.9	0.63	0.2	1.2	Clr. Bev Bottles	4,000	}
				1.12	0.5	2.4	Other Pl. Bottles	7,200	}
				0.12	-	0.2	Col. Bev Bottles	800	211 }
				1.91	0.8	3.1	Food Packaging	12,300	
				2.14	1.2	3.2	Other Dense Pl.	13,800	
Textiles	1.1	3.4	2.1	2.13	1.1	3.4	Textiles	13,700	123
Miscellaneous Combustibles	1.4	13.6	8.1	4.21	0.5	7.3	Disp. Nappies	27,200	166
				3.90	0.9	6.3	Misc. Combustibles	25,200	
Glass	2.7	16.9	9.3	1.31	0.3	2.8	Brown Glass	8,500	}
				2.39	1.2	6.4	Green Glass	15,500	} 6,345
				5.37	1.1	7.3	Clear Glass	34,700	}
				0.20	0.1	0.4	Other Glass	1,300	
Putrescribles	13.9	27.8	20.2	3.40	0.7	6.5	Garden Waste	22,000	
				16.77	13.2	21.3	Other Putrescibles	108,000	
Ferrous Metal	2.8	10.8	5.7	0.53	-	1.2	Fe Beverage Cans	3,400	}
				3.74	2.6	6.0	Food Cans	24,200	} 7,030
				0.06	-	0.5	Batteries	400	
				0.40	-	0.9	Other Cans	2,500	
				0.98	0.2	2.2	Other Ferrous	6,300	1,828
Non Ferrous Metal	0.3	3.9	1.6	0.43	0.1	0.8	Non Fe. Bev. Cans	2,800	177
				0.47	0.1	0.6	Foil	3,000	77
				0.71	0.1	2.5	Other Non-Ferrous	4,600	
Fines	3.5	12.4	6.8	6.77	3.5	12.4	10 mm Fines	43,800	
TOTALS	-	-	100.0	100.0				646,500	35,068

Table extracted from Warren Spring Report:
"Cost assessment of source separation schemes applied to household waste in the UK (Nov. 1993)"

Notes:

(a) The basis is the District Collections figure of 744,758 tonnes less commercial Waste collected, 98,248 tonnes, which amounts to 646.510 tonnes

In the past, municipal waste has been considered as just a burden of worthless material to be disposed of. But that burden is sizeable in Bolton let alone throughout the country as a whole. This is approaching £7 million annually to collect and dispose of and so, in the face of increasing environmental awareness and rising costs, minds are becoming concentrated on how to contain those costs and be more environmentally friendly.

There appear to be two ways of reducing the amount of waste to go to final disposal.

a) Reduce the amount of waste produced in the first place i.e. waste minimisation.

b) Take anything from the waste that can be useful, including heat and energy, and pass it to someone else to use i.e. reclamation/recycling.

Consider the contents of a typical waste stream; Table 1 shows this, courtesy of Warren Spring Laboratory, for waste collected in the Greater Manchester districts within the UK. Table 2 shows the typical contents of UK dustbin waste in general.

Table 2: Typical composition for U.K. dustbin waste

	Paper and Card	17.5% }	
	Plastic	8% }	
Packaging	Glass	9% }	- 40%
	Steel Cans	4.5% }	
	Aluminium Cans & Foil	1% }	
Newspaper & Magazines			16%
Kitchen & Garden Waste			20%
Disposable Nappies			4%
Textiles			2%
Batteries, Scrap Metal and miscellaneous			18%

Scope for Waste Minimisation

Local authorities have little or no influence over the amount of waste available to go into the waste stream - they can't ask people to buy and read fewer newspapers and magazines, or eat less to produce less kitchen waste or have less grass and fewer plants in their garden.

Almost everything we buy is packaged in a bottle or a can, in paper or cardboard, in foil or in plastic. Manufacturers, packers and retailers could have greater impact here by reducing packaging material - local authorities can only campaign in this direction.

Modern living and the high priority of convenience has a lot to answer for in this respect as illustrated by the growth in use of disposable razors, ladies tights, plastic bottles and drinks cans. For example 3,285 million disposable nappies are used annually, weighing 821,000 tonnes. They are made of multi-materials and use 10 times the raw materials used in a cotton nappy, 5 times the energy and produce 10 times the waste. A worthwhile saving in waste could be made by banning disposables - could we? should we?

Questions for both consumers and package manufacturers to ask are various. Why do we use something only once and then throw it away? Why do we throw bottles away - why can't we return them to be refilled like a milk bottle? Why do supermarkets have milk in plastic bottles and cardboard cartons that cannot be refilled and just go into the dustbin?

One simple solution is for local authorities to charge individual households for the amount of waste put in the bin - the more waste there is the more that has to be paid! This would certainly raise awareness of how much the disposal of packaging is costing, and consumers might then pressurise retailers to reduce it. Such a remedy could lead to "fly tipping" rather than putting waste in the bin and if this happened, then it would be counter productive. However, it might just encourage people to use facilities for recycling their waste bottles, cans, newspapers and so on.

Recovery from the Waste Stream

Is there any treasure buried in this trash which has a value and can be useful elsewhere , thereby reducing the amount of rubbish for disposal and perhaps being helpful to the environment?

Consider again the contents of a typical Bolton dustbin, and what it might be worth , based on a figure of 80,500 tonnes of waste collected from the bins (see Table 3).

If we recover the most recyclable materials then there are 41,755 tonnes less for disposal (that is about 50% of the collected waste) at say £15 per tonne gate fee, this is a saving of £626,325. Adding this to the value of the material at £1,592,090 makes a grand total of £2,218,415. On this basis things are looking up.

Unfortunately, the situation is not that simple because of the four following major points.

Duty to collect waste: A town like Bolton has a duty as a waste collection authority to collect household waste and deliver it to the Greater Manchester Waste Disposal Authority for disposal.

Bolton is charged for the service not on a per tonne basis but on a per capita basis - therefore any reduction of waste is not reflected in a cost saving. However, to help overcome this difficulty, provision was made in the Environment Protection Act 1990 for Recycling Credits to be paid for household waste that was collected for recycling. The credit is to be paid by a waste disposal authority to reflect the savings made by not having to dispose of that waste.

Table 3: Potential value in Bolton's bins

Material	%	tonnes	Price/tonne delivered(£)	Potential Value (£)
Paper & Card	17.5	14,088	10	140,880
Plastic Film	6	4,935	NIL	NIL
Plastic Bottles	2	1,505	90	135,450
Glass	9	7,245	18	130,410
Steel Cans	4.5	3,622	25	90,5504
Aluminium Cans/Foil	1	805	900	724,500
Newspaper & Magazines	16	12,880	35	450,800
Kitchen & Garden Waste	20	16,100	NIL	NIL
Disposable Nappies	4	3,220	NIL	NIL
Textiles	2	1,610	230	370,300
Miscellaneous	18	14,490	NIL	NIL
Totals	100	80,500		1,592,090

So if the 41,755 tonnes of material in the waste stream could be recovered for recycling and avoid disposal, then a Recycling Credit of approx. £11 per tonne would be paid by the Greater Manchester Waste Disposal Authority - which equals £459,305.

The net result is that if all the available material was collected and sold for recycling then there would be an income to Bolton of £2,051,395 from the sale of materials and recycling credit.

Mixed waste: Recyclable materials may be in the waste stream, but are mixed up together and are unsaleable until the different materials are separated out and presented to the market in an acceptable condition - invariably to a recycler of that particular material.

Markets: It is pointless to collect and separate the material if it cannot be sold to anyone. A market is essential.

Recycling efficiency: The fourth point is the question of how much of that material which is actually present is in fact practically recoverable, as a great deal of it - particularly paper, card and plastic film - is contaminated with other wastes in the bin e.g. contents spilled from cans and bottles, waste food contamination, fats and oils and so on.

The UK Government has set a target to recover by the year 2000, 50% of the recyclable part of household waste, which is roughly 25% of the total. Local Councils are achieving only about 5% - why?

The short answer is that it costs too much to collect and separate materials so they are saleable at an economic price.

The prices paid for recyclable material do not relate to the cost of collecting that material, but are determined on international commodity markets - paper, aluminium, oil (plastics) steel, and take into account the costs of providing virgin materials to the markets. If it is cheaper to buy virgin material rather than recycled, then that is what happens.

The prices paid for recycled household material by and large do not cover the costs of providing it. A recent example is the price of waste paper. In 1992/93 the prices paid were £15-20 per tonne, in 1993/94 the price fell to £5-7 per tonne and, at one stage, there was a charge to take it away. Now the price is up to £30 per tonne.

How waste material is collected and sorted in Bolton

"Bring (or drop off)" schemes are those where the public is relied upon to deliver material for recycling to special containers at various locations in the community. The larger the containers, the lower the frequency of emptying and the lower the transport costs and the more cost effective the scheme is. But the number of large supermarket car parks is relatively small and so how to increase the rate of collection is a major problem - smaller banks, more of them, emptied more frequently is one answer but this increases costs.

Bolton intends to increase its 60 recycling sites to 105 by 1996 (1 to 2500 head population). A special vehicle is required to service the site and keep the materials separate, and storage bays need to be constructed to consolidate loads for long haul to the recyclers. On top of all this, there are operating costs to keep the whole thing running. The result is a net cost of recycling bottles and cans of approximately £103 per tonne as compared to the current collection and disposal costs of household waste at about £75 per tonne.

The Local Authority also collects plastic bottles, but for the last year there has been no market for mixed plastic bottles. As a result, a sorting plant has been set up with assistance from the company Recoup so that it now costs about £160 per tonne to recycle plastic bottles.

Kerbside collection schemes using blue boxes or twin bins and associated sorting facilities are even more expensive to set up and operate, and "high tech" central processing of wastes requires investment way beyond the means of individual councils.

So why bother recycling at all?

It is obvious that local authorities like Bolton are not in it for the money - and as far as I know there are few, if any, local authority recycling schemes that actually financially break even without grant aid, subsidy or sponsorship.

At the beginning of this paper the impression was given that local councils embarked upon recycling to perhaps reduce overall disposal costs - that is not really true.

In 1979 Bolton installed glass banks in the town to support the glass industry's initiative - not to reduce costs or make money, but because it was a sensible thing to do, and the scheme just about broke even.

At about the same time, the Council began supporting charity organisations who were collecting newspapers and magazines for their own funds, in conjunction with a local paper merchant; again this was not to cut costs or generate income but because it was a good idea.

In the late 1980's and early 1990's, there was a great increase of concern for the environment, and Bolton responded by trying to enhance its recycling facilities by increasing the number of glass banks, and introducing banks for cans, paper and textiles. But because of the costs involved (in banks alone), the Council worked in partnership with recyclers and other organisations to initiate and develop new schemes at minimum cost.

The point is that local authorities are there to satisfy the needs and aspirations of their residents, and certainly one of those growing aspirations is towards care and concern for the environment, and recycling features prominently in this concern. It is for this reason initially that Bolton began to be more involved in recycling.

This involvement became more focused when the Environment Protection Act 1990 required each local authority to produce a Recycling Plan to show how each might recycle 25% of its household waste by the year 2000. Ever since there has been growing pressure to demonstrate that councils are environmentally friendly in everything they do, and they are now charged with producing a Local Agenda 21 which is an action plan put together by all sections of the community that will ensure that generations in the 21st century and beyond will inherit an environment capable of satisfying their needs.

Where does recycling fit into the well-being of the environment?

Referring to household waste - the present system of work is that energy is expended in extracting natural resources. More energy is used in transporting and processing that material into something useful e.g. a bottle, can, newspaper, plastic container and so on. When that item is discarded, it goes into the bin and is dumped into a landfill site, never to be seen again. Thus the need for another bottle, can or whatever requires that we go through the whole process again.

Thus recycling:

Saves Raw Materials
Saves Energy

Saves Pollution
Saves Disposal

Raw Materials: If raw materials have already been extracted then it makes sense to use them again if possible. This means that reserves last longer into the future. It means there is less environmental impact due to mining, quarrying, oil and gas drilling, deforestation and the like. If there are fewer of these operations, less energy is used to carry them out.

Energy: Most energy used is produced by burning fossil fuels - coal, oil and gas. It takes special geological conditions and millions of years to produce these fossil fuels. They are being used up much faster than they can be renewed and so eventually they will run out - not in our lifetime but someone in the future is likely to suffer.

Recycling saves energy because there is less need to extract basic raw materials, and less to transport to processing plants.

If we already have a bottle or can or a newspaper, much less energy is required to transform it into another bottle, can or newspaper than making one from raw material ingredients. In the case of an aluminium can the energy saving is 95%, for a steel can 75%, paper 40% and glass 20%. These are very worthwhile savings on any dwindling resource.

Pollution: Pollution in relation to raw material extraction has already been mentioned - quarries, spoil heaps, destruction of natural beauty, destruction of wildlife habitat, oil spills in transportation and extraction (e.g. N. Siberia where the tundra is saturated with oil from leaking pipes). In addition, there is pollution from processing and manufacturing plants - chemical works, paper mills, oil refineries and so on. Recycling plants and processes using recycled products may possibly be cleaner than primary processing industries.

Then there is pollution from energy production itself - burning fossil fuel produces greenhouse gas to add to global warming and sulphur dioxide to produce acid rain; vehicle fuel combusion produces pollutnats which generate photochemical smog.

Recycling uses less energy so there is less pollution.

Disposal: Quite simply if we are recycling our waste, then the need to dispose of it by burial disappears and landfill sites will have a longer life. Furthermore, the concern regarding burning it and causing pollution that way vanishes, although there is growing movement in some quarters which says that burning waste and recovering heat and energy is the answer to everything!

However, Friends of the Earth say that burning the waste will only recover about 3% of the energy it took to produce the waste in the first place. That does not seem to be a good trade off !

A personal view is that the real treasure in municipal trash is the potential for environmental improvements by recycling as much of it as possible, thereby conserving natural resources for future generations, conserving energy supplies, and reducing pollution.

These are all elements to which a price tag has never been added. If they were properly valued and fed into the economics of recycling, I suspect we should be aiming to recycle 70% of our household waste and be achieving it!

What is being done to encourage recycling?

Various measures already exist or are in the pipeline to encourage better waste management and recycling.

Recycling Credits	- paid to collectors of material for recycling to reflect the savings made by avoiding the costs of disposal, thereby making recycling more attractive.
Supplementary Credit Approval	- permission for local councils to borrow money beyond their current limit to fund capital expenditure on recycling schemes - but not to assist in operating costs. But councils still have to find the money!
Landfill Tax (1996)	- to make the disposal of waste more costly and encourage waste reduction, recycling and incineration.
Producer Responsibility Group (PRG) and Valpak	- a compulsory levy on the packaging chain to be used to achieve a recovery rate (not recycling rate) of 58% by the year 2000. This puts the emphasis on industrial and commercial packaging and incineration of household waste with energy recovery.
European Packaging Directive	- member states directed to recover 50-65% of packaging waste (including incineration with energy recovery) and to recycle 20-45% of packaging waste (including 15% of each individual packaging materials by the year 2000).
National Waste Strategy	- reduce waste, support close-to-home recycling facilities, promote local authority composting schemes, and promote incineration.

It remains to be seen just how effective these measures will be in recycling more household waste as well as industrial and commercial waste.

It seems that greater recycling of household waste is only likely to be achieved by continued public demand and HM Government making available resources specifically for this purpose.

Conclusions

The 3 R's of waste management are

Reduce	- the amount of waste produced
Reuse	- as much as this waste as possible
Recycle	- the remainder if we can.

These all contribute to a more sustainable use of our natural resources.

But there is a 4th R:-

Respect - for the Environment

The Environment gives us food to eat, water to drink, air to breathe and all the other resources to enhance our quality of life, yet all we seem to do in return is to abuse it! One day, at this rate, the environment is going to give up on us and quit - then what?

There is only one Environment - it must be treated with the respect it deserves, which brings us back to municipal waste. There is clearly treasure in municipal trash in terms of useful materials contained within it. There is even more treasure to be found in the environmental benefits to be gained from recovering those materials.

What is missing is an all embracing evaluation of that treasure and the will to go and get it!