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T. S. McRoberts, Director of the Wolfson Recycle Unit, Queen Mary College, London, describes the background to the unit's work.

IN ANY study of recycling a great deal can be learnt from what industry is already doing. Many industries already carry out recycling in some form. The chemical industry operates large scale polymerisation plants where the economics of manufacture depends critically on the recycling of monomer. The efficient converter of plastics recovers and reuses offcuts and rejects from moulding operations. The UK paper and paperboard industry finds almost half of its feedstock in waste paper. Yet the bulk of plastics are consigned to municipal dumps after their first use and only about a third of paper is returned to mills for reconstitution and reuse.

Recycling of an obviously profitable nature is already being practised. The most notable example is the scrap metal trade, where an infrastructure of small and large merchants has been built up over many years to feed ferrous and non-ferrous metals back to the smelters. Only the more easily available and profitable sources are tapped, however, and it is estimated that 1 million tonnes of metal are discarded annually into domestic dustbins.

A major obstacle to the reuse of materials has been the cyclical nature of many key industries. At times when business is in the doldrums and mainstream plants are underloaded, prices of products from virgin materials are depressed close to marginal manufacturing costs and the waste recovery industry is immediately jeopardised. Among such industries are the plastics and paper industries, which are the subject of a technical and economic study by our unit.

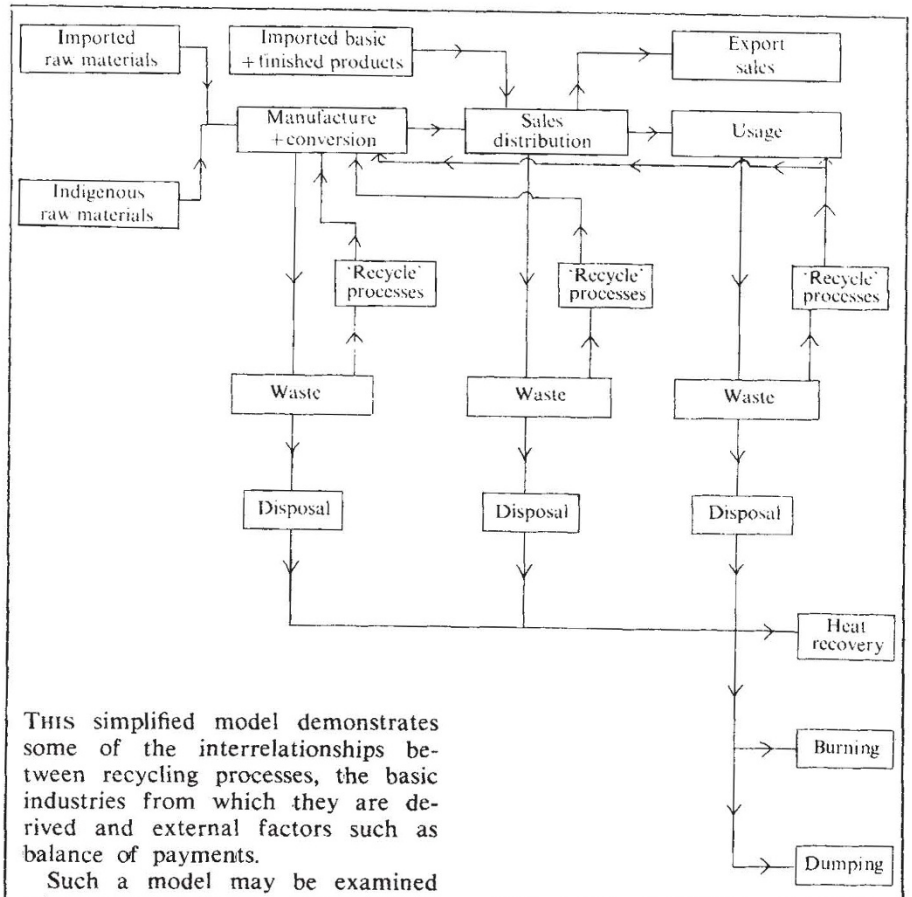
Both the plastics and paper industries are now entering a recession. The comparatively new plastics recovery industry is under severe economic strain and waste paper merchants have large amounts of expensive working capital tied up in stocks which are proving difficult to sell.

While the waste recovery industry is preoccupied mainly with its own efficiency and profitability, the nation as a whole has a balance of payments crisis linked to heavy importation of energy in the form of oil. The UK imports most of its paper requirements in the form of pulp or finished paper; for example domestic wood pulp accounts for only one-sixth of its wood pulp requirements. The plastics industry depends almost entirely on feedstocks from oil, all of which is at present imported. It is obviously important from a national viewpoint that the maximum amount of worthwhile recycling of both paper and plastics should take place. The future of recycling in these industries will depend to some extent on a successful formula being found for mitigating the worst effects of economic fluctuations in the primary industries.

The technology of recycling is influenced by the fact that both paper fibres and plastics materials deteriorate in quality in the course of both processing and reprocessing. Each time paper or paperboard is recycled its fibres become shorter and therefore less satisfactory for paper and paperboard products requiring strength. Although this does not appear yet as a limiting factor in recycling, it may well have to be taken into account as more and more paper is recovered.

The problem of deterioration in quality and performance is much more serious in the case of plastics. Of the two major groups, thermosets and thermoplastics, only the latter can be considered seriously for recycling purposes. The largest outlet for thermoplastics is in packaging, which absorbs 35–40% of production and most of which appears as waste within weeks.

One would prefer to recycle a material back to the use from which it came, but if the material is degraded on reprocessing, so that it is not acceptable for its original use, a crucial question will be the size of the market for the degraded material. □



THIS simplified model demonstrates some of the interrelationships between recycling processes, the basic industries from which they are derived and external factors such as balance of payments.

Such a model may be examined with several different objectives in mind, such as (1) maximisation of profits to the companies involved; (2) minimisation of energy use; (3) maximisation of exports; (4) minimisation of imports; (5) maximum contribution to balance of payments.

The profitability of a recycling process may be affected greatly by the actions of a government preoccupied by items (2) to (5) as well as by the demand and supply situation for products from virgin material.

A macro model of the type outlined above is a useful accompaniment to any microstudies, since it enables the effect of changes in external factors to be predicted.

The basic parameters describing such a model are interrelated and capable of mathematical treatment. Constraints, such as limitation of size of market, can be expressed as inequalities, and mathematical programing can be used to choose between competing procedures or processes on the basis of maximising functions such as profit or minimising functions such as energy and external payments. This model approach can be extended to company level where profit is the main consideration in deciding between alternative processes. It can be used also to guide research into the potentially most rewarding areas.