Mass Balance
of UK Newspapers

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In 2002, newspapers contained over 65% recycled fibre

New Biffaward mass balance published

A new study by the University of Paisley carried out under the Biffaward mass balance programme has now produced a national mass balance for newspaper flows through the UK economy. Over 13 million national newspapers are sold each day with around 70 million regional free and paid-for papers circulated each week. That adds up to 2.2 million tonnes each year. Whilst the Biffaward study has produced many good statistics, it has also highlighted how little we really know about some of the flows. Project leader, Professor Peter Tucker comments that "The research has now set the scene for an understanding of how the UK newspaper resources might be managed".

FULL STORY STARTS PAGE 1

Newspaper mass balance sponsors revealed

By THE NATIONAL SOCIETY FOR CLEAN AIR AND ENVIRONMENTAL PROTECTION (Project Administrator)

The main contractor was the University of Paisley. The third party sponsors were Sun Chemical & Usher Walker, Bridgewater Paper Co. & Cheshire Recycling, and Stora Enso.

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Biffaward Programme on Sustainable Resource Use

MASS BALANCE OF UK NEWSPAPERS

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Environmental Technology Group

UNIVERSITY of PAISLEY

This report has been prepared by the University of Paisley on behalf of the National Society for Clean Air and Environmental Protection as part of the Biffaward Mass Balance Programme on sustainable resource use.

Biffaward
investing in the environment

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FOREWORD

The Biffaward Mass Balance Programme

This report forms part of the Biffaward programme on sustainable resource use. The aim of the programme is to provide accessible and well-researched information about the flows of resources though the UK economy based either singly or on a combination of material streams, regions and industry sectors.

Information about resource flows though the UK economy is of fundamental importance to the cost-effective management of those flows, especially at the point at which those flows become 'wastes'.

In order to maximise the programme's full potential, data has been generated in ways that are consistent both with each other, and with methodologies of other generators or resource flow/ waste management data.

In addition to the projects having their own means of dissemination, their data and information will be gathered together in a common format to facilitate decision making at corporate, regional and national levels.

"How can you manage it if you haven't measured it?"

The Newspaper Industry Environmental Technology Initiative at the University of Paisley

The Newspaper Industry Environmental Technology Initiative was founded in 1995 by a consortium of multi-national industries supplying the newsprint and news inks for UK newspapers. The mission of the Initiative is to provide new and improved data sets of strategic relevance to the industry and to place those data in the public domain following stringent and scientific peer review. The Initiative additionally seeks to compile new tools and procedures to support environmentally sound decision making throughout the industry. The major sponsors of the Initiative are **Bridgewater Paper Company Ltd**. and **Cheshire Recycling, Stora Enso**, and **Sun Chemical** and **Usher Walker**. In-kind supporters of the Initiative include The Newspaper Publishers Association, The Newspaper Society and SMG Newspapers.

Researching the Total Environment of the Newspaper Recycling Loop

The Initiative has completed or is actively pursuing research in the following areas:

- Understanding consumer recycling behaviours;
- Monitoring and evaluating local authority recycling performances;
- The environmental impacts of the reuse and recycling of newspapers and their process by-products;
- Mass balance studies around the newspaper life cycle;
- New markets and new technologies for valorisation of old newspapers and their recycling by-products.
- Modelling and simulation studies:
  - Household recycling performances;
  - Waste paper markets;
  - Newspaper flows through the UK economy.

Full details of the research programme are published on the Initiative's website:

http://www.newspaper.paisley.ac.uk

Project Steering Committee

Mr Jan Olausson, Research Advisor, Publication Paper, Stora Enso Oyj.
Mr Roger Guest, Group Health Safety and Environment Manager, Sun Chemical Ltd.
Ms Debbie Stringer, Environmental & Chemical Systems Coordinator, Bridgewater Paper Co, Ltd.
Mr Peter Mansfield, Operations Manager, Cheshire Recycling.
Professor Malcolm Crowe, Associate Dean (Research), University of Paisley.

Review

Before publishing this report, a provisional draft was sent out to key stakeholders across the newspaper industry for their review and comment. All those comments, observations and recommendations have been duly taken into consideration in producing the final report. The time, effort and advice given by the consultees is most gratefully acknowledged.

Other Acknowledgements

Special thanks go to Mr David Morton, Strategic Development Director, John Menzies Distribution for his exceptional levels of help and constructive comment throughout the project. We would also like to thank all the other organisations and individuals who supplied data and information to the project. Final thanks go to Michael Sturgess (PIRA International) and Emily Freer and John Barton (Leeds University) who, in researching the mass balance of UK periodicals, were able to share much data with this project.

Disclaimer

The mass balance, and any interpretations made from it within the report, remains entirely the responsibility of the University of Paisley.

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EXECUTIVE SUMMARY

Overview

This report presents the results of an investigation of the material flows of printed newspapers through the UK economy. The research forms part of the Biffaward mass balance programme aimed at providing the baseline material accounts of material resource flows in the UK. The results of the current investigation have been reconciled into a fully interlocking mass balance of UK newspapers and newsprint. The resultant mass balance is based around the UK newspaper recycling loop including all the sources and sinks of materials to that loop. Mutually compatible, balances are described for magazines, newspaper inks and for the key metallic components contained therein. The balances have been calibrated for the time horizon 2001 - 2002. However, they should not be regarded as being static. The period 2002 - 2003 has seen significant changes, especially in the recovery sector of the recycling loop. Those changes have also been modelled. The overall newspaper mass balance has been developed as an interactive computer simulation model as well as the paper representation presented in this report. That simulation model enables:

- The progressive updating of the balance as new circumstances evolve;
- The evaluation of the sensitivity of the balance to alternative professional assumptions;
- The evaluation of 'what-if' scenarios for different possible futures.

Possible future scenarios are modelled for the period 2004 - 2005.

Definitions

The balance is centred on 'newspapers' which are defined here as publications, principally on newsprint, that are audited or have verified distributions as newspapers. This definition does not encompass all UK newspapers, and excludes advertising papers that effectively do not contain any news. It also excludes publications on newsprint that are audited as magazines.

The 'newspaper' is defined further to be the total package that is received by the consumer. That includes the standard newsprint sections, plus any separate weekend colour supplements, plus all the direct mail inserts and any plastic wrapping of the contents.

For the majority of the newspaper life cycle, published statistics do not identify newspapers as a separate entity. The classifications into which newspapers are brigaded differ around the life cycle, and there is much vagueness in some of those definitions. In waste paper classification systems, and in many research investigations, newspapers are usually taken as being synonymous with newsprint. Newspaper colour supplements are often counted as magazines. Magazines printed on newsprint can be classified as newspapers. The aggregated reporting and lack of consistency introduces many uncertainties in 'unpicking' true newspaper flows from any published accounts.

Data Availability and Quality

Whilst some key flows around the newspaper life cycle are known to a reasonable level of certainty, other nationally quoted statistics tend to be vague, or implausible, or contradictory. Many of the finer details are simply not known, and estimates can only be obtained through the extrapolation of small-scale research results up into national averages. It has proven very difficult to elicit any new supplementary data from individual organisations that can help narrow down the overall uncertainties.

Headline Statistics

Over 13 million national newspapers are sold each day with around 70 million regional free and paid-for papers circulated each week. That adds up to around 2.2 million tonnes of newspapers produced and circulated each year. In 2001 - 2002, it is estimated that around 765,000 tonnes out of the 2.2 million

tonnes of newspapers in circulation were recovered for recycling. That gives a national newspaper recycling rate of just under 35%. Around 726,000 tonnes of those recycled newspapers were recovered through local authority collections with only a relatively small minority being recovered from commercial and institutional waste streams.

1.6 million of the 2.2 million tonnes is embodied in the 4.6 billion (thousand million) national newspapers in annual circulation. The remainder goes into some 3 billion regional newspapers and free pick-up titles. In addition it is estimated that there may be up to 125 thousand tonnes of advertising papers and magazines based on newsprint in annual circulation. Around 5.3 billion newspapers (1.85 million tonnes) pass through wholesalers, who perform a 'nightly miracle' in receiving, routing and despatching those newspapers (13 million each night) to the retail outlets within a matter of one or two hours. Fourteen percent of those newspapers (12.8% of the total weight) are unsold. Nearly all unsold copies are returned for recycling.

Precisely where the sold newspapers end up is less certain. Retailers will take newspapers for doorstep distribution and/or casual sales at the retail outlet. Customers not only include individual households, but also include commercial, industrial and institutional consumers, and individuals in transit as well (e.g. commuters, travelling passengers, hotel guests). Newspapers delivered to households, or bought in the high street, can also be carried into (and consumed in) the workplace. The numbers of newspapers discarded into commercial as opposed to household waste streams is still unclear, though could potentially be of the order of half a million tonnes a year. Amongst the sectors contributing most strongly to commercial newspaper wastes are the transportation industry and the hotel trades. However, the bulk of the material is thought to arise from the aggregated wastes of the multitude of offices, shops and businesses throughout the country.

Households are estimated to reuse around 100,000 tonnes of newspapers for other purposes around the home. Roughly a third of that is destroyed in lighting fires or from it being used in the garden. The remainder are likely to be contaminated by the nature of their reuse, and then disposed of into the dustbin. Some 29,000 tonnes of the estimated 726,000 tonnes of newspapers that are collected by local authorities are believed to be lost through sorting losses, lack of markets or for the recovered paper being of non-marketable quality. It is considered that those losses may be increasing in line with a general fall in recovered paper quality.

The overall total recovery of pre-consumer and post-consumer newspaper wastes in the UK in 2001 - 2002 was estimated to be 1.13 million tonnes out of a total recovery of 1.76 million tonnes of newspapers, pamphlets and magazines. Sixty-four percent of the recovered newspapers were post-consumer in origin, the remainder being made up of 266,000 tonnes of over-issued newspapers and 133,000 tonnes of printers wastes. The recovered papers are not only used to make new newsprint, but are also to make other grades of recycled paper and a number of other products as well. The other papers produced containing a component of old newspaper are principally amongst the packaging and corrugated grades, and household and sanitary papers. Other paper grades account for 150,000 tonnes of recovered newspapers per annum. Other products made out of old newspapers include animal bedding and pet litter, moulded pulp packaging, thermal insulation and fibre fuel. Together these take in 59,000 tonnes of old newspapers. In 2001 - 2002 the UK was also a net exporter of newspaper, with exports amounting to around 92,000 tonnes of recovered newspaper (or possibly higher).

Together the UK newsprint mills took in 1.15 million tonnes of newspaper, pamphlets and magazines in 2002 (70% of which was old newsprint), and produced 1.05 million tonnes of new newsprint. The average recycled fibre content of home produced newsprint was close on 90%. This percentage should increase to 100% by the end of 2003. Some 346,000 tonnes wet weight of sludge (225,000 tonnes dry matter) was produced by the UK newsprint mills as a by-product of their paper recycling - the sludge containing the poor quality fibres, inks and excess minerals stripped off the recovered paper during de-inking. The majority of the sludge was incinerated with energy recovery. Most of the remainder was spread on land as a soil conditioner. A proportion of the incinerator ash and some sludge found reuses in roadway construction and capping material on landfill sites.

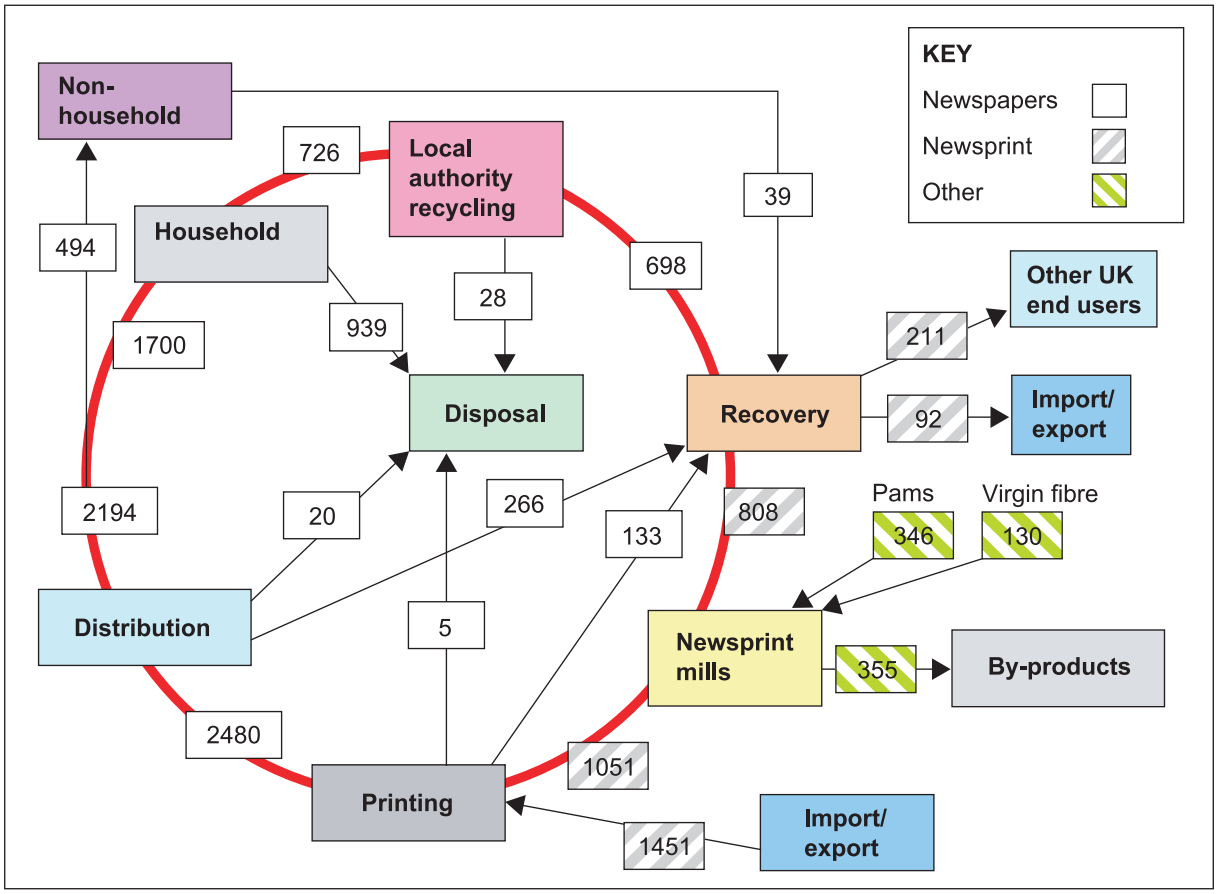
In 2002, 200,000 tonnes of the home produced newsprint was exported and 1.65 million tonnes of newsprint were imported. The total recycled fibre content of the overall mix used for printing UK newspapers was just over 65%. All but 125,000 tonnes of 2.5 million tonnes of home consumed newsprint was used for printing newspapers. The remainder was spread amongst the production of

magazines and advertising sheets. In addition, an estimated 145,000 tonnes of magazine papers were consumed in making colour supplements. Approximately 16% of the total weight of UK newspapers was contained in colour supplements. Forty-four thousand tonnes of inks were used to print the newspapers at an average density of 1.6 percent ink on a printed page. 46,000 tonnes of direct mail were inserted into those newspapers. Average print wastes were around, or just over, 5%. Nearly all of those wastes were recycled. Additional ink wastes incurred by the printers were of the order of 1.5% of the total ink consumed.

The loop then closes and the cycle begins again.

The skeleton flow diagram for 2001 - 02 is shown below. Note that this is a simplified representation with many of the constituent flows omitted. The diagram is presented here simply to provide an overall visualisation of the orders of magnitudes involved. It should not be taken as providing 'a balance'.

Skeleton Mass Flows around the Newspaper Recycling Loop for 2001 - 2002 ('000 Tonnes p.a.)



Note 1: Not all flows are shown
Note 2: All flows include ambient moisture

The report additionally addresses the embodied flows of some of the minor components of the newspaper, and provides a partial analysis of some of the non-embodied flows that are also associated with the newspaper recycling loop.

An often-ignored component of the newspaper is water. Newsprint starts off at typically 8.5% moisture. Newsprint, being highly absorbent, can take up large quantities of water, or may lose water in dry environments. A change in moisture content of just 1.5% during consumption would make a difference of around ± 10,000 tonnes in the yield of local authority recovered newsprint. Other embodied components measured were the 'heavy' metal contents. Cadmium, lead and mercury were not detected in any newspaper sample. The metal that warrants most consideration is copper. Copper contents in printed newspapers were 41 mg/kg in 2002, and typically 130 - 200 mg/kg in the newspaper de-inking sludge. Copper levels are the limiting factor in the constructive agronomic reuse of that sludge by-product.

Copper levels in newspapers are increasing due to the increase in colour printing (copper being a component of blue inks).

Associated Flows and Environmental Considerations

The non-embodied flows associated with the newspaper lifecycle are relatively minor. Packaging levels are typically of order grams per tonne through wholesale. Much of this packaging is reused or recycled.

The total chemical usage during newspaper printing was estimated to be around 4 to 5 litres per tonne of newspapers produced. Other process consumables used by the printing sector comprised tapes and foil, the refurbishment of blankets and rollers, and cleaning materials, all of the order of a few tens of grams used per tonne of newspaper produced.

The major environmental burdens of the newspaper life-cycle (in terms of carbon dioxide emissions) are in newsprint production and landfill disposal. Transportation costs for newsprint, newspapers, and waste paper are all around 20 kg CO_2 emitted per tonne of newspapers conveyed. This compares with 1,000 to 3,000 kg/ tonne during newsprint production.

There is significant and substantial evidence to show that the elemental metal concentrations in newspapers are highly unlikely to give rise to environmental concern if those newspapers or their reprocessing residues are returned to the environment in agronomic or gardening applications.

The Future Mass Balance

The main part of the study presented in this report was based on the year 2001 - 2002. Since then there have been several significant changes. Newspaper weights fell during 2001 and 2002, but may now be increasing again. The percentages of households serviced by kerbside collections of newspapers increased from around 51% in 2001 - 2002 to near 58% in 2002 - 2003. The most significant change, however, is the expansion of UK recycled newsprint capacity. At the end of 2003, an additional UK capacity of 320,000 tonnes per annum waste paper processing capacity became operational converting all UK newsprint production to 100% recycled. To help meet this demand, kerbside collections were increased significantly during 2003 and it is now estimated that 79% of households in England and Wales receive kerbside paper collections.

Simulations undertaken in the current study show that it may take more than the achieved expansion of kerbside recycling to 75%+ of UK households in order to fully furnish the extra waste paper requirements, unless the tonnages collected from the new schemes and from existing schemes are raised dramatically above the kerbside yields seen in recent years. If that cannot be achieved, the UK may then have to import waste paper in order to fulfil its new de-inking capacity. However, whether the UK has to import more waste paper will also depend on the home demand for newsprint. If home consumption increases then domestic waste paper supply will increase too, thereby offsetting the need for extra imports. It is considered that the developments in 2003 will lead to a reduction in landfilling old news and pams of around 200,000 - 250,000 tonnes p.a. though this figure could be less if home consumption increases significantly. Any industry efficiencies to reduce pre-consumer waste could also have a significant effect on the mass balance. Currently pre-consumer inputs to paper recycling provide a tonnage equivalent to twelve million kerbside paper collections. The conversion to 100% recycled fibre will not provide the UK with any significant new paper production capacity, and the UK will still need to import over 60% of its domestic newsprint requirements.

Conclusions

Overall, the results have provided a framework of the flows of newspapers and their embodied components through the UK economy. That framework will evolve as new events and circumstances unfold, and as our knowledge and data sets improve. A computer simulation version of the balance provides a tool to follow and forecast the newspaper mass balance into the future, under different sets of assumptions and different evolving scenarios.

Data uncertainties, data gaps and data conflicts are significant to the overall balance. The most important of these unknowns are:

- How much newspaper is collected in commercial, industrial and institutional waste streams as opposed to household waste streams;
- The true weight of newspapers in household residual waste.

Very little detail is known about commercial wastes arising in the UK and more sectoral audits need to be undertaken in order to define those mass flows in greater depth. Securing greater recovery of newspapers from households and issues surrounding recovered paper also need to be addressed.

Different professionals make different estimates of UK resource flows, and policy decisions can be taken based on those estimates. All the estimates seem quite plausible at first sight until, that is, you try to tie them together or try to tie them in with other evidence. This study highlights many of the problems of reconciling conflicting, uncertain and sparse evidence.

INTRODUCTION

1.1 What is a Newspaper?

The definition of a newspaper according to Collins English Dictionary is *"a weekly or daily publication consisting of folded sheets and containing articles on the news, features, reviews and advertisements".*[1] Most of the newspaper is printed on newsprint *"an inexpensive wood-pulp paper used for newspapers"*, though newsprint may also be used in the printing of some magazines *"a periodical paperback publication containing articles, fiction, photographs, etc."* Magazines and [weekly] newspapers both fit the dictionary definition of a periodical *"a publication issued at regular intervals, usually monthly or weekly"*. Other periodicals include advertising papers, focusing on jobs or property and so on, or may carry more general adverts. Some might look like newspapers, though they carry no news. In contrast, some sections of the newspaper, i.e. the glossy weekend supplements, might look very much like magazines.

Newspapers are classified by the industry into national and regional titles, though there is a slight blurring and ambiguity as to where the Scottish national dailies and the London evening papers should be placed.

In this study, a newspaper is taken to be:

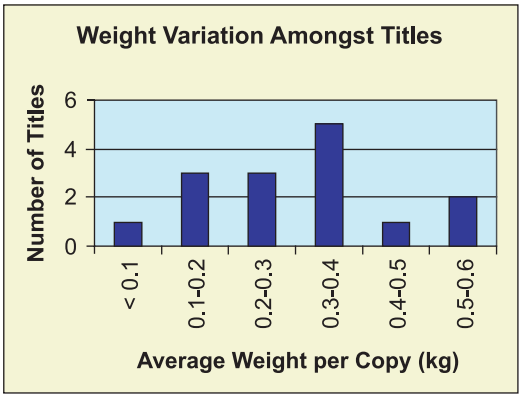
- A publication listed as a newspaper in the Audited Bureau of Circulation (ABC) classification or in the Newspaper Society classification (or otherwise unambiguously identified as a publication on newsprint carrying news and not classified as a magazine).
- The whole newspaper package including any colour supplements.

In their whole lifecycle, newspapers are normally only separately identified as newspapers during their production and circulation stages. Once they pass through the consumer, they become subsumed into an amorphous material classification called 'paper and card' in Government and most other national or regional statistics. At best, they will be identified as 'news and pams' (newspapers, pamphlets and magazines - which are normally taken to include advertising papers, catalogues and brochures as well as pamphlets and magazines). Customs and excise adopt yet different classifications for the paper and paper products that are imported or exported into and out of the UK.

1.2 The Total Newspaper Package

Daily newspapers are usually made up from a number of sections - the basic news section, various supplementary sections such as sports pages, money pages, travel, and so on, additional colour supplements (usually at the weekends) and, increasingly, advertising and promotional inserts as well. The distinction between the different types of supplements is important to the material accounts of the newspaper, so some clarification of the classification terminology is necessary (table 1.1).

Typically, averaging over a week's run of newspapers, including the Sunday editions, an average copy of the daily newspaper including colour supplements weighs in at over 300 grams, though there is considerable variation in weight amongst different newspaper titles and, indeed, amongst individual issues of a given title. A single weekend issue of one of the heavier broadsheets can easily weigh in at over a kilogram. Copy weights also tend to vary seasonally, being slightly lighter in summer than in winter. Perhaps more importantly the dominant variation in copy weights lies



Based on 15 daily newspapers titles measured for 2 weeks in February 2002 (University of Paisley, unpublished).

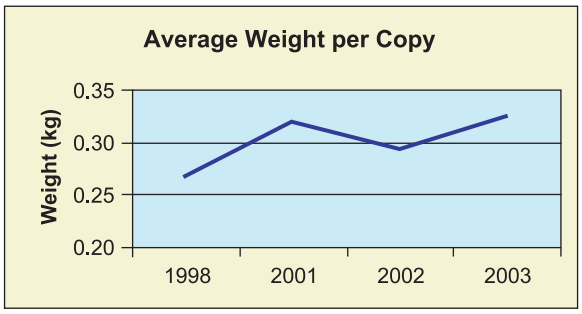
[1] See the Newspaper Society website for alternative definitions.

in the space given over to sold advertising. The editorial sections tend to remain relatively constant in size. Advertising revenue is the dominant factor controlling newspaper size.

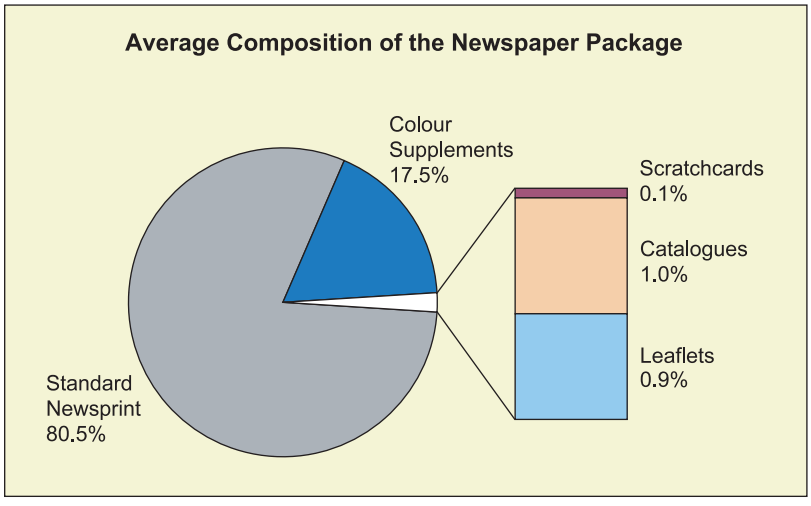
Table 1.1 Types of Paper and Ink used in Newspapers

Newspaper component	Definition	Material Characteristics	
		Paper	Ink
Standard newsprint sections	The main section of the newspaper and supplements like sport and travel that are printed on the same kind of paper	• Standard newsprint	• Coldset web offset (CSWO) • Flexographic
Colour supplements	Supplements in a magazine format, usually stapled, and normally associated with Saturday and Sunday editions	• Improved newsprint • Improved newsprint • Super-calendered • Coated	• Heatset web offset (HSWO) • CSWO • Gravure • HSWO
Inserts	Loose inclusions in the form of leaflets, scratch cards and catalogues[2]	• Various	• Various

The slump in advertising during late 2001 and 2002 resulted in a significant reduction in average weights of most national newspapers, though it had much less effect on the regional press. The slump impacted on the pagination of both the standard newsprint sections and the colour supplements, breaking the trend of a progressively increasing pagination over the last decade. In 2003, the indications are that paginations and weights have recovered back to their 2001 levels.



Based on 15 daily titles measured in the last 2 weeks of February each year (University of Paisley, unpublished).



Other changes that have occurred over the last decade have been an increase in the numbers of colour supplements, doubling in numbers between 1992 and 1998, though remaining more constant in number since. Changes in the paper/ ink mixes used in individual supplements have occurred quite regularly over time. Colour supplements have typically comprised around 15-18% of the total weight of the national newspaper package over recent years.

[2] There is an increasing trend towards more add-ons. Nowadays inserts might also include CDs and even books.

The average weight of inserts has increased from 6.7 grams per national copy in 2001 to 7.4 grams per copy in 2003, split fairly evenly between catalogues and leaflets.

One further material component of the newspaper package that has started to be seen in recent years is the containment of the colour supplements, or the whole package, in a polythene bag. So far, the weights of bags have accounted for only very little (0.0034%) of the total weight of the overall package weight. Individual bags weigh between 4 and 7 grams.

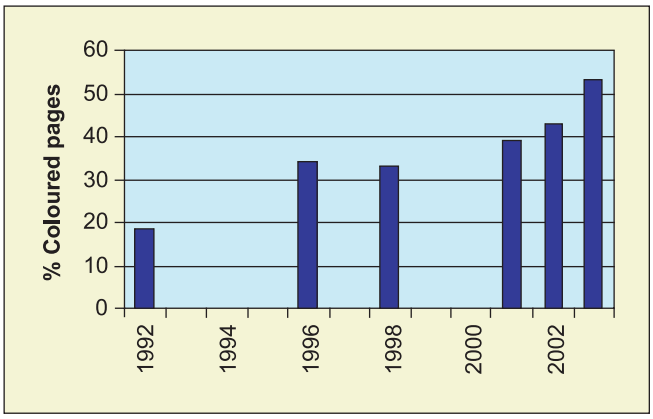
1.3 Recycling and Colour

Perhaps the two most significant changes occurring in newspapers over recent years have been the increasing recycled contents and the escalation in the use of colour printing. These changes are important to the UK newspaper industry mass balance in terms of the changing ink balance (colour printing) and in the elemental compositional balance of both the paper and the inks. As will be shown later, some aspects of the elemental balance can take on some environmental significance for some sectors of the newspaper industry. The responsibility to increase the recycled fibre content in UK newspapers has profound consequences on the material accounts right round the newspaper recycling loop.

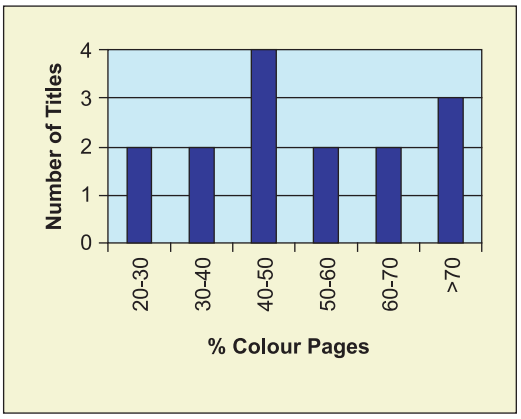
In 1991 the average recycled fibre content of UK newspapers stood at 28%. In that year, newsprint manufacturers and newspaper publishers reached a voluntary agreement with Government that by the year 2000 UK newspapers would include 40% recycled fibre. That target was actually achieved by 1996. In 1998 the average recycled content reached 52.4%. In April 2000, further voluntary agreements set new targets of 60% recycled fibre content by the end of 2001, 65% by 2003 and 70% in 2006. The 65% target was reached a year early with "recycled paper making up 65.1% of the raw materials for UK newspapers in 2002"[3].

NEWSPAPERS SUPPORT RECYCLING

The number of coloured pages, i.e. the number of pages containing some coloured printing (not the number dyed e.g. pink), has risen sharply over the last decade. The sharpest increase occurred between 2001 and 2003 in line with the new colour printing presses installed and commissioned over that period. Variations in the percentages of colour pagination still remain significant amongst different newspaper titles. Although today's presses now have high colour capacities, a full exploitation of those capacities has not yet been taken up. Observations on today's newspapers, indeed, show that in many titles some of the colour pages actually contain very little colour - perhaps just a small highlighted box or just header text. This tends to occur mainly in the classified sections with the editorial sections seeing higher and much more uniform colour coverage.



Based on analyses over the last 2 weeks of February each year.
Source: Tucker and Douglas, submitted for publication.



Based on analyses in February 2003.

[3] This form of wording is used on the text placed next to the recycling logo in published newspapers. The actual definition used to calculate recycled content is the weight of recycled fibre consumed per tonne of newsprint consumed. This figure can exceed 100%

1.4 Rationale and Emerging Issues

Key issues facing the newspaper sector over the last decade have been:

- What target should be set for the recycled fibre content of newspapers (see e.g. IIED, 1999);
- Whether it is environmentally preferable to incinerate rather than recycle old newspapers (see e.g. BNMA, 1995);
- Stimulating new markets for reuse of old newspapers, for without those end markets extra recovery would be commercially meaningless.

Whilst definitive answers to these issues are yet to emerge, it is now becoming clear that:

(i) The current target of 70% recycled fibre content by the end of 2006 should be achievable and should raise no unsolvable technical issues. To go further than that is still a subject of debate. Some commentators argue for an 80% target.

(ii) Incineration still has a role to play in newspaper management though recovery is emerging as the preferred [dominant] option for the UK;

(iii) Markets for recovered newspaper, other than reprocessing into new paper, are unlikely to account for anything more than a fraction of the recovered waste. As such, any UK newspaper mass balance needs to centre on the recycling loop.

Recycling is also considered to form the Government's preferred waste management option and Best Practicable Environmental Option (BPEO) for treating waste paper in the UK (DEFRA, Waste Strategy, 2000). Newspapers are nearly 100% biodegradable and are considered to be one of the priority waste stream for diversion from landfill. Achieving those diversions will be essential if the country is to fulfil its Landfill Directive obligations. So closing the newspaper recycling loop is now a key goal for the UK, however it must also be realised that the loop can never be closed completely. Newspaper fibres cannot be recycled forever and some losses will necessarily be incurred during each recycling episode. The input of some new virgin fibre will always be essential to ensure process sustainability.

The key need is to optimise the flows round the central recycling loop. The Waste Resources Action Programme (WRAP) have already sought to reduce one of the major bottlenecks in that loop - the limited UK reprocessing capacity - through stimulating new capital investment for an additional 320,000 tonnes per annum reprocessing capacity at Shotton newsprint mill in north Wales. Also, new newsprint manufacturing capacity in Belgium can be expected to make some additional use of UK post-consumer newspaper wastes. In order to service these new outlets significantly more old newspapers now need to be recovered

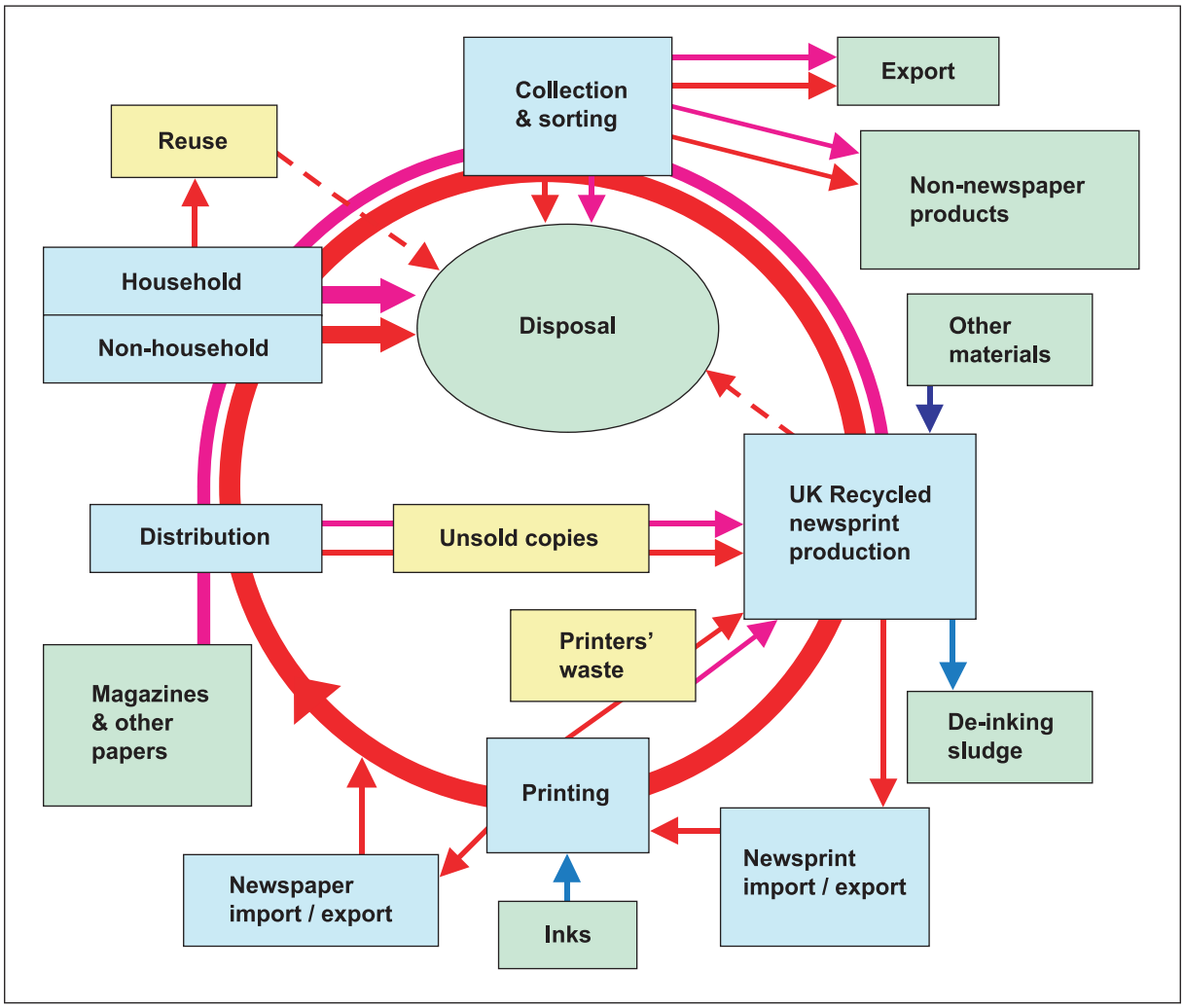
It should be noted here that some 30% of the current feedstocks to the recycled newsprint mills comprise paper grades other than old newspapers (e.g. periodicals and magazines, direct mail, catalogues and brochures, directories etc.). Those other papers are normally collected alongside the newspapers, with their recovery being highly dependent on newspaper recovery, though not necessarily vice versa (Tucker, 2001). Newspaper recovery is the main driver for recovery of those other paper grades, and their conversion into newsprint is the most significant single outlet for those papers. Managing the newspaper recycling loop is essential to managing the recycling of those other papers as well.



The inclusion of other paper grades into the newsprint furnish are essential to efficient de-inking, though that inclusion causes other issues in reprocessing, principally through their contribution to the solid wastes of the newsprint mills. The fillers and coatings in those papers are not convertible into new newsprint, and it is generally not economically viable to attempt the separate recovery of those materials. Not only do they contribute to the mass flow of the process wastes, they also contribute to the elemental flows of 'potentially toxic'

elements into those wastes (e.g. chromium, lead, barium etc.). Also the inks, stripped out during the de-inking process, can be particularly rich in copper, with that copper also being concentrated into the solid waste. There are significant emerging issues surrounding the outlets for newspaper de-inking wastes (e.g. landspreading) which will be brought into sharper focus as new EU legislation on sludges is developed - see Appendix B.2).

The Newspaper Recycling Loop



1.5 Methodology

The project methodology sought to derive the holistic flow map for UK newspapers within the UK economy. The balance was made notionally for the time period 2001 - 2002. It was based on the concept of the newspaper recycling loop.

The methodology adopted a three-stage process:

1. Derivation of estimators and associated measures of confidence for all input/ output flows and the key intermediary flows separately for every sector of the loop. For this, the loop was divided into four prime sectors:
   - Production
   - Distribution
   - Consumption
   - Recovery

2. Statistical reconciliation of all the estimators, weighted according to their confidence, into an interlocking mass balance around the whole loop. Effectively this was achieved, wherever possible, by obtaining a range of estimates of each flow from a number of different sources. This results in an over-determined system in which 'good' data in one part of the system can help 'upgrade' the more uncertain data elsewhere.
3. Decomposition of the balanced flows into their constituent materials as appropriate. This part of the research concentrated primarily on deriving the balances of specific metallic elements of potential environmental relevance.

Uncertain data quality and poor data quantity turned out to be major issues in deriving the mass balance. Some significant flow pathways were very poorly defined with little consensus from professionals as to what those flows might be. Also much of the data that was available referenced only a sample of the population rather than its totality. The paucity of these raw data was compounded by the fact that few of the available statistics actually reported newspaper flows by weight. For example, circulation figures reported numbers of copies distributed. Recovery statistics did give weights of paper but did not differentiate newspaper from the other types of papers collected.

In order to estimate the national newspaper flows, the following algorithm had to be applied:

Mass flow estimator = Available statistic x Multiplier

The multiplier assumes the following forms according to the nature of the available statistic:

- Population covered by the available statistic ÷ total population (for sub-national samples);
- Average weight per newspaper copy (for circulation figures);
- % newspaper normally expected in the paper mix collected (for recovery statistics);
- Case study figures from other countries (where UK data were particularly sparse).

It is recognised that as well as the uncertainties in the available statistics, there can also be uncertainties in the multipliers. Often these had to be derived from limited research data based on small sample populations. Such investigations, by their nature, have tended to be highly localised with limited spatial coverage and unknown statistical representation of the country as a whole.

Sections 2 to 5 of this report address each of the four specific sectors of the newspaper recycling loop. Individual component material balances around the newspaper recycling loop are presented in section 6, primarily addressing the ink flows and the heavy metal flows associated with the recycling process. Section 7 then draws the information together, reconciling the data to provide the 'best' estimate of the interlocking material balance for the loop as a whole. Section 8 provides an overall discussion, recommendations and improvement analysis.

Other issues are reported as a series of appendices, covering the associated packaging flows and the flows of other materials that are not embodied into the newspaper product (where data is available), and the transportation and life-cycle considerations for specific sectors around the loop.

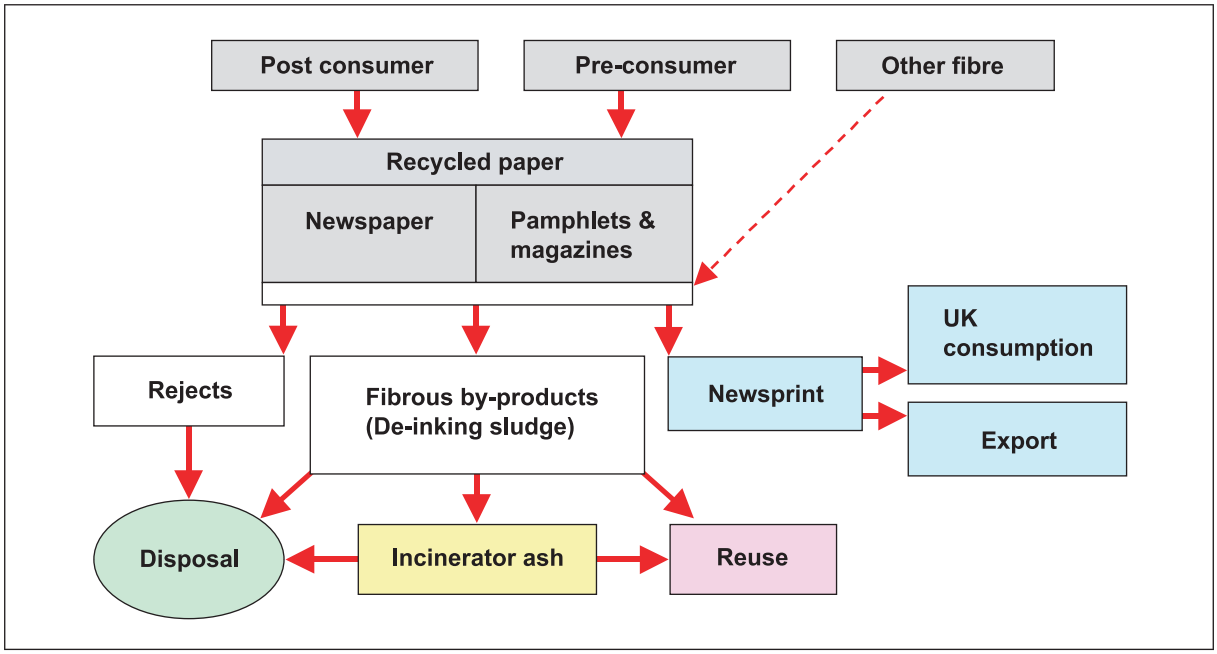
2. NEWSPAPER PRODUCTION

2.1 Sector Overview

The newspaper production sector comprises the supply and production of newsprint to the printers and the printing and distribution of newspapers by the printers. Those newspapers are not only made up by their newsprint sections but also include the colour supplements that are issued with the Saturday and Sunday nationals, and the 'direct mail' inclusions that are often inserted between the newspaper pages, together with any bagging of supplements or newspapers prior to their distribution. Printed newspapers also, of course, include the inks printed on those newspapers. The sector therefore encompasses both the supply of newsprint and the supply of other papers, and the supply of printing inks.

Newsprint supply comprises domestic (UK) production together with imports (mainly sourced from Scandinavia and Canada). Domestic supply contained around 86% recycled fibre in 2002, which is set to become 100% recycled fibre by the end of 2003. This conversion of UK newsprint production to 100% recycled content should more than satisfy the 70% recycled fibre target, and could exceed 75%.

2.2 Newsprint Production



The newspaper de-inking process rejects some 20% of the incoming paper furnish as unsuitable for converting into new newsprint. That furnish typically comprises 70% old newspapers and 30% old magazines, acquired from both post consumer and pre-consumer sources. In the de-inking process, the incoming waste paper is pulped and the coarser impurities (grit, staples, plastics, etc.) are removed by physical separation processes[1]. The majority of the inks and filler materials are then separated out using the process of froth flotation (see technical note 2.1). As well as inks and fillers, the flotation rejects also contain around 50% paper fibres, largely made up of fibres that have been rendered too short or too weak to be of use in new paper making. The froth flotation rejects are normally blended with other fibrous solid wastes from the paper making process including the waste water treatment residues (including excess biomass from the tertiary, biological, treatments). The combined solid residues are thickened and filtered to provide a [de-inking] sludge by-product. That sludge can then be incinerated (with energy recovery) or it can be utilised in other ways - its utilisation as a soil amendment being the most common of those uses. However, there are issues of sustainability concerning this outlet for the sludge. Those issues are discussed in Appendix B, section B.2 of the report.

[1] Screens and hydrocyclones

Because of the loss of mass incurred through removing the materials that are not suitable for new paper making, some 20% more old paper feed is needed over the weight of newsprint produced. Together, the three newsprint mills in the UK took in over 1.2 million tonnes of waste paper in 2001 and 1.150 million tonnes in 2002 (Confederation of Paper Industries). In 2001 - 2002, an estimated 130,00 tonnes of virgin fibre was also embodied into UK-produced newsprint[2]. This fibre was, in the main, derived from thermomechanical wood pulp sourced from UK plantations. This virgin pulp input is now being phased out, and by the end of 2003, the feedstock for UK newsprint manufacture will comprise 100% recycled fibre.

UK newsprint production was 1.090 million tonnes in 2001, and 1.0482 million tonnes in 2002 (Confederation of Paper Industries).

The input-output mass balance around the UK newsprint mills is given in table 2.1.This table only considers the major 'solid' process waste streams emanating from the UK newsprint mills. It does not consider any solid losses contained in the process effluents (i.e. suspended solids), nor does it consider any particulates emitted in gaseous phases. Those quantities are very small in comparison with the other solid wastes[3], and their discharge levels are highly regulated. Table 2.1 also neglects any chemical additions to the de-inking and paper making processes and any wastes arising from those additions. A full life cycle inventory of inputs and outputs to newsprint production can be found in BNMA (1995). Updated statistics can be found in the Biffaward mass balance study of the UK paper industry (2003).

Table 2.1 Input-output Statistics for UK Newsprint Manufacture (Based on 2002 data)

	Tonnes per annum	Moisture content (%)	Tonnes per annum dry matter
Input			
Recovered paper*	1,150,000	8.5% (estimated)	1,052,250
(Recovered newsprint)	(805,000)		(736,575)
Output			
Solid rejects	8,341	72%	1,501
De-inking sludge	343,212	36%	219,656
Newsprint	1,059,500	8.5%	969,443

* Note: The input figures refer only to the recovered fibre flows and do not record other any other material inputs
Source: UK newsprint mills, & Confederation of Paper Industries

The results highlight how much effect water can have on the overall mass balance. Considerable amounts of water are used in paper making though much of this is internally recycled. The newspaper industry water balance is discussed separately in section 6.3 of the report.

The 'de-inking' sludge (which is really the bulked product from all paper-making sludges) is in the large majority put to constructive use. The major outlet in the UK is through incineration with energy recovery. The ash product from the incineration is also constructively used to a large extent, though like household reuse of old newspapers (section 4.2), its reuse life is short and it is soon buried in landfill. The major outlet for the incinerator ash in the UK is in constructing roadways on a landfill site (Aylesford, 2002, 2003). The overall environmental benefit lies in product substitution rather than in waste diversion. Some sludge is also used as a capping material on restored landfill sites. However, most of the non-incinerated sludge is applied as a soil conditioner to agricultural land (i.e. landspread). Currently other reuses remain relatively minor. Those uses include animal bedding, soil production and land restoration. A small percentage is composted. There is emerging activity in the use of the sludge in fabricating building materials. Research into extending these markets and applications is actively being explored (WRAP, 2003b; Biffaward project B1904a, http://www.newspaper.paisley.ac.uk)

[2] This equates to around 180 - 190 thousand tonnes per annum wood consumption.

[3] Aylesford Newsprint report 68 tonnes of suspended solids in 2001 in concentrations of 15 mg/l in the process effluent, with airborne particulate concentrations of 1.4 mg/m^3 (Aylesford, 2002, 2003).

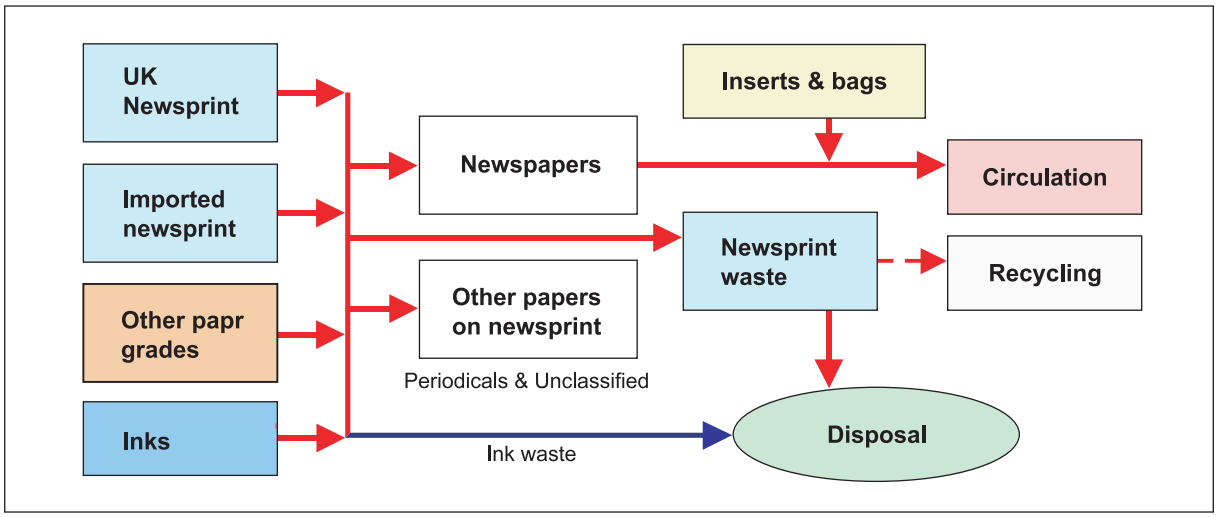
Table 2.2 De-inking Sludge Utilisation

Sludge Utilisation	('000)Tonnes per annum
Incineration with energy recovery / ash landfilled (or fate unknown)	32
Incineration with energy recovery with ash reused	45
Land spreading	95
Composting and vermiculture	~1
Other sludge reuses	49
Landfill disposal	0

Note 1: There were some missing data in the overall accounts supplied to the project. Estimates of those data have been made though their reliability cannot be guaranteed.

Note 2: These accounts refer only to the fibrous rejects from the de-inking process/ papermaking. Wastes from thermomechanical pulp production and excess biomass from secondary water treatment are not included.

2.3 Newspaper Printing



In 2001, the UK printing industry consumed 2.6310 million tonnes of newsprint, and 2.5019 million tonnes in 2002. Of these totals, 922,500 tonnes came from domestic production in 2001 (851,500 tonnes in 2002). Newsprint imports were 1.7085 million tonnes in 2001 and 1.6504 million tonnes in 2002 (Source: Confederation of Paper Industries). The imports were mainly derived from Scandinavian and Canadian sources. To balance this, 137,000 tonnes of home produced newsprint were exported in 2001, and 200,000 tonnes were exported in 2002.

Newsprint consumption in the UK is not all directed into newspaper production. Significant amounts are used for the production of other published papers as well. Some of those other papers are classified, for the purposes of audit, as magazines or periodicals. Other papers, notably amongst the papers with 100% advertisement content, might not be classified either as newspapers or as magazines. Strictly they should not be considered as newspapers as they contain no news. However, to the local authorities collecting paper for recycling they all count as 'newspaper'. Overall, it is estimated that 125,000 tonnes of newsprint is used in magazines and papers other than newspaper (see section 3.7)

In section 1.2 it was noted that not all of the newspaper was made of newsprint. The Saturday and Sunday weekend colour supplements issued with the national titles are made up of a range of different paper grades. Some are printed on 'improved' newsprint, others are printed on various coated papers, or

super-calendered paper. Inks are added and they can contribute around 1.6% to the newspaper weight (see section 6.1 for the UK newspaper ink balance). Direct mail is often inserted into the newspaper in the form of pamphlets, leaflets or game cards. Sometimes the newspaper, or parts of it, is encapsulated in plastic bags.

Table 2.3 shows the input/ output balance for the UK newspaper printing sector. The data for the balance have been derived, in the main, from national statistics or from the University of Paisley longitudinal study into newspaper material compositions. Few data could be elicited from the printers. The sector as a whole provided a particularly poor response to requests for information, although a few companies did provide the project with detailed and meticulous material accounts. The table concentrates almost exclusively on the major fibre and ink flows. The material accounts for the other materials consumed in newspaper printing are discussed in Appendix A.

Table 2.3 Input-output Flows through the Newspaper Printing Sector

	Tonnes per annum
Input	
Newsprint	2,375,000
Other paper grades	153,000
Inks	45,000
Inserts	46,000
Bags	65
Output	
Newspapers	2,480,000
'White' printers waste - printed	89,000
'White' printers waste - unprinted	30,000
Ink waste	675

The printers' wastes comprise all the consumed newsprint that is not incorporated into the newspaper produced for distribution. It is made up of the trimmings and reel ends from the news print reels together with 'imperfect' or 'spoiled' copies from the print runs (arising mainly at the start up of a print run). On average the printers' wastes contain around 67 - 75% printed material.

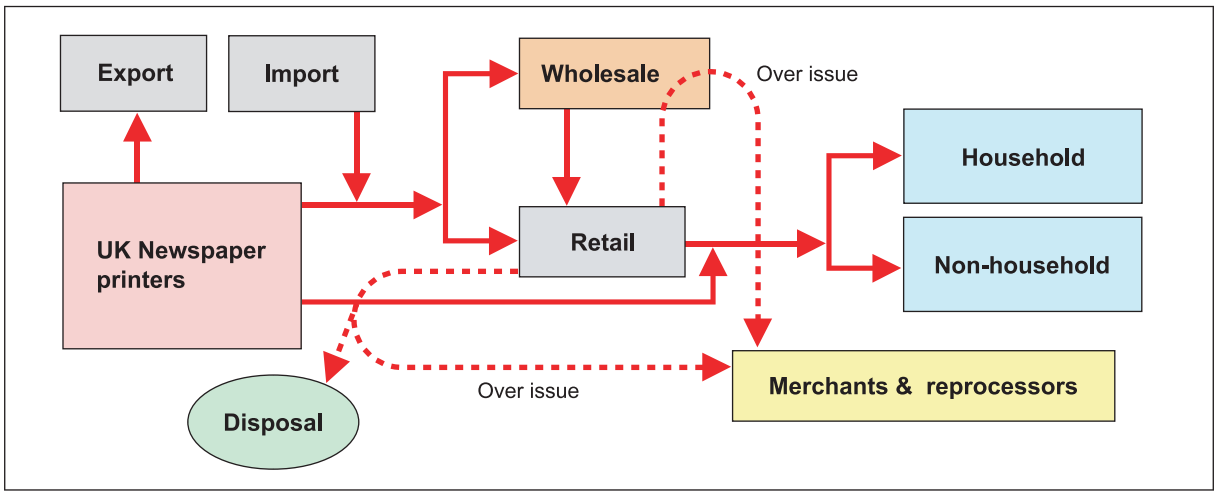
Statistics on the amount of print waste generated vary from printer to printer. A survey of Scottish newspaper printers carried out by TRL (2001) revealed an average of 6.3% print waste (minimum = 3.3%; maximum = 19%). Fairhead, IFRA (2001) estimated that newspaper printing operations at that time were generating approximately 4.5% print waste average. The current survey (this project) received responses ranging from 1.8% to 6% (small regional printers) and 4% to 5.8% (national printers). Some of the major printers contacted are now targeting levels of around 4.5% print waste and are now close to, but not always achieving, those targets. Approximately two-thirds of the newsprint waste generated comprises printed copy with the remaining third being unprinted waste.

For the purposes of the mass balance, 5.0% print waste has been taken to be the estimator for the industry average[4].

The majority of the newspaper printers' wastes that are produced in the UK are recovered. Normally that recovery is handled by independent paper merchants. The destinations of the recovered paper might be back into newsprint manufacture, or to be incorporated into other UK-made products, or they might be exported (see sections 5.10 - 5.12). However a number of the smaller printers, especially those far from markets, are still landfilling their print waste. TRL (2001) estimate that 25% of the printers' waste produced in Scotland is landfilled. It has not proven possible to get representative figures on the overall tonnages of print wastes that are landfilled across the UK as a whole, however they are considered likely to represent only a relatively small percentage of the overall print waste arisings.

[4] It should be noted that print wastes from magazine publishing are somewhat higher at over 11% (Mass Balance of the Periodicals Publishing Sector, 2003)

3. DISTRIBUTION AND CIRCULATION



3.1 Sector Overview

The newspaper distribution chain is an extremely complex logistical operation that involves transferring some 13 million [national] newspapers every day, from their points of production to all their points of sale, right across the country, all within a matter of just a few hours. It has sometimes been called “the nightly miracle”. For nearly all of the national newspaper titles, this distribution chain follows the normal sequence: from printer to wholesaler to retailer to customer. In contrast, most regional paid newspapers do not pass through the wholesale link, and are delivered to the retail outlets directly by the printers or through contractors. Other newspapers can bypass the wholesaler/ retailer links altogether. These might include free local newspapers that are delivered directly to the doorstep, free sheets[1] handed out on the street or at transport terminals in some cities, and may potentially include some postal deliveries as well.

The circulations of the distributed newspapers can be to both household and non-household consumers, including institutions, and commercial and industrial premises. Circulations are not normally separately identified between household and non-household consumers. Most commercial consumers simply buy their copies directly from the retailer just like households[2].

Distributed copies that are not sold, or are not taken by the consumer are normally returned back through the supply chain where they are bulked and passed on through merchants to reprocessors for recycling.

In the analyses, we have tried as far as possible to distinguish amongst:

- National daily (defined as those titles listed as national newspapers in the Audited Bureau of Circulation, ABC);
- Regional newspapers - subdivided into paid and free titles (comprising all titles listed in the Newspaper Society database except for those classified as nationals by the ABC[3]);
- Bulk distribution (papers that are distributed freely for customers to pick up outwith normal retail outlets[4]);

Other publications that are printed on newsprint have also been considered, to a much more limited extent, in order to try to close the newsprint balance. The products in this latter category include:

- Periodicals printed on newsprint;
- Free advertisement sheets and paid for ad publications;
- Specialist recruitment, property and other specialist publications;
- Community newspapers.

[1] Classified by the Audited Bureau of Circulation (ABC) as bulk deliveries.
[2] Some bulk purchases by, for examples, airlines and hotel chains are separately classified as multiple copy sales by ABC.
[3] The Scotsman, Scotland on Sunday, the Daily Record, and the London Evening Standard.
[4] The Metro series of titles typified this class.

3.2 Wholesale

National daily newspapers make up the vast majority of the newspapers that pass through wholesale distribution. As such, wholesaler-derived flow statistics will largely reflect the circulation and distribution of the national titles. However, it must be borne in mind that because there is no clear cut boundary separating national and regional newspaper distributions, the wholesale figures may provide an overestimate of national newspaper distributions, accounting for some regional distributions as well.

Data for the wholesale sector were aggregated from a survey of all UK newspaper wholesalers. The dominant share of the market is split between three companies, though there are a significant number of smaller players as well. All wholesalers were contacted. The responses received accounted for 91.02% of the overall wholesale market. The data received back was scaled up pro-rata to 100%

Over five thousand million newspapers passed through wholesalers in the year 2001, which is over 13 million copies per day. Well over 99% of those newspapers were routed on to retail outlets (see technical note 3.1). In 2001, some seven hundred and seventy million of those newspapers were recovered by wholesalers 'unsold'. That amounts to around two million unsold newspapers being returned every day. Normally, any unsold copies distributed by the wholesaler to the retailer are returned back to the wholesaler for disposal[5].

In terms of weights of product, around 1.85 million tonnes of newspaper passed through wholesale distribution during the course of 2001 (5,100 tonnes per day) with over 239 thousand tonnes of those newspapers (or 655 tonnes per day) being returned unsold.

Unsold newspapers remain the property of the publishers and, after collection by the wholesalers, are sold on for recycling, under a mix of loose and fixed contracts made between the newspaper publishers and recycling merchants. Over 228,000 tonnes of unsold newspapers were recycled from wholesalers in 2001. On the data received, this number does not quite tally with the number of unsold copies that were returned by the retailers. All national and major regional titles returned to wholesale are passed on for recycling and are fully accounted for by the wholesalers. Where there may be a gap is where a regional title does its own returns or where a 'periodical-type' is accounted for as a periodical in the wholesale systems (see also technical note 3.2). None of the returned newspapers were disposed as waste.

Table 3.1 Wholesale Distribution Statistics - Numbers of Newspapers*

	Number
Number of copies of incoming newspapers received during 2001	5,343,133,303
Number of copies of newspapers distributed during 2001	5,321,736,304
Number of copies of newspapers returned from retailers during 2001	769,026,228

* Scaled up from 91.02% returns

Table 3.2 Wholesale Distribution Statistics - Weight of Newspapers*

	Tonnes
Weight of incoming newspapers received during 2001	1,856,584
Weight of newspapers distributed during 2001	1,849,149#
Weight of newspapers returned from retailers during 2001	239,240

* Scaled up from 91.02% returns # Estimated from numbers of copies distributed

Table 3.3 Fate of Returned Newspapers - Wholesale*

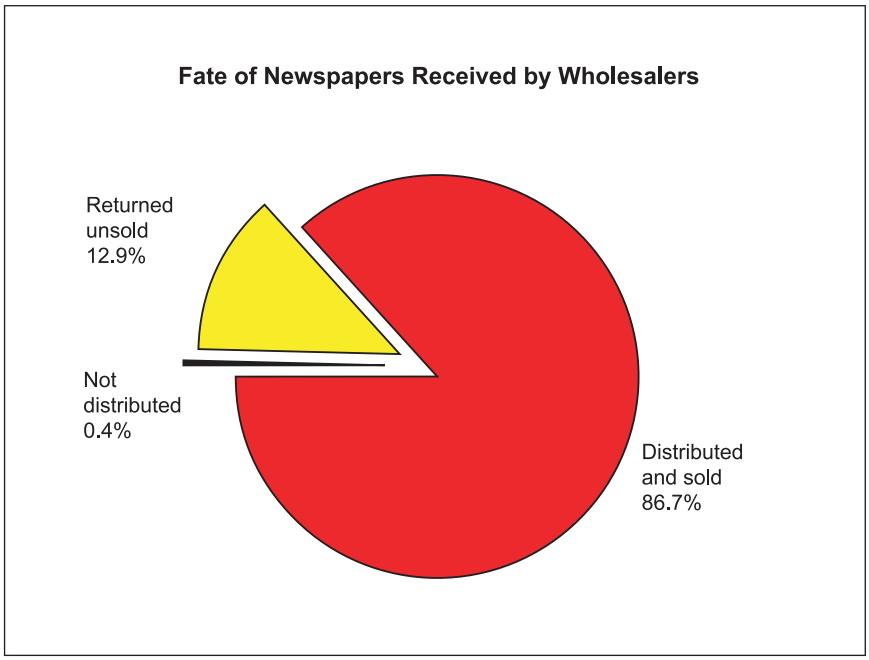
	Tonnes
Sent under contract for recycling	228,843
Otherwise disposed of	0

* Scaled up from 91.02% returns

[5] Wholesalers promt the retailers with recall advice and do the pick-up. Wholesalers are accountable to the publishers for this recovery.

Overall, 14.45% of newspaper copies passing through wholesalers in 2001 were returned unsold[6]. This represents 12.88% of the total weight of the distributed newspapers, indicating that slightly more of the issued lighter weighing titles, compared to the heavier weighing titles, are not sold.

Based on wholesaler statistics, the average weight of a newspaper passing through wholesale was 0.347 kg (see also technical note 3.3).



3.3 Regional Newspaper Distribution

The only source of representative statistics on the distribution of regional newspapers is their published [audited or otherwise verified] circulations (see section 3.5). The majority of those regional newspapers do not pass through the wholesale link. It is estimated that 84% of regional evening papers, 78% of regional weeklies and 33% of regional morning titles are delivered directly by the printers' own van fleets or through contractors (source: Newspaper Society). This is in contrast to the national market where nearly all national copies pass through wholesale.

We were unable to obtain representative statistics on the levels of over-issue of regional newspapers. For the purposes of the mass balance it has been assumed that the over-issue of paid-for regional titles are likely to be comparable to the percentage of over-issue found for the nationals. Any over-issue of free [delivered] newspapers is considered likely to be much smaller and for the purposes of the mass balance has been neglected. This provides an estimate of around 6-7% of over-issue in total. These figures concur with the estimate of 6% made by TRL (2001) for Scottish newspapers. There are no reliable data on the percentages of the bulk-delivered newspapers not taken up by customers, nor on the percentages of advertising sheets that are not taken up.

The larger publishing companies generally collect back their over-issue and pass it on to paper merchants for recycling, though a number of smaller publishers landfill their unsold returns. Also, some unsold copies are directly disposed of by the retailers. These disposals can be to the general shop waste or might be to local authority paper collections[7]. It was not possible to source any nationally representative statistics on the likely extent of this 'leakage'

[6] This compares with an average over-issue of around 33% of magazines (Wessenden Marketing, 2001). This issue is covered in more detail in the parallel mass balance of the Periodicals Publishing Industry (PIRA, 2003).
[7] The authors have witnessed bundles of unsold copies in paper banks and set out at kerbside for collection.

3.4 National Newspaper Circulations

Statistics on the audited circulations of the national daily titles are published monthly by the Audited Bureau of Circulations (ABC). Those statistics are broken down coarsely by the country of consumption: - the UK excluding Scotland, Scotland, the Republic of Ireland, and 'other'. It is noted here that of the UK home countries, only Scotland is separately identified in the statistics.

The ABC circulation statistics are also broken down into different categories of sales. Only one of those sales types - 'multiple copy sales' is considered to be of relevance here. The other sub-categories of sales do not impact on the mass balance. Multiple-copy sales are normally made to large nationally distributed outlets, particularly airlines and hotel chains who give out those newspapers freely to their customers.

The published ABC data on newspaper distributions refer strictly to the circulations, that is the numbers of copies that are distributed to consumers. Over-issue copies are excluded from the circulation statistics.

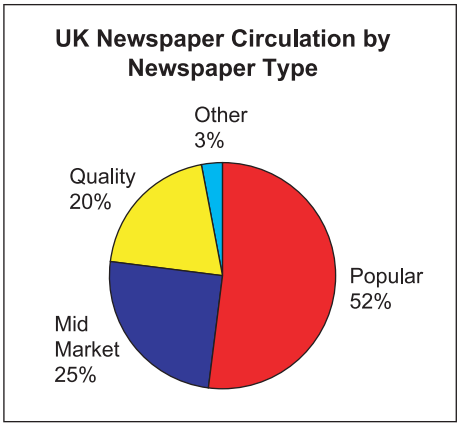
In order to extract mass flow data from the circulation figures, the figures need to be converted to tonnages. This is effected through the multiplier:

Tonnes per year = Annual numbers of copies circulated x Average weight per copy.

The average weight per copy has been estimated to be 0.347 kg based on wholesale data, or 0.337 kg based on a 'snapshot' weighing of newspapers from retail outlets (technical note 3.3).

Table 3.4. National Newspaper Circulation Figures

Newspaper	UK total	Scotland
Morning popular	6,439,812	990,436
Morning mid-market	3,183,749	207,259
Morning quality	2,429,755	165,531
Morning sporting	80,752	4,425
London evening	427,588 0	
Sunday popular	7,594,416	1,044,778
Sunday mid market	3,100,963	159,971
Sunday quality	2,755,326	223,081
Sunday sporting	46,872	0
TOTAL UK DAILY	12,561,656	1,367,651
TOTAL UK SUNDAY	13,497,577	1,427,830
TOTAL FOR YEAR*	**4,621,110,676**	**500,954,272**



* Assuming 312 distribution days p.a. (dailies) and 52 p.a. (Sundays)

Source: ABC statistics Sept 2001 - Feb 2002

Overall, over 4.6 billion (thousand million) national newspapers were consumed in the UK in 2001, with just over half the market comprising the popular titles. Over 12.5 million newspapers were consumed each weekday, and nearly 13.5 million on Sundays. Scotland consumed over 500 million daily newspapers per year, which represents a slightly higher per-capita consumption than seen across the UK as a whole.

Based on the audited circulation figures, estimates of the total weight of national newspapers in circulation per annum are given in the table overleaf.

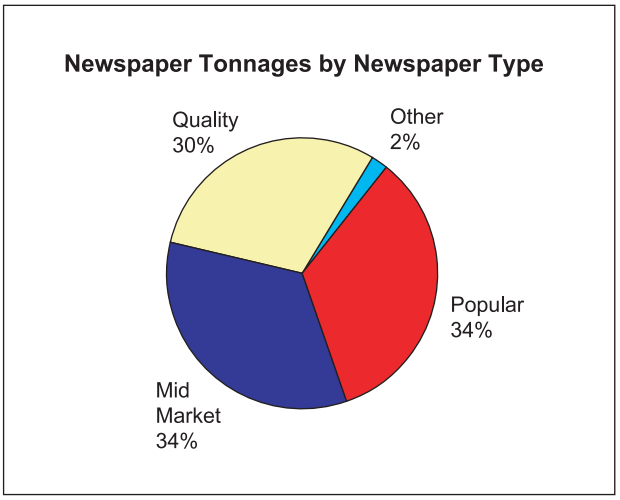
Table 3.5 Average Weight of Circulated National Newspapers

UK Total		Scotland	
Tonnes p.a. based on 0.347 kg/copy	**Tonnes p.a. based on individual copy weights**	**Tonnes p.a. based on 0.347 kg/copy**	**Tonnes p.a. based on individual copy weights***
1,603,525	**1,524,967* 1,557,314**	**173,831**	**165,315* 168,821**

* Excluding the weight of inserts and polythene wrapping

In terms of total weights, the popular, mid market and quality sectors contribute roughly equal amounts of material, reflecting the generally higher paginations but lower circulations of the quality titles compared with the more popular titles.

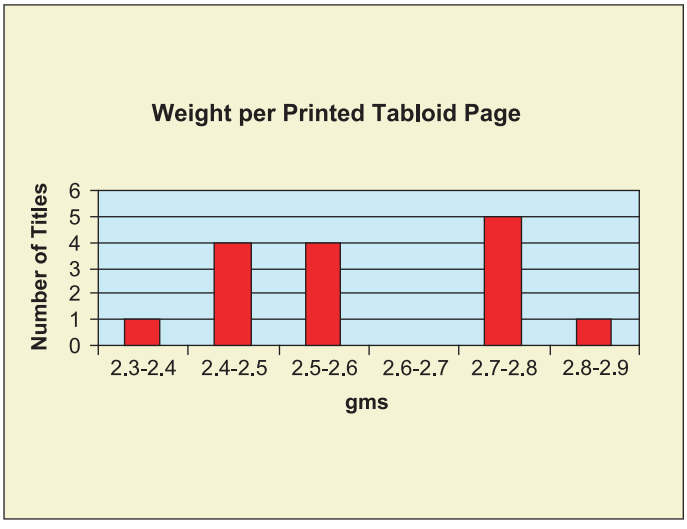
The highest overall weight per title occurred for one of the mid-market titles, which achieved relatively high circulations and provided relatively high paginations as well.



3.5 Regional Newspaper Circulations

Whilst some audited data on regional circulations and verified distributions are held on the ABC database, more comprehensive databases of all the regional newspaper circulations are held by the Newspaper Society and by JICREG (Joint Industry Committee for Regional Press Research).

The JICREG database also provides figures on the average paginations expressed as multiples of tabloid pages. Taking the average weight of a tabloid page to be 2.6 grams (technical note 3.4), this allows the total tonnages to be calculated for each separate regional title.



In 2002, nearly 41 million regional paid-for newspapers were sold each week and over 29 million free newspapers were delivered (source: Newspaper Society). Full circulation and pagination details were available for over 88%[8] of those newspapers on the JICREG database. The computed weights for those titles are given in table 3.6, broken down by Government Office region. These figure provide a reasonable indication of how the tonnages are distributed across the country, though it is considered that they significantly underestimate the weight of the total stock in circulation.

[8] Excluding the Daily Record, Sunday Mail, Scotsman and Scotland on Sunday, which have already been accounted amongst the nationals.

Also, some 315,875,820 distributed newspaper copies per annum are attributable to bulk distribution for consumer pick-up (source ABC statistics). Those copies are estimated to account for a further 34,025 tonnes of newsprint per annum[9]

Table 3.6 Circulations and Calculated Weight of Circulated Regional Newspapers by Geographical Region (Estimated 88% of Total Regional Circulation[10])

	Free titles		Paid-for titles	
	Circulation p.a.	Weight (Tpa)	Circulation p.a.	Weight (Tpa)
Northern Ireland	10,912,356	1,112	86,649,004	11,706
Wales	42,362,216	5,194	57,005,260	7,878
Scotland	79,921,244	8,043	222,486,732	32,607
North East	98,440,264	11,357	141,593,972	14,914
North West	165,108,216	26,526	185,655,964	29,041
Yorkshire/ Humber	93,395,536	10,584	193,160,708	25,822
East Midlands	107,951,168	15,303	129,290,980	22,921
West Midlands	142,488,216	23,764	191,695,088	22,121
East Anglia	44,162,196	6,558	82,672,304	10,335
London	183,957,696	30,482	22,322,820	3,976
South East	322,718,916	57,903	173,230,148	32,502
South West	91,928,772	11,850	159,967,184	27,007
TOTAL UK	1,383,346,796	208,676	1,645,730,164	240,831
TOTAL (all titles)	**3,029,076,960**	**449,507**		

Source: JICREG Statistics

The under-estimations provided in the above table arise through a combination of:

- Missing data on circulations and/or paginations in the Newspaper Society/ JICREG databases.
- Newspapers not listed in those databases;
- Uncertainties in the recorded total pagination figures arising from unrecorded supplements[11].

It is estimated that regional supplements might account for around 70,000 - 80,000 tonnes of paper in total; however it is not clear how much of those supplements represent additional consumptions and how much are already subsumed into the weights recorded in the table above (see technical note 3.5).

A search for other papers printed on newsprint (source BRAD (2000) - see technical note 3.6) identified more than 150 titles not listed on the JICREG database. It was difficult to ascertain the exact status of those titles, although the wording of the titles indicated that the majority of the identified copies might be newspapers rather than simply advertising sheets. However, a significant number of advertising sheets were also identified within the list. If it is assumed that all these 'other' papers had weights comparable with local free newspapers, it would add a further 60,000 tonnes into the annual newsprint circulation.

The average weight of the identified regional newspapers was 0.148 kg per edition based on reported total paginations. For the mass balance this has been adjusted upwards to 0.155 kg to include the 'extra' supplements not accounted for in the total pagination[11].

Based on a weekly circulation of 70 million copies (less the four Scottish titles), it is estimated that regional newspapers as a whole account for an annual circulation of 535.5 thousand tonnes of printed newsprint, plus a very small amount of printed magazine paper. Adding in the bulk-deliveries raises this overall figure to 570 thousand tonnes per annum.

[9] Based on a spot measurements of copy weights
[10] Excluding The Scotsman, Scotland on Sunday, Record and Sunday Mail
[11] See technical note 3.5

3.6 The Total Newspaper Market

In order to establish the total newspaper consumptions in the UK, it is also necessary to know the amount of non-UK titles imported into the UK in addition to the domestic consumptions of the UK printed titles. It should be made clear at this point that the UK export of printed newspapers need not necessarily equate to the consumption of UK newspapers by countries outside the UK. Not all foreign consumptions arise through physical exports of the printed media. Contents can be transferred electronically to overseas countries allowing the copies to be printed locally.

Her Majesty's Customs and Excise provide the national import and export statistics for printed media. However those statistics do not separately or unambiguously identify newspapers as a separate product. The only freely available statistics refer only to the months of July and August 2001 (table 3.7). Those statistics were then used to make notional estimates for the whole of 2001.

Table 3.7 Import and Export Statistics for Newspapers and Allied Products

	Jul 2001 Quantity (kg)		Aug 2001 Quantity (kg)	
Description	**Total Imports**	**Total Exports**	**Total Imports**	**Total Exports**
Newspapers, journals and periodicals, appearing at least four times a week.	361,551	1,415,527	378,716	1,679,420
Newspapers, journals and periodicals, appearing once a week.	5,678,478	942,662	18,612,421	926,393
Newspapers, journals and periodicals, appearing once a month.	929,013	1,128,165	858,112	1,314,552
Newspapers, journals and periodicals not specified elsewhere.	1,027,737	3,323,649	1,089,426	2,467,089

Source: HM Customs and Excise data July/ August 2001

In order to 'unpick' the newspaper faction from the above statistics, it is necessary to make some assumptions as to the likely newspaper content within each category. Here, it has been assumed that 100% of newspapers, journals and periodicals appearing at least four times each week are likely to be newspapers. It is further assumed that 10 - 20% of publications appearing once per week may be newspapers. On these assumptions, the annual weight of newspaper imports and exports would be:

	Jul 2001 Quantity (Tonnes)		Aug 2001 Quantity (Tonnes)	
Description	**Total Imports**	**Total Exports**	**Total Imports**	**Total Exports**
Newspapers, journals and periodicals, appearing at least four times a week.	361	1,416	379	1,679
Newspapers, journals and periodicals, appearing once a week.	568 - 1,136	94 - 188	1,861 - 3,722	93 - 185

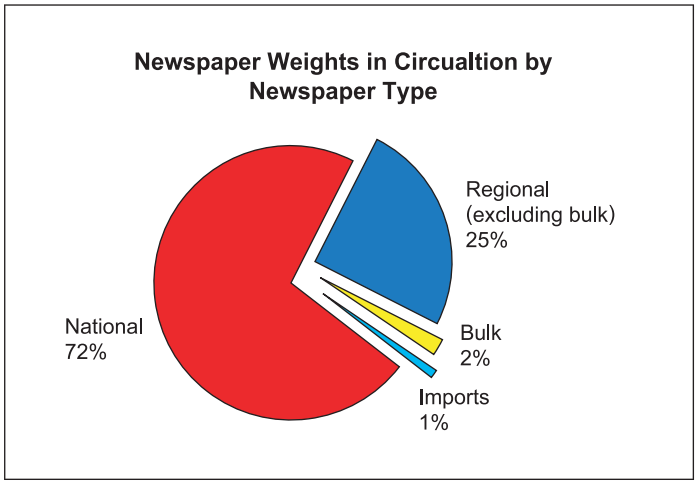
The results indicate that imports and exports of printed newspapers might be of reasonably similar quantities, both being of order of around 20,000 tonnes per annum[12].

Based on ABC circulation figures, the overseas circulations of UK national titles amount to 953,723 copies of daily titles and 745,851 copies of the Sunday editions. Together these realise an annual consumption of 336 million copies outside the UK. If all these copies were exported in their printed form, the annual export tonnage would amount to over 116 thousand tonnes. However, it is believed that the majority of those overseas sales may be attributable to UK titles being printed locally overseas. Similarly, there may be also local printing of overseas titles in the UK. However the extent of this practice could not be quantified.

[12] These figures do not include any international titles printed locally in the UK

Overall, the total UK newspaper market may account for a total of some 2.19 million tonnes of printed paper per annum. Nearly three quarters of the weight of those newspapers are embodied into the UK national titles with nearly all the remainder split approximately evenly between the paid-for and the free regional titles. Bulk distributions and imports together only amount for a small percentage (~3%) of UK consumption.

Consumption in Scotland is estimated to be 217,712 tonnes in 2001 - 2002 based on national, regional and bulk distributions. This compares with an estimate of 226,444 tonnes of total newspaper arisings in Scotland in 1999 (TRL, 2001; SEPA, 2002). However, it should be noted that the TRL estimate additionally included a number of advertising publications, which together contributed 4,220 tonnes to the total.



3.7 Other Publications Printed on Newsprint

Whilst the above figures provide a working estimate of the quantities and weights of ‘newspapers’ in circulation in the UK, they have not yet accounted for all ‘newspaper-like’ products, principally the advertising sheets that are printed on newsprint, and also any magazines that are printed on newsprint.

It has already been noted that advertising publications in Scotland accounted for 4,220 tonnes of the total ‘newspaper’ arisings there in 1999 (TRL, 2001), which amounts to 1.9% of mass of circulated newspapers. If those figures were extrapolated to the UK as a whole, it would imply a consumption of 40,000 tonnes of newsprint going into advertising papers.

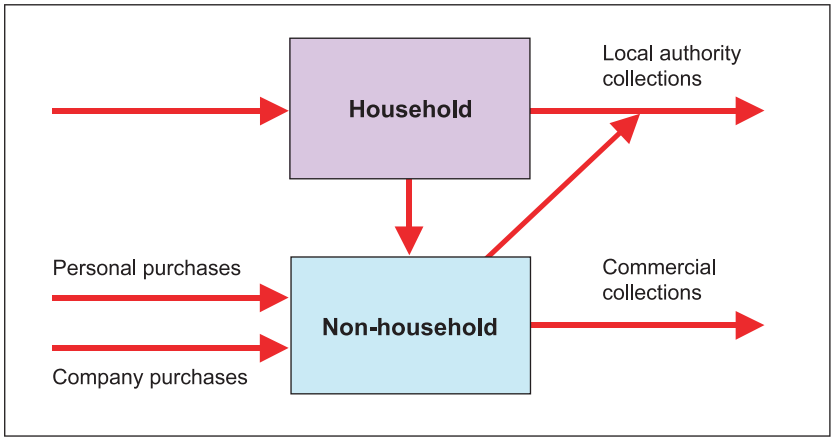
The search for other papers printed on newsprint (see technical note 3.6) revealed a number of advertising sheets amongst the titles listed there. However, it was noticeable to the authors that some specific advertising sheets that they knew of personally were not included in that list.

No information could be sourced on the amount of magazines printed on newsprint.

At the end of the day, the total weights attributable to all these other papers can only be determined by the difference between the combined newsprint consumptions of the identified papers and the overall national newsprint consumption (see section 7.1).

4. NEWSPAPER CONSUMPTION

4.1 Sector Overview



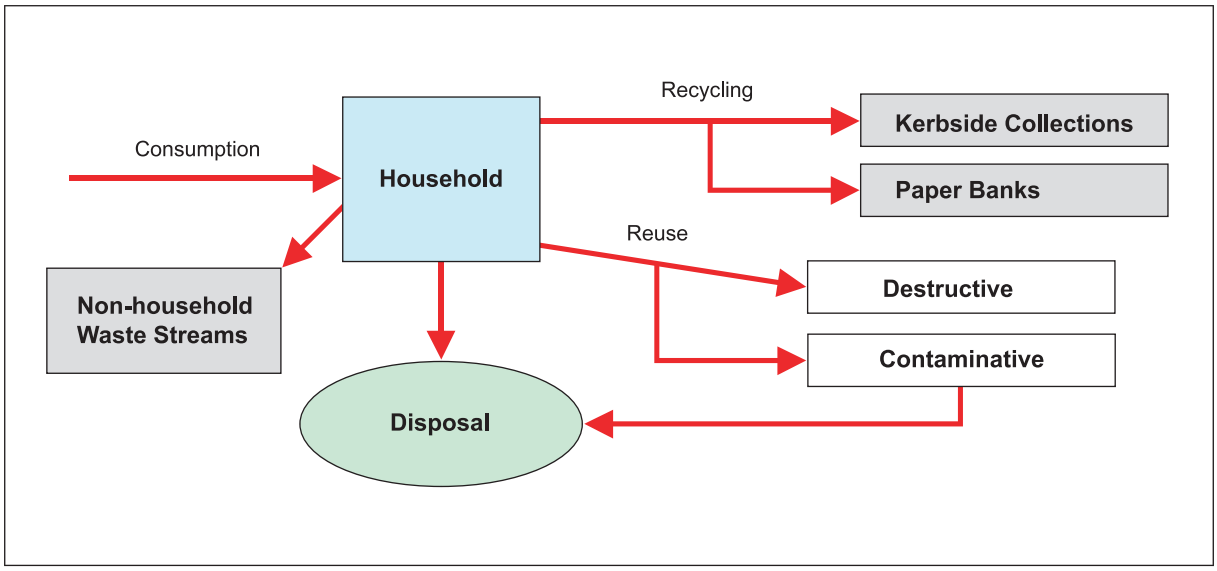
There are no authenticated breakdowns of UK newspaper compositions by consuming sector or points of consumption. Readership statistics, in the main, simply consider the demographic and geographic profiles of the readers, making no distinction as to whether those consumptions are for domestic use, based in or away from the household, or are associated with commercial businesses. The breakdown by point of consumption and, more importantly, by place of discard is very important to the overall mass balance, as that information would help delineate:

- The material flows through the household waste stream;
- The material flows through commercial waste streams;
- The amount of material in each of those waste streams that is recovered or recycled.

In a written answer to The United Kingdom Parliament (2002), Lord Whitty, Parliamentary Under-Secretary of State, Department for Environment, Food, and Rural Affairs (DEFRA) wrote "... Recent estimates indicate that newspapers and magazines comprise at least 1.5 million tonnes of household waste in England, approximately 7 per cent by weight.... Assessing the proportion of used newpapers that are recycled is difficult; current estimates are that between 40 per cent and 55 per cent of the 1.5 million tonnes is collected for recycling. There are few data on what happens to the remainder, but it is likely that much of it is landfilled". Those words express an uncertainty of at least 125,000 tonnes, annually, in the nation's newspaper recovery statistics. The UK Department of Trade and Industry, (date uncertain) estimate that "the arisings of used newspapers in the UK amount to between 2.2 and 2.3 million tonnes per annum" , some 0.7 - 0.8 MT more than DEFRA's estimates for household disposal. That surplus may be disposed of as industrial and commercial waste rather than household waste, however there are no national data on industrial and commercial disposals or consumptions of newspaper that can help ratify those figures.

4.2 Household Newspaper Mass Balance

The household segment of the newspaper mass balance is mainly concerned with the extent of material diversion from residual waste streams (dustbin and civic amenity site 'black bag') into recycling collections or for reuse about the home. More precisely, the question is "What proportion of the consumed newspapers are recycled through household waste recycling schemes" and "What happens to the rest?"



The household material partition coefficients depend on the product of two parameters, the participation rate for newspaper recycling and the material capture rate from the participants:

Participation rate	=	**Percentage of households serviced by a scheme that use the scheme at least once over a given period**
Material Capture Rate	=	**Amount of specific material collected per participating generator / Total amount of that specific material in the waste stream of the participating generator served**

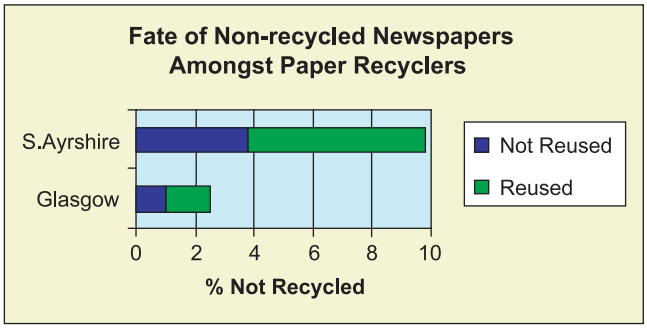
Household recycling participation rates are normally too difficult and too resource intensive to monitor routinely by direct measurement. Per-collection [kerbside] set out rates are more practical to measure though they can significantly under-estimate true participations. There is some published guidance on the likely scale-up factors between set-out rates and participation rates (Tucker, 2001). On the small number of statistics available, monitored kerbside participations would appear to be very variable across the UK ranging from 20% in some areas to over 90% in other communities. There are no reliable monitoring data on the participation rates at bring recycling sites or civic amenity site recycling centres. Many estimates of local recycling participations have been made through direct questioning in household surveys, however the reliability of such data must be questioned. Many householders tend to exaggerate their levels of recycling activity when questioned[1]. Researchers have reported over estimations of 15-40% in claimed participations compared with actual participation levels (Tucker and Speirs, 2003).

Material Capture

Absolute measurements of material capture rates are only possible through carrying out concurrent measurement of all possible waste streams generated by the household. Complete measurements are almost impossible to make, though some isolated results have been reported.[2] Inferences from other sources, including household surveys, have also been used as expedients for estimating the capture rates of recyclers. Most reported results put the capture of newspaper from paper recyclers at around 85% to 95% of their overall newspaper consumptions[3] (Tucker, 2001). A figure of ninety percent capture is considered to provide the best working estimate. Few surveys have gone on to provide an audit trail of the leakage of the other 10%. One study that did audit that leakage (Tucker et al., 1998) provides comparisons between a city area in Glasgow with a small town in South Ayrshire.

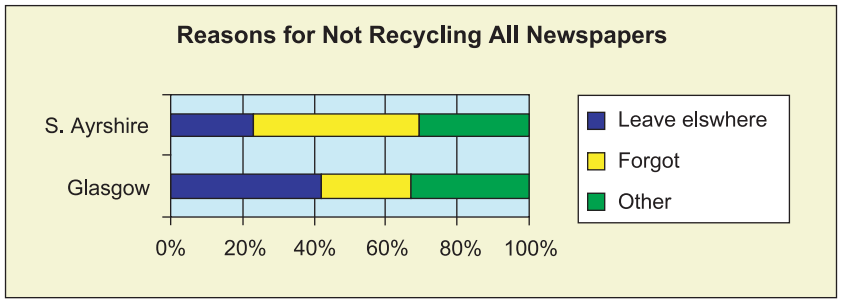
[1] See technical note 4.1
[2] See technical note 4.2
[3] See technical note 4.3 for a summary

In the survey, it was found that around 60% of the non-recycled newspapers (by newspaper recyclers) had been put to positive reuses. Of the remaining 40%, approximately a third was attributable to discarding the newspapers into non-household waste streams (e.g. leaving them at work or on the train). The fate of the other portion was not specified but was assumed to be the household dustbin. A range of excuses applied, the most common of which was forgetfulness.



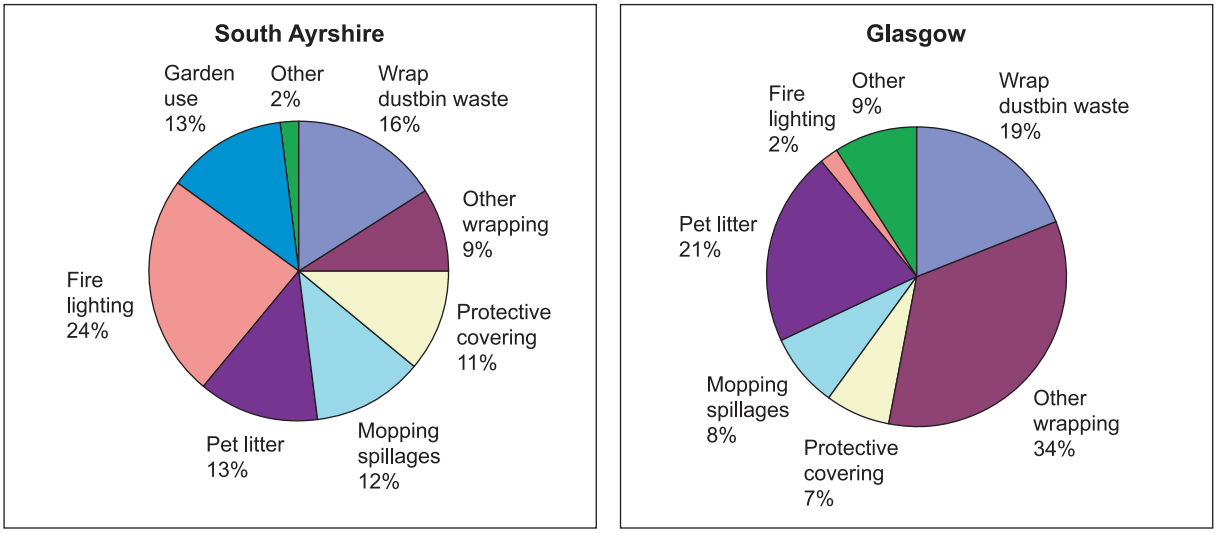
Source: Tucker et al. (1998)

Reuse practices were broadly similar between the two areas with the exception of fire lighting and gardening, with almost no diversion into those activities amongst the Glasgow sample, reflecting the highly urbanised nature of that sample. Garden uses (composting, mulching, trench lining etc.) took just under 1% of consumed newspaper in South Ayrshire.



Source: Tucker et al. (1998)

A more recent survey into home composting behaviour (Tucker and Speirs, 2001) found that composters on average put 88 grams of newspaper (around 3% of their weekly newspaper consumption) into their compost bins each week.



Source: Tucker et al. (1998)

When considering reuse, it must be remembered that the reuse activity is merely an additional activity within the overall life cycle loop of the newspaper. After reuse, the newspaper could then be discarded, most probably into the dustbin! The benefits of reuse lie in product substitution more than material diversion. Reuse can be categorised essentially as ‘potentially contaminative reuses’ and ‘destructive’ reuses. Potentially contaminative reuses include pet litter, mopping spillages, protective covering, and many wrapping applications. Such uses may render the used newspaper unsuitable for recycling into new products. The second category of reuse destroys the newspaper. Applications here include fire lighting and composting.

The above results refer only to the standard newsprint sections of the newspaper. The capture rates for the other components can be much lower (Tucker et al., 1998).

Table 4.1 Capture Rates of Non-newsprint Components of Newspapers and Pams

Component	% Capture from paper recycling households
Colour supplements	~ 80%
Newspaper inserts/ direct mail	~ 80%
Magazines & periodicals	42 - 53%

Source: Tucker et al. (1998)

Estimates of the newspaper mass flows into reuse and non-household disposal activities can now be made, according to the following assumptions:

- Newspaper consumptions are 1.4 kg/hh/w (nominally 1.7 MT p.a. nationwide);
- Reuse activities are also undertaken by non recyclers (latest research shows that reduce/reuse activities are not preferentially undertaken by recyclers; Tucker (2003));
- 6% of consumed newspapers are reused;
- 1.2% of newspapers are discarded outside the household - by non-recyclers as well as recyclers.

Table 4.2 Fate of Newspapers Not Recycled by Newspaper-recycling Households

Household newspaper diversion activity	Flow (tonnes/year)
Discard in non-household waste streams	22,800
Reuse/ product substitution	102,000
Of which: Garden and other destructive uses	20,000 - 40,000*
Potentially contaminative reuses	65,000 - 80,000

* Higher figure based on estimate from composters, assuming that 30% of households home compost

Newspaper Flows into Residual Waste

Newspaper flows into the residual waste have only ever been quantified through 'snapshot' measurements on very restricted populations. Many of the dustbin waste analyses that have been carried out did not distinguish newspaper from the other paper and card fractions. However, some dustbin waste analyses separately distinguishing newspaper have been sourced. These were sourced from Project Integra (Hampshire), from other waste authorities in confidence, and from data posted on the internet.

Table 4.3 Estimates of the Newspaper Flows into Household Residual Waste

Weights of newspaper in dustbin waste	Mean (Kg/hh/w)	Maximum	Minimum
In areas with kerbside paper collections	0.74	0.07	2.31
In areas without kerbside paper collections	1.09	-	-

The average of 62 separate waste analyses (1999-2001) based on data from Hampshire (MEL, 1999) and data from the north of England

Kerbside recycling was available to approximately 50% of households in 2001 - 2002. Extrapolating the data up to the whole UK provides an estimate of 1,010,000 tonnes of newspapers consigned to the residual (dustbin and c.a. 'black bag' waste streams)[4]. However, it should be positively noted that some 65,000 - 80,000 tonnes of that waste might have passed through a reuse phase before it was discarded.

[4] This estimate is probably artificially high. In a dustbin environment, newspapers can soak up considerable quantities of moisture, which can add up to 25% to their recorded weights (see section 6.3). It is often not clear in reported weight data as to whether moisture contents have been taken into account.

The amount of newspaper recycled by households is best estimated from aggregated local authority statistics (see section 5 of this report). Those estimates reveal that some 670,000 - 770,000 tonnes of newspaper might be recovered annually in the UK (610,000 - 710,000 tonnes in England). That would put the total flow of newspapers through the household sector at around 1.6 - 1.7 million tonnes p.a. in England[5]. This can be compared with the United Kingdom Parliament (2002) estimate, and the estimate of Parfitt (2002) that 1.574 million tonnes of newspapers and magazines are contained in the combined recycled and residual household waste streams.

4.3 Non-household Newspaper Mass Balance (I)

There are almost no available statistics of the mass flows of post-consumer newspapers into non-household waste streams e.g. into commercial and industrial waste streams. Apart from a very small number of site-specific waste audit case studies, no compositional analyses could be sourced that attempted to separately identify newspapers in UK commercial and industrial waste[6]. However some recent studies into these issues have been carried out in other countries, notably USA and Australia. A summary of those studies is presented in technical note 4.4

Non-household waste can arise from any combination of industrial, commercial, institutional, and municipal non-household sources. The latest national figures for commercial and industrial waste arisings, as a whole, are based on an Environment Agency Waste Production Survey undertaken in 1998/9 (DEFRA, 2003). The figures for commercial waste, broken down by commercial sector and selected waste type are reproduced in table 4.4. The total arisings of commercial waste were 24,802 thousand tonnes.

Over 90% of the separately identified paper and card fractions of commercial waste were recycled. However over 90% of the major component 'general commercial', which accounted for over three quarters of the commercial waste arisings, were not recovered. It is likely that a significant amount of this mixed waste is also made up of paper and card.

Table 4.4 Potential Sources of Newspaper in Commercial Waste ('000 tonnes)

Sector	Waste type	
	Paper and Card	General Commercial
Wholesale	539	2,098
Retail (motor trade)	62	654
Retail (other)	951	3,515
Hotels, catering	126	3,083
Finance	173	653
Education	78	1,681
Travel agents, other businesses and others	305	3,977
Real estate and computer	63	877
Social work and public administration	206	1566
TOTAL	**2,502**	**18,105**
Reused or recycled	2,281	1,514

Source: DEFRA (2003)

5 A parallel Biffaward study "Mass Balance of the Periodicals Publishing Sector" estimated the annual flow of magazines through the household to be 673,000 tonnes.

6 Except, of course, for the printers and distributors of newspapers

Of the 50 million tonnes of industrial waste produced, 2.74 million tonnes was identified as paper and card wastes, and a further 155,000 tonnes was classified as general commercial waste. The quantities of newspaper in industrial and commercial paper and card wastes and in general commercial wastes were not determined.

If it is assumed that a nominal 2.6% of mixed commercial wastes and 0.07% of industrial wastes are newspapers (based on the case study data from Australia, reported in technical note 4.4), that would put approximately 470,000 tonnes of newspaper in the UK commercial waste stream and some 35,000 tonnes of newspapers into the UK industrial waste stream. Whilst these figures can only be taken as providing broad indications of the possible newspaper loads that could potentially occur in UK non-household waste, it is noted that such loadings are reasonably compatible with, and would go some way in reconciling the mismatch (highlighted earlier) between DTI production figures and DEFRA household recovery figures.

The remainder of this section now examines the UK non-household sector in greater detail.

Non-household consumptions of newspapers arise through a variety of reasons and routes:

- Acquisition by commerce, industry, and institutions to support their business;
- Library and reference materials;
- 'Give-aways' to customers;
- Acquisition by employees/patrons for consumption at work or within a non-household institution;
- Acquisition by individuals for consumption whilst travelling.

Those newspapers might then be discarded:

- Into the general industrial or commercial waste streams;
- Into commercial recycling schemes;
- Into the general municipal waste (litter bins or street litter or taken home and discarded into the dustbin);
- Taken off premises and recycled through local authority schemes.

Some of the non-household consumptions (mainly the give-aways by airlines and hotels) can be identified from the Audited Bureau of Circulations (ABC) statistics for multiple-copy sales. Based on ABC figures, around 3.37 million copies a week are sold through multiple-copy sales, which amounts to 60,880 tonnes of finished newspapers. However those statistics do not necessarily reflect the totality of the 'give-away' markets. A significant proportion of the markets may be sourced from normal retail outlets. Similarly consumptions at many institutions are also serviced by normal retail outlets. Also, many individuals take their household-delivered newspapers, or their high street purchased newspapers, to their work place to read, or will read them in transit to and from work.

The main non-household sectors that are considered likely to consume newspapers are:

- Commercial, industrial and Government offices;
- Airlines and other travel terminals;
- Hotels;
- Restaurants;
- Hospitals;
- Public libraries;
- Universities, colleges and schools;
- Others, e.g. military bases, prisons etc.;

The relative consumptions and waste management practices for each of above sectors were investigated:

(i) Through a literature survey;

(ii) Through a nationwide survey of players from each sector;

(iii) Through a survey of all businesses located within a selected geographical area.

Airlines and Airports

An airport's waste comprises many very different waste streams emanating from many different tenants including the airport authority, the airlines and all the retail outlets located at the airport. Network Recycling (1999) undertook a survey of waste arisings and compositions at selected UK airports. Network Recycling commented that few waste managers in the airport sector had detailed information relating to waste compositions and that providing details of the quantities of waste generated was also considered difficult by many.

Extrapolating the data reported by Network Recycling to the whole of the UK produces an estimate of some 10,000 to 14,000 tonnes of newspaper generated annually by UK airports (see technical note 4.5).

Whilst pilot recycling schemes at airports are reported by Terminal Recycling (Network Recycling 1999), there is no reliable representative data on the total newspaper recoveries from UK airports.

Constraints against wider recycling practices lie in: (i) security considerations that limit the siting of waste collection [recycling] bins in public areas, (ii) time constraints for the aircraft cleaners. Cleaners might have as little as 15 minutes turn-round time to clean a plane, (iii) health and safety issues over any hand segregation of recyclable materials from mixed cabin waste.

Other Transportation Hubs

A follow-on project by Network Recycling "Terminal Rail" is now investigating train and station waste arisings. Figures are not yet available on the total waste arisings from the sector, though preliminary audits have shown that 16 - 45% of various rail terminal wastes[7] may be made up of newspapers and magazines (Network Recycling, pers. comm.). It is not yet known how much of this is currently recycled. Like airports, security issues act against the siting of waste collection bins at many UK rail terminals.

Research in Melbourne estimated that rail terminal wastes were nearly four times higher than the airport wastes there (technical note 4.4). If these parallels hold in the UK, some 40,000 to 50,000 tonnes per annum of waste newspapers may be expected in train and station waste annually in the UK.

Hotels

Newspaper arisings in the hotel sector occur in the main through guests 'bringing in' newspapers and discarding them in their room waste. Most higher category hotels and many of the motels also offer a free morning newspaper to their guests. Many other hotels will also purchase newspapers on the direct request (and on payment by) their guests. Hotel management and staff are also likely to consume newspapers on the premises.

Around 122 million person nights are spent in hotels in the UK each year, plus a further 60 million in guesthouses and other serviced accommodation (see technical note 4.6). Those guests are estimated to leave around 20,000 - 45,000 tonnes, or more, of discarded newspapers. At least another 8,000 tonnes could easily be generated by the hotel staff themselves (see technical note 4.6).

Hotel and catering wastes amount to nearly 3.6 million tonnes annually in the UK, of which over 80% is classified as unsegregated general waste. However, it is not known how much of these wastes may be attributable to hotels as opposed to catering establishments. Around 30% of UK hotel and catering establishments provide accommodation (see technical note 4.6). A pro-rata split based on this figure would apportion 1.2 million tonnes of waste to hotels and guesthouses.

[7] See technical note 4.5

Oxford Brookes University (2001) carried out a waste audit of 27 hotels in West Oxfordshire. They found that the average amount of newspapers in the wastes of those hotels was 5.29% by weight. The percentages of newspapers arising in different categories of hotel was as follows:

Table 4.5 Newspaper Arisings by Hotel Category (% of waste stream)

Bed and Breakfast	Hotel	Hotel with restaurant	Public house	All
7.02%	7.69%	3.11%	3.34%	5.29%[8]

Source: Oxford Brookes (2001)

Based on the average figure of 5.29% and an estimated 1.2 million tonnes of hotel waste generated annually, the total mass flow of newspapers into hotels and guesthouses could be around 57,000 tonnes per annum (or 51,000 tonnes at 4.6%). However, these figures are very sensitive to the apportionment of the total hotel and catering wastes amongst the hotel sectors and amongst the other catering establishments.

Overall, the newspaper weight arisings for the hotel sector still remain relatively uncertain, although it can be stated that those arisings will be relatively high. The working estimate would put the scale of those arisings at many tens of thousands of tonnes per annum, at least 30,000 tonnes and perhaps as much as 60,000 tonnes or more.

In a random survey of hotels across the UK, none of the hotels we surveyed recycled their newspaper waste. Most was disposed of as unsegregated room waste and disposed through the commercial mixed waste stream. Bulk newspaper deliveries to hotels that were not taken up by guests were normally returned to the retailer or wholesaler as over-issue.

Restaurants

Unlike hotels, the main input of newspapers into restaurants is not through the patrons leaving their personal copies of newspapers, but through the free copies bought by a limited number of restaurants for their patrons' use. The practice is most commonly seen in roadside restaurants, but is becoming increasingly practised in town eating places and coffee shops. Also, as with any other business, restaurant staff might bring personal copies of newspapers into work and discard them there.

One restaurant chain was identified as taking delivery of 6,000 newspapers per day over its 380 outlets. This equates to 480 tonnes of newspaper a year. However this situation is not the norm. If newspapers are taken for the courtesy of the patrons, the number of copies normally number around 5 per establishment. Restaurants in general are not a major sink for newspapers.

Hospitals

Newspaper arisings in hospitals occur through a combination of the purchases made at hospital retail outlets and of the newspapers brought in and discarded by staff, in- and out-patients and visitors. Little quantitative information could be elicited on on-site sales. Those sales are managed locally, often involving the voluntary sector, and can be very variable between hospitals. Of the hospitals directly contacted during this project, local 'shop' records appeared to be based on revenues rather than on circulations and tonnages.

The total 'household' hospital 'black bag' waste arisings for NHS hospitals are reported to be 150,000 tonnes per annum (NHS spokesperson, pers. comm.) It is considered by some commentators that hospital black bag wastes have roughly the same composition as normal household wastes (Wasteonline.org.uk). As such, between 7% and 10% of newspapers may be assumed to arise within those wastes, contributing between 10,500 and 15,000 tonnes per annum. Audits elsewhere in the world (see technical note 4.4) have revealed slightly lower percentages of newspapers arising in hospital waste (1 - 6%).

[8] Weighing the arisings by the relative number of bed spaces reduces the average to 4.6%

None of the hospitals spoken to in this project carried out any segregation or recycling of newspapers from their general waste. Whilst it is conceivable and likely that some UK hospitals may be recovering newspapers for recycling, it is believed that the majority of newspapers arising in hospital waste are being disposed within the residual [general] waste of those establishments.

Public libraries

A random survey of public library holdings from UK central and branch libraries indicated that weekly consumptions were just over 7.5 kg per week per service outlet (see technical note 4.6). This amounts to an estimated 1,632 tonnes of newspapers consumed by public libraries across the UK.

Some newspaper titles are discarded the following day, whilst most others are discarded within 3 to 6 months. Few titles are retained in perpetuity in their printed form. It is not known what proportion of the newspapers is recycled, though it is noted that many libraries express a policy intention to recycle discarded stock.

The largest newspaper-taking library in the country, the British Newspaper Library, takes in 154,645 hard copy issues each year, amounting to a little over 40.2 tonnes of newspaper stock (British Library, pers. comm,). All those copies were archived.

Universities, colleges and schools

The newspaper consumption by this sector is very difficult to quantify. The University sector has moved strongly towards the provision and use of electronic newspapers for education and research, though paper copies of most UK broadsheets and the major local regional papers are still kept in university libraries. Significant numbers of the major international titles can also be taken by the libraries. Secondary school libraries take fewer papers. Typically, school library web pages report around 3 titles on average being taken on schooldays. Newspaper consumptions by the primary and FE sectors were not specifically researched, but would also contribute to the total.

Overall, it is estimated that there could be of order 2,000 to 5,000 tonnes per annum of newspapers passing through educational libraries in the UK (see technical note 4.7).

Recycling policy varies locally, and no estimates can be made of the amounts of newspapers recycled by the sector.

The above estimates take no account of the newspapers that are brought into educational establishments, and discarded there, by the staff and students of those establishments. Estimates of those arisings are given later in section 4.4.

Other, e.g. military bases, prisons etc.

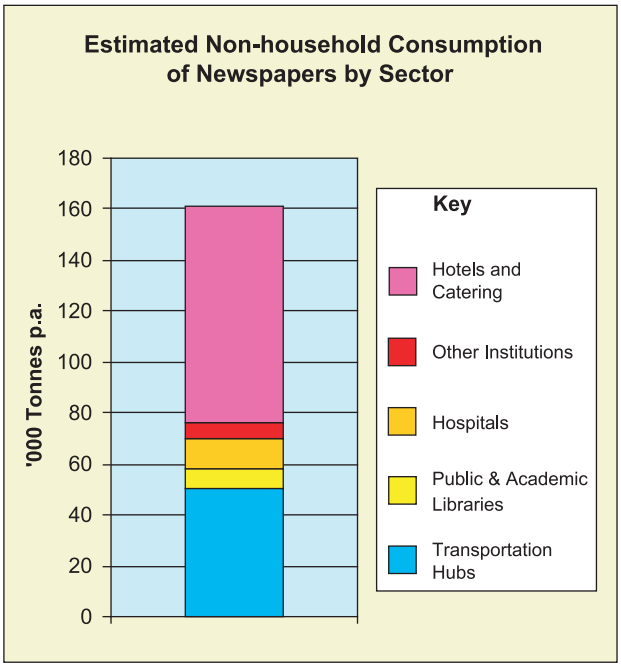
Military bases and other institutional housing (prisons, hospitals, boarding schools, etc) account for just 0.31% of the households in the UK, with military bases making up the bulk (0.27%) of that housing stock. Assuming that newspaper consumptions per household in those areas follow the national average, then just 5,000 tonnes per annum of newspapers might be expected to be consumed inside military bases, with the other institutional areas contributing a further 700 tonnes per annum. We were unable to obtain any information on in-base recycling.

No central information is held by the prison service as to quantities of newspapers recycled. Each prison orders its own newspapers from a local newsagent or wholesaler. A limited survey of prisons revealed an intake of around 0.17 newspapers per day per inmate. This scales up to a total of around 1,100 tonnes per annum nationally (see technical note 4.9). Only a small percentage of the finished newspapers are currently recycled. The majority enters the waste stream as commercial waste.

In 1999 the UK prison service introduced a ‘greening’ policy, and prisons are now being encouraged to set up their own recycling activities.

Overall

This section has provided a preliminary analysis of the possible quantities of newspapers that might be entering some of the non-household waste streams in the UK. The figures that have been presented here are not prescriptive and should be taken as no more than notional estimates of the likely consumptions that might be occurring in each commercial or institutional sector. Clearly some key organisations such as central and local Government offices, large finance houses etc. must also be counted amongst the relatively large consumers of newspaper, although they have not been specially researched for this project. Government has now adopted a positive policy towards reducing its own departmental waste. Significant reductions are being made by individual Departments and at local Government offices as well. However, the role played by newspapers in those reductions has not been quantified. Departmental figures, where published, only report total paper wastes.



In summary, newspaper acquisitions in all sectors are through the combination of central purchasing for individual consumption and for workplace libraries, together with the personal copies brought into the workplaces by individuals. The indications to date are that central purchasing of newspapers by organisations may not make up the main flux of newspapers passing through those organisations. The aggregated purchases of individuals may well provide the dominant input.

Overall, there have been very few waste compositional analyses of the individual sectors contributing to the UK commercial [and industrial] waste streams. The isolated audits that have taken place have either considered paper and card as a single material and/ or have been based on very small sample sizes. Few audits have been openly published. Many are regarded as being commercially sensitive.

There are even fewer data on the extent of newspaper recycling from the commercial waste streams. From personal communications with waste paper merchants, it is estimated that some 10% of recovered office paper may comprise newspapers in recycling schemes where newspaper is accepted. In office recycling schemes not targeting newspaper, between 1% and 2% newspaper contamination is considered to be the norm. WRAP (2003) independently report 1.34% newspaper present in a high-grade office paper collection.

It is not possible, from the broad surveys that have been undertaken, to provide any reasonable estimates of the total tonnages of newspapers that might be being recycled through office recycling schemes.

In order to get a better picture of the flow of newspapers through the commercial waste sector, it becomes necessary to carry out further audits throughout the sector. However, there are very significant and insurmountable logistical and resource constraints to undertaking nationwide surveys of such a nature. However, expedient analyses are possible if the geographical coverage of the survey base is much more restricted in scale. For the purposes of the current analysis, a new newspaper waste audit of the commercial sector was conducted. The results from that audit are presented in the next section.

4.4 Non-household Newspaper Mass Balance (II): Case Study in Paisley

It was highlighted in section 4.3 that around 0.5 million tonnes of newspapers could be ending up in the general commercial waste stream each year. Investigations of specific sectors showed that hotels, transportation and hospitals provide particularly rich concentrations of newspaper in their general commercial wastes at produce relatively high waste tonnages. Together, it was estimated that these sectors alone could potentially add up to 160,000 tonnes or more annually. It was conjectured that the other 340,000 tonnes could be spread thinly amongst all the other businesses and institutions across the country. To carry that hypothesis forward any further requires independent corroborating data. That data is now presented.

In order to provide an individual business survey that was both realistic and representative, the survey aimed at achieving a high proportional coverage of all businesses located within a given geographical area. The area chosen was the town of Paisley in Scotland. At the time of writing, the survey is still underway, however it is possible to provide some interim results should be indicative of the scale of newspaper disposals within general commercial waste. To date 495 organisations have been surveyed across the manufacturing sector, the construction industry, wholesale and retail, transport (excluding passengers wastes), general business activities, health and social work, and other community services[9]. So far, only limited data has been elicited from the hotel, educational, public and finance sectors in Paisley. Table 4.6 summarises the results to date. The results from the full survey will be published in greater detail elsewhere once they become available.

The methodology used for the survey was by telephone interviews with each company, or with each department of the company if the company was large. The contacts were made with workers and/or the cleaning staff. Individual newspaper titles were recorded separately and totals were scaled by the average weights of those titles.

Table 4.6 Newspaper Flows into General Commercial Wastes by Industrial Sector*

SIC section		No. Businesses surveyed	No. employees	Papers/ employee /wk	Kg/ employee /wk
D	Manufacturing	51	902	1.40	0.29
F	Construction	45	587	1.25	0.24
G	Wholesale and retail	168	1618	1.37	0.27
I (**)	Transport & storage	22	656	1.43	0.32
K	Real estate+ business activities	73	656	1.18	0.25
N (#)	Health and Social work	42	674	1.03	0.21
O	Other community services	62	606	1.66	0.35
H+J+L+M	($)	32	562	0.86	0.18
Total		**495**	**6261**	**1.30**	**0.27**

(**) Employees' wastes only, excludes customer wastes. Rail transport not included to date.

(#) Excludes hospitals

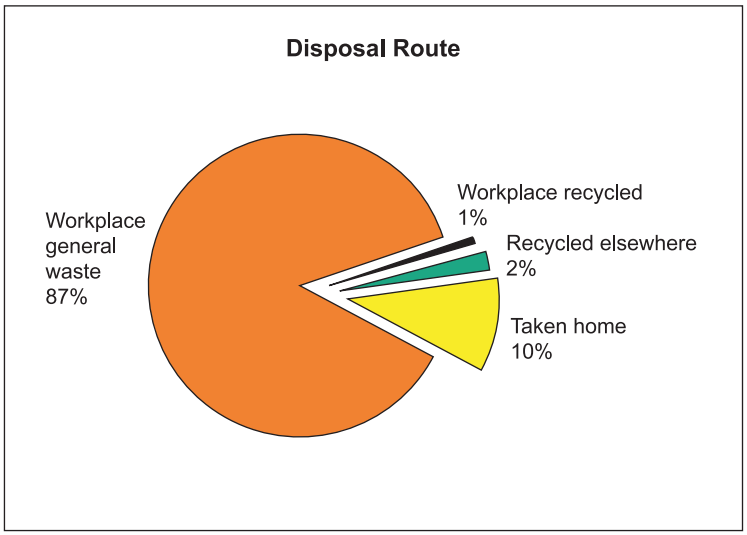
($) H = Hotels & Restaurants. Only group 55.5 (canteens and catering) included to date;
J = Financial intermediation;
L = Public administration and defence;
M = Education. Only section 80.4 (Adult and other education) included to date.

* Note: All data are provisional and are likely to change as further businesses are surveyed.

9 SIC codes D,F,G,I,K,N,O

The results show an overall disposal of 1.30 newspapers per employee per week into the general workplace waste in Paisley. That equates to 0.27 kg of newspapers per employee per week. The highest per capita waste arisings were in the community, social and personal services sector (SIC section O). It should be noted that the arisings from this sector also include the courtesy newspapers bought for the clients as well as those consumed by the workforce (e.g. by hairdressers, sporting, political and social clubs etc.)

Few of the workforce claimed to recycle any of their finished newspapers. Just over 2% of newspapers were taken from the workplace and recycled through local authority recycling schemes whilst less than 1% were recycled through workplace recycling schemes. Around 10% of newspapers were taken home at the end of the day. Their fate is unknown though most would probably end up as general household waste. Only a very tiny percentage was reused.



Taking an average 0.27 kg per employee, and taking a labour force of 27 million in the UK (National Statistics) with 48 working weeks in the year, scales up to 349,920 tonnes of newspapers annually for the UK. Whilst these figures are still provisional and are subject to much uncertainty, it is evident that they are of the right scale of magnitude to corroborate the other evidence (presented earlier) of the likely scale of newspaper arisings in the general commercial waste stream.

A survey of the fate of newspapers in a large Paisley hospital has also been undertaken (table 4.7). Figures include both ward wastes and wastes generated by hospital staff. Total newspaper waste arisings at the hospital amount to 48 tonnes per year. Scaling those figures up by bed spaces gives a projected annual arising of around 16,000 tonnes for NHS hospitals in the UK. This compares with the independent estimate of 10,500 to 15,000 tonnes made earlier in section 4.3.

Table 4.7 Newspaper Waste Arisings at a Paisley Hospital

Staff	Beds	General Waste	
		Papers/ week	Kg/ week
1191	796	3808	516.5

5. RECOVERY AND MARKETS

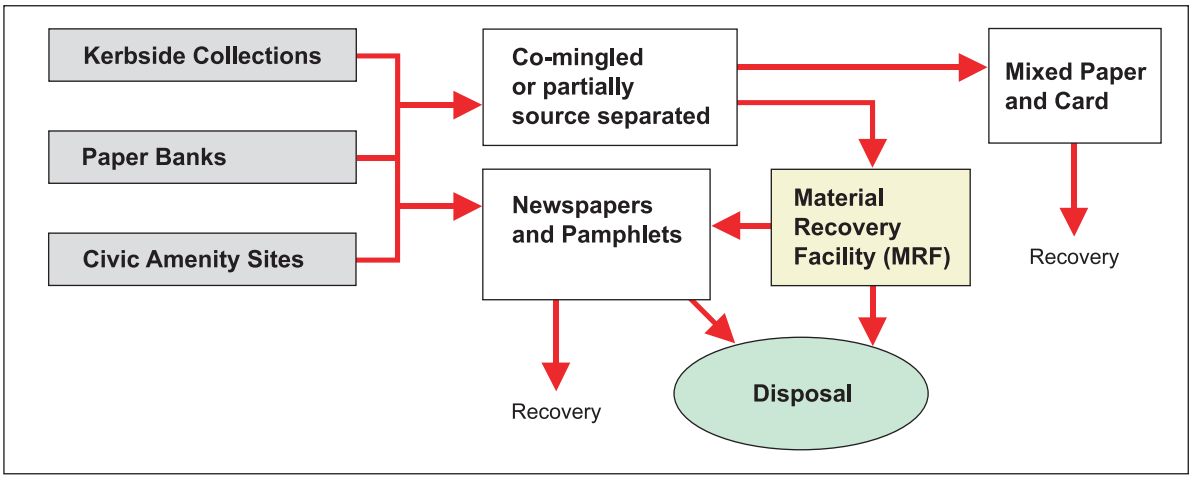
5.1 Sector Overview

The recovery and reuse sector focuses on the recovery of old newspapers from consumers and their distribution to end users, who can include reprocessors and other converters both inside and outside the UK. Whilst the majority of the newspaper recovery is from domestic consumers through local authority recycling schemes, there are also recoveries from the commercial and industrial waste streams as well. These non-household recoveries are much more difficult to quantify though, as shown later in this section, local authority recycling yields too can be subject to many uncertainties.

End users can take both post-consumer and pre-consumer wastes (printers wastes and over-issue), although the origin of the waste is not always unambiguously identifiable. However, the major uncertainty in the recovery and end use sectors arises because newspapers are not normally identified separately in most mass flow statistics. Usually newspapers are brigaded with pamphlets and magazines (pams) and often with other paper grades as well. To 'unpick' the newspaper flows from the overall statistics it is necessary to estimate the 'multiplier' that distinguishes the newspaper component from the total paper [and card] flows.

It must also be recognised that not all recovered paper reaches the end user. Paper can be recovered from the consumer but unable to attract a market, or the quality of the recovered paper may not meet market specifications. Such losses also need to be delineated.

5.2 Household Waste Recycling Collections: Overview



In the UK, Waste Collection Authorities (WCAs) are charged with the responsibility of collecting the recyclable waste from households, through providing kerbside collections of recyclables from the householder's premises, and by installing recycling banks at locations within the community to which residents can bring their recyclables Waste Disposal Authorities (WDAs) are charged with the disposal of the residual waste. The WDAs are also responsible for the civic amenity (household waste) sites and have separate responsibility for administering the recycling collections at those sites. In England, the WCA role is generally taken on by the district councils, with county councils being the WDAs, although there are some unitary authorities that assume both functions. In Scotland and Wales all councils are unitary authorities. The reason for distinguishing civic amenity (ca) sites from other recycling bring sites in the current study is that the mix of paper recyclate collected at ca sites can be very different from other bring sites. Different multipliers will be needed to 'unpick' newspaper weights from each class of site.

5.3 Household Collections: Paper and Card Recoveries

Paper and Card Collections

Recycling statistics for England are published annually by DEFRA, with similar compilations published locally for Scotland (by SEPA), Wales and Northern Ireland. The Chartered Institute for Public Finance and Accountancy (CIPFA) additionally provide a more detailed breakdown of the statistics for England and Wales, including the breakdown across individual local authorities. In interpreting the statistics, it must be noted, particularly with the CIPFA statistics, that not all authorities respond to the calls for information (normally there is around a 75% response rate for the CIPFA compilation). Of those authorities that do respond, some authorities do not respond in full. The published grossed statistics in the CIPFA compilations, attempt to 'correct for' non-responses and missing data. The data used in this study (table 5.1) have been drawn from the 2000 - 2001 CIPFA compilations. The equivalent figures from DEFRA (table 5.2) and from the other national authorities (e.g. table 5.3) are normally based on close on 100% returns from individual local authorities.

Table 5.1 CIPFA 2000-2001 Actuals Paper & Card (Tonnes)

	London boroughs	Metro-politan districts	Non-metro districts	Unitary author-ities	Wales	England & Wales
WCAs	160,649	105.098	457,087	111,600	36,388	870,822
WDAs	61,107	59,621	86.621	}	}	
Total	**221,756**	**164,719**	**543,708**	**111,600**	**36,888**	**1,078,671**

Source: CIPFA (2002)

Table 5.2 DEFRA Paper and Card Recoveries 2000 - 2001

Region	'000 Tonnes	Kg/hh/year
North East	20	18.8
North West	103	36.3
Yorkshire & Humber	50	23.9
East Midlands	70	40.2
West Midlands	68	31.4
East	123	54.6
London	163	52.0
South East	15	58.3
South West	117	56.5
England*	**910**	**43.9**

Source: DEFRA (2002) * Excludes an additional 24,000 tonnes collected by voluntary and charity organisations

Table 5.3 SEPA Data - Scottish Paper & Card Recoveries 2000 - 2001

	Tonnes pa	Scheme	Tonnes pa
Paper	33,966	Kerbside	17,523
		Bring/CA	16,443
Mixed paper & card	6,082	Kerbside	3,118
		Bring/CA	2,964
Card	3,421	Kerbside	777
		Bring/CA	2,644
Co-mingled	2,351		
Commercial mixed paper & card	4,162		

Source: SEPA (2002a)

Government figures for paper and card recoveries in Wales are 33,000 tonnes in 2000 -2001 (DEFRA, 2002), and for Northern Ireland an estimated 15,628 tonnes[1] in 1999 - 2000. (Northern Ireland Environment and Heritage Service, 2001).

A further UK-wide survey was undertaken by the University of Paisley in 2002 to elicit specific details on newspaper and pams flows rather than the total paper and card flows recorded in the other surveys. Full details are provided in technical note 5.1.

Roughly equal quantities of paper were collected by kerbside schemes as through bring and civic amenity collections schemes in 2000-2001. Paper and card yields averaged around 1.0 - 1.1 kg per serviced household per week for kerbside schemes with around 0.34 - 0.39 kg per week per household being taken to bring sites.

Table 5.4 Average Kg of Recovered Paper per Serviced Household per Week broken down according to Collection Scheme (CIPFA statistics)

Kerbside	Bring	CA
1.01	0.34	0.13

Source: CIPFA (2002)

Table 5.5 Tonnages of Paper and Card Collected by Collection Scheme 2000-01 DEFRA

Integrated schemes		Separate Collections		Bring & ca sites	
'000	Kg/hh/y	'000	Kg/hh/y	'000	Kg/hh/y
tonnes	(kg/hh/w)	tonnes	(kg/hh/w)	tonnes	(kg/hh/w)
25	64	458	58	427	20.6
	(1.23)		(1.11)		(0.39)

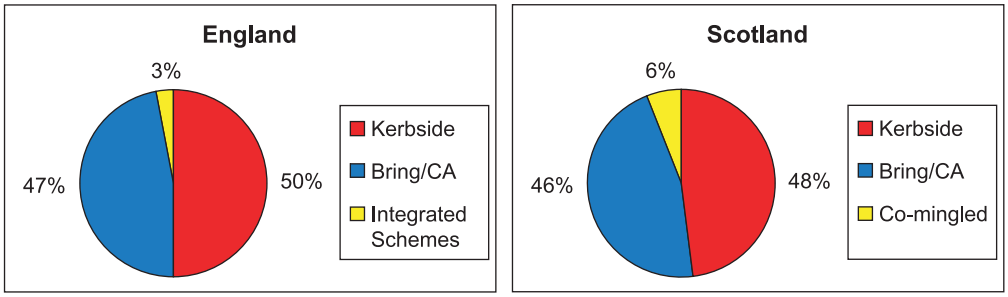
Source: DEFRA (2002)

Table 5.6 Paper and Card Collected by Collection Scheme 2000-01 in Scotland (Tonnes)

Co-mingled	Kerbside	Bring & ca
2,351	20,641	19,407

Source: SEPA (2002a)

Paper and Card Recoveries by Collection Scheme



Co-mingled collections

In addition to the separate collections of paper and card, some 11%[2] of local authorities recovered paper and card co-mingled with other recyclables in their kerbside collections. Further co-mingled recyclate was additionally recovered at bring sites and ca sites (table 5.7).

1 54,834 tonnes of household waste was collected for recycling, 28.5% of which was paper and card
2 Estimated from CIPFA returns

Table 5.7 Co-mingled Recyclables Collected in 2000 - 2001 (England), '000 tonnes

Integrated schemes	Separate collections	Bring & ca sites	Total (England)
47	114	43	206

Source: DEFRA (2003)

5.4 Household Collections: Estimated Newspaper Recoveries

In order to extract newspaper recoveries from these data, it becomes necessary to know what proportion of the collected paper and card is newspaper. That ratio can be very variable across the country and will depend on a multiplicity of factors. The main factors will be:

• Whether card is collected alongside newspapers and pamphlets and magazines (pams);
• The local consumptions of newspaper, magazines and other recyclable paper;
• The relative capture of newspaper versus other types of wanted paper.

With these statistics, the collected newspaper can then be estimated as:

Collected newspaper and pams = Collected paper and card x % newspaper and pams in the collected paper & card.

Collected newspaper = Collected newspaper and pams x % newspaper in the collected newspaper and pams

There are no national statistics on the newspaper content, or indeed the newspaper & pams content, of household paper collections. These ratios are not normally monitored by collection authorities, except perhaps during a coarse inspection to ensure that the mix meets the specification of the downstream purchaser. Estimates of the 'average' newspaper content tend to be made only in special circumstances, normally through specialised research investigations.

The multiplier 'Newspaper' to 'All collected paper' can take on a broad range of values according to the details of the collection scheme. For the mass flow audit, these can be divided, largely, into three major categories:

(i) News and pams only collections (both kerbside and bring);
(ii) Mixed paper collections and co-mingled (mainly kerbside);
(iii) Civic amenity site collections;

Recovered paper compositions for the different regimes have been collated from a number of research investigations and these are reported in technical notes 5.2 to 5.4. It should be noted here that there has been no standard categorisation of the individual paper fractions reported in those research data. A major source of discrepancy or uncertainty amongst all data sets relates to how newspaper colour supplements are classified. Where they are not identified separately, it is not clear whether they have been counted as newspapers or as magazines.

It is not possible to derive any global averages from the research data as the data is too sparse, and too temporally and spatially disparate for any meaningful statistical aggregation. For the purpose of the mass balance the following 'working estimates' have been assumed (based on the data sets from the previous research measurements and from more recent data provided by WRAP (2003).

No representative data could be sourced to indicate the newspaper content of collected co-mingled recyclate. Typically such recyclate contains of the order 60 - 80% paper and card. A working figure of 35 - 40% newspaper was assumed for co-mingled collections.

Table 5.8a Working Estimates of 'Multipliers' in Paper and Card Collections (Estimated from Previous Research Data - see Technical note 5.2)

	Newspaper	News + pams
% in a news and pams collection	65 - 75%	90 - 95%
% in a mixed paper collection	40 - 45%	70 - 75%
% in a paper recyclate from a civic amenity site	?	~ 40%
Ratio: Newsprint: Colour supplements: Magazines: Other pams	65%: 10%: 14%: 11%	

Table 5.8b Working Estimates of 'Multipliers' in Paper and Card Collections (Estimated from WRAP(2003) - see Technical note 5.3)

	Newspaper	News + pams
% in a news and pams collection	~ 65%	87 - 92%
% in a mixed paper collection	~ 50%	70 - 80%
Ratio: Newsprint: Colour supplements: Magazines: Other pams	61%: 9%: 18%: 12%	

The major deviation[3] between the two data sets is that the newspaper contents appear to be some 5-10% lower in the WRAP (2003) analyses than in the previous research analyses. It is not known now much these differences were attributable to the differences in the sample bases, and how much could be attributed to real temporal trends[4].

Further estimates of the percentage of newspaper and pams in municipal paper and card collections were also made based on the Scottish (SEPA) returns and the CIPFA/ University of Paisley surveys respectively (see technical note 5.4). These estimates indicated that 87% of the recovered paper and card was made up from newspapers and pams in Scotland, with 91% of the paper and card being made up from news and pams in England and Wales. A working estimate of 90% news and pams in household paper and card collections may then be assumed.

5.5 Household Collections: Material Losses

Not all of the newspaper that is collected by local authorities is passed on to downstream users and reprocessors. Some material may have been collected when the markets for it were not in place. Other material may be out of the specification set by the downstream purchaser, for example it could breech maximum or minimum limits for newspaper content or for magazine content, or it could contain too many contraries, or it may simply be too wet.

Data on material losses has been reported nationally for Scotland (SEPA, 2002a) but not for other parts of the UK. An estimate for the UK was made on the basis of the University of Paisley survey (see technical note 5.1) in which details of material losses were specifically requested. Results are shown in table 5.9.

Table 5.9 % Paper Collected by Local Authorities that is Not passed on to a Receiver

Scotland	0.65%
UK survey	1.45%

Sources: SEPA (2002a), University of Paisley survey (unpublished) - based on returns from 33% of UK authorities

[3] A greater proportion of contrary material was also found in the WRAP (2003) analysis –though this is considered to be due largely to the strict classification of that analysis against BS EN643 whereas previous analyses adopted looser classifications of what was eligible material.

[4] If the figures are construed as representing real temporal trends, then by logical argument, the increases seen in paper recycling over the last two years are due to more 'non-newspaper, non-newsprint' papers being recovered, with newspaper recoveries being much more static.

It should be noted that the above data, supplied by local authorities, may or may not include some MRF losses.

In the UK survey, 99.2% of the above losses were landfilled and 0.8% incinerated.

WRAP (2003) note that up to 1.75% of paper consigned by local authorities to paper merchants comprised spoiled paper, for example newspaper that was too wet or was burnt.

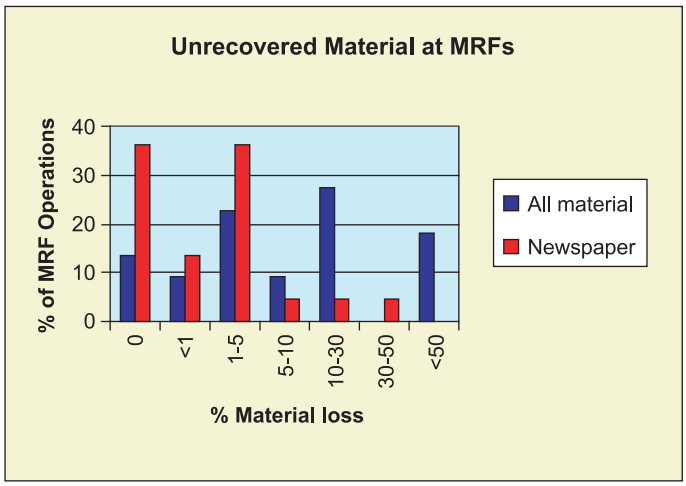
A second source of material loss is in the centralised separation of partially source-separated, co-mingled and non source-separated material. These operations take place at specialised 'Materials Recovery Facilities' commonly known as MRFs.

For the purposes of audit, two classes of MRF operation have been identified:

- Where paper enters the MRF separately bagged from other collected recyclates;
- Where the paper is commingled with the other dry recyclates (or unseparated waste) and is separated out through mechanical processes or by hand picking.

In the former case, there is normally no loss of paper. In the latter case, losses can be incurred through incomplete separations or through contamination of the separated paper leading to loss of markets.

In 2001, a total of 2,440,588 tonnes of waste passed through material recovery facilities in the UK, however it is not known how much of this material was newspaper. The losses of newspaper at MRF operations were not separately recorded, however most MRF operators thought they could supply reasonable estimates of those losses. For the study, 22 MRF operations were surveyed, representing a 32% sample of all UK operations on the basis of the tonnages they handled.



The percentage losses of newspaper at MRFs was generally considered to be much lower than for other materials. At around a third of the MRFs surveyed it was considered that there was no loss of newspaper. Around 25% put the losses at 0 to 5%. Just three of the 22 operations surveyed reckoned newspaper losses to be in excess of 10%. The average loss was calculated to be around 2.5%

Overall, newspaper aggregated losses were estimated by MRF operators to amount to 6,059 tonnes across the 22 operations, which extrapolates to an estimated annual national under-recovery (or loss) of 18,930 tonnes.

5.6 Household Collections: Provisional Mass Balance

Based on the above considerations, the following provisional mass balance has been constructed for local authority newspaper recoveries from household waste (table 5.10). Whilst the figures in the tables refer to the time horizon 2000 - 2001[5], it must be noted that considerable dynamic changes have occurred in household recyclate recoveries over recent years, and those changes are escalating. National statistics can be over a year old before they are available in the public domain.

[5] 2001 - 2002 figures have since been published. The main implications of the new figures are summarised in table 5.11 at the end of this section.

Table 5.10a Household Newspaper Recoveries (Paper and Card Collections) Consolidated Data

	Tonnes per annum (2001)		
	Paper & card collected	**Newspaper & PAMs collected**	**Newspaper collected** (including colour supplements)**
England	1,041,783* 910,000#	937,604 819,000	675,075 589,680
Scotland	38,250	34,425	24,786
Wales	36,888*	33,200	23,904
	33,000#	29,700	21,384
N.Ireland	15,628##	14,060	10,123
UK TOTAL	**1,132,549*** **996,878#**	**1,019,289*** **897,185#**	**733,888*** **645,973#**

* CIPFA, #DEFRA
1999-2000 figures
** Assuming 72% of collected news and pams is newspaper (colour supplements inclusive)

Table 5.10b Estimated UK Newspaper Recoveries (LA Collections)# 2000 - 2001

LA paper & card collections	Co-mingled collections	MRF and other losses	Total passed on
646	**90***	**25 - 30**	**701 - 706**

Based on DEFRA figures for England and Wales
* England data scaled up to UK and assuming 40% newspaper content

Between the 2000 - 2001 and 2001 - 2002 time horizons, the overall tonnages of paper and card collected by local authorities have risen by around 5%, with similar increases seen in the tonnages of co-mingled recyclables collected (table 5.11). In particular, kerbside recoveries increased by nearly 10% between the two horizons, mainly reflecting the increased number of properties receiving a kerbside [recycling] collection service. As a consequence bring and ca site recoveries have diminished.

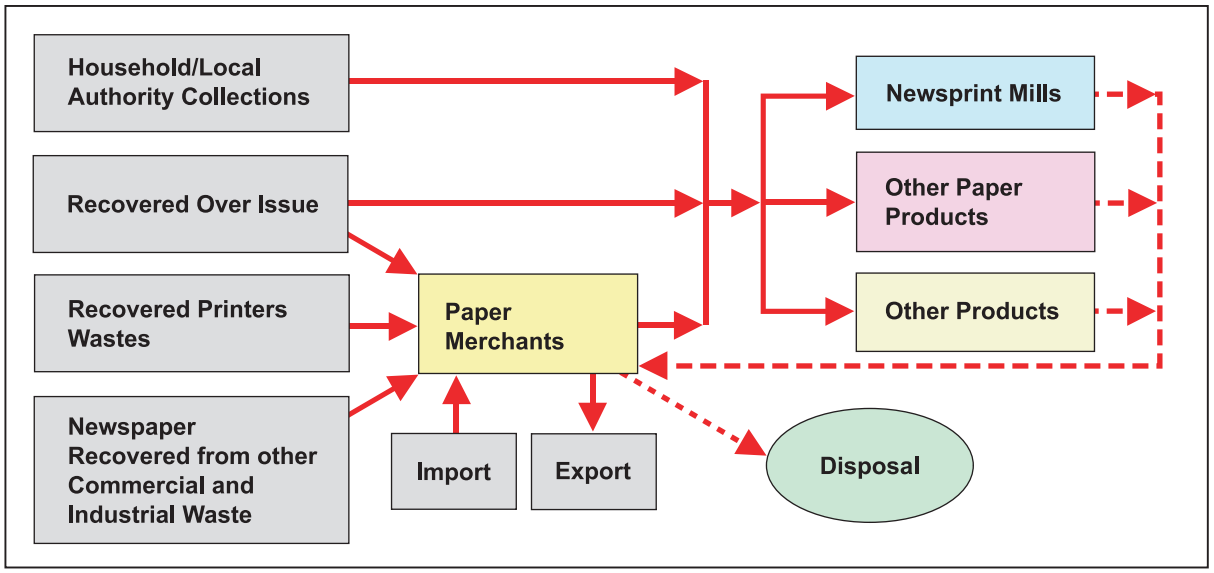
However, it cannot be determined whether newspaper recoveries have strictly followed the same overall trends as paper and card. It was noted in section 1.2 and 2.3 that the weight of newspapers in circulation and the home consumption of newsprint both diminished between 2001 and 2002 by the order of 5%. Those changes could have largely offset any tonnage gains from the increased recycling participation.

Table 5.11 Changes in Tonnages collected by English Local Authorities between 2000-01 and 2001-02 ('000 Tonnes)

	Integrated schemes		Separate collections		Bring and ca sites		Total LA	
	2000-01	**2001-02**	**2000-01**	**2001-02**	**2000-01**	**2001-02**	**2000-01**	**2001-02**
Paper & card	25	30	458	511	427	418	910	959
Co-mingled	47	50	114	140	43	28	204	217

Source: DEFRA 2003

5.7 Recovered Paper Markets: Overview



Whilst the majority of the consumed newspapers that are recovered by local authorities pass directly under contract to the end user, significant quantities are also handled by independent paper merchants and by waste management companies, acting as intermediaries. Over-issue newspapers recovered by wholesalers are also handled by paper merchants through contracts drawn up by the publishers. The major proportion of regional over-issue also passes through intermediaries. Very few of the intermediaries were willing to contribute data to this mass balance project and the data collected from their sector is considered to be too unrepresentative to be utilised in effecting the overall mass balance. The statistics presented in this section have been compiled solely from the input flows to the identified end users, including any imports and exports of recovered newsprint wastes as far as those imports and exports could be ascertained.

The flowchart for the sector also highlights some potential minor flows, including losses incurred by paper merchants and the resale of paper back into the market by the end users. It has not proven possible to acquire reliable data on any of those flows.

Waste paper transactions in the waste paper market are classified according to standardised paper grades. From 2002, the European list of standard grades (European standard EN643) has been adopted as the grading system for the UK (table 5.12). At the 2001 time horizon, however, many transactions still referred back to the old UK grading system (table 5.13).

The majority of the paper grades only specify newspaper concentrations in terms of the maximum or minimum limiting amounts of newspaper that are allowable. In order to fully 'unpick' the newspapers from these accounting systems, estimates need to be made of the typical newspaper contents that are likely to be present in each grade. Such estimates are inevitably quite subjective. Actual figures might be quite variable between different batches of material. The working estimates used in this study are reproduced in the last column of tables 5.12 and 5.13.

By far the largest end users of old newsprint are the newsprint mills that recycle the old newspapers back into new newsprint. There are just three newsprint mills in the UK: Aylesford Newsprint, Bridgewater Paper Co. Ltd., and Shotton Paper, though some mills in Sweden and in a number of other countries also take in recovered UK newspapers for recycling back into newsprint.

As well as making new newsprint, old newspaper is also recycled into a number of other products as well. Basically, these lesser users split into two main categories:

- Paper products other than newspaper
- Non-paper products

Table 5.12 European Classification of Recovered Paper Grades Relevant to Newspaper Recycling

Classification	Description	Specification	Estimated average % newspaper
1.02	Mixed Paper and Boards	Maximum 40% newspapers & magazines	20*
1.06	Unsold Magazines		0
1.08	Mixed Newspapers and Magazines I	Minimum of 50% newspapers	65
1.09	Mixed Newspapers and Magazines II	Minimum of 60% newspapers	70
1.10	Mixed Magazines and Newspapers	Minimum of 60% magazines	30
1.11	Sorted Graphic Paper for De-inking	Min 40% newspapers and 40% magazines	45
2.01	Newspapers		100
2.02	Unsold Newspapers		100
2.08	Coloured Wood-free Magazines		0
3.14	White Newsprint		100

* Could be an over-estimate. Some merchants (pers, comm.) have advised a figure closer to 10%

Table 5.13 UK Paper Grades Relevant to Newspaper Recycling

Classification	Description	Specification	Estimated average % newspaper
Group 3	White & Lightly Printed Mechanical	Includes white unprinted news	30
Group 5	Heavily Printed Mechanical	Includes post consumer news and pams and over-supply news	75
Group 9	Mixed Papers	Maximum 10% newspapers and pams	5

5.8 End Users: Newsprint Mills

Together the three UK newsprint mills consumed a total of 1.22 million tonnes of recovered paper in 2001, and 1.15 million tonnes in 2002 (Confederation of Paper Industries). Table 5.14 provides the breakdowns of mill inputs by recovered paper grades.

Table 5.14 Annual Newspaper Flux into UK Newsprint Production (2002 figures)

	Classification	Tonnes	Estimated % newspaper	Estimated tonnes newspaper
Unsold magazines	1.06	152,191	0	
Mixed news & mags II	1.09	613,273	70	429,291
Unsold news	2.02	53,987	100	53,987
White newsprint	3.14	173	100	173
News and pams	Not specified	330,376	85*	280,819
TOTAL		**1,150,000**		**764,271**

* Believed to contain a relatively high percentage of over-issue newspapers

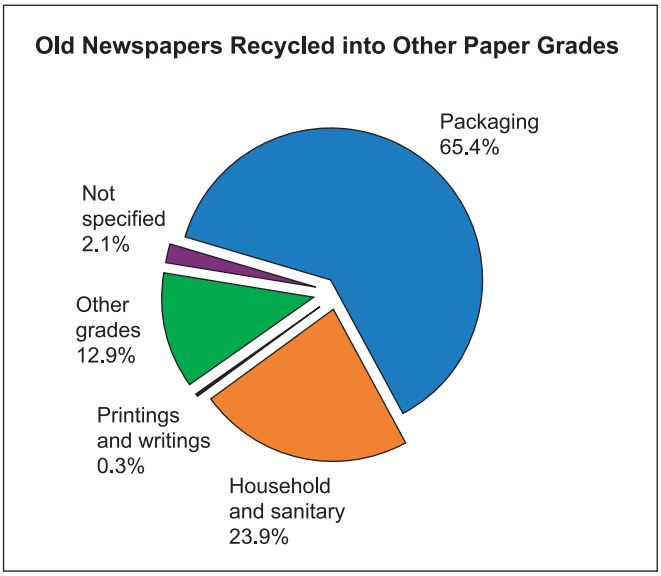
5.9 End Users: Other Paper Products

Thirteen UK paper companies were identified as taking in waste paper grades that could contain some newspaper (as a wanted component) as part of their process feed stock (table 5.15).

Table 5.15 Annual Newspaper Flux into Non-newspaper Paper Making

	Classification	Tonnes	Estimated % newspaper	Estimated tonnes newspaper
Mixed papers/ board	1.02	10,235	20	2,047
Mixed news & mags I	1.08	1,040	65	676
Sorted graphic paper	1.11	10,997	45	4,948
Unsold news	2.02	2,926	100	2,926
White newsprint	3.14	141	100	141
Lightly printed mechanical	UK Group 3	60,152	25	15,038
Heavily printed mechanical	UK Group 5	43,848	70	30,694
Mixed papers	UK Group 9	17,045	5	852
News and pams	Not specified	120,500	75	90,375
TOTAL		**266,884**		**147,698**

The 'best' estimates would indicate that nearly 148,000 tonnes of recovered newspapers are used in the manufacturing of other paper products. However, that estimate is, again, sensitive to the assumptions made about the newspaper contents of the various paper grades.



Nearly two-thirds of the recovered newspapers used for making other paper products are used in making packaging papers and corrugated case materials. Nearly a quarter is used in making household and sanitary papers. Plasterboard liner is the largest outlet of the other paper grades manufactured, with fibreboard accounting for most of the rest. Almost no newspaper was used in making any graphics papers.

Three companies, accounting for 60% of the recovered newspapers, took those newspapers directly from local authority collections. Nearly all the other material used by the 'non-newsprint' end users was obtained through paper merchants.

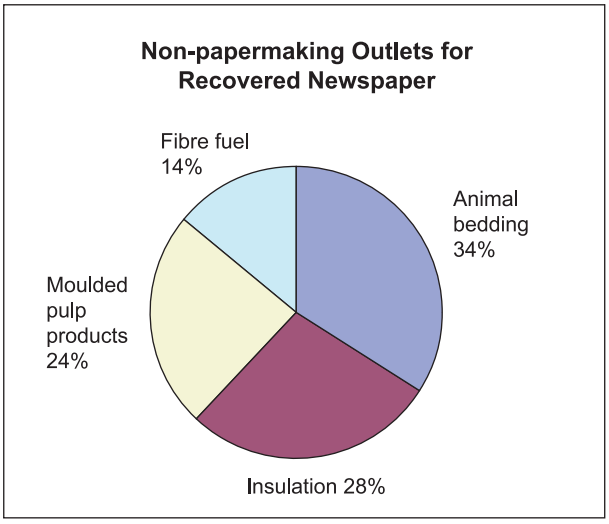
5.10 End Users: Non-Paper Products

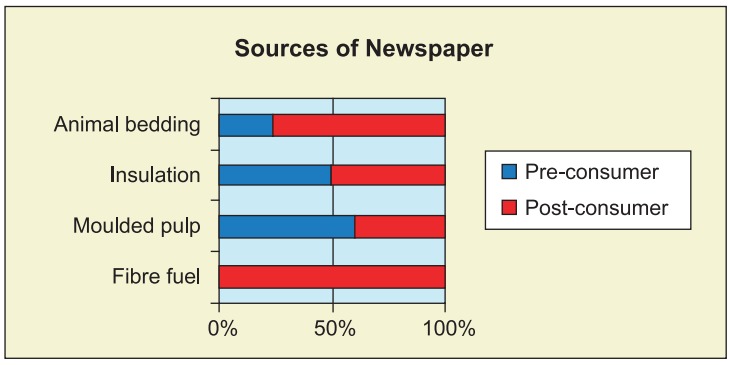
The manufacturers and other end users in these markets were identified through searching national advertising directories and through internet searches. 100% of all identified companies were contacted. Whilst it is not known whether the responses account for the whole of each market, it is believed that they account for a very large market share of those markets. There are a relatively large number of organisations involved in the animal bedding/ pet litter market, though the majority of those organisations did not use recovered newspapers in their products. The animal bedding market, in the main, comprised relatively small enterprises that individually took in quite small amounts of newspapers, several consuming less than 5 tonnes a week.

The numbers of companies making pulp mouldings are considerably fewer than those making animal bedding and, like the bedding market, not all of the companies used old newspapers in their manufacturing. Very few companies who incorporated old newspapers into insulation or fibre fuel could be traced.

Table 5.15 Annual Newspaper Flux into Non-paper Products

End use	Tonnes
Animal bedding	18,275
Insulation	15,000
Moulded pulp products	12,830
Fibre fuel	7,300
TOTAL	**53,405**





Only the fibre fuel market used 100% post-consumer waste. Some over-issue newspapers were used in making animal bedding and insulation, whilst printers' wastes were additionally incorporated into some pulp mouldings.

5.11 Import/ Export

It is recognised that there is considerable export of waste and scrap paper out of the UK. The market can be very variable and quite volatile, and it would be difficult to come up with any definitive 'average' figure. The statistics on the import and export of goods from the UK are held by Her Majesty's Customs and Excise. Again, like other nationally held statistics, the Excise statistics do not identify newspapers as a separate item. They are brigaded with magazines and other mechanical pulp based papers (classified as code 4707 30 10 in the common nomenclature). The only freely available published statistics for this category refer to the months of July and August 2001. Those statistics were then used to make notional estimates for the whole of 2001 (table 5.16).

Again a multiplier needs to be derived to 'unpick' the newspaper fraction out of the statistics, and again this is again quite subjective. Taking a notional 60% newspapers would indicate annual exports of around 75,000 tonnes. A further breakdown of H.M. Customs and Excise statistics showed that the major export markets were the EC and the Far East. For July and August 2001, the amounts of imported newspaper waste were less than 10% of that exported.

It is considered that the estimates shown in table 5.16 may not be fully representative of the overall position in 2001, and that the actual export figures may well be higher. For example, Medway Ports alone reported 120,000 tonnes of news and pams passing out of their ports in 1999, most of that en route to Scandinavia. However, it is very difficult to get a full picture nationwide. Some industry

professionals (pers. comm.) consider export levels to be very much higher than the levels quoted above. Apart from the regular consignments to Scandinavia (and other potential regular markets, e.g. opening up in Belgium), the rest of the export markets tend to be quite volatile. Any average figure covering such markets may not be too meaningful.

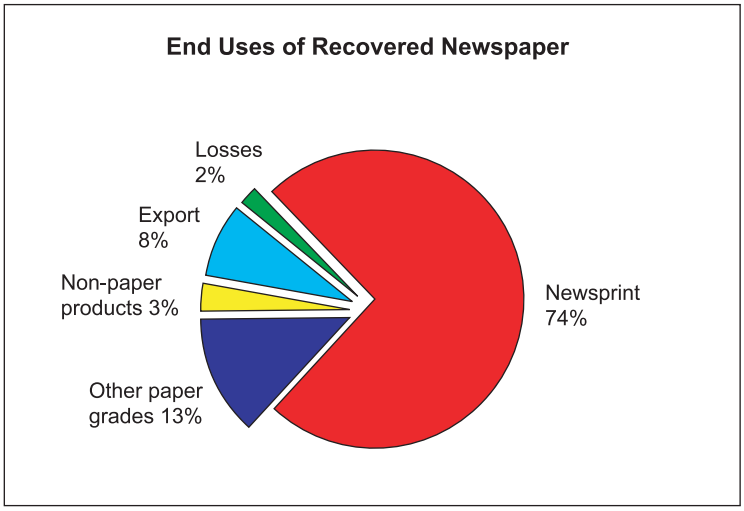
Table 5.16 Import and Export of Waste paper Grades that might contain Old Newspapers

CN Product code	Description	Imports		Exports	
		Jul-Aug Aug 2001	Extrapolated yearly total	Jul-Aug Aug2001	Extrapolated yearly total
4707 30 10	Old and unsold newspapers and magazines, telephone directories, brochures and printed advertising material	1,635	9,810	20,725	124,348

Source: HM Customs and excise

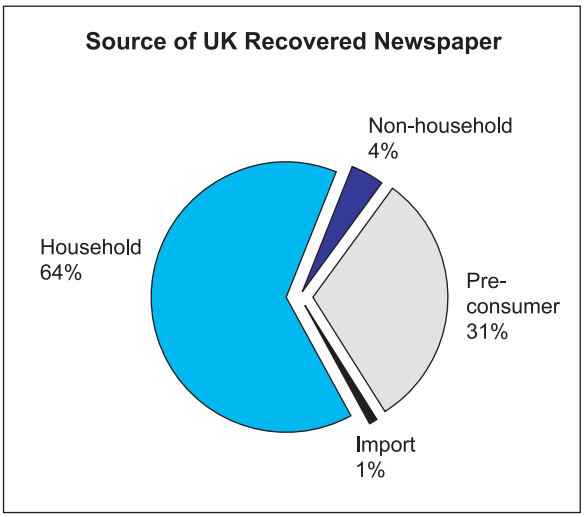
5.12 Consolidated Mass Balances for the Recovery Sector

Overall, it is estimated that around 75% of the recovered newspapers, pamphlets and magazines in the UK is for making new newsprint, 13% goes into other paper products, and 3% into making non-paper products. The remainder is either exported or is lost as waste.



However, it should be stressed that not all of that recovered material will actually be embodied into new products. There will be an inevitable manufacturing loss of material in making most of those products, with potentially up to 20% of the recovered newsprint ending up as reprocessing wastes.

The sources of the recovered newspaper (see sections 2.3. 3.2, 3.3, 4.3, 5.6) indicate that 64% of the recovered newspaper is post consumer in origin, whilst thirty-one percent is made up of pre-consumer wastes. Two-thirds of the pre-consumer wastes are made up from newspaper over-issue.



6. COMPONENT MATERIAL FLOWS

6.1 The Ink Balance

Most newspapers are printed using offset lithography using coldset lithographic inks, though one major national newspaper uses the flexographic printing process in the majority of its production. Newspaper supplements are printed using a wider range of ink types, the most common being heatset (web offset lithographic) and to a lesser extent coldset (web offset lithographic) for supplements printed on improved newsprint grades, heatset web offset for supplements on coated papers and gravure inks for supplements printed on super-calendered paper.

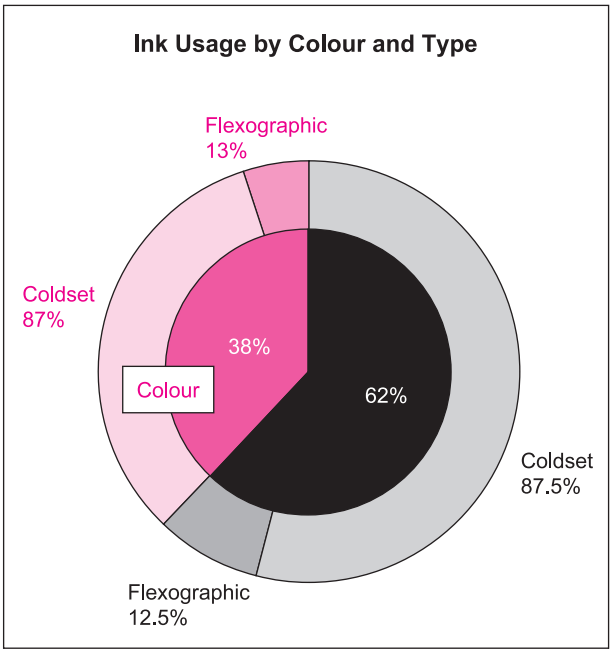
Newspaper inks comprise black inks and coloured inks, normally yellow, magenta and cyan. A typical formulation for a black cold-set ink (Printing Ink Manual, 1993) is:

Carbon black	20%
Mineral oil[1]	38%
Varnish	35%
Solvent	5%
Additives	2%

The most commonly used coloured pigments are diarylide yellow (pigment yellow 12), lithol rubine (pigment red 57:1), and phthalocyanine blue (pigment blue 15:3).

The annual total newspaper ink usage is reported to be 39,000 tonnes (British Coatings Federation). Based on an annual newsprint consumption of 2.5 million tonnes, this equates to approximately 1.6% ink being incorporated into each printed newspaper page. Small printing operations using only black news ink report ink usage figures equivalent to 1.4 - 1.5% ink per printed page. Larger (national) printers report 1.67 - 1.9 % ink per printed page.

The ink usage in magazine printing is higher, estimated at 2.8% per printed page (Mass Balance of the Periodicals Publishing Industry (2003). Similarly, higher ink loadings will be associated with the coloured newspaper weekend supplements. Some 140,000 tonnes of magazine-format newspaper supplements are printed each year (section 7.4), together with a comparable quantity of supplements printed on improved newsprint grades. At 2.8% ink, this equates to approximately 8,000 tonnes of inks consumed annually in newspaper weekend colour supplement production.



The breakdown of the usage is shown in the chart, the inner pie showing the split between black and coloured ink, and the outer pie showing these broken down between coldset and flexographic. There is also a small amount of letterpress ink (1,000 tonnes per annum) used (0.004%). The three coloured inks are used in roughly the same proportions, though consumptions by individual printers do fluctuate.

Ink wastes reported by publishers ranged, on average, between 1% and 1.5% (maximum 4.5%) of the inks consumed. For the balance, as estimator of 1.5% was assumed.

[1] Alternative vegetable oil formulations can be produced based on soya oil

The ink balance around the newspaper-recycling loop is relatively straightforward. Inks are introduced by the printing sector and are removed during the de-inking stage of producing recycled newsprint. It is considered that ink removal is better than 99% for solvent-based ink formulations. Other formulations (e.g. flexographic inks, which are water based, and xerographic inks used to an extent in some minor publications) are not removed as efficiently[2].

6.2 Metal Flows

The metal flows embodied in the newspaper lifecycle split into two components:

- Metallic components;
- Elemental concentrations of metals in the non-metallic components.

Metallic Components

The only metallic component embodied into a newspaper is the stitching wire (staples) used to bind the colour supplements. Printers, who were able to supply figures, estimate consumptions of stitching wire between 0.04 and 0.13 kg wire per tonne of printed newspapers produced. Wire wastes were considered to be around 0 - 15% of consumption. On these figures, directly embodied metals would amount to around 200 tonnes per annum across the UK.

Elemental Concentrations

The newspaper mass balance has delineated a number of 'sinks' around the recycling loop where the newspapers or their processing residues are put to constructive re-uses, where they will interact directly with the environment. These uses include garden applications, composting, animal bedding, the agronomic application of de-inking sludge, and use of incinerator ash in construction. When considering all these applications, it is important to ascertain whether there are any potential health or environmental implications associated with returning old newspapers (or their residues) back into the environment in such ways. The main issues centre around the contained metal concentrations. A summary review of the environmental considerations is given later in appendix B of the report. This section concentrates on deriving the mass balances of those contained metals.

The most recent analysis of newspaper metal contents given by Tucker and Douglas (submitted for publication) provide an aggregate analysis over 15 daily newspaper titles in 2002 (table 6.1). The results refer to the whole newspaper package, including colour supplements. Metal concentrations are generally higher in the supplements than in the standard newsprint sections, due to use of coated papers, higher filler contents, and higher ink loadings. Comparison data is shown for the latest traceable figures for printed magazines, which were measured in 1996. Expanded details are given in technical note 6.1.

Table 6.1 Metal Concentrations of Printed Newspapers and Magazines (mg/kg)

	Ag	Ba	Cd	Cr	Cu	Hg	Mn	Ni	Pb	Sn	Zn
Newspaper package*	<1	14.4	<1	4.4	41.6	<5	39.8	2.8	<4	<5	15.1
Magazines#	0.7	59.2	<0.2	16.2	46.3	<5	23.5	5.9	<4	7.4	44.8

* Source: Tucker and Douglas (submitted)
\# Source: Tucker and Douglas (2001)

Cadmium, mercury and lead were not detected in any newspaper sample in 2002.

Copper is associated with the copper phthalocyanine pigment used in most blue and green news inks. Barium, chromium (and titanium also), which are all present in significantly higher concentrations in

[2] Different de-inking technologies are needed to cope effectively with these inks. UK newspaper de-inking operations have been optimised for solvent-based inks.

the supplements and magazines than in the standard newsprint, are associated mainly with the fillers used in some of the magazine papers though can also arise in some red ink formulations. Chromium is mostly associated with the 'glossy' coatings on some of the coated magazine papers. Manganese has its origins principally in the wood fibre used to make virgin newsprint[3].

Most contained metals are stripped from the newspapers (and magazines) during the de-inking and waste water treatment processes at the newspaper recycling mills. In the main, the metals are concentrated into the de-inking sludge at concentrations around 4 times those that occur in the printed newspaper. Metal concentrations in the liquid mill effluent are very much lower than those present in the sludge, with typical concentrations in the order of micrograms per litre[4].

Mass Balance of Newsprint Mills

Tucker and Douglas (2001) carried out a 'metals' mass balance of three recycled newsprint mills, reporting results separately for the de-inking lines and the waste water treatment plants. Illustrative results from a de-inking line at one of those mills are reproduced overleaf. In the figure, the results are shown in the form of a Sankey diagram, where line thicknesses are scaled approximately to the magnitude of the flows. The elemental flows in the pulp streams are shown in black whilst the elemental flows in the make up and recovered water flows are shown in grey.

Overall, the study showed that copper and chromium were present at levels of less than one part per million in the water streams and were quite effectively removed from the waste paper feedstock into the de-inking sludge. The aluminium and titanium from the fillers in the paper feed also remained strongly associated with the solid phase. Higher proportions of the barium, magnesium, calcium and zinc were associated with the water phase. However, concentrations of zinc were still below four parts per million in all water streams measured, and barium levels below two parts per million, which are some fifty times below most legal discharge limits. The flow paths for the majority of the metals was in with the waste paper and out via the sludge, however small quantities of all metals did remain with the processed [de-inked] pulp to be incorporated into the new paper. The carry through of barium, zinc and manganese were the most significant of these.

Mass Balance of Metals around the Recycling Loop

The studies of Tucker and Douglas (2001) allowed metal mass balances to be constructed around the whole newspaper recycling loop, providing the audit trails for the flows of metals associated with newspaper recycling. Good balances were derived for copper, barium, chromium, and manganese, however it was not possible to fully reconcile the data for zinc.

The main input of copper into the loop is from the newspaper inks. Recovered newspapers and magazines contribute roughly equal amounts of copper to the waste paper furnish, with the dominant output being via the de-inking sludge. An almost comparable amount of the copper left the loop to outlets other than re-conversion back to newspaper. Those other outlets include recovery for production of other grades of paper, animal bedding and composting, and bulk incineration as well as landfill disposal. Some copper was retained in the recycled paper at concentrations of around 2 mg/kg. Overall approximately 100 tonnes of copper are in annual circulation in newspapers.

The mass balance for barium is very different to that of copper. The major input is from the magazines that are collected alongside the newspapers, and associated with the higher loadings of fillers in these papers. Whilst there is preferential partitioning into the de-inking sludge during recycling, the residual levels of around 12 ppm in the recycled paper provide a proportionately high circulating load around the recycling loop, diluted slightly by the addition of virgin fibre, but enhanced by the possible input of some barium from the inks.

Like barium, chromium enters the loop mainly through the magazine papers, principally the glossy papers. The majority of chromium in circulation does not enter the finished newspaper at all. It is effectively removed from the magazines into the de-inking sludge. Chromium concentrations around the rest of the loop remain very low. Approximately five tonnes of chromium are estimated to be stripped out

[3] Further details can be found in Tucker et al. (2000) and Tucker and Douglas (2001)
[4] Full technical details are given in Tucker and Douglas (2001), and are summarised in technical note 6.2.

of magazines per year during the recycling process.

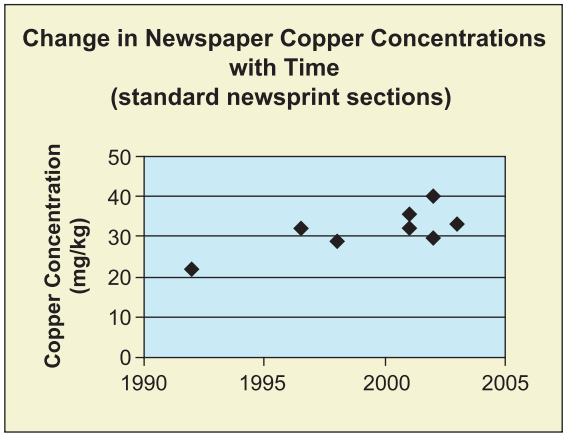
The balance for manganese is very different again to the metals considered so far. The main input of manganese is via the paper, especially the newsprint based on virgin fibre. Manganese levels tend to be lower in the more highly processed magazine grades, and lower in the recycled paper than in the paper made from virgin fibre. There is still a reasonably high circulating load of manganese around the recycling loop, though, with losses occurring into the recycling mills' sludge and effluent streams. Some 90 tonnes of manganese may be circulating annually in UK newspapers.

Updated mass balances for the above metals are presented in section 7.4 of this report.

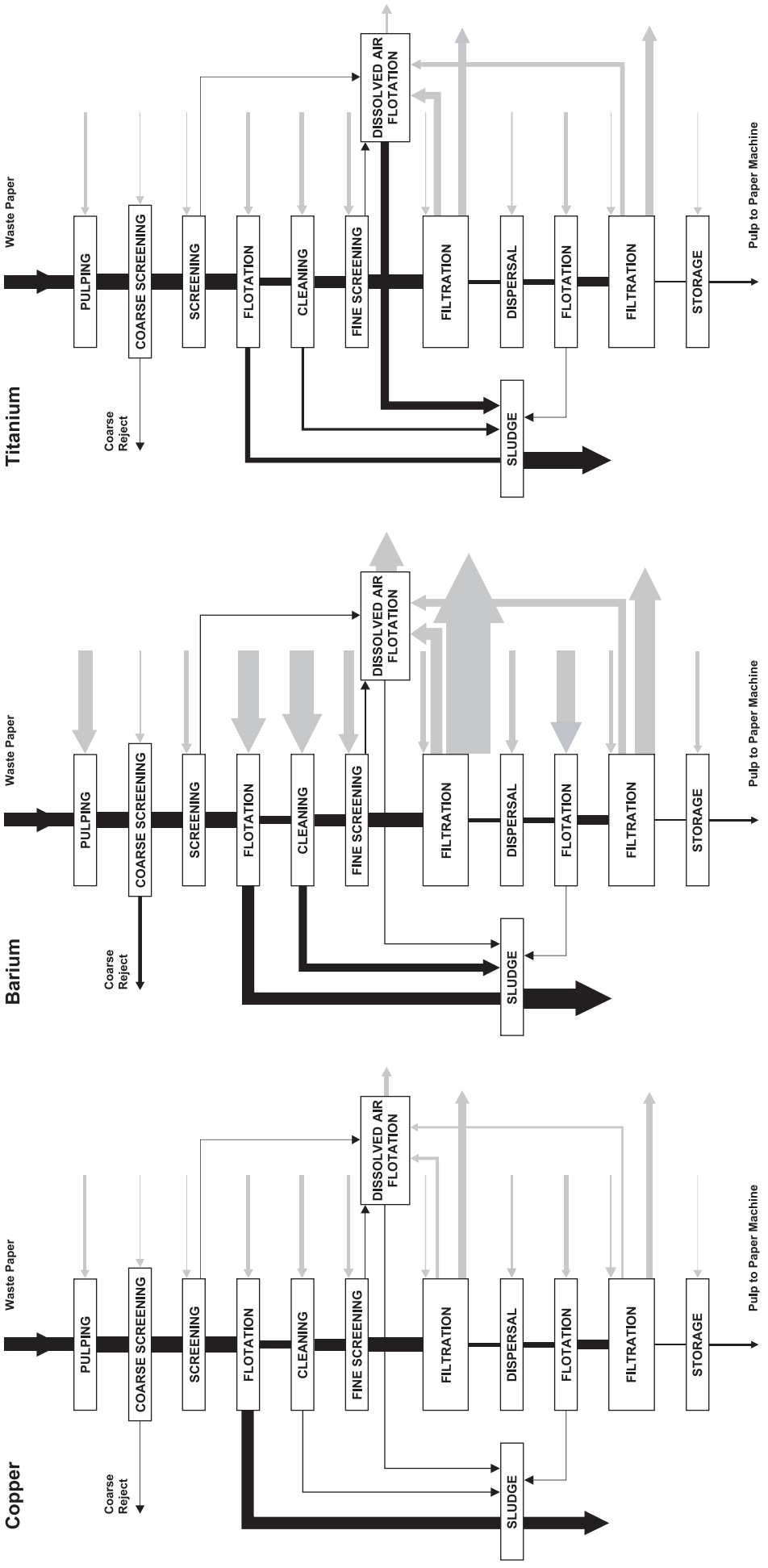
Longitudinal Trends

The results of a longitudinal study by Tucker and Douglas (submitted for publication) show that there have been small increases of 12% relative in barium concentrations in the overall newspaper package between 2001 and 2002 continuing a gradual upward trend apparent from 1996. Measured chromium concentrations have also risen since 1996, though the absolute levels have remained low at just over 4 mg/kg chromium. Zinc levels have been erratic. Manganese concentrations, in contrast to the other metals, have decreased with time, by about 10% relative since 1996. All these changes are consistent with the increases in recycled fibre content of the newspapers.

Copper concentrations have increased in the standard newsprint sections over time, in line with the increased usage of coloured inks in newspaper printing. However, the copper concentrations in the overall newspaper package have remained relatively constant since 1999. This reflects less copper being present in the printed colour supplements. This is thought to be due to a slight decrease in supplement paginations and changes in the overall paper/ ink mixes used in producing the supplements.



Source: Tucker and Douglas



Metal Flows Through a Newspaper De-inking Line 9Source: Tucker and Douglas, 2001)

6.3 The Water Balance

Newspapers

Newsprint is normally produced at a specification that contains approximately 8.5% water. This water content is considered to be the optimum for downstream printing operations. To help preserve the 'as-produced' moisture contents, newsprint rolls are over-wrapped with barrier papers to inhibit moisture ingress.

Newspaper is a highly absorbent material that can absorb 40% or more of its own weight of water. That is why it is so useful in mopping up spillages (section 4.2). Newspapers exposed to damp environments can take up extra moisture (and so become heavier) during their life cycle. On the other hand some household and office environments tend to be very dry (especially in centrally-heated spaces), and newspapers in those spaces would tend to dry out and lose moisture. Spot checks on post-consumer newspaper moisture contents (store for 5 days in a centrally-heated office) revealed moisture contents of around 3 - 6%. Recycling collections on rainy rays may well produce wetter (and heavier) products than on sunny days.

The ambient moisture content of newspapers provides an additional uncertainty to the mass balance during its consumption and recovery stages. The European paper recovery standard (EN 643) stipulates a maximum of 10% moisture for recovered paper[5]. Some end users, however, tolerate up to 17% moisture.

It is additionally noted that newspaper samples retrieved from dustbin waste have sometimes been reported to contain over 25% moisture (DoE, 1995). Clearly those newspapers had soaked up significant quantities of water from other co-mingled wastes present in the dustbin. However those figures also serve to flag up a much more general warning. Any measurements made of recovered waste newspaper weights (especially from dustbin waste analyses) might be subject to considerable uncertainties. This could amount to as much as 25% over estimation of the weights originally consigned to the dustbin, unless moisture content is separately taken into account.

Reprocessing

Paper de-inking and paper production are water-intensive processes. Typically for de-inking and paper formation alike, solids are diluted to around 3% consistency (% solids by weight). However, much of the water used in the processes is internally recycled, and all discharges are treated through the mills' waste water treatment plants, to a specification that is normally cleaner than the original waters abstracted. The net usage of water is around 12.1 cubic metres per tonne of newsprint produced (Aylesford, 2003). Aylesford newsprint in 2002 reported a total mill water abstraction of 6.348 million cubic metres. This would imply a total of over 17 million tonnes water abstraction annually to support the UK production of newsprint.

[5] At 10% moisture, UK local authority recovered paper would contain 10,000 tonnes extra water above that contained in the newsprint as produced.

7. AN INTER-LOCKING MASS BALANCE

Sections 2 to 5 of the report addressed the fibre flows through the four prime sectors of the UK newspaper recycling loop: production, distribution and circulation, consumption, and recovery respectively. The flows of the minor material components of the newspaper were addressed separately in section 6. This section now draws all those data together to provide an estimate of the inter-locking mass balance around the whole recycling loop.

7.1 Nodes of Uncertainty

Few of the statistics gathered can be regarded as certain. Most are based on assumption, estimates or derivations from other data. In drawing those data together to provide an overall picture, three major areas of uncertainty can be identified:

- Utilisation of newsprint;
- The partition of newspapers between domestic and commercial waste;
- Recovery against export of old newspapers.

Utilisation of Newsprint

The newsprint accounted for through the production of national newspapers, regional newspapers and bulk-distributed newspapers accounts for around 2.36 million tonnes of consumed newsprint including its associated printers waste and over-issue. This leaves some 125,000 tonnes[1] of consumed newsprint to be accounted for by other products (including all their over-issue and their process wastes). At least 45,000 tonnes of this is considered to be used for the production of advertising 'papers' and a further quantity will go into magazine production. However, those two utilisations could not be fully traced or verified. There remains a possibility that the amount of newsprint used in newsprint production may be under-estimated, either through: (i) an over-optimistic estimate of the general level of print wastes, or (ii) an underestimate of weights per copy, or (iii) an underestimate of free newspaper over-issue.

Partition of Newspapers between Domestic and Commercial Wastes

There are no reliable data, nor any reasonable professional estimated on this partition. There are no data on newspaper consumption by households, and no representative data on the amount of newspapers in household (dustbin) waste. Newspapers directly purchased by commerce and industry, including multiple copy sales, may well amount to 100,000 - 200,000 tonnes plus. The major uncertainty, however, lies in the newspapers purchased by individuals that are subsequently disposed of in the commercial, industrial and institutional waste streams. There could well be more than half a million tonnes of newspapers disposed of in these ways.

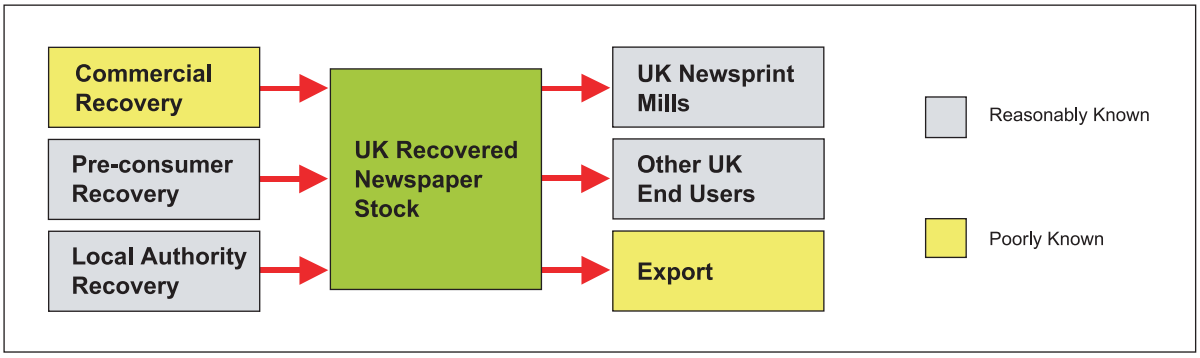
In the final reconciliation, nearly 0.5 million tonnes of newspapers (22.5% of consumption) are assigned to the commercial waste stream. This is consistent with the assumptions that newspapers comprise 2.6% of commercial wastes and is broadly compliant with the limited data available with sub-sectoral audits within that sector. That leaves 1.70 million tonnes per annum of newspapers in the combined household residual and recycled waste. That equates to 1.36 kg per household per week (or just over 5 newspapers per household per week). Kerbside material capture rates of 55 - 60% (together with the bring and ca collections) provide the 726 thousand tonnes of newspapers that are recovered through local authority schemes (1.16 kg/hh/w). That leaves 939 thousand tonnes of newspapers in household residual waste, which is broadly consistent with figures obtained from scaling up research audits (bearing in mind the uncertainties in accounting for absorbed moisture in some of those estimates).

[1] This figure would be reduced to around 75,000 tonnes if newspaper print waste was 7% rather than 5.4% assumed

The reconciled figures can also be compared with other recent independent estimates. These range from 1.574 million tonnes combined news and pams in combined household residual and recycled waste[2] (1.26 kg/ household per week total consumption) to 4 million households being able to provide 320 thousand tonnes per annum news and pams recyclate[3] (1.54 kg/ household per week recoverable through recycling). If both these estimates are taken at their face value, the UK has the remarkable achievement of recycling one and a quarter times the amount of the news and pams that it consumes!

Newspaper Recovery versus Newsprint Export

The estimates of the amounts of newspapers (and pams) recovered from pre-consumer waste and from local authorities, and the amounts of that recovered material passing to UK end users are probably all good to (10% or better. What is less certain is how much newspaper and pams are recovered from non-household sources and how much newspapers and pams are exported out of the UK. Uncertainty in one implies uncertainty in the other, as they are direct inputs and outputs to the same [recovery] node in the newspaper life cycle flowsheet.



7.2 What-if? and Why?

The UK newspaper mass balance is almost certainly not unique amongst the UK resource flow mass balance studies in producing 'uncertain' data. Most estimates of most resource flows across all studies either aggregate partial data into national statistics or simply admit data gaps. Many flows are not, or cannot be, verified. Many assumptions are made along the way, and some commentators may not always agree with those assumptions. Also, resource flows are not static, and will vary continuously over time. The 'snapshot' numbers printed in a research report are often out of date before that report is printed. It is all well and good reporting that process x takes yyy tonnes. But what if a learned professional disputes those figures. And what if yyy this year becomes zzz next year. What then are the implications?

In this report, we will provide snapshots that should be of interest, that might be disputed by learned professionals, and that are now out of date. But, those snapshots will balance around the whole newspaper life cycle. However, the emphasis of this research investigation is not to produce snapshots, it is to produce working models that can be used to explore future scenarios, quantify future changes and test the sensitivities of how different professional assumptions might affect the overall balance. The principal outcome of this research is not this report. The principal output is a software simulation model that (i) allows the impact of changes to be investigated, (ii) allows different assumptions to be tested, and (iii) allows different futures to be forecasted.

The model must be calibrated, and that calibration has been achieved through the reconciliation of the statistics presented in this report. This baseline calibration is based on to the time period 2001 - 2002.

The results of the calibration are presented at the end of this section. The final assumptions adopted for the calibration are listed in Appendix C of the report.

[2] Parfitt
[3] WRAP (2003)c, Letsrecycle.com (2003)

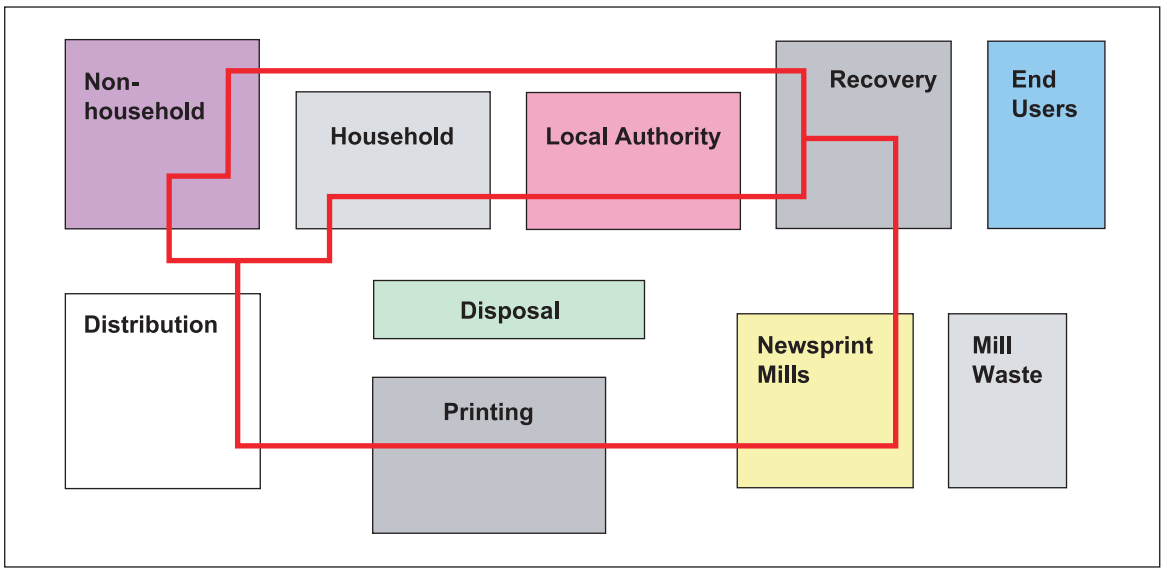
7.3 Commentary on the Model Results

All results presented in this section are presented as screen dumps from the computer simulation model. In the model, the options available for displaying mass flow data are[4]:

- Newspaper flows
- Newsprint flows
- Magazine flows
- Newspaper ink flows
- Newspaper dry matter flows
- Metal flows (copper, zinc, barium, chromium, and manganese)

Presentation Structure

The mass balance output is structured into a network of panels, each panel representing an individual sub-sector of the newspaper recycling loop. The newspaper recycling loop is traced by red flow lines. Black flow lines denote mass flows that are added to or are removed from the loop. White flow lines denote imported and exported masses.



From printing round to recovery, mass flows refer to newspapers as a composite product. However, the outputs from the recovery sub-sector and their flows through the newsprint reprocessing mills (and flows to other end users) refer to the flows of newsprint (whatever its source)[5]. The total mass flow accounts for all newspapers, pamphlets and magazines together are summarised separately at a number of places around the recycling loop.

Apparent Imbalances

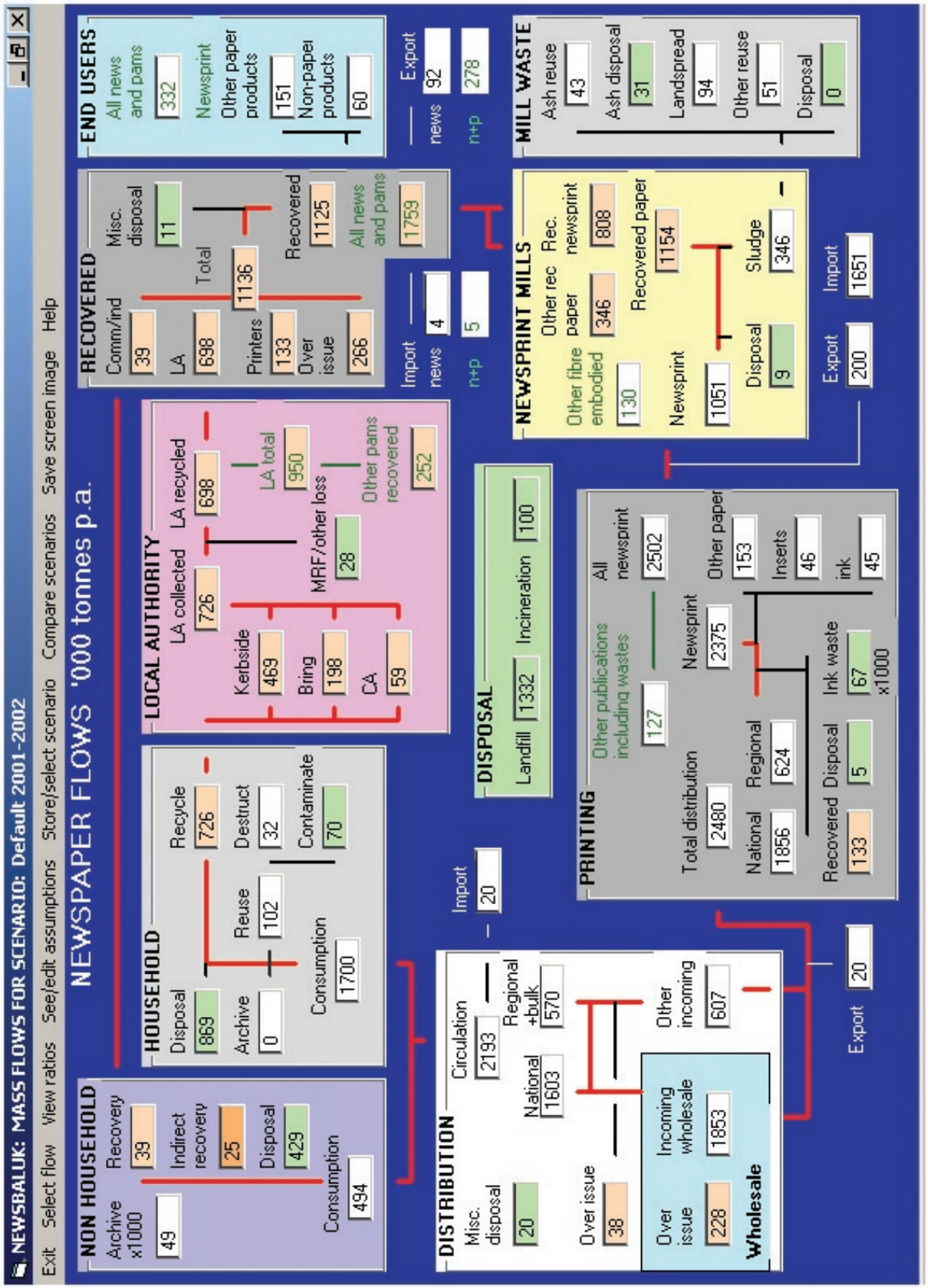
At a number of places, some apparent imbalances might be detected in the results.

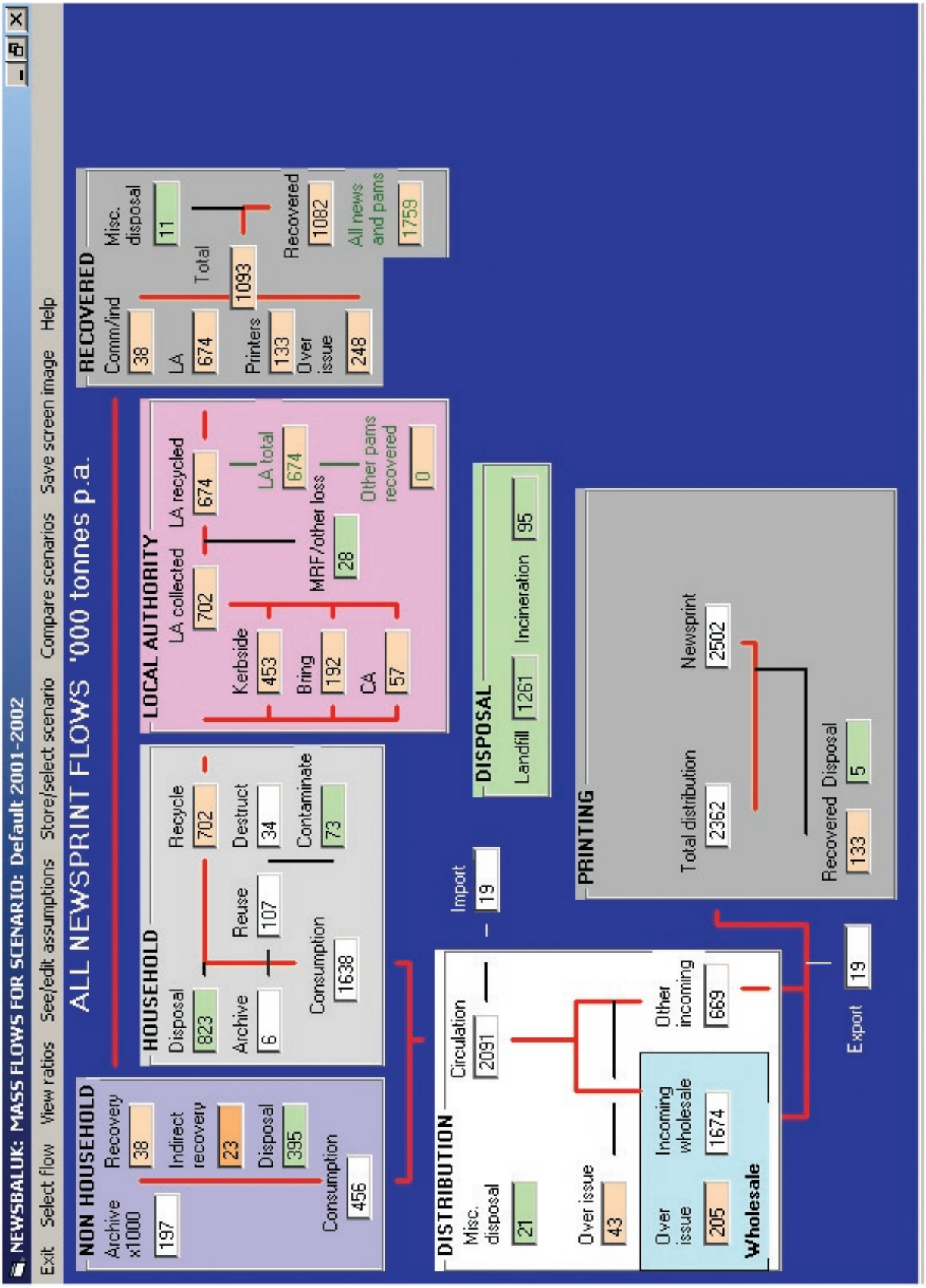
- Household and non-household outputs could add up to more or less than their respective inputs. This will occur when moisture is gained or lost[6].
- Combined newsprint mill outputs are greater than the newsprint mill input. This is also due to extra water being incorporated.
- Final solid wastes, and byproducts, from the newsprint mills are less than the sludge weights going into those wastes. This reflects loss of moisture and loss on ignition (i.e. phase transfer to the gaseous phase) during combustion/ ash production.

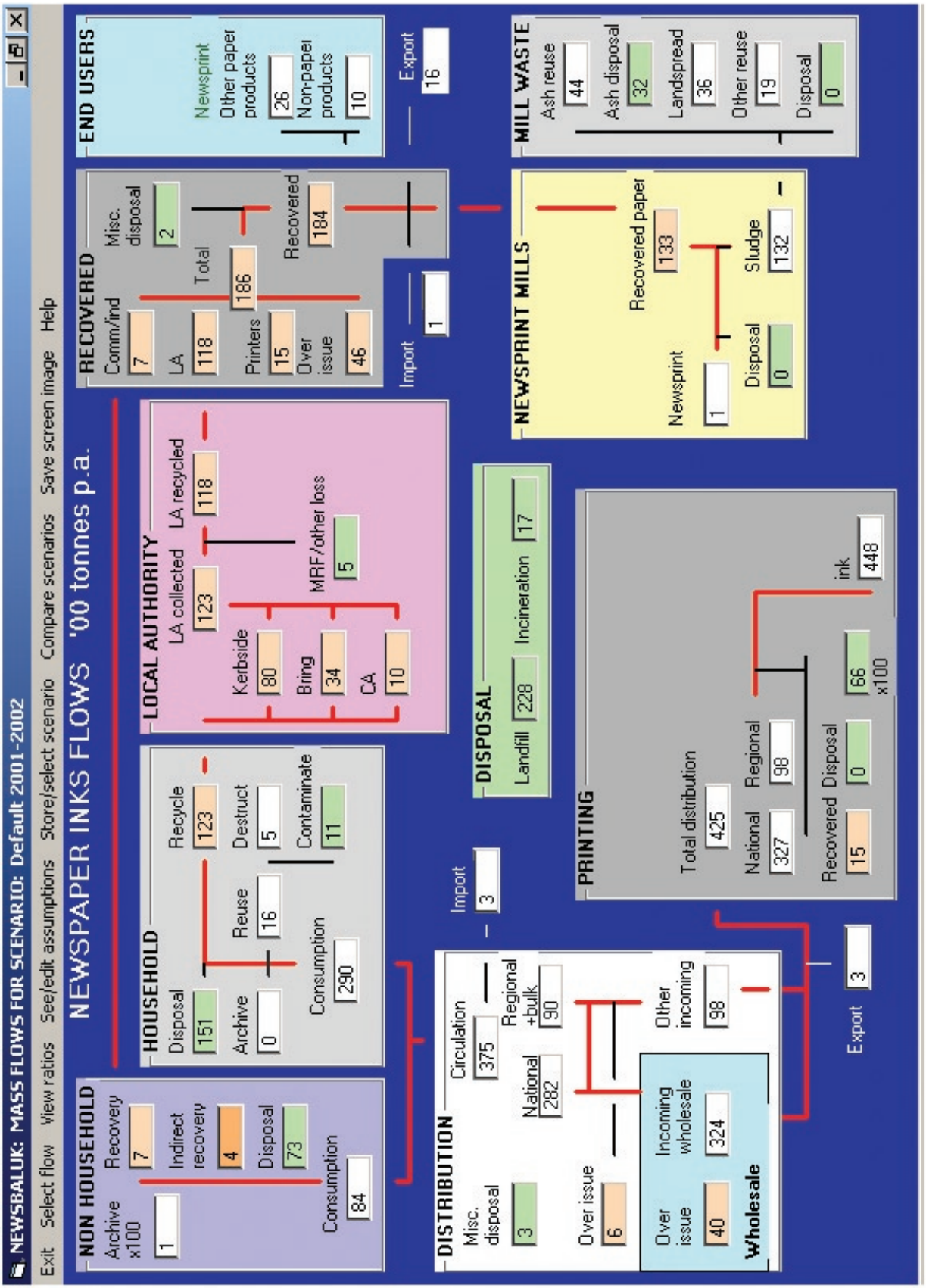
[4] Either as full flows or as flow differences between different scenarios.
[5] At this stage newspapers are no longer traceable as a composite product.
[6] All moisture gain is assumed to take place at the consumption stage.

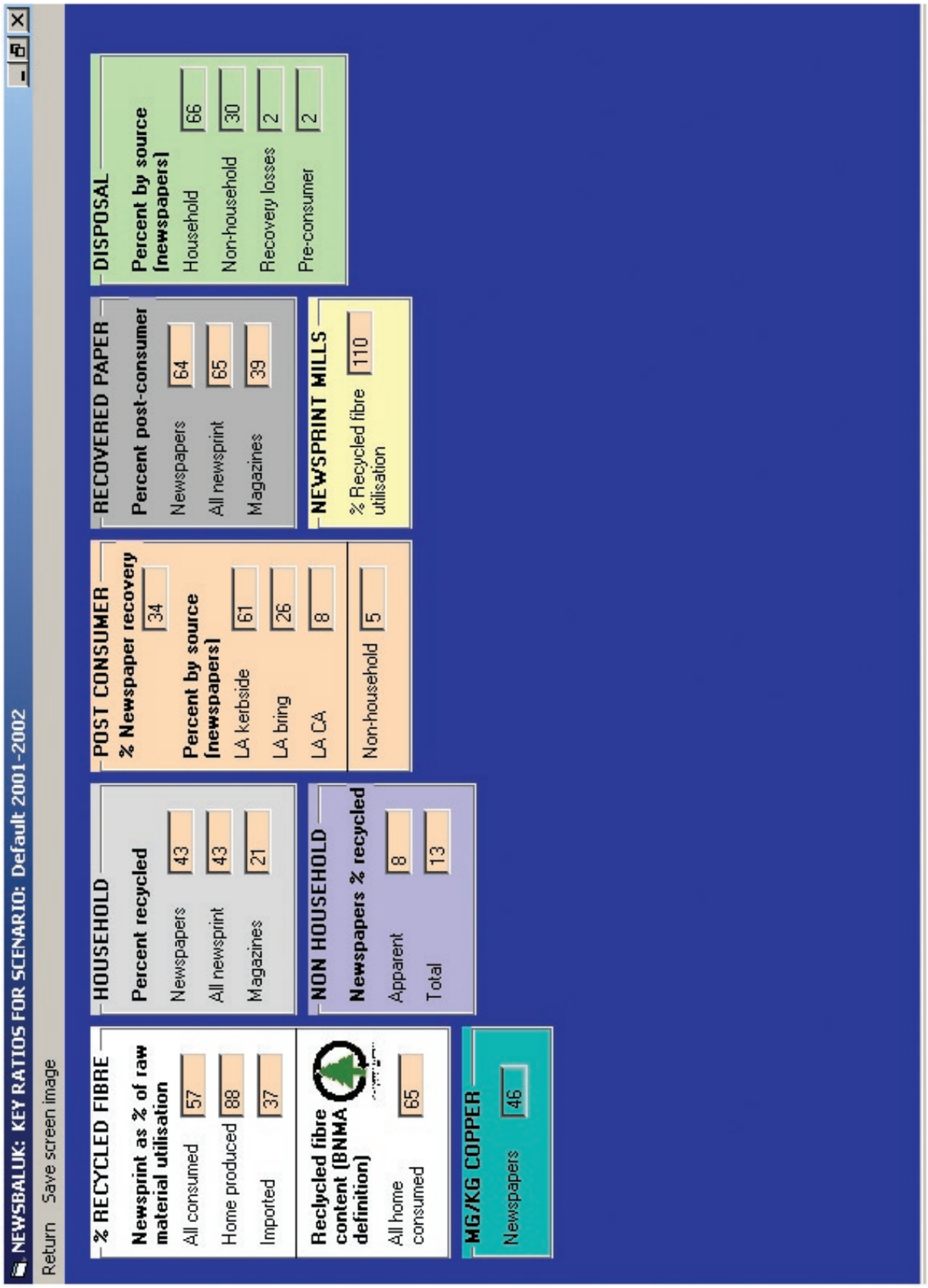
7.4 Results

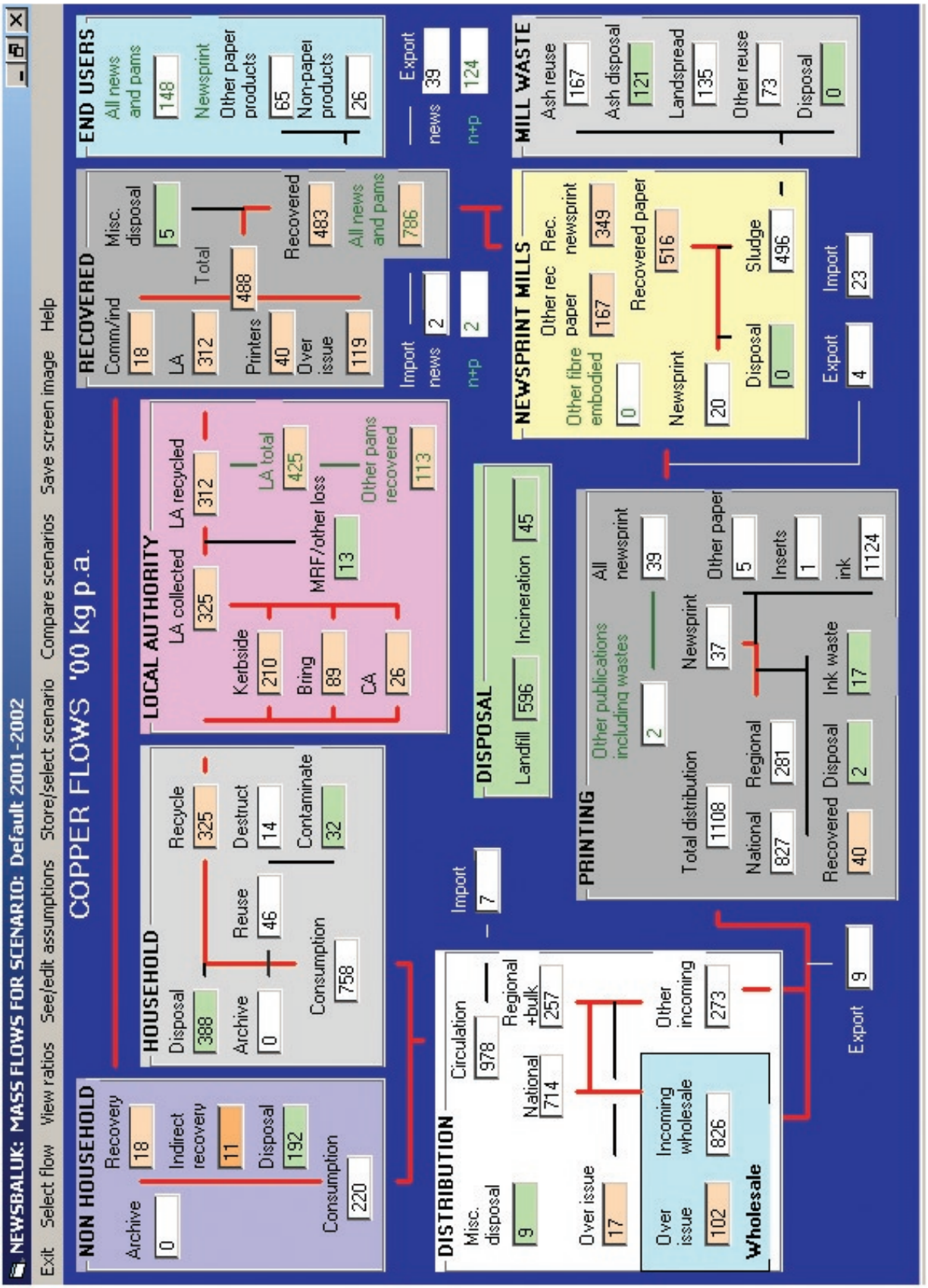
The model calibration results for the period 2001 - 2002 are shown on the following pages.

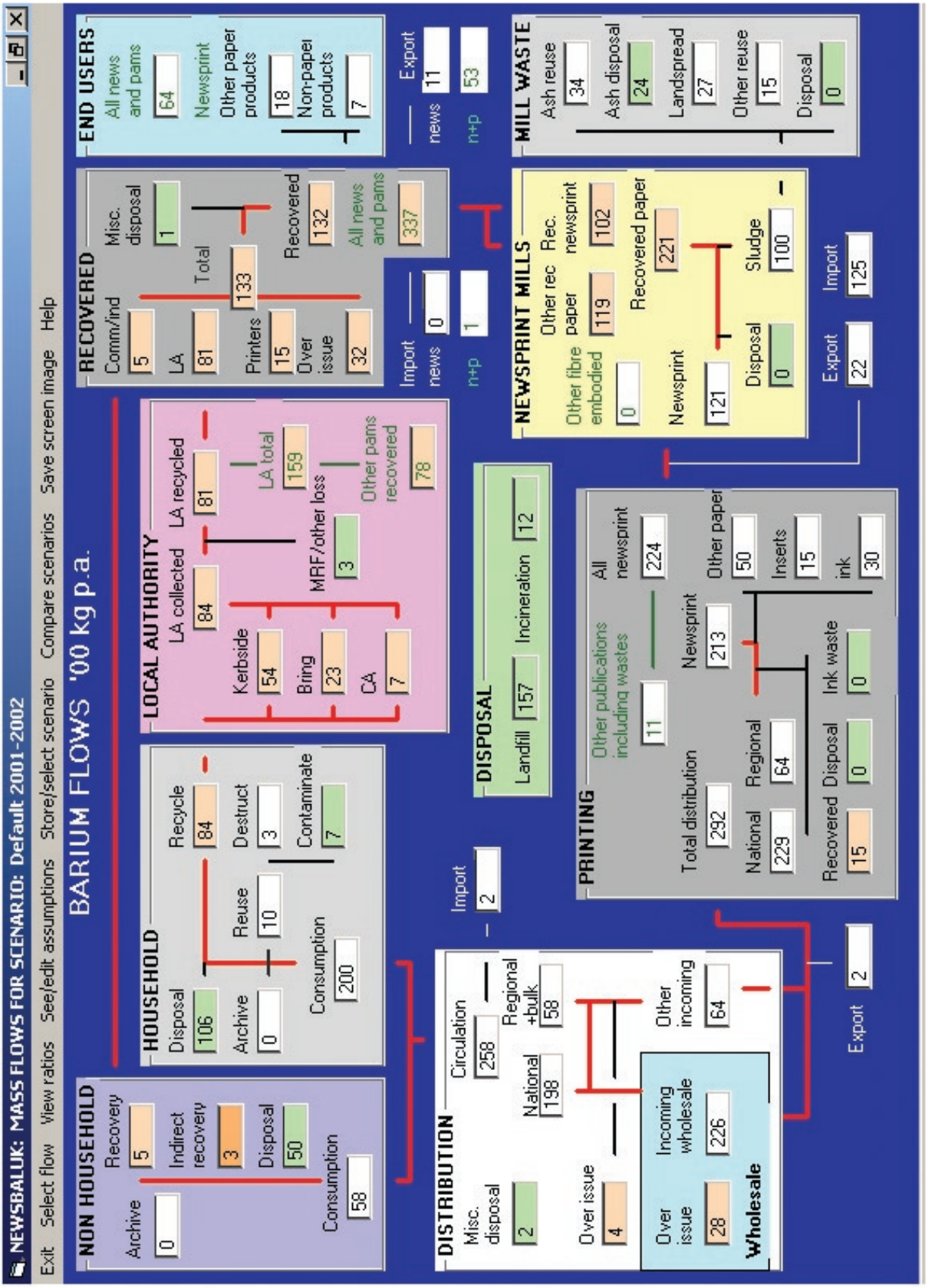

NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
NEWSPAPER FLOWS '000 tonnes p.a.
NON HOUSEHOLD
Archive x1000
49
Recovery
39
Indirect recovery
25
Disposal
429
Consumption
494
HOUSEHOLD
Disposal
869
Recycle
726
Archive
0
Reuse
102
Destruct
32
Consumption
1700
Contaminate
70
LOCAL AUTHORITY
LA collected
726
LA recycled
698
Kerbside
469
LA total
950
Bring
198
MRF/other loss
28
CA
59
Other pams recovered
252
RECOVERED
Comm/ind
39
Misc. disposal
11
LA
698
Total
1136
Printers
133
Over issue
266
Recovered
1125
All news and pams
1759
Import
news
4
n+p
5
END USERS
All news and pams
332
Newsprint
Other paper products
151
Non-paper products
60
Export
news
92
n+p
278
MILL WASTE
Ash reuse
43
Ash disposal
31
Landspread
94
Other reuse
51
Disposal
0
NEWSPRINT MILLS
Other fibre embodied
130
Other rec paper
346
Rec. newsprint
808
Recovered paper
1154
Newsprint
1051
Disposal
9
Sludge
346
Export
200
Import
1651
DISPOSAL
Landfill
1332
Incineration
100
Import
20
PRINTING
Other publications including wastes
127
All newsprint
2502
Total distribution
2480
Newsprint
2375
Other paper
153
National
1856
Regional
624
Inserts
46
Recovered
133
Disposal
5
Ink waste
67
x1000
ink
45
DISTRIBUTION
Misc. disposal
20
Circulation
2193
Regional +bulk
570
National
1603
Over issue
38
Other incoming
607
Over issue
228
Incoming wholesale
1853
Wholesale
Export
20

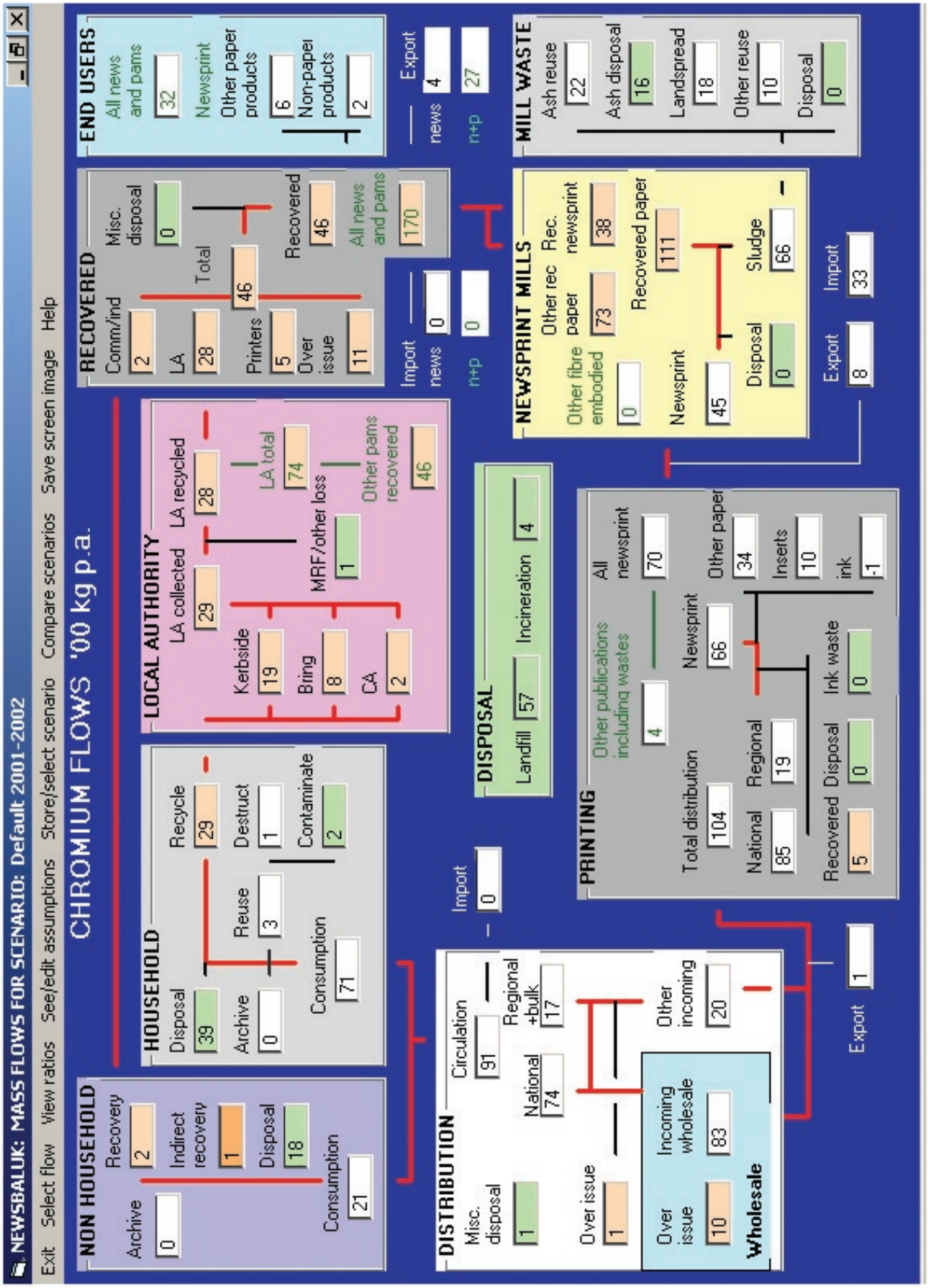

NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
ALL NEWSPRINT FLOWS '000 tonnes p.a.
NON HOUSEHOLD
Archive x1000
197
Recovery
38
Indirect recovery
23
Disposal
395
Consumption
456
HOUSEHOLD
Disposal
823
Recycle
702
Archive
6
Reuse
107
Destruct
34
Consumption
1638
Contaminate
73
LOCAL AUTHORITY
LA collected
702
LA recycled
674
Kerbside
453
LA total
674
Bring
192
MRF/other loss
28
CA
57
Other pams recovered
0
RECOVERED
Comm/ind
38
Misc. disposal
11
LA
674
Total
1093
Printers
133
Over issue
248
Recovered
1082
All news and pams
1759
DISTRIBUTION
Misc. disposal
21
Circulation
2091
Import
19
Over issue
43
Over issue
205
Incoming wholesale
1674
Other incoming
669
Wholesale
DISPOSAL
Landfill
1261
Incineration
95
PRINTING
Total distribution
2362
Newsprint
2502
Recovered
133
Disposal
5
Export
19

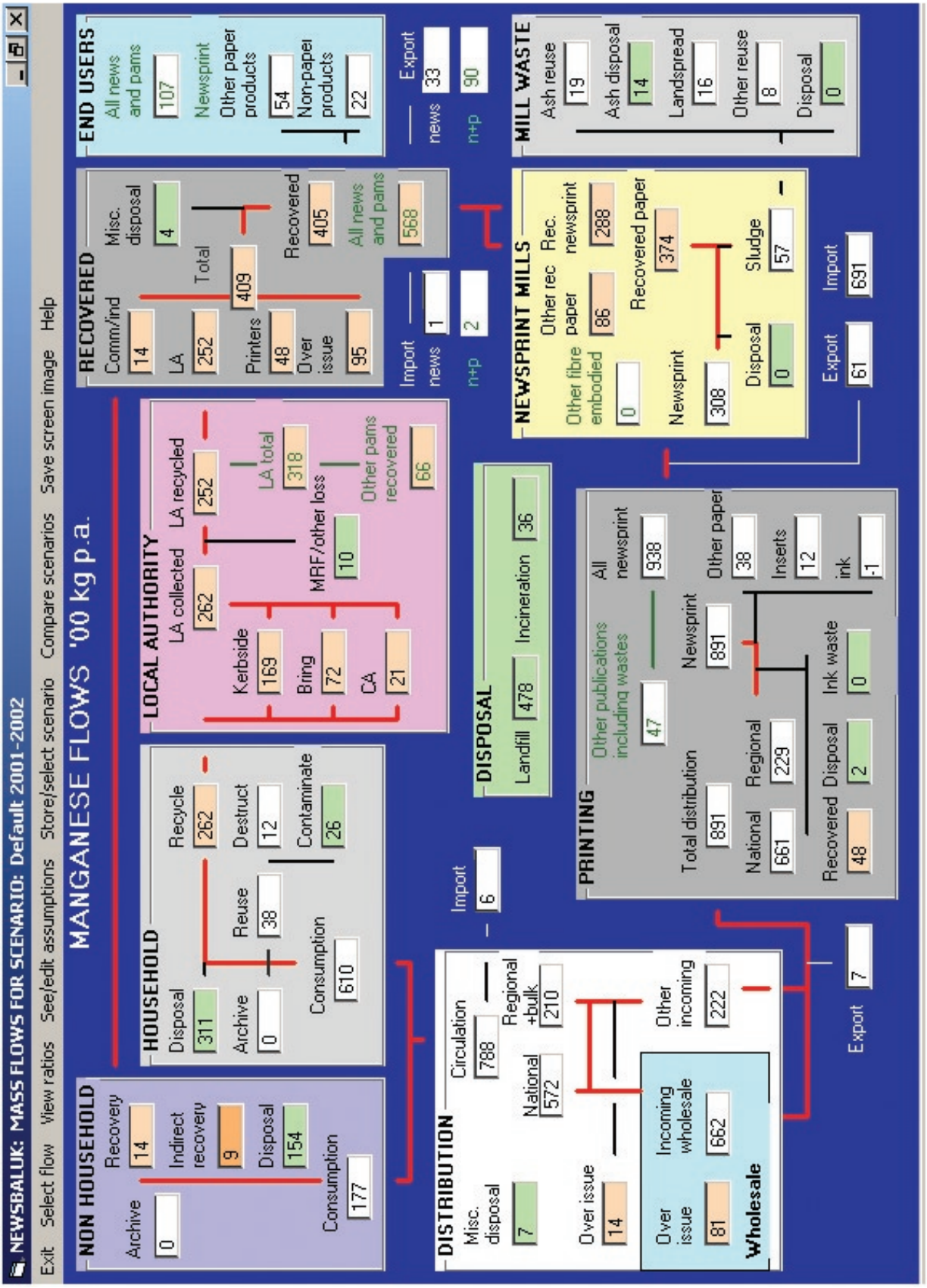

NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
NEWSPAPER INKS FLOWS '00 tonnes p.a.
NON HOUSEHOLD
Archive x100
1
Recovery
7
Indirect recovery
4
Disposal
73
Consumption
84
HOUSEHOLD
Disposal
151
Recycle
123
Archive
0
Reuse
16
Destruct
5
Consumption
290
Contaminate
11
LOCAL AUTHORITY
LA collected
123
LA recycled
118
Kerbside
80
Bring
34
CA
10
MRF/other loss
5
RECOVERED
Comm/ind
7
Misc. disposal
2
LA
118
Total
186
Printers
15
Over issue
46
Recovered
184
Import
1
END USERS
Newsprint
Other paper products
26
Non-paper products
10
Export
16
NEWSPRINT MILLS
Recovered paper
133
Newsprint
1
Disposal
0
Sludge
132
MILL WASTE
Ash reuse
44
Ash disposal
32
Landspread
36
Other reuse
19
Disposal
0
DISPOSAL
Landfill
228
Incineration
17
Import
3
PRINTING
Total distribution
425
National
327
Regional
98
Recovered
15
Disposal
0
ink
66
x100
448
DISTRIBUTION
Misc. disposal
3
Circulation
375
National
282
Regional +bulk
90
Over issue
6
Other incoming
98
Over issue
40
Incoming wholesale
324
Wholesale
Export
3


NEWSBALUK: KEY RATIOS FOR SCENARIO: Default 2001-2002
Return
Save screen image
% RECYCLED FIBRE
Newsprint as % of raw material utilisation
All consumed 57
Home produced 88
Imported 37
Reclycled fibre content (BNMA definition)
All home consumed 65
MG/KG COPPER
Newspapers 46
HOUSEHOLD
Percent recycled
Newspapers 43
All newsprint 43
Magazines 21
NON HOUSEHOLD
Newspapers % recycled
Apparent 8
Total 13
POST CONSUMER
% Newspaper recovery 34
Percent by source (newspapers)
LA kerbside 61
LA bring 26
LA CA 8
Non-household 5
RECOVERED PAPER
Percent post-consumer
Newspapers 64
All newsprint 65
Magazines 39
NEWSPRINT MILLS
% Recycled fibre utilisation 110
DISPOSAL
Percent by source (newspapers)
Household 66
Non-household 30
Recovery losses 2
Pre-consumer 2


NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
COPPER FLOWS '00 kg p.a.
NON HOUSEHOLD
Recovery 18
Archive 0
Indirect recovery 11
Disposal 192
Consumption 220
HOUSEHOLD
Disposal 388
Recycle 325
Archive 0
Reuse 46
Destruct 14
Contaminate 32
Consumption 758
LOCAL AUTHORITY
LA collected 325
LA recycled 312
Kerbside 210
Bring 89
CA 26
MRF/other loss 13
LA total 425
Other pams recovered 113
RECOVERED
Comm/ind 18
LA 312
Printers 40
Over issue 119
Total 488
Misc. disposal 5
Recovered 483
All news and pams 786
Import news 2
n+p 2
END USERS
All news and pams 148
Newsprint
Other paper products 65
Non-paper products 26
Export news 39
n+p 124
DISPOSAL
Landfill 596
Incineration 45
Import 7
NEWSPRINT MILLS
Other fibre embodied 0
Other rec paper 167
Rec. newsprint 349
Newsprint 20
Recovered paper 516
Disposal 0
Sludge 496
Export 4
Import 23
MILL WASTE
Ash reuse 167
Ash disposal 121
Landspread 135
Other reuse 73
Disposal 0
PRINTING
Other publications including wastes 2
All newsprint 39
Total distribution 1108
Newsprint 37
Other paper 5
National 827
Regional 281
Inserts 1
Recovered 40
Disposal 2
Ink waste 17
ink 1124
DISTRIBUTION
Misc. disposal 9
Circulation 978
Regional +bulk 257
National 714
Over issue 17
Other incoming 273
Over issue 102
Incoming wholesale 826
Wholesale
Export 9


NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
BARIUM FLOWS '00 kg p.a.
NON HOUSEHOLD
Archive 0
Recovery 5
Indirect recovery 3
Disposal 50
Consumption 58
HOUSEHOLD
Disposal 106
Recycle 84
Archive 0
Reuse 10
Destruct 3
Contaminate 7
Consumption 200
LOCAL AUTHORITY
LA collected 84
LA recycled 81
Kerbside 54
Bring 23
CA 7
MRF/other loss 3
LA total 159
Other pams recovered 78
RECOVERED
Comm/ind 5
LA 81
Printers 15
Over issue 32
Total 133
Misc. disposal 1
Recovered 132
All news and pams 337
Import news 0
n+p 1
END USERS
All news and pams 64
Newsprint
Other paper products 18
Non-paper products 7
Export news 11
n+p 53
NEWSPRINT MILLS
Other fibre embodied 0
Other rec paper 119
Rec. newsprint 102
Recovered paper 221
Newsprint 121
Disposal 0
Sludge 100
Export 22
Import 125
MILL WASTE
Ash reuse 34
Ash disposal 24
Landspread 27
Other reuse 15
Disposal 0
DISPOSAL
Landfill 157
Incineration 12
Import 2
PRINTING
Other publications including wastes 11
All newsprint 224
Total distribution 292
Newsprint 213
Other paper 50
National 229
Regional 64
Inserts 15
Recovered 15
Disposal 0
Ink waste 0
ink 30
DISTRIBUTION
Misc. disposal 2
Circulation 258
Regional +bulk 58
National 198
Over issue 4
Other incoming 64
Over issue 28
Incoming wholesale 226
Wholesale
Export 2


NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
CHROMIUM FLOWS '00 kg p.a.
NON HOUSEHOLD
Archive 0
Recovery 2
Indirect recovery 1
Disposal 18
Consumption 21
HOUSEHOLD
Disposal 39
Recycle 29
Archive 0
Reuse 3
Destruct 1
Contaminate 2
Consumption 71
LOCAL AUTHORITY
LA collected 29
LA recycled 28
Kerbside 19
Bring 8
CA 2
LA total 74
MRF/other loss 1
Other pams recovered 46
RECOVERED
Comm/ind 2
LA 28
Printers 5
Over issue 11
Total 46
Misc. disposal 0
Recovered 46
All news and pams 170
Import news 0
n+p 0
END USERS
All news and pams 32
Newsprint
Other paper products 6
Non-paper products 2
Export news 4
n+p 27
DISPOSAL
Landfill 57
Incineration 4
Import 0
DISTRIBUTION
Misc. disposal 1
Over issue 1
Circulation 91
National 74
Regional +bulk 17
Over issue 10
Incoming wholesale 83
Other incoming 20
Wholesale
Export 1
PRINTING
Other publications including wastes 4
All newsprint 70
Total distribution 104
Newsprint 66
Other paper 34
National 85
Regional 19
Inserts 10
Recovered 5
Disposal 0
Ink waste 0
ink -1
NEWSPRINT MILLS
Other fibre embodied 0
Other rec paper 73
Rec. newsprint 38
Recovered paper 111
Newsprint 45
Disposal 0
Sludge 66
Export 8
Import 33
MILL WASTE
Ash reuse 22
Ash disposal 16
Landspread 18
Other reuse 10
Disposal 0


NEWSBALUK: MASS FLOWS FOR SCENARIO: Default 2001-2002
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Save screen image Help
MANGANESE FLOWS '00 kg p.a.
NON HOUSEHOLD
Recovery
Archive 0
Indirect recovery 14
9
Disposal 154
Consumption 177
HOUSEHOLD
Disposal 311
Recycle 262
Archive 0
Reuse 38
Destruct 12
Contaminate 26
Consumption 610
LOCAL AUTHORITY
LA collected 262
LA recycled 252
Kerbside 169
Bring 72
CA 21
MRF/other loss 10
LA total 318
Other pams recovered 66
RECOVERED
Comm/ind 14
LA 252
Printers 48
Over issue 95
Total 409
Misc. disposal 4
Recovered 405
All news and pams 568
Import news 1
n+p 2
END USERS
All news and pams 107
Newsprint
Other paper products 54
Non-paper products 22
Export news 33
n+p 90
DISPOSAL
Landfill 478
Incineration 36
Import 6
NEWSPRINT MILLS
Other fibre embodied 0
Other rec paper 86
Rec. newsprint 288
Recovered paper 374
Newsprint 308
Disposal 0
Sludge 57
Export 61
Import 691
MILL WASTE
Ash reuse 19
Ash disposal 14
Landspread 16
Other reuse 8
Disposal 0
PRINTING
Other publications including wastes 47
All newsprint 938
Total distribution 891
Newsprint 891
Other paper 38
National 661
Regional 229
Inserts 12
Recovered 48
Disposal 2
Ink waste 0
ink 1
DISTRIBUTION
Misc. disposal 7
Circulation 788
Regional +bulk 210
National 572
Over issue 14
Other incoming 222
Over issue 81
Incoming wholesale 662
Wholesale
Export 7

8. DISCUSSION, ANALYSIS, AND RECOMMENDATIONS

8.1 Data Definition and Data Quality

Establishing a mass balance for UK newspapers is not straightforward. The balance suffers from a vagueness of definition and from changing definitions around the newspaper life cycle. Newspapers are printed on newsprint, or at least most of their contents are, though not all publications that are printed on newsprint are classified as newspapers. Some are classified as magazines[1]. Other publications, notably some advertising sheets, are not audited as either being a newspaper or a magazine[2].

In its production, a newspaper gains components with the addition of printing inks, the insertion of direct mail, and sometimes through its encapsulation in a bag as well. After consumption, the inserts become separately accountable as 'pamphlets', the weekend colour supplements might well become redefined as magazines and all the non-newspaper publications printed on newsprint might all become newspapers for accounting purposes. Newspapers, pamphlets and magazines (which might also encompass catalogues and brochures - and possibly even directories - as well as periodicals) share their recovery phase as a single entity in many industry-based statistics. However, in Government statistics they are further subsumed into a much broader and more amorphous material class termed 'paper and card'. Unpicking newspapers from the broader categories is difficult, especially as what we understand as being newspaper changes throughout the newspaper life cycle. In addition to these uncertainties of definition, there is a further uncertainty in ascribing a physical weight to the newspapers. Circulations are normally given as numbers of copies or less helpfully by numbers of readers. Whilst weights can be apportioned to newspapers, those weights are not necessarily constants, and can vary significantly according to advertising demands. Newspapers are also highly absorbent and can gain or lose moisture and change weight over their life cycle.

Another very significant and major uncertainty in the newspaper life cycle concerns who consumes those newspapers and where? That can directly affect where those newspapers are disposed of. Basically this comes down to whether the newspapers are read at home, or at work, or in transit. Industry figures that give circulations or readerships tell nothing about where those readerships take place. Household disposal paths appear to account for the majority of consumed newspapers though would appear to be unable to account for a significant minority fraction of the total consumption. Major outlets that distribute multiple copies (e.g. transportation hubs, and hotels and catering sectors) can account for a sizeable proportion of those non-household consumptions. Institutional uses, e.g. libraries, hospitals, educational establishments and other institutions can account for more. However, the dominant non-household consumption appears to lie within the multiplicity of 'general' offices[3] and other businesses operating within the community. Newspapers consumed there can comprise those papers acquired directly by the organisations but, much more importantly, will also include those brought in by individuals as personal purchases.

There are no reliable statistics on the commercial and institutional consumptions and disposals of newspapers in the UK. Saying that, here are no reliable statistics on household consumptions and disposals either!

The segmentation of newspaper consumptions, and their disposals, across each consuming sector, including the household, must inevitably be based on some quite significant assumptions. Some of those assumptions are no more than 'professional judgements'. In undertaking the data acquisition for this study, it was very clear that many stock and purchasing managers, and waste managers, across industry and commerce generally had almost no detailed knowledge of newspaper flows within their organisation.

Newspapers are normally only identified separately from other waste fractions through specialist research investigations. By their very nature, and resourcing, those investigations have been very localised and based on quite small samples, and are single snapshots in time. Extrapolating the results

[1] Some may be defied as both, e.g. the Times Educational Supplements are called magazines by the publishers but are newspapers according to libraries.
[2] It is noted here that the British Newspaper Library rejects advertising papers that contain no news.
[3] Both public and private sector.

from 27 hotels to the UK's 45,000 serviced accommodations will inevitably be subject to uncertainty and error. Likewise, questioning, or analysing the waste of 500 to 1000 of the UK's 24 million households will not provide a national average with a high degree of certainty. Larger-scale analyses (e.g. WRAP, 2003) only provide one isolated snapshot in time, and may still not be representative. However these 'small windows' into the overall picture are the only data we have!

At the officially-recognised [lower] levels of resolution, records are kept and are normally available in heavily aggregated form in Government statistics, and also in many trade association data sets as well[4]. Individual company/ organisation returns are not normally available. Different national compilations of the same statistic can vary, as witnessed in the mismatch between the DEFRA and CIPFA recycling statistics. Missing data and differences in interpretation both play a cause. Research surveys tend to suffer even more heavily from non-responses and poor returns.

A final source of uncertainty lay in the temporal separation between different parts of the data. Whilst the intention was to provide a baseline balance for the year 2001 -2002, some of the data recorded and supplied to the project went back to 1999 or before - which was the latest that was available in some areas.

In undertaking the mass balance of the UK newspaper industry, it became apparent that the major data uncertainty was accounting for newspapers that were not recycled. At the end of the day, it must be said that nearly all of them (amounting to some 1.4 million tonnes) have been landfilled. That part is almost certain. The uncertainty lies in which waste stream they were in when they were landfilled. The strategies needed to divert material from the commercial waste stream will be quite different to those required for the household waste stream.



Overall, the data from the four sectors of the newspaper recycling loop (production, distribution, consumption, and recovery) did reconcile reasonably well. However, the achieved balance must be thought of simply as the 'best' estimate that can reconcile all the data conflicts and can resolve the data uncertainties in the available data sets.

Parts of the balance may well be disputed, but those disputes can only serve to add new insights into the pool of available information, enabling constructive refinements to be made to the balance. The newspaper industry mass balance should not be regarded as static. The period since 2001 has seen significant and substantial changes within the recovery sector of the newspaper recycling loop, culminating in the step increase of 320,000 tonnes in UK reprocessing capacity in late 2003.

The balance, now it has been established, needs to be maintained and continually updated.

[4] Though it should be noted that the Newspaper Society publishes much data in fully disaggregated form.

8.2 Some Key Issues: Improvement Analysis

The balance has enabled many new insights to be gained into the newspaper recycling loop, and has answered several outstanding questions; however it has also raised several new questions and highlighted a number of emerging issues. Clearly keeping the balance maintained and as up to date as possible, as new circumstances unfold is still a vital task. To enable this, an electronic 'simulation' version of the balance has been developed. That simulation can also be used to explore the effects of 'what-if' scenarios, and to forecast the evolution of UK newspaper flows for different and alternative futures.

The remaining part of this section provides commentaries on individual parts of the newspaper recycling loop, concentrating on those areas where there is apparent or real potential for improvement, or where pressures could arise for changed management practices.

In the production sector one issue concerns the utilisation of de-inking and reprocessing by-products. That issue is discussed further in section B2. The issues for the distribution sector lie in establishing the potential for any reduction of the amount of unsold copies and other pre-consumer wastes. The issues for the two consumption sectors centre on increasing newspaper recoveries. In this respect it is just as important to address the non-household sector as it is to address the household sector. In the recovery sector the main issue may well relate to the quality of recovered newspapers. In part, this may be determined by how those newspapers were recovered, whether co-mingled or segregated from other materials. In part, it may also relate to the quality of the separations that are achieved by individual recyclers.

Printers Wastes

Over the past 15 years, [newspaper] printers' wastes have dropped from around 15% to 5% or less. It is considered by industry professionals that a target of 4.5% may be close to the practical limit. The room for improvement may be higher in the magazine printing sector where, according to a parallel mass balance study, print wastes are still exceeding 11%.

Unsold Copies

Unsold newspapers have a financial cost implication throughout the supply chain, including the indirect environmental costs associated with their production and transportation. Whilst significant effort has been made by the supply chain over recent years to reduce the proportion of unsold copies, the capacity for further reductions may be quite limited given the current marketing strategies. One key element of those strategies is a focus on ensuring newspaper availability, that is to ensure that copy does not run out on news stands no matter what the demand. Lack of availability decreases revenue but, more importantly, can jeopardise longer-term brand loyalties. Demand and casual sales can be quite volatile depending on the precise daily news stories on offer.

Sources within the industry (pers. comm.) estimate that if all publishers adopted a policy of maintaining sales without seeking total availability then a reduction of around 5-10% in current unsolds could be achieved. Specifically this might be achieved by reducing supplies to the more volatile outlets. However with the emerging availability of more sophisticated management tools (computer models) for unsold copy management, it is considered that it should be possible to reduce unsolds by between 1 and 3% absolute without compromising any availability considerations (systems developer, pers. comm.).

Increasing Household Recycling

In terms of available tonnage to be diverted from landfill, this still remains the most important sector to address.

Stringent waste minimisation targets have now been set for the country. The forthcoming target for local authorities to recycle or compost 25% of household waste by 2005 (2006 in Scotland) presents a considerable challenge. In 2000 - 2001 recycling levels were just 11.2% in England, 7.0% in Wales, and 7.4% in Scotland.

Councils have now set out their waste management strategies for increasing recycling rates. Basically, the measures being adopted are a combination of:

- Making the required behaviours more convenient to perform - essentially providing greater kerbside recycling;
- Educating and instilling greater awareness amongst the public.

In addition, there are strong moves in some quarters towards discouraging undesired behaviours - e.g. discarding recyclable materials in the general or residual wastes. Two approaches stand out:

- Reducing the size of the household residual waste container, or reducing its frequency of collection. This measure is intended to force households into finding alternative ways to manage their waste - hopefully recycling.
- Directly charging for residual waste disposal by volume or weight.

However, all the actions taken by the local authorities can only seek to make recycling more attractive to their residents. They cannot compel their residents to recycle[5]. For a resident to participate in a local recycling programme in the UK, the resident must first judge that the programme is suitable, and then must be sufficiently motivated to use it.

Recent years have seen much activity in making recycling more convenient. The proportion of households serviced by kerbside collections has increased to 58% (2002) from around 51% in 2000 - 2001. As well as providing more kerbside collections, councils are also increasing the numbers of materials they are collecting. Several paper-only schemes have been converted to multi-material collections, typically collecting mixed cans and textiles alongside the paper, together with either glass or plastic.

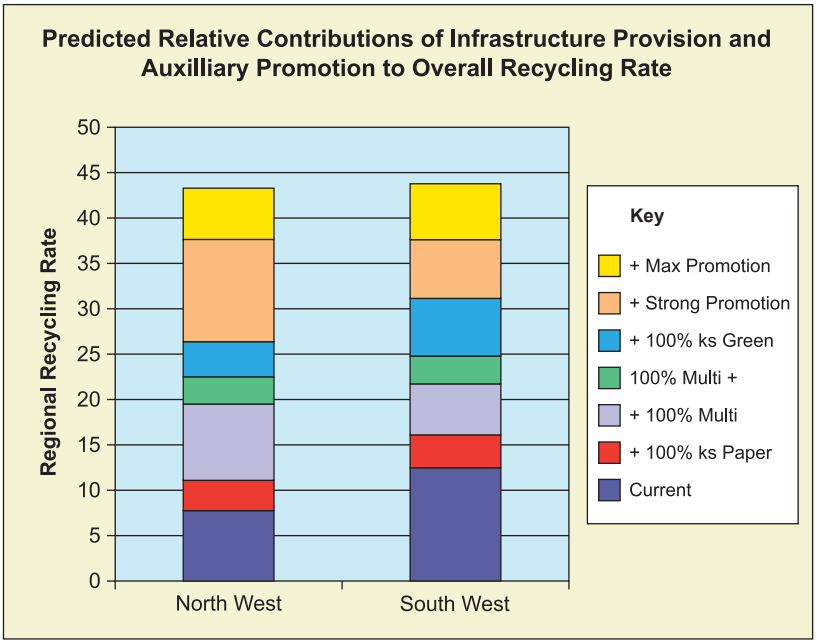
Whilst this report is concerned only about newspapers, newspaper recycling cannot be considered in isolation to the recycling of other household materials. Research is Chesterfield, North East Derbyshire and North Warwickshire has demonstrated that when you collect other materials alongside the newspapers and pams, the newspaper and pam yields will increase, on average, by a factor of around 1.4 (see technical note 8.1).

Bring site paper recoveries tend to fall as kerbside provision is increased. Typically, paper bank recoveries fall by around 40% when kerbside paper collections are introduced into the area, however the net gain overall is always significant and is usually quite substantial.

Using rigid containers (bins or boxes) for collecting recyclable materials, rather than using plastic sacks can also help to increase recyclate yields (Tucker, 2003). More frequent collections or same day collections as the residual waste have been noticed by some researchers as increasing recycling, though other researchers have found no significant effects.

However, there is a limit to what can be achieved simply through providing better recycling infrastructure. Public education will be needed as well. Tucker and Speirs (2002) made model forecasts on the relative proportions of improvement that could be expected through infrastructure changes alone, and how much may need to be developed through education. The introduction of enhanced recycling infrastructures was predicted to lead to comparable step changes in material capture across all districts, with the differentials in performance between well-performing and poorly-performing districts being largely maintained. That is, a relatively well-performing district will continue to be well-performing with better recycling provision, whilst a relatively poorly-performing district will continue to be relatively poorly-performing despite enhanced recycling provision.

[1] Mandatory recycling has been introduced in some regions of the world, notably in some states of the US. Participations and waste diversions are generally much higher than those achieved by voluntary schemes.



Source: Tucker and Speirs, 2002.

Multi = paper, glass, cans, textiles; Multi + additionally includes plastic bottles and cardboard; Strong Promotion assumes a successful targeting of 'pro-cycling' attitudes, awareness and procedural information and minimum weights; Max Promotion additionally successfully targets 'personal cost' factors such as time, effort, distaste and forgetfulness.

Inter-district differences will only be fully eroded through additional promotional and education campaigns. But what do those campaigns need to do? There are many ideas out there, but as yet little hard evidence about which types of campaign work best and how much real change they can stimulate. Discussion on how attitudes relate to recycling behaviours and to behavioural change are given by Tucker (2003).

In the UK, Governments have addressed household waste management within the context of broader environmental education campaigns, targeting (for example) energy usage as well. In England and Wales the DEFRA campaign is "Are you doing your bit?", the Scottish equivalent is "Do a little, change a lot". There are also national campaigns, funded through a combination of public and private sector monies: "Rethink Rubbish[6]" in England, "Waste Aware Scotland", and "Wake Up To Waste" (Northern Ireland). There are also regional campaigns such as "Slim Your Bin" (Anglia region), county-wide campaigns and many more local campaigns as well.

In conclusion, it can be said that central Government is making funding available to local authorities to enable them to increase their recycling infrastructures, and a significant amount of funding is being given to support the management and implementation of awareness, education and promotion. What we do not know is how successful those policies and actions will eventually turn out to be.

A more comprehensive discussion into all the factors affecting household recycling rates is given by Tucker (2003).

[6] Due to be replaced

Increasing Non-Household Recoveries

This area is considered to present significant opportunities. However, it is also an area where the current baseline is largely unknown. As such, it is difficult to quantify the full potential of what could be achieved. Many offices are recycling paper, and newspapers are a component in those recoveries. As few offices provide for a segregated collection of newspapers and pams, newspapers are mainly valorised as mixed wastes or, even worse, they are recovered as a contaminant in higher grade waste paper streams.

Concentrated sources of newspapers are present in some commercial and institutional waste streams, for example in aircraft cabin wastes, train wastes, hospital patient wastes, and hotel room wastes. These could be specially targeted for recovery. All should be easily segregated with a little effort by the cleaning staff. However, to do so extra cost would have to be borne by the generating organisations. In the case of aircraft cabin wastes, time scales may also be prohibitive. Collection for centralised (MRF) sorting of those newspaper rich wastes may provide a viable alternative.

Most public sector organisations have now adopted 'greening' policies of which increased recycling is an important component. If managed appropriately newspapers could be extracted in a concentrated form. But, like households, the onus will be mainly on the individual to recycle, and for those individuals to recycle correctly. Individual holdings of newspapers within the commercial sector are considered to outweigh any corporate holdings. Work place education of individuals must be regarded as an important consideration.

Paper Quality and Collection Losses

The drive to increase UK [paper] recycling levels has seen considerable increases in the introduction and expansion of local authority collection schemes. Driven by statutory targets, considerable emphasis has been placed on increasing quantities recovered. Some commentators (e.g. MRW, 2003) argue that the consequence of increasing quantity may be a lowering of quality. Aylesford Newsprint (2003) concur that the recovered paper received at their mill was of lower quality in 2002 than in 2001. Increasing use of co-mingled rather than source-separated paper collection systems across the country is widely thought to be one of the reasons for the deterioration in quality of the recovered paper.

The debate on this issue has been further fuelled by the revision of the European Standard for Recovered Paper and Board in 2001 (BS EN643). BS EN 643:2001 provides specifications on the eligible fibre composition for the main grades and sub-grades of recovered paper and board. It is an absolute standard. That is, to meet a given grade the consignment must contain only the materials specified in the standard for that grade. BS EN643 was established to ensure that paper is no longer collected as refuse but segregated to ensure it is free from contamination. This new standard sets the framework to ensure that all paper collected for recycling within Europe can be recycled.

A major implication of BS EN 643 is that paper obtained from refuse sorting operations is considered to be not suitable for making new paper. Adherence to the standard implies that only recovered paper from source segregated collections is suitable for recycling into new paper. However it should be noted that the standard is not mandatory. Many paper mills are still accepting paper from co-mingled collections, though others are leaning more to trying to ensure better compliences with the standard.

Table 8.1 Acceptable Source for Paper Recovered for Recycling into Newspaper

Paper from mixed refuse (i.e. 'dirty' MRF) or in bags collected with refuse	Paper from a two-stream MRF, or a paper only collection and sorting system	Paper separated from source to user (i.e. segregated kerbside collection)	Kerbside collection of all papers together (without subsequent sorting)	Kerbside collection of paper mixed with other dry recyclables (i.e. 'clean' MRF)	Bring (bank) systems of separated paper types	Bring (bank) systems of unseparate d paper types
X	Q	✔	X	Q	✔	Q

Adapted from a table published by WRAP (2003)
Q = needs questioning on a case to case basis

In October 2003, WRAP published a report on analyses made on 560 UK recovered paper and board samples, representing the range of collection systems operating in the UK. The objective was to ascertain whether there was any evidence that co-mingled collections gave rise to lower paper qualities than did source separated collections.

The results showed that almost none of the samples tested met the requirements stipulated in the standard. However, most collection systems approached the requirements of the standard. 'News and pams' samples on average contained nearly 91% eligible material. Little difference was apparent between systems in terms of paper quality produced. WRAP (2003) conclude that the widespread perception of poor-quality material arising from kerbside mixed collection systems is incorrect.

Whether the UK moves towards stricter compliance with the standard still remains a very serious question for the recovered paper industry. If the apparent trend towards lower recovered paper qualities increases then more intensive pre-sorting may be required prior to utilisation of the recovered paper. This may demand a MRF or similar operation to 'polish' paper from segregated collections as well as treating co-mingled and mixed multi-material collections. This will inevitably lead to further recovery losses, which will offset some of the gains achieved through stimulating increased consumer recycling. The more fundamental and preferred solution would be to stimulate increased qualities of separations from the consumer. Consumer education needs to address these quality issues as well as simply encouraging people to recycle more.

8.3 Recent and Future Developments

The study presented in this report was based on the financial year 2001 - 2002. Since then, there have been several significant changes. Newspaper weights fell during 2001 and 2002, but may now be increasing again. The percentages of households serviced by kerbside collections of newspapers have increased from around 51% to near 58%. The most significant change, however, is the expansion of UK recycled newsprint capacity. By the end of 2003, an new capacity of 320,000 tonnes per annum waste paper processing capacity should be operational at Shotton paper company converting all UK newsprint production to 100% recycled. Earlier in 2003, Stora Enso finished commissioning a new recycled newsprint mill in Langerbrugge, Belgium. That mill may also look to the UK as a potential source for some of its recycled fibre. Those demands together are likely to considerably outstrip the supply of recovered fibre collected in the UK unless UK recoveries can be increased dramatically over and above that recovered in 2001 - 2002 figures. At the time of writing, the latest published recovery figures indicate that domestic recycling rates have not yet increased sufficiently to meet the new demands, though there are media claims that the extra 320,000 tonnes per annum capacity at Shotton have been secured (Letsrecycle.com, 2003).

The picture for 2004, however, is still very much a "What-if?" situation. All claims still need to be ratified, and forecasts need to be confirmed with actual data. The simulation model in the current study predicts that simply increasing kerbside provision to an additional 4 million households will be insufficient to meet the 320,000 tonnes p.a. extra waste paper demand. To meet that demand there also needs to be a significant increase in material capture rates, compared to the rates achieved in 2001 - 2002. Effectively that means more participants must be recruited, and/or those participants must contribute more of their available newspapers [pamphlets and magazines]. Ultimately this comes back to the successes achieved in waste awareness, and promotional campaigns. But what are those successes? Campaigners seem very reluctant to quantify what they achieved in real terms (e.g. of extra material their campaigns have diverted from landfill).

In 2001 - 2002, the recovered stock of news and pams was slightly pams-rich compared to the optimum balance for new newsprint production (i.e. 70% old newsprint, 30% pams). The simulations for 2004 show that the news/ pams imbalance will continue or could become slightly more acute with proportionally more pams likely to be recovered from the household sector. The limiting factor for sustainably meeting the demands for an extra 320,000 tonnes p.a. recovery is likely to be the amount of available recovered newsprint. Perhaps we are already seeing evidence of the recovered waste paper stock becoming more pams-rich. The evidence from compositional analyses undertaken by WRAP in 2003 reports just under 60% 'newspaper' in mixed news and pams collections[7].

[7] As such, the material fails to meet the specifications os a minimum of 60% newspaper needed for grading under BS EN 643 classification 1.09. However market information indicates that the majority of recovered news and pams (for newsprint production) are being traded under classification 1.09 (see sections 5.8 and 5.9).

If the apparent trend towards waste paper recoveries becoming richer in pams continues, then under certain scenario conditions the UK may have to become a net importer of newsprint rich wastes and a net exporter or pams-rich wastes, and may need to 'cherry-pick' newsprint-rich wastes from the domestic markets. All these changes could have significant implications of the economics of the waste paper market; however to comment further is beyond the scope of this report. A separate follow-on Biffaward project B2085 has been commissioned to develop a simulation model of UK waste paper markets (see http://www.newspaper.paisley.ac.uk).

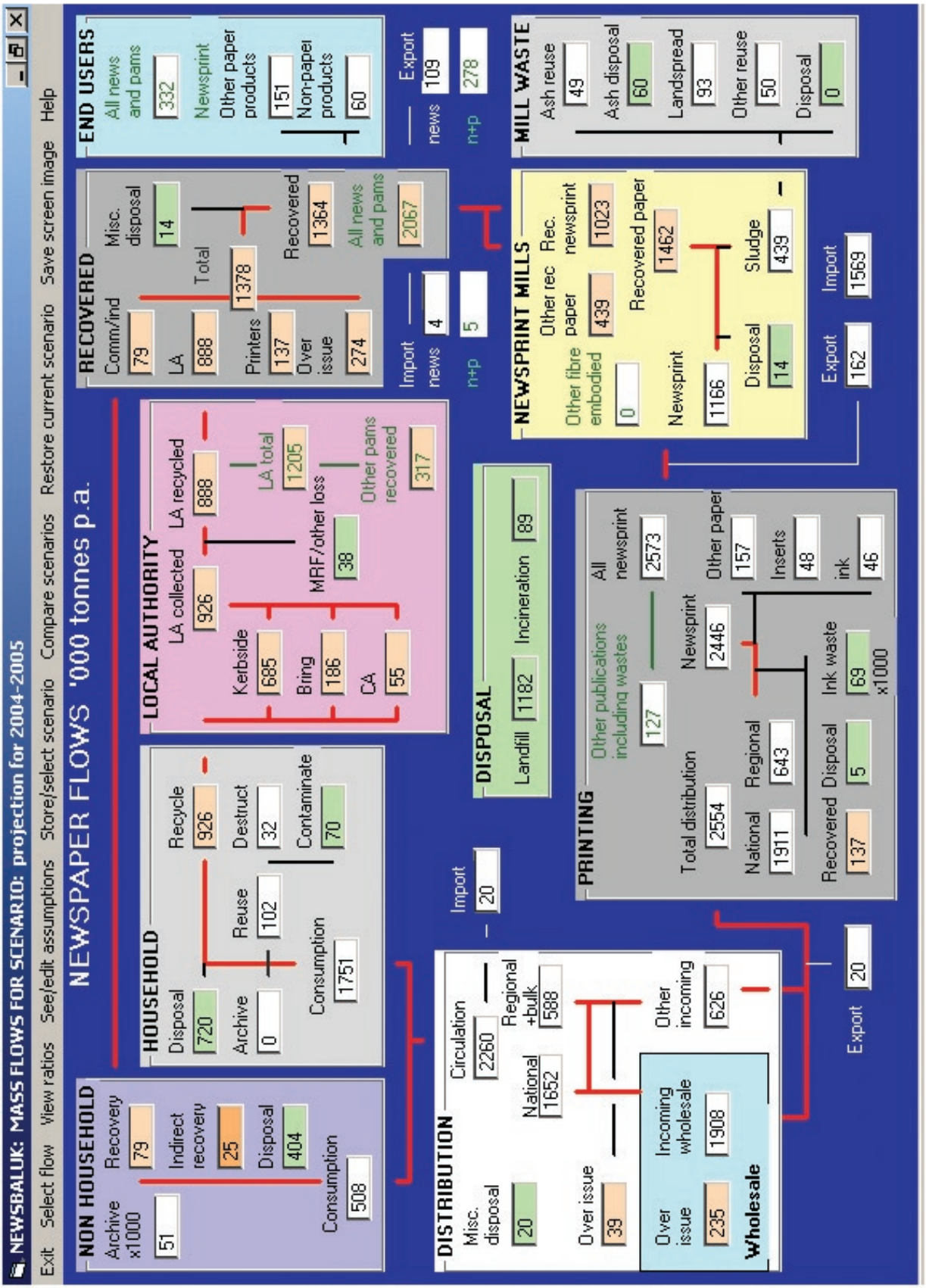
A simulation of the UK newspaper mass balance for 2004 - 2005 is provided on the following page. This simulation is based entirely on the assumptions made by the principal author of this report, based on the restricted market information available to the author. It is considered to be a realistically achievable scenario. However, it should be noted that this is just one of many possible scenarios dependent on a wide range of alternative assumptions. All those alternative scenarios can be simulated using the UK Newspaper Mass Balance simulation model. All those different futures will depend on the exact nature of the assumptions that are made, and those assumptions will reflect the windows of knowledge [and possibly prejudices] held by individual forecasters.

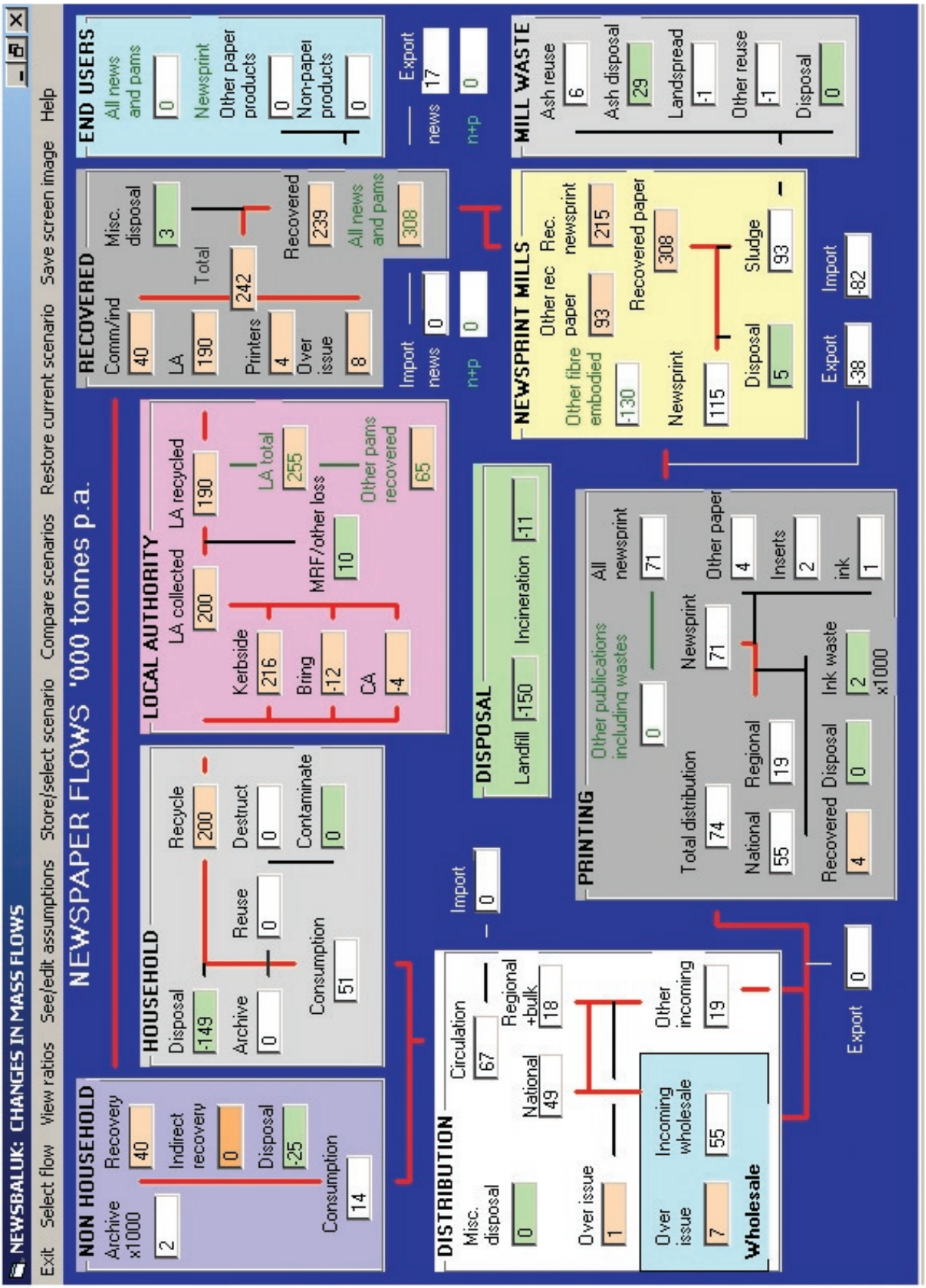
Assumptions underpinning the Mass Flow Forecast shown overleaf for 2004-05

1. 320,000 tonnes extra newspaper de-inking capacity in the UK
2. UK newsprint production at 100% recycled fibre
3. 5,000,000 extra households serviced by kerbside [paper] collections since 2002.
4. 2% increase in average newspaper capture by kerbside schemes since 2001-02
5. 7.5% increase in newspaper recovery from commercial waste streams
6. 3% increase in newspaper pagination since 2001-02
7. Domestic market share for home-produced newsprint increased by 5%
8. Maximum export market for home produced newsprint assumed to be 250,000 tonnes p.a.
9. Old newsprint exports set to a minimum quota of 70,000 tonnes p.a. (to honour ongoing contracts)
10. Increased production of de-inking sludge is all incinerated.

The first diagram shows the predicted newspaper flows under the above scenario conditions. The second diagram shows the predicted changes in mass flows between 2001 - 2002 and 2004 - 2005.

A detailed step by step 'walk through'of this scenario is given in Appendix D together with further comment and discussion.


NEWSBALUK: MASS FLOWS FOR SCENARIO: projection for 2004-2005
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Restore current scenario Save screen image Help
NEWSPAPER FLOWS '000 tonnes p.a.
NON HOUSEHOLD
Archive x1000 51
Recovery 79
Indirect recovery 25
Disposal 404
Consumption 508
HOUSEHOLD
Disposal 720
Recycle 926
Archive 0
Reuse 102
Destruct 32
Contaminate 70
Consumption 1751
LOCAL AUTHORITY
LA collected 926
LA recycled 888
Kerbside 685
Bring 186
CA 55
MRF/other loss 38
LA total 1205
Other pams recovered 317
RECOVERED
Comm/ind 79
LA 888
Printers 137
Over issue 274
Total 1378
Misc. disposal 14
Recovered 1364
All news and pams 2067
Import news 4
n+p 5
END USERS
All news and pams 332
Newsprint 109
Other paper products 151
Non-paper products 60
Export news 109
n+p 278
DISTRIBUTION
Misc. disposal 20
Circulation 2260
National 1652
Regional +bulk 588
Over issue 39
Over issue 235
Incoming wholesale 1908
Other incoming 626
Wholesale
Import 20
Export 20
DISPOSAL
Landfill 1182
Incineration 89
PRINTING
Other publications including wastes 127
All newsprint 2573
Total distribution 2554
Newsprint 2446
Other paper 157
National 1911
Regional 643
Inserts 48
Recovered 137
Disposal 5
Ink waste 69 x1000
ink 46
NEWSPRINT MILLS
Other fibre embodied 0
Other rec paper 439
Rec. newsprint 1023
Recovered paper 1462
Newsprint 1166
Disposal 14
Sludge 439
Export 162
Import 1569
MILL WASTE
Ash reuse 49
Ash disposal 60
Landspread 93
Other reuse 50
Disposal 0


NEWSBALUK: CHANGES IN MASS FLOWS
Exit Select flow View ratios See/edit assumptions Store/select scenario Compare scenarios Restore current scenario Save screen image Help
NEWSPAPER FLOWS '000 tonnes p.a.
NON HOUSEHOLD
Archive x1000
2
Recovery
40
Indirect recovery
0
Disposal
-25
Consumption
14
HOUSEHOLD
Disposal
-149
Recycle
200
Archive
0
Reuse
0
Destruct
0
Consumption
51
Contaminate
0
LOCAL AUTHORITY
LA collected
200
LA recycled
190
Kerbside
216
Bring
-12
CA
-4
MRF/other loss
10
LA total
255
Other pams recovered
65
RECOVERED
Comm/ind
40
LA
190
Printers
4
Over issue
8
Total
242
Misc. disposal
3
Recovered
239
All news and pams
308
Import news
0
n+p
0
END USERS
All news and pams
0
Newsprint
0
Other paper products
0
Non-paper products
0
Export news
17
n+p
0
DISPOSAL
Landfill
-150
Incineration
-11
Import
0
DISTRIBUTION
Misc. disposal
0
Circulation
67
Regional +bulk
18
National
49
Over issue
1
Other incoming
19
Over issue
7
Incoming wholesale
55
Wholesale
Export
0
PRINTING
Other publications including wastes
0
All newsprint
71
Total distribution
74
Newsprint
71
Other paper
4
National
55
Regional
19
Inserts
2
Recovered
4
Disposal
0
Ink waste
2
x1000
ink
1
NEWSPRINT MILLS
Other rec paper
93
Rec. newsprint
215
Other fibre embodied
-130
Recovered paper
308
Newsprint
115
Disposal
5
Sludge
93
Export
-38
Import
-82
MILL WASTE
Ash reuse
6
Ash disposal
29
Landspread
-1
Other reuse
-1
Disposal
0

9. TECHNICAL NOTES

Section 2

Technical Note 2.1 Flotation De-inking

The process of froth flotation is the stage in newspaper de-inking where most of the inks and unwanted minerals are removed from the incoming waste paper. At this stage the pulp has been dispersed in water and coarse impurities have been removed. Air is bubbled through the pulp and the inks and impurities attach to the air bubbles, which rise and are removed as a froth. The separation occurs because of a difference in surface properties between the ink and mineral particles and the fibre, the inks and minerals being hydrophobic. The hydrophobicity is enhanced by adding flotation reagents. Other chemicals such as dispersants and sodium hydroxide (to adjust the pH) may also be added prior to flotation.

A flow diagram depicting the metal losses from one possible configuration of the de-inking process is shown in section 6.2. Details differ amongst de-inking mills.

Chemical additions in de-inking and papermaking were not addressed in the overall balance, as that was an aim of a separate Biffaward mass balance study of the UK paper industry (2003). Accounts can also be found in BNMA (1995).

Section 3

Technical Note 3.1 Non-distributed Newspapers by Wholesalers

It is normal practice for the newspaper wholesaler to take in a small excess of newspapers to ‘top-up’ supplies if the need arises.

Some of this imbalance is especially attributable to an excess of colour supplements being taken. Colour supplements are printed in advance of their parent newspapers. It is often normal practice to supply a small excess of supplements as it is not known in advance what the precise print run of the associated newspapers might be. If a major news story breaks over the weekend, the newspaper print runs might be increased.

Losses through copies being damaged in transit are considered to be negligible.

Technical Note 3.2 Recovery Losses from Returned Newspapers at Wholesale

Wholesalers report the reuse of some of 138.8 tonnes old newsprint as a wrapping material in 2001 (see Appendix A, section A2). However, this practice has now largely died out.

A small loss can also be incurred from any cleansing of the returned newspapers by the wholesalers, that is, the removal of any plastic bags and inserts prior to passing on the newspapers for recycling. One wholesaler reported removing 21 tonnes of plastic bags from over-issue newspapers, and consigning those bags to landfill. However, other sources amongst the wholesalers consider that newspaper cleansing is not a normal practice across their industry.

Technical Note 3.3 Daily Newspaper Weights

A regular measurement of daily newspaper weights is carried out by the University of Paisley. The longitudinal study references the last two weeks in February each year. Fifteen daily newspapers including their associated Sunday editions (12 national and 3 regional titles) are analysed at each time horizon. In 2001, the mean weight per title per week was 2.59 kg (range 1.0 kg - 4.25 kg). The average daily weight of the national titles, weighted by circulation was 0.33 kg per copy, including all colour

supplements but excluding inserts and plastic wrapping. This bulks up to 0.337 kg when the weight of inserts and over wrap are included.

Technical Note 3.4 Weights per Newspaper Page

In order to establish an average weight per tabloid page, fourteen regional newspapers (conforming to normal tabloid size) were weighed, and the average weight per page was calculated. Results were consistent with 45 g/m^2 paper with 1 g/m^2 ink.

Technical Note 3.5 Regional Magazine Supplements

Overall, 381 pull-out or separate supplements are printed [on newsprint] by the regional press each year, plus a further 117 magazine-type supplements (source: Newspaper Society). Most of the supplements are issued as pull-outs or as separate supplements. Most supplements are produced on a weekly basis, though a significant number have longer production intervals - annually in some cases. This is particularly true with many of the magazine-type supplements. Paginations for the regional newspaper supplements, which cover jobs, property, motors and so on, are listed in the Newspaper Society database. Comparing those figures with the reported paginations of the parent newspapers indicated that some newspapers had subsumed the supplement paginations into the total pagination figures, whilst other appeared not to have done so and have treated the supplements as extras.

The total weights given over to the regional supplements were difficult to estimate exactly. Many pagination figures were missing. Assuming 'average' figures for the missing data gives an estimate of 70,000 - 80,000 tonnes in total. The proportion of this that might be 'extra' material is difficult to ascertain, though could potentially account for a third to a half of the reported total.

Technical Note 3.6 Other Papers Printed on Newsprint

A realisation that ABC and JICREG did not include advertising papers such as the AdTrader series led to a comparison with titles listed in BRAD (BRAD 2000). This revealed more than 150 titles which were audited by bodies other than ABC, or whose circulations were self-certified by the publisher, or whose circulations were not audited at all and not listed (which had to be excluded from the count). Many did not give paginations and therefore an average was used for these titles, which may have led to an underestimate of the weight involved. Many of these titles were free advertising papers, paid-for free-ad publications, free community papers, or small independent local papers. 71% were published weekly, 6% published fortnightly, 22% monthly and 1% at other intervals. Other 'papers', e.g. housing and job advertising publications and The Times Educational Supplement, were listed in BRAD as periodicals, but as no information is given regarding the type of paper on which they are printed it was not possible to differentiate them from the other periodicals listed.

Section 4

Technical Note 4.1 Self-reported Recycling Participation Rates

In recycling behaviour surveys, self-reported behaviours are often taken at their face value. However, it must be recognised that the results can be subject to error and bias. Respondents often tend to exaggerate the extent of their behaviours when those behaviours are perceived to be morally good. It is considered that the figures might reflect what people think they should be doing rather than what they actually are doing (Tucker, 2003). The extent of exaggeration might range from around 15% (Tucker, 2003; Perrin and Barton, 2000) to nearly 30% (Williams and Kelly, 2003).

Technical Note 4.2 Material Partitions to the Household Recycling Stream

(i) By co-measurement of recycling and residual waste streams

Type of collection	News & PAMs collections	Mixed paper & card collections
Newspaper	55	67

Data from Hampshire. Source: MEL (1999)

(i) Inferred from self-reports

A nationwide survey cross Scotland (SWAG, 2002a) interviewed just under 9,000 households. Published area summary reports (SWAG, 2002b) provide details of the numbers claiming to recycle newspapers and magazines (participation rates) and the percentage of available materials recycled (capture rates from participants) for 4,251 households from that sample. From those data, the estimated capture rates for newspapers was 36.6%

Technical Note 4.3 Newspaper Material Capture Rates from Paper Recyclers

Locality	Date %	Capture	Notes	Reference
Birmingham & Sheffield	1990	80-90	1	MEL (1990,1991)
Milton Keynes	1990	88	2	Thomas (1991)
Luton	1997	85-87	3	Coggins et al. (1997)
	1997	78 90 190	4	Waste Watch (1997)
Scotland & Lancashire	1997	87-98	5	Tucker et al. (1998a)
South Ayrshire	1997	90 85	6 7	Tucker et al. (1998)
Glasgow	1996	97	6	Tucker et al. (1998)
Renfrewshire	2001	89	6	Tucker (unpublished)
Clackmannanshire	2002	79	6	Tucker (unpublished)
Scotland (various)	2002	80-100 (mean 93)	6	SWAG (2002b)

Notes:

1. % claiming to recycle all or nearly all available material.
2. 100 * Ratio of measured weight of recyclables collected to expected weight of recyclables (based on dustbin weights measured prior to scheme commencement).
3. Ratio of kerbside recyclate weight to combined recyclate and dustbin weight of newspapers amongst recycling households.
4. 100 * Measured wt. of recyclables collected / (Measured wt. of recyclables + dustbin wt. of recyclables [recyclers + non-recyclers]) / Measured % participation
5. 100 * Measured number of newspapers collected / (Number of newspapers collected + Inferred 'missing' newspaper editions) + numbers of missing pages
6. Self-reported rates
7. Ratio of newspapers found in recyclate to number of newspapers consumed (scaled according to claimed recycling frequency).

Technical Note 4.4 Newspaper Contents in Commercial and Institutional Waste: Survey of non-UK Data

Waste compositional analyses carried out in Florida found that summer samples of commercial waste contained 5.5% newspaper, and 3.1% in winter. Newspaper made up 13.7% of the total paper waste. Nearly all was reported to be landfilled or incinerated. Waste analyses in Douglas County, Washington State (1999) found that newspapers accounted for 2.47% of the commercial waste stream (11.6% of the paper waste) and 0.07% of the industrial waste stream (2.5% of the paper waste). California Integrated Waste Management Board reports 3.6% newspaper in their commercial waste (9.2% of the paper wastes). North Carolina Department of the Environment and Natural Resources (2002) reports 4.1% newspaper in commercial waste (7.9% of the paper and card wastes). Vermont Department of Environmental Conservation (2002) report 3.3-4.1% newspapers and inserts in office waste, 1.6-3.6% in the waste from retail establishments, 1.1-1.6% in restaurant waste, 3.4-13.4% from grocery stores, 8.44% in hotel and motel waste, and 2.75 (minimum: 1.1, maximum: 7.4% in mixed commercial waste).

The Council of the Environment of New York City (1995) report three case studies into waste compositions in offices and institutions in NYC. Results showed the newspaper contents of the wastes generated to be 7%, 8% (including magazines), and 5% newspaper respectively.

A commercial and industrial waste audit in Honolulu broke down the percentages of newsprint in commercial waste by commercial sub-sector (Source: Opala, date unknown).

Newsprint Contents of Commercial Waste by Sector

Single office buildings	Multi-tenant offices	Whole-sale	General retail	Restau-rants	Fast food	Apparel manu-facture	Printing publish-ing	Food stores	Hotel
10.8%	11.1%	1.7%	9.9%	1.9%	1.9%	0.6%	13.5%	10.0%	7.5%

Source: Opala

Newsprint Contents of Institutional Waste

Public elementary schools	Junior high schools	Private schools K-8th grade	Private schools 6-12th grade	Psychiatric hospitals	Skilled nursing facilities	Municipal hospitals
1.79 - 3.32%	1.87 - 4.36%	1.50 - 4.36%	3.12 - 6.62%	2.07 - 3.68%	0.83 - 3.27%	1.33 - 4.16%
Teaching hospitals	**Non-profit hospitals**	**Government offices**	**Correctional facilities**	**Colleges universities**	**Public high schools**	**Transport-ation hubs**
4.52 - 5.96%	2.29 - 3.94%	8.70 - 11.46%	2.79 - 6.49%	5.23 - 9.57%	3.10 - 5.91%	29.4 - 36.4%

Source: Opala

A series of sector-specific newspaper audits have been carried out in Australia (Publishers National Environmental Bureau, 2002). In Melbourne, an audit of bulk delivered newspapers taken by railway commuters showed that 50% were left at stations (in garbage bins), 10% left on trains, and 40% were taken home. Similar percentages applied to ferries, though very few newspapers were found discarded on trams. Newspapers also made up eighty percent of the non-catering waste coming off aeroplanes in Melbourne. Other audits showed that newspapers made up 2% of the office waste stream in Australia, though where in-office recycling facilities were provided nearly all of that newspaper was recycled. In Australian hotels newspapers accounted for 10% of the total waste stream (4 and 5 star hotels - where newspapers were normally provided free to guests), reducing to 1-2% of the waste stream (1-3 star hotels - where free newspapers were not normally provided). It was estimated that 30% of the hotels were recycling their recovered newspapers. Street bins typically contained around 10% newspaper, though overall quantities were low. Libraries in Melbourne each consumed around 30 newspapers per week, and most of those were eventually recycled. Two percent of the total waste (including both ward

waste and office waste) of Sydney hospitals comprised newspaper. In shopping and retail complexes, newspaper was virtually absent in the back-of-store waste.

The Publishers National Environmental Bureau (2002) concludes that of the newspapers not already recovered, and excluding material that is unavailable (i.e. archived or soiled), twenty-two percent of those un-recovered newspapers arise in commercial waste streams. Office waste accounted for two thirds of all newspapers arising in commercial waste.

Breakdown of Un-recovered Newspapers in Commercial Waste by Sector

Offices	Rail	Air	Hospitality	Other
70%	11%	3%	10%	6%

Source: Publishers National Environmental Bureau, Australia (2002)

Technical Note 4.5 Transportation Hubs

Airport and Aircraft Waste

The following summarises the research data found by Network Recycling (1999) in the Terminal Recycling Project.

In Bristol airport, newspapers and magazines were found to comprised 51.38% of aircraft waste, totalling 228 to 286 tonnes per annum, i.e. 117-146 tonnes per annum recyclable news and pams. In Leeds/Bradford 48.49% of in-flight waste was newspapers and magazines and in Manchester the figure was 46.77% amounting to around 1,000 tonnes per annum. In Stansted, an estimated 288 to 360 tonnes per annum of newspapers and magazines may have arisen in in-flight waste. Overall, Leeds/Bradford, Birmingham and Manchester airports were found to produce between 0.12 and 0.15 kg of cabin waste per passenger. In the terminals most newspapers and magazines were left loose on seats and floors of public areas.

In Stansted the main terminal building yielded 647 tonnes of waste per year, of which 6.4% (or 41 tonnes per annum) was considered to be newspapers and magazines. The main office block at Stansted contributed an estimated 78 tonnes of waste per annum, containing 20.65% newspapers and magazines.

Based on the above considerations, a total of some 0.8 to 1.0 kg of newspapers and magazines may be associated with each passenger journey including the in-flight waste, terminal waste and office waste in support of those journeys. With around 170 million aircraft passengers passing through UK airports, this would amount to between 13,500 and 17,000 tonnes of newspapers and magazines in airport waste, which could be expected to contain between 10,000 and 14,000 tonnes of newspapers.

Rail Terminal Wastes

- Office Waste - approximately 16% of the total waste is newspaper and magazines.
* Train Waste (on-board) - 39.4% of total waste is newspaper, 5.8% is magazines (combined results from 2 separate audits).
* Train station & on-board waste combined - newspapers magazines constitute 19.8% of total waste (results from 1 audit).
* Retail/catering outlets (Departures Lounge) - 26.3% of waste stream is newspapers/magazines.

(source: Network Recycling 'Terminal Rail' project, pers. comm.)

Technical Note 4.6 Estimation of Newspaper Arisings in Hotel Wastes

There are 10,951 classified hotels in the UK, including at least 495 motor lodges. In addition there are a further 32,300 bed and breakfast establishments, guesthouses, inns, youth groups and farmhouses offering accommodation (Star UK). This compares with 52,633 restaurants and 46,320 bars (National Statistics). As such, just over 30% of classified hotel and catering premises are premises offering accommodation.

Hotels and motels offer 799,200 bed spaces with an additional 393,000 bed spaces being provided by the other serviced accommodations (Star UK). The average room occupancy in 2001 was 57% with the average bed space occupancy being 42%. This amounts to 122.5 million person nights spent each year in hotels and motels, plus 60.25 million in other serviced accommodation.

There is no available information on the per-capita disposal of newspapers in hotel rooms by hotel guests. For the estimation of waste arisings, between 0.3 and 0.7 copies per guest has been assumed. If each guest leaves [say] between 0.3 and 0.7 newspapers per night, this aggregates to between 20,000 to 45,000 tonnes per annum (for all serviced accommodation).

In 2001, 315,000 staff were employed by 10,890 hotels in the UK (National Statistics). Work place disposal of personally purchased newspapers may be higher in the hotel sector compared to the community average, simply because the workplace may also be the home for many staff.

If it is taken that a nominal 0.2 newspapers are disposed of at the hotel by each member of the hotel staff each day, this would add 8,000 tonnes per annum to the hotel sector newspaper waste arisings. This equates to an average of just 5.78 newspapers per hotel per day.

It is considered that these figures for hotels could easily be under-estimates.

Technical Note 4.7 Estimated Newspaper Mass Flows through Public Libraries

An analysis of newspaper holdings (in the form of printed copy) was undertaken based on a random sample of 286 central and branch public libraries; the data being derived from an internet search of library holdings. Those libraries together took 846 daily titles and 598 weekly titles, on average 2.96 daily newspapers and 2.09 weekly newspapers. Assuming an average weight of 0.347 kg per daily title and 0.18 kg per weekly title gives an average weekly consumption of 7.56 kg/ week per library, or 392 kg per library per year. There are 4,150 library service points in the UK, giving an aggregated total of 1,632 tonnes of newspapers consumed by public libraries in the UK.

Technical Note 4.8 Estimating Newspaper Mass Flows through Educational Libraries

Spot checks on newspaper holdings by university libraries and secondary school libraries (made through internet searches) indicated around 20 paper copies of UK titles per day might be typical for a medium-sized university, and around 2 to 4 copies could be typical for a secondary school library. This grosses up to some 1,600 tonnes per annum. Insufficient data was found to be able to make quantitative predictions on foreign language titles and the consumptions in the FE and primary sectors. These could account for the order of another 1,500 to 3,000 tonnes per annum.

Technical Note 4.9 Estimating Newspaper Mass Flows through Prisons

In prisons, a small number of newspapers are normally ordered for general circulation, and most prisoners are allowed to purchase their own papers in addition. Figures obtained from three Scottish Prisons showed an average consumption of 0.17 newspapers per inmate per day.

Prison	Inmates	Newspapers per day	Newspapers/ inmate/day
1	200	54	0.27
2	300	52	0.17
3	330	38	0.11

In 2001 the average prison population in the UK was 71,000 (National Statistics).

Section 5

Technical Note 5.1 Estimated Tonnages Collected by Local Authorities across the whole UK (University of Paisley new Survey for 2000/01)

	News + PAMs Collected separately (all recycling)	Mixed paper & card Civic amenity collections	Mixed paper & card Bring and kerbside collections
Adjusted total	713,787	17,254	141,977
Estimated % News & PAMS	x 95% = 678,098	x 40% = 6,902	x 75% = 106,483
UK Estimator	**791,483**		

Note 1: Only 33% of authorities responded to the questionnaire
Note 2: The UK-wide estimates were made by aggregating all data received, then scaling up to a UK total using a population-based multiplier.
Note 3: Consequently the reliability of these data are considered much lower than the DEFRA and CIPFA statistics.
Note 4: The 40% and 70% multipliers are the 'best' working estimates (see table 5.7a).

Technical Note 5.2 Research Measurements of Newspaper Contents of Recycled Paper Collections

Kerbside

	Hampshire News & PAMs	Hampshire mixed paper & card	Hampshire paper recyclate from civic amenity sites	WRL (2001) Mixed paper card
Newspapers	71.1%	51.5%	{ 39.9%	42.9%
Magazines	24.4%	23.9%	{	27.3%
Other paper	3.6%	10.6%	7.0%	10.3%
Non-recyclable paper	0.0%	0.6%	1.4%	3.2%
Card	0.9%	13.4%	51.7%	12.1%

Sources: MEL (1999), WRL & AEA (2001) Table x.6 Recovered Paper %

Leeds

	Paper bank	Kerbside 1	Kerbside 2	Kerbside 3	Kerbside 4
Newspapers	64.3%	68.6%	63.0%	67.6%	69.7%
Magazines	12.0%	15.8%	16.1%	19.1%	12.2%
Paper magazines & supplements	3.8%	2.5%	3.4%	5.1%	3.2%
Glue binding	5.2%	3.5%	2.8%	3.9%	1.6%
Glossy paper leaflets	2.7%	7.3%	4.2%	3.0%	2.5%
Catalogues	5.5%	-	5.8%	-	4.9%
Other paper	8.5%	2.3%	3.7%	1.3%	5.9%

Source: Perrin and Barton (2001) Scotland (1996/97)

Scotland (1996/97)

	Scotland Kerbside News & PAMs		Fylde Kerbside News & PAMs		Scotland Paper Banks	
Newspapers*	82.0%	82.5%	70.0%	70.0%	68.7%	87.8%
Magazines	10.7%	10.6%	17.5%	18.0%	13.3%	5.9%
Catalogues/brochures	3.4%	4.1%	4.8%	5.2%	2.1%	1.2%
Leaflets	1.6%	1.3%	7.1%	6.0%	7.7%	3.2%
Other paper	0.9%	1.0%	0.2%	0.4%	7.2%	1.3%
Contaminants	0.2%	0.5%	0.4%	0.4%	1.0%	0.5%

* Includes colour supplements; Source: Tucker (2001) and unpublished data

Kerbside, Fylde Borough

	1999	March 2000	April 2000	May 2000	June 2000
National	} 54.2%	39.8%	38.8%	42.4%	42.1%
Evening	}	7.3%	7.1%	5.6%	7.6%
Other local	5.9%	1.7%	4.4%	4.1%	4.3%
Glossy supplements	12.7%	12.7%	13.2%	12.4%	12.1%
Non-glossy supplements	11.9%	15.7%	17.3%	15.3%	12.0%
Magazines	7.2%	10.2%	8.1%	7.4%	5.9%
Catalogues	3.2%	4.0%	2.7%	4.1%	7.6%
Direct mail	4.8%	7.8%	8.4%	8.4%	8.2%
Contaminants	0.1%	0.8%	0.1%	0.3%	0.1%

Source: University of Paisley unpublished data

Kerbside, Renfrewshire

	2001
Newspaper	65.1%
Colour supplements	11.8%
Magazines	7.8%
Catalogues	8.4%
Junk mail	5.8%
Computer paper	1.0%
Non-recyclable paper	0.1%

Source: University of Paisley unpublished data

Technical Note 5.3 Recent Estimates of Percentage of Newspaper in Local Authority Consignments

WRAP (2003) measured the compositions of 560 paper and board samples collected from 80 local authorities. The samples were taken at the point of consignment at which collected paper is consigned to the reprocessor by the local authority. Samples were taken from a spread of collection systems:

- Paper from mixed refuse (dirty MRF) or in bags collected with refuse
- Paper from a 2-stream MRF, or a paper-only collection and sorting system
- Kerbside source segregated paper
- Kerbside collection of all papers together
- Kerbside collection of paper mixed with other dry recyclables
- Bring bank - source segregated
- Bring bank - unseparated paper types.

The compositional analysis classified the paper into 13 broad categories and 118 detailed categories. However even with 118 categories, the newspaper colour supplements were not separately identified from the magazines.

Analyses were undertaken separately for samples consigned as 'mixed paper' and samples consigned as 'news and pams'. It must be stressed when assessing the analyses that the analyses refer to material that has passed through a MRF where active 'picking' of newspapers and pams had occurred.

In the two segregated systems studied, 55-60% of the recovered paper was 'newspaper' with 23-26% 'magazines'. However, in the analyses newspaper supplements were all classified as magazines (WRAP, pers. comm.). Assuming that 16% of the recovered national newspapers were made up of coloured supplements (see section 1.2), and taking 70% of the recovered newspapers to be national titles, then some 57% x 75% x 16% ÷ 84% = 8% supplements would be expected in the total, leaving around 15-18% of the material classified as magazines to be actual magazines not associated with newspapers.

Samples consigned as news and pams contained an average of 8.20% contrary fibres and 0.83% non-fibre contamination.

Newspaper Contents of Local Authority Paper Collections: (1) Samples Consigned as mixed Paper

	Collection system				
	Dirty MRF	**2 Stream MRF***	**Kerbside all papers together**	**Kerbside mixed dry recyclables**	**Bring bank unseparated paper**
No. samples	7	23	32	11	26
Newspaper	22.66%	48.02%	47.21%	41.14%	41.09%
Magazines	14.92%	21.70%	20.09%	19.33%	21.13%
Other eligible paper	59.75%	29.55%	31.33%	36.16%	35.70%
Other paper	1.07%	0.07%	0.24%	0.24%	0.24%
Non-paper	1.60%	0.66%	1.12%	1.12%	1.12%

* Papers collected in separate container to other dry recyclables. Papers then sorted separately. Source: WRAP (2003)

Recalculated Percent Newspapers*

	Collection system				
	Dirty MRF	**2 Stream MRF**	**Kerbside all papers together**	**Kerbside mixed dry recyclables**	**Bring bank unseparated paper**
Newspaper	25.7%	54.4%	53.5%	46.6%	46.6%
Magazines	11.9%	15.3%	13.8%	13.8%	15.5%

* Based on 70% of circulated newspapers containing 16% colour supplements

Newspaper Contents of Local Authority Paper Collections: (1) Samples Consigned as News and Pams

	Collection system				
	Dirty MRF	**2 Stream MRF**	**Kerbside all papers together**	**Kerbside mixed dry recyclables**	**Bring bank unseparated paper**
No. samples	16	8	199	95	40
Newspaper	74.13%	48.53%	59.34%	57.54%	55.31%
Magazines	12.57%	29.24%	22.99%	21.57%	25.81%
Other eligible paper	6.04%	10.41%	9.87%	10.44%	6.73%
Other paper	6.56%	9.85%	7.06%	9.52%	11.09%
Non-paper	0.70%	0.62%	0.75%	0.53%	1.06%

Source: WRAP (2003)

Recalculated Percent Newspapers*

	Collection system				
	Dirty MRF	2 Stream MRF	Kerbside all papers together	Kerbside mixed dry recyclables	Bring bank unseparated paper
Newspaper	84.0%	55.0%	67.8%	65.2%	62.7%
Magazines	2.7%	22.8%	14.5%	13.9%	18.4%

* Based on 70% of circulated newspapers containing 16% colour supplements

Technical Note 5.4 Estimates of the 'Newspaper and PAMs' to 'All Paper and Card' Ratio

The estimate for the Scottish authorities was based on the SEPA returns (SEPA, 2002a), applying a 70% multiplier for the mixed paper and card collections and assuming co-mingled collections contained around 45% news and pams and 20% card. On this basis, the newspaper and pams to all paper and card multiplier for Scotland household collections was computed to be 87% news and pams in all paper and card.

For England and Wales, the ratio of newspapers and pams to all paper and card was derived by comparing the returns from the University of Paisley survey (Technical Note 5.1) and the CIPFA survey (CIPFA, 2002) across authorities that had commonly replied to both. The extended resolution of the University survey isolated identified newspaper and pams only collections separately, whereas those authorities had reported all paper and card to CIPFA. The average news and pams to paper and card multiplier based on the differences between the two surveys was 91% news and pams in the total paper and card.

Section 6

Technical Note 6.1 Average Metal Concentrations in Different Parts of the Newspaper Package

Metal Concentrations of Printed Newspapers (2002): Expanded Details - mg/kg

	Ag	Ba	Cd	Cr	Cu	Hg	Mn	Ni	Pb	Sn	Zn
Newspaper package*	<1	14.4	<1	4.4	41.6	<5	39.8	2.8	<4	<5	15.1
Standard newsprint sections	<1	13.8	<1	3.8	39.9	<5	41.8	2.6	<4	<5	15.6
Colour supplements	<1	20.7	<1	10.2	58.9	<5	20.1	4.0	<4	<5	10.4
Catalogue inserts		19	<1	21	46	<5	34	5	<4	<5	12
Leaflet inserts		20	<1	4	35	<5	31	142	<4	<5	12
Scratch card inserts		15	<1	10	45	<5	27	2	<4	<5	15

Source: Tucker and Douglas (submitted for publication)
* Analyses are the average of 15 daily newspapers across a 2-week period in February 2002

Technical Note 6.2 Illustrative Published Values of Input & Output Metal Concentrations in Newspaper De-inking Mills

Illustrative Values of Metal Concentrations (mg/kg) in Paper Mill Sludges

Metal	A	B	C	D	E	F	G	H
Al			2700				4500	
As			1.4	<2.0	<2.0	<2.0		
Cd	<0.2		0.09	<1.0	<1.0	<1.0		<0.25-0.5
Co				2.5-3.7	1.0-2.7	2.0-2.2		
Cr	16-118	9.4	14	100-120	12-115	90-107		<1.0-16.0
Cu	31-400	169	150	162-250	37-70	195-220	60	2-349
Fe			700				2600	
Hg			0.01	<1.0	<1.0	<1.0		<0.01-0.03
Mg			88				760	
Mn	31-680							
Ni	1-25	7.5	8.0	200-230	10-45	160-250	34	<1.0-8.7
Pb	3-210	5.0	4.0	3.5-4.5	1.2-1.3	4.5-5.5		<1.0-14.8
Se				<2.0	<2.0	<2.0		
Sb				<2.0	<2.0	<2.0		
V				4.0-4.5	5-25	2.5-3.4		
Zn	36-1200	40.7	200	125-300	55-100	140	250	1.3-157

A = Usherson (1992); B = Pridham & Yau (1992); C = Ettala (1993); D,E,F = Raitio (1992), G = D'Souza et al. (1998); H = CEPI (2000)

Partitioning of Metals Amongst Recycling Mill Inputs and Outputs

Metal	Inputs		Outputs		
	Waste paper	Process water	Product	Effluent	Sludge
Al	99-100%	0-1%	1-3%	1%	96-99%
Ca	75-86%	14-25%	6%	18-24%	70-75%
Cu	100%	0%	0%	0%	100%
Fe	18-19%*	1%*	2-3%	1%	96-97%
Mg	25-35%	65-75%	10-12%	51-52%	37-38%
Mn	74-82%	18-26%	9-12%	15-17%	1-2%
Zn	100%	0%	1-4%	1-2%	94-98%

* 81-82% input with process chemicals. Source: D'Souza et al., 1998

Metal Contents in Recycled Paper Mill Effluent

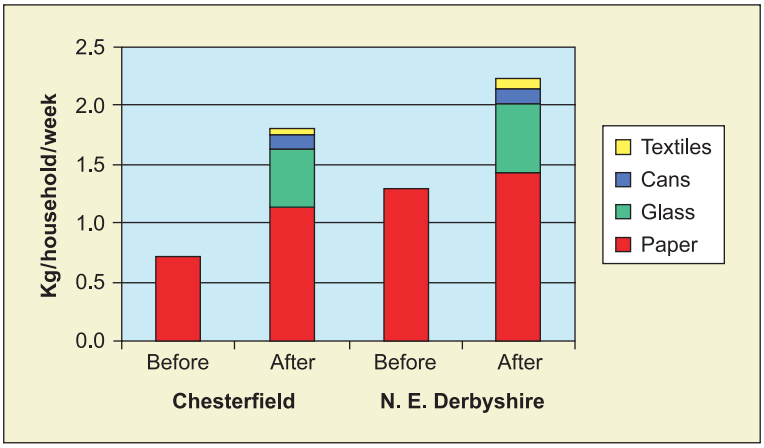
Metal	Concentration
Al	0.8 mg/l
Ca	180 mg/l
Cd	< 1.5 µg/l
Co	< 5 µg/l
Cr	< 4 µg/l
Cu	<0.2 µg/l
Fe	0.5 mg/l
Mg	29 mg/l
Mn	0.2 mg/l
Ni	<5.5 µg/l
Pb	<14 µg/l
Zn	50 µg/l

Source: D'Souza et al. (1998)

Section 8

Technical Note 8.1. The Impact on Newspaper Recoveries through Changing Paper-only Kerbside Collections to Multi-material

The districts of Chesterfield and North East Derbyshire changed from newspaper and pams kerbside collection to multi-material collections from late 2001 through 2002. News and pams yields increased by factors of 1.1 to 1.4 reflecting increased participations and increased captures from prior participants. A similar change in Noth Warwickshire in early 2003 had even more dramatic effects with news and pams yields there increasing by a factor of 2.2 (Tucker, 2003).



Source: Tucker (2003).

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APPENDIX A. NON-EMBODIED FLOWS

A.1 Production

Newsprint Production

New statistics were not compiled for this project as the relevant statistics were scheduled to be compiled under a parallel Biffaward mass balance study on the mass balance of the paper industry. At the time of writing those data are not yet publicly available.

Newspaper Printing

The study has produced new data for the non-embodied flows associated with newspaper printing. Those flows split into the incoming and outgoing packaging and the other materials consumed in the production of printed newspapers. Overall there was a relatively poor response from printers for requests for information, and the compiled statistics represent a very limited percentage of the overall market. As such there may be considerable uncertainties in extrapolating the data to a representative national picture. All data refer to papers printed by offset lithography.

The mean packaging flows into and out of the printing sector are given in table A.1 and A.2.

Table A.1 Incoming Packaging (Newspaper Printing)

Material	Kg per tonne printed newspaper	% recycled
Brown waste (wrapping and cores of newsprint reels)	4.8	100

Table A.2 Outgoing Packaging (Newspaper Printing)

Material	Kg consumed per tonne printed newspaper	Kg waste per tonne printed newspaper (%) waste	% waste recycled
Strapping	0.16	0.008 (5%)	*
Underwrap	0.74	0.04 (5%)	*
Polythene shrinkwrap	0.99	0.06 (5%)	*
Mailing bags	< 0.003	Unknown	-

* Collected by contractor, fate unknown

The material consumptions associated with processing are recorded in table A.3.

Table A.3a Non-embodied Flows Associated with Printing

Material	Amount consumed per tonne printed newspaper	Amount waste per tonne printed newspaper (% waste)	% waste recycled
Camera to Plate			
Plates	2.78 kg	2.78 kg (100%)	100
Developer	0.33 litres	0.31 l (96%)	#
Replenisher	0.74 litres	0.71 l (96%)	#
Other chemicals	0.04 litres	0.04 l (98%)	#

Some collected by contractor, fate unknown, some discharged to common drain. The split between the two is uncertain.

Table A.3b Non-embodied Flows Associated with Printing

Material	Amount consumed per tonne printed newspaper	% waste per tonne printed newspaper	% waste recycled
Press room			
Blanket wash	1.05 litres	100%	*
Fount solution	2.40 litres	5 - 20%	*
Other chemicals	0.15 litres	100%	#
Tape/ foil/ tabs	0.07 kg	100%	*
Blankets/ blanket cloth/ underpacking	0.11 kg	100%	*
Rollers recovering	0.01 kg	100%	*
Cleaning cloths	0.18 kg	100%	*
Gloves	0.03 kg	100%	*

* Collected by contractor, fate unknown
# Some collected by contractor, fate unknown, some discharged to common drain. The split between the two is uncertain.

A.2. Wholesale Distribution

The incoming and outgoing packaging flows to wholesale activities are listed in tables A4 to A6. These figures are based on data supplied by 92% of the overall wholesale market.

Table A.4 Packaging Associated with Incoming Newspapers (Wholesale)

Packaging material	Tonnes per annum	Kg of packaging per tonne of newspaper	% reused or recycled	% passed on without re-packing
Wood pallets	54,954	32.5	100%	-
Plastic pallets	26,698	15.8	100%	-
Plastic strapping	584	0.346	0.6%	33.6%
Cardboard boxes	0	-	-	
Shrink wrap	116	0.069	3.4%	
Stretch film	275	0.163	-	
Wrapping paper	57	0.034	Some	
Wrapping paper (old newsprint)	53	0.031	Some	
Cardboard and reel ends	5	0.003	0%	-

Table A.5 Packaging Associated with Distributed Newspapers (Wholesale)

Packaging material	Tonnes per annum	Kg of packaging per tonne of newspaper
Wood pallets	2.5	0.001
Plastic pallets	0.02	~ 0
Plastic strapping	103	0.061
Twine and string	46	0.027
Cardboard boxes	0	-
Shrink wrap	0	-
Stretch film	46	0.027
Wrapping paper (purchased)	136	0.080
Wrapping paper (old newsprint)	139	0.082
Roll cages*	227	n/a

* All returned

Table A.6 Packaging Associated with Returned Newspapers (Wholesale)

Packaging material	Tonnes per annum	Kg of packaging per tonne of newspaper	% reused or recycled
Wood pallets	0	-	-
Plastic pallets	0	-	-
Plastic strapping	10	0.046	0 %
Twine and string	110	0.505	0 %
Cardboard boxes	1	0.005	100%
Shrink wrap	0	-	-
Stretch film	0	-	-
Wrapping paper	0	-	-
Wrapping paper (old newsprint)	4	0.018	0 %
Roll cages	227	n/a	100%

A.3. Collection and Recovery

Most local authorities questioned passed on their recovered newspapers loose and unbaled. No figures were returned to indicate any packaging of the recovered materials. Few figures could be elicited from paper merchants. Baling (over-wrap and strapping) is much more common for exports than for home supplies. However, quantitative data was unavailable.

APPENDIX B. ENVIRONMENTAL BURDENS

B.1 Transportation and Carbon Dioxide Emissions

Research into the environmental emissions of transportation of newspapers, waste newspapers and other wastes generally report the environmental burden as one of two indicators[1]:

- Kilometres travelled per tonne of material conveyed;
- Kg of gas emitted per tonne of material conveyed.

The second descriptor can be derived from the first, provided fuel consumptions (litres per kilometre) and emission factors (grams pollutant per litre of fuel) are known. If the national tonnages are known then those results can be converted into the annual tonnages of emitted gases.

Almost every previous study has only considered the transport emissions from newsprint production recovery of old newspapers, or the disposal of wastes. The key missing data in the loop are the emissions incurred through delivery of newspapers from printers to consumers. Historically those data were neglected because they were a constant in the alternative waste management scenarios investigated through previous research.

This project has furnished new data on the transportation costs of wholesale delivery to retail (table B.1). However there are still data gaps on deliveries from suppliers to wholesale (collection by wholesalers from suppliers only account for a very small minority of the journeys), and the deliveries from printers directly to retail outlets or directly to consumers.

Table B.2 and B.3 set these new data in the context of published estimates of the transport costs incurred in other stages of the newspaper life cycle.

Table B.1 Delivery Journey Statistics (Wholesale)

Journey	Distance ('000 miles)	Km travelled per tonne of newspapers conveyed	Fuel consumption ('000 gallons diesel)	Litres diesel per tonne of newspapers conveyed
Collected by wholesaler from suppliers	8,166	47	561	9.2
Delivery to retailers (newspapers only)*	500	54 # 47 ##	31 +	6.8 # 5.9 ##
Delivery to retailers * (newspapers and magazines transported together)	74,371		3320	

• Including returns of over-issue

This figure refers to tonnages of newspapers and magazines combined - based on the weights distributed and return journey distances. No allocation is made to the weights of over-issue carried on the return journeys.

This figure is the estimated allocation to newspapers based on newspaper tonnages only and assuming an allocated share of 65% of all transport costs allocated to newspapers (the 65% figure is based on analyses by wholesalers).

+ 2,900 gallons petrol and a small amount of LPG

Based on wholesalers reported fuel consumptions and the multiplier 3,036.256 grams CO_2 /litre diesel (White et al., 1995)[2], wholesale deliveries would account for 20.7 Kg CO_2 per tonne of newspapers and magazines delivered, or 18.0 Kg CO_2 per tonne of newspapers delivered[3]. The emissions resulting from collections from suppliers are 28.0 Kg CO_2 per tonne collected.

1 A minority of research reports use the alternative descriptor Energy consumed (KJ) per tonne conveyed.
2 Based on the whole life cycle environmental costs of the fuel (including its production as well as its use).
3 Based on an allocated share of transports costs to newspapers.

Table B.2 Newspaper Life Cycle Journey Statistics (Published Data) Km/tonne

Journey	Published estimates		
Forest to pulping (UK)	20[1]		
Paper distribution	100[1]		
Deliveries of newsprint to customers	5.6[2]		
Special journeys by consumers to paper banks	110	13 - 420[4]	9 - 106[5]
Journeys from paper banks to bulking depot	161[3]	0 - 80[5]	
Kerbside collection journeys	10 - 20[4]		
Waste collection to re-pulping	140[1]		
Waste collection to landfill	160[1]		
Delivery from bulking depot to reprocessor	9.2[1]		

1 Source: Leach et al. (1997).
2 Source: Aylesford Newsprint (2001). Data refers solely to deliveries to and from Aylesford paper mill. Deliveries to customers include UK road deliveries only. The figure for raw materials deliveries to the mill does not specify the origins of the material.
3 Source: Powell et al. (1996). The study refers to rural Norfolk.
4 Source: Butler and Hooper (2000). Based on 30 UK bring sites.
5 Source: Speirs and Tucker (2001). The study refers to sites in Ayrshire and Glasgow.

Table B.3 Newspaper Life Cycle Journey CO_2 emissions (Published Data) Kg CO_2/ tonne Newspaper (newsprint)

Journey	Published estimates	
Consumer to paper bank	24.95[1]	2 - 30[2]
Consumer to bulking depot (bring schemes)	19 - 41[2]	
Kerbside collection journeys	21.86[1]	
Transport paper bank to mill	20.37[1]	
Transport household to landfill	7.92[1]	

1 Source: IIED (1999)
2 Source: Speirs and Tucker (2001)

In terms of the whole newspaper lifecycle, carbon dioxide emissions from transportation are only considered to account for a small percentage of the CO_2 emitted over the whole newspaper life cycle. CO_2 emissions from newsprint production are estimated to range between 2,500 - 3,500 Kg/ tonne (Leach et al., 1997) and 1,233 Kg/ tonne (net greenhouse gas emissions (IIED, 1999). IIED additionally estimate the net greenhouse gas emissions resulting from the disposal of old newspapers to be 1,240 Kg/ tonne. Aylesford Newsprint (2003) report CO_2 emissions of 1,062.5 kg CO_2 per tonne of newsprint produced.

B.2 Metal Contents of Newspapers

The material balance study has indicated that an estimated 120,000 tonnes per annum of de-inking sludge is returned annually from the newsprint industry to the environment for agronomic applications, mainly through direct land spreading as a soil conditioner, but also after treatment through composting or vermiculture. Further quantities of de-inking sludge based at least partially on newspaper and magazine sources are also being generated by other recycled paper manufacturers who recycle newspapers and magazines in their processes. De-inking residues (as sludge or ash) can also enter the environment through many other reuses, e.g. as landfill capping material, road making material or in building products. An estimated 25,000 - 35,000 tonnes per annum of old newspapers are consumed in gardening applications and 18,275 tonnes per annum are used for animal bedding.

In considering all these applications, it is important to ascertain whether there are any potential health or environmental implications associated with returning old newspapers (or their residues) back into the environment. In the past, concern was expressed about the levels of heavy metals contained in

printers' inks. Nowadays, newspaper inks no longer contain the lead and chromium pigments that gave rise to those concerns. Industry and environmental organisations both agree that the heavy metal levels in today's news inks are unlikely to constitute a significant environmental problem (e.g. Anon, 1991; Endriss, 1993; Grund, 1994; Friends of the Earth, 1997). Tucker et al. (2000) and Tucker and Douglas (2001) provide reviews of the corroborating scientific evidence, giving particular emphasis to copper concentrations. Copper is the only 'heavy' metal that is designed into today's news inks. That copper is in the copper phthalocyanine pigments used in most blue (and green) news inks.

The reviews showed that a number of studies into the ingestion of newspapers by livestock concluded that newspapers are relatively safe for ingestion by cattle and sheep. Abnormal or elevated levels of either copper or zinc were not found in the blood and liver of newspaper-fed specimens compared to those in the control groups (e.g. O'Connell and Meaney, 1997; Temple, 1990; Comerford and Spencer, 1993; Grieve et al., 1982 and others). The aluminium and copper contents of blood or bones of broilers (young chickens) and pigs were not increased when the animals were bedded on de-inking paper sludge (DPS) or when DPS was included in the diet of the broilers (Beauchamp et al., 2002). Toxicity tests on the copper phthalocyanine pigments demonstrated no carcinogenic or mutagenic effects on mice and rats, with acute toxicity tests found lethal dose levels (LD50) to be very high (Webb, 1984). Evidence presented by the US EPA (Federal Register, 1991) concluded that "On the basis of molecular weight, extremely low solubility in water, and data from sub-chronic toxicity tests, the phthalocyanine pigments are not expected to be appreciably absorbed by any route of exposure or metabolized to yield the copper ion" ... "Because copper does not appear to be available from phthalocyanine pigments, bio-accumulation of copper is not a concern".

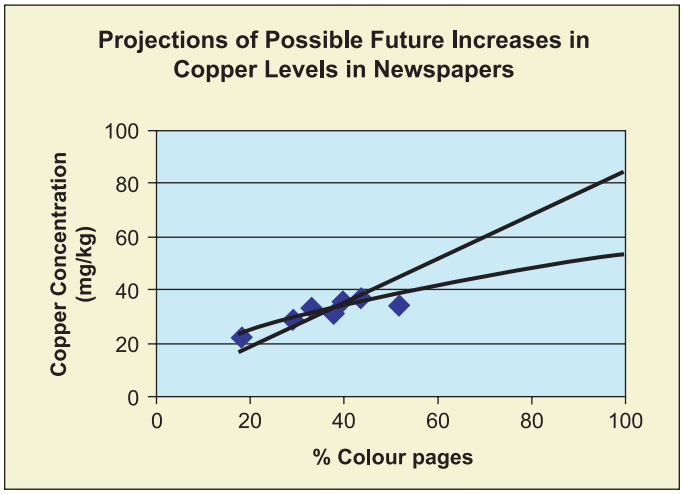
Regulations, however, tend to focus on total metal levels rather than the bioavailable components of those metals even if the metals are not readily metabolised or liberated by organisms, or are not leached chemically into the aqueous environment, and are unlikely to pose any environmental problem. Whilst current Waste Management Licensing Regulations, (SI 1994/1056), exempt paper mill sludges from requiring a license for their application to land as a soil conditioner, the paper industry have provided their own code of practice (Paper Federation, 1998). Currently, statutory limits for sludge-amended soils are in place solely for sewage sludge amended soils, though potentially, in the future, limits could be broadened to cover certain industrial sludges as well. The EC Working Document on Sludge - 3rd Draft (2000) includes fibre and paper sludge within its classified list of sludges. The document sets out proposals (still mainly focused on sewage sludge) for reducing the limit concentrations of sludges spread to land. The proposals under consideration would reduce maximum allowable copper concentrations in the sludges from 1,000 - 1,750 mg/kg dm (dry matter) (Directive 86/278/EEC) to 1,000 mg/kg; limit the copper concentrations in sludge amended soils from 50 - 140 mg/kg dm (Directive 86/278/EEC) to 20 mg/kg dm for soils of pH5-6, 50 mg/kg dm for soils of pH6-7, and 100 mg/kg dm for soils of pH≥7, and limit the amounts of copper that may be added annually to soil, based on a 10 year average, 12,000 g/ha/y (Directive 86/278/EEC) to 3,000 g/ha/y. Such proposals if implemented and applied to paper sludges could impact on usage even though the sludges might demonstrate 'ecological improvement' or 'agricultural benefit'.

At this point it is informative to provide some comparisons of the actual copper levels in newspaper and newspaper de-inking sludge with copper levels measured in other materials. Typical copper levels in de-inking sludge are of order 100 - 250 mg/kg (see technical note 6.2) compared with around 1,000 mg/kg or more in sewage sludge and distillery sludge (Tucker and Douglas, 2001, SEPA, 1999). UK Department of the Environment analyses of 33 components of the domestic waste stream found copper concentrations of 24 mg/kg in the newspaper fraction, 31 mg/kg in other papers, compared with 45 mg/kg in kitchen putrescibles and 70 mg/kg in the garden wastes that we would have no hesitation to compost (DoE, 1995).

The analyses presented in section 6.2 of this report showed that copper levels in standard newsprint were increasing over time, linked to the increased use of colour printing. Projections to 100% colour printing would indicate a limiting maximum value of between 50 and 90 mg/kg copper in the standard newsprint sections, depending on how far the increased colour capacity is actually utilized.

Moving to a scenario of 100% coloured pages could effectively double the sludge copper concentrations, impacting on the practical re-use of that by-product through restricting the amount that can be applied annually to land. It is also noted that new British compost standard PAS100 (BSI 2002) recommend an upper limit of 200 mg/kg copper for finished compost. Composting the paper sludge in order to realise its

added value as a soil conditioner could breech this level, especially if newspaper colour levels continue to rise. Simply incinerating the sludge is not a universal solution, and will not be acceptable to everybody. Application to land may remain the best practicable environmental option in some circumstances (SEPA, 1999). New treatment technologies are now being researched that can ensure compliance with standards whilst continuing to realise the agronomic values associated with the product. One of these possibilities is to co-compost the paper mill sludges with other substrates that are lower in copper (Biffaward project B1604a, University of Paisley, 2003. http://www.newspaper.paisley.ac.uk).



APPENDIX C. FINAL PARAMETER VALUES

PARAMETER	VALUE	UNITS	COMMENTS
Circulations			
National newspapers	4621	Million p.a.	
(Average weight per copy)	347	Grams	
Regional newspapers	3680	Million p.a.	
(Average weight per copy)	155	Grams	
Magazines	744000	Tonnes p.a.	From periodicals mass balance
(% on newsprint)	5	%	Estimate, figure uncertain
Other papers on newsprint	71000	Tonnes p.a.	Adjusted to balance
Imported newspapers	20000	Tonnes p.a.	
Exported newspapers	20000	Tonnes p.a.	
Imported Magazines	60000	Tonnes p.a.	From periodicals mass balance
Exported Magazines	43000	Tonnes p.a.	From periodicals mass balance
Newspaper components			
Colour supplements on newsprint	8	%	
Colour supps. (other paper)	8	%	
Inserts (nationals)	2	%	
Inserts (regionals)	1.5	%	Estimate, figure uncertain
Mags Inserts/covermounts/polywrap	7.9	%	From periodicals mass balance
Ink on page	1.6	%	
Ink on page (colour supplements)	2.8	%	Assumed same as magazines
Ink on page (magazines)	2.8	%	From periodicals mass balance
Printing			
Total print waste	5.4	%	
(% of which unprinted)	33	%	
Total print waste (magazines)	12	%	From periodicals mass balance
Ink waste	1.5	%	
Print waste recycled (nationals)	100	%	
Print waste recycled (regionals)	95	%	
Print waste recycled (magazines)	100	%	
Wholesale			
Nationals through wholesale	94	%	Adjusted to balance
Regionals through wholesale	20	%	
Magazines through wholesale	59.5	%	From periodicals mass balance
Magazines oversupply cleansed	85	%	From periodicals mass balance
Over-issue			
Nationals	12.8	%	
(% of which recycled)	97	%	
Paid-for regionals	12.8	%	
(% of which recycled)	75	%	Estimate, figure uncertain
Magazines via wholesale	31.2	%	From periodicals mass balance
(% of which recycled)	97.6	%	From periodicals mass balance
Free and other papers on newsprint	3.5	%	Estimate, figure uncertain
(% of which recycled)	30	%	
Household			
% Circulation to household waste streams	77.5	%	Estimate, figure uncertain
% Circulation to h/h waste (other papers)	95	%	Estimate, figure uncertain
% Circulation to households (magazines)	85.6	%	From periodicals mass balance
Destructive reuse	32000	Tonnes p.a.	
Contaminative reuse	70000	Tonnes p.a.	

PARAMETER	VALUE	UNITS	COMMENTS
Archived	0	%	
Archived (magazines)	18	%	From periodicals mass balance
Kerbside recycling capture (paper-only)	48	%	Kerbside:bring:ca ratios consistent with national statistics. Figures sensitive to assumption on the partition between household and non-household waste streams
‘’ (Multi-material collections)	55	%	
‘’ (Co-mingled collections)	60	%	
Bring site capture rates	16.5	%	
Civic amenity site capture rates	4.9	%	
Kerbside (paper-only collections, mags)	26	%	Adjusted to fit local authority recovery figure reported in periodicals mass balance, and to be consistent with research data.
(Multi-material collections, mags)	30	%	
(Co-mingled collections, mags)	34	%	
Bring recycling capture (mags)	9	%	
Civic amenity recycling capture (mags)	4	%	
Local authority			
H/hs serviced by paper-only kerbside	17	%	Estimated from CIPFA returns
H/hs serviced by multi-material kerbside	26	%	
H/hs serviced by co-mingled kerbside	13	%	
Other pams (ex. magazines) in recovered paper	9	%	
Multi-material collected paper to MRF	80	%	Estimate, figure uncertain
Losses at MRF	7.5	%	Percentage adjusted to match estimated tonnage losses
Other local authority losses	1	%	
Non-household streams			
Recovery to newspaper-eligible grades	8	%	Estimated consistent with exports
Recovery to other paper grades	5	%	Estimate, figure uncertain
Archived	0.01	%	
Recovery (magazines)	34.3	%	From periodicals mass balance
Archived (magazines)	2.9	%	From periodicals mass balance
Partitions of recovered paper to end-users			
To UK newsprint mills	1150000	Tonnes p.a.	
(% of which is newsprint)	30 %		
To other UK paper making (newsprint)	150000	Tonnes p.a.	
To UK non paper-making (newsprint)	75000		
From import (newsprint)	7000	Tonnes p.a.	
To export (newsprint)	65000	Tonnes p.a.	Broadly consistent with HMCE figures
Merchant & other losses to landfill	1	%	Estimate, figure uncertain
Newsprint mills			
Mill capacity utilised	1050000	Tonnes p.a.	
Additional wood fibre consumed	130000	Tonnes p.a.	Adjusted to balance
Percentage lost to sludge (dry weight)	20	%	
(moisture in sludge)	39	%	
Other rejects (wet weight)	0.25	%	
(moisture in rejects)	72	%	
Ink to sludge	99.5	%	
Sludge incinerated	58	%	
(weight loss on incineration)	63	%	
Ash reused	58	%	
Sludge not incinerated - landspread	65	%	
Sludge not incinerated - other reuse	35	%	
Other			
Moisture content newsprint as produced	8.5	%	
Moisture content recovered newsprint	8.5	%	

APPENDIX D. SCENARIO MODELLING FOR 2004 - 2005

D.1 Background to the Scenario

The reconciled mass balance for 2001 - 2002 was presented in section 7. The picture for that time reflected a decline in the home consumption of newsprint compared to the previous year, effectively because of lower paginations in the newspapers - mainly due to less advertising space being sold. That drop in home demand amounted to some 130,000 tonnes. Whilst increased exports helped to buffer the effect on the newsprint mills, UK domestic newsprint production did drop by some 40,000 tonnes compared to the previous year. UK mills were operating some 110,000 tonnes p.a. below capacity, with thermomechanical pulp (TMP) production being more severely compromised than the recycled fibre production. The weakening market demand for non-recycled newsprint and the UK capacity limitations for de-inking recovered newspapers (and magazines) provided the setting for the commercial decision to substitute the UK's residual TMP production with new de-inking capacity to produce newsprint containing 100% recycled fibre.

The new de-inking capacity was set to be just over 320,000 tonnes p.a. In order to sustain and feed that new de-inking capacity, there needed to be significant increases in household recoveries of old newspapers and magazines. Government policy and statutory recycling targets were already driving local authorities to increase their recycling, though the year-on-year increases of around 3% in national recycling rates were too slow to satisfy the impending necessary step change in demand. It was widely quoted that around 4,000,000 extra households would need to receive a kerbside collection service in order to satisfy that demand. However, based on DEFRA (2003) figures, the average paper and card recovery from English households serviced by kerbside collections was approximately 56 kg per household p.a. That level of recovery would, in fact, only realise a maximum of 224,000 tonnes from four million households. It must also be borne in mind that the provision of new kerbside services does not necessarily mean that all the material collected by them will be new. It has been found that around 40% of existing bring site recoveries can be transferred into the new kerbside statistics (Tucker, 2003). The average English bring site recovery of paper and card is 20.2 kg/hh p.a. (DEFRA, 2003), which breaks down to 14.8 kg/hh p.a. for kerbside serviced houses and 24.8 kg/hh p.a. for those not serviced by kerbside schemes. That implies that for each 56 kg gained at kerbside, 10 kg may be lost from bring recoveries. That puts the projected yield from 4 million households down to 184,000 tonnes. Given that only around 90% of the recovered paper and card will be news and pams, and given that some 5 - 7.5% of collected paper may be lost through sorting or lost because of quality reasons, we have actually only gained around 160,000 tonnes of new and usable material from a base of 4,000,000 households. That is about half of what is required!

However it must also be borne in mind that the notional 4,000,000 was estimated a little time after the 2001 - 2002 time horizon and many further households had already received kerbside services by then. At the end of 2003, it is estimated that 79% of English households had access to kerbside collections compared to around 56% in 2001 - 2002. Even with those extra households included, estimates still point to a shortfall of recovered paper unless other changes occur as well.

There are four types of change that can help to redress the balance:

(i) Reducing exports of waste paper;

(ii) Increasing imports of waste paper;

(iii) Increasing the capture of waste paper from consumers;

(iv) Increasing the amount of paper on the market.

A reduction in exports will, in part, help reduce the shortfall, though there will be a limit to how much current exports can be reduced because of the significant volume of long-term guaranteed trade that will remain to be honoured (e.g. with Scandinavian mills). Recent developments in Belgium and elsewhere could well raise UK export potentials.

Increasing the capture of paper from consumers means one of two things: (a) increasing the number of participants, or (b) increasing the weight recovered from each participant. Conversion of paper-only kerbside schemes to multi-material has been shown to increase paper captures by the order of 40%

(Tucker, 2003). Also, national and local campaigning is now intensifying to spread the recycling ethos more widely. If those interventions can raise average newspaper capture rate by 5% at kerbside (57 to 62%) and 2% at bring sites (17 to 19%), they could easily realise over 100,000 tonnes of extra recovery.

The fourth eventuality will arise if newspaper paginations recover towards their former higher levels. Potentially they could well surpass those levels. Given that a newspaper recycler will normally continue to recycle a major part of their newspapers, more newspaper pages means that more paper should be recycled. A 5% increase in pagination could translate into 35,000 tonnes or more of extra recovered newsprint. With extra pagination, pre-consumer wastes would also rise further increasing the recovered stock.

If scenarios (i), (iii) and (iv) together still prove insufficient to meet demand then waste paper will need to be imported.

The above considerations set the context for the simulation that follows.

D.2 Step by Step Analysis

The following simulations record the train of assumptions that culminate in the predicted UK newspaper mass balance for the year 2004 - 2005 (Section 8.3). The starting point is the reconciled 'baseline' mass balance for 2001 - 2002 (section 7.4). The key results of the new simulations are listed in tables D1 - D3 where the new scenarios are represented in terms of absolute changes from the 2001 - 2002 baseline.

Scenario 1

In scenario 1, UK thermomechanical pulp production is terminated and an extra de-inking capacity of 320,000 tonnes p.a. is introduced. An additional 21% of UK households [~ 5 million] are provided with a kerbside recycling service (balanced between paper-only, multi-material and co-mingled collections).

This scenario results in an extra 184,000 tonnes of news and pams being recovered nationally. That is sufficient to meet all UK newsprint mills requirements and leaves a small surplus for increasing exports as this assumes that both the UK and international demands for the produced newsprint remain static at 2001 - 2002 levels. There is no increase in UK newsprint production and the mills are still operating well below capacity.

178,000 tonnes of old news and pams are diverted from landfill.

Scenario 2

This scenario builds on scenario 1. It assumes that the UK market share for home produced newsprint increases 5% (from 34% to 39%). This could arise because of a more marketable product though many other factors could come into play as well. The scenario also assumes that the potential export market increases from 200,000 tonnes to 250,000 tonnes. Finally, the scenario sets a minimum requirement for 70,000 tonnes p.a. old newsprint exports.

In this scenario, UK mills are now operating close to their paper production capacity. Waste paper exports become reduced towards their minimum requirement, and the UK will need to import an extra 71,000 tonnes of waste paper to make up the balance.

Scenario 3

In this scenario, it is assumed that over and above the changes in scenario 2, material capture rates are increased over their 2001 - 2002 levels by 5% (kerbside) and to a lesser degree for bring schemes. These increases are applied to all schemes existing in 2001 - 2002 as well as to the newly introduced schemes.

This results in additional news and pams recoveries amounting to 286,000 tonnes extra recovery over that achieved in 2001 - 2002. The drop in waste paper exports is much reduced compared to scenario 2, and there is now no requirement for waste paper imports. Mill production remains the same as that in scenario 2, limited by paper production capacities. Landfill diversion reaches 267,000 tonnes p.a.

Table D1. Scenario Results ('000 tonnes)

	Baseline	Absolute change		
	2001-02	Scenario 1	Scenario 2	Scenario 3
LA collections (kerbside) newspapers	470	+171	+171	+230
LA collections (bring +ca) newspapers	726	-27	-27	-16
LA collections all news & pams	950	+184	+184	+286
Total recovered newspaper	1126	+136	+136	+201
Total recovered news & pams	1761	+182	+182	+283
Imported old newsprint	4	0	+ 60	0
Imported old news & pams	5	0	+ 71	0
Exported old newsprint	93	+18	-22	-16
Exported old news & pams	280	+18	-55	-25
Recovered paper to UK newsprint mills	1154	+164	+308	+308
UK newsprint production	1051	0	+114	+114
Newsprint exports	200	0	-11	-11
Newsprint imports	1651	0	-125	-125
Newspapers landfilled	1330	-125	-125	-187
News & pams landfilled	unknown	-178	-178	-267

Table D2. Scenario Results ('000 tonnes)

	Baseline	Absolute change		
	2001-02	Scenario 4	Scenario 5	Scenario 6
LA collections (kerbside) newspapers	470	+205	+267	+216
LA collections (bring +ca) newspapers	726	-16	-3	-16
LA collections all news & pams	950	+232	+339	+255
Total recovered newspaper	1126	+200	+270	+239
Total recovered news & pams	1761	+254	+359	+308
Imported old newsprint	4	0	0	0
Imported old news & pams	5	0	0	0
Exported old newsprint	93	-22	+48	+17
Exported old news & pams	280	-54	+51	0
Recovered paper to UK newsprint mills	1154	+308	+308	+308
UK newsprint production	1051	+114	+114	+114
Newsprint exports	200	-57	-57	-38
Newsprint imports	1651	-53	-53	-82
Newspapers landfilled	1330	-65	-130	-150
News & pams landfilled	unknown	-93	-186	-214

Scenario 4

Scenario 4 provides an alternative to scenario 3. Here it is assumed that there is no increase in material capture rates, but that the UK market demand for newsprint increases. This is modelled as an assumed 5% increase in newspaper pagination.

This scenario predicts that the tonnage of recovered news and pams will increase by 232,000 tonnes over the 2001 - 2002 levels, which is significantly less than the extra 267,000 tonnes predicted in scenario 3. A modest reduction in exports is just about sufficient to make up UK mills' requirements to allow them to operate near capacity. The main casualty, however, is the reduction in landfill diversion to just 93,000 tonnes extra in 2004 - 2005 than in 2001 - 2002.

Scenario 5

Scenario 5 combines scenarios 3 and 4, incorporating a 5% increase in material capture rates and a 5% increase in home demand for newsprint.

This returns to a situation where there is no need for additional waste paper imports and where there is a modest increase of 51,000 tonnes of waste paper available for export compared to 2001 - 2002. 186,000 more tonnes of news and pams are diverted from landfill than in 2001 - 2002.

Scenario 6

Scenario 6 assumes more modest changes in material capture rates (+ 2%) and in paginations (+ 3%) than were assumed in scenario 5. The scenario additionally assumes that newspaper recoveries from commercial waste streams are increased. In this scenario, a 7.5% increase has been modelled. Waste paper imports and exports remain close to their 2001 - 2002 levels.

Scenario 6 provides the basis for the prediction presented in section 8.3.

Scenario 7

Up till now it has been assumed that the full UK capacity for newsprint production is of order 1.16 million tonnes per annum and that the increase in de-inking capacity will not produce any additional capacity for producing more newsprint in the UK. The scenario results showed an increased utilisation of 302,000 tonnes of waste paper by UK mills beyond the levels achieved in 2001 - 2002. The reason why the full 320,000 tonnes extra capacity could not be fully utilised was a presumed marginal under-capacity to turn that amount of de-inked pulp into recycled newsprint. If all total de-inking capacity could be productively utilised, it is estimated that 1.196 million tonnes of newsprint product[1] could be realised. This situation is portrayed in scenario 7. Note that the predicted waste paper consumption increase over 2001 - 2002 levels is actually 346,000 tonnes reflecting that paper de-inking may have been running around 26,000 tonnes p.a. under capacity in 2001 - 2002.

Scenario 8

Based on scenario 7, scenario 8 portrays the additional impact of an industry reduction in pre-consumer waste. The scenario modelled here is a reduction in national newspaper over-issue from 12.8% to 9.8%. This scenario sees a significant drop in total recovered paper, prompting imports of waste paper and a reduction in waste paper exports in order to maintain UK newsprint production at its capacity. Under this scenario there will be a significant reduction in the need to import manufactured newsprint.

[1] This could include market pulp

Scenario 9

In this scenario, the conversion to 100% recycled fibre is undertaken and 21% extra household receive kerbside paper collections. Material capture rates remain fixed at their 2001 - 2002 levels. Home demand for newsprint increases by 10%. UK production raises its market share to 39% share of that home market, and additional export markets can be found if needed.

This scenario actually shows that all UK waste paper demands are fully satisfied, and there is also a small waste paper surplus for increased exports. UK newsprint production is at capacity. The downside of the scenario is that the UK will be landfilling just 63,000 tonnes less newspapers in 2004 - 2005 than it did in 2001 - 2002.

Table D3. Scenario Results ('000 tonnes)

	Baseline	Absolute change		
	2001-02	Scenario 7	Scenario 8	Scenario 9
LA collections (kerbside) newspapers	470	+216	+216	+238
LA collections (bring +ca) newspapers	726	-16	-16	-3
LA collections all news & pams	950	+255	+255	+281
Total recovered newspaper	1126	+239	+167	+306
Total recovered news & pams	1761	+308	+229	+370
Imported old newsprint	4	0	+54	0
Imported old news & pams	5	0	+63	0
Exported old newsprint	93	- 10	- 22	+50
Exported old news & pams	280	- 38	- 54	+24
Recovered paper to UK newsprint mills	1154	+346	+346	+346
UK newsprint production	1051	+145	+145	+145
Newsprint exports	200	-8	+20	-72
Newsprint imports	1651	-82	-125	+19
Newspapers landfilled	1330	-150	-155	-44
News & pams landfilled	unknown	-214	-221	-63

D.3 Discussion

The substitution of waste paper de-inking for thermomechanical pulp production in UK newsprint production should result in the UK producing an overall more marketable product. If those markets can be realised, newsprint production in the UK should return back close to capacity, recovering from the depressed markets seen in 2002. The conversion, however, will not produce any new capacity (though there would appear to be a small potential for a marginal increase). The UK will still need to import over 60% of its newsprint requirements.

The fuelling of the 320,00 tonnes p.a. extra de-inking capacity can be met through a combination of:

- diverting of waste paper exports into UK production;
- increased home recovery of waste paper, and
- increased waste paper imports.

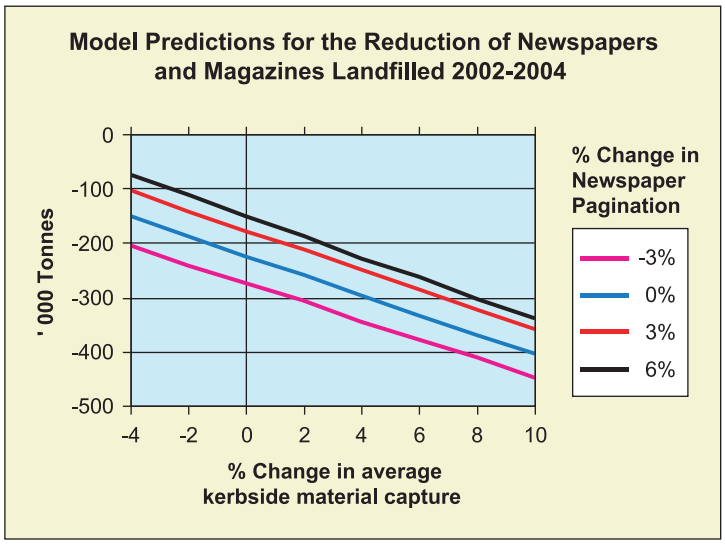
The popularised notion that putting four million extra homes onto kerbside collections will satisfy the full demand appears to be optimistic unless kerbside capture rates increase dramatically over the rates seen in recent years. Whether or not the 320,000 tonnes requirement can be fully met without necessitating extra imports may also depend on the future home demands for newsprint. If the market, i.e. home newsprint consumption, increases then home waste paper supply will increase too, thereby displacing import requirements. The downside is that if the home newsprint market does increase then so will the

tonnage of unrecovered newsprint. The tonnage of newspaper landfilled will therefore increase. Meeting the extra 320,000 tonnes of de-inking capacity will not necessarily reduce landfilling by that amount. The best estimates suggest that the resultant diversion could end up closer to 220,000 tonnes (in part due the assumed increase in consumption). The net change since 2002 could be substantially less if home newsprint consumption increases more significantly. The balance between imports and exports of waste paper and the ultimate reduction in waste paper going to landfill is also very sensitive to kerbside material capture rates. A 5% change in those rates can make a difference in landfill diversion of nearly 100,000 tones. Sustaining a positive balance for the UK economy will mean increasing those rates. That comes back to increasing the yields from household collections and/ or recovering more paper out of the commercial waste streams.

On further statistic is that the UK newsprint industry still depends on a significant input of pre-consumer wastes for its mill furnish. If those pre-consumer wastes are reduced it will have a dramatic effect on the UK newspaper mass balance. Under the best case scenario (scenario 7), a 22% reduction in newspaper over-issue would turn the UK around from being a significant exporter of waste paper to being significantly dependent on waste paper imports to sustain its domestic newsprint production. Increased industry efficiencies could therefore lead to a significant waste paper shortage, especially if the global newsprint market remains depressed. The alternative to imports would necessitate extending kerbside provision to an additional one million households. Pre-consumer sources of newspapers and magazines (i.e. printers waste and over-issue) currently provide an input equivalent to a kerbside collection from 12 million households[2].

The conversion of UK newsprint production to 100% recycled fibre should also increase the recycled content of UK newspapers from today's 65% to 75% (calculated according to the paper industry formula).

At the end of the day there remain many whats, ifs, buts, whys and whethers in what the future may bring. All those questions can be addressed by the simulation model. The analyses presented in this section have simply expanded on a limited number of possible future scenarios out of the multitude of possibilities that might occur. Further simulation could help fill in the details of all those possibilities.



2 Pre-consumer newspaper waste is estimated to be around 400,000 tonnes per annum and pre-consumer magazine wastes of order 270,000 tonnes per annum (Mass Balance of the Periodical sector; PIRA, 2003). The two streams together currently provide a fibre source equivalent to 12 million kerbside collections (at 56 kg recovered per household served per year).