Annex D: Markets and materials

Contents

1. Why market development is important

Rationale

1. The development of markets for recycled materials is crucial in ensuring that recycling is economically and environmentally viable. Recycling is about putting materials back into productive use in the economy, whether through re-use or re-manufacture, thus closing the loop. The substantial increase in recycling proposed in the new *Waste Strategy for England* will not be achievable and sustainable unless demand for recycled goods and materials is stimulated by a major expansion in the uses and applications of recyclates.

2. The UK led the way in Europe in recognising this. In 1999 the Market Development Group's report to Government concluded that if the UK is to meet domestic and international environmental obligations, a significant and sizeable expansion in demand for recyclate was essential to secure the level of increased recycling activity that would be required. The Government responded to this challenge by setting up the Waste and Resources Action Programme (WRAP) in 2000 to work on market development issues.

Barriers to market development

3. There are a number of barriers to market development for recyclates, and these have different impacts on the flow of different materials through to their end markets. The general idea of different barriers across different supply chains is illustrated in Table D.1 below for the key materials that WRAP has targeted: those for which the most significant market failures have been apparent.

Table D.1: Barriers to market development for key materials

	Supply chain Key: x = minor barrier, xx = major barrier, xxx = very significant barrier				
Material	Inadequate collection infrastructure	Quality sourcing problems	Limited reprocessing capacity	End products – need for standard/ specification/ procurement barriers	Need for alternative markets
Paper	x	x	x	xx	xx
Plastics	xxx	x	xxx	xx	xx
Glass	x	xx	xx	x	x
Wood	xxx	xxx	xxx	xxx	xxx
Compost	xxx	xx	xxx	xxx	xxx
Source: WRAP presentation to European Commission, 18 July 2003					

4. The biggest challenges to market development include consistency of collection quality and consistency of supply, technology, life cycle assessment (LCA) information on environmental impacts, specification issues, marketability, and demand. It is also important to establish an integrated approach to dealing with different sectors across a range of issues.

5. There are a number of different approaches to market development. These include:

- developing new markets for secondary materials, supporting the use and development of new technologies or novel adaptations of existing technologies, and research through strategic research and development (R&D) programmes;
- capital investment projects to support new and existing technologies;
- developing quality standards – to overcome issues of market confidence in recycled product quality and to promote greater consistency in recycled products;
- supporting investment into the recycling sector; and
- providing support for procurement of recycled products – persuading end-users to 'buy recycled' is an essential element of WRAP's overall programme.

6. WRAP has an important role in stimulating market development. WRAP's business plan for 2006–08 includes a commitment to maximise the amount and quality of recyclates used by UK manufacturing operations.[1] Over that period, WRAP intends to:

- actively support existing major markets for recycled materials in the UK, particularly for paper and glass;
- deliver three major projects that will switch a significant manufacturing process from using virgin material to recycled material input; and
- carry out research and feasibility studies to identify further opportunities for interventions which lead to production based on recycled rather than virgin materials.

Products and materials – waste and greenhouse gas priorities

7. The environmental impacts of wastes and how they are managed differ by materials. A very important impact is that of greenhouse gas emissions. Recent studies[2] have considered the relative potential benefits for climate change of the recovery of different materials using a life cycle approach.[3] There are a range of uncertainties which need to be taken into account in considering the results of such work. But, allowing for these, the findings suggest significant potential savings in greenhouse gas emissions (in the UK and elsewhere) from greater diversion of certain materials from landfill, through recycling and energy recovery, over and above current efforts.

8. The potential benefits are higher where recovered materials are of higher quality, material integrity can be maintained and virgin material production is avoided. For energy recovery, there are significant benefits in recovering heat as well as electricity (i.e. combined heat and power (CHP).

[1] *Increasing resource efficiency, reducing carbon emissions: Business Plan 2006–2008.* See http://www.wrap.org.uk/wrap_corporate/about_wrap/wrap_business.html for further information.

[2] *Carbon Balances and Energy Impacts of the Management of UK Wastes*, report by ERM (with Golder Associates) for Defra, Final Report, March 2007 (The ERM Carbon Balances Report) available at http://www2.defra.gov.uk/research/project_data

[3] *Environmental Benefits of Recycling: An international review of life cycle comparisons for key materials in the UK recycling sector,* WRAP, May 2006.

9. This strategy commits Defra to taking new measures on seven key waste materials where better waste prevention and higher recycling rates could deliver significant reductions in greenhouse gas emissions in terms of carbon dioxide equivalent and significant improvements in resource efficiency.

10. The seven waste materials and the key measures concerned (which are covered in more detail later in this Annex) are:

- **paper and cardboard** – waste minimisation, extend existing agreements/targets, possible opt-out scheme for unaddressed direct mail;
- **food and garden waste** – minimisation, anaerobic digestion, extension of Courtauld Commitment, home composting and food waste units;
- **aluminium** – better collection from streets/offices, higher targets for packaging, tackling engineering and consumer durables sectors;
- **glass** – maximising re-use as bottles, developing markets for green glass; and
- **plastics** – minimisation, better separation/collection, higher recycling targets, scheme for PVC-U windows, plastic bags, biodegradables;
- **wood** – developing energy markets for waste wood, separate collection from construction/demolition sites; and
- **textiles** – maximising clothing re-use, tackling non-clothing sectors.

11. This work will be supported by evidence and expertise from bodies and programmes such as the Environment Agency, WRAP, the Market Transformation Programme, Envirowise, the National Industrial Symbiosis Programme (NISP) and the Carbon Trust in some cases using Business Resource Efficiency and Waste (BREW) funding, and will be carried out in close cooperation with industry stakeholders.

A products and materials unit

12. Waste is a mix of very different products and materials and occurs at different stages in the life cycle of a product or the operation of a business. Through Defra's sustainable consumption and production agenda, action on products can help to reduce waste impacts, including at the design stage, and business support services are increasing resource efficiency through waste reduction and material re-use.

13. There are clearly strong synergies between products and materials – both in terms of their flows through the economy, as well as in those particular types of products and materials that have the most significant environmental impacts.

14. While work on products examines impacts from across the whole life cycle and materials work draws on evidence about carbon impacts from different end-of-life options, both strands illuminate the need to examine the movement of goods, make appropriate choices throughout the supply chain and then to design interventions that are holistic in their intention to reduce environmental impacts. A product and material focus can help prevent problems of burden-shifting or of making false choices between environment and economy, or between different types of impact.

15. During 2007 the products and materials unit will bring together the latest evidence and actions in these areas, and chart a way forward to reduce the environmental impacts associated with their production, use and disposal. A progress report on delivery in spring 2008 will highlight the evidence for prioritising particular products, materials and interventions, using examples of work currently underway to illustrate the advantages of this approach. In particular, it will draw on the product roadmaps to show the significant changes that can be achieved by working with stakeholders across the whole life cycle. It will also highlight the work being taken forward on materials as mentioned above and further explained in the rest of this annex.

2. Paper and cardboard

Rationale

16. Paper is biodegradable and therefore paper arising in the municipal waste stream is subject to the landfill diversion targets set down in the EC Landfill Directive. The ERM Carbon Balances Report[4] provides a basis for deriving estimates of achievable carbon reductions for paper and found high benefits for paper and card recycling or EfW.

17. Some paper is already subject to recycling targets in the Packaging Regulations and existing voluntary agreements, but there is considerable scope to extend the voluntary agreements to increase the recycling of other types of paper.

Facts and figures

18. Estimated total arisings are 13.7 million tonnes a year in the UK.[5] It is estimated that 18% of total municipal waste in England is paper and card. In 2005/06, this equated to 5.2 million tonnes. Of the household waste that is separately collected for recycling by local authorities, around one-fifth is paper and card equating to 1.5 million tonnes in England. It is estimated that around a further 0.5 million tonnes is collected in co-mingled kerbside collections and separated out before being sent for reprocessing.

19. The Environment Agency's Commercial and Industrial Survey in 2002/03 identified 7% (2.7 million tonnes) of waste from the industrial sector to be paper and 20% (5.98 million tonnes) from the commercial sector. There will also be some paper and card recorded in the mixed waste category.

Table D.2: Estimated total tonnages of paper packaging, newspapers, magazines and direct mail waste arisings and the proportions that arise in the household waste stream[6]

	Total	In household stream
Paper packaging	3,725,652	931,000 (25%)
Newspapers	2,470,000	2,000,000 (81%)
Magazines	630,000	630,000 (100%)
Direct mail	550, 000	550,000 (100%)
Total	7,375,652	4,111,000 (56%)

[4] *Carbon Balances and Energy Impacts of the Management of UK Wastes,* report by ERM (with Golder Associates) for Defra, Final Report, March 2007 available at http://www2.defra.gov.uk/research/project_data/More.asp?I=WR0602&M=KWS&V=Carbon+balance&SUBMIT1=Search&SCOPE=0

[5] *Ibid*. (best estimate – note caveats in report).

[6] Best available data for paper packaging, newspapers, magazines and direct mail. Equivalent to 54% of paper is subject to producer responsibility.

20. Based on the Environment Agency's 2002/03 Survey, ERM estimated that paper and cardboard accounted for around two-thirds (1.4 million tonnes) of waste arisings in the publishing and printing sector and around a third (4.5 million tonnes) of wastes in the retail sector.

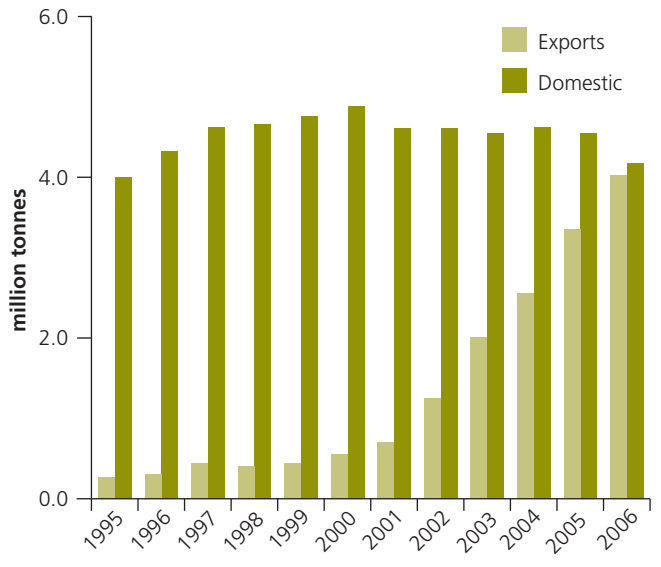
21. Based on the same data source, the sectors in which paper and cardboard account for the highest proportion of their waste arisings are: publishing, printing and recording (66%), retail (35%) and public administration (31%). However, the largest tonnages are found within the retail (4.5 million tonnes) and financial/computing/other services sector (nearly 2 million tonnes). The latter is likely to be dominated by office paper.

Management routes

Recovered paper sector

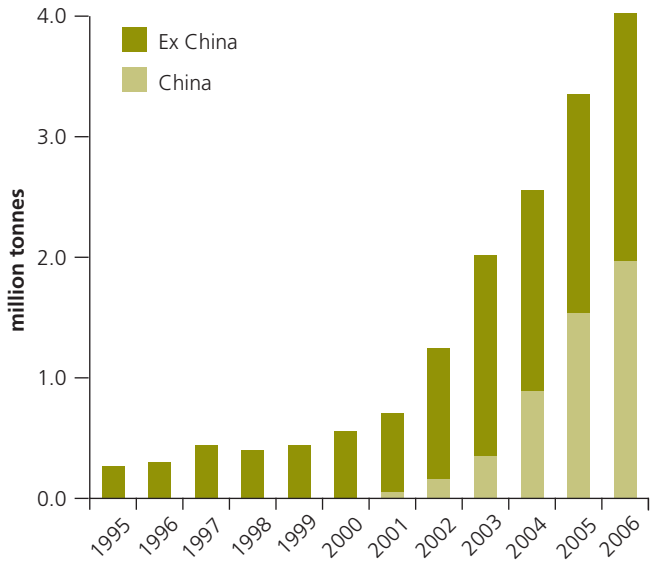
22. The collection of recovered paper has grown strongly over the past ten years, increasing by over 80%, from 4.3 million tonnes to 7.8 million tonnes. Nearly all local authorities in England collect some paper for recycling. This increase has been predominantly absorbed by the export market, and in particular by exports to China (see Charts D.1 and D.2 below). In 2006, some 1.4 million tonnes of paper packaging waste was exported for recycling. In 2005/06, around 2 million tonnes of paper and cardboard was sent for reprocessing by local authorities (including that sorted from co-mingled collections).

Chart D.1: Consumption of recovered paper (1995–2005)



Source: Confederation of Paper Industries
2006 export data annualised from Q1 data.

Chart D.2: Exports of recovered paper (1995–2005)



Source: HM Revenue and Customs
2006 data annualised from Q1 data.

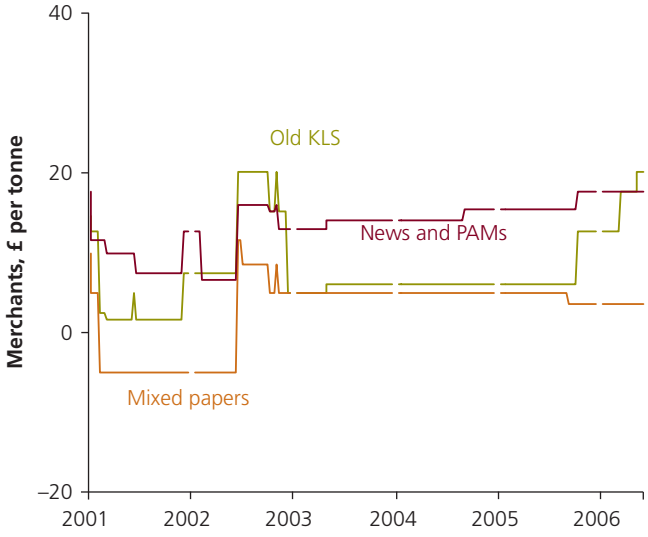
23. Although the recycled content of paper produced in UK mills has increased by almost 10 percentage points (from 59% to 68% in 2005), the decline in paper production in the UK over the same period means that consumption of recovered fibre has increased by only ca.500,000 tonnes.[7]

[7] Source: Confederation of Paper Industries. For more information see http://www.paper.org.uk/paperchain/facts/production.htm

24. Moreover, having achieved recycled content of over 80% (see paragraph 30 below) in the newspaper sector the quick wins may have been achieved. There may be scope to increase recycled content further in the other paper sectors, but it could be harder to deliver.

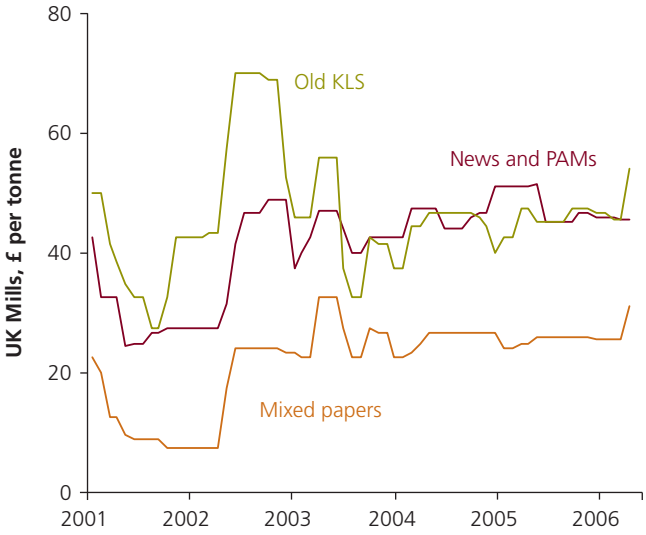
25. Despite the increase in paper collections, prices for recovered paper – as paid by both paper merchants and domestic mills – have been relatively stable (see Charts D.3 and D.4 below). In recent months, there has been evidence of a pick-up in prices for recovered corrugated packaging material.

Chart D.3: Recovered paper prices Merchants (2001–2006)



Source: MRW, midpoints of range.

Chart D.4: Recovered paper prices UK mills (2001–2006)

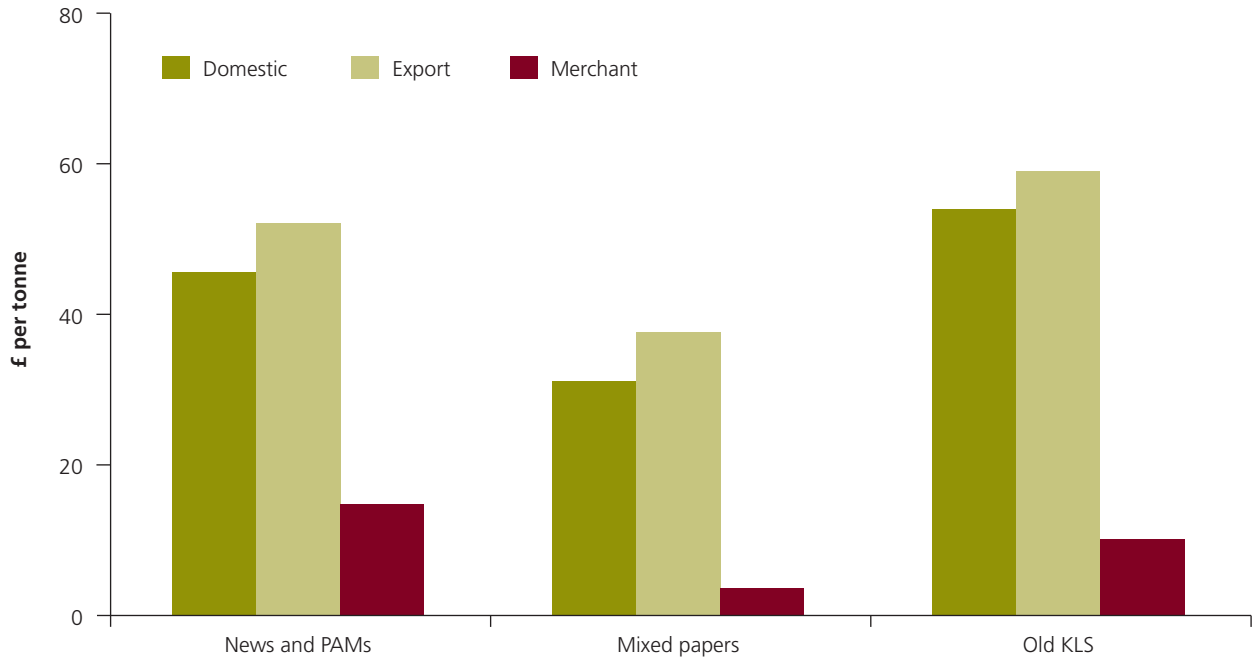


Sources: LetsRecycle.com, midpoints of range.

26. In general, export prices tend to be higher than prices paid by domestic mills owing to the additional risk associated with exporting in comparison with domestic contracts (see Chart D.5). For example, there are few long-term export contracts, and if a load is rejected owing to poor quality, repatriation is at the exporter's expense. Prices paid by paper merchants are lower still, and reflect the prices paid to collectors (e.g. local authorities) for paper that is not supplied to a mill or export specification.

27. In the absence of demand from export markets, the huge increase in collections of recovered paper might have led to oversupply in the UK market, and a decline in paper prices. Although this might have been beneficial to paper manufacturers, it might also have led to the operations of some paper collectors and merchants becoming commercially unviable, and a return to equilibrium being achieved by a reduction in overall recovery.

Chart D.5: Recovered paper prices 2007 – domestic, export and merchant



Sources: LetsRecycle.com

28. Furthermore, oversupply in the domestic market might have resulted in the surplus material being diverted to other outcomes – such as energy recovery or landfill. ERM and the Environment Agency calculations suggest that energy recovery can be as beneficial as recycling.

29. A priority project to increase the usage of recycled paper in magazine production is currently under active consideration by WRAP.

Waste minimisation

30. As a result of their Voluntary Agreement with Defra, the Newspaper Publishers Association have increased the recycled content of newsprint to 80.6% (2006). This level can not increase much further without reducing the quality of the newsprint. The Periodical Publishers Association are also involved in looking at using greater amounts of recycled material in their magazines as part of their Voluntary Producer Responsibility Agreement. They are expected to report on achievement of the first target at the end of 2007. Other paper products including packaging and direct mail, could increase the amount of recycled content, providing a further market for recyclate and achieving further carbon reductions from paper.

31. Work is under way with WRAP and the retail sector to achieve reductions in packaging used, and some of this will be paper. Under the Voluntary Agreement between Defra and the Direct Marketing Association, one objective is to achieve better targeting of direct mail sent out, with a view to reducing the amount of paper waste generated in this sector. In 2005, the direct marketing industry achieved a reduction of some 5% in direct mail sent out.

Re-use

32. Not all paper products can be re-used, but in the packaging sector, some transit items and carrier bags can. Greater environmental benefits could be obtained from office papers if these were routinely used or copied double-sided or re-used, where pages have been produced or copied on one side only.

Recycling

33. In 2005[8] the following recycling rates were achieved:

- paper packaging waste: 74%;
- waste magazines: 44%; and
- waste direct mail: 30%.

Challenges

34. The paper sector faces a number of challenges:

- the high capital cost of investment which has contributed to the decline in investment in the UK (combined with UK costs of employment, etc.);
- loss of mill capacity in the UK;
- high energy costs;
- paper is a globally traded commodity and more than 50% of UK-sourced recovered paper is now exported;
- as collection rates increase, there will be increasing issues of contamination, etc. Food contamination is of particular concern to the paper reprocessors; and
- the increase in co-mingled collections means that the quality of paper collected for reprocessing has generally declined.

Current/planned action and initiatives

35. Current initiatives to drive recovery, recycling, re-use or minimisation of waste paper include the following:

- the Packaging Regulations 2007 include targets for overall recovery of 60% and recycling of 55% by 2008, and within that, 60% recycling of paper packaging waste. In 2006, the level of recycling of paper packaging waste was 77% (targets are against the total arising in the UK waste stream);
- the Packaging (Essential Requirements) Regulations 2003 (as amended) – require packaging placed on the market to adhere to certain essential requirements including phasing out certain hazardous substances (e.g. lead) and reducing packaging to the minimum necessary. This will affect paper packaging;

[8] Table A1.70 of ERM's Carbon Balances Report; a variety of data sources are used in the origin table, so an exact year is not possible.

- the Voluntary Producer Responsibility Agreements with:
  - the Periodical Publishers Association – recycling targets of 50% by 2007; 60% by 2010; 70% by 2013; current level is approximately 34%;
  - the Direct Marketing Association – recycling targets of 30% by end 2005; 55% by end 2009; 70% by end 2013; current level is 28–30%;
  - the Newspaper Publishers Association – targets were for recycled content of 60% by end 2001; 65% by end 2003 and 70% by end 2006; current level is 80.5%;
- Food Industry Sustainability Strategy (FISS) – there is a target for the food manufacturing industry to reduce its own wastes by 15–20% by 2010. This 'own waste' will include some paper/cardboard packaging waste, although it is not known exactly what proportion of the whole this will be;
- WRAP's Retailer Innovation Fund is being used, in the context of the targets retailers have signed up to in the Courtauld Commitment, to support R&D for specific projects to design, develop test and trial innovative packaging solutions that will optimise paper packaging;
- the list of Government procurement 'Quick Wins' (which encourage Government Departments to apply minimum environmental standards across a wide range of commonly purchased products) include recycled content for copier paper (100% recycled, minimum of 75% post-consumer waste) and paper for printed publications (minimum 60%, of which 75% post-consumer waste). The Government is looking to increase cross-government procurement of paper with recycled content.

36. The future priority given to paper should be relatively high given both the estimated carbon impacts and the benefit (insofar as the paper concerned arises in the municipal waste stream) for meeting the EU Landfill Directive targets and Packaging Waste Directive targets.

37. The Government will look to establish with the paper industry an agreement to reduce paper waste and increase paper recycling, incorporating and developing the existing voluntary agreements. It is possible that each different group of producers would contribute according to set sub-targets. There may be a place for recycled content targets for some products but the Government will need to consider this with the businesses concerned.

38. The Government intends that office paper, free newspapers, catalogues and directories be incorporated into the extended voluntary agreements. There may be scope for other products as well.

39. The costs of achieving higher recycling rates and the obligation to reduce material use where possible would fall clearly on the producer, i.e. the business that puts the product (whether a newspaper, catalogue, magazine, cardboard box or paper bag) onto the UK market. There should not be costs for local authorities except where there is a pre-existing duty on them to collect, e.g. the duty to collect from the household waste stream. It will be important for producers and local authorities to increase their cooperation in relation to the products that arise as waste in the household or municipal waste stream and it will be important to find mechanisms which do not result in local authorities paying any more than they otherwise would. Consumers should also find it easier to have access to recycling facilities and this should result in higher consumer participation rates.

40. In addition, WRAP has a number of projects under its paper programme which are investigating the viability of non-closed loop recycling (i.e. paper going into non-paper applications. Examples include moulded pulp (egg boxes, etc.), fibrous insulation and animal bedding. However, non-paper applications currently account for only 0.4% of the market for recovered paper and thus these applications cannot be seen as a solution for the UK's reliance on export. To put this into context, the UK currently consumes around 50,000 tonnes of moulded pulp per annum, and collection of recovered paper is increasing by almost the same amount per month. WRAP is also promoting the growth in use of fibre products in insulation applications and other building materials.

41. Further measures that are either in train or being considered include:

- investigation of the technological barriers to the de-inking and hence recycling of paper and board printed with flexographic and digital inks;
- more work to look at collection systems and methods in order to maximise the quality of material collected. This is crucial both for home markets and for export markets as material becomes more widely available. For example, the Chinese are likely to increase the specifications of material they wish to source over time and the UK must be in a position to meet these increased specifications and to be seen as a source of 'quality material';
- further work on standards, although some already exist, for example the CEN standards for packaging at European level. This can be linked through to regulatory or commercial advantage;
- encouraging pressure from users/procurers to increase usage of recyclate. This could be particularly important for sectors such as printings and writings, including magazines; and
- understanding the role that energy from waste may have to play in management of material that cannot be recycled (either from a quality perspective or because of surplus material).

3. Food and garden waste

Rationale

42. Food and garden waste arisings include vegetation and plant matter from household, local authority and commercial landscaped gardens and food/kitchen waste from all sectors. This category is the most significant element of biodegradable waste which, if of municipal origin, is subject to the landfill diversion targets imposed by the EC Landfill Directive.

43. The EC Landfill Directive aims to harmonise controls on landfilling of waste throughout the Member States. Although the main focus of the Directive is to establish common standards for the design, operation and aftercare of landfill sites, it also aims to reduce the amount of methane, a powerful greenhouse gas, emitted from landfill sites.

44. The Directive sets three progressive targets for Member States to reduce the amount of biodegradable municipal waste sent to landfill. Biodegradable waste is the focus because it is this element of waste which breaks down to produce methane. Although the Directive only sets targets for biodegradable municipal waste, it also requires that strategies for achieving the targets must in addition address the need to reduce all biodegradable waste going to landfill.

45. All degradable waste has significant greenhouse gas potential when landfilled. For rapidly degrading wastes, such as food/kitchen waste, anaerobic digestion offers climate change and energy benefits over landfilling/landspreading, while composting has the potential to sequester carbon in soils and to improve soil fertility, which may confer additional climate change benefits.

Facts and figures

46. Similar amounts of food and garden wastes are created by the commercial and industrial sectors on the one hand, and municipal on the other (see Table D.3 below). The total estimate is 25 million tonnes.

Table D.3: Estimated food and garden waste arisings,[9] UK (million tonnes)

Type of waste	Municipal	Commercial	Industrial	Total
Kitchen/food	6.1	3.5	2.2	**11.8**
Garden/plant	6.4	3.2	1.0	**10.6**
Other organic	0	0.5	2.1	**2.6**

[9] Table A1.70 of ERM's Carbon Balances Report; a variety of data sources are used in the origin table, so an exact year is not possible.

47. WRAP estimates that UK household food waste arisings could be higher, at around 6.7 million tonnes.[10]

48. In 2005/06, municipal food/kitchen waste arisings in England were 4.9 million tonnes, or about 17% of total municipal solid waste. For the same period, the total of municipally collected garden waste was 5.9 million tonnes, or 20.5% of MSW.[11]

49. The Environment Agency's 2002/03 Commercial and Industrial Survey shows that the food, drink and tobacco sector produces more food waste than any other commercial sector, at 4.1 million tonnes for that period.

Management routes

50. Food and garden waste can be collected and treated separately or together and, since the sources can be both commercial and industrial (C&I) and municipal sources, the permutations of different management routes are particularly complex. This is demonstrated by the most recent available figures on management of food and garden waste, in Table D.4.

Table D.4: Estimate of management of food and garden waste arisings from municipal, commercial and industrial sectors in the UK (million tonnes)

Management type	Kitchen/food	Green waste	Other organic[12]
Recycling and re-use	0.2	0.03	0.2
Windrow composting	0	1.7	0
In-vessel composting	0.6	0	0.02
Anaerobic digestion	0.05	0	0
MBT	0.07	0.05	0
Combustion	1.6	0.9	0.6
Landfill	9.2	7.9	0.3
Landspreading/recovery	0.1	minimal	2.8
Total	11.8	10.6	4.0

Source: Table B1.1 of ERM's Carbon Balances Report; a variety of data sources are used in the origin table, so an exact year is not possible.

Home composting

51. One management route not reflected in Table D.4 is home composting. In fact it is a successful, growing route for managing both types of organic household residues.

[10] WRAP, 'Understanding Food Waste', March 2007.

[11] Based on compositional analysis by Dr Julian Parfitt, WRAP. Analysis for 'Waste not, Want not' (2002) available at www.defra.gov.uk/environment/statistics/waste/kf/wrkf18.htm; total waste comes from municipal waste management survey available at www.defra.gov.uk/environment/statistics/wastats/bulletin.htmwastats/bulletin.htm

[12] The 'other organic' total includes 1.3 million tonnes of sewage sludge and therefore does not match with its equivalent in the previous table, which excludes that waste stream.

52. The environmental credentials for home composting were highlighted in a study commissioned by the Environment Agency.[13] The report found that it is more sustainable for garden and some kitchen waste arisings (e.g. peelings, teabags and fruit scraps) to be managed at this level rather than being collected by local authorities to be treated centrally.

53. Home composting may not offer an appropriate solution to all households but it is clearly preferable in cases where householders are willing and able to do so. Currently about one-third of households in England with a garden – some 6 million households – are actively engaged in home composting. Around two-thirds of these composters use some elements of kitchen waste as well as garden waste. Municipal garden waste figures are reduced when household arisings of garden materials are dealt with at home without the need for collection, mainly through home composting.

Collection and treatment of municipal food and garden waste

54. A report by Eunomia for WRAP[14] (the Eunomia Report) highlights the crucial link between collection and processing of biowaste in relation to the range of management options available for local authorities. It found that separate collection of garden and food waste increased the range of choice, making economical and environmentally-friendly decisions more easily obtainable.

55. While home composting remains the preferred option for garden waste, there will be circumstances when it is not practical. Green waste can be collected by local authorities from kerbside collection schemes for household waste and can be delivered by householders to civic amenity sites.

56. Collecting this waste separately allows it to be windrow composted in the open air – the cheapest and most common treatment for collected garden waste. This can provide citizens with a valuable service – particularly to those who (for a variety of reasons) may not want to compost their waste at home and/or are not able to access their local civic amenity site. Such a service could even reduce the collective environmental impact of individual householders transporting their green waste to local civic amenity sites for composting.

57. An evaluation of composting by ERM[15] found that composting yielded net carbon savings, although not as significant as those offered by anaerobic digestion (AD). It performed relatively poorly if compost products were assumed to displace organically-derived, low-intensity alternatives. By concentrating on low value uses of composting, the savings could have been underestimated. It is acknowledged that there is a lack of evidence on these points. This shortfall is now the subject of further study funded by Defra. Compost also offers the potential to sequester carbon in soils (and in landfill) and to improve soil fertility and water retention, which may confer additional climate change benefits.

58. The Eunomia Report investigated 'the most cost effective and environmentally sustainable ways of diverting household food waste from landfill that leads to the production of a saleable product'. The report concluded that collecting food waste separately allows processing costs to be minimised but can also increase the amount of waste captured.

59. There are two established technologies for treating food waste: in-vessel composting (IVC) and (AD).[16] IVC requires a structural material and typically garden waste is used at around 50% by weight to process food waste. However, this has the built-in disbenefit of being a significantly more expensive method of treating garden waste than windrow composting.

[13] Wheeler and Parfitt (2002) *Life Cycle Assessment of Home Composting*, Proceedings of Waste 2002 Conference, Stratford.

[14] Eunomia for WRAP, *Dealing with Food Waste in the UK,* March 2007; available at http://www.wrap.org.uk/local_authorities/biowaste.html

[15] Carbon Balances and Energy Impacts of the Management of UK Wastes, report by ERM (with Golder Associates) for Defra, Final Report, March 2007 available at http://www2.defra.gov.uk/research/project_data/More.asp?I=WR0602&M=KWS&V=Carbon+balance&SUBMIT1=Search&SCOPE=0

[16] See Chapter 5 of WS2007 for more information on energy from waste.

60. By contrast, food waste can be treated alone through AD without the need to divert garden waste from cheaper windrow treatment and with tangible environmental benefits.

61. The ERM Carbon Balances Report found that a significant carbon benefit could be obtained through energy recovery via anaerobic digestion of kitchen wastes. This is primarily the result of avoiding landfill methane and offsetting fossil energy generation (energy recovery). As food/kitchen waste rapidly degrades, AD conveys climate change and energy benefits over landfilling/landspreading of raw wastes.

62. The Eunomia Report also found significant benefits for AD, suggesting that if 5.5 million tonnes of food waste were targeted for separate collection then 639 GWh of electricity could be generated per annum. Electricity produced by anaerobic digestion is eligible for support under the Renewables Obligation, the Government's main mechanism to encourage growth in renewable electricity generation. Routing the material through AD as opposed to composting would save at least 0.25 million tonnes CO_2 equivalent per annum, based on the assumption that the displaced source is gas-fired electricity generation and this is higher if it is a combined heat and power operation.

Combined treatment of municipal and commercial food waste

63. Research has also shown that there are significant economies of scale associated with processing infrastructure but this is particularly the case for AD. So, even though the AD and IVC plants may well be viable sourcing municipal only or commercial and industry waste only, it may be much more deliverable if plants take waste from combined sources.

Current/planning action and initiatives

Landfill diversion

64. The UK is bound by the Landfill Directive (99/31/EC) which sets mandatory targets for the reduction of biodegradable municipal waste sent to landfill. The UK national targets are:

- by 2010 to reduce biodegradable municipal waste landfilled to 75% of that produced in 1995;
- by 2013 to reduce biodegradable municipal waste landfilled to 50% of that produced in 1995;
- by 2020 to reduce biodegradable municipal waste landfilled to 35% of that produced in 1995.

65. Under the **Landfill Allowance Trading Scheme** (LATS)[17] authorities responsible for waste disposal have been allocated decreasing allowances for the maximum amount of biodegradable municipal waste they can landfill each year until 2020. This acts as an additional pressure to the **Landfill Tax**, which applies to both C&I and municipal wastes – including organic waste – and is dealt with in more detail in Chapter 2 of *Waste Strategy for England 2007*.

[17] See Annex C1 for further information on LATS.

Promotion and support of home composting

66. **WRAP's Home Composting Scheme** supports local authorities in encouraging and supporting households to begin or continue to home compost their own organic waste. The objectives of the WRAP home composting scheme include:

- procuring, promoting and distributing subsidised compost bins to households in partner areas throughout England; and
- engaging with householders to promote the ongoing use of their compost bin and in doing so recycle an increased amount of biodegradable household waste.

67. During the 2004–06 Business Plan period, over one million home compost bins were ordered and distributed to composting households during three growing and gardening seasons, giving the capacity to divert over 275,000 tonnes of biodegradable municipal waste. The aim for the current business plan is that by 2008 WRAP will have distributed a further 1 million supported compost bins.

68. To maximise diversion of organic waste from landfill, new partners are being sought in areas most likely to introduce completely new composters. In places were home composting is established WRAP will focus promotional activity on persuading existing composters to compost more materials. By March 2008 it is expected that 40% of UK households will be composting at home, an increase of 5% over two years.

69. The impact on this management path needs to be taken into account when planning garden waste collections, particularly when these collections are free to householders. As mentioned in *WS2007* (Chapter 2) during 2007 the Government intends to review the operation of the Landfill Allowances Trading Scheme (LATS). A UK-wide working group, convened by WRAP and including local authority representation, will explore options for monitoring the impact of supported home composting schemes on diversion of municipal waste from landfill. The recommendations from this group will inform the operational review of LATS in England.

Promotion of green waste collection

70. Green waste which is sent for composting in line with Best Value Guidance counts towards a local authority's household waste recycling and composting rate. This can help authorities to meet their household waste recycling and composting targets – which were set for each authority in 2003/04, 2005/06 and in 2007/08.

71. In October 2006 the Government published the local government white paper, which sets out a radical simplification of the local authority performance framework including fewer indicators and centrally set targets (2007/08 will be the final year of best value performance indicators and targets).

Capacity and markets for compost treated centrally

72. **WRAP's Organics Programme**, to 2008, has three aims. These are to:

- increase capacity for composting source-segregated organic waste by 450,000 tonnes per annum by March 2008 through a capital support programme with a focus on expanding processing capacity for food waste;

- open up the brownfield redevelopment market to BMW-derived compost, specifically developing 20 trailblazer projects using 100,000 tonnes of waste-derived compost by March 2008. WRAP will work with developers and planners to identify barriers to use of BMW-derived compost, and how they can be overcome; and
- increase demand for quality BMW-derived compost by 25% by March 2008 (especially compost produced to BSI PAS100:2005 specification) in the existing markets of professional and amateur horticulture, landscaping and agriculture and overcome barriers to adoption by working directly with key users of compost products.

73. WRAP will work with Defra and the Environment Agency to establish the maximum feasible scope to apply waste-derived compost to land. The first component of this work is a study called ALOWANCE, looking at the extent to which Nitrate Vulnerable Zones and other pollutant ceilings act as a barrier, whose findings will be available late in 2007.

74. The programme will try to achieve these aims through a number of projects which will include:

- a series of 20 food waste collection trials with local authorities investigating the practicalities of food waste collections and the consumer response to these;
- a capital support programme, to encourage the construction of new composting infrastructure which makes BSI PAS100 compost. This programme will support windrow composting, IVC and AD projects, given the findings of the Eunomia research[18] on which are the most cost effective and environmentally sustainable ways of recycling food and garden waste;
- using a combination of field trials, trailblazer projects and case studies to demonstrate the cost benefits of using compost in its main markets of agriculture, horticulture and landscaping. To help this process WRAP, EA, the Composting Association and the Environmental Services Association have produced a quality protocol for compost (based on BSI PAS100), which defines how garden and kitchen waste can be processed into a product that can be supplied free of waste management regulations;[19]
- promoting the findings of the trials and case studies to the target markets and working with customers and their trade bodies to establish how best to use compost. This includes encouraging consumers to buy horticultural products that contain compost for use in their gardens.

Energy recovery

75. The Carbon Trust and WRAP are cooperating to support the development of plants to deal with both source-segregated municipal waste and that from C&I sources; with the aim of diverting BMW from landfill. This project will also support plants which process garden waste either with food waste using in-vessel composting plants or in windrows. It involves:

- encouraging joint infrastructure for municipal food/garden waste and C&I waste. WRAP's Organics Programme will work on this with the Carbon Trust's 'In Source Energy' company;[20]

[18] Eunomia for WRAP, *'Dealing with Food Waste in the UK'*, March 2007; available at http://www.wrap.org.uk/local_authorities/biowaste.html

[19] The quality protocol for compost, published in March 2007, was developed by WRAP and the EA using BREW funding. It is available from the Environment Agency website at www.environment-agency.gov.uk/subjects/waste/1019330/1334884/1713670/?lang=_e

[20] www.carbontrust.co.uk/commercial/enterprises/insource_energy.htm

- technology advocacy with key stakeholders to help put together capital projects that exploit the synergies between source-segregated food waste streams; and
- working with other delivery bodies including Envirowise and the National Industrial Symbiosis Project (NISP) to attract interest from suitable businesses.

76. The Environment Agency, Scottish Environment Protection Agency (SEPA) and WRAP are working with the Renewable Energy Association and others to develop a standard and quality protocol for anaerobic digestate. If successful, this work will bring similar benefits to the market for digestate to those conferred on quality compost by the existing compost quality protocol.

77. Defra's Waste Implementation Programme (WIP) is working with WRAP to run the Greenfinch AD plant solely on food waste, to examine the operational and economic implications. WRAP will investigate markets for the digestate and promote the findings to local authorities and the waste management industry.[21]

Retailers and manufacturers

78. The **Courtauld Commitment** between major food and drink retailers, manufacturers and WRAP aims to reduce packaging waste and 'to identify ways to tackle the problem of food waste'. In November 2006 the signatories agreed to support WRAP's business plan target of securing 100,000 tonnes of household food waste reduction by March 2008. WRAP is now extending the Courtauld Commitment to food and drink brands and manufacturers.

79. The **Food Industry Sustainability Strategy** commits the food industry to reducing the amount of household waste going to landfill, including through minimising waste at source (including food waste), encouraging use of re-usable shopping bags and promotion of composting and recycling. It sets a target of a 15–20% reduction in the food manufacturing industry's own wastes by 2010. Implementation is now being discussed.

[21] See Chapter 5 of WS2007 for more information on energy from waste.

4. Aluminium

Rationale

80. Aluminium is produced from bauxite, a clay-like ore that is rich in aluminium compounds. The aluminium is only found as a compound called alumina, which is a hard material consisting of aluminium combined with oxygen. This alumina has to be stripped of its oxygen in order to free the aluminium. The alumina is dissolved in a molten salt at a reduction plant and a powerful electric current is run though the liquid to separate the aluminium from the oxygen. This process uses large quantities of energy.

81. Non-ferrous metals (of which aluminium is one) can be recycled indefinitely without losing any of their properties.

Facts and figures

82. It is estimated that 2 million tonnes (1.8 million from the C&I stream and 200,000 from the household stream) of non-ferrous metal arise in the UK each year.

83. According to the Aluminium Federation (Alfed) no data is really available on yearly arisings of prompt and end-of-life aluminium scrap arisings and so most of the figures in Table D.5 below have been developed using Alfed methodology.

Management routes

Aluminium consumption and re-use

84. Recycling rates for individual sectors are not readily available and although recycled amounts are shown in Table D.5, it is not clear how they were derived. The three largest markets for aluminium are **transport, construction** and **packaging** (for which the recycling rates are the most accurate). The recycling rate for engineering is thought to be relatively accurate as concentrations of aluminium are large but the weakest figure is for consumer durables.

85. Assuming that the recycling rates are reasonably accurate the largest losses of end-of-life aluminium occur in the **engineering, packaging** and **consumer durables** sectors.

Table D.5: Aluminium waste arisings and percentage recycled, UK (2005)

Sector	%	Tonnage consumed	Waste arising	Household arisings	C&I arisings	Recycled amount	Recycled %
Engineering	13	117,000	93,990	n/a	n/a	70,493	75
Consumer durables	9	81,000	95,850	95,850	n/a	47,925	50
other	6	54,000	19,580	n/a	n/a	9,790	50
Transport	21	189,000	232,980	n/a	n/a	221,331	95
Packaging	21	189,000	141,500*	134,000	7,000	39,956	28
Building	30	270,000	42,510	n/a	n/a	40,385	95
Prompt scrap	–	–	80,778	–	–	80,778	–
Total	100	900,000	707,188	510,658			

Breakdown (includes process scraps and housefoil):

* Figure is for 2005. Amount rises to 142,915 (2006), 144,344 (2007), 145,788 (2008), 147,245 (2009), 148,718 (2010).

Source: Alupro website/Defra data/Aluminium Federation.

86. According to the ERM Carbon Balances Report, the breakdown shows the amount of recycled aluminium to be 510,658 tonnes – although the reported figure is said to be 546,198. It is shown that 707,188 tonnes of waste arises but again the reported figure is said to be higher at 752,638. The difference in figures, however, makes no difference to the recycling rate which is between 72–73% for 2001 (but based on packaging figures for 2005).

87. The aluminium recycling rate is now believed to have risen to 74% in 2005. The 700,000–750,000 tonnes arising in the used material stream is dealt with as shown in Table D.6 below.

Table D.6: Aluminium waste arisings and management routes

Waste arising (tonnes)	Destination
200,000	Exported and recycled aboard
450,000	Recovered and recycled domestically
160,000	Landfill
Total: 810,000*	

*Takes into account manufacturing and industry stockholding practices.

Source: Industry estimates.

88. These results show that around 200,000 tonnes of aluminium is not being recovered which could be accumulating in use or lost to landfill (160,000 tonnes from household/C&I streams and 40,000 tonnes from dissipative uses). However, although the figures do show there is room for improvement in recovering aluminium, they also indicate that there are no substantial aluminium flows unaccounted for.

89. The latest British Metals Recycling Association (BMRA) report states that the majority of the UK's aluminium scrap exports go towards non-EU markets (China and India took two-thirds in 2005).

Environmental benefits

90. The carbon benefits of recycling aluminium are significant due to its high embedded energy, which is higher than for any other material. Arisings of aluminium waste are estimated at about 700,000 tonnes per year, of which about 500,000 tonnes is recycled. The largest losses of end-of-life aluminium occur in the engineering, packaging and consumer durable sectors. Provisional estimated recycling rates for these sectors are:

- engineering 75%;
- packaging 28%; and
- consumer durables 50%.

91. Recycling of all metals yields significant greenhouse gas and energy benefits. However, ferrous metals already achieve a high rate of recycling and the greatest further potential lies with non-ferrous metals, and particularly aluminium due to its high embodied energy. Each tonne of aluminium recycled saves 11 tonnes of CO_2.

Challenges

92. In order to establish exactly where further significant levels of aluminium waste arise, existing data and current recycling processes will be further examined. For example, in the building industry the window frames in houses are recycled at a high turnover but it must be clearly established which other items contain aluminium.

Current/planned actions and initiatives

93. The Packaging Regulations are intended to encourage the reduction of packaging and packaging waste, incentivise re-use and increase the recovery and recycling of packaging waste. Aluminium packaging recycling levels are stated in Table D.5 above.

94. The ELV Regulations and the recent implementation of the WEEE Directive will lead to increased recovery and recycling of aluminium.

95. A national scheme for recycling cans was launched which has increased recycling of these from 2% (1989) to 42% (2001), according to Alupro. It is believed that 2005 levels were 41%.

96. The Government will be developing proposals (subject to further analysis) for higher packaging recycling targets beyond the 2008 Directive targets and Defra will also consider commissioning work to improve data on aluminium waste arisings and management.

5. Glass

Rationale

97. ERM's first report indicates that the carbon benefits from recycling glass bottles back into glass bottles are quite significant.[22] WRAP has separately assessed these benefits and confirmed them to be substantial[23]. In addition, local authorities have been active in this area since the first bottle bank was introduced in 1977 and householders see glass as an obvious material to recycle.

98. Furthermore, the carbon benefits derived from closed loop recycling (e.g. container glass recycled as containers) are not currently being optimised in view of both the quality of material currently being collected and competition from other markets of far lower carbon benefit (e.g. aggregates).

Facts and figures

99. Data for glass recycling is more reliable for container glass than for other forms. In 2006 the container glass waste stream was 2.5 million tonnes. Final data for container glass recycling during 2006 is not yet available but in 2005 it was 1.26 million tonnes. Of this only 742,000 tonnes was recycled within the domestic container industry, although a further 242,000 tonnes was exported to continental Europe for new container manufacture. The balance of 274,000 tonnes was mainly used in aggregates applications of marginal carbon benefit.

100. Figures on total waste glass arisings (including flat, cathode ray tube (CRT) and lighting glass) are believed to be around 3.5 million tonnes. CRT glass arisings are 100,000 tonnes, lighting glass 20,000 tonnes and flat glass from all sources no more than 800,000 tonnes.

Management routes

Collection and markets

101. The growth of mixed-colour glass collection is putting pressure on the economic viability of glass recycling and its use for container manufacture in the UK. To help address this, WRAP has initiated work on a package of interventions in this area: providing advice to local authorities on the impact on material value of both mixed-colour and co-mingled glass collection and monitoring the need for intervention on colour sorting capacity.

102. Coupled with this, there is a colour imbalance within the UK due to imports of wine, packaged mainly in green glass, and exports of spirits, mainly in clear glass. Indeed, some 60% of UK production is in clear glass and only 20% is green, whereas green arisings represent approximately 50% of the total in the glass container waste stream. WRAP is working with the wine supply sector and retailers in order to redress this imbalance by encouraging more import in bulk shipping containers, followed by bottling in the UK. This not only reduces green imports but also increases domestic manufacture of green glass.

[22] *Carbon Balances and Energy Impacts of the Management of UK Wastes,* report by ERM (with Golder Associates) for Defra, Final Report, March 2007 available at http://www2.defra.gov.uk/research/project_data/More.asp?I=WR0602&M=KWS&V=Carbon+balance&SUBMIT1=Search&SCOPE=0

[23] *Environmental Benefits of Recycling: An international review of life cycle comparisons for key materials in the UK recycling sector,* WRAP (May 2006). See http://www.wrap.org.uk/wrap_corporate/about_wrap/environmental.html for further information.

103. Furthermore, bulk importing of wine provides substantial carbon savings. Combined with the carbon savings derived from reducing bottle weight (light-weighting), savings for just one of Australia's top selling wines would be 1,220 tonnes of carbon.

Challenges

104. Key challenges include the need to encourage more colour-separated glass collections, reduction in contaminants from glass collection systems and capturing more of the clear glass from the residual household waste stream (jam jars are not recycled to the same extent as glass bottles). Innovations are also required to stabilise the demand for glass packaging and closed loop recycling.

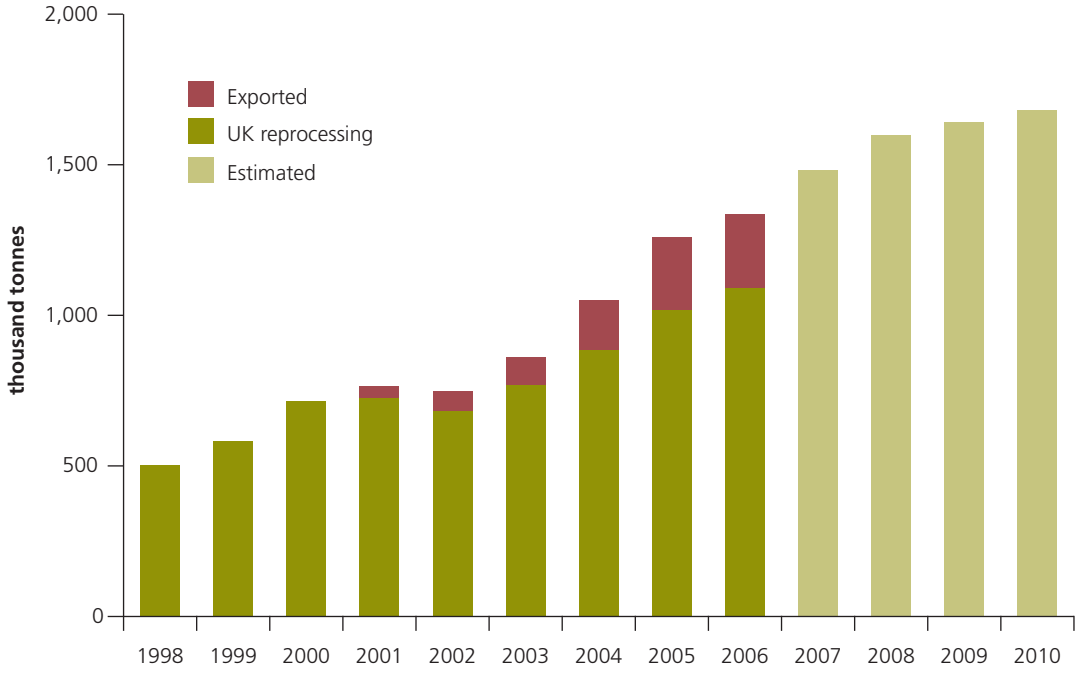
Markets and capacity

105. The growth in container glass recycling has been dramatic in recent years, driven by both the Packaging and the Landfill Directives (see Chart D6). From 2002 it has doubled mainly through the increase in kerbside collection availability.

106. Markets for the collected material have not been difficult to find. The domestic container glass sector continues to increase its output and demand for all but green glass still exceeds supply. That which is not recycled in this way finds its way to container markets in Europe, as an aggregate substitute or, increasingly, in fibreglass insulation manufacture. Several emerging markets are still developing including filtration media, brick manufacture and grit blasting.

107. These markets between them provide ample capacity to absorb anticipated recycled tonnages through to 2010 and beyond, although some are dependent on the presence of PRN (PERN) revenue (notably aggregates and European export).

Chart D.6: Recovery and recycling of glass packaging in the UK, (1998–2010)



2006 data annualised from data to Q3.
Data for 2007–10 from DEFRA projections.
Source: DEFRA and NWPD.

108. Several markets require colour-separated glass (predominantly container glass but also some filtration markets) and the growth in mixed-colour glass collection has introduced a mechanical colour-sort processing stage for this material. The efficiency of the technology involved means that up to 25% of the clear glass is unable to be separated economically.

109. Furthermore, the quality of glass delivered to processors has deteriorated with increasing contamination by ceramics and pyroceramics, both of which cause problems in glass manufacture. Beyond these specific contaminants, more general contamination is an issue, particularly for glass recovered through MRFs.

110. The environmental benefits of recycling glass back into new containers are well documented.[24]

Current/planned action

111. Action centres on three main areas: creating demand for recycled glass, waste reduction and increasing collection. WRAP in particular is helping to drive progress in these areas.

112. Actions to **stimulate demand for recycled glass** include the following:

- creating stable domestic demand for glass through WRAP's efforts to encourage greater UK bottling of bulk imported wine. This not only reduces green imports but also increases domestic green manufacture, thereby reducing the colour imbalance;

[24] *Environmental Benefits of Recycling: An international review of life cycle comparisons for key materials in the UK recycling sector,* WRAP (May 2006) See http://www.wrap.org.uk/wrap_corporate/about_wrap/environmental.html for further information

- understanding the implications and trends in materials substitution and exploiting them;
- prioritising alternative end applications to target those with both high value and positive carbon impact. It is important that the carbon benefits of recovered glass are maximised. For this to happen glass should be preferentially directed toward those markets which achieve this;
- supporting specification of recycled content by users will provide an additional driver for increased use of cullet by the container sector.[25] WRAP is currently engaged in work to encourage designers, brands and retailers to specify recycled content in their glass packaging. For this to be effective, however, sufficient recycled glass must be collected in such a way that it can be processed to meet the relevant quality specifications;
- investigating the potential of using labelling to influence consumer choice. This provides a logical adjunct to the recycled content work, through ensuring that the consumer is informed about the benefits of one packaging form as opposed to another;
- promoting growth in the fibreglass sector. There is a short-term opportunity in this sector to take advantage of the increased demand for house insulation. UK production of fibreglass insulation is anticipated to grow significantly over the next few years in order to keep up with supply. Furthermore, all manufacturers are using substantial proportions of recycled flat or mixed-colour container glass in their processes which will grow with both increasing output and as a percentage of recycled content;
- determining and exploiting end market opportunities for difficult materials, e.g. cathode ray tubes (short-term issue), plasma screens and ELV glass;
- ensuring that existing producer responsibility schemes (Packaging, WEEE and ELV) deliver against Directive targets;
- understanding the ongoing market constraints from the collection of mixed-colour glass and determining the need for any intervention (including promotion of collection of colour-segregated material);
- overcoming the barriers (technical and others) to using recycled glass in flat glass production. This sector currently uses only small amounts of recyclate and there is significant potential for growth. Any voluntary agreement could be extended to cover recycling of flat glass, providing a real driver for flat glass collection.

113. Actions to **reduce glass waste** include:

- 'light-weighting' the amount of glass in packaging and products, following 'best in class' analysis. This design work is being carried out by WRAP with retailers and brand owners under the umbrella of the Courtauld Commitment.

114. Actions to **increase collection of glass waste** include:

- maximising the amount of glass that is collected in the right form for the container sector to use, through advocacy work with local authorities so that the cullet quality issues are fully understood and collection schemes are able to meet these.

[25] WRAP is currently undertaking an initial study into understanding the economic drivers for the container sector to use cullet which will make recommendations for further work.

- developing and trialling collection services for glass from both small and larger businesses (e.g. licensed premises). Significant opportunity exists here to ensure that this glass is diverted from landfill. It is estimated that only 160,000 tonnes of commercial glass was collected in 2005/06 out of up to 600,000 tonnes discarded;
- promoting collection of jars. This is potentially a good source of glass, in particular clear glass, as many members of the public are less aware of the need to recycle these containers as well as bottles. This is particularly relevant given the scope for the container industry to use far more clear glass than is currently collected for recycling.

6. Plastics

Rationale

115. A very wide range of products contain plastics. It is estimated that plastics in products covered by producer responsibility legislation account for around half of post-consumer plastics in the UK. The Packaging Regulations[26] set a plastics specific target so data on amounts of plastic packaging waste arising and the amount recycled is good. Plastic packaging and plastic bags are also a significant focus of public concerns about waste.

116. The production and use of plastics has a range of environmental impacts. Plastics production requires significant quantities of resources, primarily fossil fuels, both as a raw material and as energy during the manufacturing process. It is estimated that 4% of the world's petroleum production is used as a feedstock for plastics production and an additional 3–4% during manufacture.[27]

117. There are carbon benefits to closed loop recycling of plastics, but where plastics are burned for energy from waste (EfW) there may be a net greenhouse impact due to the release of fossil carbon which can outweigh the returns of energy recovery.

118. Collection of plastics for recycling is not currently attractive to local authorities, because of a combination of weight-based recycling targets and the EU Landfill Directive targets, which are based on biodegradable municipal waste (BMW). In addition, plastics can be difficult and expensive to collect and recycle and are often exported for recycling.

Facts and figures

119. The total amount of plastic waste arising in the UK is estimated at 5.9 million tonnes per annum. Just over half (3.1 million tonnes) of this is plastic film, with the other half (2.8 million tonnes) being dense plastic. About 2.3 million tonnes of the total arises in the municipal waste stream, around 2.5 million tonnes in the commercial waste stream, 0.8 million tonnes in the industrial waste stream and 0.1 in the agricultural waste stream.[28] In 2002 WRAP estimated that plastics made up about 7% of the household waste stream.[29]

120. Plastics are found in a wide range of products and their use by industry sector can be approximately divided as shown in Chart D.7 below.

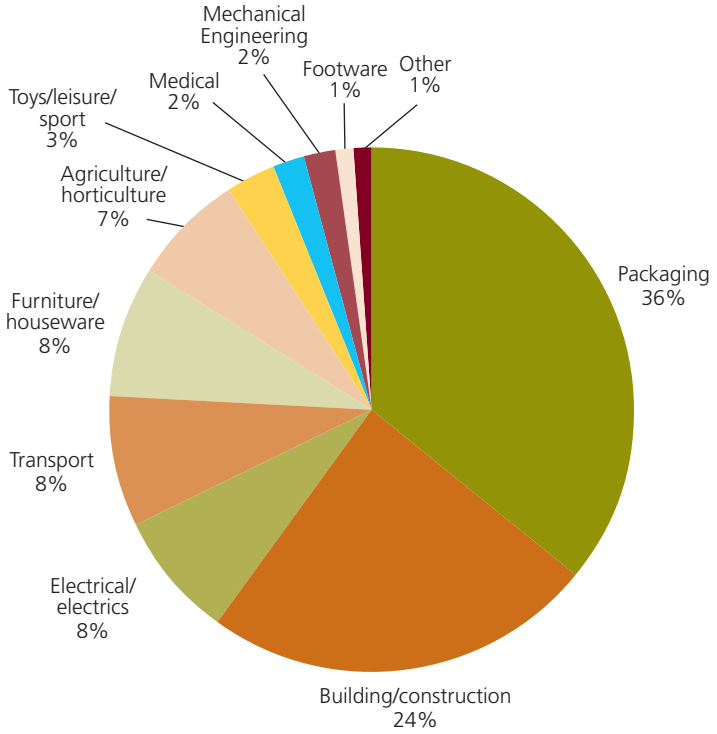
[26] The Packaging Directive (94/62/EC on packaging and packaging waste) of 1994 is implemented in the UK through the Producer Responsibility Obligations (Packaging Waste) Regulations 2007 (the 'Packaging Regulations'), as well as regulations in Essential Requirements. See Annex C8 for more information on packaging and packaging waste.

[27] See http://www.wasteonline.org.uk/resources/InformationSheets/Plastics.htm for further information.

[28] *Carbon Balances and Energy Impacts of the Management of UK Wastes*, report by ERM (with Golder Associates) for Defra, Final Report, March 2007 available at http://www2.defra.gov.uk/research/project_data/More.asp?I=WR0602&M=KWS&V=Carbon+balance&SUBMIT1=Search&SCOPE=0

[29] See http://www.wrap.org.uk/ for further information.

Chart D.7: Plastic waste arisings in different sectors



Sources: UK Consumption of Plastics by Market Sector, 2000, Valuplast Ltd (2002).[30]

121. Plastics in products covered by producer responsibility legislation – packaging, end-of-life vehicles (ELVs), waste electrical and electronic equipment (WEEE) and farm plastics – account for almost half of all plastics. Around one-third of plastic waste is in the packaging sector (1.9 million tonnes)[31]. Within plastic packaging waste, about two-thirds of this is estimated to arise in the household waste stream and one-third in the C&I waste streams.[32] Other sectors which contribute to plastics waste are the electrical and electronic sector (0.4 million tonnes),[33] ELVs (0.2 million tonnes)[34] and agriculture (farm plastics: 0.09 million tonnes).[35]

122. Due to the Packaging Regulations detailed information is available on packaging plastics. The trends for the tonnage of plastic packaging flowing onto the UK market and recycled packaging plastics are estimated as shown in Table D.7.

[30] See http://www.wasteonline.org.uk/resources/InformationSheets/Plastics.htm for further information.
[31] See http://www.defra.gov.uk/environment/waste/topics/packaging/pdf/package-datanote.pdf for further information.
[32] See http://www.valpak.co.uk/nav/page1607.aspx for further information.
[33] See http://forum.europa.eu.int/Public/irc/env/weee_2008/library?l=/gatheringframework_1/_EN_1.0_&a=d for further information.
[34] TRL Report (PR SE/483/02) 2003.
[35] Environment Agency Agricultural Waste Survey 2003.

Table D.7: Plastic packaging arisings and amounts recycled (tonnes)

	2001	2002	2003	2004	2005	2006	2007	2008
Estimated arisings	1,678,900	1,740,000	1,792,200	1,845,966	1,901,345	2,079,865	2,121,462	2,163,891
Recycled	269,962	360,418	321,205	344,317	414,225			

Source: Defra.[36]

123. The construction sector is also a significant end-user of plastics for applications such as damp-proof membranes, ducting and piping and sheeting for ground workings. The nature of products such as underground piping dictates that recovery/recycling is not possible. There is very limited data available for arisings in the construction and demolition sector as the main surveys have focused on arisings of rubble and secondary aggregates.

124. The use of **biodegradable/degradable plastics** offers a potentially attractive way to close the recycling loop for this material and could reduce the amount of plastics going to landfill, but this route needs to be treated with some caution. The potential impacts of biodegradable/degradable plastics are not clear cut; not all are suitable for composting as, depending on their composition, they may degrade to leave residual fine plastic particulates. The origin of the plastics – biogenic or fossil – will also influence how they can be managed as waste and their carbon impacts. For example, biodegradable plastics have the potential to contaminate recycling processes, and will produce methane when landfilled. WRAP is undertaking further work to understand and manage the implications of biodegradable plastics as part of its work in support of the Courtauld Commitment.

Management routes

Recovered plastics sector

125. There are around 50 different types of plastics – all of which can, theoretically, be recycled, although recycling is not an environmentally friendly option for all types of plastics. An increasing number of local authorities now collect plastics as part of their recycling service or provide drop-off facilities at civic amenity sites.

126. **Re-using** plastic is preferable to recycling as it consumes less energy and fewer resources. Long-life, multi-trip plastics packaging has become more widespread in recent years, replacing less durable, single-trip alternatives, so reducing waste. For example, the major supermarkets have increased their use of returnable plastic crates for transport and display purposes fourfold from 8.5 million in 1992 to an estimated 35.8 million in 2002. They usually last up to 20 years and can be recycled at the end of their useful life.[37]

127. The British Plastics Federation (BPF) has estimated that consumption of post-consumer plastics was 4.7 million tonnes in 2001 and that recycling accounted for 6% or 295,000 tonnes.[38]

128. Recycling methods include: direct recycling to virgin plastic, re-melting and extrusion, grinding and mixing with fillers and adhesives.

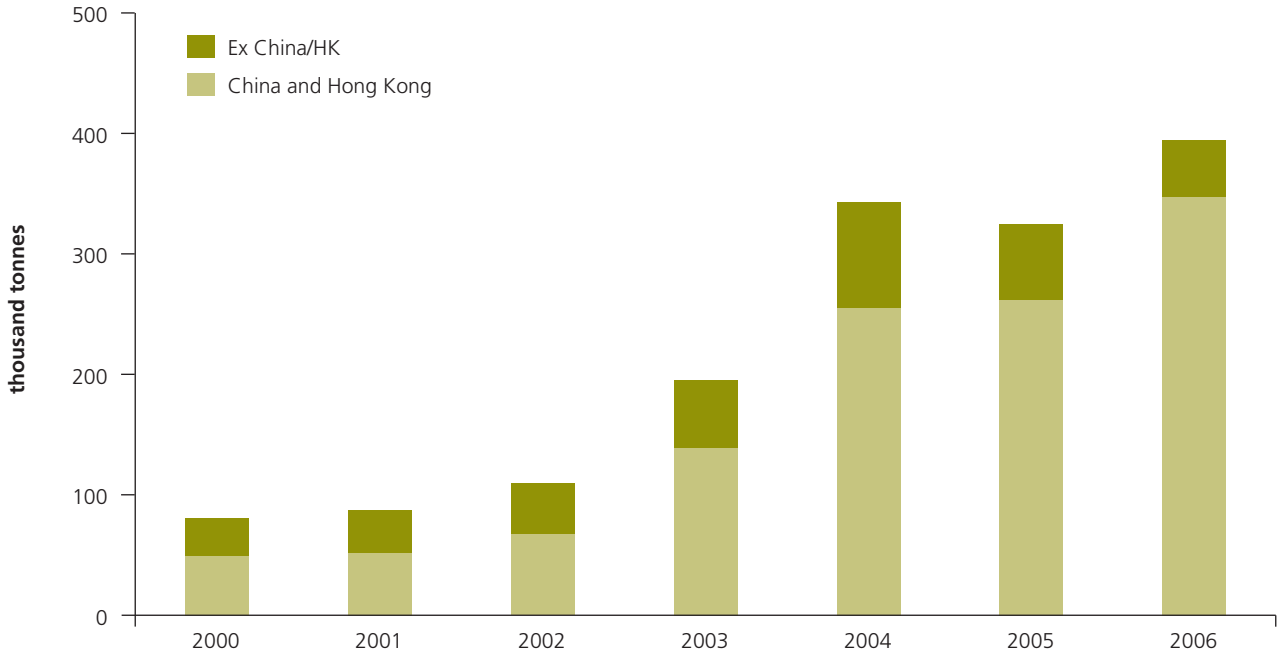
[36] See http://www.defra.gov.uk/environment/waste/topics/packaging/data.htm for further information.
[37] See http://www.wasteonline.org.uk/resources/InformationSheets/Plastics.htm for further information.
[38] See http://www.defra.gov.uk/environment/statistics/waste/download/xls/wrtb23.xls for further information.

Markets and capacity

129. Exports of recovered plastics have increased sharply in recent years (see Chart D.8 below), again driven by an increase in exports to China.

130. The market for recovered plastics is not as mature as, say, that for paper, reflecting the greater difficulty of closed-loop recycling and the less well-developed nature of the collection infrastructure.

Chart D.8: Exports of recovered plastics, (2000–2006) ('000 tonnes)



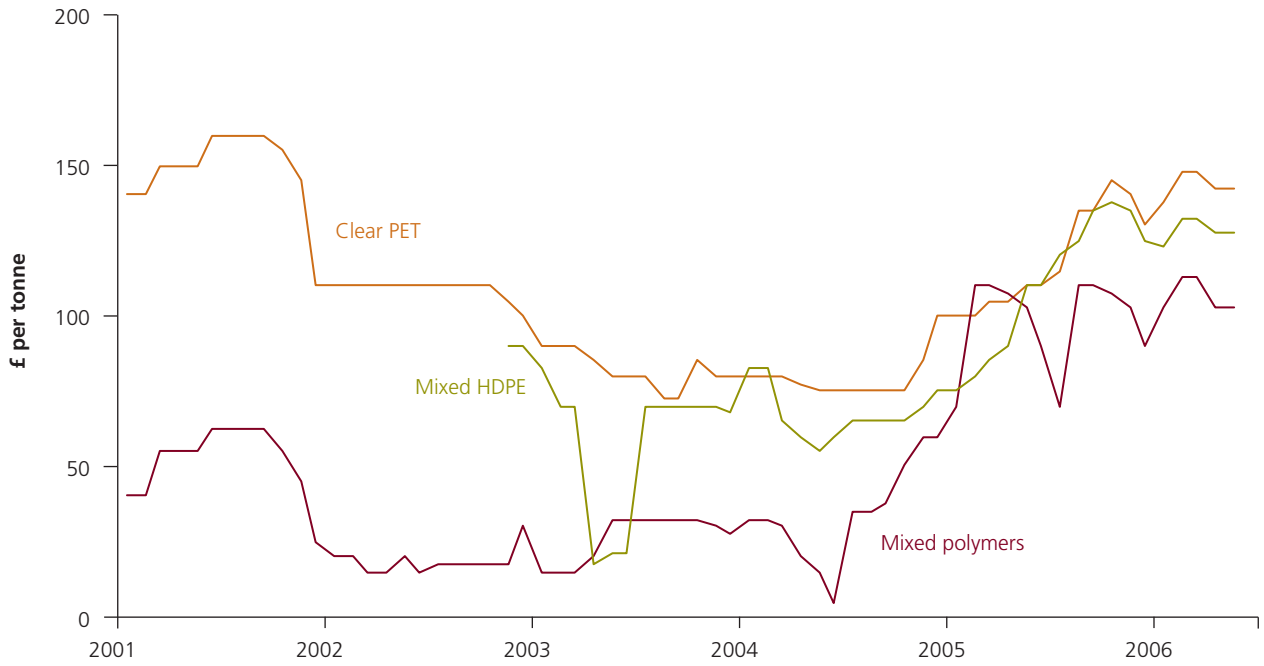
Source: HM Revenue and Customs.
2006 data annualised from Q1 data.

131. Prices for recovered plastics have been somewhat more volatile than those of recovered paper in recent years (see Chart D.9, which shows the average prices of clear PET, mixed HDPE[39] and mixed polymers since 2001). This is likely to reflect the nature of the market for recovered plastics, which is particularly sensitive to fluctuations in oil prices (a key raw material in plastics manufacture).

132. Although price volatility can discourage investment in an industry, it does not necessarily imply that a market is immature or that there is a market failure (for example, more established markets, such as for oil and commodities, have also experienced price volatility in recent years). Similarly, price stability does not imply a developed market.

[39] PET – Polyethylene terphthalate, HPDE – High Density Polyethylene.

Chart D.9: Recovered plastic prices, (2001–2006)



Sources: LetsRecycle.com, midpoints of range.

Challenges

133. Use of plastics is widespread but, generally speaking, they are not attractive for local authorities to collect – due to difficulties such as separation, cross-contamination and volume versus weight issues due to their relatively low density.

134. The many different types of plastics in use make closed-loop recycling difficult. There are limited markets for recyclate mixed plastics.

135. The value of recycled plastics is linked to oil prices – if virgin polymer prices remain high, then recyclates will be able to maintain a competitive advantage and it is likely that all plastics predicted to be collected by 2015 will be recycled to useful end applications. However, if virgin prices were to fall, then recyclates could struggle to be competitive, although this scenario seems to be less likely to occur as demand from the emerging economies for petroleum products and pressures on supplies increase.

Current/planned action and initiatives

136. The waste stream summaries on packaging and packaging waste, ELVs, WEEE and agricultural waste (including farm plastics) in Annex C include information on policies, targets and actions that address issues around the re-use and recovery of plastics in these waste streams.

137. WRAP is working with retailers and manufacturers to build on the Courtauld Commitment, aiming to increase further their use of recycled content in packaging and to reduce packaging waste. With support from WRAP, some retailers are already including up to 30% recycled content in plastic packaging following research showing that this is economically and commercially viable. WRAP is also working on:

- procurement to encourage retailers and brand owners to specify recycled content;
- encouraging retailers to use materials for which recycling is demonstrated, i.e. PET and HDPE and to avoid PP and PS[40] including providing support for demonstration trials to substitute PET/HDPE for other plastics; and
- evaluating the feasibility of encouraging retailers to reduce the use of non-rigid plastics (film, etc.) and move to rigid plastics that material recycling facilities (MRFs) can handle. This may have adverse waste minimisation implications so requires careful assessment.

138. Two early objectives for WRAP's Plastics Programme, which will focus on projects where a major shift in material use from virgin to recycled can be achieved, have been identified. These are:

- to include up to 30% of recycled HDPE in the manufacture of one-quarter of the UK's plastic milk bottle production; and
- to include up to 50% of recycled PET in selected plastic food containers and up to 30% in plastic bottles, building on successful trials with Coca-Cola Enterprises Ltd and Marks & Spencer.

139. Other WRAP projects include:

- mainstreaming the use of recycled PET and recycled HDPE in packaging applications, in particular, food grade applications.[41] Additional demand is likely to require further investment in rPET[42] reprocessing capacity, and WRAP consider that this, in turn, is likely to create demand for some kind of investment support;
- work on development of processing options and outlets for non-bottle plastics;
- investigating techniques, such as cracking processes, which could convert low quality plastics back into monomer material that can be reprocessed into new plastics. There are also significant carbon and other environmental benefits from the approach;
- understanding the implications of materials substitutions likely to result from increased scarcity of virgin materials and moves towards biodegradables;
- evaluating the potential for working with container manufacturers to reduce the range of variability in types of tops, labels, adhesives, etc. used, which cause difficulties in the reprocessing chain because of the many variants (and implement as appropriate); and
- work to understand and manage the implications of biodegradable packaging, linked to work on mixed plastics.

[40] PET – polyethylene terephthalate, HDPE – high density polyethylene, PP – polypropylene, PS – polystyrene.
[41] See http://www.wrap.org.uk/retail/case_studies_research/rpet_retail.html for further information.
[42] Recycled polyethylene terephthalate (rPET).

140. A further part of WRAP's Plastics Programme will look at managing waste plastic from new or difficult sources, e.g. WEEE and ELV. This will include:

- data generation to understand the nature and amounts of material that will arise in coming years;
- research into potential end applications and to overcome technical barriers to recycling (e.g. presence of additives);
- demonstration projects for potential end applications;
- work on standards and specifications; and
- work to encourage use of recyclates in new WEEE and ELV applications.

141. WRAP will also continue to work with the construction sector to improve its use of recycled plastics.

142. The Government will:

- develop proposals (subject to further analysis) for higher packaging recycling targets beyond the 2008 European targets to increase recycling; and
- support WRAP in its work currently under way to **increase recycling of plastics and the recycled content** of certain plastic containers.[43]

[43] See WRAP's business plan for 2006–08 at http://www.wrap.org.uk/wrap_corporate/about_wrap/wrap_business.html for further details.

7. Wood

Rationale

143. Wood has relatively low embodied energy (energy consumed in extraction) but high calorific value. Although for some kinds of wood waste re-use or recycling are better options, the ERM Carbon Balances Report found that use of wood waste as a fuel generally conveys a greater greenhouse gas benefit than recovering the material as a resource. Most waste wood is currently landfilled, so the key to realising the greatest carbon benefits lies in the availability of markets for waste wood (in the form of suitable combustion facilities) and development of the necessary supply chains.

144. Following recommendations in Sir Ben Gill's Taskforce on Biomass Energy report to Government in October 2005, Defra's Waste Implementation Programme (WIP), is taking forward work to develop energy markets for both refuse derived fuel (RDF) and waste wood.

Facts and figures

145. The best estimate, given by ERM in its Carbon Balances Report, is that there are around 7.5 million tonnes of waste wood produced annually in the UK. This is around 2% of total waste arisings. The vast majority (6 million tonnes, or 80%) is disposed of to landfill, with 1.2 million tonnes (16%) re-used and recycled, and 0.3 million tonnes (4%) incinerated with energy recovery.

146. Most waste wood arises in commercial and industrial waste streams, as well as from the construction and demolition sectors – where a study carried out for WRAP[44] suggested arisings of between 2 and 8 million tonnes. Municipal waste contains an estimated 1.1 million tonnes of waste wood (around 3% of UK municipal solid waste), making up 5% of biodegradable municipal waste.

147. The Environment Agency's Commercial and Industrial Waste Survey 2002–03,[45] estimated that in England waste wood made up 1 million tonnes (3%) of the commercial and 1.9 million tonnes (5%) of the industrial waste streams. The main sectors identified as having significant wood waste arisings were:

- wood and wood products sector – 1.15 million tonnes (78.4% of arisings in this sector);
- retail – 0.49 million tonnes (3.9% of arisings);
- furniture and other manufacturing – 0.19 million tonnes (28.7% of arisings); and
- transport, storage and communications – 0.14 million tonnes (6.3% of arisings).

148. Packaging Regulations data show that about 55% of wood packaging (0.77 million tonnes) was recovered and recycled in the UK in 2005, suggesting total waste wood packaging arisings of 1.4 million tonnes in commercial and industrial waste streams.

[44] *'Review of Wood Waste Arisings and Management in the UK',* WRAP 2005. See http://www.wrap.org.uk/manufacturing/info_by_material/wood/wood.html for further information.

[45] For more information see the Environment Agency Commercial and Industrial Waste Survey, 2002/03 at http://www.environment-agency.gov.uk/subjects/waste/1031954/315439/923299/1071046/?version=1&lang=_e

Management routes

149. WRAP's *Review of Wood Waste Arisings* also estimated that just over 50% of waste wood in the municipal waste stream arises at civic amenity sites, with around a further 40% collected from households – of which the majority is likely to be contained in the residual waste, rather than separated for recycling. The fraction arising at civic amenity sites should be relatively easy to segregate. Estimates for 2005/06 suggest that nearly 400,000 tonnes of waste wood collected at civic amenity sites was sent for recycling or re-use. Tentative estimates are that around two-fifths of waste wood in the municipal stream in England was captured for recycling or re-use, e.g. in the form of furniture.[46]

150. In 2005, the wood recycling industry estimated that it recycled about 1.5 million tonnes of waste wood a year, with capacity for 2 million tonnes and significant potential for growth.

Energy recovery – carbon benefits

151. Due to wood's relatively low embodied energy but high calorific value, the ERM Carbon Balances Report identified that recovering energy from waste wood, even at relatively low conversion efficiency, conveys a significantly greater greenhouse gas benefit than even high value recycling. Recovering energy from wood therefore presents one of the greatest potential carbon saving opportunities and is preferable to landfill and recycling, but not re-use of products such as wooden pallets or furniture, an aspect that was not assessed as part of the ERM report.

152. The greatest greenhouse gas benefit from recycling is obtained by recycling high quality wood into firewood or timber products. The scale of greenhouse gas benefit of energy from waste depends on the conversion efficiency of the combustion plant. Recovering energy from 2 million tonnes of waste wood, for example, could generate 2,600 Gwh electricity and save 1.15 million tonnes carbon dioxide equivalent emissions, with greater benefits available through using combined heat and power plant.[47]

Challenges

153. The key to realising the greatest resource efficiency and carbon benefits lies in:

- making better use of existing collection infrastructure for the purpose of aggregating waste wood from municipal and other sources;
- the availability of markets for waste wood (in particular WID-compliant plant) and development of the necessary supply chains; and
- the quality of waste wood, which is key to determining its suitability for re-use, recycling or energy recovery. More than half of arisings are understood to be too contaminated (e.g. with paint or preservatives) for re-use or recycling and so would require WID-compliant combustion facilities.

[46] R*eference Document on the Status of Wood Waste Arisings and Management in the UK*, by WRAP, June 2005 available at http://www.wrap.org.uk/downloads/WOO0041_Final_Report_June_20051.87f04129.pdf

[47] Defra analysis based on ERM's Carbon Balances Report.

Current/planned action

154. The Packaging Regulations impose a material-specific recycling target on wood packaging waste of 15%, which is significantly overachieved in the UK (at 55%) because wood recycling is used by businesses as part of their efforts to meet their general recycling obligations.

155. Local authorities already have a strong incentive to divert municipal waste wood from landfill as a result of the Landfill Allowance Trading Scheme (LATS). Waste wood from household sources sent for recycling also contributes towards achievement of their recycling targets.

156. Defra's Waste Implementation Programme (WIP) is taking forward a programme of work to develop energy markets for waste wood by addressing informational and practical barriers to expansion.

157. Non-statutory guidance to accompany construction Site Waste Management Plans (SWMPs) will highlight key waste materials, such as wood, that are predominantly consigned to landfill and identify beneficial alternatives as well as encouraging separate collection of materials at construction and demolition sites. The Government is currently consulting on making SWMPs mandatory for construction projects above a certain value.

8. Textiles

Rationale

158. The Government is developing a 'product roadmap' for clothing as one of a series of roadmaps on those products which account for a significant proportion of environmental impact.[48] The roadmaps will bring together evidence on the impacts of each priority product – across its whole life cycle – and begin to chart interventions for the short, medium and long term that will help to transform the product (or the market) towards a more sustainable future. Waste and resource efficiency are environmental impacts being considered alongside other impacts such as energy and water use. To assist the roadmap, Defra has a project under way assessing Sustainability Impacts and Interventions across the Lifecycle of Clothing. The roadmap is being developed in cooperation with stakeholders, and textile waste issues will be considered as part of this process.

159. Re-use and recycling of textiles gives strong environmental benefits, partly due to the high resource requirements of primary material production. There is also a need to reduce textile waste in the first place, whether through changes to production or consumption behaviour. The Carbon Balances Report[49] concluded that the recycling of textiles showed significant benefits over landfill, particularly in terms of reduced greenhouse gas emissions. The carbon benefits of re-use are greater still. Combustion showed a net disbenefit. In landfill, textiles are roughly as bad in carbon terms as kitchen/food waste on a per tonne basis. Charts 4.1 and 4.2 in Chapter 4 of WS2007 estimate the potential carbon benefits of diverting waste materials, including textiles, from landfill.

160. Improved policy intervention to increase re-use and recycling will deliver not only environmental, but also social and economic benefits. Charity shops receive a large (but declining) percentage of sales from used clothes and many disadvantaged people, in the UK and in developing countries, benefit from re-using clothes. Additionally, more jobs in the wider economy could be created from developing value-added markets for recycled textiles.

Facts and figures

161. Key sources of evidence include three recent reports:

- Recycling of Low Grade Clothing Waste[50] (the Clothing Recycling Report), this report for Defra (to be published shortly) integrates an economic and market study of the used clothing recycling industry in the UK with a study of technological developments aimed at improving the markets for recycling grades of clothing. The study also considers possible economic instruments and policy interventions. Its focus is on used clothing, although some consideration is given to other textiles, principally household textiles;

[48] See Chapter 4 of *Waste Strategy for England 2007* for further information on products.

[49] *Carbon Balances and Energy Impacts of the Management of UK Wastes*, report by ERM (with Golder Associates) for Defra, Final Report, March 2007 (The ERM Carbon Balances Report) available at http://www2.defra.gov.uk/research/project_data

[50] *Recycling of Low Grade Clothing Waste*, commissioned by Defra from Oakdene Hollins Ltd, the Salvation Army Trading Company Ltd and Nonwovens Innovation & Research Institute Ltd.

- a report by the University of Cambridge Institute for Manufacturing entitled *Well Dressed? The present and future sustainability of clothing and textiles in the UK*[51] (the Textile Sustainability Report). Part of the Biffaward Programme on Sustainable Resource Use, the report assessed the flow of materials through the UK associated with clothing and textiles, to provide a macro-economic materials account of the sector. It then presented a structured 'scenario analysis' which explores changes for a more sustainable future; and
- the ERM Carbon Balances Report concluded that the recycling of textiles showed significant potential for benefit, particularly in terms of reduced greenhouse gas emissions.

162. Data on textile waste arisings and management requires further development. Data on non-clothing textile waste is particularly weak. Estimates from the reports above suggest that:

- the total UK consumption of textile products is in the range of 2 million tonnes; the Textile Sustainability Report estimates about 2.15 million tonnes. The Clothing Recycling Report, which focuses on household textiles, estimates that approximately 1.9 million tonnes of textiles and footwear, were consumed in the UK in 2003;
- estimates of the total UK waste from clothing and other textiles range from 1.4 million tonnes (as a best estimate in the Carbon Balances Report), to as high as 2.35 million tonnes (the Textile Sustainability Report)[52], depending on the type of textiles covered. The Clothing Recycling Report estimates that approximately 1.2 million tonnes of textiles were disposed of as waste with an additional net amount of 303,000 tonnes collected by the secondary textile industry for re-use or recycling;
- about 500,000 tonnes of commercial and industrial textile waste arises in the UK, of which just over 440,000 tonnes arises in England (the Carbon Balances Report, using analysis of Environment Agency surveys); and
- starting with the largest components, household textile waste is estimated to be made up of women's clothing, men's clothing, non-apparel (e.g. carpets and bed linen) and a smaller amount of footwear (Clothing Recycling Report).

163. Textiles are the fastest growing sector in terms of household waste.[53] Sales of new clothing in the UK have increased by 60% in ten years. Textile waste is forecast to continue increasing as sales of new clothing continue to rise.[54]

Management routes

164. Nearly all textiles are suitable for re-use or recycling. However, the Clothing Recycling Report estimates that the secondary textile industry collects just 17% of household textiles consumed, the balance being stockpiled in homes or discarded to the household waste stream and landfilled. The Clothing Sustainability Report suggests that around 30% of used clothing in the UK is taken to a charity shop or textile bank. Other discard routes include private sales such as jumble sales or car boot sales, door-to-door collections, kerbside recycling schemes and disposal in the household bin or at the local civic amenity disposal site.

[51] *Well Dressed? The present and future sustainability of clothing and textiles in the UK* published by the University of Cambridge Institute for Manufacturing for the Biffaward Programme on Sustainable Resource Use, 2006, available at http://www.biffaward.org/downloads/projectfiles/2222-00486.pdf

[52] This amount is considered to be stockpiled, in the 'national wardrobe' and represents a potentially large quantity of latent waste.

[53] Conclusion of recent study for Defra – A. Maunder *et al. Modelling the Impact of Lifestyle Changes on Household Waste Arisings*, 2005. This finding is supported by the Clothing Recycling Report.

[54] See, for example, the Clothing Recycling Report.

165. It is estimated that, of the household textiles recovered, the most common recycling use is mattress and upholstery filling.[55]

166. Of the approximate 300,000 tonnes of post-consumer household textiles recovered annually:

- 54% are exported for re-use overseas;
- 13% are re-used in the UK;
- 19% are recycled in the UK;
- 8% are recycled overseas; and
- 6% are disposed of in landfill.

Markets and capacity

167. It is clear that current levels of re-use and recycling of clothes are low despite the excellent work of charity shops and the availability of textile banks. An estimate from industry sources is of an estimated 9,500 charity and non-charity textile banks in the UK.[56] The Clothing Recycling Report concluded that the economics of textile re-use and recycling are deteriorating as the price and quality of new clothes continue to decline. The Clothing Recycling Report found that the sales value of recycling grades of material has fallen by some 71% in real terms over 15 years, largely due to the introduction of 'value' clothing, and may now be less than the cost of collection and sorting donated textiles.

168. The Clothing Recycling Report also concluded that there is currently a mismatch between the strong growth of clothing arisings suitable for recycling and the mature/declining nature of many traditional markets for recycled fibre. There is therefore a need for more research and development to drive innovation in the use of textile fibres for new, value-added applications. The cost advantage of using recycled fibre, usually less than 40% of the cost of the virgin fibre equivalent,[57] is an incentive for the use of recycled fibre.

Current/planned action and initiatives

169. The new strategy recognises and supports the valuable role of the third sector, including community and voluntary organisations and social enterprises, in textile re-use and recycling. As announced in the interim report on the review into the future role of the third sector, the Treasury and Office of the Third Sector will work with others to consider the best way to build the framework and evidence base on the value which the third sector contributes to improving public services.

170. Examples of other policies and initiatives include the following:

- local authorities can opt to pay recycling or re-use credits to third party organisations re-using or recycling materials, including textiles, that would otherwise be included in the household waste stream. Updated guidance encourages local authorities to pay credits for re-use to third parties where there are environmental, social and economic benefits;

[55] See the Clothing Recycling Report.
[56] *Ibid.*
[57] *Ibid.*

- in 1991, the Textile Recycling Association established the Recycaltex Bonded Textile Scheme,[58] a regulatory body designed to help local authorities, charities and other organisations that want to set up services to aid the recycling and re-use of clothes and shoes. It includes the provision of textile banks with a regular agreed collection timescale, regular payments and collections from charity shops also agreed. This is supported by bond; and
- under the Landfill Allowance Trading Scheme, textiles are deemed to be 50% biodegradable, therefore diverting household textiles from landfill by recycling or re-use reduces the use of landfill allowances.

171. The Government is developing (in the light of the recent reports described above, the clothing roadmap being produced and discussions with stakeholders) policies to achieve higher levels of textile re-use and recycling and to develop more value-added markets for recycled textiles, recognising that the value of used clothing is falling. Policy intervention might be aimed at increasing collection rates for re-use and recycling, and stimulating markets for recycled textiles, perhaps through more R&D and application of technology and innovation. The Clothing Recycling Report has verified the feasibility of different processing methods for recycling low-grade clothing waste, such as for automotive components and air filtration, and finds that through using a technological approach to utilising recycled fibres and their inherent properties a premium product market can be targeted. Other potentially fruitful areas of policy development include application of technology to improve recyclability of synthetic and blended fibres; consumer education and provision of clearer messages to householders on textile re-use and recycling; producer responsibility through voluntary agreements; new business models such as product and service systems including leasing, promotion of textile repair, increased product durability, and use of procurement standards to reduce textile and waste and increase recycling and re-use.

172. Defra is also considering how data and evidence could be improved, particularly with regard to non-clothing textiles. For example, there is a need to increase carpet recycling and re-use but there is a lack of data and evidence on waste arisings and management. Evidence development will be assisted by Defra's development of the clothing roadmap and the associated assessment of sustainability impacts and interventions across the life cycle of clothing.

[58] See www.textile-recycling.org.uk/recyclatex.htm (accessed 10 May 2006). See also http://www.textile-recycling.org.uk/RecyclatexA4Leaflet.pdf for further information.

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