Sustainable waste management - possibility or pipe-dream

P.J. Mobbs
Mobbs' Environmental Research, Banbury, UK

Published in *Why Recycle?*, Proceedings of
The Recycling Council's Annual Seminar, Birmingham, 17th February 1994

ABSTRACT: The current promotion of recycling by Government and local authorities is not tackling the central problems of waste in the UK; it is un-sustainable in its present form, and does not solve the current waste management crisis. Current recycling targets are unrealistic when compared to the annual UK waste arisings, and the lack of a national waste management and recycling strategy prevents any organised solution.

1. THE SUSTAINABLE MANAGEMENT OF RESOURCES

The industrial world recently signed up to a programme of radical change in the way global resources are managed and used, through the UN Conference on Environment and Development, and the final conference document (UNCED 1992), Agenda 21 (the Agenda for the 21st Century). This requires signatory states to move towards 'sustainable' economic and social systems during the first part of the next century. Given this requirement - and the ever present prospect of increasingly scarce natural resources, can current practices - and assumptions - about waste management and recycling be carried forward into the next century without serious challenge?

The problem with 'sustainability' is that there is not one concrete definition of the term. One of the best analyses of sustainability issues and the development planning system has been produced by the Town and Country Planning Association (TCPA 1992):

"Sustainable development is a vague concept that, at once, offers a comprehensive, consensual and conservative approach able to weld together quite disparate and conflicting interests in environment and development. But, because it is vague and its implications poorly understood, in practice it offers few clear solutions. Anyone can sign up for sustainable development so long as it requires no specific commitment to do anything that will threaten their material interests."

The meaning of sustainable development is normally explained by the oft-quoted definition in the Brundtland Report (UN 1987):

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

In terms of waste management, what the industry deals with is the 'sterilisation' of resources, by burying them, burning them, or dumping them at sea, preventing their use by future generations. Although these resources can be remade, this requires large amounts of energy, and the consumption of more resources. What the waste management industry must achieve,

in association with society and industry at large, is the closing of the 'loop' - turning the currently linear use of resources into a cyclical one. This could be achieved through:

1. The minimisation of the amounts of waste/resources being lost to landfill, incineration or other forms of dumping.
2. The highest levels of recycling, where it can be shown on a life cycle analysis that this saves resources and energy.
3. Where wastes cannot be recycled or reused, urge substitution for materials which can.

Preventing waste amounts to the conservation of resources. It involves changes in production and design, with greater emphasis placed on quality, durability and utility. There must be a shift from a linear to a circular production process, instead of a succession of stages of production, each producing wastes that have to be managed in some way. This can be achieved at each stage by a combination of re-use, alternative use or recycling of materials otherwise unused during production and, wherever possible, by the use of waste products for some other useful purpose.

The consumption end of the cycle is the most important - and the hardest in practice - link to close. Products must be either returned and reused, put to secondary use, or recycled back to raw materials. This entails some sort of collection and return system, such as that now operated in Germany for some types of waste.

2. WASTE MANAGEMENT OPTIONS

Currently, waste materials have one of four fates:

1. 'In house' recycling as part of a production process.
2. Recycling of waste products after their useful life has finished.
3. Disposal to landfill.
4. Disposal to incineration (with possible energy recovery).

All these routes have their draw-backs which need to be considered when considering the advisability of which route should be selected for which type of waste. The merits of these various options are outlined by the DoE in Waste Management Paper No.1 (DoE 1992a)

The estimated annual waste arisings in the UK are roughly 400 million tonnes per annum (DoE 1992b). Table 1 gives a breakdown of the general classes and types of waste produced. These figures are extracted from recent publications on waste and recycling (DoE 1991, DoE 1992b, DoE 1993a, ARUP 1991).

From this data a number of key points can be extracted:

1. A large proportion of 'waste' arisings are not controlled under any environmental legislation. Mine, quarry and agricultural wastes in total make up 41% of total waste arisings.
2. At the present, only 8.6% of all waste material is reclaimed. It could be argued that agricultural wastes, consisting mainly of slurry, are reclaimed by spreading on the land. However, I do not consider this to be an accurate assessment of fact, since spreading is primarily a disposal option, and does not take account of the wastes potential as an energy resource.
3. Although great effort is being directed by local authorities into meeting the Governments 25% domestic waste recycling target, even when all authorities achieve this target, the total reclaimed will only be 1.3% of all waste arisings.

4. Although waste such as dredgings and some sludges are disposed of in the sea, most materials are disposed of on land - at least 330 million tonnes annually.

Table 1. UK annual waste arisings.

Waste type	Arising, Mte/yr	%	Reclaim, Mte/yr	%	% of all arisings.
Mine, quarry, slag and ash					
Colliery & slate	51	13.4	0.5	1.0	0.13
China clay	27	7.1	1.5	5.6	0.39
Fuel ash	13	3.4	6.6	50.8	1.73
Furnace slag	4	1.0	4.0	100	1.05
Other quarrying	9	2.4	--	--	--
Total:	104	27.3	13.1	12.6	3.43
Agricultural	80	21.0	--	--	--
Industrial					
General wastes	50	13.1	--	--	--
Special wastes	2.5	0.7	--	--	--
Total:	52.5	13.8	--	--	--
Dredged materials	43	11.3	0.0	0.0	0.0
Sewage sludge	35	9.2	0.0	0.0	0.0
Building wastes					
Building waste	24	6.3	11.0	45.8	2.88
Road planings	8	2.1	6.0	75.0	1.57
Total:	32	8.4	17.0	53.1	4.47
Household					
Paper	6.6	1.73	0.345	5.23	0.090
Plastic	1.4	0.37	0.070	5.00	0.018
Textiles	0.8	0.21	0.200	25.0	0.052
Glass	2.0	0.52	0.240	12.0	0.061
Metals	1.5	0.39	0.25	16.7	0.066
Organics	7.7	2.02	0.0	0.0	0.0
Total:	20	5.2	1.105	5.53	0.29
Commercial	15	3.9	1.5	38.5	0.39
Total:	381.5	32.7		8.57	

Table 2 gives the figures for controlled waste disposal in the UK (DoE 1992b). The remainder of the annual waste arisings are disposed of by spreading on the land, by uncontrolled land-filling or land-forming, and by sea disposal.

Table 2. UK controlled waste disposal.

Destination.	Total, Mte/yr	% of waste	% of all arisings
Landfill sites	119.0	85	31.2
Incineration	5.6	4	1.5
Sea dumping	5.6	4	1.5
Other (recycling).	9.8	7	2.6
Total:	140.0		36.7

The major route for waste disposal in the UK is landfill - 85% of controlled wastes are sent to landfill. Currently the UK co-disposes of many different types of waste in landfill, but this may soon change if new European directives are enforced.

At the same time as potential changes to the types of waste disposed of, new guidance from the Department of the Environment (DoE 1993b) requires that landfill sites be constructed as 'total containment' vessels, similar to the American 'dry-tomb' designs. Until recently landfills were operated on the 'dilute and disperse' principle, where pollutants were allowed to leach into the environment in the hope that dilution or natural degradation would prevent any widespread environmental damage. When all these changes to the landfilling of wastes have taken place, it is likely that the costs of landfill could increase significantly.

4% of controlled waste is incinerated. Currently, most incineration is carried out in old plants primarily designed to achieve mass reduction. These plants 'pay' for themselves through savings in the total cost of landfilling waste, and some also generate electricity or process heat for industrial/domestic use. Most of these plants will close shortly due to European directives on the operation of waste incineration plant because modification or retrofitting of pollution control equipment is too expensive.

Recycling is seen as a 'sustainable' alternative to landfilling waste, but the problem with recycling in the UK is that all the emphasis to date has been on domestic and commercial wastes, these being the most visible to the public at large. Other wastes which could be put to good use - colliery and quarry waste for example - have suffered as a result.

Recycling domestic waste has been promoted as the way forward to solving our waste and resources problems in the future. However, as highlighted earlier, even with 25% of all

domestic being recycled, only 1.3% of all waste arisings will be reclaimed. Also, because the primary responsibility for waste recycling is being put on local authorities (the domestic waste collectors) rather than the waste producers, recycling is a very expensive option, especially in rural areas.

The other disposal option noted above is sea disposal - this is mainly for harbour dredgings and sewage sludge. New European agreements will stop the dumping of sewage sludge at sea from the end of this decade, so meaning that new disposal routes will have to be found. At this moment, the greatest consideration has been incineration. New agreements on the disposal of materials containing toxic ('Red List') substances may also curtail the dumping of harbour dredgings.

3. DEVELOPING A SUSTAINABLE WASTE MANAGEMENT SYSTEM.

Agenda 21, chapter 21, sets out a programme of measures to implement more sustainable waste management systems. The objectives and targets of the chapter are listed in table 3. Reading through, if all these measures were implemented in the required timescale, the next ten years will see a fundamental shift of emphasis in the waste management industry from a primary objective of waste disposal to one of reuse and recycling.

Thus far, the main thrust of national campaigns to solve the problem of waste has been towards the packaging of domestic goods. I consider this to be of little benefit to the sensible management of resources because at most, it represents less than 1% of the whole UK waste stream. Even with the latest recycling targets for industry declared by the Department of the Environment, the actual level of recycling may never exceed 5% to 10% of national waste arisings, because these targets are aimed at the packaging industry, rather than other areas such as sludge producers, or industrial waste producers.

Table 3. Agenda 21 waste management objectives and targets.

OBJECTIVES:
* To stabilize or reduce the production of wastes destined for final disposal.
* To strengthen procedures for assessing waste quantity and composition changes for the purpose of formulating operational waste minimization policies utilizing economic or other instruments to induce beneficial modifications of production and consumption patterns.
* To strengthen and increase national waste reuse and recycling systems.
* To make available information, techniques and appropriate policy instruments to encourage and make operational waste reuse and recycling schemes.

TARGETS:
* By the year 1995 (in industrialized countries) to ensure that at least 50 per cent of all sewage, waste waters and solid wastes are treated or disposed of in conformity with national or international environmental and health quality guidelines.
* By the year 2000, ensure sufficient national, regional and

international capacity to access, process and monitor waste trend information and implement waste minimization policies.
* By the year 2000, have in place in all industrialized countries programmes to stabilize or reduce, if practicable, production of wastes destined for final disposal, including per capita wastes (where this concept applies), at the level prevailing at that date.
* To apply by the year 2000 programmes to reduce the production of agrichemical wastes, containers and packaging materials.
* By the year 2000, to promote sufficient financial and technological capacities at the regional, national and local levels, as appropriate, to implement waste reuse and recycling policies and actions.
* By the year 2000 (in industrialized countries) have a national programme, including, to the extent possible, targets for efficient waste reuse and recycling.
* By the year 2000, establish waste treatment and disposal quality criteria, objectives and standards based on the nature and assimilative capacity of the receiving environment.
* By the year 2000, establish sufficient capacity to undertake waste-related pollution impact monitoring and conduct regular surveillance, including epidemiological surveillance, where appropriate;
* By the year 2025, dispose of all sewage, waste waters and solid wastes in conformity with national or international environmental quality guidelines.

The most recent criticism of recycling has come from the House of Lords Committee on the European Communities. Their report (H. of LORDS 1993) notes that the belief that recycling is 'morally right' is simplistic and unsound, and the "political drive to recycle anything and everything has become a matter of dogma unsupported by rational economic or environmental thinking".

One of the fundamental flaws with recycling is that it does not encourage minimisation of wastage. More efficient use of materials will be encouraged during manufacturing processes due to economic mechanisms, but the 'back end' of the system - the disposal of waste materials by society at large - is not encouraged. In some cases, even though the elimination of materials could produce an environmental benefit, many view 'recycling' as a more palatable alternative.

The Royal Commission on Environmental Pollution (RCEP 1993) noted that little information existed on waste minimisation, but recent reports (ENDS 1993a) show that the results of Government sponsored projects in Northwest England have been very successful. If we take the conclusions of the Royal Commission on Environmental Pollution, made in their Eleventh Report (RCEP 1985) and restated in their Seventeenth Report (RCEP 1993):

"The Commission's general approach to waste management can be presented as a four-stage decision procedure:
1st. wherever possible avoid creating wastes.
2nd. where wastes are unavoidable recycle them if possible.
3rd. where wastes cannot be recycled in the form of materials,

recover energy from them.
4th. when the foregoing options have been exhausted, utilise the best practicable environmental option to dispose of wastes."

In their Seventeenth Report they go on to state:

"In terms of the four-stage decision procedure described at the beginning of this report, the first priority in waste management must always be to avoid creating wastes wherever possible. The view was expressed to us that waste minimisation if pursued with sufficient determination, might remove the necessity for incinerating any wastes, other than the most intractable clinical wastes. The reduction of waste arisings was discussed by the Commission in its Eleventh Report, which noted that avoiding waste can bring increased commercial benefit by altering a process, by changing from one process to another which might cost less in itself, or by decreasing disposal costs by generating less waste."

4. IS SUSTAINABLE WASTE MANAGEMENT POSSIBLE?

Although the Royal Commission echo the objectives of Agenda 21, I can see that it will be an uphill struggle to convince waste producers that investments in more expensive plants is necessary. The only way will be to begin to value waste for its true value in terms of finite resources and the energy invested in manufacture. Put more bluntly, the cost of waste disposal must rise to reflect the value of what we are throwing away.

To date, the main effort in terms of improving the sustainability of waste management systems has been the expansion of recycling. There have also been some efforts to improve the knowledge available on waste minimisation. But the greatest discussion has been on the future for waste to energy plants - burning rubbish to produce electricity.

Recently, a developer seeking permission for a waste to energy plants (GEO, 1993) stated that, "...there is a case by which the Energy Recycling Centre is a sustainable operation in its own right". It is difficult how this can be this position was arrived at; incineration plants produce waste ash which is contaminated with carcinogens. There is also the problem that the materials containing the greatest energy - plastics and paper/card - are precisely those which present the best options for recycling.

In energy terms, incineration makes no sense. Comparisons of landfill, recycling and waste-to-energy have recently been carried out (KIRKPATRICK, 1992) and this shows that there is no distinct advantage for incineration over other forms of waste disposal when looked at in terms of energy balance. Also, if we take a traditional fossil fuels such as coal, it contains more energy per unit volume than waste. If we take data from ETSU (ETSU 1987) comparing coal to waste derived fuel (RDF), burning RDF to achieve the same energy output as coal requires 56% more material by weight - which equates to nearly three times the volume of RDF. Also, to produce the same amount of energy, burning RDF produces 420% more ash. This data is detailed in Table 4.

Table 4. A comparison of coal and RDF in energy production.

Parameter.	Coal.	RDF.	Difference, percent:
Calorific value, GJ/te.	28.1	15.9	56%.
Density, kg/m3.	900	600	66%.
Ash content, %vol.	6.5	15.7	240%.

But, what is the answer to waste disposal? In essence, the purpose of waste management is to dispose of waste materials in a manner which causes the least damage to the environment. As shown by recent life-cycle analysis of waste disposal options (KIRKPATRICK, 1992) the most effective option for waste disposal is not a definite hierarchy of options. In terms of recycling the energy expended in reprocessing some materials may be as great as the energy used to manufacture them in the first place (in such situations, direct reuse or substitution would be advised).

If we relate each of the wastes noted earlier in table 1 to their 'best practicable environmental option' for 'waste management', the following options arise:

Firstly, there must be a greater emphasis on waste minimisation - over and above the current commitment given to recycling. This is required as part of the Agenda 21 programme, and will have to be addressed by the Government before submitting its review of Agenda 21 implementation to UNCED over the coming decade.

Secondly, there must be greater reuse of waste materials. Perhaps the most promising area for this is quarry/mining wastes. At the moment the only barrier to greater use is economic. The use of an 'aggregate tax' on primary extraction could even up this imbalance and encourage greater use of secondary aggregates, while at the same time preventing the destruction of the landscape through ever greater mineral extraction.

Thirdly, there is a place for recycling, but it must be noted that the most effective location for this responsibility is the waste producer. The only way to encourage manufacturers to consider the content/packaging and reprocessing of their products it to require that the waste product be returned to them for disposal - either directly or by contracting out to specialist recycling companies.

There are three other technologies, currently used in other countries, which could allow both cost effective management of waste materials, and reclamation of the materials or energy the wastes contain.

Firstly, the composting of organic wastes. This technology has proved promising for pure organic or 'garden' wastes, but there have been experiments recently involving the large scale composting of the organic fraction of domestic wastes (ENDS, 1993b) which have proven that it is a viable treatment method, although markets for the final compost have yet to be secured. The end product of this is a 'compost' which could be used for agriculture, or landscaping, but this would depend upon the the quality of the compost, and its pollutant

content.

Secondly, anaerobic digestion. This has been used for sometime to treat agricultural wastes in Europe, but has yet to see its full potential in the UK. Utilisation of sewage sludge and agricultural slurry in digesters would not only remove some of the polluting potential of these wastes, it would also generate significant amounts of electrical power or methane gas.

Finally, pyrolysis. Although the principle of pyrolysis or gasification has been known for some time, it has yet to be widely applied to waste management problems. Plants have been designed to handle specific wastes such as plastics or rubber vehicle tyres, and these may soon be operated commercially. AEA Harwell and Herbert Bevan Ltd have developed a small scale plant (AEA-Bevan 1992) which can reclaim a large proportion of the mass of vehicle tyres, producing a flammable gas, an oil rich in useful aromatic hydrocarbons (with a calorific value equal to that of diesel), and an 'activated' carbon char. The design may soon be in commercial use across the UK.

5. CONCLUSION

The current structure of the waste management industry is un-sustainable, and efforts to increase recycling are disproportionately targeted at packaging wastes, rather than waste material as a whole.

To implement 'sustainable' waste management, it will be necessary to implement measures to require waste producers to take responsibility for the fate of their materials. It will also be necessary to encourage more sound use of materials by charging - through raw material taxes levied or waste disposal charges - values which reflect the value of materials in terms of the materials they contain or the energy involved in their manufacture.

Incineration, conversely to the image some are promoting, is not a 'sustainable' waste management option. For most wastes, with perhaps the exception of biologically hazardous wastes, other more effective solutions can be found.

The next ten years, if Agenda 21 is implemented effectively, will present the waste management industry with enormous challenges.

REFERENCES

AEA-BEVAN 1992. "MPD TP-2000 Tyre Recycler", AEA-Beven Ltd 1992, Building 404, Harwell Laboratory, Didcot, Oxon. OX11 0RA

ARUP 1991. "Occurrence and Utilisation of Mineral and Construction Wastes", Arup Economics and Planning, HMSO 1991.

DOE 1991. "Recycling", Waste Management Paper No.28, HMSO 1991.

DOE 1992a. "A Review of Options", Waste Management Paper No.1, HMSO 1992.

DOE 1992b. "The UK Environment", DOE/Government Statistical Office, HMSO 1992.

DOE 1993a. "Digest of Environmental Protection and Water Statistics", No.15, HMSO 1993.

ENDS 1993a. "Yorkshire and Merseyside projects show the way on waste minimisation" p15, ENDS 221, June 1993.

ENDS 1993b. "Worm turns for composting", p15, ENDS 218, March 1993.

ETSU 1987. M.P. Landy, paper to Annual Wastes Management Conference, Torbay, 1987. Ref.: ETSU-L-20.

GEO 1993. "Environmental Statement on Proposed Energy Recycling Centre, Hespin Wood", GEO Ltd, 1992/1993.

H. of LORDS 1993. "Packaging and Packaging Waste", House of Lords Committee on the European communities, HMSO 1993.

KIRKPATRICK 1992. "Selecting a waste Management Option using Life-cycle analysis Approach", Packaging Technology and Science Vol. 6, 159-172, 1993.

RCEP 1985. "Managing Waste: Duty of Care", Royal Commission on Environmental Pollution 11th Report, Cmnd 9675, HMSO 1985.

RCEP 1993. "Incineration of Waste", Royal Commission on Environmental Pollution 17th Report, Cm 2181, HMSO 1993.

TCPA 1992. "Planning for a Sustainable Environment", Town and Country Planning Association, 1993, ISBN 1-85383-145-X; summarised in the 'Town and Country Planning Journal', May, Sept. and Oct. 1992.

UN 1987. "Our Common Future" (The Brundtland Report), World Commission on Environment and Development, 1987, Oxford University Press.

UNCED 1992. "Earth Summit '92", Regency Press 1992, ISBN 0-9520469-0-3.