



Expanding Plastic Bottle Recycling in Essex & Cambridgeshire

WasteWISE Overview Report 1 APRIL 2003

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Executive Summary



- Only 3% of plastic bottles are currently recycled in the UK.
- Other countries achieve a much better rate - up to 80% - using a virtuous circle including bottle deposits, collection and reprocessing subsidies together with a larger number of reprocessing plants.
- Only 640 tonnes of plastic bottles were recycled in Essex in 2001-02 (and a lower tonnage still in Cambs and Peterborough). There is a potential for recycling over 15,000 tonnes of plastic bottles/year, in Essex worth around £1.76 million.
- Plastic bottle recycling creates the highest number of potential jobs per tonne compared with other recyclable materials.
- A WasteWISE scheme is proposed which could create over 40 jobs in Essex and Cambs from an increase to 20% recycling in two thirds of districts.
- Although the trade price for returned bottles is high, present UK schemes are perceived to involve a fairly large net cost and are deemed less lucrative than more popular schemes such as aluminium cans and glass. Prices will increase when a critical minimum tonnage throughput is achieved.
- The economics of plastic bottle recycling require that the efficiency of collection schemes is improved, and the true price presently paid for the collection of bottles and disposal in landfill sites is taken into account.
- **Next Steps (more in para 8 below)**
 - Improve this report through discussion/consultation
 - Undertake detailed feasibility study/financial analysis in catchment area(s) likely to deliver most economic and successful recycling.

1. Background

Although they comprise only around 2% of domestic waste by weight, around 460,000 tonnes of plastic bottles are used each year in the UK, of which only 14,700 tonnes (3%) are presently recycled. Before collection costs are taken into account, these are worth *ca.* £53 million using the current average trade price of £115 per tonne for sorted and baled bottles, of which only *ca.* £1.7 million is currently recouped. There is therefore plenty of room for growth. WRAP (Waste Resources and Action Programme) have set a target of an additional 20,000 tonnes to be recycled by 2004, representing an increase to *ca.* 7% in total. The UK obtained an overall 12% recycling rate for plastics in 2000 and *ca.* 20% in 2002. .



Bottles have to be collected, usually sorted at a material recovery facility (MRF), then baled and taken to a reprocessing plant. Key barriers to plastic bottle recycling are identified as: (i) lack of collection / sorting infrastructure, (ii) adverse collection scheme economics and the low efficiency of existing collection infrastructure and (iii) the lack of market stability for collected material.

2. Estimated Quantities Available for Recycling

The current estimated availability of plastic bottles in the UK is *ca.* 800 tonnes per 100,000 people per year. Accurate figures for the regions are not available. The table shows estimated annual quantities available for recycling in Essex, Cambridge and the Eastern Region using total waste figures from 2000/01 for the region and 2001/02 for Essex.

These have been calculated assuming that the bottles comprise an average of 0.18 % waste by weight and take account of the bottles currently recycled, using the national average rate of 3.2% (WRAP). The separate figures for household and business are probably liable to large errors as WRAP, using data from Recoup (**Recycling of Used Plastics**), estimate that up to *ca.* 30% of plastic bottles are available at health clubs, cinemas etc – an area where WasteWISE projects could concentrate.

Estimated tonnes available to recycle	Household (tonnes)	Business (tonnes)	Total (tonnes)
Essex	12,400	2,900	15,300
Cambridge	4,500	1,200	5,700
Combined Estimate	16,900	4,100	21,000
Eastern Region	48,600	10,000	58,600

Plastic bottle usage continues to grow rapidly. A different calculation, using recent data for composition of household collected waste in '02 gives a figure of 2.9% waste by weight for plastic bottles produces a greater total potential figure of 15,190 tonnes for households in Essex. (data compiled for the Cambridge and Peterborough Joint Waste Management Strategy). With 637 tonnes currently recycled, the potential extra is 14,550 tonnes.

As shown in the Appendix 2, Of the 637 tonnes of bottles recycled in Essex in '01-'02, Braintree District Council achieved the highest recycling rate for collected waste at almost 22% - over half the entire total of recycled bottles for Essex. The next best region, Tendring, recycled 4.3%, around a third of



which can be credited to a one-person social enterprise operated by Janet Humphry (BBB recycling). 6 out of the 12 districts recycled 0% and the average rate for Essex was only 3.4%. In the case of civic amenity sites in Essex (Appendix 3), these collected only 114 tonnes in total and the best performer, Maldon, collected only 18 tonnes (0.25% of the total waste deposited).

The UK recycling rate of *ca.* 3% compares with rates of between 70-80% in Sweden and Switzerland, *ca.* 70 % in Germany and Holland and 22% in the USA. Various incentives such as bottle deposits of up to the equivalent of 50p per bottle, reverse vending machines and large subsidies are used in these countries. The municipality of Tuscany with a population of 3.5 million recycles 16,000 tonnes of plastic bottles – 10% more than the entire UK.

The Waste Resources Action Programme (WRAP) have researched best practices and using data from Recoup have identified that efficient kerbside schemes can collect an average of *ca.* 4 kg of bottles per household per year compared to *ca.* 1 kg for bring schemes. Recoup have recently received funding to evaluate the implications of adding plastics to collection schemes in terms of recovery rates and costs. A trial kerbside scheme has just been initiated by Chelmsford Borough Council in the Tile Kiln area serving 5,500 households. MRF facilities for plastic bottles are available in Chelmsford, Braintree and Peterborough.

Update Jan '04: Recoup have just launched a web site with useful information about all aspects of plastic bottle recycling.
(www.recoup.org/business/default.asp)

3. Financial Overview

The value of the estimated quantity of plastic bottles available in Essex is over £1.76 million using the current average value of £115 per tonne for baled bottles.

Studies of the economics of recycling plastic bottles have revealed current net costs of between £200 and £350 per tonne. WRAP estimated in March '02 that with efficiency savings and other factors taken into account these could be reduced to between £0 - £100 per tonne. The appendix shows a breakdown of estimated recycling costs based on these studies for a conventional and a proposed WISE scheme. The latter could produce a small profit.



Government has created new start-up funding for effective community recycling projects. WasteWISE will assist organisations to win funding for projects in the two counties, including in Thurrock, Southend and Peterborough. There is plenty to bid for, including: New Opportunities Funding: 'Transforming Waste', SEED funding, Fair Share projects and the new 2003/4 Government £100 million/year sustainable waste funding package.

4. Social Employment Opportunities

WasteWISE aims to create 50 reuse and recycling jobs in Essex and Cambs by 2005, including a significant percentage for people who currently have difficulties finding jobs. Using the estimated figure of 15,300 tonnes of bottles available in Essex, an increase in the recycling rate from the current national average of 3% to 23%, i.e. from *ca.* 500 tonnes to *ca.* 3,700 tonnes, translates to estimates of sustainable sorting work for *ca.* 26 people, baling work for *ca.* 6 people and collection work for *ca.* 8 people, making 40 in total or 2 people per percentage point increase in recycling rate.

In support of these figures, a recent report for London Remade has confirmed that plastic bottle recycling offers the best prospects for job creation and calculates that over 14 jobs could be created per 1000 tonnes of recycled PET bottles, compared to only 1.3 jobs/1000 tonnes for paper and card.

5. Environmental Issues

Plastic bottles produce bulky landfill, which can take an estimated 500 years or more to degrade and dumping represents an enormous loss of resources and energy. Plastics are produced from petrochemicals, which are a limited resource and produce pollution during transportation and refining/processing. The toxic effects of incineration have not been completely researched. It is estimated that taking into account the energy used for collection and reprocessing to plastic flake and comparing this to the energy required to produce new material, a single recycled 2-litre water bottle (weight 50 g without cap, saves enough energy to power a 60W light bulb for 6 hours. If every plastic bottle in the UK were to be recycled, the amount of energy saved would be equivalent to the electrical power used in around 1.2 million or *ca.* 5 % of UK households, using an average consumption figure of 3000 kWh/year. Emissions of CO₂ and NO₂ are also reduced by reprocessing.



6. Potential Partner Organisations

- WASTEWISE and WISE - WISE provides detailed development and management training for recycling/other social enterprise managers in Essex, Cambridgeshire and neighbouring areas.
- Recycling social enterprises and community/environment groups
- Essex and Cambs county councils, district and unitary councils, and joint waste strategy and recycling initiatives
- Essex ReMaDe, and other initiatives/umbrella organisations
- External partners? e.g. RECOUP
- Local recycling, waste and other businesses.

7. Key Issues for Further Analysis/Discussion

The business targets set by the Producer Responsibility Obligations (Packaging Waste) Regulations currently in effect are 59% for recovery and 19% for material-specific recycling. It was announced in October '02 that these will remain at the same levels throughout 2003 in anticipation of a new directive giving specific targets for domestic waste. It would appear that this issue will not have any practical relevance to WasteWISE schemes for the next few years based on the current position.

8 Next Steps/Detailed Financial Analysis

See also processing cost issues discussed in Appendix 1.

Our standard two stage approach at WasteWISE is, with partners, to

- a Consult on discussion drafts like this, then improve and publish a final 'overview report'
- b To then undertake a detailed feasibility study and financial analysis with partners on a real potential scheme covering a defined catchment area that is projected to deliver economic and successful recycling. This will normally cover at least three council districts in Essex and/or Cambs, and the study will be overseen by the creation of a 'task and finish' project group



including key partners.

In the case of plastic bottles, the issues to be costed in detail include:

A FIXED COSTS (** costs reduced by partnerships/links)

Capital investment

- recycling banks appropriate to bottles
- * collection vehicle and systems for bulking a light material
- ** premises/bulking/external storage
- ** processing equipment/baler

* Operating costs

- business rates, phones etc
- promotion/media

B VARIABLE COSTS PER TONNE

Staff costs

- collection
- * sorting
- * transport to market

Operating costs

- fuel, electricity

C INCOME

Price per tonne

Recycling credit per tonne

Packaging recovery notes

Financial support from local authority

Staffing contribution re: placing people with learning disability

Potential one off assistance from industry/packaging compliance schemes

Local partners interested in reprocessing outputs

Potential grant aid and start up funding.



9. Contacts/Information Sources

Neil Thomson, Project Manager, Remade Essex, tel: 01245 259351,
neil.thomson@eepartnership.co.uk.

Andrew Simmons, Chief Executive Officer, Recoup, tel: 01733 390021,
andrew.simmons@pps-ltd.com Personal Communication (Including 2002
Data update).

Plastic Bottle Recycling in the UK, Scott Wilson and Save Waste and Prosper
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2002.

A New Perspective on the Cost of Collection and Disposal of Plastic Bottles
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Technical Review, **3**, 1, 2002.

The Composition of Household Waste in Cambridgeshire, Report to the
Cambridge and Peterborough Joint Waste Management Strategy,
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Estimating Job Creation from Recycling and Reprocessing, Report for London
Remade, Anne Gray et al. June 2002.

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2000, Recoup (Recycling of Used Plastics, www.recoup.org/).

Plastic/Polymer Recycling, Ahmad Lotfi, School of Engineering, Nottingham
Trent University
(www.domme.ntu.ac.uk/people/alotfi/personal/recycle/plastic.html).

www.plasticsrecycling.org/pet.htm

www.defra.gov.uk/environment/statistics/wastats/

www.jj-plastics.co.uk/

www.plasticscommerce.com/reprise/



www.wastewatch.org.uk/



Appendix 1 – Technical and Processing Cost Issues

Collection schemes focus on two or three types of plastic bottle; PET and HTPe in roughly equal amounts and, less frequently, PVC (*ca.* 4% and falling). Together these three polymers account for around 90% of the plastic bottles in domestic waste. Bottles of the type used for carbonated and some still drinks are mainly made out of polyethylene terephthalate, known as PET and coded 1 in the scheme of seven categories developed by the Society of the Plastics Industry. Codings are normally found on the bottom of bottles, which are usually colourless or tinted pale blue. This is a type of polyester which can be reprocessed to produce products as diverse as carpets, clothes and cassette tapes. The bottles cannot be simply sterilised and re-used because the material deforms at the high temperatures used. There a fairly simple way of changing the composition of PET to allow for heat treatment and sterilisation - derivatives such as PEN (polyethylene naphthalate) can be used to produce bottles can be recycled 20 times or more over 3 or 4 years. Although they cost more to manufacture, these are already in use in Denmark and the USA. Other bottles such as milk and detergent containers are composed of high density polyethylene (HDPE – coded as 2) which is reprocessed to produce plastic pipes rubbish bins or non-food application bottles. Plastic Reclamation in St Helens, Merseyside, recently won the 2002 national recycling award for best recycled product for their new Knotwood wood-plastic composite which is able to utilise HDPE from plastic bottles as well as waste wood. PVC bottles can also be reprocessed.

Research into the development of biodegradable and photo-degradable plastics continues but these types of material also have associated problems and they are unlikely to replace current materials in the short to medium term.

Collection.

Around 50% of councils had plastic bottle collection schemes in 2001. These included bottle banks at municipal sites and supermarkets and kerbside collections. There are currently (as of March '03) around 4000 plastic bottle collection banks and kerbside collections from about 4.5 million households. Efficiency problems arise due to the bulk of the material. Bins have to be emptied frequently unless they incorporate crushers and lorry loads can be uneconomic because of the low density.



Sorting

Good sorting is needed prior to reprocessing as just one PVC bottle in a batch of 10,000 PET bottles can spoil reprocessing. The problem is said to be compounded by labels and the widespread use of different plastics for bottle tops and attachments (normally polypropylene or PP, coded as 5). The cost of sorting is a major economic factor. It is estimated that a single trained worker can manually sort around 1,200 bottles an hour, including time for other material movement activities and baling. This translates to around 60 kg of PET when applied to 2 litre mineral water bottles.

Much higher rates can be achieved using automatic sorting methods. X-ray and near-infrared (NIR) Fourier Transform (FT) spectroscopy can be applied to plastics identification. The latter has the advantage that it is completely safe to use and can easily distinguish between all types of plastic quickly and accurately. There only a few MRF sites in the UK using automatic sorting equipment – examples are Hurn, Dorset, Sompting in West Sussex and Rainham in Essex – but hundreds of systems worldwide with capacities of up to and greater than 30,000 tonnes per annum. The most elaborate systems use conveyer belts equipped with infrared detectors and compressed air directors. The cost of conveyor belt NIR sorters starts at around £60,000. It may be possible to obtain much cheaper, handheld NIR detectors for use in small social enterprises but these may be more appropriate for Waste Electrical and Electronic Equipment (WEEE) and End of Life Vehicle (ELV) plastics. Infrared Fiber Systems in the USA (www.infraredfibersystems.com) are working on a budget, stand alone unit but currently manufacture only a video camera sized device - the PlastiScan – which has to be connected to a laptop, presumably for the FT processing. Southampton University has an engineering department which has pioneered infrared plastics detection and they been contacted for possible use with the WISE programme.

Reprocessing

The polymers can be reprocessed to produce either flake or, after more extensive treatment, raw component chemicals which can be used to produce new plastics. Current reprocessing capacity in the UK can cope with a doubling of the current number of collected bottles. Provided bottles are delivered after primary sorting into PET, HDPE or PVC and containers contaminated with oil etc. are removed, pre-treatment at reprocessing plants can easily separate residual PP from PET using flotation methods based on density differences and labels can be removed in hot alkaline solution.



However, largely due to the low popularity of recycling schemes, reprocessing plants are rare. There is fairly limited capacity for reprocessing mixed materials as only three plants exist in the UK for handling mixes of PET, HDPE and PVC (Reprise in Merseyside and J.J. Plastics in Manchester and Flint) There are wider markets for mixed materials through export and prices of up to £45 per tonne have been reported. Higher prices are paid for sorted materials – currently 2 to 3 times as much. There are only five major reprocessing sites for sorted materials in the UK, including new plants at Flint and Merthyr Tydfil. Because these sites are so far and few between, transportation costs are a significant factor when considering the economics of recycling. Other UK plastics recycling plants could perhaps accept bottles if there are sufficient available – supply is more of a problem rather than reprocessing capacity. Estimate of Recycling Scheme Costs

Plastic bottle recycling costs are estimated for two schemes, as shown in Table 1. The conventional scheme is based on those outlined in the WRAP and RECOUP surveys. The WasteWISE estimate takes into account collection and disposal savings mentioned in these, together with other savings.

Debits:

1. Collection. The new project, assisted by WasteWISE, could use a low-cost bring scheme – for example to bins outside supermarkets. The November 2001 WRAP survey showed that only 18% of the leading chains provided them. A typical return for a mid-large town supermarket of 10 tonnes per year is quoted. Recoup can help assess this figure more accurately when applied to local schemes. An efficient kerbside scheme that isn't in competition with a bring scheme might collect *ca.* 4 kg per household per year, equivalent to 10 tonnes per 2,500 households per year. This figure can be increased significantly – Recoup recently report that top performing schemes are achieving 8-11 kg/hh/yr. It may also be possible to collect from cinemas, sports centres etc., where it is estimated *ca.* 30% of plastic bottles are deposited. Assuming a 50:50 split of costs between overheads and wages, 200 tonnes would provide *ca.* 1 year's collection work for 1 person.
2. Scheme promotion. It may be possible to make savings here using posters with artwork provided by RECOUP etc.
3. Sorting. Manual sorting for the scheme assumes a typical sort rate of 60 kg/h (1,200 bottles per hour and pay of £5/h. 120 tonnes would provide



ca. 1 year's sorting work for one person. No allowance is made for overheads.



Table 1 Estimate of Plastic Bottle Collection Scheme Costs

Conventional Scheme

Activity	Debit (£/tonne)	Credit (£/tonne)
Plastic Bottle Collection	140	
Scheme Promotion	30	
Automatic Sorting	90	
Baling	25	
Delivery to Sort and Reprocessing Sites	30	
Administration	40	
Collection Scheme Gross Cost	355	
Avoided Collection and Disposal Cost		25
Baled Bottle Sales Revenue		115
Collector Gross Income		140
Collector Net Income (loss)	-215	

WISE Scheme

Activity	Debit (£/tonne)	Credit (£/tonne)
Plastic Bottle Collection	100	
Scheme Promotion	10	
Manual Sorting	80	
Baling	25	
Delivery to Sort and Reprocessing Sites	30	
Administration	10	
Collection Scheme Gross Cost	255	
Avoided Collection and Disposal Cost		170
Baled Bottle Sales Revenue		115
Collector Gross Income		285
Collector Net Income (loss)	30	



4. Baling. The WRAP figure is used - it is not clear how this is derived. For the scheme, the use of a second-hand baler is assumed, which would cost *ca.* £7,500, together with a throughput of 500 tonnes/year, interest/depreciation of 15% and four hours work per tonne at £5/h. 500 tonnes would provide *ca.* 1 year's work for 1 person. There are MRF sites for plastic bottles in Chelmsford and Braintree which would provide baling services, although the added transportation might complicate the scheme and add costs. Paper merchants might also offer contract baling. It might be thought more logical to have a system where plastic bottles are sorted and ground before transportation. However, there is no significant weight difference between granulated and high density bottles and the costs of maintenance and Health and Safety issues are much more significant for granulators. This would also appear difficult to implement at present because of the quality control systems used by reprocessors, although Sonepa (www.sonepa.nl/) in the Netherlands appear to accept ground PET.
5. Delivery to sort and reprocessing sites. Figures of £10 per tonne for delivery to the sorting plant and £10 –20 per tonne for delivery to the reprocessor are quoted, depending on distances and bale densities. These could be reduced if, for example, supermarkets could be persuaded to use their empty lorries returning to depots, but this might not be viable in practice because of the logistics and handling issues of waste and new products within the same vehicle.
6. Administration. This is assumed to be low relative to other costs.

Recycling Credits:

1. Avoided collection and disposal costs. This is possibly the most contentious item in the scheme but the most important, since it turns the operation from loss into profit. Using data provided in the WRAP report and CIWM paper, the usual composite figure of £25, derived using values of £21/tonne for collection costs and £27/tonne for landfill charges is arguably inappropriate for plastic bottles because it is based on weight rather than volume. When proper allowance is made for this the true collection cost is multiplied by a factor of six and the disposal cost is doubled.



2. Baled bottle sales revenue. This figure is the current average price (as of 6 Jan.'03) for PET bottles. For HDPE, the average figure is marginally higher. These values fluctuate roughly inline with the price of new materials.

This report has been compiled to the highest accuracy using the best available information, but prospective users should check details prior to setting up a new social enterprise. The WasteWISE team requests anyone using this analysis or other assistance to set up a new enterprise to acknowledge the role/contribution of WasteWISE and other partners e.g. councils, to such projects.

RESEARCHED AND WRITTEN BY: Andrew Stevens, MAY 2003



Appendix 2
Essex District Council Collections and Civic Amenity Sites 2001-02
Plastic Bottles

DISTRICT COUNCIL	potential* total (tonnes)	total recycled (tonnes)	% recycled	not recycled (tonnes)	% not recycled
BRAINTREE	1492	325.20	21.79	1167	78.21
TENDRING	1369	59.21	4.32	1310	95.68
COLCHESTER	1656	56.38	3.41	1599	96.59
EPPING	1431	44.66	3.12	1386	96.88
UTTLESFORD	945	15.38	1.63	929	98.37
BASILDON	2160	22.18	1.03	2138	98.97
BRENTWOOD	672	0	0	672	100.00
CASTLE POINT	1010	0	0	1010	100.00
CHELMSFORD	2088	0	0	2088	100.00
HARLOW	818	0	0	818	100.00
MALDON	607	0	0	607	100.00
ROCHFORD	943	0	0	943	100
DISTRICT TOTAL (tonnes)	15190	523.01	3.44	14667	96.56
CA TOTAL (tonnes)	114.00	114.00	100	0	0
District + CA TOTAL (tonnes)	15304	637.01	4.16	14667	95.84

*Estimated using data from Joint Waste Strategy Report to Cambridge and Peterborough Oct.'02 (Table 12)

% Plastic Bottles in Domestic waste = 2.90

Average % Recycling Rate = 3.44 (District)

Assumes 100% CA bottles are recycled (precise figure unknown)



**Appendix 3
Essex County Council
Civic Amenity and Recycling Centres 2001-02**

PLASTIC BOTTLES

Site Name	Tonnes	Total Waste	%Total
Maldon, MALDON	18.1	7333	0.247
Drovers Way, CHELMSFORD	25.41	11758	0.216
Shrub End, COLCHESTER	30.8	16257	0.189
Witham, BRAINTREE	7.89	6118	0.129
Saffron Walden, UTTLESFORD	5.03	5294	0.095
Shalford, BRAINTREE	5.36	5658	0.095
Rush Green, TENDRING	6.96	10962	0.063
Temple Bank, HARLOW	4.94	12706	0.039
Coxtie Green, BRENTWOOD	3.56	10088	0.035
Martins Farm, TENDRING	1.28	5401	0.024
Pitsea, BASILDON	3.3	14442	0.023
Kirby-le-Soken, TENDRING	0.61	4950	0.012
Luxborough Lane, EPPING	0.76	9082	0.008
S. Woodham Ferrers, CHELMSFORD	0	6114	0
Mountnessing, BRENTWOOD	0	7093	0
Mill Lane , EPPING	0	4016	0
Waltham Abbey, EPPING	0	4608	0
West Mersea, COLCHESTER	0	1529	0
Dovercourt, TENDRING	0	5186	0
Burnham, MALDON	0	5000	0
Newlands, CASTLE POINT	0	8084	0
Rayleigh, ROCHFORD	0	12269	0
Total	114	173948	0.00066

% material = 0.066%