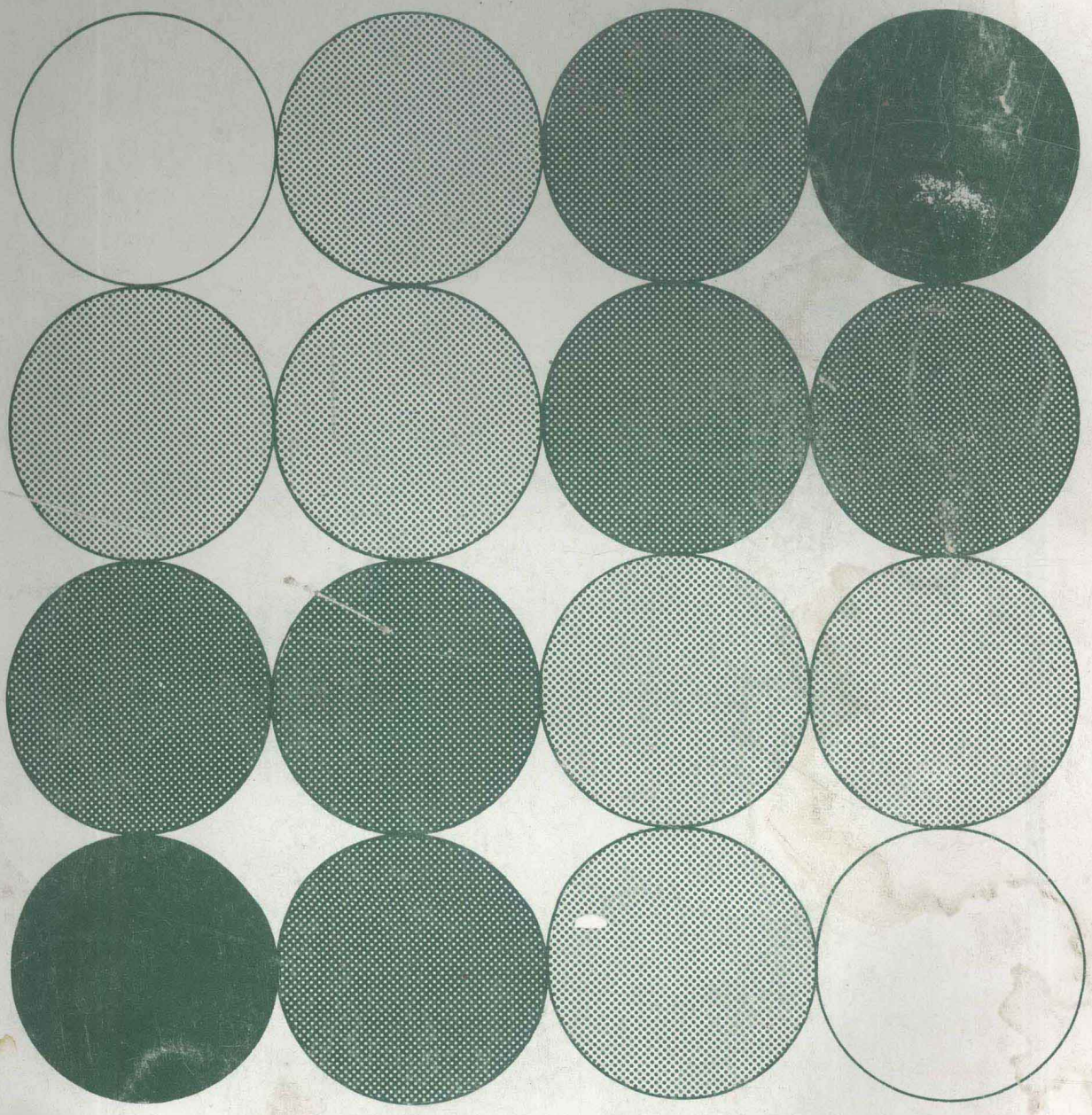
The Economics of Recycling

Environmental Resources Ltd



Published by
Graham & Trotman Limited
for the Commission of the European Communities

The Economics of Recycling

Environmental Resources Ltd

A report on the potential for further recovery of materials from wastes in Europe, prepared for the Environment and Consumer Protection Service of the Commission of the European Communities by Environmental Resources Ltd.

Published by
Graham & Trotman Limited
for the Commission of the European Communities

Published in 1978 by
Graham & Trotman Limited
Bond Street House, 14 Clifford Street,
London, W1X 1RD

for the Commission of the European Communities, Directorate-General Scientific and Technical Information and Information Management, Luxembourg

ISBN 0 86010 123 1
EUR 5995e

CONTENTS

II. CONCLUSIONS AND RECOMMENDATIONS

PART B

APPENDIX II

Page

BIBLIOGRAPHY

PREFACE

1. *In early 1975, Environmental Resources Limited (ERL) were asked by the Consumer and Environment Protection Service of the Commission of the European Communities to undertake a study of the potential for further recycling in the EEC. The Study was completed in 1976.*

This volume is based on the final report that was submitted to the Commission. Thus: in Part A we discuss the economics and principles of materials recovery: the methods, the potential and the action that might be taken to realise the potential. In Part B, we summarise the information relevant to recycling in the EEC: waste arisings, costs of recovery, values of recovered materials and action currently being taken by EEC governments to encourage further recovery. Existing government action is discussed in more detail in Appendix II.

The principal findings of the report are summarised immediately before Part A.

It has not been possible to publish the complete report. Two further volumes were prepared which included background data and analyses on which the report is based.

2. *The materials covered by the study were ferrous metals, non-ferrous metals (aluminium, copper, lead and zinc), paper, glass, plastics, rubber, textiles, chemical wastes, waste lubricating oils, mining wastes and power station ash, food and agricultural wastes.*

The study includes:

- *an examination of waste arisings from industrial, trade and consumer sources in the EEC and estimates of the quantity of potentially reclaimable materials;*
- *an examination of methods used to recover and re-use materials arising as waste and estimates of quantities already recovered;*
- *an analysis of the net costs of recovering the materials from waste taking into account the savings in disposal costs;*
- *an examination of the value of materials recovered and of potential benefits arising from import savings, savings in scarce resources, reduction of environmental damage, etc.,*
- *an examination of the type of action that might be taken to promote reclamation and of the action that has been taken by EEC governments.*

3. *It is important to stress two points:*

   (i) The purpose of this study was to examine reclamation (recycling, re-use and by-product generation) at a general level in order to identify why materials were currently discarded and not reclaimed from waste and to help the Commission with the necessary policy decisions.

(ii) *In order to put the problems into perspective, we have developed a large number of estimates of quantities and costs.*

4. *There is a shortage of reliable quantitative information on many of the subjects covered by this report; in developing these estimates we have therefore found it necessary either to quote data that we were unable to verify or to derive figures from the limited information available. The resulting approximations are, in our view, preferable to no figures at all, insofar as they provide some guide to the quantities, volumes and costs involved. As further information becomes available, the estimates can be refined. We must, however, stress that the figures included in this report should be treated with considerable caution and should not be quoted out of context.*

5. *Finally, Environmental Resources Limited would like to express their sincere gratitude for the considerable assistance they received from governments, local authorities and industry in all the member countries of the Community, in Sweden and the USA during the preparation of the report.*

Environmental Resources Limited, London
September 1977.

REPORT REVIEW

1. The objective of the study was to examine the economics of material reclamation(1) and to indicate what action the Community might take to encourage the recovery and use of materials that were currently disposed of as waste. To achieve these objectives, ERL collated available information on waste arisings in the EEC, on current reclamation practices and their economics and on the action being taken by governments to promote further reclamation. The materials covered by the study include ferrous metals, non-ferrous metals, (aluminium, copper, lead and zinc), paper, glass, plastics, rubber, textiles, chemical wastes, waste lubricating oils, mining wastes and power station ash, food and agricultural wastes.

It should be noted that for many of the topics covered by the study there is a shortage of reliable quantitative information. The figures quoted should therefore be taken only as a preliminary indication of the quantities involved and as a guide to selecting priorities for action.

WHAT QUANTITY OF MATERIAL IS AVAILABLE FOR RECLAMATION?

2. The following estimates were prepared for the total quantity of materials available for reclamation in the nine EEC countries. Materials were defined as "available" for reclamation if they are currently discarded as waste, are not at present recovered and are not dissipated to an extent that would make recovery impractical (e.g. lead in exhaust emissions, very low concentrations of materials in waste waters). Estimates are given in million tonnes per year (m.tpa) for 1974-75.

FERROUS METAL (10-20 m.tpa) arising from packaging (less than 4 m.tpa) cars (less than 1 m.tpa), remainder from obsolete plant, machinery, construction, etc.

NON-FERROUS METALS (1-2 m.tpa) arising from packaging (less than 0.5 m.tpa) cars (less than 0.5 m.tpa), remainder from household durables, obsolete plant and machinery, construction, etc.

PAPER (about 20 m.tpa) arising mainly from packaging, newsprint, office paper, etc.

GLASS (about 6 m.tpa) arising mainly from packaging and holloware.

---

(1) "Reclamation" is used as a generic term to include recovery (the separation out of materials and discarded products from waste), re-use (the recovered product is used again for a similar purpose), recycling (the recovered material is used for the production of more of a similar material) and by-product generation (the recovered materials and products are used for a different purpose).

PLASTICS (about 3 m.tpa) some from industrial sources but mainly (about 80%) from discarded products (packaging, etc.).

RUBBER (about 1-2 m.tpa) arising mainly (about 60%) from tyres, some from industrial sources and the remainder from other products.

TEXTILES (about 2 m.tpa) arising almost entirely from discarded clothes and furnishings.

CHEMICALS (very roughly 5-10 m.tpa) arising entirely from industrial sources.

LUBRICATING OILS (over 1 m.tpa) arising mainly (over half) from vehicles.

RESIDUALS FROM MINING, colliery spoil (about 160 m.tpa), metal mine tailings (30-35 m.tpa), metallurgical slags (5-10 m.tpa) and pulverised fuel ash (PFA) (about 10 m.tpa).

FOOD PRODUCTS (perhaps 40-60 m.tpa) arising from kitchen wastes (about one third of total); remainder from agriculture and food processing industry.

3. The report notes that:

- A high proportion of waste materials arising from manufacturing industry are already reclaimed. The main exceptions are certain chemical wastes and food wastes. In addition, there may be metals available in the form of obsolete plant and machinery.

- A very high proportion of the paper, glass, plastics and textiles available for recovery arise in the form of discarded products (including packaging) and are disposed of as municipal solid wastes (1). The available rubber and lubricating oil also arises mainly from used consumer products (vehicles) but is not usually disposed of in municipal solid waste.

- A HIGH PROPORTION OF MATERIALS AVAILABLE FOR RECLAMATION IN THE EEC ARISE AS PART OF A MIXED WASTE.

Of necessity the report discusses reclamation at a general level. It should, however, be remembered that there are different grades for many of the materials and different uses to which they may be put and this will affect the extent to which a specific waste may be recovered and the financial attractiveness of doing so.

---

(1) Total quantity of municipal solid wastes requiring disposal in EEC is estimated at 72 m.tpa.

HOW MAY THESE AVAILABLE MATERIALS BE RECOVERED?

4. Where materials arise in a mixed waste they first need to be separated if they are to be recycled or re-used. This can be achieved by separation at source or by separation at a centralised recovery plant. Alternatively, the materials may be used for by-products such as fuel or compost; in this case prior separation may not be necessary.

The report notes that:

- It is financially advantageous to the Community for materials to be recycled wherever practical rather than used to produce a fuel or compost since their value as a substitute for a primary material is higher than as a by-product.

- Where materials are to be recycled they should, wherever practical, be separated at source as subsequent cleaning and decontamination may prove difficult and the material itself may undergo physical changes that can reduce its value as a substitute material. However, separation of materials from municipal solid waste requires the participation of the householder. High participation rates and local users of the material may be required if the scheme is to be financially successful.

- Some materials cannot be recycled (such as food wastes, mining residuals, residues from mixed municipal wastes, some chemical wastes, etc); in these cases by-product uses and markets for these will need to be further developed if they are to be used. However, in general the financial incentives may prove low.

- The extent to which reclamation of materials from a specific arising proves financially advantageous, will depend on local factors such as the cost of transport of the material to the potential user, the quantity arising in the area and the scale of the processing plants.

- Some of the materials currently recovered could be upgraded and therefore substituted for more valuable primary materials.

The report shows that, for all the materials examined, there is at least one recovery route where the potential value of the material recovery is likely to exceed the costs involved, allowing for a saving in disposal costs.

SHOULD THE AVAILABLE MATERIALS BE RECOVERED?

5. In general materials are recovered from waste where this proves financially attractive to one or more of the parties concerned. Some additional reclamation may be expected to take place if the cost of disposal and the price of resources continue to increase. Nevertheless, it is probable that a large proportion of the materials in mixed waste will continue to be discarded in the absence of fundamental action (1) by government to encourage the recovery and use of secondary materials. It is necessary to decide whether such fundamental action (and the costs associated with it) are justifiable in face of the benefits of further reclamation.

6. Apart from financial benefits, recovery offers the following additional benefits:

- Savings in imports. Of the materials that could be further recovered, the Community is particularly dependent on imports of metals (other than aluminium), paper, oil-based products (lubricating oils, plastics, rubber), paper and energy. Energy savings may be achieved by use of secondary materials; in particular, metals, plastics, rubber, paper and cullet.

- Reduction of pollution There is often a serious environmental impact associated with extraction of resources and disposal of wastes. In general, but there are exceptions, the use of recovered materials as compared with original materials should reduce the total environmental impact.

In addition, there are the longer term benefits to be derived from improving the utilisation of available resources. Savings in disposal costs are a further benefit; these are considered in the report in the estimates of financial attractiveness.

The report comments on the extent to which these 'non-financial' benefits are applicable in the case of each material; such benefits need to be taken into account when developing recycling policy and objectives.

WHY ARE THE AVAILABLE MATERIALS NOT RECOVERED?

7. Many of the possible reclamation options are potentially financially attractive: that is, the potential value of the recovered material as a substitute for a primary material is greater than the costs of recovery. But there are a number of reasons why recovery does not take place; these, to some extent, determine the actual financial attractiveness. Such reasons may be specific to the individual material or the location of the waste arising; or they may be of a more general nature.

---

(1) Fundamental action is used here to refer to fiscal or regulatory measures designed to increase the financial attractiveness of recovering secondary materials or other measures designed to increase the use of secondary materials.

- In general, industry is organised to accept and use raw materials from primary and not secondary sources (1). Often, secondary materials are an additional source of supply for which there is little or no demand during times of economic recession; while in times of peak economic activity when primary materials are scarce, secondary materials are at a premium. The consequence is severe fluctuations in the demand and the price for the secondary material; this acts as a disincentive to potential suppliers to organise themselves to recover materials from waste.

- The potential user may prefer to use materials from primary sources or products made from primary materials. This preference may be based on technical considerations: in particular, that the performance of the secondary material is not comparable with that of the primary substitute. However, discrimination against the use of secondary materials may not relate to the technical performance but to other qualities: for example, dark specks in paper from secondary materials, coloured glass products from cullet. Alternatively, the preference may be groundless and based on an historical bias against the use of waste material. One result may be that manufacturing specifications may unnecessarily exclude the use of secondary material.

- There may be technical difficulties associated with the initial separation of the material from mixed waste or from mixtures in the product; with the decontamination and upgrading of the secondary material to a quality comparable with that of the substitute primary material; with the use of the secondary material in conjunction with the primary material.

- There may be organisational difficulties. Waste producers, particularly where these are individual householders, may not be prepared to separate out materials from waste. Waste handlers (local authorities and private contractors), have historically been primarily interested in waste disposal and the experiences of local authorities with resource recovery enterprises may have been limited and, in the past, unsatisfactory. The resource recovery enterprises themselves have not in general employed sophisticated management to techniques. In addition, the availability of information on waste arisings and on the market for secondary materials may not always be adequate.

---

(1) The main exceptions relate to the recovery and use of some scrap metals for recycling and waste paper for low grade uses (e.g. cardboard).

WHAT ACTION MAY BE TAKEN BY GOVERNMENT TO ENCOURAGE FURTHER RECOVERY?

8. Action may be taken by government to promote the use of recovered materials. For example:

- Fiscal measures can be introduced, designed to favour the use of recycled materials, either through levies on the use of selected virgin materials, through subsidies for the use of recovered materials, or a combination of the two.

- Regulations and taxes can be introduced, designed to encourage the re-use of products - in particular, beverage containers.

- The government can require that public authorities establish specifications for the minimum amount of secondary material to be included in goods they purchase.

- Secondary material standards can be established which guarantee a certain material quality and regulations can be introduced to prevent discrimination against secondary material on other than technical grounds.

- Funds can be made available for research into methods of upgrading the quality of recovered material and for establishing new outlets.

9. The government can also take action to promote the initial recovery of the material from the waste stream. For example:

- Charges or deposits can be levied on certain products (e.g. cars) to ensure that these are returned at the end of their useful life and the materials recovered.

- Taxes or regulations can be introduced to limit the use in products of materials or material combinations that are difficult to recover.

- The government can introduce measures designed to reduce demand and supply fluctuations: through financing "stockpiles" of recovered materials or through the requirement that the secondary materials' industry should make long-term contracts with their suppliers.

- Funds may be made available for research and development into recovery methods and systems.

10. The report concludes that:

- a high proportion of the wastes arising from industrial sources are already reclaimed: but there are large quantities of mining wastes, agricultural and food wastes and some chemical wastes which are not recovered;

- there is a substantial quantity of unrecovered material in post-consumer waste arisings both in trade and domestic waste and as obsolete scrap;

- many methods of recovery are in principle financially attractive, but there are technical and market factors which limit the recovery potential;

- the action that may be taken to promote reclamation is of various types including measures to increase demand, to improve the technical quality of the secondary material and to improve separation techniques;

- the total value of the unrecovered materials is of the order of $10,000m. per year; recovery would offer savings in the quantity of materials imported by the EEC (of the order of $5,000 to $7,000m) and some other benefits arising from the saving of scarce resources and reduction of pollution.

11. The report recommends that:

- Action must be designed to increase the demand for the secondary materials as well as supply; for many of the materials, actions designed solely to increase the supply will depress the secondary materials prices and discourage the waste recoverers.

- Priority should be given to actions that maximise the over-all benefit to the Community: in particular, materials should be recycled and products re-used where practical, rather than used as an energy source or soil conditioner. However, the report recognises that a large proportion of materials available for recovery arise as potentially mixed waste and their use in this form may prove the only viable option.

- Measures should be designed to achieve their objective with the minimum of unwanted side-effects. To avoid such side-effects, it will be necessary to examine in detail all the potential effects and to introduce new measures gradually.

12. **SPECIFIC RECOMMENDATIONS TO THE COMMISSION(1)**

A. THE COMMISSION SHOULD ESTABLISH A WASTE RECLAMATION PLAN, IDENTIFYING OBJECTIVES AND PRIORITIES FOR ACTION.

This report should provide adequate information for decisions to be taken on the objectives and the selection priorities for a reclamation action plan. At a general level, the objectives are likely to stress the need to reduce waste and conserve resources.

These objectives are interlinked but the emphasis is likely to influence the selection of priorities for action: so, for example, if minimising the cost of imports is of prime importance, then measures to encourage the recycling of non-ferrous metals may be a priority; but such action would be of low priority if the objectives were to reduce the total amount of waste requiring disposal or to minimise the risk of pollution.

When the priorities are set then the alternative methods by which these may be achieved should be identified and examined. In addition, the plan should identify where research and development will be required and where further information should be collated.

B. THE COMMISSION SHOULD CONSIDER WAYS TO ENCOURAGE THE DEMAND FOR SECONDARY MATERIALS.

If stimulus can be given to the demand for secondary materials, then manufacturers and suppliers may be expected to organise themselves to ensure their recovery and use. Without such a stimulus, secondary materials will remain an additional source of supply rather than a primary source. Actions to increase demand include procurement policies whereby public bodies within the EEC would specify, where practical, the use of secondary materials in products which they purchased; the establishing of standards and specifications for secondary materials and products to enable the users to select the correct substitute for a primary material and have confidence in its performance; examination of standards and specifications to ensure that secondary materials are not discriminated against unnecessarily. More fundamental changes that might be examined include regulations and fiscal incentives favouring secondary materials.

C. THE COMMISSION SHOULD OBTAIN AND DISSEMINATE INFORMATION ON WASTE ARISINGS, RECLAMATION AND USE OF SECONDARY MATERIALS.

There is, as already noted, a shortage of reliable information necessary both for government decision-making and to assist those involved with reclamation. In particular, information is required on waste arisings and their location and the technical and economic aspects of recovery and upgrading. This information should be obtained and held centrally by the CEC and member governments and should be made readily available to local authorities and the reclamation industry.

Publicity should be used to encourage all aspects of material recovery; in particular, to encourage the design and use of products that are easily recycled.

Industry should be asked for their co-operation in the collection of data and in publicising successful recycling projects.

D. THE COMMISSION SHOULD EXAMINE THE EFFECTS, THE COSTS AND BENEFITS OF PROPOSED MEASURES.

It is obviously important that the objectives of waste reduction and resource conservation should be achieved in the most cost-effective way. To this end, the Commission should ensure that, for the purposes of decision-making, information is available on the cost of achieving particular objectives and the benefits that will be obtained. A full analysis should be made of the costs and benefits of any proposed course of action In particular, possible dislocation to manufacturing and distribution in the Community should be identified, as should the environmental impact of any proposed change.

---

(1) See Part C Section III, for full list of recommendations.

DEFINITIONS

We list below definitions of some of the terms used in this study: we would particularly draw attention to the distinctions between recycling, re-use and by-product generation. The terms are also explained diagramatically on page 14.

Secondary material:	A material reclaimed from waste before it has been re-processed.
Raw material:	Material in a form used as an input for the manufacture of products from that material (e.g. glass).
Waste:	Matter that has no value other than as a potential source of secondary material or energy.
Industrial waste:	Waste arising during the extraction of the constituents of the raw material, the processing of material or the fabrication of a product: wastes from the manufacture of the material are referred to as prompt (scrap) and from the later stages (e.g. product fabrication) as process (scrap).
Post-consumer waste:	Waste arising from products or from their final consumption: the wastes are also described as obsolete (scrap).
Reclamation:	The separation out and recovery of material/energy from waste.
Recycling:	The reclamation and subsequent use of a material for the manufacture and/or fabrication of a product similar to that from which the waste originated (e.g. use of cullet to manufacture bottles).
Re-use:	The reclamation of a material in its end-use form and its subsequent use in this same form (e.g. re-use of glass as bottles).
By-product generation:	The reclamation and subsequent use of a material for fabrication of a product different from that from which material was reclaimed (e.g. use of cullet for reflective paint).