

PRIORITY RESOURCE STREAMS

Final Report

Identifying Opportunities to Develop the Recycling Infrastructure in Scotland

A report investigating current and future arisings and recycling of ten priority resource streams. The report identifies which priority resource streams have the greatest potential to contribute to meeting the 70% carbon-based recycling target by 2025, considers the economic opportunities for Scotland and recommends developments in appropriate infrastructure to deliver the Zero Waste Plan objectives.

Project Code: IMR001

Research date: September 2011 to April 2012 **Date:** June 2012 *(with updated carbon metric factors)*

Zero Waste Scotland works with businesses, individuals, communities and local authorities to help them reduce waste, recycle more and use resources sustainably.

Find out more at
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Written by: Iain Weir, John Taylor and Hayley Welsh

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Optimat Limited has made all reasonable attempts, within the scope and resources available to the project, to ensure the data in this report is accurate. Estimations of the resource stream arisings and recycling rates in Scotland are based on published sources which have been fully referenced in this report. As such, the accuracy of the data contained within this report is reliant on this referenced information. Optimat Limited does not therefore accept any liability which may arise through the use of the content of this report.

Executive Summary

The Scottish Government's Zero Waste Plan¹ sets a vision of a closed loop economy in Scotland where the economic potential is accrued from materials arising in the waste stream. Targets defined are 70% recycling and a maximum of 5% to landfill by 2025. Improvements to the quality and quantity of material collected and reprocessed is essential to achieve these goals. Zero Waste Scotland (ZWS) is addressing this task and has specified relevant areas of action in its Delivery Plan².

This report provides a robust evidence base that identifies the need for **additional** recycling capacity in Scotland that will provide significant economic benefit. It projects the arisings of resource streams to 2025, defines recycling tonnages required to meet targets, assesses the current situation, identifies the need for new facilities to enhance the recycling of these resource streams and assesses the scale of commercially and environmentally attractive activities. It concludes with recommendations of the most attractive options for development. **This approach ensures that opportunities that address resource streams that are not being effectively recycled are recommended.**

The collection, management and recycling of ten resource streams were analysed, namely:

- Aluminium cans & foil
- Batteries (post consumer non-auto)
- Paper & Board
- PVC (including forming)
- WEEE
- Average plastic film (including bags)
- Glass (packaging)
- Polystyrene (including forming)
- Textiles & Footwear
- Wood

The Scottish Government Zero Waste Plan and The Waste (Scotland) Regulations 2012³ on dry recyclable collections from households and businesses set challenging weight and carbon based recycling targets over the next three years, as shown opposite for each source of arisings.

This shows that the recycling rate for the C&D waste stream already exceeds the weight and carbon-based 70% target and the industrial waste stream exceeds the 70% carbon-based target.

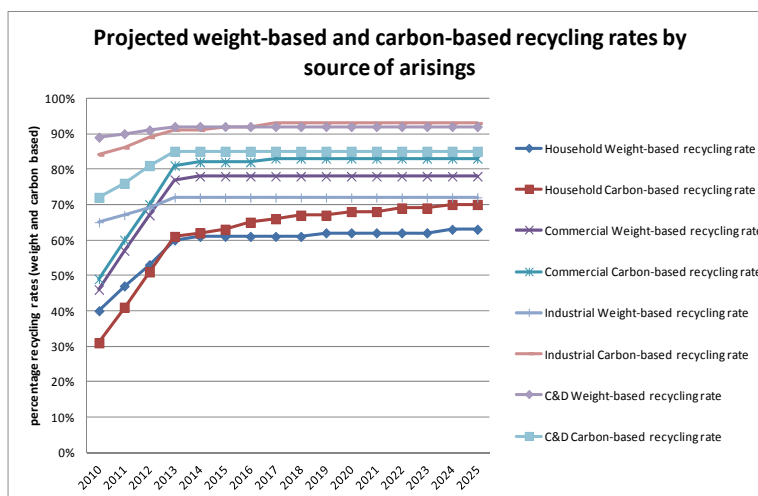


Figure 1: Projected increases in weight-based and carbon-based recycling rates, by source

The Economic Assessment of the Zero Waste Plan⁴ assumes maximum recycling rates for up to eight materials which, when combined, will achieve a minimum of 70% recycling (carbon-based) for each waste streams by 2025. This is just one combination of recycling rates for each material that could

¹ Scotland's Zero Waste Plan, The Scottish Government, 2010

² Zero Waste Scotland Delivery Plan, 2011-15, Zero Waste Scotland

³ <http://legislation.gov.uk/sdsi/2012/978011016657/contents>

⁴ Economic Assessment of the Zero Waste Plan for Scotland, Eunomia for Zero Waste Scotland, July 2011

achieve the 2025 target and an infinite number of variations on this could be used to achieve the same goal.

The model developed for this project follows the maximum recycling rates used in the Economic Assessment of the Zero Waste Plan. Using the projected 2025 recycling levels for the ten priority resource streams and comparing them with 2009 baseline estimates provides an indication of the additional tonnes of each resource stream to be recycled. This can then be adjusted using carbon metric weightings for each resource to show the relative importance of the different priority resource streams in achieving the 70% target. This analysis, as presented in Figure 2⁵.

	Relative Contributions of Additional Recycling by 2025 (%)	
	Weight-based	Carbon-based
Aluminium Cans and Foil	2	18
Average Plastic Films	3	3
Batteries	0	0
Glass	12	3
Paper and Board	52	40
Polystyrene	1	1
PVC	3	2
Textile and Footwear	6	8
WEEE	9	11
Wood	12	14
	100	100

Figure 2: Comparison of weight-based and carbon-based contribution to additional recycling to 2025

This figure clearly demonstrates the importance of paper & board, aluminium cans and foil, wood, WEEE and textiles & footwear, which together represent over 90% of the projected annual increase in recycling by 2025 from a 2009 baseline (based on carbon metric adjusted figures). It should be noted that this is only the additional recycling required for the ten priority resource streams under investigation in this report and does not include food waste, etc.

In the shorter term, the main driver for increasing recycling will be The Waste (Scotland) Regulations 2012, which require local authorities to offer separate collection of dry recyclables and require all businesses to present dry recyclables for separate collection. These regulations come into force on 1st January 2014 and Figure 1 shows the impact on recycling expected with the introduction of these regulations. The additional tonnages required by 2013 compared to 2009 levels are shown in Figure 3.

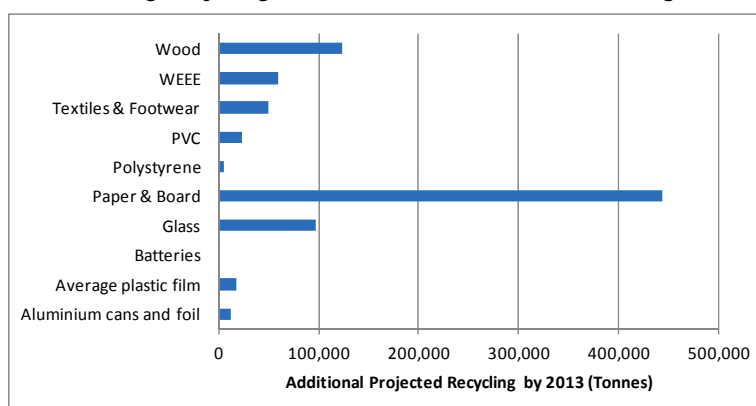


Figure 3: Additional annual recycling required by end 2013

The figure shows that the most significant weight of additional recycling will be required for paper & board (444,000 tonnes), wood (124,000 tonnes), glass (97,000 tonnes), WEEE (60,000 tonnes) and textiles & footwear (50,000 tonnes) and the remaining five priority resource streams account for a total of 59,000 tonnes of projected additional annual recycling by 2013. This results in total additional annual recycling requirement (from these ten priority resource streams) of 834,000 tonnes.

Opportunities for Development

The priorities for infrastructure development were identified by analysing each resource stream. The analysis assessed the current situation, identified key issues or barriers to recycling and potential

⁵ Relative contributions are rounded

opportunities to address these issues and barriers. The viability of each was then assessed. The most attractive economic options identified were:

- Equipment for Washing/Drying Textiles
- Carpet Recycling Plant
- Equipment to Increase the Quality of Material for Recycling
- Equipment for Aluminium Can Crushing at Source
- Equipment to Increase the Capabilities of WEEE Recycling Plants
- Facilities for Cleaning and Drying of Mixed Plastic Film
- Plastic to Oil Refinery
- PVC Recycling Facility

The importance of increasing collection activity and improving the quality of materials collected was identified as an important factor across all resource streams.

The estimated increase in recycling capacity and potential economic impact from the opportunities identified can be presented as follows⁶:

Intervention Option	Equipment Costs (£) per Facility	No of Plants	Potential Capacity (tonnes per annum)	Estimated Economic Impact (£ per annum)
Washing and Drying Textiles	£1,000,000	1	1,040	£676,000
Carpet Recycling Plant	£75,000	5	7,500	£1,305,000
Paper Finishing Plant	£500,000	1	40,000	£2,800,000
Aluminium Can Crushing at Source	£800	700	700	£595,000
Establish WEEE Plastics Facility	£2,000,000	1	5,000	£2,250,000
Cleaning and Drying of Mixed Plastic Film	£2,270,000	2	14,000	£6,300,000
Plastic Refinery	£7,000,000	2	12,000	£4,200,000
PVC Recycling Facility	£1,500,000	1	12,000	£5,400,000
TOTAL			92,240	£23,526,000

Note: Economic impact is based on turnover of new businesses based on these facilities

Figure 4: Increased capacity and potential economic impact of shortlisted opportunities

Thus the additional annual capacity projected from implementing these opportunities is 92,240 tonnes (providing a significant environmental benefit of avoided landfill and/or substitution of virgin material with secondary raw materials) and an increase in sector turnover of £23,526,000 per annum is estimated indicating a significant economic impact.

⁶ Detailed assumptions on equipment costs, potential capacity and estimated economic impact are included in the detailed analysis of each priority resource stream. The expected annual turnover achieved by the new capacity is used to estimate the economic impact.

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1. Introduction

1.1 Background

The Scottish Government's Zero Waste Plan sets a vision of a closed loop economy in Scotland where the economic potential is accrued from materials arising in the waste stream. Targets defined are 70% recycling (based on the carbon metric) and a maximum of 5% to landfill by 2025.

Improvements to the quality and quantity of material collected and reprocessed is essential to achieve these goals. Zero Waste Scotland (ZWS) has been tasked with addressing this and has specified relevant areas of action in its Operating Plan.

This report describes the results of a study to provide a robust evidence base that ZWS can use to catalyse development of the recycling capacity and capability in Scotland. Firstly it projects arisings of priority resource streams to 2025, together with the recycling tonnages required to meet short and longer term targets. These projections set robust and challenging targets for recycling and for development of recycling capacity in Scotland. The report then:

- Reviews the potential for closed loop recycling of a number of resource streams
- Identifies the barriers to their development
- Identifies the need and economic opportunity for further industrial and/or infrastructural development to enhance the collection and reprocessing capacity for these resource streams
- Assesses the scale of commercially and environmentally attractive activities

It therefore identifies further industrial and/or infrastructure development by addressing the issues and weaknesses in the current collection and recycling capacity in Scotland.

It then concludes by recommending the most attractive options for developing recycling capacity in Scotland.

1.2 Scope

1.2.1 Projecting Future Need

Projections of arisings and recycling tonnages to 2025 have been developed to guide the analysis of the need for additional collection and recycling capacity for each resource stream. Projections to 2025 have been included so that this analysis is consistent with the recent work carried out for the Scottish Government on economic assessment of the Zero Waste Plan⁷.

1.2.2 Materials

Zero Waste Scotland has identified a number of priority resource streams that have the potential to be recycled into closed loop applications in Scotland or have the potential to undergo additional added-value processes in Scotland to prepare them for further recycling elsewhere. These have been investigated in this study and are (in alphabetical order):

- 1 Aluminium cans & foil
- 2 Average plastic film (including bags)
- 3 Batteries (post consumer non-automotive)
- 4 Glass (packaging)
- 5 Paper & Board
- 6 Polystyrene (including forming)
- 7 PVC (including forming)
- 8 Textiles & Footwear
- 9 WEEE
- 10 Wood

⁷ Economic Assessment of the Zero Waste Plan for Scotland, Eunomia for Zero Waste Scotland, July 2011

1.2.3 Supply Chain Activity

This study considers the management of these resource streams from the point of arising to the supply to end use markets. It, therefore, includes collection and segregation as well as processing activities. This scope is considered essential to ensure that capacity is developed to optimise the diversion of these resource streams from landfill.

1.3 Study Methodology

Our methodology is shown in Figure 5, below:

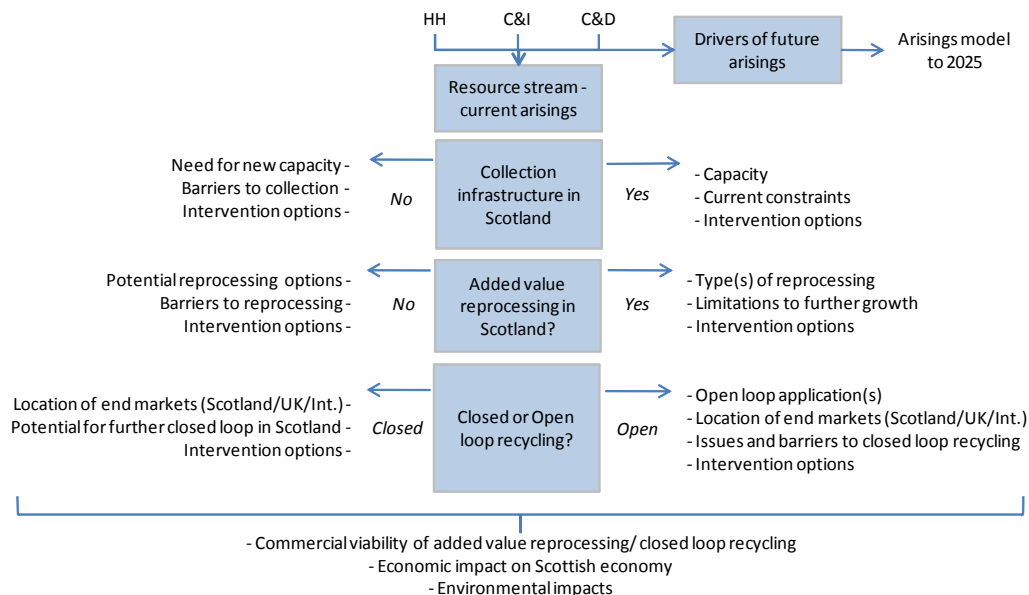


Figure 5: Study Methodology

The above figure highlights:

- Analysis of arising from household, commercial and industrial, construction and demolition and agricultural waste stream – using current data and projections of arisings to 2025
- Assessment of the collection infrastructure in Scotland and whether it is sufficient to manage current and projected arisings
- Similar assessment of the materials reprocessing capacity in Scotland
- Identification of opportunities to add value to collection and reprocessing activities in Scotland
- Assessment of the commercial viability of these opportunities
- Analysis of the economic and environmental impact of these opportunities
- Recommendations on the most attractive options for developing the recycling industry in Scotland
- The management of all specified resource streams has been included in this study. Collection and segregation activities are assessed separately from the subsequent recycling of each specified resource stream as the majority of resource streams are collected in a mixed or partially mixed form.

1.4 Report Structure

Following this introductory section, this report is structured in five key sections, namely:

- 1 The current position - recycling of the ten priority resource streams
- 2 Future recycling requirements - projections to 2025
- 3 Material collection and segregation
- 4 Detailed examination of each priority resource stream (including analysis of commercial viability and economic and environmental impact of attractive opportunities)
- 5 Conclusions and recommendations

2. The Current Position – Recycling of Priority Resource Streams

The starting point in the analysis is the current position of waste arisings and recycling in Scotland. The baseline used for both arisings and recycling is 2009 data to ensure a complete data set and consistency with the economic assessment of the Zero Waste Plan¹.

2.1 Developing a Baseline Data Set – Data Sources and Issues

This section summarises the approach used to develop the baseline data set of arisings of each resource stream from a number of sources including:

- Household
- Commercial & Industrial (C&I)
- Construction & Demolition (C&D)
- Agriculture (in the case of average plastic film only)

The detail of how baseline arisings estimates were derived is contained with the relevant resource stream sections later in this report.

The underlying approach used in developing the baseline data and projections to 2025 were:

- Each of the above waste streams are modelled separately within an MS Excel driven model before being combined to estimate total arisings and projected increase in recycling
- The growth of arisings from the baseline year to 2025 uses rates consistent with the Economic Assessment of the Zero Waste Plan for each waste stream
- The projected maximum target recycling rates of the various material streams are consistent with those used in the recent Economic Assessment of the Zero Waste Plan
- The path of growth in recycling rates, from estimated baseline levels to maximum achievable recycling rate, mirrors the growth of recycling used in the Economic Assessment of the Zero Waste Plan (i.e. the majority of the increase taking place up to the period 2014 and then either a zero, or lower growth rate to 2025, depending on which waste stream the material arises from)
- The additional recycling required for each resource stream was calculated by subtracting estimate baseline recycling from projected 2025 recycling. This calculation was carried out to derive a weight-based estimate of additional recycling required. The appropriate carbon metric weighting was then applied to these figures to enable comparison to be made of the relative contribution each resource stream could make to additional recycling on a carbon basis
- The sources used contain the most recently available data across all waste streams and a complete set of data from the same period is used
- The best available data set for each waste stream should be used with data checks made, where possible, using other available data

During the process of developing the baseline data arisings a number of observations were made:

- The most up to date data published by SEPA covering both household and C&D waste is for 2009. Both these data reports are based on data returns by local authorities and licensed waste companies respectively and are considered to be relatively robust. Waste composition analysis estimates were used to identify arisings of specific resource streams from household and C&D. This can lead to error being introduced where even a small error in percentage composition can be exacerbated when multiplied by a national arisings figure
- **One key difference between the data used in this report and that used in the Economic Assessment of the Zero Waste Plan is the source of C&I figures.** The Economic Assessment of the Zero Waste Plan used SEPA data on waste arisings from C&I combined with the best available composition analysis to identify estimates for individual material streams. The C&I data is based on a survey conducted in 2006 and is updated each year in response to changes in business population, etc. to derive new estimates. There is a significant confidence interval around the reported expected values (up to +/- 60% at the 90% confidence level, based on perfectly correlated errors). When the resulting estimated baseline figures were crosschecked against other sources (e.g. national packaging waste data, other published WRAP reports, etc) there were several priority resource streams with significantly different results. The differences were most prominent in estimates of paper & board, wood and average plastic film. For example, an in-depth analysis of the estimates of C&I plastic waste arisings revealed that using a combination of SEPA C&I data (expected values) with best available composition analysis resulted in a figure that was almost ten

times greater than the estimate of plastic waste arisings which aligns with data from the ZWP data on packaging waste. It was, therefore, agreed with ZWS that estimates of C&I waste arisings would be based on sources other than reported SEPA C&I data. A detailed description of the arisings calculations and associated sources used are provided for each priority resource stream later in this report.

- SEPA published data on arisings from the agricultural waste stream was used in the estimate of average plastic film

2.2 Data Uncertainty

It is important to note that there is uncertainty surrounding the data estimates. The main sources of this uncertainty are:

- The estimates of resource streams from C&I sources use multiple data sources, some of which are based on factoring down UK wide figures. No adjustment has been made for the differing mix of commercial and industrial economic activity between the UK and Scotland
- Composition analysis data has been used to identify baseline arisings of resource streams from households and C&D sources. As mentioned previously, a small error in percentage composition can be magnified when used to decompose a national arisings figure

Notwithstanding these uncertainties, the resulting baseline data estimates are summarised in the following section.

2.3 Baseline Data – Estimated Arisings by Material and Source

The baseline data used for this project can be summarised as follows:

		Household			Commercial & Industrial		
		Arisings	Recycled	% Recycled	Arisings	Recycled	% Recycled
		(tonnes)	(tonnes)		(tonnes)	(tonnes)	
1	Aluminium Cans and Foil	25,873	3,278	12.7%	3,520	1,320	37.5%
2	Average Plastic Film*	74,475	0	0.0%	37,623	13,348	35.5%
3	Batteries**	3,862	394	10.2%			
4	Glass	197,290	92,630	47.0%	71,310	42,786	60.0%
5	Paper & Board	600,324	302,486	50.4%	550,077	269,538	49.0%
6	Polystyrene (incl. forming)	12,745	548	4.3%	2,354	777	33.0%
7	PVC (incl. forming)	971	206	21.2%	8,135	3,010	37.0%
8	Textiles and footwear	152,744	44,714	29.3%	17,424	1,742	10.0%
9	WEEE	110,531	41,385	37.4%	28,800	1,306	4.5%
10	Wood	138,102	69,136	50.1%	63,999	28,160	44.0%

		C&D			Total		
		Arisings	Recycled	% Recycled	Arisings	Recycled	% Recycled
		(tonnes)	(tonnes)		(tonnes)	(tonnes)	
1	Aluminium Cans and Foil				29,393	4,598	15.6%
2	Average Plastic Film*	1,774	350	19.7%	132,880	17,500	13.2%
3	Batteries				3,862	394	10.2%
4	Glass				268,600	135,416	50.4%
5	Paper & Board	37,599	7,520	20.0%	1,188,000	579,544	48.8%
6	Polystyrene (incl. forming)				15,099	1,325	8.8%
7	PVC (incl. forming)	35,921	6,466	18.0%	45,027	9,682	21.5%
8	Textiles and footwear				170,168	46,456	27.3%
9	WEEE				139,331	42,691	30.6%
10	Wood	127,999	92,159	72.0%	330,100	189,455	57.4%

* It has been estimated that arisings of plastic film from agriculture are 19,008 tonnes and that 3,802 tonnes are recycled (20%). This is included in the plastic film arisings shown in the 'Total' table

** Battery arisings and recycling figures are shown in the household stream as data is reported for all post-consumer batteries as a whole. In reality the source of these batteries also includes businesses

Figure 6: Summary of Baseline Arisings and Recycling Data

The recycling levels of different resource streams vary significantly, essentially reflecting the maturity of recycling activities and difficulties in managing and recycling some resource streams.

The data are also used as baseline figures for the model with projections to 2025. This is discussed in detail in the following section.

3. Future Recycling Requirements - Projections to 2025

As previously mentioned the model was developed to project the arisings and recycling of the ten priority resource streams. The model also analysed the projected increase in recycling by weight and by the carbon metric adjusted measure.

The assumptions used for growth rates in arisings are described in this section. In addition to this the maximum recycling rates to be achieved by 2025 are described along with the impact of The Waste (Scotland) Regulations 2012.

3.1 Projected Waste Arisings – Assumptions for Growth

The projected waste arisings used in the model are consisted with those used in the recent Economic Assessment of the Zero Waste Plan for Scotland (with the exception of C&I which is combined in the model to reflect the different data sources used – as outlined in section 2.1, above). These assumptions are as follows:

Household Arisings

- Assumption of 0% growth rate in total household waste

Source: *Economic Assessment of Zero Waste Plan for Scotland, ZWS/Eunomia, July 2011, p.8*

Commercial & Industrial Arisings

- As previously stated the SEPA C&I baseline data was not used as a source for this report. Instead a number of different sources were used to estimate arisings of each priority resource stream instead of using a composition analysis on a total C&I figure. The growth in arisings of each waste stream is estimated to be zero, where any expected increase in arisings from increased economic activity is offset by resource efficiency measures being implemented.

Construction and Demolition Arisings

- ".....we believe that the potential for waste prevention in the C&D sector is significant and instead of modelling a significant bounce back [after the recession] we have modelled a reduction in arisings of 0.7% from 2009 onwards".

Source: *Economic Assessment of Zero Waste Plan for Scotland, ZWS/Eunomia, July 2011, p.9*

Agricultural film Arisings

- Assumption of 0% growth rate in agricultural film (in line with the assumption for household and C&I growth). This waste source is only included for arisings of average plastic film as it is a significant contributor to this resource stream

3.2 Meeting Recycling Targets

A key target in the Zero Waste Plan is achieving a minimum of 70% recycling (based on the carbon metric⁸) across all waste streams by 2025 (household, commercial, industrial and construction and demolition). The figure below shows the projected path to achieving this.

⁸ *The Scottish Carbon Metric, Zero Waste Scotland, March 2011 and March 2012 Update*

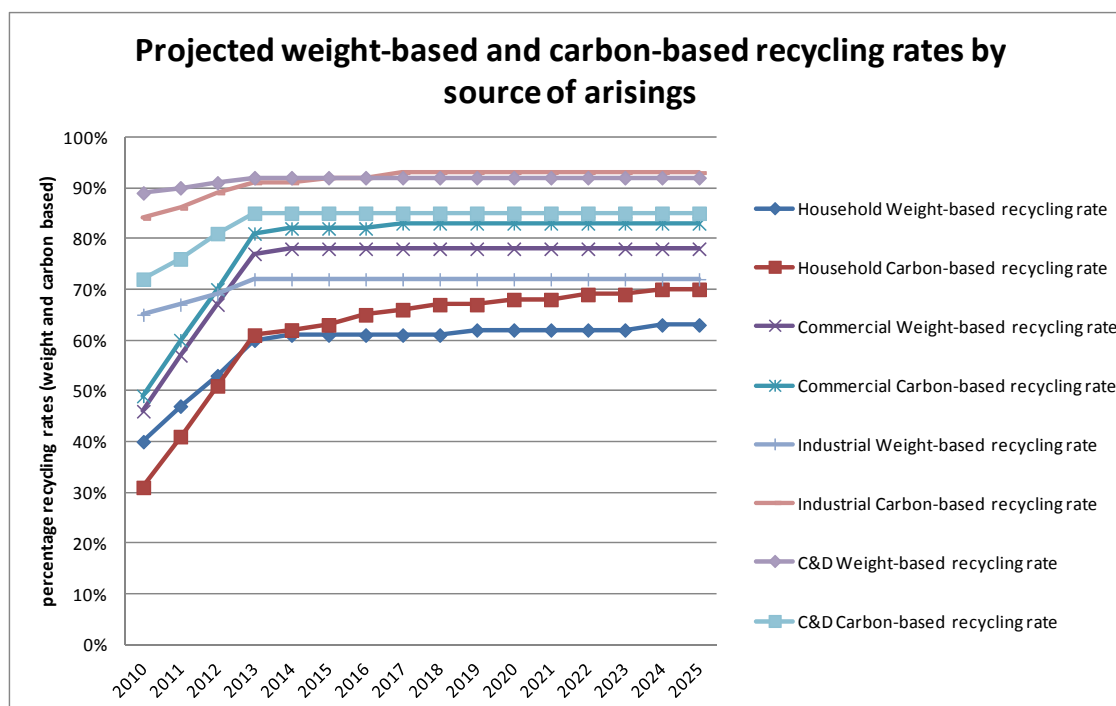


Figure 7: Projected Weight-based and Carbon-based Recycling Rates by Source of Arisings

The above figure shows a sharp increase in recycling from 2010 to 2013. This is due to a combination of increasing landfill tax and The Waste (Scotland) Regulations 2012 requiring households to be offered recycling options for key dry recyclables (glass, metal, plastics, paper and card) and for businesses to present these dry recyclables for collection separate from residual waste.

It can be seen that the carbon based recycling rates for the industrial and construction and demolition waste streams already exceed the 70% target. The commercial waste stream is anticipated to exceed the target (both weight and carbon based) in 2013. The household waste stream is not anticipated to achieve the carbon based 70% target until 2024, although projections do show a significant increase in the current recycling by 2013.

The pace of growth evident in the above figure is used as a guide to the pace at which recycling of individual material streams is projected to grow in the material flow model.

Individual, maximum achievable (weight based) recycling rates are identified for key material streams in the economic assessment. The economic model developed for this project uses data consistent with these maximum achievable recycling levels. It should be noted that this combination of maximum recycling rates is only one of an infinite number of combinations that could achieve the 70% recycling target by 2025. Other combinations could be modelled but it was decided to align with the set of maximum recycling rates used in the Economic Assessment of the Zero Waste Plan for consistency. A summary of the weight based recycling rates to be achieved for individual resource streams (from different waste streams) is given below.

Recycling Assumptions

Maximum achievable weight based recycling targets under the Zero Waste Plan by 2025:

Source: Economic Assessment of Zero Waste Plan

Household

- Paper and card – 85%
- Dense plastic – 45%
- Plastic film – 15%
- Glass – 90%
- Non-ferrous metal – 75%
- Textiles – 60%

Commercial

- Paper and card – 92%
- Dense plastic – 67%
- Plastic film – 57%
- Glass – 90%
- Non-ferrous metal – 90%
- Textiles – 81%

Industrial

- Paper and card – 90%
- Dense plastic – 80%
- Plastic film – 50%
- Glass – 95%
- Non-ferrous metal – 95%
- Textiles – 80%

Construction and Demolition

- Paper and card – 95%
- Dense plastic – 75%
- Glass – 90%
- Non-ferrous metal – 90%

Notes:

- 1 For batteries the UK recycling targets are used (25% by 2012 and 45% by 2015)
- 2 For WEEE the recast 2016 target of 85% by 2016 is used – even though this has yet to be finalised
- 3 For wood, targets are estimated to be 90% recycling over all the waste streams
- 4 Agricultural plastic film recycling is assumed to increase to 30% by 2014 and 50% by 2025
- 5 Where commercial and industrial recycling rates are combined an explanation is provided (in section five) as to how the figure has been derived

3.3 Projected additional recycling from Priority Resource Streams

Using the above assumptions, combined with the baseline arisings and recycling data detailed in Section 2, a model was developed to project resource flows to 2025. Before discussing each resource stream in detail, the relative contribution each one makes to achieve the Zero Waste Plan recycling target of 70% is examined. The sections below include analysis of all waste streams combined followed by separate sections analysing households, commercial & industrial and construction & demolition.

The data is analysed to show the relative contribution each priority resource stream makes to the projected additional recycling by 2025. The analysis presents the data both by weight and using carbon metric adjusted values⁹.

The carbon metric weightings used for each priority resource stream were:

- Aluminium cans and foil – 100
- Average plastic film – 11.61
- Batteries – 5.26
- Paper & board – 8.62
- Polystyrene – 13.38
- PVC – 9.58
- Wood – 13.21

In three instances, the categorisation of the carbon metric weightings did not exactly match the priority resource stream definitions investigated in this report:

⁹ Carbon metric weightings are taken from 'The Scottish Carbon Metric Carbon Factors', Table 2, Zero Waste Scotland, March 2012

- Textiles & footwear: carbon metric weightings available separately for textiles (recycling only) – 11.90 and footwear – 47.32
- Glass: carbon metric weightings available separately for colour separated glass – 4.23 and mixed coloured glass – 2.40
- WEEE: carbon metric weightings available separately for WEEE (small) – 15.99, WEEE (mixed) – 14.82, WEEE (large) – 13.66 and WEEE (fridges and freezers) – 7.08

In the latter three cases an estimate was made of a single carbon metric weighting, as summarised below (sources for data estimates can be found in the appropriate sub-sections of section five of this report).

Textiles & footwear

Total arisings of textiles & footwear is estimated to be 152,744 tonnes. Textiles accounts for 141,818 tonnes and footwear, 10,926 tonnes.

Multiplying the carbon metric for footwear (47.32) by the arisings of footwear (10,926 tonnes) gives a carbon weighted value of 517,018 (this is a relative measure for comparison). Doing the same with textiles results in a carbon weighted value of 1,687,634. The total carbon weighted value for both materials is 2,204,652. Dividing this by the total tonnes arising (152,744 tonnes) produces an adjusted carbon weighting value which is used in the model (14.43). This assumes that any increase in recycling occurs equally for both textiles & footwear.

Glass

It is estimated that 135,416 tonnes of glass is recycled. Industry sources interviewed as part of this project suggest that 70% of glass collected is mixed (94,791 tonnes) and 30% colour separated (40,625 tonnes).

Multiplying the carbon metric for mixed glass (2.40) by the amount of mixed glass collected (94,791 tonnes) gives a carbon weighted value of 227,499. Doing the same with separated glass results in a carbon weighted value of 171,843. The total carbon weighted value for both separated and mixed glass is 399,342. Dividing this by the total tonnes arising (135,342 tonnes) produces an adjusted carbon weighting value which is used the model (2.95). This assumes that future recycling collections will maintain the 70/30 ratio of mixed to separated glass.

WEEE

It is estimated that EEE arisings in 2009 were 1,546,565 (this is a UK figure that can be used as the ratio of the different resulting WEEE types is assumed to be the same). It is assumed that the segregated collection of WEEE results in three broad types: large WEEE' (483,956 tonnes) 'mixed WEEE' (1,345,666 tonnes) and 'fridges and freezers' (200,899 tonnes). Multiplying these tonnages by their respective carbon weighting results in values of 1,422,365 (fridges and freezers), 6,610,839 (large WEEE) and 12,770,542 (mixed WEEE). The total carbon weighted value for the three WEEE types is 20,803,746. Dividing this by the total tonnes arising (1,546,565 tonnes) produces an adjusted carbon weighting value which is used in the model (13.45). This assumes that any increase in recycling of WEEE is reflected equally over the three types identified above.

3.3.1 Additional recycling projected from all waste sources

The figure below shows the projected increase in recycling (by weight) by priority resource stream, to 2025, required to meet the 70% target (based on total recycling from households, C&I and C&D).

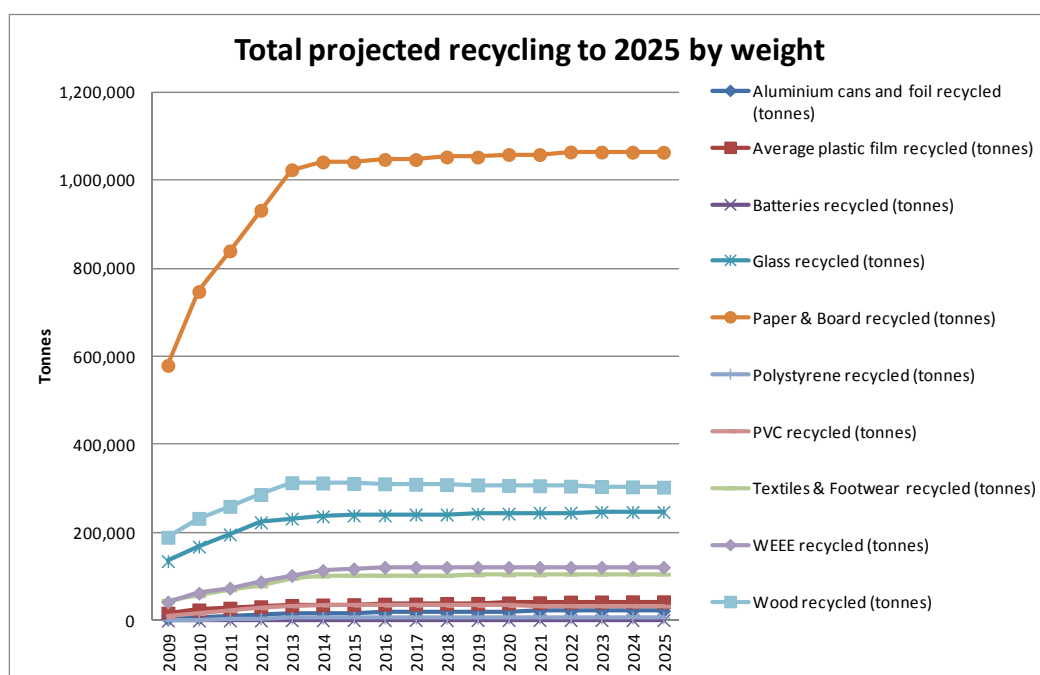


Figure 8: Total Projected Recycling to 2025 by Weight (all waste streams)

The above figure shows that paper & board, wood and glass are the most significant contributors to recycling (based on weight), and that large increases in the tonnages recycled are required, particularly for paper & board, despite the current high levels of recycling. The graph provides a useful overview but it is also useful to examine the change in recycling from the 2009 baseline data.

The figure below shows the additional tonnes that are projected to be recycled by 2025 (i.e. additional to the 2009 baseline tonnage data).

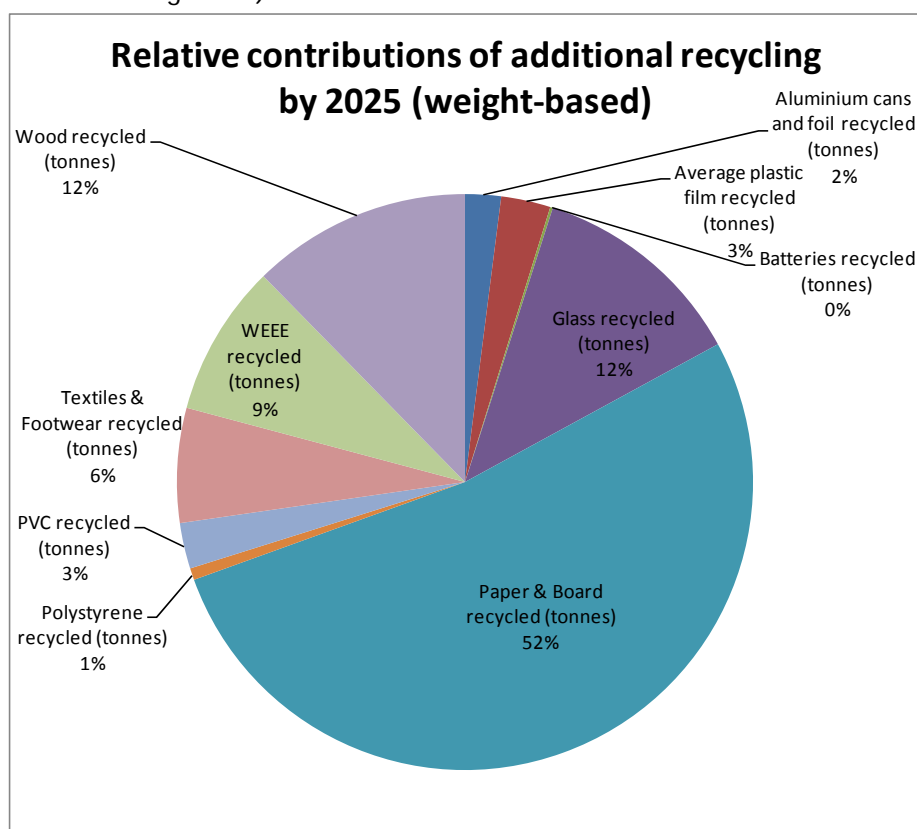


Figure 9: Relative Contributions of Additional Recycling by 2025 (Weight-based) (all waste streams)

This figure shows that paper & board is the key material stream that will be the source of over half of the additional tonnes of material to be recycled by 2025 (note that the above figure relates only to the ten resources streams being investigated as part of this report and does not include materials such as food waste). The total additional recycling projected in 2025, from the ten priority resources streams, is just over 920,000 tonnes per annum more than in the 2009 baseline year.

The target of 70% recycling by 2025 is, however, based on the carbon metric. The figure below shows the projected material recycled with carbon weighting factors applied.

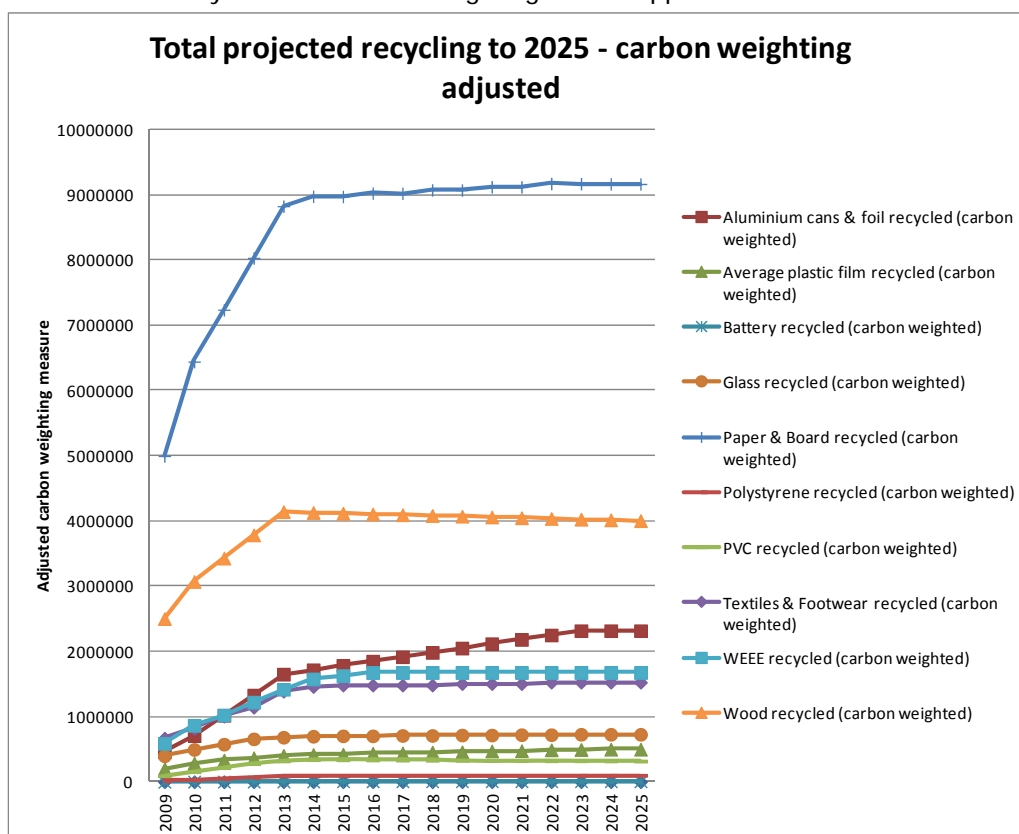


Figure 10: Total Projected Recycling to 2025 – Carbon Weighting Adjusted (all waste streams)

The above figure shows the importance of paper & board, wood and aluminium cans and foil to carbon weighted recycling performance.

To examine the change in performance further, we can consider the relative contributions made by each priority resource stream based on the change in recycling from 2009 to 2025. The figure below shows the relative contributions of this change in recycling with carbon metric weighting factors applied.

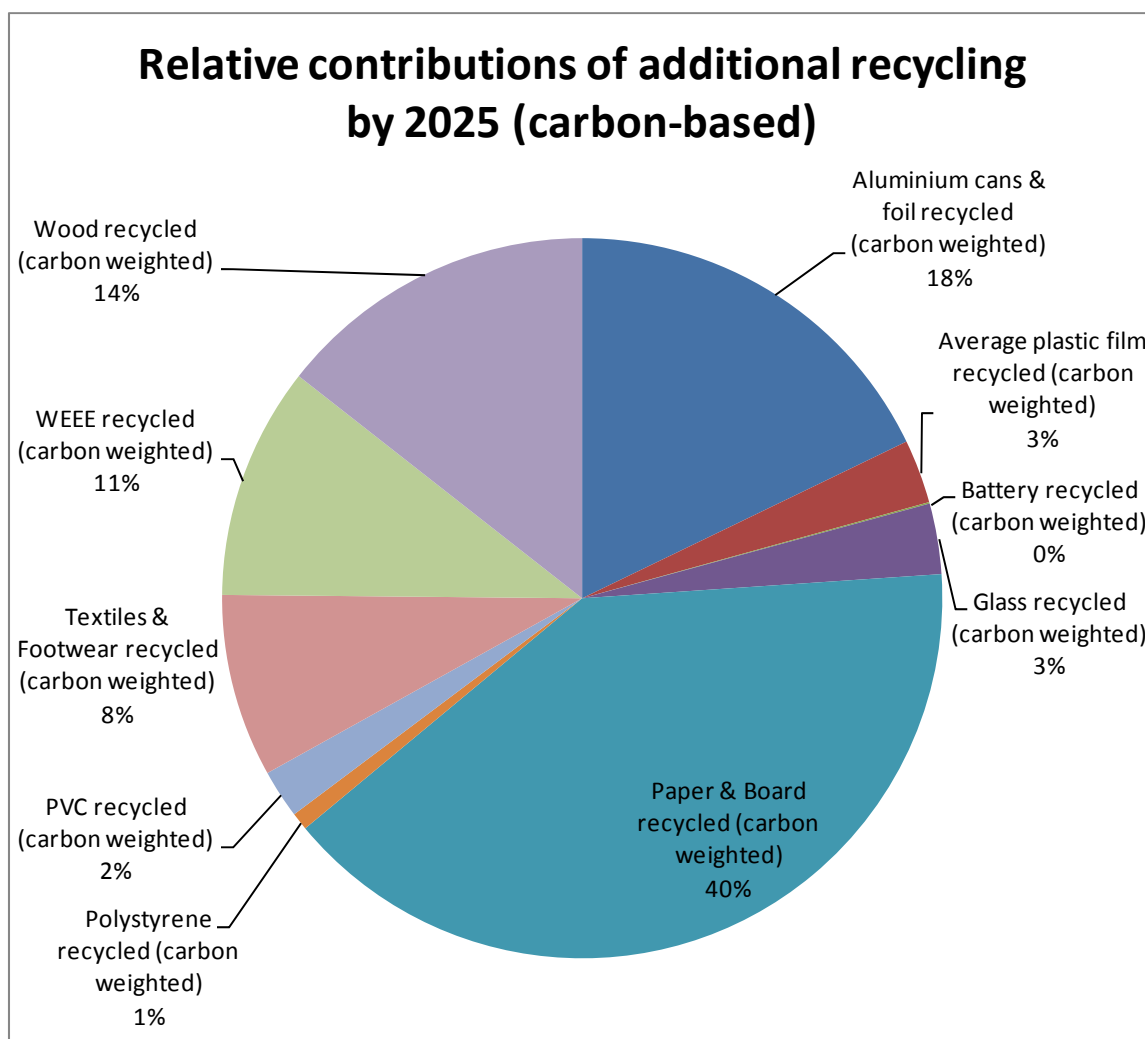


Figure 11: Relative Contributions of Additional Recycling by 2025 (Based on Carbon Weighted Values) (all waste streams)

The above figure shows that, from a carbon-based perspective, paper & board is the key contributor to additional recycling to 2025, accounting for 40% of the total additional projected recycling. Aluminium cans and foil only accounted for 2% of the increase in weight of materials recycled but accounts for 18% of the carbon weighted total. Other important materials in terms of their contribution to additional recycling required from the 2009 baseline (from a carbon perspective) are wood (14%), WEEE (11%) and textiles & footwear (8%). The remaining five materials account for just 9% of the contribution to additional recycling.

In addition to the above analysis of the total additional recycling, it is useful also to consider the key materials in each waste stream (household, C&I and C&D).

3.3.2 Additional recycling projected from households

The figure below shows the projected increase in recycling (by weight) by priority resource stream, to 2025, required to meet the 70% target (based on recycling from households).

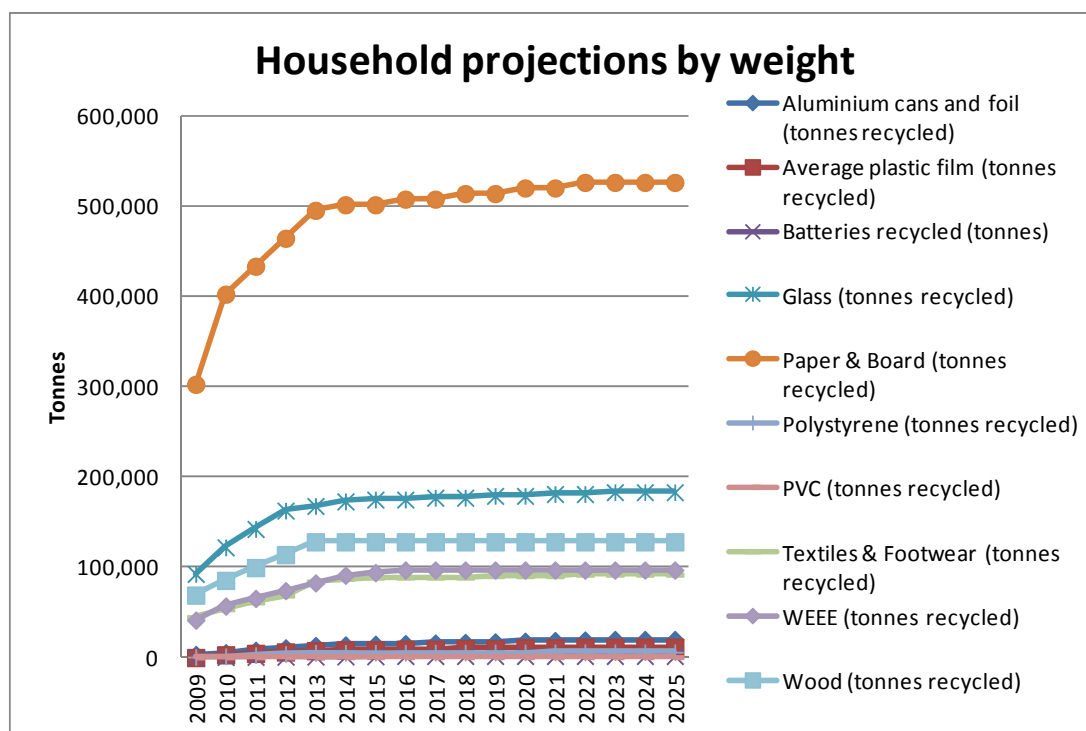


Figure 12: Total Projected Recycling to 2025 by Weight (Household)

The key materials (by weight) recycled from the household waste stream are paper & board, glass, wood, WEEE and textiles & footwear. The 2009 baseline estimate indicates total recycling of priority resource streams from households to be around 555,000 tonnes. By 2025 this is projected to rise to 1,065,000 tonnes. The figure below shows the relative contribution (by weight) that each priority resource stream makes to this projected additional 511,000 tonnes of material recycled by 2025.

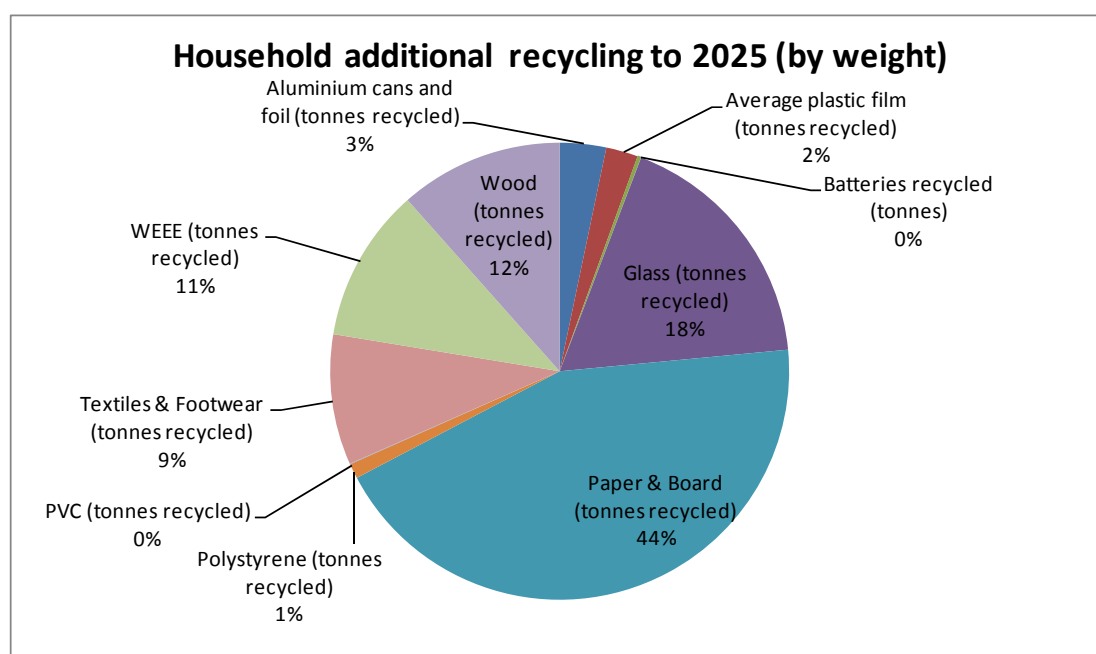


Figure 13: Relative Contributions of Additional Recycling by 2025 (Based on Weight) (Household)

The above figure shows the key priority resource streams from households (by weight) are paper & board (44%), glass (18%), Wood (12%), WEEE (11%) and textiles & footwear (9%). The remaining five resource streams account for a total of 6% of the additional weight of materials recycled by 2025.

However, given that the 70% recycling target will be based on the carbon metric it is necessary to analyse these figures adjusted by the relevant carbon weightings. The figure below shows the projected additional recycling from households to 2025, adjusted using carbon weightings.

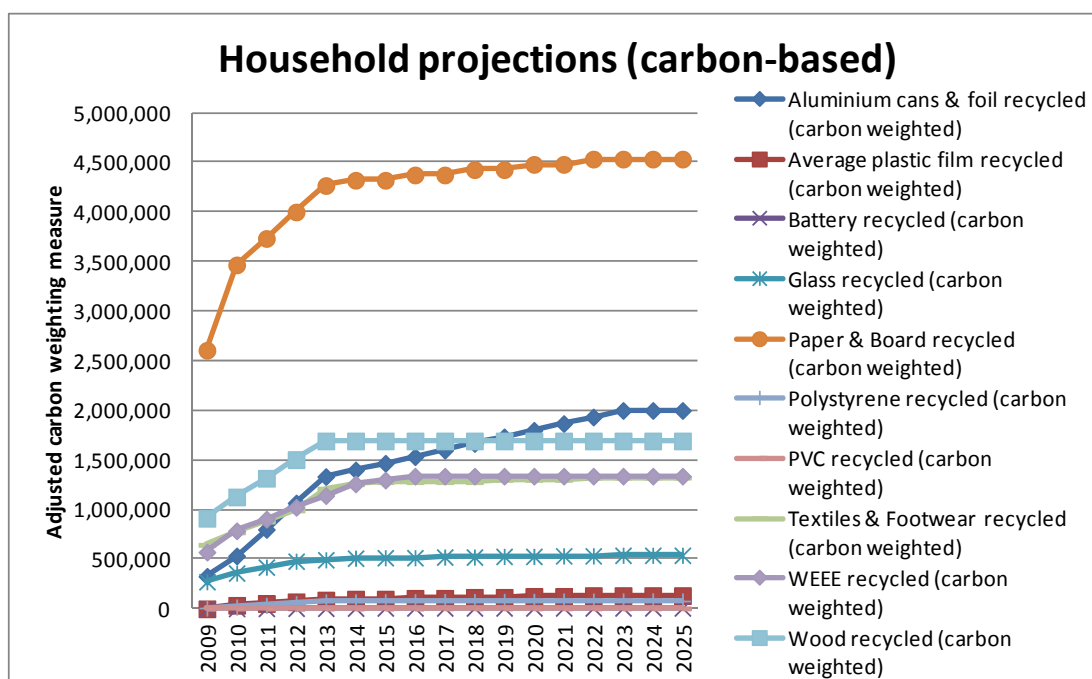


Figure 14: Total Projected Recycling to 2025 – Carbon-based (Household)

The above figure clearly shows the relative importance of paper & board to the household waste stream (on the carbon based measure). The same data is shown in the figure below which identifies the relative percentage contribution to projected increases in recycling.

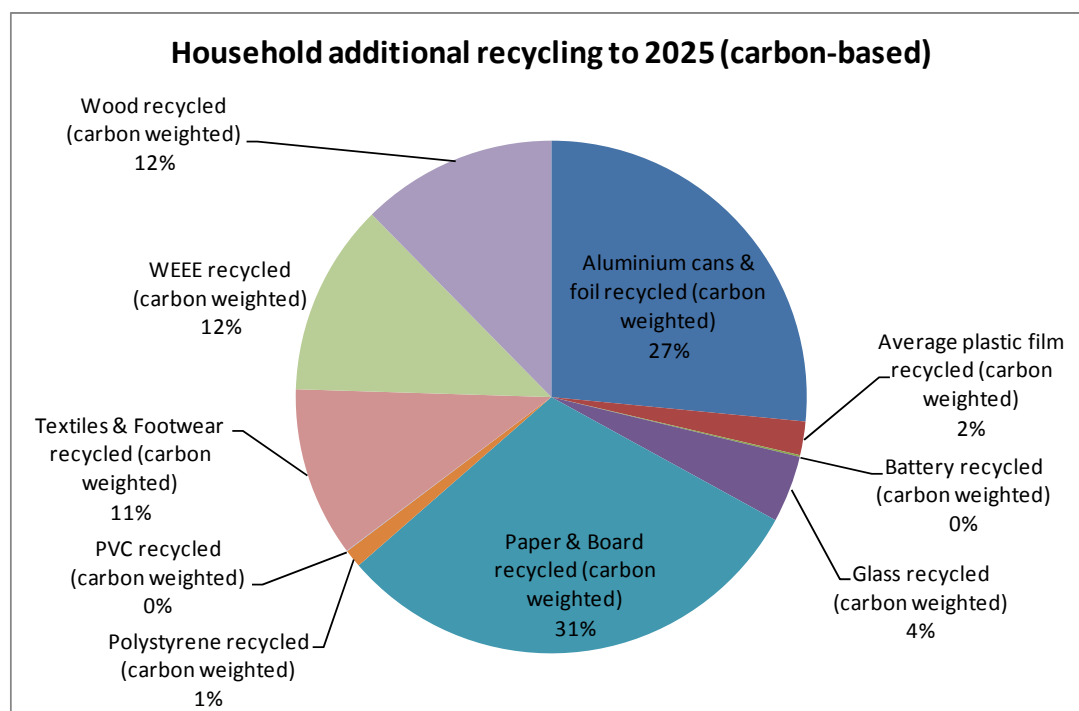


Figure 15: Relative Contributions of Additional Recycling by 2025 (Carbon-based) (Household)

The above figure shows that paper & board contributes 31% of the additional recycling projected by 2025 (carbon-based). Other significant material streams include aluminium cans & foil (27%), wood (12%), WEEE (12%) and textiles & footwear (11%). The remaining five resource streams contribute just 7% to the projected additional recycling.

The next section provides an analysis of the projected additional recycling from the commercial and industrial waste stream.

3.3.3 Additional recycling projected from commercial & industrial sources

The figure below shows the projected increase in recycling (by weight) by priority resource stream, to 2025, required to meet the 70% target based on recycling from C&I sources.

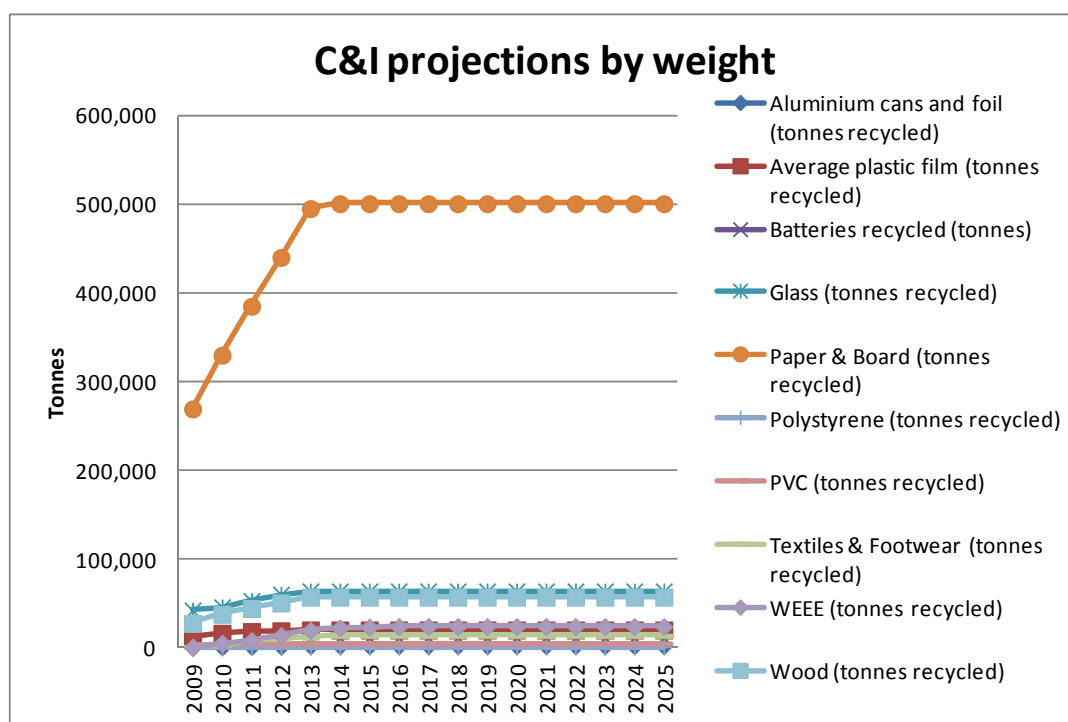


Figure 16: Total Projected Recycling to 2025 by Weight (C&I)

The key material (by weight) recycled from the C&I waste stream is clearly paper & board, with wood and glass being other significant (but minority) contributors. The 2009 baseline estimate indicates total recycling of priority resource streams from C&I sources to be around 362,000 tonnes. By 2025 this is projected to rise to 692,000 tonnes. The figure below shows the relative contribution (by weight) that each priority resource stream makes to this projected additional 330,000 tonnes of material recycled by 2025.

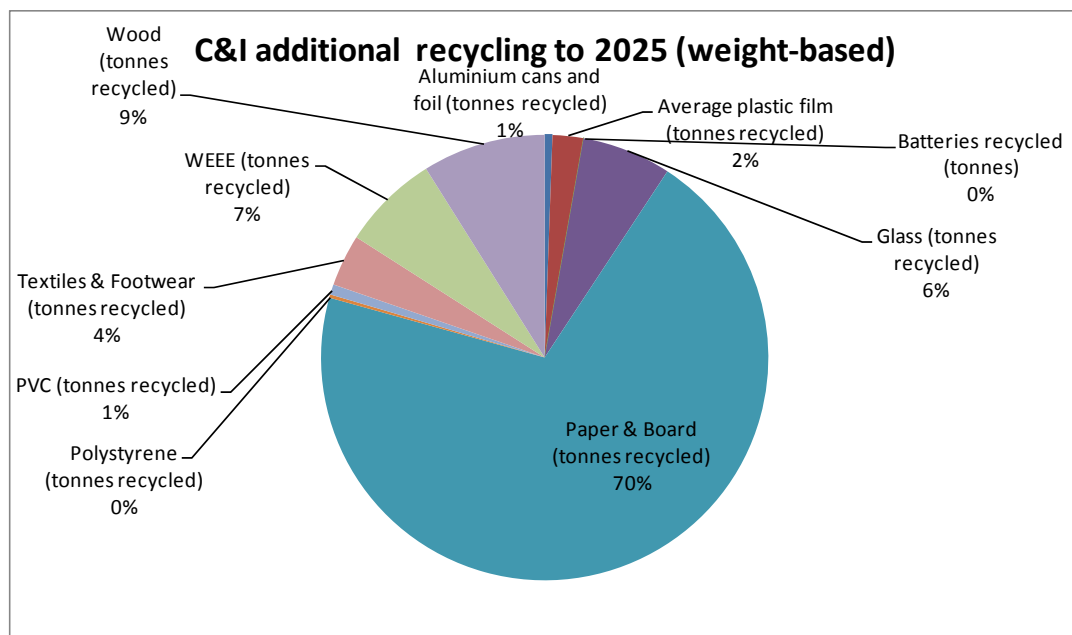


Figure 17: Relative Contributions of Additional Recycling by 2025 (Weight-based) (C&I)

The above figure shows the key priority resource streams from C&I sources (by weight) are paper & board (70%), wood (9%), WEEE (7%), glass (6%), and textiles & footwear (4%). The remaining five resource streams account for a total of 4% of the additional weight of materials recycled by 2025. However, given that the 70% recycling target will be based on the carbon metric it is necessary to analyse these figures adjusted by the relevant carbon weightings. The figure below shows the projected additional recycling from C&I sources to 2025, adjusted using carbon weightings.

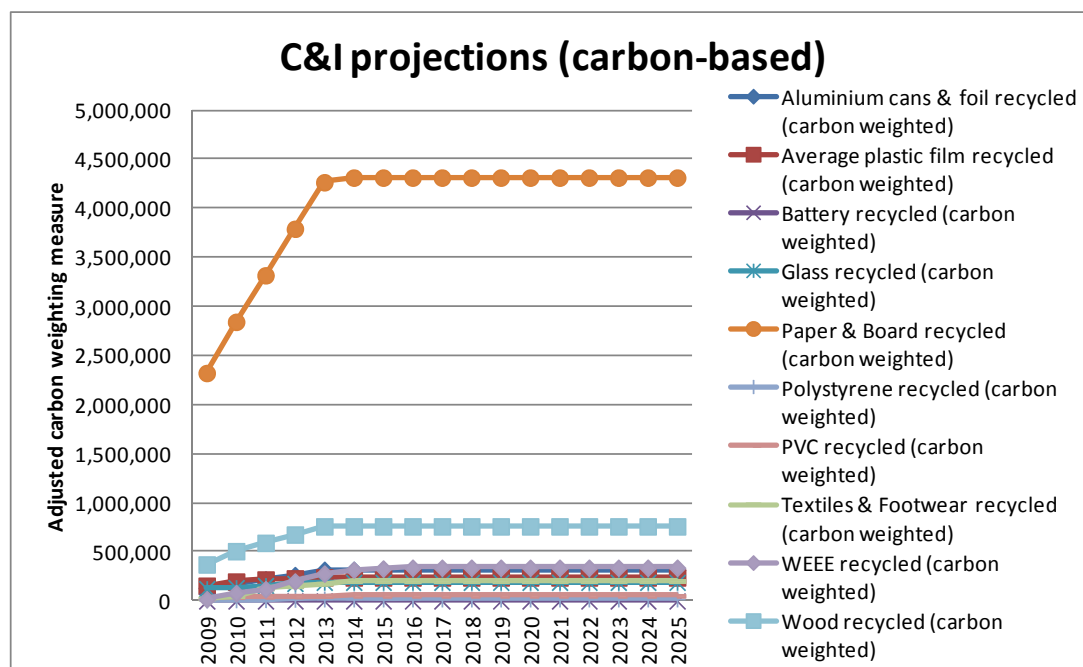


Figure 18: Total Projected Recycling to 2025 – Carbon-based (C&I)

The above figure clearly shows the relative importance of paper & board to the C&I waste stream (on the carbon based measure). Wood is also significant. The same data is shown in the figure below, which identifies the relative percentage contribution to projected increases in recycling.

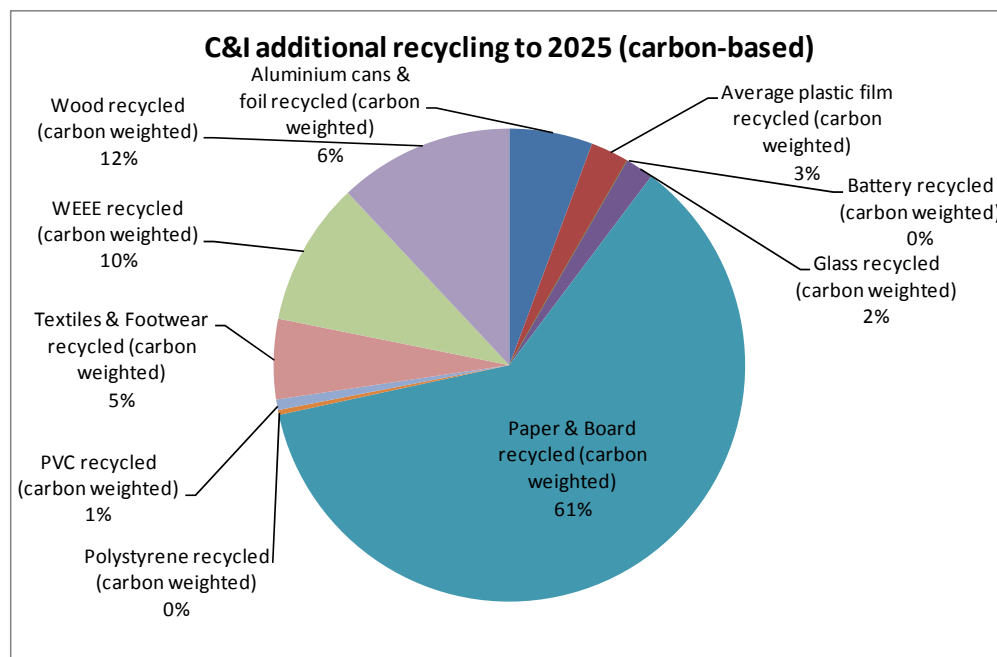


Figure 19: Relative Contributions of Additional Recycling by 2025 (Based on Carbon Weighted Values) (C&I)

The above figure shows that paper & board contributes 61% of the additional recycling projected by 2025 (carbon based). Other significant material streams include wood (12%), WEEE (10%), aluminium cans & foil (6%) and textiles & footwear (5%). The remaining five resource streams contribute just 6% to the projected additional recycling.

The next section provides an analysis of the projected additional recycling from the construction & demolition waste stream.

3.3.4 Additional recycling projected from construction & demolition sources

The figure below shows the projected increase in recycling (by weight) by priority resource stream, to 2025, required to meet the 70% target (based on recycling from C&D sources).

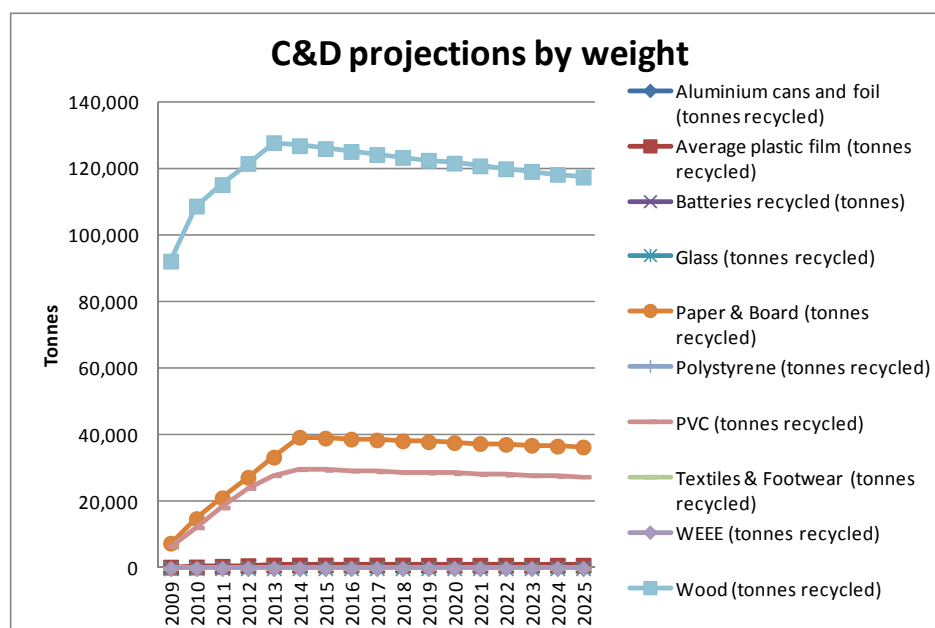


Figure 20: Total Projected Recycling to 2025 by Weight (C&D)

The key material (by weight) recycled from the C&D waste stream is wood, with paper & board and PVC being other significant contributors. The 2009 baseline estimate indicates total recycling of priority resource streams from C&D sources to be around 106,000 tonnes. By 2025 this is projected to rise to 182,000 tonnes. The figure below shows the relative contribution (by weight) that each priority resource stream makes to this projected additional 76,000 tonnes of material recycled by 2025.

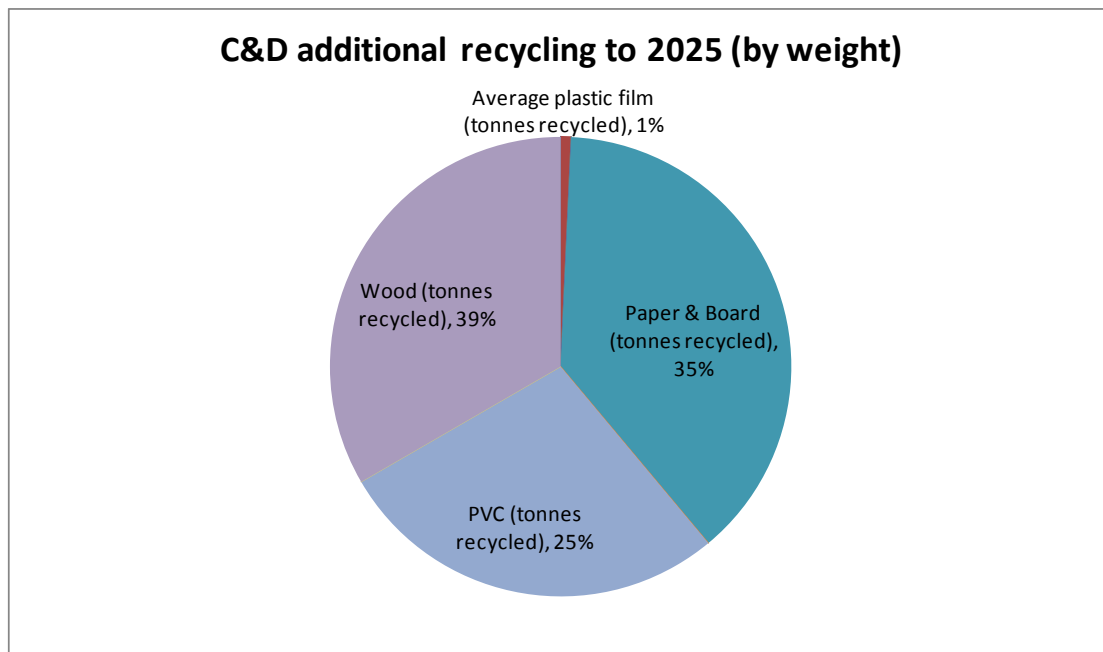


Figure 21: Relative Contributions of Additional Recycling by 2025 (Based on Weight) (C&D)

The above figure shows the key priority resource streams from C&D sources (by weight) are wood (39%), paper & board (35%) and PVC (25%). The only other priority resource stream arising from C&D sources is assumed to be average plastic film (accounting for just 1% of the additional weight of materials recycled by 2025). The 'glass', investigated during this project only refers to packaging glass and excludes flat glass (and it is assumed that there are no significant quantities of packaging glass from C&D sources).

The 70% recycling target will be based on the carbon metric and it is necessary to analyse these figures adjusted by the relevant carbon weightings. The figure below shows the projected additional recycling from C&D sources to 2025, adjusted using carbon weightings.

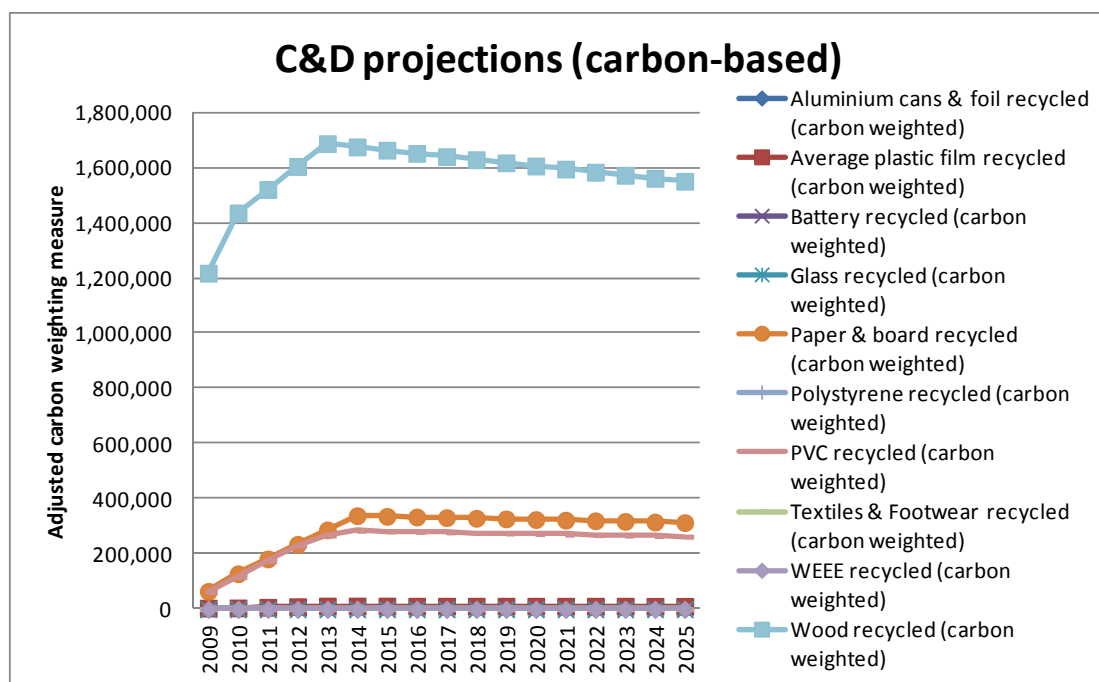


Figure 22: Total Projected Recycling to 2025 – Carbon-based (C&D)

The above figure clearly shows the relative importance of wood to the C&D waste stream (on the carbon-based measure). Paper & board is also significant, as is PVC. The same data is shown in the figure below, which identifies the relative percentage contribution to projected increases in recycling.

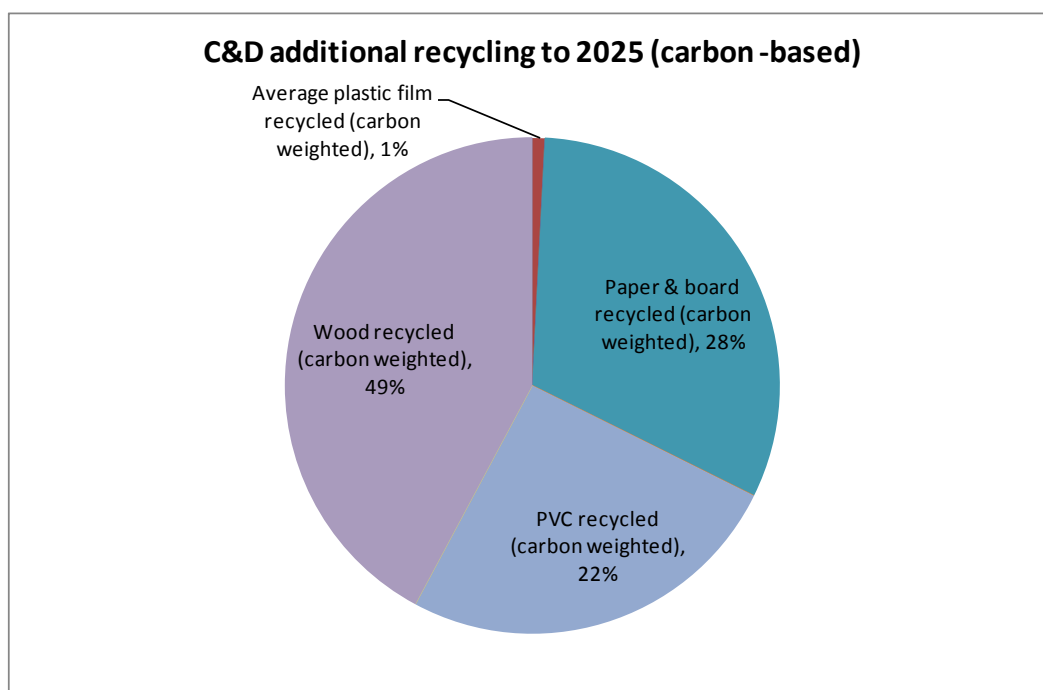


Figure 23: Relative Contributions of Additional Recycling by 2025 (Carbon-based) (C&D)

The above figure shows that wood contributes almost half of the additional recycling projected by 2025 (carbon based). Other significant material streams include paper & board (28%) and PVC (22%). The remaining 1% is attributed to average plastic film.

The figures in the preceding sections highlight the relative priority of increased recycling (carbon-based measure) within the different sources of arisings. This can be summarised as follows:

Resource Stream	Priority level by source of arisings (1 is highest)			
	Household	C&I	C&D	Agricultural
Aluminium cans & foil	1	2		
Average Plastic Film	3	3	3	1
Batteries	4	4		
Glass	3	3		
Paper & Board	1	1	1	
Polystyrene	3	4		
PVC	4	3	1	
Textiles & Footwear	2	2		
WEEE	2	2		
Wood	2	2	1	

Key:

- 1 - Major priority for increased recycling (20%+ share of additional carbon-based recycling)
- 2 - Secondary priority for increased recycling (>5% but <20% of additional carbon-based recycling)
- 3 - Lower priority for increased recycling (>0% but <5% of additional carbon-based recycling)
- 4 - No significant impact (~0% share of additional carbon-based recycling)

Figure 24: Ranking of Resource Streams (Based on Share of Additional Carbon-Based Recycling) By Source

The above prioritisation of resource streams, by source of arisings, is based on the evidence of additional recycling required to meet carbon-based recycling targets. It should be noted that the estimate of arisings of average plastic film from C&I sources is at the lower end of available figures (37,623 tonnes) and if the higher end estimate were used (210,484 tonnes) then it is likely it would be at least a 'secondary priority' rather than a 'lower priority' for the C&I waste stream.

This above figure is used to guide the identification of potential opportunities to bring about these increases later in this report. Whilst some of the opportunities are around the provision of additional reprocessing infrastructure others require action earlier in collection and/or segregation activities. The section that follows contains findings from the research relating to collection and segregation activities.

4. Materials Collection and Segregation

The Scottish Government has set a target of achieving at least 70% recycling rate for households and all other sources. To help achieve this, new regulations will shortly be introduced that will impact on the collection and segregation of material.

By the end of 2013, local authorities will have to offer separate collection of glass, metals, plastic, paper and card to both households and businesses. By the same deadline all businesses must present these dry recyclables for separate collection. Co-mingled collections may be used but must result in single stream material of a similar or better quality to that resulting from separate collections.

A consistent message received from recycling companies, when discussing opportunities to add value to the materials they receive was the need to improve the material quality through better collection processes. Whilst co-mingling upstream may prove to be a more economically attractive option, recyclers suggest it also limits added value opportunities and frequently leads to material being exported. The Scottish Government has sought to overcome this issue by providing an option in The Waste (Scotland) Regulations 2012 to introduce mandatory minimum standards should the industry fail to deliver the necessary quality of material from co-mingled collections.

4.1 Materials Collection

This section summarises the key changes anticipated in materials collection as a result of measures proposed by The Scottish Government. These measures are being established to achieve a 70% recycling rate for households and all other waste streams by 2025¹⁰.

In the previously published Economic Assessment of the Zero Waste Plan¹¹ the change in recycling rate is shown for each material source (both by weight and by carbon metric). This required change in recycling rate is shown in the figure below.

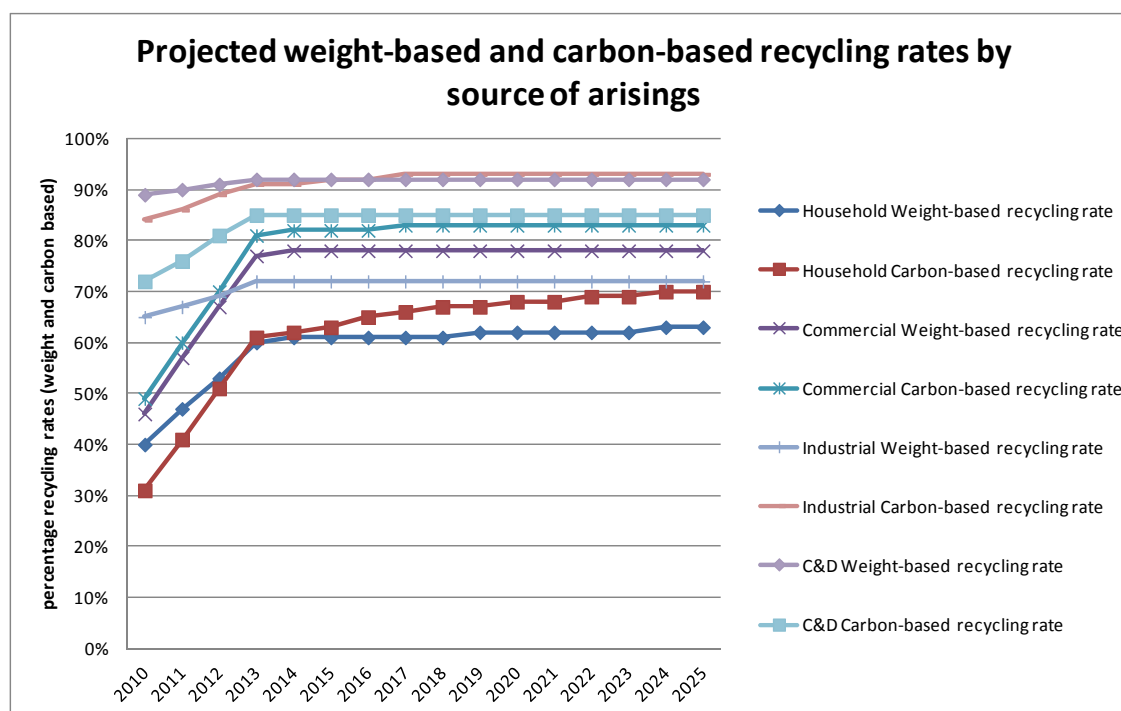


Figure 25: Projected weight-based and carbon-based recycling rates by source of arisings

¹⁰ Policy Statement – Zero Waste Regulations, The Scottish Government, October 2011, p.5

¹¹ Economic Assessment of the Zero Waste Plan for Scotland, Zero Waste Scotland, 2011

As shown in the above figure, recycling from construction and demolition is already above the target of 70% using both the weight and carbon metric measures. Recycling from industrial sources is also above the 70% target using the carbon metric measure but is at around 65% using a weight based measure.

The two sources of material requiring the greatest increase in recycling rate are commercial and household (using both the carbon metric and weight based measures). The key date for implementation of many of the new statutory measures is January 2014, which explains the rapid increase of recycling rate at this point (assuming businesses comply with the regulations).

The Policy Statement also details The Scottish Government's view on co-mingled versus. source segregation. The document quotes the revised Waste Framework Directive (rWFD) on the importance of high quality recycling (a recurring theme from the primary interviews carried out with members of the Scottish recycling community):

"co-mingled collection of single waste streams may be accepted as a derogation from the requirement for separate collection, but the benchmark of 'high quality recycling' of separately collected single waste streams has to be regarded; only if subsequent separation can achieve high quality recycling similar to that achieved with separate collection, co-mingling is acceptable against Article 11 of the rWFD and the principles of the waste hierarchy".

The regulations will stipulate that the outputs from the materials recycling facility (where co-mingled collections are segregated) **are of comparable quality to that collected at the kerbside**. There will be provision in the regulations to allow Scottish Ministers to introduce statutory based standards if it is believed intervention is required to achieve better quality outputs.

4.1.1 Households

In the recently published Zero Waste Regulations Policy Statement the intention to introduce a new statutory requirement on local authorities was highlighted. This will mean local authorities having to offer separate collection of glass, metals, plastic, paper and card to householders by 2013. Of course, householders will not be under a statutory obligation to recycle and the Zero Waste Plan outlines other educational and awareness raising activities to help achieve the household recycling rates required.

4.1.2 Commercial & Industrial

The Waste (Scotland) Regulations 2012 are expected to introduce a requirement on all businesses (regardless of size) to present dry recyclables for separate collection by the end of 2013 (paper, card, glass, metals and plastic).

To ensure businesses receive a minimum level of service to support these separate collections local authorities will be required to offer such a service.

4.1.3 Construction & Demolition

The same requirement to present dry recyclables for collection will apply to businesses operating in the construction and demolition sector.

4.2 Materials Segregation

4.2.1 Scottish Capacity

Mixed waste is segregated in a number of materials recycling facilities (MRFs) and waste transfer stations (WTS) throughout Scotland.

Waste management contractors that handle C&I and C&D waste arisings are increasingly trying to segregate a range of materials and supply these to recycling companies rather than send to landfill. The majority of these waste management companies are essentially employing staff to manually

separate these materials. These companies are not restricted by the availability or scale of equipment. They essentially have a variable capacity as they can adapt the scale of their workforce to suit the amount of materials available. Although a very basic operation, it has the potential to significantly increase the amount of materials being recycled.

There are, however, concerns within the recycling industry¹² regarding the quality of materials segregated and supplied to recycling companies. Materials are often supplied in a mixed form or with high levels of contamination and are, therefore, difficult to process and sell on. This has been particularly highlighted by the plastics industry as a major barrier to increasing recycling. Two categories of material (mixed hard plastics and mixed plastic film) have low market value and are very difficult to recycle. Typically these materials are exported to China but when markets are depressed there is no demand for this material. As discussed later in this document, this is inhibiting recycling of these materials.

Of course MRFs are much more sophisticated, high investment operations that mainly focus on local authority collected waste, although often these are run by commercial companies.

MRFs, major waste transfer stations are listed in the following table¹³:

¹² *Feedback from stakeholder interview programme*

¹³ *Sources include*

a) Market Scenarios for Municipal MRF Tonnage up to 2015, WRAP Report prepared by Optimat, March 2009

b) Additional data from Zero Waste Scotland and Optimat

c) Web-based research

Company	Location	Post-Code	Company	Location	Post-Code
60 North Recycling Limited	Shetland	ZE1 0PY	Levenseat Ltd	Lanark	ML11 8EP
All Waste Recycling Ltd	Airdrie	ML6 8RL	Lomond Recycling Ltd	Glasgow	G1 3DX
Alloa Community Enterprises Ltd	Alloa	FK10 2AL	Lowmac Alloys Ltd	Irvine	KA11 5AR
Argyll Resources Group	Oban	PA34 4PL	Moffat Can	Moffat	DG10 9HB
Armstrong Waste Management	Dumfries	DG2 0EF	Munro	Alness	IV17 0PG
Augean plc	Paisley	PA3 1RB	New Town Skips Ltd	Motherwell	ML1 1PR
Avanti Environmental Group	Stirling	FK9 4TU	Northern Recycling Solutions Ltd	Invergordon	IV18 0QR
Banff Environmental Action Team	MacDuff	AB44 1QD	Oakbank Services Ltd	Dumfries	DG1 4PH
Biffa Waste Services Ltd	Aberdeen	AB12 3BQ	Oran Environmental Services	Grangemouth	FK3 9UB
Biffa Waste Services Ltd	Edinburgh	EH5 1QG	Patersons Waste Management	Glasgow	G32 8JF
Biffa Waste Services Ltd	Cambuslang	G32 8RG	Recycled Scotland	Leith	EH6 8QX
Binn Skips Ltd	Glenfarg	PH2 9PX	Recycling Solutions Ltd	Linlithgow	EH49 6LH
Blue Group	Stirling	FK9 7ST	Ross and Fullerton Ltd	Greenock	PA15 2BU
Bowman Skip Hire	Fort William	PH33 7AW	Scotnet Recycling Ltd	Buckie	AB56 1UQ
Burnside Recycling Ltd	Kennoway	KY8 5JN	Scotwaste Recycling Solutions Ltd	Bathgate	EH48 2HR
Can Do Community Recycling	Fraserburgh	AB43 9SU	Shanks Waste Solutions	Glasgow	G21 2RL
Can Do Recycling Ltd	Glasgow	G73 1UZ	Shanks Waste Solutions	Broxburn	EH52 6PG
Changeworks Recycling	Edinburgh	EH6 5PY	Shanks Waste Solutions	Aberdeen	AB12 3BQ
Chris Baylis Ltd	Stirling	FK7 7SN	Shanks Waste Solutions	Dingwall	IV16 9XJ
D J Laing (Contracts) Ltd	Dundee	DD2 4SH	Shanks Waste Solutions	Dumfries	DG1 3PG
D Shaw Ltd	Larkhall	ML9 2UJ	Simple Waste Solutions Ltd	Glasgow	G81 1RG
Dalkeith Demolition	Mayfield	EH22 4AD	Sims Recycling Solutions	Dumfries	DG2 0NR
David Morton (Larbert) Ltd	Larbert	FK1 2BQ	SITA	Aberdeen	AB12 3BG
David Ritchie and Sons Ltd	Carr-Bridge	PH23 3AD	SITA	Glenfarg	PH2 9PX
Davidson of Rora Ltd	Peterhead	AB42 4UT	Smurfit Kappa Recycling Ltd	Glasgow	G41 1LT
Dow Waste Management	Cumbernauld	G67 2RL	Stephen Dalton Skip Hire Ltd	Edinburgh	EH12 9BU
E. Nicholsons Ltd	Glasgow	G22 6NX	STIR Network	Edinburgh	EH7 5QZ
easyWaste Solutions Ltd	Glasgow	G81 1RG	Stirling Fibre Ltd	Kilsyth	G65 9TS
EIS Waste Services	Aberdeen	AB12 4LP	T.O.M. Waste Solutions	Newarthill	ML1 5ST
Enviroco Ltd	Peterhead	AB42 3GL	Taylor's Industrial Services	Aberdeen	AB12 3LY
Envirokleen Ltd	Kirkcaldy	KY1 3NL	Tayside Agri-Waste	Aberfeldy	PH15 2EA
Forth Valley Recycling and Packaging Ltd	Denny	FK6 5DW	TWMA	Aberdeen	AB12 3BN
GREAN	Golspie	KW10 6RN	Veolia	Aberdeen	AB12 3BG
Greenlight Environmental	Greenock	PA15 4UE	Veolia	Falkirk	FK2 7UY
Greenlight Environmental	Alexandria	G83 0TL	Veolia	Grangemouth	FK3 9XB
Hamilton Waste Ltd	Musselburgh	EH21 8QJ	Viridor	Glasgow	G69 7RW
Highland Waste Services	Invergordon	IV18 0LE	Viridor	Edinburgh	EH17 8RY
Innovative Environmental Services Ltd	Falkirk	FK1 4AX	WasteCare Ltd	Livingston	EH54 5DR
J&M Murdoch	Neilston	G78 3NA	William Tracey Ltd	Linwood	PA3 3BD
J&M Murdoch	Glasgow	G53 7SP	William Tracey Ltd	Broxburn	EH52 5ND
J Gordon Williamson Ltd	Moray	IV30 1XZ	William Tracey Ltd	Glenrothes	KY6 2SY
Junk Me	Glasgow	G45 9UH			

Figure 26: List of Key Scottish MRFs and Major Waste Transfer Stations

It is estimated that almost 1,000,000 tonnes per annum of materials segregation capacity is available in Scotland¹⁴. A number of facilities are used to segregate co-mingled household waste and several are directly linked to local authority contracts. Recently published data on additional operational waste management infrastructure capacity required to meet Zero Waste Plan targets¹⁵ suggests that there is a need for the following:

- 1,980,000 tonnes of additional capacity needed to manage source segregated recyclables and source segregated organic wastes for composting and anaerobic digestion (incl. clean MRFs)
- 1,730,000 tonnes of additional capacity to manage unsorted waste including mechanical sorting, thermal and biological treatment (incl. dirty MRFs)

4.2.2 Best Practice Approaches

Best practice, whether in a MRF or waste transfer station, should achieve high quality segregation of materials.

WRAP has already delivered initiatives to support operators to run MRFs effectively and the ability to successfully segregate materials in MRFs has already been demonstrated and reported by WRAP¹⁶.

¹⁴ Calculation made using confidential data held by Optimat Limited

¹⁵ Zero Waste Plan Annex B, Regional Capacity Table December 2011, Scottish Government

¹⁶ Several reports are available at http://www.wrap.org.uk/recycling_industry/market_information/municipal_mrf.html

Within waste transfer stations, the range and quality of materials to be handled is more variable - operators are trying to manually separate all types of mixed waste. However it is asserted by the recycling industry that basic care and attention during materials segregation activities can offer significant advantages to those subsequently handling materials.

4.2.3 Potential Intervention Options

Our analysis indicates that interventions here should focus on:

- Minimising the volumes of recyclable material disposed of as general waste
- Optimising segregation activities in waste transfer stations (including local authority civic amenity sites)

These can be achieved through awareness and training activities, establishing best practice trade waste recycling centres and improving the operating environment in waste transfer stations.

Awareness and training is required at a number of levels. Firstly there is still a requirement to encourage those generating waste to manage it properly – segregation at source should be encouraged in all activities. This is a very generic activity that we consider is outside the scope of this study. Secondly it is important that those working in waste transfer stations understand the importance of segregation, the different materials that they are handling and how to recognise these different materials. This can be achieved by:

- Basic training of waste transfer station staff
- Hands on management of waste transfer stations
- Preparation of robust signage that lists and shows examples of recyclable materials that can be provided to all waste transfer stations

Establishing a minimum standard for the operating environment and for operating procedures for waste transfer stations is important to maximise the quality of materials processed.

Setting up additional trade waste recycling centres should be pursued. These should ideally:

- Be easily accessible from major road networks
- Be structured to accommodate a wide range of segregated materials
- Include facilities for adding value to segregated materials (e.g. granulation of electrical wire and plastics)
- Be effectively promoted to the local business community

These could be developments of existing waste transfer stations or new facilities. Obviously one of the development options here is to allow local authority operated recycling centres to accept non-household waste arisings.

5. Recycling of Segregated Resource Streams

5.1 Aluminium Cans and Foil

Aluminium can recycling has a fairly well established infrastructure in Scotland and across the UK. Novelis is a world-leading aluminium can recycling company with its largest European plant based in Warrington. It has invested significantly in the current can recycling infrastructure in the UK. The company has recently signed a commitment to ensure that 80% of its manufactured output is made from recycled material. It is likely, therefore, that this will increase demand, UK-wide, for recycled aluminium packaging.

Significant levels of investment are required for reprocessing of aluminium and so the options available to support the sector are primarily related to increasing the collection and capture rates from household and those consuming product away from home. ZWS have had initial discussions with Alupro regarding a pilot communications programme for the Metalmatters campaign that is designed to increase the capture rate of metal from households. Positive results from trials in England would indicate that this would be a positive step for ZWS to take, particularly as it resulted in an uplift of all dry recyclables from household collections in the trial groups. It will also complement the 'Every Can Counts' initiative recently taken up by ZWS to capture more cans 'away from home'.

Current Arisings By Source

Household

Total household waste arisings in Scotland, for 2009, were 2,818,422 tonnes¹⁷. Of this total, 1,755,757 tonnes is residual, 685,728 tonnes is kerbside dry recyclables and 376,937 tonnes is composted¹⁸.

Figures from a recent composition analysis suggest that non ferrous metal cans make up 0.63% of total residual waste and 1.16% of total dry recyclables collected¹⁹. This suggests that (assuming all non-ferrous cans are aluminium) the total arisings of aluminium cans from households is 11,061 tonnes (0.63% of 1,755,757) from the residual waste stream and 7,954 tonnes (1.16% of 685,728) from the dry recyclable waste stream. The total arisings of aluminium cans from households is therefore estimated to be 19,015 tonnes.

SEPA Waste Data Digest tables indicate there is no aluminium foil recycling recorded in local authority data returns²⁰. The ZWS composition analysis report identifies that 0.03% of kerbside dry recyclables are composed of aluminium foil – equating to 206 tonnes. It may be that local authorities do collect foil but record it as 'Other' in their Waste Data Flow returns. For the purposes of this report we have used the actual return information published by SEPA, i.e. no foil collected for recycling in 2009. The residual amount is 1,755,757 tonnes and this can be used in conjunction with the ZWS composition analysis. It is assumed that this residual household waste is split between 'residual household collected waste' (85%), 'household waste recycling centre waste' (HWRC) (11%) and 'street litter' (4%)²¹.

The estimated proportion of foil in these waste streams is 0.43% (kerbside residual), 0.09% (HWRC) and 0.38% (street litter). Therefore, the estimated arisings of foil from these three sources is 6,417 tonnes from kerbside residual (85% of 1,755,757 x 0.43%), 174 tonnes from HWRC (11% of 1,755,757 x 0.09%) and 267 tonnes from street litter (4% of 1,755,757 x 0.38%). Total foil arisings are estimated to be 6,858 tonnes.

¹⁷ Waste Data Digest 11: Data Tables 2009-2010, SEPA, Table 1

¹⁸ Waste Data Digest 11: Data Tables 2009-2010, SEPA, Table 2

¹⁹ The composition of municipal solid waste in Scotland, Zero Waste Scotland 2010

²⁰ Waste Data Digest 11: Key facts and trends, SEPA, 2011

²¹ Estimates made from data in Table B2: Household waste collected for disposal. Local Authority Waste Arisings Survey 2005/06, SEPA (note this is the most recently publicly available report that provides a Scottish level split of residual household waste by source)

The total estimated arisings of aluminium cans from households is, therefore, 19,015 tonnes with a further 6,858 tonnes of aluminium foil entering the waste stream from this source (total of 25,873 tonnes).

Commercial & Industrial

The Packflow report, estimates 2009 'consumer away from home' and 'non-consumer' aluminium packaging at 40,000 tonnes in the UK. These are assumed to enter the C&I waste stream as aluminium cans and foil. The amount entering the market in Scotland can be estimated using total employment estimates for Scotland in comparison to the UK²². Using these figures suggests that Scotland has an 8.80% share of total UK employment. Using this proxy, the aluminium cans and foil entering the C&I waste stream in Scotland can be estimated at 3,520 tonnes.

Construction & Demolition

It is assumed that the proportion of C&D waste consisting of aluminium cans and foil is so small that it is effectively zero for the purposes of these calculations.

Total aluminium can and foil arisings

The total arisings of aluminium cans and foil from household, commercial and industrial streams is estimated to be 29,393 tonnes.

Current Collection And Treatment

The collection methods for aluminium cans are well established. The collection of cans tends to be by:

- General waste collections (MSW and C&I)
- Comingled waste collection (MSW and C&I)
- Kerbside collection (MSW)
- Can banks (MSW and C&I)
- Collection schemes e.g. schools, workplace, etc. (C&I)

Collection services tend to be operated by three key groups.

Local authorities

Local authorities operate all general waste collection services from households in Scotland, either through their own service provision or by subcontracting the service to a commercial waste management company. The general waste will include some amount of aluminium cans and foil that will either be recovered through the Dirty MRF to which the general waste is taken for sorting or will be taken direct to landfill.

Local authorities also operate recycling services for both households and commercial and industrial customers. In some instances this will be co-mingled collections of dry recyclables that will most often include aluminium cans and foil (e.g. blue bin collections). Some local authorities, however, are moving towards source segregated collections from households where food waste, glass, paper and aluminium are collected separately or sorted at the roadside.

Local authorities also run a number of Recycling Banks throughout Scotland where people can bring their waste to be recycled. At most sites there will be a provision for aluminium cans with some also accepting aluminium foil, although this must be kept separate from cans as it is made up of a different alloy and will be recycled into other aluminium products (e.g. for automotive engines to help with lightweighting).

Commercial / third sector waste management companies

Commercial waste management companies will primarily collect commercial and industrial waste – both general waste and recyclables (either individual waste streams such aluminium cans and paper or co-

²²

Business Register Employment Survey – 2009, p.2 'Total Employment' category, Office for National Statistics

mingled). Where there are sufficient volumes of material (e.g. aluminium cans from pubs and sports venues) then separate collections will be of more value.

Metal merchants or 'cash for cans' centres

Can collection schemes are operated throughout Scotland and these will generally be run by non-ferrous metal merchants or privately owned 'cash for cans' centres. Generally, can collection bins/boxes will be set up in schools, workplaces, sports centres and other such public and private areas to collect cans being discarded away from the home. This often provides a small income for the organisation collecting the cans, while the operating company accesses higher quality material for selling on to a metal reprocessor.

The value chain for aluminium cans in particular is shown in Figure 27 below. This highlights the various routes that the waste material takes in the collection, recovery and recycling process.

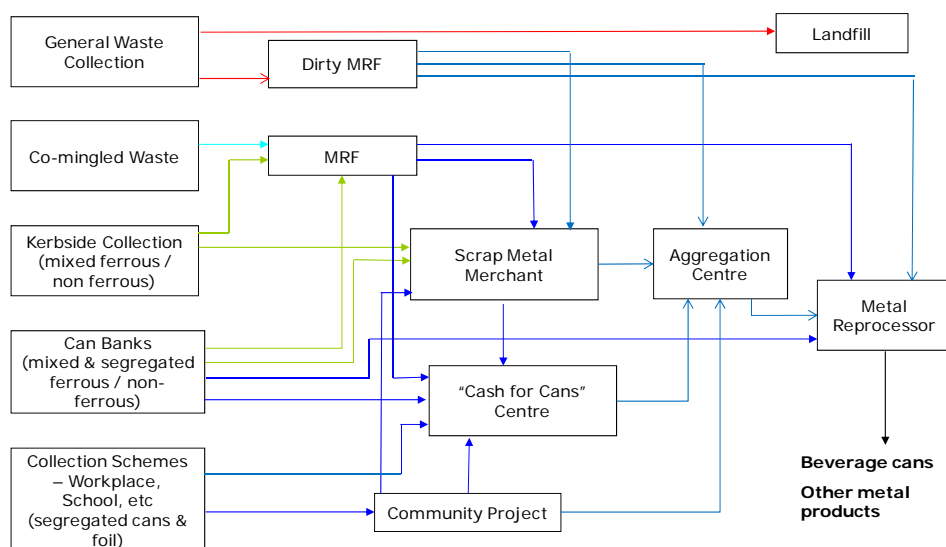


Figure 27: Value chain for aluminium cans

With regards to treatment and reprocessing of cans, the infrastructure in the UK is well developed, with Novelis recycling a significant proportion of aluminium cans (and foil) collected in Scotland. Overall, Novelis has played a significant part in developing the UK's aluminium can recycling infrastructure in recent years and operates Europe's largest used beverage can recycling plant in the UK. In this closed loop process, the plant in Warrington recycles aluminium drinks can into ingots that are then sold onto can makers to be made into new drinks cans. The plant has the capacity to recycle 130,000 tonnes of used beverage cans each year, which is more than every aluminium drink can sold in the UK. At present, this plant is almost working to capacity, although it is understood that a proportion of its material processed is imported. It is understood that Novelis are looking to extend the site at Warrington to increase its capacity and so would be able to address a future increase in the level of aluminium collected for recycling in Scotland.

Novelis only accept clean, UK sourced aluminium cans and packaging foil for recycling at this plant and this is accessed through its own recycling network. There are eight aggregation centres set up around the UK where Novelis registered suppliers can take their collected aluminium cans for bulking prior to being transported to Warrington. These are located in Scotland, North East, East, Manchester, Midlands, South East, South West and South Wales. The only Scottish aggregation centre is based in Alloa (Alloa Community Enterprises - ACE) and receives aluminium cans from Novelis registered suppliers for onward delivery to the Novelis recycling plant in Warrington. All aluminium cans collected for Novelis in Scotland must go through ACE and all collectors receive the same price as they would do if they had delivered it to Warrington themselves. ACE sends around 1,750 tonnes of aluminium cans to Novelis each year. There is no perceived benefit to increasing the number of aggregation centres

based in Scotland as it is unlikely to affect the collection levels, which is the key issue within the industry.

The aggregation centres also collect beverage cans from a Novelis supported network of 'Think Cans' members that offer a 'cash for cans' service to the public. These Think Can Centres can access increased volumes of cans through the promotional material provided and the schemes being run in schools, offices, etc., adding value to their business. Can Do Recycling, based in Rutherglen, is the key network member in Scotland. There is a number of other 'cash for cans' centres located around the UK that work in association with Alupro to collect used beverage cans for recycling.

Novelis has recently made a corporate wide commitment that 80% of its products will be made from recycled aluminium by 2020, up from its current level of 34%. The company will be investing in its recycling infrastructure deal with this as well as working with stakeholders to expand existing recycling programmes and educating consumers on the value of recycling. Given the scale of this commitment, Novelis will be trying to access as much post consumer aluminium as possible and will accept as much as can be collected throughout the UK. This will feed the plant in Warrington as well as other Novelis plants producing beverage cans in Europe, should there be excess material available.

Discussions with Scottish recyclers also suggest that Novelis are making it more attractive to get material from Scotland. In April 2011, Novelis ceased publishing its market pricing which allows it to negotiate more and offer better deals to customers where appropriate. This will help customers to achieve market prices for their aluminium packaging and may divert some material from export.

Within Scotland, there is very little aluminium reprocessing taking place. There are some small organisations that will melt the aluminium and sell it on to specialist component manufacturers. This does not, however, represent significant volumes of material.

Over and above this, SEPA's 2011 public register of reprocessors and exporters of packaging waste indicates that there are two accredited exporters of aluminium packaging waste in Scotland. These are John R Adams & Sons Ltd and William Tracey Limited. PRN figures indicate that around 40% of all aluminium packaging collected in the UK is sold to the export market, a figure with which recyclers in Scotland agree to be accurate on a Scottish basis as well. The decision to export product is based simply on the price that can be achieved, with material being recycled into a number of different applications. As mentioned previously, UK prices have been better in 2011 and so recycling rates within the UK indicate an increase on 2010 figures.

Early 2012 has given rise to new concerns within the metal recycling sector. The UK Government is seeking to ban cash transactions from scrap metal in an amendment to the Legal and Sentencing Bill. This means that 'cash for cans' activities would effectively becoming illegal and risks slashing the recycling rate for drinks cans in the UK. Around 10% of aluminium cans collected for recycling in the UK comes through cash for cans programmes²³ (which provide a valuable income stream for charities and youth groups throughout the country) and the industry organisation Alupro is concerned about the damage this ban will do to the can recycling industry in the UK.

Recycling Rates

Household

A total of 13,095 tonnes of metal cans were recycled from the Scottish local authority municipal waste stream in 2009/2010²⁴ (note that this only refers to local authority collected cans and does not include the 'Cash from cans' collections which are assumed to be included in 'Consumer – away from home', which is estimated within the C&I wastes stream). The 13,095 tonnes consisted of²⁵:

- Steel cans – 5,301 tonnes

²³ Alupro comments within MRW article (*Scrap metal cash ban could reduce can recycling*), 21/02/12

²⁴ Waste Data Digest 11: Key facts and trends, SEPA, 2011

²⁵ Waste Data Digest 11: Data Tables, Table 12, SEPA 2011

- Aluminium cans – 1,936 tonnes
- Mixed cans – 5,858 tonnes (Assuming mixed cans are composed of 30.4% aluminium cans (see above section on household arisings) then the estimated weight of aluminium cans from this mixed source is 1,781 tonnes)

The total aluminium cans recycled from the municipal waste stream is, therefore, 3,717 tonnes. Data are not available to separately identify the proportion of aluminium can recycling from household sources. An estimate can, however, be made by assuming the cans are collected at the same rate between the two sources. Household arisings represent 88.2% of local authority collected municipal waste²⁶. If it is assumed that recycling is proportionately the same from both household and non-household then it can be estimated that 3,278 tonnes of aluminium cans were recycled from households.

According to Table 12 of the Waste Data Digest 11 Data Tables, there was no recycling of aluminium foil from the MSW stream in this period²⁵.

Comparing to the household arisings figure of 25,873 tonnes suggests that the household recycling rate is around 12.7%.

Considering just the recycling rate of cans we can estimate a figure of 17.2% (3,278/19,015). This figure is considerably lower than the PackFlow 2012 estimate of household aluminium packaging recycling of between 38% and 39% (a UK figure)²⁷. The model developed for this report uses the figure of 12.7% recycling of aluminium cans and foil from households (based on the calculations detailed in this section) but it should be noted there is considerable uncertainty in this estimate when compared to the Packflow estimate.

Commercial & Industrial

The Packflow 2012 report estimates that aluminium packaging recycling from 'consumer away from home' and 'non-consumer' collections was 15,000 tonnes. It is assumed here that 'consumer away from home' will include aluminium cans and foil recycled at the workplace, events, etc.). The amount entering the market in Scotland can be estimated using total employment estimates for Scotland in comparison to the UK²². Using these figures suggests that Scotland has an 8.80% share of total UK employment. Using this proxy, the aluminium cans and foil recycled from the commercial and industrial stream is estimated to be 1,320 tonnes.

Comparing this to the estimate of arisings from total C&I sources (3,520 tonnes) suggests a recycling rate of 37.5%.

Total recycling

The total aluminium can and foil recycled from household, commercial and industrial waste streams is estimated to be 4,598 tonnes. Comparing this to estimated arisings of 29,393 tonnes suggests an overall recycling rate of 15.6%

Pricing Trends

The figure below highlights the pricing trends for aluminium cans between September 2009 and December 2011. These are based on baled cans being delivered to a Novelis regional processor. From April 2011, however, Novelis no longer publish their market prices and so the figures shown after this time are based on marker price indicators.

²⁶ Waste Data Digest 11: Key facts and trends, SEPA, 2011, p.7

²⁷ PackFlow 2012, Volume 1: Summary Report & Recommendations, Valpak Consulting, Nov 2009, Fig ES3

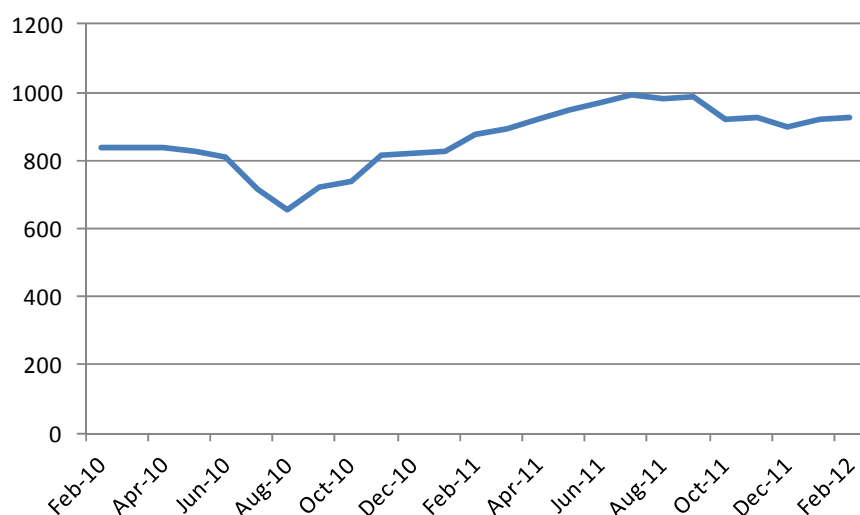


Figure 28: Aluminium can pricing trends to February 2012²⁸

The pricing trends for aluminium foil are shown in Figure 29 indicating a steady market price for the material over the last two years.

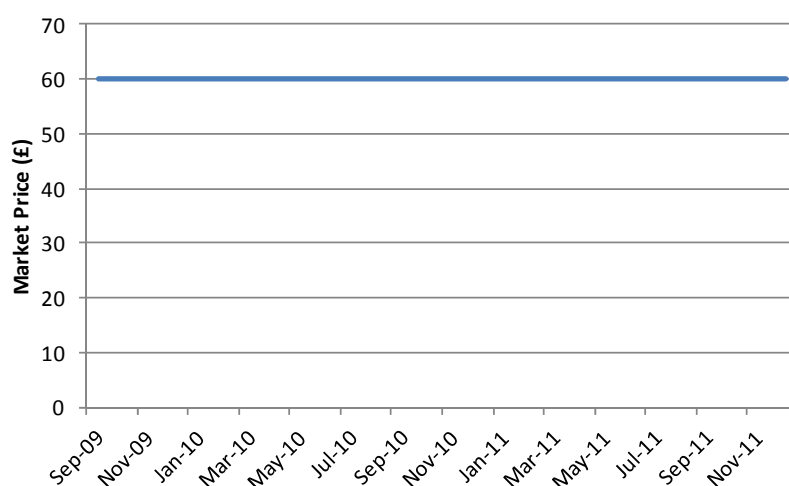


Figure 29: Aluminium foil pricing trends to December 2011²⁹

Good Practice Added Value Approaches

There is an established robust network for transferring collected aluminium cans to recycling organisations, such as Novelis; this being part of a UK closed loop recycling success. Some opportunities may exist in added value reprocessing but for the industry as a whole these are a lower priority than accessing increased volumes of material from the waste stream. An example of added value reprocessing is in technologies that can be used within MBT and incineration facilities to recover aluminium from MSW. The material recovered from this process cannot be used to make beverage cans but can be used in a number of different applications, such as the manufacture of new vehicles. The Shanks Group, based on their experience of recovering materials from MSW, believes that around 54,000 tonnes of aluminium could be recovered each year from MSW³⁰. The pressure to recover material in this way, however, will be price and volume driven.

²⁸ WRAP Materials Pricing – Time Series Data

²⁹ www.letsrecycle.com Prices

³⁰ For further details see <http://www.letsrecycle.com/news/latest-news/metals/uk-aluminium-can-recycling-rate-jumps-to-55>

Some examples of good practice in the collection infrastructure include:

- Alupro's Aerofoil Programme – this was a two year programme to increase local authority collections of foil and aerosols. The target set for the programme was to have 80 LAs to add foil and aerosols to their collection systems but the target was exceeded, with 96 LAs signing up. One of the pilot councils was in Dorset and it increased the aerosol content of its collections from 3.5% to 6%. The programme dispelled a number of perceived problems in handling aerosols, with communication to LAs and householders a key aspect of the work. The Aerofoil programme has now been merged with the Metalmatters programme
- Metalmatters – this is essentially a pilot communication programme. It is a partnership between UK drinks can manufacturers, WRAP, aluminium and steel packaging recycling industries and local authorities. It was designed to increase the capture rates of metal packaging from households and has achieved an average 13% increase since it was launched. The highest increase through the programme has been 40%.
 - Alupro are currently in discussions with Aberdeen City Council and ZWS to try to deploy the programme in Scotland.
 - The Metalmatters and Aerofoil programmes had a significant impact on recycling in the pilot areas achieving an overall uplift of all dry recyclables from households, not simply in the materials being targeted
- Every Can Counts Programme – developed and managed by Alupro, this is essentially about getting people to recycle their beverage cans when they are at work, college or simply 'out and about'. One in every 3 drinks can sold in the UK is consumed outside the home and so it is a key aspect of collection that needs to be addressed. The programme helps organisations to start recycling drinks cans and promotes recycling to staff and customers
- Alupro are in the process of signing a contract with ZWS to launch the initiative in Scotland to increase recycling rates north of the border. This is being launched in Aberdeen and the central belt during the first year and it is hoped that the initiative will go national thereafter. A programme manager will be appointed in the first year and will probably work alongside ZWS personnel in delivering the programme
- CanCrush UK – the company provides can crushing machines that can be used for 'on the go' collection of cans, both indoors and outdoors. The machines reduce the volume of a can by 90%, reducing waste and cutting collection costs and storage associated with lightweight materials

There is also research being done in the US looking at using recycled aluminium as an alternative lower cost hydrogen storage material. These alternative materials will be important to support growth of fuel cells as a mainstream energy technology. The technologies are currently too expensive.

Issues And Barriers To Adding Value

There are a number of issues within the aluminium packaging recycling sector that need to be addressed to increase aluminium recycling rates. The added value tends to be in the form of cleaner, high quality material being captured rather than in the reprocessing of cans and foil.

- The volume of cans being collected 'away from home' is relatively low. Currently around 30% of cans sold in the UK are for consumption away from home and the capture / recycling of these needs to be encouraged with more recycling points
- Communication with householders about the value of aluminium packaging recycling is relatively low
- In Scotland, of the 32 local authorities, only 21 currently collect aerosols and 12 collect aluminium foil and so a significant amount of metal is being put through general waste collections. There is evidently a lack of consistency in the approach to the capture of materials throughout Scotland

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

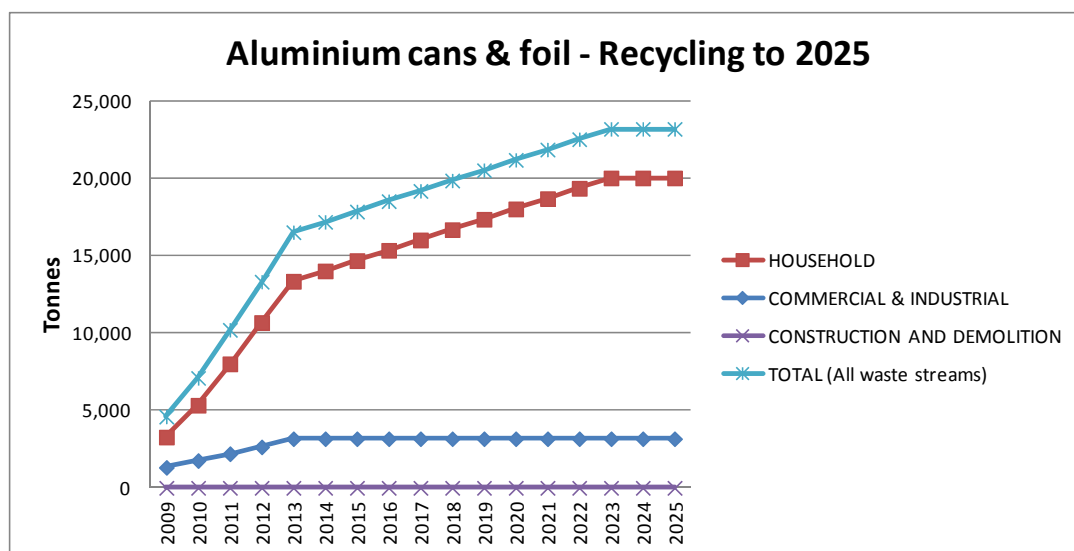


Figure 30: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

Options to consider include the following:

- **Metalmatters – Alupro** are trying to launch this initiative in Scotland and are seeking support for ZWS to do this. The pilot would cost around £70,000, with half of the funding being requested from ZWS. The programme would be run with the poorest performing councils initially to hopefully have the biggest impact. If being rolled out nationally, the costs will depend on the number of households being targeted – the cost is around 35p per household. The programme would consist of a leaflet drop to inform the household of the initiative and encourage them to support the scheme (this would be done twice at key points to reinforce the message), radio advertising to reinforce the messages and panels on collection vehicles to further remind households to recycle. As mentioned previously, the pilot schemes run in England identified an overall uplift in all dry recyclables as a result of the campaign
- **Support to aid the introduction of can crushers for ‘on the go’ and commercial arisings** – discussions with Alupro indicate that can crushers positioned in strategic locations (e.g. beaches, shopping centres, sporting events) can significantly increase the capture rate of beverage cans. In fact, a trial by Bournemouth Council in 2009 diverted six tonnes of metal from landfill in a ten week period by installing can crushers on the sea front. In this trial, six can crushers were positioned alongside existing recycling and rubbish facilities, with all rebranded with ‘Every Can Counts’ stickers. A promotional campaign on local radio accompanied this and the results were significant. Around 400,000 cans were collected during this trial period. Overall, in 2011, the Every Can Counts programme captured around 51 million beverage cans.
- **Each can crusher holds 700 cans and costs around £800.** The cost will inevitably be a barrier to many organisations that want to introduce such equipment as part of their service. The benefits, however, that have been found in using can crushers include:
 - Reduced volume of cans
 - Increased interest levels in recycling
 - Better quality (i.e. only beverage cans being fit in the bin)
 - Increased value of the recycle
 - Lower collection costs

Introducing can crushers is a proven way to collect cans that are not being captured elsewhere and presents an opportunity for Scotland to increase its aluminium can capture rate. On-the-go arisings of beverage cans (including workplaces, events, etc.) are inevitably difficult to capture for recycling and can crushing equipment can provide a novel and attractive way of doing this. It also leads to more efficient collection systems as around 700 cans can be collected at one time without transporting ‘air’ around the country.

As mentioned, each can crusher holds 700 cans and there are around 65,000 cans in a tonne³¹. In the Bournemouth trial mentioned previously, each can crusher collected around 1 tonne of cans in a ten week period. If a value of around £900 can be achieved for each tonne of aluminium cans, then the can crusher would pay for itself in a relatively short space of time. Rolling out the use of can crushers throughout Scotland could offer huge potential to capture aluminium cans that would otherwise end up in landfill. Targeting hotels and restaurants, shopping centres, busy tourist resorts and large event venues should be the initial focus.

ZWS could run some pilots in Scotland to demonstrate the success of such equipment and highlight the benefits of the investment to other organisations in Scotland. For example, the Royal Highland Show at Ingleston is run in June each year and attracts around 185,000 visitors over four days. If ZWS were to trial the use of can crushers (in conjunction with Every Can Counts) positioned throughout the show, then it could prove to be a very successful case study to promote to others. If each person attending that one event disposed of one beverage can in the can crusher, then almost three tonnes of cans could be captured from a single event. The Royal Highland Centre hosts over 200 events each year alone; it would not be unrealistic to assume that this single location could capture around 50 tonnes per year that may otherwise be landfilled.

If the programme could be rolled out to other venues and locations throughout Scotland, the recycling benefits could be very significant.

³¹

5.2 Average Plastic Film

Average plastic film includes a range of material qualities from clean single stream material to poor quality mixed dirty material. Arisings in Scotland are estimated at over 133,000 tonnes per annum. There are number of small companies that collect and sell on waste plastic film and three companies with recycling facilities in Scotland. These three companies are BPI Recycled Products (reprocessing agricultural film), PET Processors (reprocessing PET) and PTS Ltd (reprocessing of a range of plastics in both film and rigid form). These companies recycle material from throughout the UK and parts of Europe.

There are established and reliable UK markets for high quality materials. Lower quality materials are typically exported when there is strong market demand for material.

The ability to clean and add value to poor quality material would be attractive to UK reprocessors so a facility to do this would be an attractive addition to the Scottish infrastructure. A process has recently been demonstrated, utilising shredding and cleaning equipment that transforms mixed plastic film into a useable product. Estimates suggest that this process is viable on a 7,000 tonne capacity. It is recommended that investment in this process in Scotland is encouraged. Model projections suggest an additional 12,000 tonnes of average plastic film being recycled by the end of 2013 (from existing recycling estimates of around 17,500 tonnes).

Here average plastic film is defined as single stream or mixed plastic film. This can therefore range from very high quality, clean material (classified, for example as 99:1 or 98:2), to very poor quality dirty mixed material (comprising of film of different polymer types together with contamination such as labels, soil, oil, etc). As discussed below, the recycling of such a range of quality requires very different approaches.

Current Arisings By Source

Analysis of published data on waste arisings indicates the followings by source:

Household

Arisings of plastic film from households are estimated to be 74,475 tonnes³².

Commercial & Industrial

Different estimation methodologies of plastic waste arisings in Scotland result in significantly different results. It is estimated that there are between 50,841 tonnes and 284,438 tonnes of plastic arisings in the C&I waste stream in Scotland in 2009. A detailed explanation of the methodology behind these calculations is included in a report into plastic waste arisings in Scotland published by ZWS³³. The lower range estimate is used with the model developed for this report but **it is important to consider that the upper range is considerably higher than the lower range** and the results for average plastic film should be viewed with this in mind.

The lower range estimate of 50,841 tonnes consists of an estimated 37,623 tonnes of plastic film waste.

Note that if the upper range estimate of total plastic arisings in the C&I waste stream is used the estimated plastic film arisings from this source would be 210,484 tonnes.

C&D

Composition analysis of the C&D waste stream suggests that there are no significant arisings of plastic film³⁴. Evidence from a number of plastics recycling companies in Scotland contradicts this data as

³² Developing the Evidence Base for Plastics Recycling in Scotland, Zero Waste Scotland, Fig. 3, p.4, April 2012

³³ Developing the Evidence Base for Plastics Recycling in Scotland, Zero Waste Scotland, April 2012

³⁴ Economic Assessment of the Zero Waste Plan for Scotland, Table 38: Calculated Compositions for Construction & Demolition Waste Streams, p.91 Zero Waste Scotland, 2011

these companies highlight that there are significant tonnages of film recovered from companies in the C&D sector. Estimates from recent work carried out by Optimat Ltd for ZWS³² suggests that there are 1,774 tonnes of plastic packaging arising from the C&D waste stream in Scotland. This is assumed to be plastic film packaging.

Agriculture

Agricultural film arisings in Scotland were estimated to be 19,008 tonnes in 2009³⁵.

Total average plastic film arisings

The total estimate of average plastic film arisings in Scotland in 2009 is 132,880 tonnes. Again, this figure should be treated as a lower end estimate due to uncertainty of the C&I data. **Using an upper range figure for plastic film waste arisings could result in this estimate being considerably higher at 305,741 tonnes.**

Current Collection And Treatment

There are a variety of collection methods. These vary depending on the source and quality of the film. The main methods are shown in the following value chain:

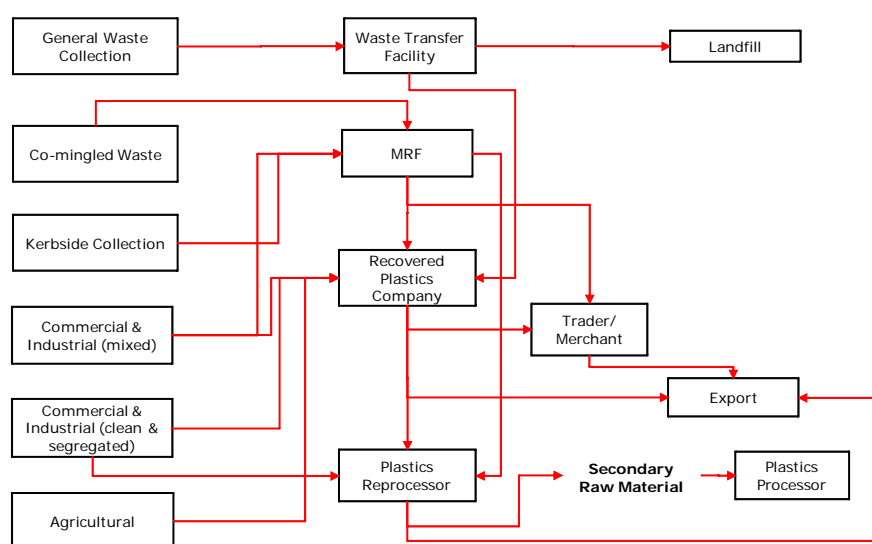


Figure 31: Plastic Film Value Chain³⁶

Significant quantities (estimated at between 5,000 and 10,000 tonnes³⁷) of high quality single stream material (classified as 99:1 [99% good material and 1% of contamination] or 98:2) are sourced from commercial, industrial and agricultural sources. This material is attractive to reprocessors and companies collecting it in Scotland can easily sell this material to UK based reprocessors.

Material that is of a slightly lower quality (e.g. 90:10), mainly sourced from commercial and industrial sources is also of interest to UK based reprocessors, but in lower quantities and the level of interest tends to be more sensitive to market conditions. Typically UK reprocessors will take some of this material when buying larger quantities of high quality material.

Lower quality materials (80:20 and worse) are typically obtained, according to the recycling industry, from customers in the construction and demolition industry (contradicting the evidence from published data sources) and from the waste management industry (from segregation of mixed waste).

³⁵ Non-natural Agricultural Waste Arisings – 2009 Estimates, SEPA

³⁶ In this supply chain, a recovered plastics company collects, segregates and consolidates plastics prior to supply to reprocessing companies which manufacture pelletised material that can be used for manufacture of plastics products. These will be manufactured by plastics processors.

³⁷ Developing an Evidence Base for Plastics Recycling in Scotland, Optimat report for Zero Waste Scotland, 2012

Companies underline that this is not an attractive material for the recycling industry but is typically taken as part of a package that includes higher quality plastics and cardboard. There is clearly an industrial practice to make deals that include a mix of good and bad materials. This experience in Scotland is clearly consistent with the rest of the UK as shown opposite.

There are typically no UK markets for this material and it is generally exported. However this is dependent on market conditions. At the moment in a depressed market there is no demand for this material. Companies that collect these grades are stockpiling material just now.

Excerpt from “Cleaning and Recycling of Residual Mixed Plastic Film”, WRAP, September 2011

“Waste collectors and processors have a relaxed attitude to the collection and processing of (mixed) film. For most, this waste stream is seen as a complication – difficult to collect, even more difficult to sort, with little or no commercial value to be seen at the end of the process. It is a major irritant to those who are geared to create revenue from paper streams. There is a lack of overall market for mixed films, providing little incentive for waste collection facilities to focus on more volume film recovery.

This state of affairs is exacerbated when the film may be in a variety of formats colours and polymers and is heavily contaminated. This is certainly the case with MSW generated films and residual films left over after the “good” films (mostly clear PE) have been removed at dry recyclable MRFs and C&I processors.”

The problem of recycling this type of mixed waste highlights the importance of source segregation and the potential for enhanced recycling levels when source segregation is effectively carried out. The proposed zero waste regulations should significantly reduce the amount of this type of material placed in the recycling industry.

Focusing on Scottish capacity, the following companies are handling waste plastic film and supply to the next stages of the supply chain:

- Wyllie Recycling
- WRC Recycling Ltd
- Solway Recycling Ltd
- Trident Recycling Ltd
- PG Products Ltd
- Recycled Packaging Ltd
- Polyfarm Recycling Ltd
- Plastic Recycling Services Ltd
- Northern Recycling Solutions

The vast majority of the waste plastics handled by these companies arise in Scotland. Some companies, based on location, are likely to process some materials from England and Northern Ireland.

In terms of reprocessing materials there are the following activities:

- BPI Recycled Products processes waste agricultural film at its facility in Dumfries, sourcing materials from a number of suppliers. It is understood that BPI Recycled Products has the capacity to processes around 20,000 tonnes per annum in Dumfries. It manufactures pelletised material, some of which is used to manufacture new plastic products.
- Evidence from the British Plastics Federation³⁸ suggests that around 20% of arisings of agricultural plastic film is already collected and recycled and that this is supplied to a number of customers in addition to BPI. It is also understood that the collection infrastructure is less well developed north of the Central Belt and that some material that could be recycled is currently being burned (under a

³⁸

British Plastics Federation Recycling Group – Films Working Group – www.bpf.co.uk/Recycling/Working_Group/Films.aspx

- SEPA exemption³⁹). It is suggested that development of the collection infrastructure and restriction to the burning of plastic film would enhance the tonnages reprocessed.
- Polymer Technology Services Ltd, also based in Dumfries. It processes several thousand tonnes of a range of post industrial waste plastics per annum. Its output is typically sold to the plastics processing industry.
 - PET Processors LLC, again based in Dumfries, which processes waste PET. It mainly reprocesses post industrial waste plastic that is sourced from the UK and Europe. The plant has a capacity well in excess of 10,000 tonnes.

The rest of the material reprocessed in the UK is sent to various facilities in England and Wales. These companies are major competitors to the Scottish based collectors listed above as they target larger customers and provide balers / trailers etc. So this material is going directly to England and Wales for processing and is not handled by Scottish companies. We are not able to accurately estimate the tonnages following this route but evidence from companies interviewed indicates that it amounts to several thousand tonnes.

It is estimated⁴⁰ that over 70,000 tonnes of waste plastics (**of all types**), 45,000 tonnes of which is polyethylene (defined as waste, parings and scrap, of polymers of ethylene, so it includes film and rigid materials) is exported from Scotland each year, with over 90% going to China or Hong Kong. This is considered the major market for waste plastics.

Recycling Rates

Household

According to published data⁴¹, there was no recycling of plastic film from the household waste stream in this period carried out by local authorities. It is known, however, that supermarkets provide plastic bag recycling facilities and some have recently expanded the scope of these collections to accept a wider range of plastic film. These should appear in the commercial waste stream (although estimates found that these amounts were not significant – see below).

Commercial & Industrial

A recent report⁴² indicates that the estimated plastic film recycling rate for this waste stream is 0%. However, stakeholder feedback³³ suggests that several thousand tonnes of commercial and industrial film are recycled each year. The model therefore includes some average plastic film recycling (see section below on total recycling).

C&D

There are no robust sources of data to identify the recycling rate of plastic film from C&D sources. Anecdotal evidence from the recycling industry highlights modest tonnages of waste from C&D sources are being collected and the model therefore reflects this (see section below on total recycling).

Agriculture

The estimated recycling rate of agricultural plastic film is taken to be 20% in 2009⁴³. Based on arisings of 19,008 tonnes this suggests recycling of 3,802 tonnes.

It is estimated that recycling of plastic film from the agricultural waste stream (at a UK level) is estimated to be 32,200 tonnes⁴⁴. Taking total UK arisings of agricultural plastic film to be 114,365 tonnes⁴⁵, this suggests a recycling rate of 28.2%.

³⁹ http://www.sepa.org.uk/waste/waste_regulation/agricultural_waste/frequently_asked_questions.aspx, accessed 16/12/2011

⁴⁰ UK Trade Info data from HMRC, with allocation for Scotland based on share of UK GVA
⁴¹ Waste Data Digest 11: Data Tables, Table 12, SEPA, 2011

⁴² Economic Assessment of the Zero Waste Plan for Scotland, Table 37: Calculated Compositions for Commercial and Industrial Waste Streams, p.89 Zero Waste Scotland, 2011

⁴³ British Plastics Federation Recycling Group – Films Working Group – www.bpf.co.uk/Recycling/Working_Group/Films.aspx

⁴⁴ AWP Collection and Recovery Programme – Interim Report 2006, Valpak/ADAS

Total recycling of average plastic film

Based on industry feedback it is estimated that between 15,000 and 20,000 tonnes of plastic film is currently recycled. A figure of 17,500 tonnes is used in the model which is equivalent to a 13.2% recycling rate (based on total arisings of 132,880 tonnes). Taking into account the estimated recycling from agriculture (of 3,802 tonnes) the remaining 13,698 tonnes is assumed to be recycled from C&I sources (13,348 tonnes) and C&D (350 tonnes). Evidence from the industry indicates that the majority (over 80%) of this material is recycled out of Scotland (elsewhere in the UK or overseas).

Note that if the upper range estimate of total plastic film arisings of 305,741 tonnes is used then the baseline recycling rate would be 5.7%.

Pricing Trends

Recent pricing trends for plastic film are as follows:

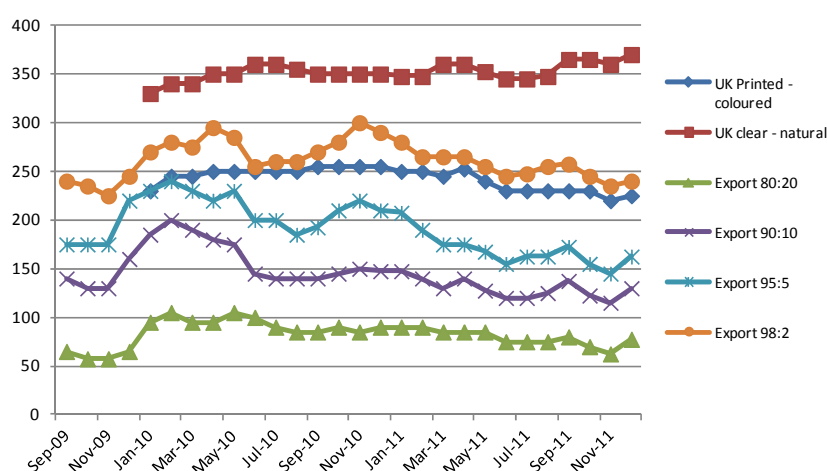


Figure 32: Pricing Trends for Plastic Film²⁹

This shows the variability in price with material quality as well as significant fluctuations over time. It also indicates that the material is treated as a commodity that is traded internationally.

Good Practice Added Value Approaches

Segregated, clean material is attractive to UK reprocessors. Leading players have indicated that they would purchase higher volumes of material if it were available.

Therefore the challenge for the Scottish recycling industry is to source higher volumes of clean material. The importance of segregation at source has already been highlighted. The other key issue is therefore to address mixed plastic film and this problem is considered further below.

Typically mixed plastic film is composed of HDPE, LDPE, PP, other plastics, moisture and contamination with around 80% being HDPE, LDPE and PP, 5% other plastics and the remainder moisture and contamination⁴⁶. Drying and cleaning would significantly improve materials quality and then a number of UK based reprocessors would be interested in this material. A process has been demonstrated⁴⁶ that effectively cleans and dries this mixed film and it has been shown that the resultant material has similar properties to LDPE and can be moulded into a range of products.

An alternative approach has been demonstrated by Omnia Recycling, a company based in England. It has demonstrated extrusion technology to produce "planks" that can be used in the manufacture of street furniture and fencing. However it is not clear if the company is commercially successful.

⁴⁵ AWP Collection and Recovery Programme – Final Report 2007 (Research Trial 6/7), Valpak/ADAS

⁴⁶ Cleaning and Recycling of Residual Mixed Plastic Film, WRAP, September 2011

In addition there are options to use mixed waste plastic as a raw material for manufacture of biodiesel – as developed by several companies (e.g. Clyvia Technologies). SITA has recently gained planning permission for a waste plastic to diesel facility in Bristol, as part of the Bristol Resource Recovery Park.

More specifically, the availability of agricultural film reprocessing capacity in Scotland suggests that this is an attractive material to focus on. Ireland is quoted as a best practice example in terms of the volume and quality of materials collected, managed by the Irish Farm Film Producers Group Ltd (IFFPG). It includes activities such as bring events to increase collection levels.

Issues And Barriers To Adding Value

As indicated above, the key issue here is the low quality of a significant percentage of the materials collected (mixed plastic film). This requires improved and extended source segregation or the investment in materials drying, cleaning and processing capacity.

Focusing specifically on agricultural plastics the key issues is increasing collection, where of course the Scottish geography is a major barrier.

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

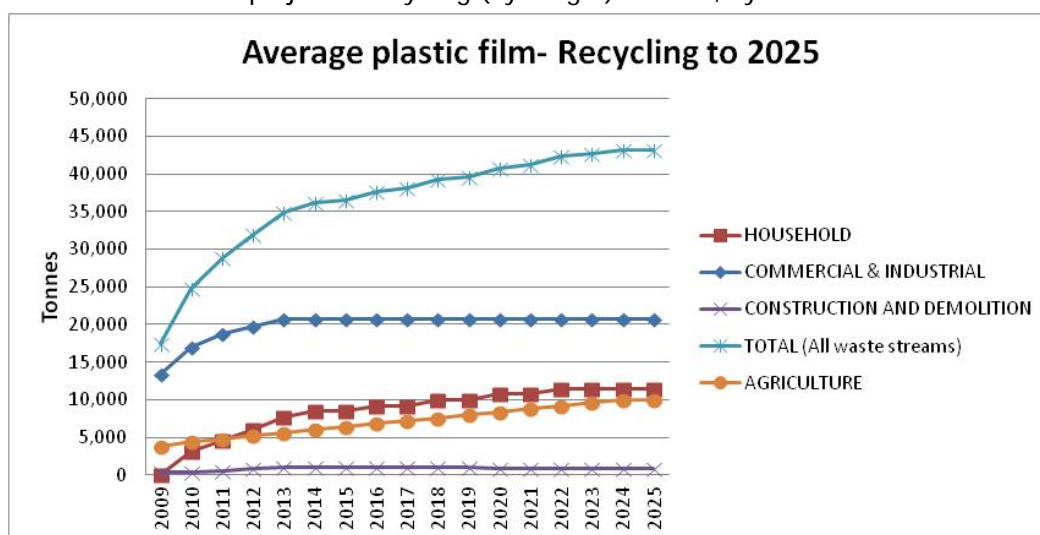


Figure 33: Projected recycling (by weight) to 2025, by source

Potential Intervention Options

Potential intervention options proposed here are:

- Mixed Plastics Drying, Cleaning and Recycling Facility
 - This facility could be based on the WRAP report entitled "Cleaning and Recycling of Residual Mixed Plastic Film"⁴⁶. This report shows that a facility with an output of 7,000 tonnes should be viable, based on a £2.27 million investment in facilities and an end product price of £450 as shown in the basic financial model opposite.
 - The expected growth in arisings in Scotland, as shown in Figure 33 above suggests that almost three plants are required to deal with **additional** recycling requirements to 2025. The opportunity to process current arisings that are currently exported or are not suitable for existing recycling routes due to, for example, composition and contamination issues suggest that Scotland could support at least three of

Film dry cleaning and Extrusion		
Input tonnes	11781	
output tonnes	7069	
yield	60%	
waste to landfill - moisture	1532	
landfill costs	318,087	
	£	£ per tonne
Investment for 7000 tpa	2,270,000	of output
Sales	3,180,870	450
Material	294,525	42
Labour	297,203	42
Energy	359,438	51
other direct costs	578,910	82
Gross Margin	1,650,794	234
Fixed & Indirect Costs	993,630	141
	1,572,540	
Annual Gross Profit	657,164	93
EBIT on sales	21%	
Simple ROI	29%	

these plants at 7,000 tonne capacity.

- Plastic to oil refinery
 - This opportunity also addresses the problem of contaminated mixed plastic film. It is therefore an alternative to the above mixed plastic drying, cleaning and recycling facility.
 - A number of proprietary technologies have been developed to manufacture oil based products from mixed plastics. There are four basic approaches, as follows:
 - Plastic to fuels (P2F), including diesel, petrol and others from the refining family
 - Plastics to refinery feeds (P2RF). This typically includes materials like:
 - Pseudo crude oil for mixing with natural crude and running through the entire refining process
 - Production of materials targeted on individual refining processes e.g. wax for use in steam crackers
 - Pure monomers e.g. ethylene and propylene, terephthalic acid (from xylene)
 - Plastic to other valuable bulk petro-chemicals. This includes the potential for cracking polymers to provide feedstock which will lead to materials such as solid waxes and industrial solvents (both aromatics and aliphatics)
 - Plastics to functional specialities. Here the cracked polymer would be converted to specialities such as lubricants, surfactants, fatty acids, or functional intermediates used in their manufacture

There are a number of potential advantages and disadvantages to each approach, dependent on a number of factors including the composition of waste arisings and the development strategies of the investor (e.g. focusing on high or low added value markets).

Zero Waste Scotland is currently carrying out an analysis of the potential to collect contaminated plastics and to treat them to produce feedstock for diesel or crude oil processing in Scotland. This analysis is expected to be completed by the end of June 2012.

The manufacture of biodiesel from low grade mixed waste plastic is currently the approach that is gaining most attention in the UK. SITA UK has recently secured planning permission to build the first UK waste plastic to diesel facility in Bristol (a 6,000 tonnes per annum plant). It is expected to be the first of 10 plants established by SITA in the UK. These plants will use Cynar Technology process technology that is based on liquefaction, pyrolysis and distillation of mixed waste plastic. It is claimed that the process will provide diesel suitable for commercial vehicles and it is expected that full scale plants will be profitable within five years of operation⁴⁷. This “plastics to oil” technology and the scale of operation is attractive for implementation in Scotland – with at least three plants being required to address expected future arisings. Information on the financial details involved in setting up and operating these plants are commercially confidential.

⁴⁷

<http://www.cynarplc.com/news-display.asp?action=change&ID=56>

5.3 Batteries (Post Consumer Non-Automotive)

Battery arisings (post consumer non-automotive) in Scotland are less than 4,000 tonnes per annum. Even assuming that the target recycling rate of 45% is achieved by 2016 this still means that less than 2,000 tonnes are collected for recycling.

There are no alkaline battery recycling plants currently in the UK (alkaline being the most common battery chemistry). The majority of batteries are being sent to England (for sorting and subsequent export) or exported directly to mainland Europe.

Plans have been announced by Veolia to establish a battery recycling plant in England and such a plant would absorb a significant amount of UK arisings. Veolia runs the UK's largest battery compliance scheme, BatteryBack, which has Duracell (through parent company Proctor & Gamble) as a member (accounting for approximately 55% of the UK portable battery market). It has not yet been confirmed whether this investment is mobile (and as such a potential inward investment opportunity for Scotland)

Any intervention options for this resource stream should focus on encouraging battery recycling – although ultimate responsibility for this lies with the battery producers themselves.

There are several pieces of legislation in the UK that govern the treatment of waste batteries. These are:

- Waste Batteries and Accumulators Regulations 2009⁴⁸
- Environmental Permitting (England and Wales) Regulations 2010⁴⁹
- Hazardous Waste Regulations (2005)
- Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (2009)⁵⁰

Current Arisings By Source

Data on post consumer non-automotive batteries are estimated for total arisings rather than for the individual sources of arisings used for other resource streams.

The National Packaging Waste Database states that, in 2009, 45,754 tonnes of portable batteries were placed on the market by battery compliance scheme members⁵¹.

This can be adjusted to a Scottish level by using population numbers as a proxy. The UK population in 2007 was 60,975,300 with 5,144,200 residing in Scotland (8.44%)⁵². This indicates that arisings in Scotland are around 3,862 tonnes per annum (assuming arisings are equal to batteries placed on the market).

Current Collection And Treatment

These can be segmented into domestic and industrial. There are a number of established collection schemes for batteries from households. For example, BatteryBack one of the compliance schemes, has over 10,000 collection points in the UK, in retail outlets such as Argos, Asda, Boots and Esso where batteries can be deposited in appropriate containers. These are also available to businesses.

The value chain for battery collection is as follows:

⁴⁸ <http://www.legislation.gov.uk/ukxi/2009/890/contents/made>

⁴⁹ <http://www.legislation.gov.uk/ukxi/2005/894/contents/made>

⁵⁰ <http://www.legislation.gov.uk/ukxi/2009/1348/contents/made>

⁵¹ *National Packaging Waste Database, Summary of Batteries Placed on the Market in 2010, March 2011*

⁵² *Key Population and Vital Statistics, No. 34, 2007 Edition, Office for National Statistics, 2009*

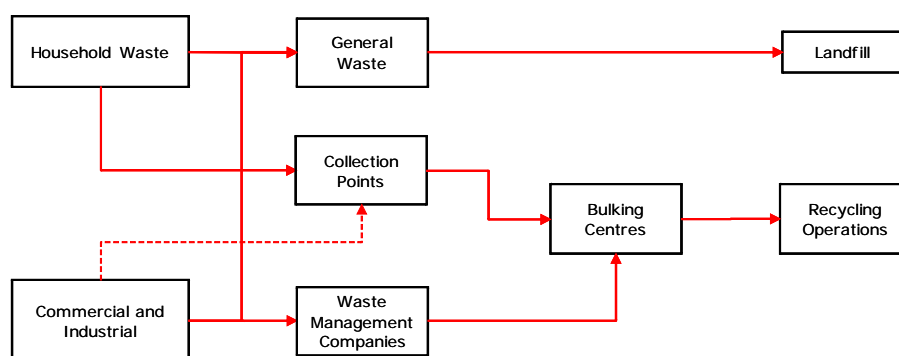


Figure 34: Battery Recycling Value Chain

The segmentation of the supply of non-automotive batteries and the preferred recycling routes is as follows (note this table contains estimates of batteries placed on the market rather than estimates of waste battery arisings – although the two are assumed to be equal the model developed for this project):

Battery Type	Chemistry	Application Examples	Recycling Route	Market Share (ERM Report - 2003)	Market Share (Valpak Report - 2010)
Portable (primary - i.e. non-rechargeable)	Zinc Carbon (ZnC)	Torches, toys, clocks, radios	Pyrometallurgical and Hydrometallurgical	18.62%	88.00%
	Alkaline Manganese (AlMn)	Toys, electronic games, cameras	Pyrometallurgical and Hydrometallurgical	59.96%	
	Silver Oxide (AgO)	Cameras, pocket calculators	Mercury distillation and chemical silver recovery	0.02%	0.60%
	Zinc Air (ZnO)	Hearing aids, medical devices	Pyrometallurgical and Hydrometallurgical	0.05%	
	Lithium (Li)/ Lithium Manganese (LiMn)	Photographic equipment, remote controls, watches	Pyrometallurgical and Hydrometallurgical	0.47%	
Portable (secondary - i.e. rechargeable)	Nickel Cadmium (NiCd)	Emergency lighting, cordless phones, power tools	Pyrometallurgical	9.19%	2.20%
	Nickel Metal Hydride (NiMH)	Mobile phones, laptops, personal audio equipment	Pyrometallurgical	5.23%	2.00%
	Lithium Ion (Li-ion)	Mobile phones, laptops, cameras, power tools	Pyrometallurgical and Hydrometallurgical	4.28%	1.50%
	Lead Acid (PbA)	Hobby applications	Pyrometallurgical	2.17%	5.50%

Figure 35: Battery Market Segmentation and Recycling Routes⁵³

These recycling techniques are typically bespoke chemical processes developed and patented by individual companies. Some UK companies (e.g. G & P Batteries [<http://www.g-pbatt.co.uk/>]) have licensed proprietary technology for battery recycling.

There are three companies approved by SEPA as type treatment operators. These are:

- Enviroco Ltd.
- Regeneris (Glasgow) Ltd.

⁵³ Table compiled with reference to 'RENEW Battery Recycling Market Research Report, Valpak 2010' and 'Battery Waste Management Life Cycle Analysis' Commissioned by Defra and conducted by ERM, 2006

- WEEE Solutions Ltd.

It is understood that these companies collect batteries but do not have recycling facilities in Scotland.

Recycling Rates

A total of 51 tonnes of post consumer non-automotive batteries were recycled from the Scottish local authority municipal waste stream in 2009/10⁵⁴. Battery collections are, however, offered by obligated retailers such as supermarkets and the overall recycling rate achieved in 2010 was 10.2% (of the batteries placed on the market in 2009). This equates to recycling of 394 tonnes in Scotland.

The Waste Batteries and Accumulators Regulations sets targets of 25% recycling by 2012 and 45% by 2016.

Pricing Trends

Data on the price of recycling batteries is less well developed than for other resource streams. One of the leading battery compliance schemes, BatteryBack, provides an indicative total cost of compliance with the Waste Batteries and Accumulators Regulations of £300 per tonne⁵⁵. In the short term it is anticipated that these costs may increase due to the closure of a major battery recycling plant in Europe (through bankruptcy) and the delay in investment in new facilities due to uncertainty of new battery recycling processing standards⁵⁶.

Good Practice Added Value Approaches

Good practice examples include:

- The BatteryBack collection infrastructure is already established in Scotland. There are similar schemes run by retailers and councils but BatteryBack seems to have the most widespread coverage. BatteryBack is the leading UK battery compliance scheme with Duracell (through its parent company Proctor & Gamble) as a member. Duracell have an estimated 55% UK market share.

Issues And Barriers To Adding Value

Two key issues are very important here:

- Volumes of batteries collected – these are not sufficient to support processing activities (assuming a facility only processed Scottish arisings – it would be possible to import battery arisings from elsewhere in the UK but the viability of such an operation would be affected by plans for a battery recycling facility in England – see below)
- The scale required for a cost effective processing operation

Veolia (which runs the BatteryBack recycling scheme) announced, in 2010, that they would be investing in a battery recycling plant in England (having secured Duracell as a member). The final decision is awaiting European guidance on recycling efficiencies to be achieved by treatment plants. If these are set at the higher end then it may make some hydrometallurgical processes viable, which have a lower capital investment requirement than the more common pyrometallurgical plants used on mainland Europe. If such a development was to proceed in England then it would be highly unlikely that a recycling facility in Scotland would be viable.

These factors suggest that activity in Scotland should focus on collection, bulking and supply to processors elsewhere (subject to any potential discussions with BatteryBack about the location of their proposed recycling plant). However, the infrastructure for this is already established which suggests the key issue is increasing awareness of the current infrastructure.

⁵⁴ Waste Data Digest 11: Key facts and trends, SEPA, 2011

⁵⁵ <http://www.batteryback.org/faq.html>

⁵⁶ Capacity squeeze 'to push battery recycling costs up', LetsRecycle.com, 8th September 2011

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

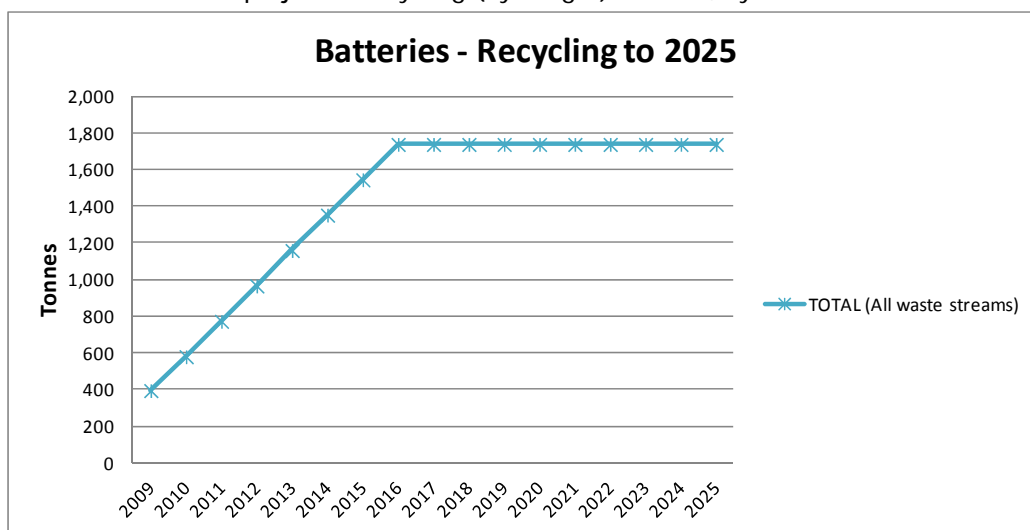


Figure 36: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

As indicated above, Veolia plans to set up a battery recycling facility in England. It is unlikely that the UK would support more than one battery recycling facility due to the level of input required to achieve a viable operation. The UK's leading battery compliance scheme is operated by Veolia – with market leaders, Duracell as members. Veolia are in a favourable position to proceed with their planned facility once regulations about minimum processing standards are finalised. Unless such a facility was mobile and could be attracted to Scotland then it is unlikely that a recycling facility would be viable in Scotland.

Achieving the targets set out in the Waste Batteries and Accumulators Regulations (25% recycling by 2012 and 45% by 2016) is the responsibility of producers (directly or via battery compliance schemes) and a number of collection schemes are already in place. So a supply chain already exists – the priority is to maximise its utilisation. Opportunities in this area, therefore, should focus on increasing awareness of the existing collection network for batteries to support the achievement of 2012 and 2016 recycling targets and on extending it where appropriate. Examples of such support already exist. For example, the ZWS 'Recycle On The Go' Capital Support Fund (PAC004) provides support for recycling infrastructure in public places and also for revenue costs for communication activities to support the use of recycling facilities.

5.4 Glass (Packaging)

The glass recycling sector in Scotland is seeing a gradual shift in the way that glass is collected, which has an impact on how it can be recycled and its end use applications. Less colour separated glass is being collected from both households and businesses and hence more material is being collected mixed; which has a higher probability of being recycled into the aggregate or fibre glass. Achieving high quality colour separated glass is increasingly becoming an issue for Scotland's container remelt sector. For example, Viridor Glass Recycling indicates that around 70% of the material treated at their facility is mixed glass, a significantly higher proportion than five years ago. Viridor have recently announced, however, that they are investing in a state-of-the-art glass sorting facility in Midlothian, which has the potential to increase the availability of colour sorted glass for remelt applications in Scotland. There is certainly a demand for colour separated glass in Scotland, with two plants manufacturing glass containers that currently need to import the required quality and quantity of material.

The need to increase recycling rates overall remains a key challenge. There may be opportunities to encourage recycling from the C&I stream by supporting companies, particularly in the hospitality sector, to install glass crushers, which appear to have good financial and environmental benefits. The changing dynamics in Scotland's glass processing sector, however, and the uncertainty over where the colour separated glass will be used, suggests that ZWS might wish to 'wait and see' how the market reacts before making any significant investments in this area.

Further investigation is also recommended for ZWS to understand the costs and benefits of colour separated collections compared to mixed collections and automated colour separation compared to mixed collection for use in non-remelt applications. This will help to inform longer term strategies for the glass recycling sector as the shift towards mixed collections continues.

It is worth highlighting at this point that ZWS are currently undertaking additional work to investigate glass collection and reprocessing options in Scotland, with the aim of understanding potential opportunities to increase closed loop recycling of glass back into containers in Scotland. The outcomes of that research will add further insight to this sector and guide intervention options available to ZWS.

Current Arisings By Source

Household

Packaging glass represents 7.0% of total household waste arisings⁵⁷. Total household waste arisings in 2009 were 2,818,422 tonnes¹⁷, indicating that total packaging glass arisings were 197,290 tonnes.

Commercial & Industrial

An estimate of the packaging glass arisings from the C&I waste stream can be made by using the total glass packaging arisings figure used in the Zero Waste Plan data (which is estimated by the Scottish Government at 10% of the UK figure). For 2009, this amounts to 268,600 tonnes⁵⁸. Deducting the 197,290 tonnes estimated to come from household sources this leaves 71,310 tonnes. This amount is assumed to arise from commercial sources such as hotels, bars, restaurants, etc. (some of which is collected by local authority collections and recorded as non-household).

Construction & Demolition

It is assumed that there are no significant arisings of packaging glass from this waste stream.

Total glass arisings

Total packaging glass arisings are estimated to be 268,600 tonnes.

⁵⁷ The composition of municipal solid waste in Scotland, Zero Waste Scotland, Table 19

⁵⁸ Zero Waste Plan data, SEPA (Table 12) - http://www.sepa.org.uk/waste/waste_data/zero_waste_plan_data.aspx

Current Collection And Treatment

Glass is collected in a number of ways in Scotland. For household collection, this is done at the kerbside and is either kept mixed or separated by the collectors in specially adapted vehicles. There is concern among the industry, however, that glass is increasingly being collected co-mingled, which decreases the likelihood that the material will be supplied into remelt.

For businesses, particularly in the hospitality sector, both colour separated and mixed glass will be collected regularly by commercial or third party waste management companies. In some cases, crushing machines may be installed on the premises to minimise the space taken up by the stored glass containers. This may cause issues with regards to the weight of the bins but is a practice that many companies find very useful. Some of the issues that have been raised with regards to the use of glass crushing machines were highlighted in a WRAP report entitled 'Hospitality Sector Glass Compactor Trials' in 2010, with the size of the crushed glass being an important factor in the ability to colour separate it at recycling plants. Additional work is being carried out in this area and ZWS will be able to access the data when the work has been completed.

The figure below highlights the value chain for recovered colour separated glass in Scotland.

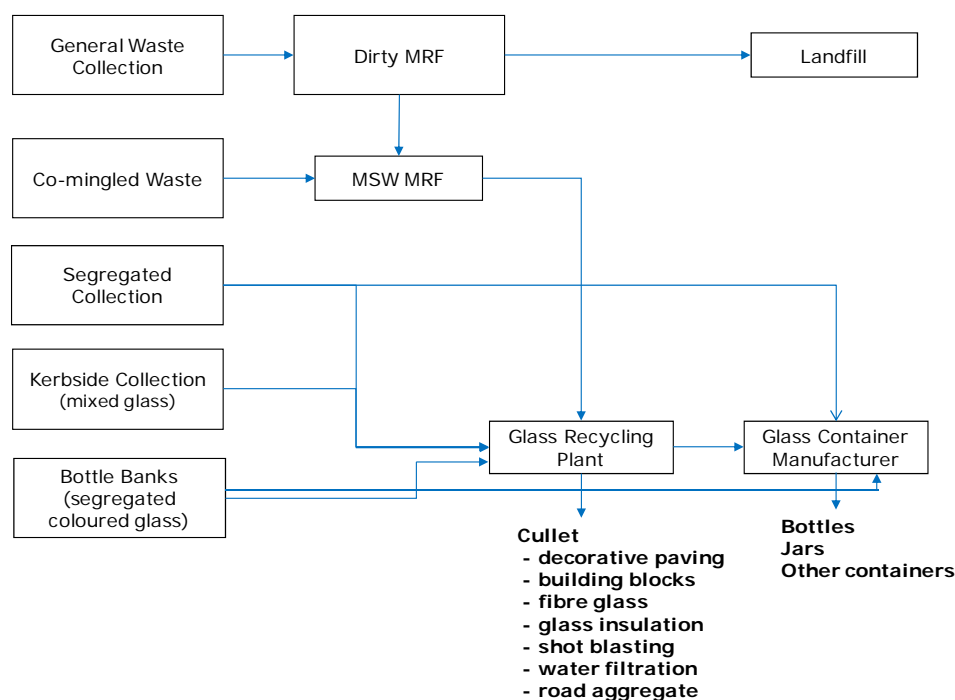


Figure 37: Value chain for recovered glass

A proportion of glass will go through MRFs in Scotland before being passed on to reproprocessors. Glass recovered in this way, however, tends to go to reuse in the aggregate industry rather than being recycled back into glass products. Discussions with industry suggest that when glass goes through a MRF then it cannot be used for container remelt due to the level of contamination and the current lack of facilities in Scotland for colour separation of mixed glass. Many MRFs themselves have difficulties in dealing with glass due to the type of equipment used, which can be damaged by glass waste.

As with most resource streams, there are a number of glass 'recyclers' throughout Scotland who collect colour separated or mixed glass from customers and simply crush or gather the glass before passing it on to an accredited reproprocessor (e.g. Ekko Glass based in Ayrshire or Alloa Community Enterprises in Alloa). For many collectors of waste glass, they will admit that it is easier, quicker and cheaper to collect mixed glass from customers but with the current lack of colour separation capabilities in Scotland, separated glass collection still offers the best environmental solution to ensure that as much as possible goes into remelt.

During preparation of this report, Viridor Glass Recycling announced that it will invest £6 million in a state-of-the-art sorting facility in Midlothian, providing Scotland with Europe's most advanced glass recycling site. This investment will clearly affect the dynamics of the glass recycling sector in Scotland and will hopefully increase the amount of glass that will be available for container remelt rather than going into aggregate or other applications. The site will have the capacity to process 140,000 tonnes of glass in Scotland per year. Viridor indicate that they currently collect around 70% of their glass in mixed form and 30% colour separated, with the percentage of mixed glass having increased significantly in the last five years. Currently 40% of their glass is supplied to container remelt in both Scotland and the rest of the UK.

Discussions with container glass reproprocessors in Scotland suggest that a significant amount of cullet is being imported to meet the demand from their processing plants. One processor indicated that they receive very little recovered glass from Scotland and would very happy if they could access colour separated glass locally for recycling here. If the levels of colour separated glass for remelt applications do not increase within Scotland (a particular risk as some councils are beginning to opt for more comingled collections e.g. North Ayrshire, South Ayrshire) then there could be a serious risk to container glass manufacturing in Scotland. There is definitely a demand for the material but it needs to be colour separated or it cannot be used for remelt. Initial discussions with manufacturers indicate that there would be no problem in accepting glass that has been put through colour separation equipment or glass crushing machines, providing the required level of separation has been carried out, particularly for clear glass.

SEPA's 2011 public register of accredited reproprocessors and exporters of packaging waste indicates that there are eight reproprocessors of glass packaging operating in Scotland. These are Ardagh Glass Ltd, Comhairle Nan Eilean Siar, Locheil Logistics Ltd, O-I Manufacturing UK Ltd, Shetland Amenity Trust, Superglass Insulation Limited, Viridor Glass Recycling Ltd and William Tracey Limited.

Recycling Rates

Household

A total of 105,023 tonnes of glass were recycled from the Scottish local authority municipal waste stream in 2009/10⁵⁹. This consisted of:

- Green glass – 28,140 tonnes
- Brown glass – 8,854 tonnes
- Clear glass – 28,602 tonnes
- Mixed glass – 39,427 tonnes

Data to separately identify the proportion of glass recycling from household sources are not available. An estimate can, however, be made by assuming the glass is collected at the same rate between household and non-household sources. Household arisings represent 88.2% of local authority collected municipal waste¹⁸. It can therefore be estimated that 92,630 tonnes of glass was recycled from households (47.0% of arisings).

Commercial & Industrial

It is estimated that 55% of commercial glass arisings are recycled and that 92% of industrial glass arisings is recycled⁶⁰. It assumed that the majority of glass collected is from commercial sources so the estimated recycling rate is 60% (this is consistent with glass packaging recycling performance for the UK⁶¹). This suggests that 42,786 tonnes were recycled (assuming all arisings are container glass).

⁵⁹ Waste Data Digest 11: Key facts and trends, SEPA, 2011

⁶⁰ Economic Assessment of the Zero Waste Plan for Scotland, Table 37: Reuse, Recycling and Recovery Rates for Commercial and Industrial Waste Streams, p.89 Zero Waste Scotland, 2011

⁶¹ Advisory Committee on Packaging Annual Report 2010/11, June 2011, p.25

Total glass recycling

A total of 135,416 tonnes of container glass is estimated to be recycled (50.4% of arisings). Industry sources estimate that 30% is collected colour separated and 70% mixed. Data on the split between use as remelt and other applications was not identified during the research for this report.

Pricing Trends

The pricing trends for colour separated and mixed glass is shown below. These are per tonne delivered to a collector. The prices paid for collected glass tends to be relatively stable, with companies often managing to get reasonably secure long term contracts. The prices can, however, be subject to fluctuation if the PRN price varies substantially. The guide price shown for mixed glass (for comparison) reflects the prices that may be paid by the aggregates sector or recyclers using mixed material.

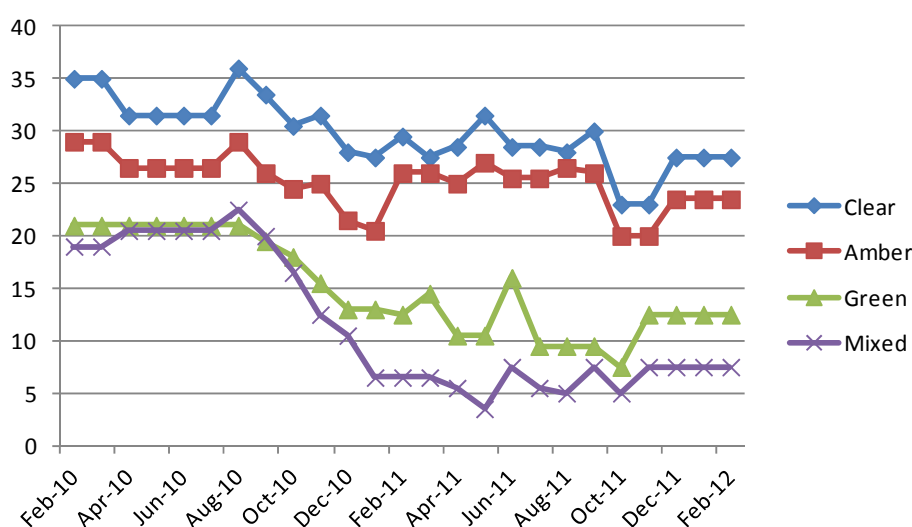


Figure 38: Glass pricing trends to February 2012²⁸

Good Practice Added Value Approaches

The key added value reprocessing for the glass sector in Scotland is the use of automated colour separation equipment in glass recycling facilities. There is significant investment required for this, however, which means that only large organisations with significant throughput (e.g. Viridor) have the capability and capacity to make the investment commercially viable.

One UK based organisation, Krysteline, claim to have a solution that offers MRFs the capability to extract remelt quality cullet from their operations without degrading other high value materials. The technology claims to densify glass and leave it sharp free, allowing high quality glass processing at MRFs⁶². It is not clear whether this technology is currently in commercial use in the UK.

Issues And Barriers To Adding Value

There are consistent messages coming from recycling organisation with regards to the issues surrounding glass recycling.

- Colour separation at source or at the point of collection is necessary to ensure sufficient quality of material is available for remelt. The increasingly mixed nature of collections is a barrier to increased closed loop recycling
- Lack of awareness among local authorities about the disadvantages of mixed glass collections
- Local authorities considering the inclusion of glass in comingled collections will cause further issues for glass recycling and also for handling issues within MRFs (this collection system has already been implemented in some local authority areas e.g. North Ayrshire, South Ayrshire)

⁶² For further details see <http://www.krysteline.net/>

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

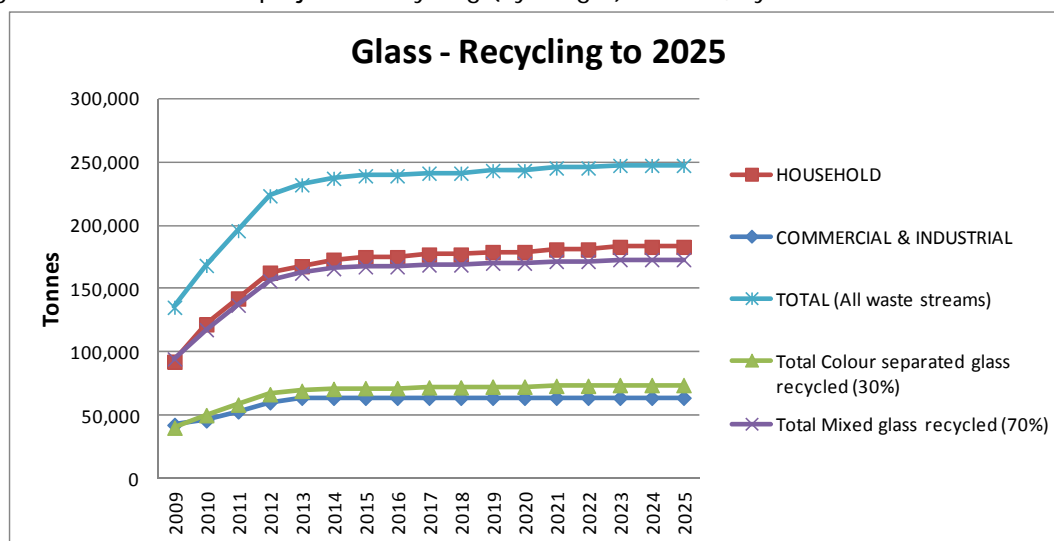


Figure 39: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

There are some potential opportunities to help Scotland increase the quality of glass available for remelt applications:

- Further investigation into support for service organisations to install glass crushers in pubs, clubs, hotels, etc. to encourage increased recycling of glass. Glass crushers will significantly reduce the space required for the storage of waste glass containers and will reduce the environmental impact and costs for the business. Viridor's new glass sorting facility will provide a way for mixed crushed glass to be separated into individual colour streams – there remains uncertainty, however, as to how much of this will be used in remelt applications. Thus further investigation is advised before support is offered in this area so that ZWS can maximise closed loop recycling of glass in Scotland. Advice from the current work being carried out by WRAP in relation to glass crushers, however, will be important to consider.
- Providing advice and encouragement to local authorities in Scotland presents an opportunity to increase the level of colour separated collections from both households and commercial streams. At present, some local authorities are already changing their collection systems to comingle glass along with other dry recyclables; this will not support increased closed loop recycling of glass. If ZWS can provide information and support in reversing these decisions and/or discouraging others from adopting the same approach then there is an opportunity to maintain or increase the quality of glass for remelt applications. This advice should also be applied to collections from bottle banks that often end up being mixed within the collection vehicle, in spite of being segregated at source.

5.5 Paper & Board

Paper and board recycling is fairly well established across the UK with significant amounts of paper and card collected for recycling each year in Scotland. There is, however, very limited reprocessing in Scotland, with the vast majority of the material being processed in other parts of the UK or exported. Only one small mill in Scotland processes recycled paper (around 100 tonnes per month) with all other UK reprocessing carried out south of the border. A new mill opened in January 2012 near Manchester that will require around 0.5 million tonnes of cardboard and hard mixed paper each year. This will impact the Scottish market as one of Scotland's key paper and board collection and sorting organisations (Stirling Fibre) is now part of the group that will operate the mill. There will, therefore, be an increased demand for material in Scotland (and UK wide) and it is expected that significant volumes of Scottish arisings will be diverted from export.

In spite of this, there are still high volumes of paper and board being sent to landfill due to contamination from co-mingled collections. Opportunities may exist, however, to introduce processes that can increase the quality of material that might otherwise have gone to landfill or to the export market. ZWS should consider providing support to organisations that can increase the quality and availability of recyclable material in Scotland, particularly as local authorities lean towards increasing comingled collections. Encouraging segregated collections of paper and card, instead of comingled, will add value to the sector as is the case with all recyclable materials.

Within Scotland, there are organisations that successfully collect material from a range of different sources, including households, businesses, local authority sites, etc. Very little reprocessing, however, is actually undertaken here. Very little paper and board collected remains in Scotland for reprocessing, but opportunities exist for potential closed loop recycling elsewhere in the UK.

Current Arisings By Source

Household

Cardboard accounts for 5.2% of total household waste⁵⁷. Total household waste arisings in 2009 were 2,818,422 tonnes¹⁷, indicating that total cardboard arisings were 146,558 tonnes. Paper ('Newspapers & magazines' and 'other paper') accounts for 16.1% of total household waste⁵⁷. Total household waste arisings in 2009 were 2,818,422 tonnes¹⁷, indicating that total paper arisings were 453,766 tonnes.

Total paper and board arisings from households are therefore estimated to be 600,324 tonnes.

Commercial & Industrial

There is limited data available about the amount of paper and cardboard in the C&I waste stream. To derive an estimate for this we can use total UK consumption of paper and board as a starting point. According to the most recent market situation report, published by WRAP⁶³, the UK consumption of paper and board fell by around 10% in the first three quarters of 2009. If the fourth quarter is consistent with this trend then this implies total consumption was 11.88 million tonnes. If we assume that Scotland accounts for 10% of this (which is the approximation used by the Scottish Government when factoring down UK packaging arisings to a Scottish level) then this gives an estimate of total paper and board arisings of 1.188 million tonnes (assuming that arisings are equal to consumption).

Having estimated paper and board arisings from households to be 600,324 tonnes and paper and board arisings of 37,599 tonnes from the C&D waste stream (see below) we can assume the remainder is from the C&I waste stream. The estimate of paper and board from the C&I waste stream is therefore 550,077 tonnes.

⁶³ Market Situation Report – Winter 2009/10: Realising the value of recovered paper: an update, Table 1: UK consumption of paper and board, WRAP

Construction & Demolition

Total C&D waste arisings (excluding hazardous and naturally occurring material) in Scotland, for 2009, were 3,759,910 tonnes^{64&65}. Paper and card represents 1.0% of these arisings³⁴. This suggests arisings of 37,599 tonnes.

Total paper & board arisings

Total paper & board arisings are estimated to be 1,188,000 tonnes.

Current Collection And Treatment

Waste (or recovered) paper and board is collected via a number of different methods. It may be through:

- General waste (MSW and C&I)
- Comingled recyclables (MSW and C&I)
- Kerbside segregated collection (MSW)
- Paper banks (MSW and C&I)
- Civic amenity sites (MSW)
- Segregated paper and packaging (C&I)

Collection services tend to be operated by specific groups within the industry:

Local authorities

Local authorities manage all general waste collection services from households in Scotland, either through their own service provision or by subcontracting the service to a commercial waste management company. The general waste will include an element of paper and board that may be recovered through a “Dirty MRF” to which the general waste is taken for sorting. Paper not deemed fit for recycling tends to be landfilled.

Local authorities also operate recycling services for both households and commercial and industrial customers. In some instances this will be co-mingled collections of dry recyclables that includes paper and board of varying qualities and types (e.g. blue bin collections). Some local authorities are moving towards source segregated collections from households where paper and/or board is collected separately from other recyclables. Two stream comingled collections are also in operation in some areas in Scotland where dry recyclables are sorted further by households/businesses e.g. paper and card in one box and plastics and glass in another.

Civic amenity sites also allow for households to bring paper and board for recycling.

In addition, local authorities run a number of paper banks throughout Scotland where householders and businesses can bring their waste paper to be recycled. It will either be collected by the local authority or by a contractor acting on its behalf.

Commercial / third sector waste management companies

Commercial waste management companies will primarily collect commercial and industrial waste – both general waste and recyclables. They will also operate the paper banks and recycling points throughout Scotland on behalf of charities and/or local authorities. The value of recovered paper has increased considerably over time and so businesses that generate significant volumes of paper are encouraged to segregate this from other waste materials and the collection of this may be offered as a standalone service. Confidential waste paper is another way in which waste management companies access material. Large volumes of cardboard are produced by companies in the retail and manufacturing sectors and so arrangements will often be in place for waste management companies and/or merchants to collect this material separately for processing. Some organisations may even install balers at their customer's premises to minimise the storage of material and increase its value in the marketplace.

⁶⁴ Construction and demolition waste arisings and management across Scotland in 2009, SEPA

⁶⁵ Economic Assessment of the Zero Waste Plan for Scotland, p.90 Zero Waste Scotland, 2011

Recovered paper merchants handle the vast majority of the paper that is recovered in Scotland and will often be an independent operator. Waste management firms will have relationships in place with one or more paper merchant at any one time to ensure they can get the best price for this valuable commodity.

The value chain for recovered paper and board is shown in Figure 40 below. This highlights the various routes that the waste material takes in the collection, recovery and recycling process.

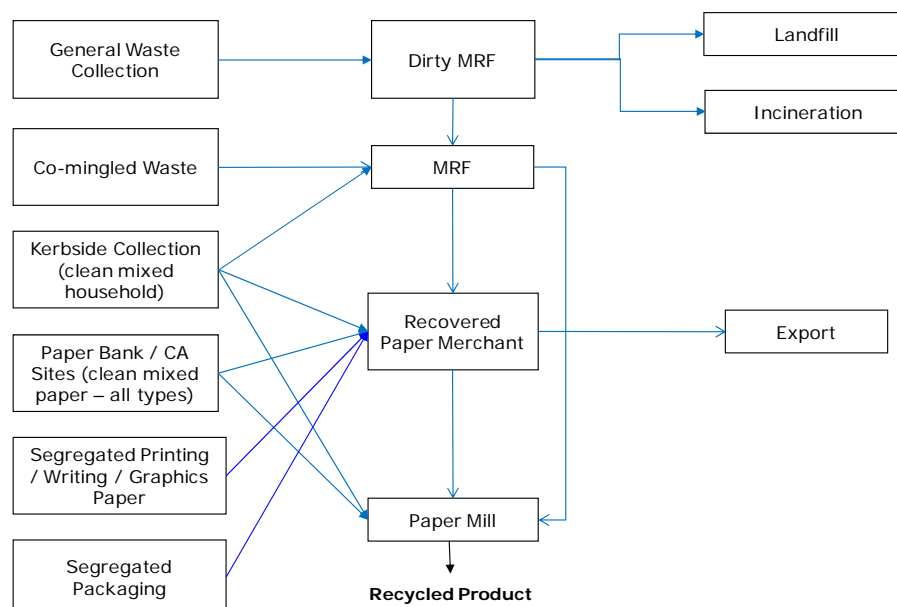


Figure 40: Value chain for recovered paper and board

There are a number of organisations that collect recovered paper and board in Scotland as well as the merchants that buy from these organisations and sell on to mills or for export. MRW's online directory list seven waste paper merchants in Scotland and we are aware of a number of others operating in the industry in Scotland.

There is very little recycling of recovered paper in Scotland's paper mills. Recently, however, a relatively small mill was restored in Fife by Fourstones of Northumberland and now sources waste paper locally to produce recycled products for the tissue and packaging paper markets. This mill requires around 100 tonnes of waste paper each week and so is a relatively small scale operation.

No other mill in Scotland sources waste paper and/or board for its production process and so no other waste paper or board is reprocessed here, providing little opportunity to add value to the sector. The other mills in Scotland are operated by Tullis Russell (uses pulp), Arjo Wiggins (uses pulp) and UPM Kymenne (uses wood); all are making high quality papers and premium packaging materials and so unlikely to move to using recycled paper in their processes.

The use of recovered paper to make newsprint is common place in the rest of the UK. There are, however, only three newsprint mills in the UK. They are: Aylesford Newsprint in Kent, Palm Paper in Norfolk and UPM Shotton in north Wales. Within the cardboard processing sector the UK wide outlets (over and above the new SAICA mill opened in 2012) include the St Regis Group with a number of mills including Kemsley in Kent and Smurfit Kappa, with plants in Birmingham and in Kent.

Recycling Rates

Household

There were 255,416 tonnes of paper and board collected for recycling by Scottish local authorities in 2009⁴¹. An estimate of recycling from households can be made by taking household arisings as 88.2% of local authority collected waste²⁰ (assuming that paper and board are collected at the same rate from both households and non-households). This implies that total recycling of paper and board from households was 225,277 tonnes. Comparing this with estimated household arisings of 600,324 gives a recycling rate of 37.5%.

Commercial & Industrial

The estimated recycling rate for paper and cardboard from the C&I waste stream is 49%⁶⁶. This suggests that 269,538 tonnes of paper & board are recycled from this waste stream.

Construction & Demolition

The estimated recycling rate for paper and cardboard from the C&D waste stream is 20%⁶⁷. This suggests that 7,520 tonnes of paper & board are recycled from this waste stream.

Total paper & cardboard recycling

Total recycling of paper & cardboard is estimated to be 502,335 tonnes (42.3% of total paper & cardboard arisings). Note this is a significantly lower rate than the 67% overall paper and board recycling figure for the UK, found in the most recent WRAP market situation report on recovered paper⁶³, highlighting a degree of uncertainty over the estimates.

Pricing Trends

The figure below highlights the pricing trends for recovered paper and cardboard in the UK between February 2010 and February 2012. Prices are per tonne.

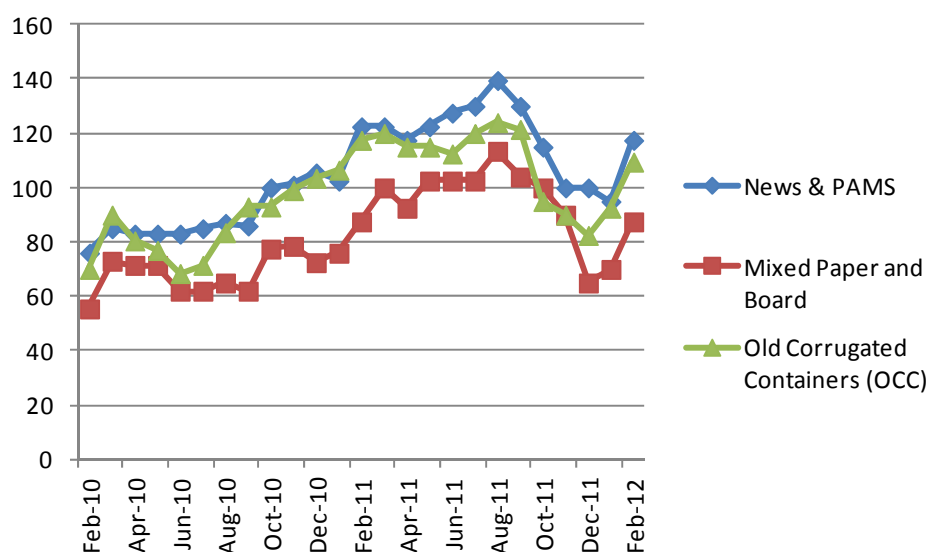


Figure 41: Recovered paper pricing trends to February 2012²⁸

October 2011 saw a marked decrease in export prices for recovered paper, which is reflected in the figure above. Towards the end of December 2011, the prices paid for mixed paper fell as low as £65 per tonne. It is believed that this 'market correction' had been expected by merchants, exporters and brokers but it appears unlikely that there will be the same type of crash that was seen in the market in

⁶⁶ *Economic Assessment of the Zero Waste Plan for Scotland, Table 37: Reuse, Recycling and Recovery Rates for Commercial and Industrial Waste Streams, p.89 Zero Waste Scotland, 2011*

⁶⁷ *Economic Assessment of the Zero Waste Plan for Scotland, Table 38: Calculated Composition and Reuse/Recycling Rates for Construction & Demolition Waste Streams, p.91 Zero Waste Scotland, 2011*

2008. Global economic conditions, a strike at the Alize mill in northern France and uncertainty in the US were contributing factors to the situation.

Good Practice Added Value Approaches

As mentioned, there is a degree of uncertainty around the comparatively low recycling rates for paper and board in Scotland compared to the rest of the UK. The collection and reprocessing sector here, however, is well established with some key international players investing in Scotland. New pressures from the SAICA mill and The Waste (Scotland) Regulations 2012 mean that situation is changing, with increasing emphasis on accessing more and more paper and card from both C&I and household waste streams.

Issues And Barriers To Adding Value

There are a few issues that are worth highlighting with regards to paper and board recycling in Scotland.

- Local authority co-mingled collections are affecting the potential for high value recycling of good quality paper and card that is discarded from households. Dual stream, paper and card, collections would enable more value to be taken from the material and ensure less is sent to landfill
- There is a concern about the future of newsprint mills in the UK sector as more and more people use electronic sources

In addition, the Confederation of Paper Industries has written to the UK government recently to voice its concerns over the prospect of punitive measures being imposed in both the UK and Brussels that might damage the competitiveness of the paper industry (and other energy intensive industries) in the UK⁶⁸. The main concerns are summarised here:

- European Union's Emissions Trading Scheme (EUETS) – comes into force in 2013 and means that free carbon allowances will only be given for heat use and then only against a benchmark for the most efficient 10% of EU sites. Free allowances are being withdrawn altogether for electricity generation and CHP generated power. Until now, carbon allowances have been issued free of charge to the pulp and paper industries based on historical energy use
- Carbon Floor Price – the UK government is imposing this tax on carbon emissions meaning that UK industry will pay more than any other EU state and significantly more than its competitors outwith the EU. The paper industry is one (among others) that is at risk from so called 'carbon leakage' and the CPI wants to see the industry let off from the tax
- The continued commissioning of EfW plants is a threat to the continued availability and cost of one of the paper industry's raw materials – waste paper and board. There is concern that co-mingled waste collections will result in a lot of recyclable fibre going to energy generation instead of new paper products
- With regards to the last point here, however, it is worth noting that the Zero Waste Regulations in Scotland will limit the types of material that can be used in EfW plants and so this concern is not expected to be such an issue north of the border.

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

⁶⁸

http://www.paper.org.uk/aboutcpi/communication/mps/mpsnewsletter_issue3_October%202011.pdf

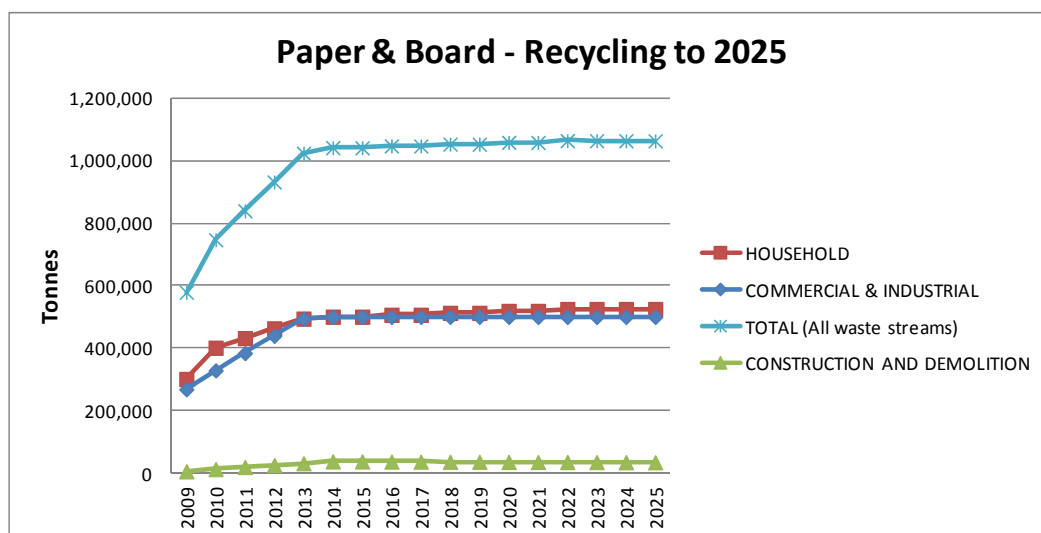


Figure 42: Projected recycling (by weight) to 2025, by source

Potential Intervention Options

There is not believed to be a significant economic opportunity to develop paper and board reprocessing in Scotland. One option, however, that could benefit the paper/board sector is:

Investment in equipment to increase the quality of the output from their processes to make otherwise low quality material fit for recycling/reprocessing and to ensure it is diverted from landfill. There are ways in which paper recyclers can process low quality material that would make it suitable for use in UK mills, rather than being exported or sent to landfill. A “cleaning/polishing” plant for paper and board would cost around £500,000 to set up but would have the capacity to divert around 30-40,000 tonnes of dirty/low quality paper from landfill each year. Such a facility would not be designed to displace separate collections of paper and card or encourage comingled collections from local authorities; it would be used to capture paper and board that would otherwise be destined for landfill (e.g. from MRFs after sorting) and would serve domestic demand (not export markets) e.g. the SAICA mill near Manchester that demands high volumes of material.

5.6 Polystyrene (including Forming)

Polystyrene is used in two forms – standard and expanded material. These materials are used in a variety of applications. Arisings in Scotland are estimated at around 15,100 tonnes per annum but little is recycled at the moment.

Waste polystyrene is collected from C&I sources in mixed waste plastic.

Expanded polystyrene is widely used in packaging and construction applications. There are significant volumes but low tonnage arisings in the waste stream. Its large volume and low weight makes it an obvious problem, but these characteristics make it difficult to recycle. Compacted expanded polystyrene is considered a commodity with a current market price of typically £150 to £170 per tonne. It is estimated that 95% of material collected in this form is exported to China. Establishing compaction facilities is the practical first stage in recycling this waste material. However, it is not currently considered a viable proposition, based on sale of compacted material at market prices. No evidence of established UK based companies manufacturing secondary products was identified. It is therefore difficult to identify intervention options that offer commercially sustainable businesses.

Polystyrene is used to manufacture a range of everyday products (e.g. plastic cutlery, CD cases, smoke detector housings, license plate frames) where a fairly rigid, economical plastic is desired. Therefore waste polystyrene will typically be included in mixed household and C&I waste streams.

Expanded polystyrene applications are dominated by packaging (52.4% UK market share) and construction (42.9% UK market share)⁶⁹. Construction applications are in insulation where typically the material has a long lifetime. However, waste packaging appears in the waste stream very quickly and is the major focus of expanded polystyrene recycling activity.

Current Arisings By Source

Household

A total of 685,728 tonnes were collected as household dry recyclables in 2009¹⁸. According to a recent composition analysis¹⁹, kerbside dry recyclables are composed of 0.02% EPS (137 tonnes) and 0.06% PS (411 tonnes). The remaining EPS and PS are contained within the residual waste stream. The residual amount is 1,755,757 tonnes and this can be used in conjunction with the ZWS composition analysis. It is assumed that this residual household waste is split between 'residual household collected waste' (85%), 'household waste recycling centre waste' (HWRC) (11%) and 'street litter' (4%)²¹.

The estimated proportion of EPS and PS in these waste streams is 0.24% and 0.46% (kerbside residual); 0.30% and 0.17% (HWRC); and 0.72% and 0.48% (street litter). Therefore, the estimated arisings of EPS and PS from these three sources is 10,447 tonnes from kerbside residual [(85% of 1,755,757 x 0.24%) + (85% of 1,755,757 x 0.46%)], 907 tonnes from HWRC [(11% of 1,755,757 x 0.30%) + (11% of 1,755,757 x 0.17%)] and 843 tonnes from street litter [(4% of 1,755,757 x 0.72%) + (4% of 1,755,757 x 0.48%)]. Total EPS and PS arisings entering the residual waste stream are estimated to be 12,197 tonnes.

Adding this to the estimate of 548 tonnes captured in dry recyclable collections provides an overall household arisings estimate of 12,745 tonnes of EP and PS.

Commercial & Industrial

There is a lack of robust data on the C&I waste stream – both total arisings and composition data. Different estimation methodologies result in significantly different results. For example, in a report carried out by Optimat for ZWS on plastic waste arisings in Scotland, the estimated plastic arisings from the C&I waste stream was between 50,841 tonnes and 284,438 tonnes⁷⁰.

⁶⁹ Expanded polystyrene (EPS) industry outlook in the UK to 2015, GlobalData, 26/07/2011

⁷⁰ Developing the Evidence Base for Plastics Recycling in Scotland, Zero Waste Scotland, April 2012

The lower estimate of plastic waste arisings is used in the model for this project and this lower estimate is based on there being 37,970 tonnes of plastic packaging in the C&I waste stream. It is estimated that 6.2% of all plastic packaging entering the commercial and industrial waste stream is polystyrene (PS and EPS)⁷¹. This suggests that the arisings of polystyrene from this source is 2,354 tonnes. This takes no account of non-packaging polystyrene as no robust composition data can be identified. ***It should be noted that the considerable uncertainty over the plastic arisings in the C&I waste stream means that the data on plastic arising from the model should be treated with caution.***

Construction & Demolition

No data on polystyrene arisings in the construction sector was identified.

Total arisings of polystyrene

Total arisings of polystyrene from all of the above waste streams are estimated at 15,099 tonnes. Feedback from a key industry player in Scotland suggests that this figure may be high with actual EPS arisings of 7,000 tonnes per annum⁷². This highlights a significant degree of uncertainty around the 15,099 tonnes figure used in the model.

Current Collection And Treatment

The low weight to volume ratio for expanded polystyrene (EPS) seriously affects the viability of polystyrene collection and recycling. This can be addressed by compaction processes where typically 80:1 volume reduction (e.g. in cold compaction equipment) can be achieved. However, this is only practical if arisings of waste material (e.g. 150 tonnes per annum) are available at a given location. Companies that do produce this volume of waste in-house typically have no cost of collection and remove significant waste management and landfill costs. These companies have in-house compaction machines that are used to reduce the volume of EPS prior to sale to materials merchants. These merchants include Enviro (GY), CK Polymers, Allansway and Regent Hill. Enviro (GY) claims to be the largest UK recycler of EPS with a 25% market share. Using it as an example, it offers to:

- Provide a compaction machine and transport free of charge to those with high volume EPS arisings
- Collect EPS in standard form for the transport cost to its facility in Grimsby

However, for third party providers of a compaction service, it is further complicated by the fact that there are several grades of EPS and each grade needs to be processed under different conditions.

There is no notable commercial collection or recycling capacity for EPS in Scotland and there is little or no interest in collecting polystyrene in Scotland at the moment.

Some companies do collect EPS as part of the service it provides to clients but only does so because it feels it must to win/retain business. An established recycling company in Scotland that does have a compaction machine but cannot commercially justify its use has been identified. It is not considered commercially viable due to the lack of arisings of consistent grades of EPS.

"You would only invest in an EPS compactor if you were wealthy enough to lose money slowly – never in a month of Sundays can you make money compacting EPS" - Scottish Recycling Company

The majority of compacted EPS is exported, mainly to China. Chinese companies (e.g. Intco Recycling) promote the capability to process compacted polystyrene into feedstock that can be used in the manufacture of polystyrene products (e.g. photo frames).

⁷¹ *Plastics in the UK economy, Waste Watch, 2003, p.21*

⁷² *Data supplied by Zero Waste Scotland, May 2012*

One UK company, Rabbitt Recycling, has been identified that will accept compacted EPS for UK based product manufacture. It is understood that it is launching a new process that uses the material as a feedstock for manufacture of plastic lumber, an alternative fuel and as a part substitute to lightweight concrete blocks. Previously Robust Recycled Products manufactured plastic lumber from waste EPS but it went into liquidation in 2009.

We understand that two major waste management companies in central Scotland have recently evaluated the opportunity to purchase and operate an EPS compactor but both concluded it was not a commercially viable proposition.

Similarly one plastic recycling company used to provide a service when Scotland had a significant electronics manufacturing industry and there was sufficient arisings at individual sites. This service has also been withdrawn due to the lack of arisings.

The current value chain for polystyrene is therefore as shown below:

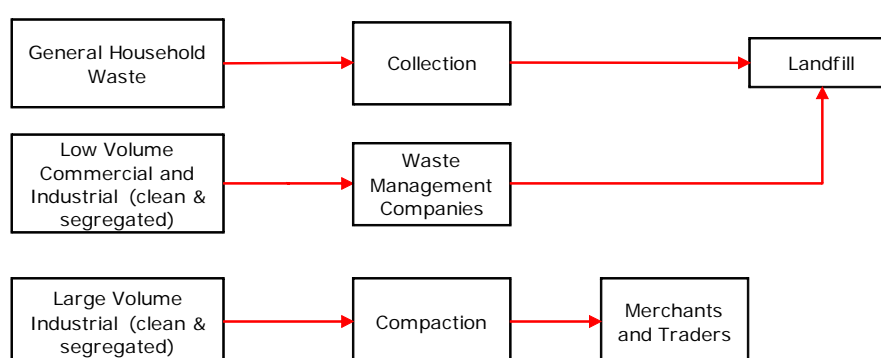


Figure 43: Polystyrene Value Chain

Recycling Rates

Household

According to a recent composition analysis⁷³, kerbside dry recyclables are composed of 0.02% EPS (137 tonnes) and 0.06% PS (411 tonnes). This suggests a total of 548 tonnes of polystyrene recycled from households.

Commercial and Industrial

The UK recycling rate for EPS manufactured in the UK was 33% in 2009⁷³. Using this figure it is estimated that 777 tonnes are recycled from the C&I waste stream. As previously detailed, there is significant uncertainty about the overall arisings figure and this obviously carries over to the estimate for recycling. In addition to this, industry sources suggest that the overall recycling rate is nearer 20%⁷⁴, highlighting uncertainty in the 33% figure used in the model.

Total polystyrene recycling

Total recycling of polystyrene is estimated to be 1,325 tonnes (8.8% of total polystyrene arisings).

Pricing Trends

There is a demand for **compacted** polystyrene. Plastic merchants are willing to pay between £150 and £170 per tonne, delivered to their premises. Typical transport costs would be £40 per tonne, leaving a residual income of £110 - £130 per tonne.

⁷³ BPF Expanded Polystyrene Group – www.eps.co.uk

⁷⁴ Data supplied by Zero Waste Scotland, May 2012

Good Practice Added Value Approaches

There are two process options to reduce the volume of EPS – thermal densification (typical compaction ratio of 90:1) and cold compaction (typical compaction ratio of 35:1) and several suppliers of equipment.

Potentially transferrable examples of polystyrene recycling activities include:

- **EPS Compaction Facility - England**
 - A facility for compacting expanded polystyrene has been set-up by an English public sector organisation. Household holders can deposit materials for free and C&I customers are charged £10 per load. Compacted material is shipped elsewhere in UK for onward export to the Far East.
 - This initiative however is not commercially viable and is subsidised by the public sector organisation to divert the material from landfill.
- **Toll compaction of EPS**
 - A recycling company based in England has set up an EPS compactor to process in house waste. It can process 65 kg per hour (approximately 120 tonne per annum). It offers to process EPS for third parties free of charge if material is delivered to the factory.
 - The company however asserts that:
 - It initiated recycling of EPS as it did not seem right to landfill the material. It was a decision based on conscience rather than robust economic analysis.
 - The machine will never pay for itself, even though it was purchased second-hand
 - The income generated does not pay for the man to run the machine
 - "If you ran it all day, every day you would lose money on EPS"
 - Trying to compact different grades of polystyrene (a factor that a toll service has to deal with) causes machine operating problems

Essentially the company gains access to other more lucrative materials because it has the facilities to manage waste EPS and this is why the company persists with offering the service.

Issues And Barriers To Adding Value

The major issue for expanded polystyrene is its low weight to volume ratio as highlighted above. This means that it is difficult to achieve viability in collection activities.

The use of brominated fire retardant in construction products means that it cannot subsequently be used for food grade use, limiting recycling opportunities where different types of EPS are mixed.

The mixing of low density EPS (e.g. from packaging) and higher density EPS (e.g. for construction use) can also make the recycled material insufficiently dense for use as an input into construction product manufacture.

There are examples of companies making low grade plastic lumber from EPS in England and industry sources suggest they cannot currently secure sufficient supplies of EPS⁷⁵.

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

⁷⁵ Information supplied by Zero Waste Scotland, May 2012

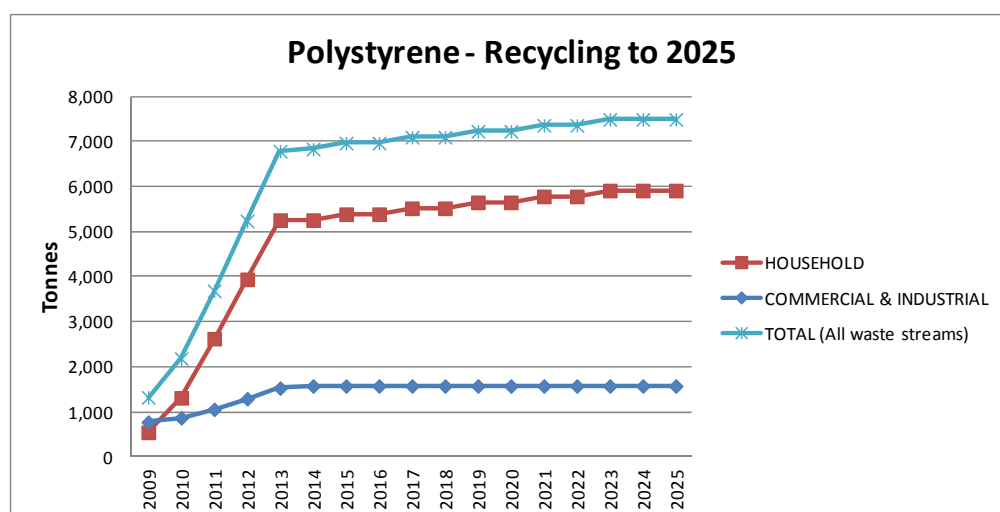


Figure 44: Projected recycling (by weight) to 2025, by source

Potential Intervention Options

The most obvious intervention option is establishment of regional / local compaction facilities for EPS. However, this is not a viable activity, assuming the sale of compacted material at market prices. A simple cost analysis is as follows:

	Case study (England)	
Capacity (per annum)	30	tonnes
Operator costs	£10,000	
Transport costs	£1,200	£200 per load
Overhead		
Income	£4,800	
Balance	-£6,400	
Reduced landfill fees	£2,400	assume £80 per tonne
Revised balance	-£4,000	

Figure 45: Estimated Basic EPS Processing Costs

This model assumes no cost of capital to purchase equipment and no costs for collection. It also excludes energy / overhead costs. Furthermore, increasing capacity does not improve the cost model. It is therefore difficult to identify commercially viable intervention options for the material.

As the figure above essentially shows that the income generated from selling compacted material is insufficient to cover the cost of labour for carrying out the compaction it is realistic to conclude that this type of operation would need a permanent subsidy. It is therefore not considered a practical option to pursue.

5.7 PVC (including Forming)

PVC is widely used in a number of domestic, industrial and construction applications, with construction being the main market application.

PVC waste arisings in construction (e.g. window profiles, pipes and cables) are collected, segregated and supplied to the PVC product manufacturing sector. Several companies in Scotland are already actively collecting and handling mixed construction waste and segregating PVC. It is estimated that around 10,000 tonnes will be recycled in Scotland in 2011. There are established, reliable markets for good quality segregated materials in the UK, where many companies have demonstrated the ability to use recycle in manufacturing processes – a closed loop process. This market is encouraging waste materials collection.

PVC arisings in other markets tend to be included within mixed waste and it is difficult to extract value from this waste stream.

The development of additional construction waste collection and segregation capacity would ensure higher levels of PVC recycling. Furthermore this should be linked to a PVC recycling facility that transforms waste windows into raw material for supply to manufacturers of window profiles. Evidence from elsewhere indicates that a 5,000 tonne per annum facility is a viable business proposition. Model projections suggest an additional 20,000 tonnes of PVC could be recycled from C&D sources by 2013.

The market for PVC in Western Europe, the Czech Republic, Hungary and Poland in 2010 was as follows⁷⁶:

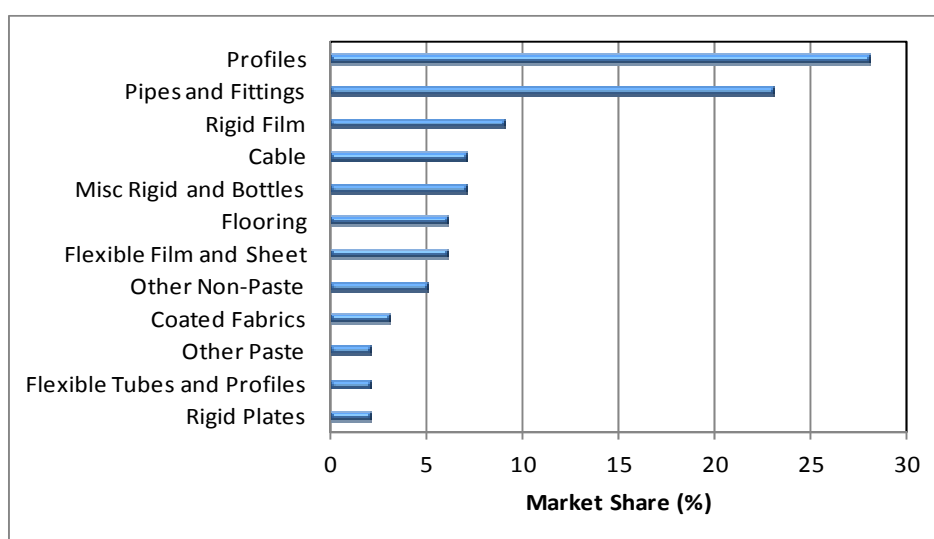


Figure 46: PVC Market Segmentation

This highlights the importance of the construction sector, which is the market for three of the four largest products groups.

Current Arisings By Source

Household

A total of 685,728 tonnes were collected as household dry recyclables in 2009¹⁸. According to a recent composition analysis¹⁹, kerbside dry recyclables are composed of 0.03% PVC (206 tonnes). The remaining PVC is contained within the residual waste stream. The residual amount is 1,755,757 tonnes and this can be used in conjunction with the ZWS composition analysis. It is assumed that this residual household waste is split between 'residual household collected waste' (85%), 'household waste recycling centre waste' (HWRC) (11%) and 'street litter' (4%)²¹.

⁷⁶ Vinyl 2010, see <http://www.vinyl2010.org/about-us/what-is-pvc.html>

The estimated proportion of PVC in these waste streams is 0.05% (kerbside residual), 0.01% (HWRC) and zero in street litter. Therefore, the estimated arisings of PVC from these three sources is 746 tonnes from kerbside residual (85% of 1,755,757 x 0.05%) and 19 tonnes from HWRC (11% of 1,755,757 x 0.01%). Total PVC arisings entering the residual waste stream are estimated to be 765 tonnes.

Adding this to the estimate of 206 tonnes captured in dry recyclable collections provides an overall household arisings estimate of 971 tonnes of PVC.

Commercial & Industrial

A specific composition analysis of plastic types in the commercial & industrial waste stream has been difficult to identify. The best available estimate is that 16% of plastic consumption, by weight, is PVC and that a significant proportion of this occurs in the manufacture of pipes, profiles, flooring etc⁷⁷.

The available data on total plastic arisings in the C&I waste stream is limited. A recent report by Optimat for ZWS found that the estimates varied significantly depending on the source data and methodology used. Estimates range from 50,841 tonnes to 284,438 tonnes⁷⁸.

The lower figure is used in the model developed for this report. Combining the estimate of total plastic arisings of 50,841 tonnes with the estimated 16% PVC composition results in an estimate of 8,135 tonnes of PVC arising in the C&I waste stream. ***It should be noted however, that there is significant uncertainty in the total plastic waste arisings from this waste stream and as such, this estimate and the output of the model should be treated with caution.***

Construction & Demolition

C&D waste arisings for Scotland, in 2009, are estimated to be 3,821,352 tonnes. This figure is calculated by starting with the SEPA reported estimate of total C&D waste generated in 2009 of 7,600,504⁷⁹. This figure needs to be adjusted to the basis upon which the 70% minimum recycling rate, from the revised Waste Framework Directive, will be calculated (i.e. where the 70% is applied to the total non-hazardous C&D waste less the naturally occurring material defined in EWC 17 05 04 (soil and stone)). This adjustment is carried out to align with the method used in the recent Economic Assessment of the ZWP⁸⁰. The same proportion of total C&D waste generated to the estimated C&D waste (less hazardous and 17 05 04) for the 2008 figure is used, i.e. 50.28% of the C&D waste generated. Using the SEPA reported C&D waste generated figure for 2009, of 7,600,504 tonnes, this means that the C&D waste (less hazardous material and naturally occurring material in EWC 17 05 04) is estimated at 3,821,352 tonnes.

It is estimated that 2% of this C&D waste consists of dense plastic⁸¹, suggesting arisings of 76,427 tonnes. PVC accounts for approximately 47% of total plastics used in construction⁸², suggesting that arisings of PVC could be around 35,921 tonnes.

Total PVC arisings

The estimated total PVC arisings is estimated at 45,027 tonnes.

Current Collection And Treatment

PVC is collected from all waste sources using a variety of methods:

- Household waste in mixed, co-mingled and single stream format

⁷⁷ Materials and products from UK-sourced PVC-rich waste, WRAP, 2004, Fig 4.1a

⁷⁸ British Plastics Federation Recycling Group – Films Working Group – www.bpf.co.uk/Recycling/Working_Group/Films.aspx

⁷⁹ Construction and demolition waste arisings and management across Scotland in 2009, SEPA

⁸⁰ Economic Assessment of the Zero Waste Plan for Scotland, p.90 Zero Waste Scotland, 2011

⁸¹ Economic Assessment of the Zero Waste Plan for Scotland, Table 38, Zero Waste Scotland, 2011

⁸² APRICOD Guide - Towards Sustainable Plastic Construction and Demolition Waste Management in Europe, p.12

- C&I in mixed, plastic only and PVC only streams
- C&D in mixed, plastic and PVC only streams

The PVC recycling value chain can therefore be presented as follows:

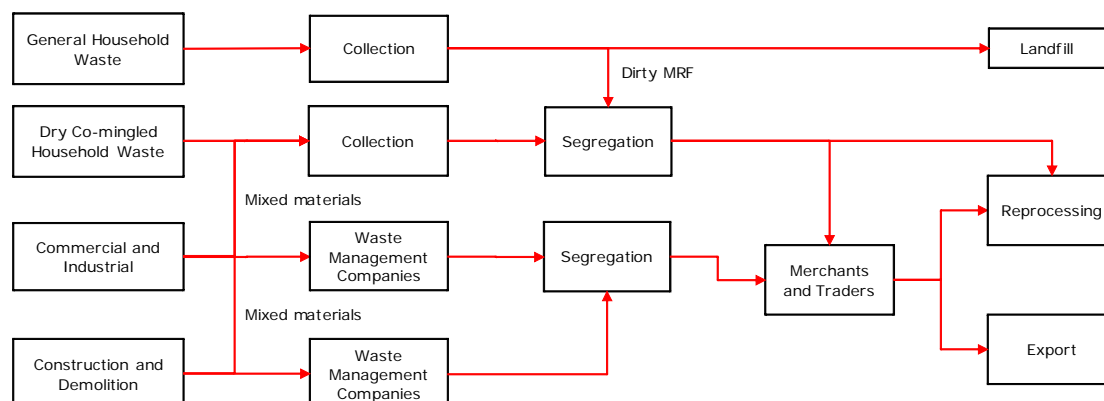


Figure 47: PVC Recycling Value Chain

Specialist plastic recycling companies that handle PVC include:

- 1 Trident Recycling Ltd
- 2 WRC Recycling Ltd
- 3 Stirling Fibre Ltd

Some Scottish companies operating MRFs and waste transfer stations have also taken a strong interest in PVC. These are:

- 4 All Waste Recycling
- 5 Newtown Skip Hire

Recovinyll is an initiative of the PVC industry to maximise PVC recycling in Europe. There are 23 registered “Recovinyll” recyclers in the UK but none are in Scotland⁸³. The members are mostly manufacturers of window and door profiles, most of which advertise the ability to include post-consumer recyclate in the manufacturing process.

A number of these companies also deal with electrical cable, where segregation of the copper and plastic sheathing (usually PVC) enables a profitable operation. The value of copper is such that a good return from investment in cable stripping or shredding equipment can be easily achieved. The potential income opportunity here is recognised by the recycling industry.

Recycling Rates

Household

As noted in the earlier arisings section, PVC accounts for 0.03% of kerbside dry recyclables¹⁹. In 2009 there were 685,728 tonnes of kerbside dry recyclables collected in Scotland¹⁸, suggesting that 206 tonnes of PVC were recycled (21.2% of arisings).

Commercial & Industrial

If we assume that PVC in the commercial waste stream is recycled at the same rate as the broader category of ‘dense plastics’ then we can apply a recycling rate of between 32% and 58% (the rates used for ‘dense plastic’ recycling in the commercial and industrial sectors, respectively – based on data used in the recent Economic Assessment of the Zero Waste Plan for Scotland⁸⁴). An average recycling

⁸³ http://www.axionrecycling.com/userfiles/file/Recovinyll%20Update/RecovinyllUpdate_issue1.pdf

⁸⁴ *Economic Assessment of the Zero Waste Plan for Scotland, Table 37: Reuse, Recycling and Recovery Rates for Commercial and Industrial Waste Streams, p.89 Zero Waste Scotland, 2011*

rate of 37% is assumed to reflect that the commercial sector is larger than the industrial sector (the Scottish economy has a 'service' element of around 74%⁸⁵). This suggests that 3,010 tonnes of PVC are recycled from this waste stream.

Construction & Demolition

If we assume that PVC in the C&D waste stream is recycled at the same rate as the broader category of 'dense plastics' then we can apply a recycling rate of 18%⁸⁶ (again, taken from the Economic Assessment of the Zero Waste Plan for Scotland). This suggests that 6,466 tonnes of PVC are recycled from this waste stream.

Total PVC recycling

A total of 9,682 tonnes of PVC are estimated to be recycled (21.5% of estimated arisings).

Data check: 50,000 tonnes of post consumer PVC was recycled in the UK in 2008 (<http://www.axionrecycling.com/userfiles/file/RecovinylnNewsletterissue34.pdf>). European recycling levels were approximately 180,000 tonnes in 2008 and are estimated at 240,000 tonnes for 2010 (<http://www.recovinyl.com/news>). Similar growth in the UK would suggest a figure of 62,500 tonnes in the UK in 2010 and a Scottish figure (based on 10%) of approximately 6,250 tonnes.

9,682 tonnes is used in the model although it should be noted that this figure is higher than the data check and therefore the estimate of additional recycling required could potentially be lower.

Pricing Trends

Market prices for PVC are not published to the same extent as other plastic materials. Indicative prices for 2011 in Europe⁸⁷ were:

	Nov '10	Jun '11	Aug '11	Sept '11
PVC (unplasticised)	£400	£443	£365	£452
PVC (plasticised)	£296	£287	£148	£226

Figure 48: PVC Price Trends

Good Practice Added Value Approaches

Examples of good practice that are transferrable include:

- 1 C&D contractor recycling hubs (e.g. the All Waste Recycling model or the "VEKA Northern Hub" in Burnley)
- 2 Independent collection of post consumer window frames and recycling into raw material for sale to window profile manufacturers – achieving a closed loop solution (e.g. PVC Recycling Ltd).
- 3 Closed loop recycling of window and door profiles (e.g. VEKA and Merritt Plastics Ltd).

Issues And Barriers To Adding Value

There is clear evidence (e.g. see examples above) that closed loop recycling of post industrial and post consumer PVC can be successfully achieved. The challenge is to collect sufficient good quality materials to feed into the PVC product manufacturing industry. This has already been demonstrated by some Scottish companies highlighted above.

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

⁸⁵ Structure of the Scottish economy - <http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Q/pno/2>

⁸⁶ Economic Assessment of the Zero Waste Plan for Scotland, Table 38: Calculated Composition and Reuse/Recycling Rates for Construction & Demolition Waste Streams, p.91 Zero Waste Scotland, 2011

⁸⁷ Plastics Market Report, October 2011, Plasticker (www.plastiker.de)

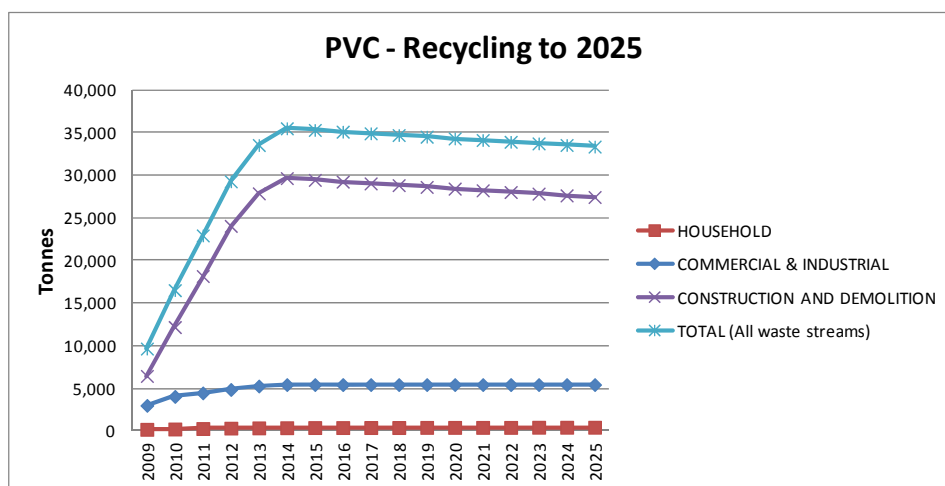


Figure 49: Projected recycling (by weight) to 2025, by source

Potential Intervention Options

■ Extension of current C&D recycling hub capacity

It has already been demonstrated that waste PVC window and door profiles can be successfully collected in a segregated fashion for transfer to recycling facilities. This is essentially a low cost activity that existing recycling companies can integrate into existing facilities, whether they currently target C&D or other sources of waste. Development of this capacity is essential to support the following opportunity – in fact, development of the following opportunity will set up a major market pull for increased PVC collection activities.

■ Development of a PVC recovery facility

This opportunity is based on the second example of good practice highlighted above and is selected because it is an independent operation rather than one linked to a window profile manufacturer (of which there are none in Scotland).

Evidence indicates that an investment of £1.5m in materials processing equipment is sufficient for a 5,000 tonne per annum PVC recycling plant. The output material will be raw material for window profile manufacturers (value of around £400 to £450 per tonne) thus achieving closed loop recycling.

A simple financial model is shown opposite, indicating that it is a profitable operation, assuming it is working at full capacity. Future projections of additional PVC arisings from the C&D industry indicate that several plants of this size would be viable. However it is important to note that the UK plants that currently offer this service are all operating below capacity so there would be an expected level of competition for additional materials available

PVC Reprocessing Facility

Output tonnes	5,000
Sales price (per tonne)	425

	£	£ per tonne
Investment for 5,000 tpa	1,500,000	
Sales	2,125,000	425
Materials	600,000	120
Labour	300,000	60
Other costs	200,000	40
Overhead	660,000	132
Total cost	1,760,000	352
Annual gross profit	365,000	73
EBIT on sales	0.17	
Simple RoI	24%	

5.8 Textiles and Footwear

This report covers two different aspects of the textile market – textiles and footwear (including clothing, blankets, curtains and other such material) and carpets.

Industry sources indicate that, in Scotland, around 80% of textiles collected are exported for re-use globally. This is the most significant end market for used textiles and it offers a very high price for clean, graded material that can be re-used in developing nations around the world. Very little processing of textiles occurs in Scotland and where it does it is of very low value, indeed it often costs less to export material for reprocessing and ship it back to Scotland. For household textiles, the biggest barriers to increased recycling are the lack of awareness and understanding about the types of material that can be recycled and the lack of opportunity for householders to 'easily' recycle unwanted goods. Industry sources indicate that education and communication with householders is key to increasing collection and recycling levels as well as accessing higher quality material. Of increasing concern is the fact that local authorities seem to be encouraging textiles to be collected comingled, much of which ends up in MRFs and ends up being landfilled due to the poor quality of output.

Another opportunity to improve the quality of textiles is investment in washing/drying facilities. This would add value to material that might otherwise be sent to landfill and ensures that further treatment is possible.

Carpet waste is something that is often regarded as 'non-recyclable' with little awareness of the capabilities that existing in the UK for reuse and recycling. Around 420,000 tonnes of carpet are sent to landfill each year in the UK, with only 10% of waste material currently being recycled. Very little reprocessing currently takes place in Scotland at present, with only three companies identified by the UK trade association (two of which are for reuse of carpet tiles). There are significant gaps in Scottish processing capabilities and ZWS should harness the opportunity to encourage infrastructure development here. While investment will be needed by companies taking on carpet waste recycling it presents a commercially viable opportunity to increase recycling capacity in Scotland.

In addition, however, there is a need to increase awareness of carpet waste recycling – among local authorities as well as householders and businesses. Carpet Recycling UK offers support for organisations in this area and there may be opportunities to collaborate in bringing different members of the sector together to better understand how the sector can move forward together.

The textile market (specifically clothing and footwear) is volatile, like any commodity market. Over the last 10 years, however, the market price paid for what is described as 'charity rags' (reusable clothing for export) has increased to around £600 per tonne in 2011⁸⁸. When the material is sorted further, high grades of material can be sold for significantly higher values. The textiles market is subject to a wide range of global influences, from changes in cotton pricing to the rise in demand from emerging economies such as China and India.

Another important type of waste classified under 'textiles' within the UK is carpet waste. Carpet waste in the UK tends to be thought of as 'not suitable for recycling' and so is often not given consideration by householders or commercial organisations at end of life. There are, however, a number of carpet recycling operations within the UK (mainly south of the border) that provide opportunities to divert significant volumes of material from landfill. For example, one organisation is using carpet waste to produce a 100% recycled underlay; other organisations are recovering materials (e.g. nylon, PP) from carpet waste for use in other applications; one organisation is researching the use of cryogenics to recover all constituent parts of carpet waste for reuse; and there are numerous trials and research taking place to develop end markets for carpet and carpet tile waste (e.g. soil improver, land reclamation, new adhesives). It should be noted, however, that carpet waste is sent for both recycling and reuse (48% of total in 2011) as well as energy recovery (52% of total in 2011).

⁸⁸

Discussions with Scottish companies

Current Arisings By Source

Household

Data on textile & footwear arisings in the waste stream is limited as there is widespread use in recycling of clothing prior to disposal which is not necessarily reflected in waste data reporting. To address this difficulty a 2009 Defra commissioned report on UK textile arisings⁸⁹ has been used with UK figures adjusted to Scottish level through the use of population or workplace GVA data. The Defra project was commissioned as part of the Sustainable Clothing Roadmap and examined evidence on clothing and textile reuse and recycling. The report highlighted some data gaps in imported textiles placed on the market and the final destination of exported goods.

UK consumption of clothing is estimated at 1,251,000 tonnes (this includes an estimated 11,000 tonnes of corporate workwear which is disposed of mainly in the municipal waste stream, although the Defra report highlights the growth in takeback schemes). The proportion arising in Scotland can be estimated using a figure of 8.44% (Scottish share of the UK population⁹⁰). This leads to an estimated consumption of clothing of 105,584 tonnes. This figure can be adjusted to an estimated arisings figure by subtracting 13.7% which is assumed to be stored by the consumer each year (figure derived from the aforementioned Defra study). This results in an estimate of arisings of clothing of 91,119 tonnes.

UK estimated consumption of footwear is 150,000 tonnes. Using the same method of converting to a Scottish level figure (8.44% of UK population⁹⁰) gives an estimated footwear consumption figure of 12,660 tonnes. If the same assumption is made on footwear stored by the consumer (13.7% of consumption) then the estimated arisings of footwear is 10,926 tonnes.

UK consumption of household textiles (blankets, bed linen, towels etc.) is estimated at 265,000 tonnes. Using the same method of converting to a Scottish level figure (8.44% of UK population) gives an estimated household textiles consumption figure of 22,366 tonnes. If the same assumption is made on household textiles stored by the consumer (13.7% of consumption) then the estimated arisings of household textiles is 19,302 tonnes.

Finally, UK consumption of household carpets is estimated at 372,000 tonnes. Using the same method of converting to a Scottish level figure (8.44% of UK population) gives an estimated household carpet arisings figure of 31,397 tonnes (this time assuming that consumption equals waste arisings as carpets are less likely to be stored).

Total textile and footwear waste arisings from households (including clothing, household textiles, carpet and footwear) are therefore estimated to be 152,744 tonnes.

Commercial & Industrial

It is assumed that the 11,000 tonnes of corporate workwear disposed of in the UK is included in the household figures (in reality, due to the need for secure disposal of workwear by some companies a proportion will be disposed of via waste management companies). As no data can be identified on the amount of workwear disposed of in this manner the approximation is used that it is all accounted for through the household waste stream). The textiles arising in the C&I waste stream are assumed to come solely from commercial carpet. The 2009 Defra commissioned report on UK textile arisings⁹¹ estimates that there are 198,000 tonnes of commercial and event carpets consumed in the UK (which is assumed to equal arisings, although the actual figure is likely to be lower given that some of the carpet will be installed in new buildings and not be replacement carpet). The proportion arising in Scotland can be estimated using the Scottish proportion of UK total employees (8.80%)²². The estimated Scottish arisings of textiles from the C&I waste stream is therefore 17,424 tonnes (8.80% x 198,000).

⁸⁹ *Maximising Reuse and Recycling of UK Clothing and Textiles EV0421: Appendix 1 – Technical Report, Oakdene Hollins commissioned by Defra, 2009*

⁹⁰ *Key Population and Vital Statistics, No. 34, 2007 Edition, Office for National Statistics, 2009*

⁹¹ *Maximising Reuse and Recycling of UK Clothing and Textiles EV0421: Appendix 1 – Technical Report, Oakdene Hollins commissioned by Defra, 2009*

Construction & Demolition

It is estimated that there are no significant arisings of textiles and footwear from this waste stream (corporate workwear is assumed to be disposed of in the household waste).

Total arisings of clothing, footwear, household textiles and carpets

Combining the arisings from the above waste streams gives a total estimated figure of 170,168 tonnes.

Current Collection And Treatment – Clothing And Footwear

A summary of the current routes for the collection and treatment of textiles and footwear in Scotland is shown below.

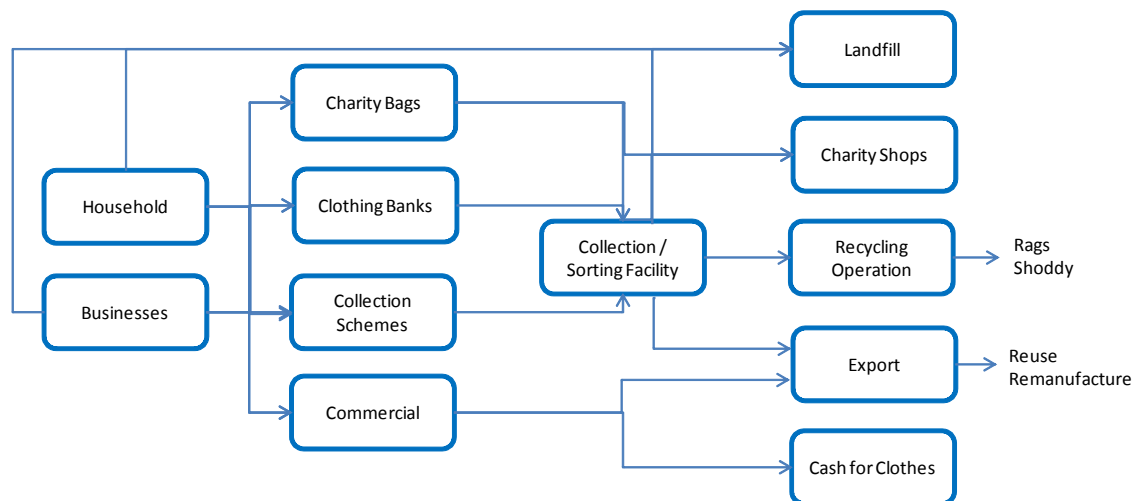


Figure 50: Value chain for textiles and footwear

Collection

The collection methods for textiles are relatively well established, with a significant amount of unwanted clothing, footwear, bedding, etc. being donated from households to charity shops on a regular basis. The collection of textiles tends to be through:

- Kerbside collection (MSW)
- Household charity bags (MSW)
- Clothing banks (MSW and C&I)
- Collection schemes e.g. schools, workplace, etc. (MSW and C&I)

Some local authorities offer collections of textiles as part of their household kerbside collection scheme. This will be collected by either the local authority or its designated subcontractor.

Charities also collect textiles directly from households through their charity bag drops where clothing tends to be exported, with a limited amount being used in charity shops but with the money raised going directly to the charity. One of the concerns in this area, however, relates to fraudulent and illegal operators who pass themselves off as charities, act without licenses and often steal collection bags from other charities operating in the same area.

Clothing banks are operated either by or on behalf of charities, with the collection and maintenance of the banks taken on by waste management organisations.

Collection schemes in workplaces, schools, etc. offer fundraising opportunities for these collectors and are often operated by specialist textile recycling organisations.

Treatment

In Scotland, once textiles and footwear have been collected from households, clothing banks or organisations running collection schemes, they will go to a company for sorting and/or grading. Some organisations will perform an initial sort of materials where they will separate clean material from dirty clothing and take out material that is not clearly re-usable (which will then be landfilled). Dirty clothing will often be washed to bring it up to the standards required for further processing and to ensure that some value is obtained from its sale. While this is an expensive process (that is generally outsourced), it is currently being done by a number of Scotland's recyclers as it ensures that the material is diverted from landfill. It is also a commercially viable activity for textile recyclers to undertake as there is still a net value for the material once it has been cleaned. Textiles will then be sold on to a larger organisation (with capacity and contacts for exporting), if it does not go direct to them when collected.

In general, primary sorting will establish three main routes for material⁹²:

- Good quality clothing and shoes will be exported for re-use in developing countries that rely on second hand clothing and in some cases sent to charities in the UK
- Damaged textiles may be processed for use as wiping cloths
- Other suitable materials will be graded for fibre reclamation and for insulation and filling applications

Larger organisations involved in textile recycling in Scotland will sort the textiles further into different grades of material. Large premises are required to undertake this task due to the amount of throughput and the space required to store material for trading. To be economically viable, an organisation looking to pick and sort material on a larger scale would need to collect around 100 tonnes per month. The vast majority of material coming out of these premises is exported to developing nations around the globe for re-use. Different grades of material will achieve different prices in the export market, where around £1,200/tonne is not an unrealistic value for clean, high quality materials such as white shirts and blouses.

Where low grades of material are identified in the sorting process, they are often sold for reprocessing into 'shoddy' (material that has been shredded or pulled into small fractions and fibres) for use in sound proofing, industrial insulation, etc. There are a small number of organisations based in the UK that can do this type of reprocessing.

Reprocessing of textiles for reworking into rags is done on a small scale basis in the UK, with material generally exported for this purpose. Some organisations have the in-house capabilities to process small amounts of cloth but some sources indicate that it is not economically viable to more than this. It is cheaper (including transport costs) to export the material for reprocessing and to buy it back for onwards sale as industrial wiping cloths.

Discussions with textile recycling organisations indicate that textiles passing through MRFs tend to end up in landfill rather than being recycled. Due to compaction and or general contamination with other waste, including food and kitchen waste, the textiles end up wet and damaged and cannot be recycled, either for re-use or for industrial rags (as the material for these also have to be of a certain standard).

The recycling rates that are highlighted in the next section are lower than those suggested through conversations with recycling organisations. For example, one Scottish company alone collect more than the figures shown, with almost all of the material being exported for re-use or recycled. This would suggest, therefore, that the amount of material being collected from schools, community groups and charity shops, etc. is not being counted within the waste data figures publically available. Given the volume of clothing and footwear that is sent to charity shops, etc and not put through any household collection system, the recycling rate for textiles is significantly higher than indicated in the waste data figures.

⁹² Textile Recycling Association www.textile-recycling.org.uk

Overview Of Carpet Recycling In Scotland/UK

The UK's trade association, Carpet Recycling UK, estimates that there are around 420,000 tonnes of carpet waste arisings in the UK each year⁹³. This equates to around 11% of residual waste in civic amenity sites. The carpet waste stream is made up of post consumer (94%), post industrial and post installation waste. Mixed synthetic carpets account for 59% of total arising, wool rich carpets make up 27% and carpet tiles account for 14% of arisings in the UK⁹⁴.

Carpet waste in the UK tends to be collected from households via civic amenity sites or bulky waste collections by local authorities. Post industrial and post installation waste will be generated by manufacturers and retailers/carpet fitters. Recent figures released by Carpet Recycling UK⁹⁵ indicate that, in 2011, 16.5% of all carpet waste in the UK was diverted from landfill; an increase on the 2010 figure of 10% diversion. 48% of this was reused or recycled and 52% was used for energy recovery. The remainder, however, ends up in landfill. With an estimated 4.2 tCO₂e savings for every tonne of carpet waste recycled, it presents a significant opportunity for Scotland, where there is little evidence of significant recycling taking place.

Different types of carpets are recycled in different ways due to the constituent parts. Thus the outlets for the recovered materials are also different. For example:

- Carpet tiles
 - Nylon recovery – for recycling back into yarns and used in new carpets
 - Bitumen backing recycled into roofing and road applications
 - Reuse – collected, cleaned and re-fitted in new locations
- Synthetic Carpet
 - Polypropylene recovery – this has been trialled on post consumer carpets but not on an industrial scale. The PP can be shredded, granulated and extruded into pellets and moulded into products such as plant pots and buckets
 - Nylon recovery – can be extruded and injection moulded into engineering plastics
 - Equestrian surfaces – shredded and mixed with rubber crumb and sand
- Wool rich carpets
 - Intact carpets for mulch mats (although some regulatory concerns)
 - Use in growing media as fertiliser – due to its high nitrogen content (some regulatory restrictions)
 - Non-woven products – fibres can be pulled and blended with other fibres for use in underlay and insulation products
- All carpet types
 - Energy from waste – particularly suitable due to its high calorific value. Carpet is shredded and made into fuel flock to replace coal in cement kilns

Carpet Recycling UK currently has 24 specialist carpet recyclers listed as members – eight are re-use specialists (mainly tiles) and 16 are recyclers and fuel flock producers. Only two members are located in Scotland and are involved primarily in the re-use of carpet tiles (Spruce Carpets, Glasgow and Clean Close, Dundee). Another company, based in Fife takes carpet waste from Fife Council. It is worth noting here that Fife Council is a member of Carpet Recycling UK. In addition, a company in the North East of England claims to recycle carpets from all areas of Scotland, including the Highlands.

There are evidently gaps in the Scottish collection and processing infrastructure for carpet waste. Indeed there is limited awareness of the ability to recycle carpet waste at all, both at household and local authority level. This presents an opportunity for Scotland, both in terms of diverting materials from landfill and in expanding processing infrastructure to deal with Scottish arisings.

⁹³ Carpet Recycling UK Presentation at Harrogate Flooring Show , 5th September 2011

⁹⁴ Carpet Recycling UK Presentation 'Annual Report and Vision' at 3rd Annual Conference, 6th July 2011

⁹⁵ Carpet Recycling UK Newsletter, February 2012

Industry wide action plan

The flooring industry has prepared an industry wide action plan that identifies the actions needed to reduce flooring waste in the UK and improve resource efficiency. It sets out actions for the flooring industry in general and includes specific action plans for five different flooring types, including broadloom carpet and carpet tiles. The Flooring Resource Efficiency Plan (2010), prepared in conjunction with a number of industry stakeholders, including BRE, CFA and CPA among others was jointly funded by BRE and WRAP. A framework has also been set out for a Flooring Sustainability Partnership (FSP) to drive the work forward and continue with the collaborative approach to reduce the amount of waste going to landfill. This highlights the importance of the issue among the flooring industry as a whole and as part of the wider construction industry, that has targets to meet as part of the Strategy for Sustainable Construction, published in 2008. The plan adopts the principles of the waste hierarchy for waste prevention i.e. prevention, reuse, recycle, recovery, disposal.

Some of the key challenges highlighted in the Flooring Resource Efficiency Plan include:

- Lack of robust data collection across the flooring sector on the quantities of waste produced and recycled
- Knowledge gap, and lack of dissemination of existing and potential end markets, for flooring waste in the UK
- Lack of sustainable economic instruments and mechanisms to support the recycling of flooring waste
- Provide awareness and easily understandable guidance for flooring waste producers
- Potential future Government legislative/policy changes on certain materials types restricted from being sent to landfill
- Need for the UK flooring industry to respond to the ever changing landscape of product standards and their impact on the sector and its approach to sustainability

Recycling Rates

Household

As mentioned previously, a significant volume of clothing and footwear is sent to charity shops, etc and not put through any household collection system. The recycling rates for textiles are, therefore, significantly higher than indicated in the waste data figures.

At present, only 10% of carpet waste in the UK is believed to be recycled⁹⁶. Applying this to estimated arisings of 31,397 tonnes in Scotland suggests 3,140 tonnes of carpets being recycled.

Footwear is estimated to have a low level of recycling at 5%⁹⁷. Applying this to estimated arisings of 10,926 tonnes suggests 546 tonnes of footwear being recycled.

In the absence of any evidence, an assumption has been made that 10% of the 19,302 tonnes of household textiles are recycled (1,930 tonnes) (this is made up of bed linen, towels etc. and is assumed to be disposed of as rags. This figure is estimated on the basis that household textiles are less likely to be recycled than clothing but greater than zero). It is recommended that further research is required in this area to establish a more robust figure for recycling.

No separate recycling rate is given for clothing in the Defra report. A total figure for collections for resale and recycling of clothing and textiles for the UK of 523,000 tonnes is provided in the report⁹⁸. This can be converted to a reuse/recycling percentage by taking the total UK consumption estimate of 2,226,000 tonnes and deducting the estimate of 310,000 tonnes stored by the consumer (1,916,000 tonnes estimated arisings). The estimated reuse/recycling rate is therefore 27.3% (523,000/1,916,000). Assuming the Scottish reuse/recycling performance is in line with UK levels then

⁹⁶ Carpet Recycling UK www.carpetrecyclinguk.com

⁹⁷ Maximising Reuse and Recycling of UK Clothing and Textiles EV0421: Appendix 1 – Technical Report, Oakdene Hollins commissioned by Defra, 2009, p.20

⁹⁸ Maximising Reuse and Recycling of UK Clothing and Textiles EV0421: Appendix 1 – Technical Report, Oakdene Hollins commissioned by Defra, 2009, p.31

the total clothing/footwear/household textiles and carpets reuse/recycling (household and C&I) is 46,456 tonnes (27.3% of 170,168). Deducting the amount of carpets (household and C&I) (3,140 tonnes + 1,742 tonnes), footwear (546 tonnes) and household textiles (1,930 tonnes) which is estimated to be recycled leaves 39,098 tonnes which can be assumed to be the level of clothes recycling (42.9% of total clothing arisings).

Total recycling of clothing, footwear, household textiles and carpets from the household waste stream is therefore estimated to be 44,714 tonnes.

Commercial & Industrial

As highlighted above, only 10% of carpet waste is thought to be recycled. Applying this to estimated arisings of 17,424 tonnes suggests 1,742 tonnes of carpets being recycled.

Total recycling

Total recycling from all streams is 46,456 tonnes (27.3% of arisings).

Pricing Trends

The high price of textiles (clothing and footwear) has prompted concerns over widespread theft of material from both textile banks and door-to-door collection bags, with some claiming that organised criminals are involved. In January 2011, the Minister for Civil Society initiated talks with the textile recycling industry, charities, regulatory bodies and the police to address the issue of bogus textile collections⁹⁹.

Monthly price movements for textiles are shown in the figure below:

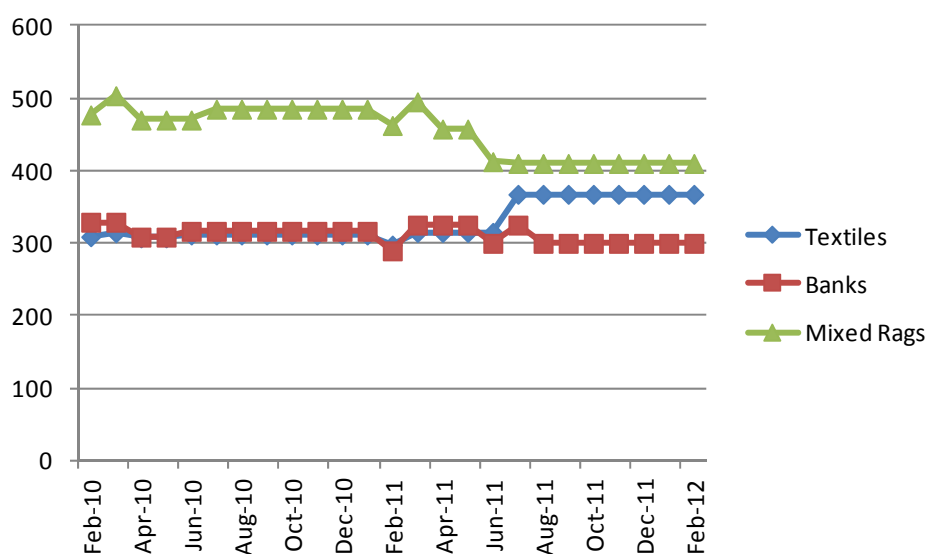


Figure 51: Textile pricing trends to February 2012²⁸

Sorted and graded textiles are capable of achieving higher prices than this in the export market.

The cost of disposing of carpet waste is generally competitive with landfill costs in any specific region. It is a relatively new sector of the waste management sector and costs may decrease in future as recycling levels increase and end markets for the materials develop further.

Good Practice Added Value Approaches

With regards to clothing and footwear, bedding, etc., the majority of textiles collected in Scotland, and indeed the UK, are exported for re-use in developing countries throughout the world. It is believed that

⁹⁹

www.letsrecycle.com/prices/textiles

around 80% of textiles from Scotland are exported for this purpose¹⁰⁰. There are limited examples of organisations adding value to the reprocessing or re-manufacture of textiles in the UK.

One organisation, however, is trying to address the recycling of corporate work wear that has lower recycling rates than other types of clothing in the UK. Worn Again works with large organisations to 'upcycle' their existing textiles waste into new products while developing and integrating closed loop textiles solutions for the future. In 2011, Worn Again announced that it was working with McDonalds to create the UK's first closed loop corporate uniform for 85,000 staff. The uniforms are being designed to ensure that they can be recycled into new uniforms at end of life with no waste going to landfill. In addition, in 2010, the company was commissioned by Eurostar to create bespoke bags for its train managers made from their disused uniforms. Around 98% of corporate garments in the UK end up in landfill¹⁰¹ but the high content of polyester in corporate wear makes it highly suitable for closed loop upcycling¹⁰².

There are other examples of chemical recycling of post consumer textiles in Japan by the Asahi Kasei Fibres where they recover fibres for polyester textiles for use in applications such as innerwear, outerwear, work uniforms, components and sportswear¹⁰³. There is no evidence, however, of this being used in the UK.

There are also good practice examples within the UK of organisations that incentivise the collection of textiles to encourage recycling from households and increased diversion from landfill. These include:

- **Recyclatex** – Recyclatex is essentially an accredited body, setup by the Textile Recycling Association, with a membership of specialist textile recyclers that conform to the highest quality and service delivery requirements of the scheme. Only organisations that can comply with its strict rules and conditions can become a member of the scheme. The body offers local authorities a comprehensive reclamation service covering all requirements from textile banks to doorstep collections. The scheme ensures that services are provided to a high standard and will be maintained even when an operator ceases trading¹⁰⁴
- **RecycleBank** – RecycleBank is a private reward and loyalty company that works with local authorities to incentivise recycling services. The organisation contracts with an authority and/or its waste contractor and collects data on household recycling collections. Points are awarded to individual households according to the quantity of recyclate collected. The householder can then convert these points into rewards in the form of vouchers to spend at a variety of retailers/service providers¹⁰⁵

With regards to carpet waste, there are numerous good practice examples of where recycling of carpet waste is creating significant cost savings for organisations as well as presenting new business opportunities. These include:

- **Penthouse Carpets** – one of the founding members of Carpet Recycling UK, Penthouse Carpets went from landfilling 140 tonnes of post-production carpet waste per year to having zero carpet waste to landfill in 2010, saving £20,000 in landfill costs¹⁰⁶. The company now makes its own brand of eco-friendly underlay using carpet by-products from the manufacturing process; it sends hard waste (with a jute backing applied) to 4Recycling for use in land reclamation projects; and soft waste (woven wool fibres prior to backing) is turned into underlay by Anglo Felts, a classic example of closed loop recycling

¹⁰⁰ Discussions with various textile recycling organisations

¹⁰¹ Centre for Remanufacturing and Reuse

¹⁰² www.wornagain.co.uk

¹⁰³ Maximising reuse and recycling of UK clothing and textiles, Oakdene Hollins for DEFRA, December 2009

¹⁰⁴ Further details can be found at <http://www.textile-recycling.org.uk/recyclatex.htm>

¹⁰⁵ Further details can be found at <http://www2.halton.gov.uk/content/newsroom/latestnews/1674866?a=5441>

¹⁰⁶ http://www.carpetrecyclinguk.com/downloads/penthouse_carpets_case_study.pdf

- 4Recycling, based in Leeds, is working with local retailers on a take-back service for old wool and synthetic carpets as well as off cuts from installation¹⁰⁷. Material is palletised and bulked up at the retailer for collection by 4Recycling, offering customers a guarantee that carpets are being recycled and not sent to landfill. This is currently being undertaken with The Floor Store in Leeds and Winder Carpets and Beds in Bradford

Issues And Barriers To Adding Value

There are a number of issues affecting the collection and reprocessing of textiles in Scotland. Some of these are:

- Textiles being collected by local authorities as part of their co-mingled collections – there is concern among the industry that this practice is becoming more widespread as councils seek ways to save money. Including textiles within comingled collections, however, means that material will get dirty and torn as it passes through the MRF, giving it less value and a higher probability of ending up in landfill
- Using industrial washing machines on-site is a way in which companies can add value to the textiles collected, with washing saving a significant amount from being landfilled. The cost is very high, however, and there are concerns about the quality of the material at the end of the process. There are also issues related to waste water that is regulated by SEPA
- With regards to householders, there is lack of awareness of the value of textiles, including lower quality textiles that may be slightly damaged. People are often reluctant to recycle 'poorer quality' textiles (e.g. worn out socks) but don't realise that they can still be recycled and do not need to be landfilled. Textile collectors do not advertise this fact, however, and so householders cannot be blamed for placing material in the residual waste stream. This should, however, be addressed to increase recycling rates throughout the sector
- There is concern among the industry that those working within the local authorities are not aware of best practice within the industry. Research being conducted is not circulated widely or consistently and so the people making decisions are often not aware of the issues relating to particular collection/processing options
- There is little awareness of the ability and capability to recycle carpet waste. There will be significant arisings within all CA Sites in Scotland and if these are not dealt with carefully i.e. kept dry, clean and separated then the ability to recover fibres and other materials diminishes. There is also very limited processing capability in Scotland, in spite of some regions within the UK (e.g. North West of England) having numerous sites with relatively advanced processing capabilities and technology developments (e.g. one company is developing a cryogenic separation technology to recover 95% of the constituent parts of carpet waste)
- Flooring contractors are not aware of how to get their carpet waste recycled and they also need to be aware that there is a cost associated with it (at a Carpet Recycling UK seminar in the North East of England in 2010, flooring contractors felt uneasy about paying to have the carpet waste recycled as they believed that this was essentially the raw material for another organisation's business)
- The logistics of transporting low value material (carpet waste) around the country is an issue that needs to be considered

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

¹⁰⁷

http://www.carpetrecyclinguk.com/downloads/cruk_retailer_case_study_sep2011_1.pdf

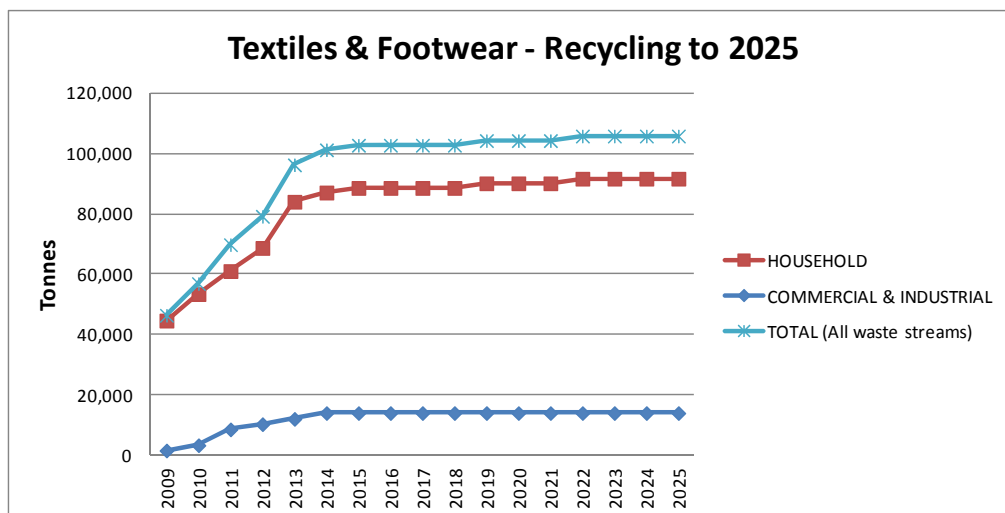


Figure 52: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

Most clothing and footwear development opportunities are related to collection rather than reprocessing. Anecdotal evidence suggests that reprocessing of textiles into wiping cloths and industrial rags is a low value business and Scotland cannot compete with lower cost economies such as Eastern Europe. In addition, fibre separation for use in other applications such as shoddy (which is a combination of fibres which have been separated from textiles and then compressed into items such as car door panels), while taking place in UK and Western Europe, would require large scale investment with little return in the short-medium term. Exporting textiles for re-use in developing countries is the most valuable aspect of the sector and comes highest in the waste hierarchy.

Given the importance of diverting household textiles from landfill, the options indicated below should be considered seriously. One of the most significant barriers to recycling within this area is a lack of awareness – of the value of textiles, the ability to recycle them (not simply reuse) and the carbon emissions that could be avoided by recycling them. Some options to consider for textile recycling include:

- Focus on improved information/education for householders and textiles stakeholders – this may encourage recycling of ALL textiles to divert more from landfill. As mentioned previously, people are often unaware of the ability to recycle textiles (rather than reuse), even those that are damaged or of poor quality. By educating householders then it may be possible to capture more clean material that can be recycled
- Engagement with local authorities to impart understanding of best practice in the treatment of textile waste – this will help decision makers understand the processes that are involved within the sector and the reasons for ensuring that textile waste is clean, dry and separated from other waste materials
- Further investigation as to the potential for fibre separation and respinning fibres in Scotland – anecdotal evidence suggests that this type of low value reprocessing is not commercially attractive for companies in Scotland but additional research to investigate this further could prove useful to understand the barriers and ways in which they might be overcome
- Investment in industrial washing / drying facilities (e.g. an industrial laundry) may add value to textiles that would otherwise be landfilled and will help to ensure that further treatment is possible. A caveat to investment in this type of activity, however, is that local authorities do not perceive this as an alternative to separate collections of textiles from households. Keeping textiles out of comingled collections and MRF operations is key to increasing recycling rates and meeting Scotland's targets. A relatively large scale washing/drying facility could be set up in a strategic location to serve Scotland's key textile collectors/recyclers. There are implications for waste water that would need to be overcome with SEPA, but with support it might be possible to achieve a viable commercial opportunity (in a similar way to St Jude's third sector operation in Edinburgh). For example, investment of £1 million would allow around 20 tonnes of textiles to be treated each week

(a labour intensive process), providing a turnover of around £450,000 per year, based on pricing to textile recyclers. This in itself, however, will not make the operation profitable. It will need to service local businesses, such as hotels, restaurants, nursing homes, etc. to bring the average income up to a level where the business was sustainable. Some basic calculations are provided here - these are based on an estimated average income that includes other commercial businesses, not simply textile recyclers. This indicates that such an opportunity would be worth pursuing further.

Throughput tonnes	1,040	
Charges (per tonne)	650	
		£
Investment	1,000,000	assumed for equipment, set up and initial operating costs
Income	676,000	
Labour	168,000	assume 10 staff
Operating costs	350,000	heat, energy, compressed air
Other overheads	100,000	
Total costs	618,000	
Annual gross profit	58,000	

(Note WRAP's project on textile collection guidance for local authorities, carried out in late 2011, may contribute to developing improved information and education across Scotland)

With regards to carpet recycling, there are a number of opportunities to consider. These relate to both awareness raising and improving/creating reprocessing capabilities in Scotland:

- Awareness raising events and/or communications to highlight to Scottish organisations the fact that carpets can be recycled. This could be conducted in association with Carpet Recycling UK that has facilitated seminars in other UK regions to bring together carpet recyclers, manufacturers, local authorities and other stakeholders to develop a better understanding of what can be done now, and by whom, and what could be done in the future
- Encourage local authorities to join Carpet Recycling UK. Fife Council is already a member and it has actively engaged with a local waste management company to collect and process all of its carpet waste. This step could catalyse the collection and processing of carpet waste in other local authority areas and encourage the material to be kept clean and dry within local bring sites
- Invest in companies that are looking to set up carpet recycling facilities in Scotland, either as an additional service or a new business venture. There are different degrees to which organisations could process carpet waste, which it is assumed would initially be a mechanical process, for example:
 - Collection/receipt and sorting for onward sale to other UK recyclers
 - Collection/receipt, sorting, shredding and baling for onward sale to other recyclers
 - Collection/receipt, sorting, shredding, baling and development of end market buyers (e.g. equestrian, filler, PP shred)

There may also be opportunities for companies to develop their own technologies or initiate trials for developing new outlets for the waste material.

The key to achieving a degree of success, however, is similar to the previous opportunity, where local authorities need to be proactive in keeping waste carpet material clean and dry within local CA sites and through bulky waste collections. If material is left to get dirty and contaminated then it is more likely to end up in landfill. Local authorities should also ensure, through their waste management contracts, that household and commercial carpet waste is treated and recycled where possible.

The type of equipment that would be needed to process carpet waste would include identification equipment, a splitter, a granulator, a shredder and a baler as well as a forklift truck to move volumes of carpet waste. Some basic calculations have been done to look at the viability of such an operation. These calculations are based on modest input volumes of clean carpet waste with around 80% of the

material being recycled for use in established end user markets e.g. equestrian surfaces, filler material, plastics recycling (PP).

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	
Tonnage input	600	960	1320	
Gate fees	39000	62400	85800	assume £65/T
Capital equipment	25000	25000	25000	assumes costs spread over 3 years
Rent/rates	18000	18000	18000	
Operator costs	36000	48000	60000	assume 3 in year 1, 4 in year 2 and 5 in year 3
Overheads	15000	15000	15000	
	<u>-55000</u>	<u>-43600</u>	<u>-32200</u>	
Material sale	65400	104640	143880	assume 60% equestrian, 10% PP shred, 10% filler
Landfill costs	9600	15360	21120	assume 20% landfill @ £80/T
	<u>800</u>	<u>45680</u>	<u>90560</u>	

Figure 53: Carpet recycling facility costings

Refused Derived Fuel (RDF) is an additional option for carpet waste that cannot be recycled and would otherwise go to landfill (for example, around 20% in an operation such as that described above). While gate fees would be applied, they would be lower than landfill costs. In addition, the residual material has a high calorific value and low enough chlorine levels to be suitable for this process, which is more sustainable than landfill. It should be emphasised, however, that this is not an alternative to recycling; it is a last resort for material that cannot be recycled for any other use.

With regards to the above costings, it should be noted that transportation costs to move material to end user markets is not included within this calculation. It also assumes modest volumes of throughput, which would be feasible for an existing waste management operation to include within its service offering. There would be the potential for a number of such facilities to be set up in different locations throughout Scotland in the short-medium term, with potential longer term investment in developing end use markets and applications.

The basic calculations indicates that a carpet recycling operation, reprocessing modest volumes of material and selling into UK end user markets, could present a viable business opportunity in Scotland. It would provide added value reprocessing in Scotland and divert carpet waste (a material previously regarded as non-recyclable) from landfill.

5.9 WEEE

There are currently 35 authorised treatment facilities for WEEE in Scotland. Those within the industry believe that there is sufficient capacity in Scotland to treat and recycle all the WEEE arising in the country. At present, however, due to the high level of exports from Scotland and product being sent to England for treatment, there is insufficient material being brought into existing facilities for recycling. Plants in Scotland have significant capabilities to treat WEEE at end of life, either in re-use or by recycling the constituent parts of the equipment. Some organisations are actively importing WEEE from England to safeguard Scottish jobs and feed existing plants.

A number of resources are successfully recovered from WEEE including plastics, metal, glass, cable, etc. There are established markets for the onward sale of these materials. ZWS could actively support existing organisations to expand their capabilities to recover and/or recycle more materials from WEEE here in Scotland (e.g. WEEE plastics, valuable metals). This might attract additional UK wide WEEE to Scotland and divert more WEEE from export markets.

Operators in the industry are concerned about the volume of illegal exports of WEEE and those not treating products with a duty of care at end of life. This is creating a negative image of the WEEE recycling sector while it is working hard to divert as much material as possible from landfill. There is also a great deal of concern regarding the lack of awareness amongst the general public about the regulations governing the sector and the capabilities available in Scotland to add value to these resources, either in reuse or recycling. Education and awareness raising is needed to ensure that householders in particular have enough knowledge to enable them to dispose of WEEE appropriately.

There are four key pieces of legislation that impact on the way electrical and electronic equipment is treated in the UK at 'end of life'. These are:

- The Waste Electrical and Electronic Equipment Regulations 2006 (WEEE Regulations)
- Environmental Permitting (England and Wales) Regulations 2010
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2006 (RoHS Regulations)
- Transfrontier Shipment of Waste Regulations 2007

The industry in Scotland widely believes that there is sufficient capacity to treat the WEEE arising here. There is concern, however, that a vast proportion of WEEE is being exported (both legally and illegally), leaving WEEE recyclers in Scotland importing WEEE from England and Ireland to feed their plants. Illegal exports of WEEE are investigated by organisations such as SEPA to prevent broken and untested items being passed off as fit for purpose to countries such as Ghana and Nigeria. Legal exports, however, tend to be driven by the prices that can be achieved in the export market.

Current Arisings By Source

Household

The recycling rates for assessing compliance under the WEEE producer responsibility legislation are calculated on the basis of the WEEE received for treatment compared to the average tonnes of electrical and electronic equipment placed on the market in the previous two years. The latter is taken as a proxy for WEEE arisings, even though there is not a perfect correlation between new sales of EEE and WEEE entering the waste stream. Based on this principle we can calculate the annual average WEEE placed on the market (split by household and non-household) using data published by the Environment Agency¹⁰⁸ (UK EEE data reports).

The total HH EEE placed on the market in the UK in 2009 was 1,220,348 tonnes. The equivalent figure for 2010 was 1,206,246 tonnes. The associated estimate of average annual HH WEEE arisings was 1,213,297 tonnes. The estimate can be presented at a Scottish level by using number of dwellings as a

¹⁰⁸ WEEE UK data reports, Environment Agency - <http://www.environment-agency.gov.uk/business/topics/waste/111016.aspx>

proxy (Scotland having 9.11% of total UK dwellings¹⁰⁹). This results in an estimate of HH WEEE arisings for Scotland of 110,531 tonnes.

Commercial & Industrial

The total Non-HH EEE placed on the market in the UK in 2009 was 326,217 tonnes. The equivalent figure for 2010 was 328,329 tonnes. The associated estimate of average annual Non-HH WEEE arisings was 327,273 tonnes. The estimate can be presented at a Scottish level by using total employment as a proxy (Scotland having 8.80% of UK total employment)²². This results in an estimate of Non-HH WEEE arisings for Scotland of 28,800 tonnes.

Construction & Demolition

It is assumed that there are not significant quantities of WEEE arising from this waste stream (where this does occur, e.g. used power tools, this is assumed to be captured in the non-household WEEE allocated to the C&I waste stream).

Total arisings of WEEE

Total arisings of WEEE (for household, commercial and industrial waste streams) can be estimated at 139,331 tonnes.

Current Collection And Treatment

The organisations that have legal obligations under the WEEE Regulations are producers of EEE, distributors of EEE, operators of Approved Authorised Treatment Facilities (AATFs) and operators of reprocessing operations. Other organisations such as local authorities, charities and household users of EEE, while not obligated under the Regulations are encouraged to play their part when discarding waste or when looking at reuse and refurbishment of equipment.

Household WEEE is dealt with through Producer Compliance Schemes¹¹⁰ (PCSs) and the collection of waste from Designated Collection Facilities (DCFs)¹¹¹. In addition, retailers/distributors of EEE for household use in the UK have a take-back obligation under the WEEE Regulations, and so must offer adequate facilities for consumers to return their WEEE or by offering in-store take-back services when they sell a new product that is of a similar type.

For non-household WEEE, however, there are different arrangements, which are more closely linked to the relationship between the producer and the user. Non-household WEEE must be collected directly from the user either by the obligated producer or their compliance scheme, instead of through a collection facility or a distributor. A producer (or their compliance scheme) will be contacted at 'end of life' to collect WEEE directly from the user, regardless of whether or not the units are being replaced (for goods put on the market after 13th August 2005). WEEE from goods that were put on the market before 13th August 2005, when being replaced with similar items, however, must be collected by the producer replacing the items regardless of who supplied them. In addition, producers are allowed to make alternative arrangements with users at the time the sales contract is being negotiated to pass on the obligations to the customer at 'end of life'.

The value chain for WEEE is shown overleaf.

¹⁰⁹ Table 7.1 – Stock of dwellings (2009 data), Regional Trends Online Tables – Regional Statistics, Housing, Office for National Statistics

¹¹⁰ Producer Compliance Schemes offer administrative and practical services to producer members. They help producers discharge their obligations under the WEEE Regulations

¹¹¹ Local Authorities can have their civic amenity and bulky waste sites registered as Designated Collection Facilities to support the separate collection of WEEE at their sites. The cost of collecting, treating and recycling any household WEEE that passes through the DCF is the responsibility of the PCS

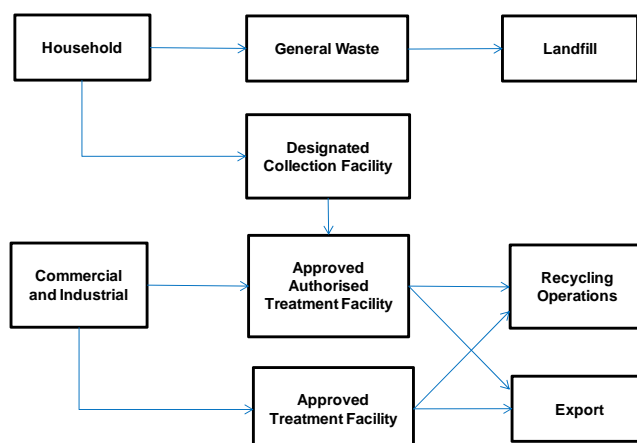


Figure 54: Value chain for WEEE

If an organisation wants to treat WEEE then it must be an Authorised Treatment Facility (ATF), have an appropriate waste management license, Pollution, Prevention and Control (PPC) authorisation or an appropriate exemption. ATF's must meet the treatment requirements for separately collected WEEE, which are laid out in the Waste Management Licensing Regulations 1994¹¹² (as amended by the WEEE Management Licensing Regulations 1996). WEEE must also be treated in accordance with the guidance on best available treatment, recovery and recycling techniques¹¹³ (BATRRT).

WEEE can be treated by any ATF. Only Approved ATFs (AATFs) or Approved Exporters (AEs), however, can issue the evidence that compliance schemes need to show that WEEE has been treated to the required standard. Currently, there are 35 AATFs approved by SEPA operating in Scotland and 10 Approved Exporters¹¹⁴. Some AATFs collect WEEE for export, either via ports in England or through EAs in Scotland. Other organisations, however, have invested in recycling facilities to treat small and/or large WEEE and recycle the constituent parts of the products.

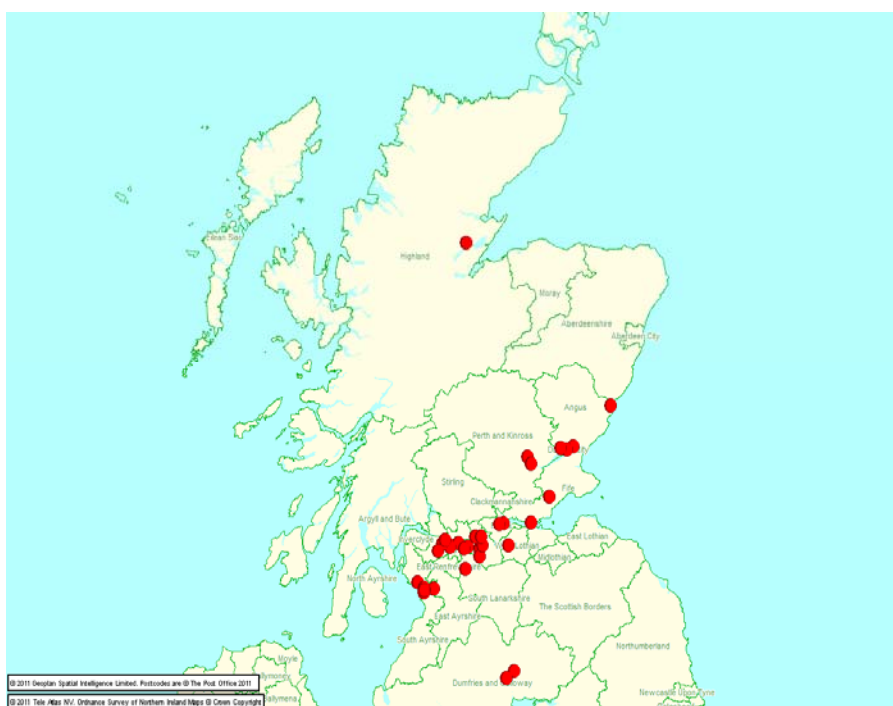


Figure 55: Location of WEEE AATFs in Scotland

¹¹² <http://www.legislation.gov.uk/ukxi/1994/1056/contents/made>

¹¹³ <http://www.defra.gov.uk/environment/waste/producer/electrical/documents/weee-batrrt-guidance.pdf>

¹¹⁴ <http://www.sepa.org.uk/waste/waste-regulations/producer-responsibility/weee/public-register.aspx>

If more WEEE was available for recycling in Scotland, rather than being exported, then additional valuable materials could be recovered to further processing. Companies have identified that there are established markets for the majority of materials streams from WEEE. For example, there is an established supply chain in the UK with a number of companies that are extracting high value metals from WEEE components. However plastics were identified as a problem material stream that is difficult to find recovery and recycling routes for.

Recycling Rates

Household

Total household waste electrical and electronic equipment collected in the UK (for 2009) was 454,283 tonnes¹¹⁵. This can be adjusted to a Scottish level by using stock of dwellings as a proxy (9.11%)¹⁰⁹. This indicates that WEEE collected in Scotland was around 41,385 tonnes per annum.

As a cross-check, a total of 34,169 tonnes of WEEE was recycled from the Scottish local authority municipal waste stream in 2009/10¹¹⁶, consisting of:

- Fridges and freezers – 7,913 tonnes
- Large domestic appliances – 7,629 tonnes
- Small domestic appliances – 11,308 tonnes
- Cathode ray tubes – 7,256 tonnes
- Fluorescent tubes – 63 tonnes

This does not include the WEEE collected as part of distributor take-back schemes (e.g. where a product such as a washing machine is collected at the same time a new one is delivered). In the national statistics this source accounts for around 10% of total household WEEE collected, indicating that the total estimate for Scotland of 41,385 tonnes is reasonably robust. Compared to the estimated household WEEE arisings of 110,531 tonnes this represents a recycling rate of 37.4%.

Commercial and Industrial

UK data for non-household WEEE suggests recycling of 14,844 tonnes. This can be adjusted to a Scottish level using the proportion of UK total employment (8.80%)²². This suggests a C&I WEEE recycling level in Scotland of 1,306 tonnes. Comparing this to estimated arisings of 28,800 tonnes suggests a WEEE C&I recycling rate of 4.5%.

Total recycling

Total recycling of WEEE is estimated to be 42,691 tonnes, suggesting an overall recycling rate of 30.6%.

Pricing Trends

The WEEE resource stream consists of a number of different categories with very different material composition. There is, therefore, a lack of pricing trend information for this resource stream.

Good Practice Added Value Approaches

Over and above the work carried out by compliance schemes in the UK, there are some examples of good practice carried out by organisations recycling WEEE. For example:

- Sims Recycling Solutions, which has capacity in Europe to process over 300,000 tonnes of WEEE each year. Linked to this capability is a dedicated plastics recycling centre that has a capacity of around 70,000 tonnes per annum.
- William Tracy has recently announced a partnership with Sunersol Waste Management for the recycling of all WEEE collected in Scotland. Sunersol have a 100% UK reuse model for WEEE through its Electrofarm division and ensures that all material treated at its UK recycling facilities is

¹¹⁵ WEEE UK data reports, Environment Agency - <http://www.environment-agency.gov.uk/business/topics/waste/111016.aspx>

¹¹⁶ Waste Data Digest 11: Data Tables 2009-2010, SEPA

either reused for the UK market or pre-treated before sending to its recycling facilities for full recovery. The company claims to provide total closed loop recycling. Its Electrofarm division is the UK first national company to re-sell used electrical equipment back into the UK market. All products sold have a full warranty and are certified as being market standard before sale.

- Blue Sky Plastic Recycling Ltd claims to be the “UK’s first WEEE plastic recycling and processing plant”. It has built a state of the art plant to produce different streams of recovered plastics from WEEE plastics waste stream. The output material is multicoloured streams of polypropylene, ABS and polystyrene.

Issues and barriers to adding value

There are a number of issues to highlight with regards to the WEEE recycling sector in Scotland:

- Legitimate businesses are concerned about the amount of WEEE exported from Scotland and from the rest of the UK. This decreases the volumes of WEEE available for recycling in Scotland
- Based on feedback from industrial sources:
 - There is a perceived lack of support for the commercial WEEE recycling sector with regards to capital funding and enforcement of regulation
 - The number of illegal operations and exports from Scotland is a concern to businesses operating in the sector
- Some products cannot be sold back into the market due to confidentiality issues e.g. reuse of computers and laptop
- Lack of communication with and education to households and business about the value of WEEE recycling
- Some existing collection systems (e.g. some CA sites) undermine the reuse and recycling potential of WEEE by having open skips into which equipment is thrown, broken and crushed

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

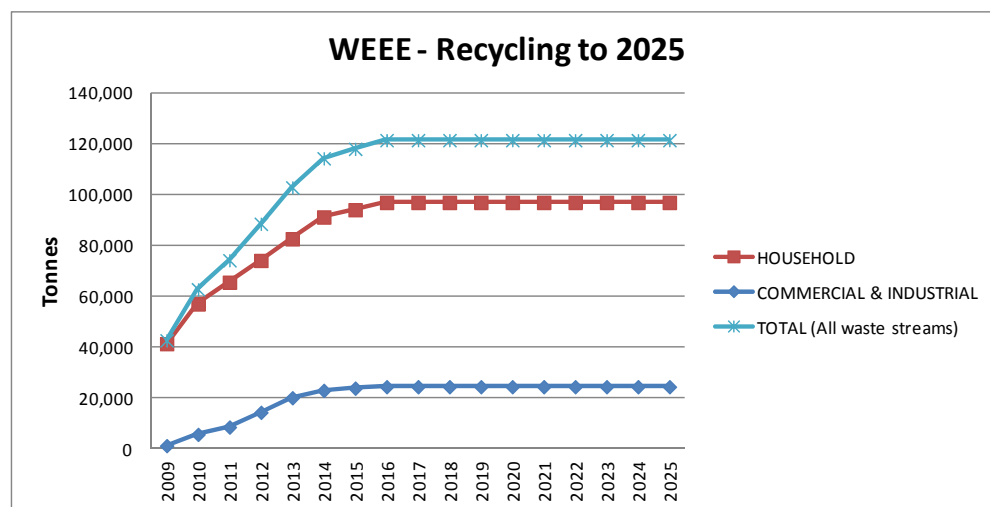


Figure 56: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

Opportunities to consider within this sector include:

- Develop communications programmes with industry to ensure the general public are aware of regulations surrounding WEEE and the ability and capability of reusing and recycling products at end of life
- Recovery and reprocessing of WEEE plastics, thus addressing the material highlighted as a concern by the industry. Evidence from existing facilities suggests a plant of 12,000 tonnes per annum can be a viable operation. Such a plant would require an initial investment in equipment in excess of £2M and it is estimated it would take several years to pay back this investment. Existing UK players considered it was not appropriate to provide more detailed commercial information.

5.10 Wood

The assumptions used for this report estimates arisings at 330,100 tonnes in 2009. Industry feedback has suggested that, even with a landfill ban, a maximum of 250,000 could be recovered. There is already a high recycling/recovery rate for wood with competition to obtain the material resulting in decreasing gate fees. Wood panel producers in Scotland have voiced concern about future supply of the material resulting from increased demand from biomass facilities. Demand for recovered wood in Scotland (excluding co-firing) is anticipated to increase to 1.6 million tonnes by 2017. This is compared to projected arisings (based on the estimate above) of 0.33 million tonnes in the same year.

The use of biomass will count as recovery and not contribute to recycling targets. The scope for intervention is therefore in encouraging segregation of waste wood to enable high grade wood to be recycled and not used in biomass facilities. The development of a waste wood protocol (covering material for landscaping and panel board manufacture) by the Environment Agency may help drive the market demand for this to the point where it becomes more economically attractive to either source segregate different grades of wood or invest in automated sorting equipment. The availability of such a protocol will increase confidence in the market to specify standardised grades of material. Although developed by the Environment Agency, SEPA are corresponding members on the Technical Advisory Group.

Current Arisings By Source

Household

Total household waste arisings in Scotland, for 2009, were 2,818,422 tonnes¹⁷. Wood represents 2.8% of these arisings¹⁹. This equates to 78,916 tonnes. A further 2.3% of household waste is furniture (consisting of wooden furniture, soft furniture and kitchen units and worktops)¹⁹. If it is assumed that all the furniture is disposed of via the HWRC then the HWRC composition data can be used to remove the soft furnishings from the overall furniture figure. The composition of the remaining (non-soft furniture) furniture amount is estimated at 2.1% (consisting of wooden furniture and kitchen units and worktops). This adds a further 59,187 tonnes to household wood arisings, giving a total of 138,102 tonnes.

Commercial & Industrial

There is limited data on the arisings of waste wood from the C&I sector. A WRAP report on waste wood arisings¹¹⁷ suggests that the total for Scotland is 330,100 tonnes. The ratio of C&I to C&D arisings in this report is around 1:2.

Taking the estimated household arisings of 138,102 tonnes from the total of 330,100 tonnes leaves 191,998 tonnes. The above ratio of 1:2 suggests that the C&I waste arisings can be estimated at 63,999 tonnes.

Construction & Demolition

Again using the same reference source as above, and the 1:2 ratio of C&I to C&D (of the non-household waste wood arisings), then the estimated wood waste arisings from the C&D sector are 127,999 tonnes.

Total wood waste arisings

The total wood waste arisings, from all sources, in Scotland is estimated to be 330,100 tonnes. This can be compared with estimates from a 2009 Remade Scotland report¹¹⁸ which suggest arisings of wood waste (incl. moisture content) of 95,221 tonnes (household), 367,572 tonnes (C&I) and 290,000 tonnes (C&D). The total Scottish wood waste arisings estimated in this report is, therefore, 752,793

¹¹⁷ Wood waste market in the UK, Table: Regional analysis by wood waste stream, p.2, WRAP, 2009

¹¹⁸ 'Arisings of Waste Wood from the Scottish Waste Management Industry for the Development of the Biomass Industry', Table 1, Remade Scotland (for the Scottish Government), May 2009

tonnes – more than double the estimate used in the model. This highlights significant uncertainty of arisings for this resource stream, particularly from C&I sources.

Current Collection And Treatment

Wood is collected by a number of commercial waste management contractors. A significant proportion of these materials are segregated from mixed waste at materials recycling facilities.

The recovered wood value chain can be presented as follows¹¹⁹:

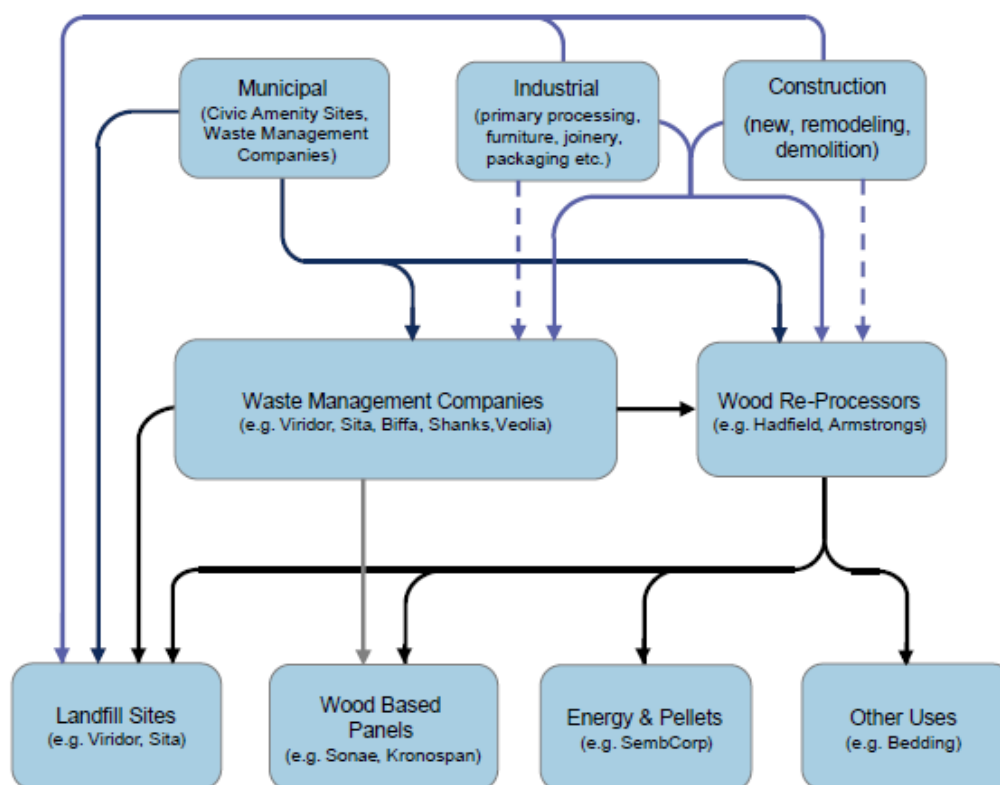


Figure 57: Recovered Wood Value Chain

The major wood reprocessing operations in Scotland are:

- A W Jenkinson Woodwaste Ltd – supply partner for EON's 220,000 tonne per annum biomass plant in Lockerbie is collecting recovered wood (at no cost in late 2010) across Scotland
- Tracey Timber Recycling Ltd – processing 50,000 tonnes per annum from across Scotland, according to its website and supplying a range of applications including panel board manufacture, pathways and coverings, equine surfaces and biomass.
- Harper Contracts – wood collection and manufacture of secondary products (e.g. arena coverings)
- Timberpak Scotland – processes wood waste at its facility in Barony in Ayrshire.
- Norbord – manufacture of medium density fibreboard

Recycling Rates

Household

A total of 78,385 tonnes of wood was recycled from the Scottish local authority municipal waste stream in 2009/10²⁵. This consisted of:

- Wood – 71,995 tonnes
- Chipboard and MDF – 4,239 tonnes
- Composite wood – 2,151 tonnes

¹¹⁹ Wood Waste Market in the UK, WRAP report prepared by Poyry and Oxford Economics, August 2009

Data are not available to separately identify the proportion of wood recycling from household sources. An estimate can, however, be made by assuming that wood is collected at the same rate between household and non-household sources. Household arisings represent 88.2% of local authority collected municipal waste²⁶. It can therefore be estimated that 69,136 tonnes of wood was recycled from households (56.8% of arisings).

Commercial & Industrial

Recycling of wood from the commercial waste stream is estimated to be 31%¹²⁰. Recycling of wood from the industrial waste stream is estimated to be 83%¹²⁰. An average recycling rate of 44% is assumed to reflect that the commercial sector is larger than the industrial sector (the Scottish economy has a 'service' element of around 74%¹²¹). Using the previously derived arisings figure of 63,999 tonnes, this suggests that 28,160 tonnes of wood waste are recycled from the C&I waste stream.

Construction & Demolition

Recycling of wood from the construction and demolition waste stream is estimated to be 72%³⁴. Using the previously derived arisings figure of 127,999 tonnes, this suggests that 92,159 tonnes of wood waste are recycled from the construction and demolition waste stream.

Total wood recycling

Combining wood waste recycled from all of the above waste streams provides a total recycling figure of 189,455 tonnes (57.4% of total arisings). Anecdotal evidence from an industry source suggested that around 200,000 tonnes per annum is currently recycled, which is consistent with the figure estimated here.

Pricing Trends

Recent gate fees for wood are as follows:

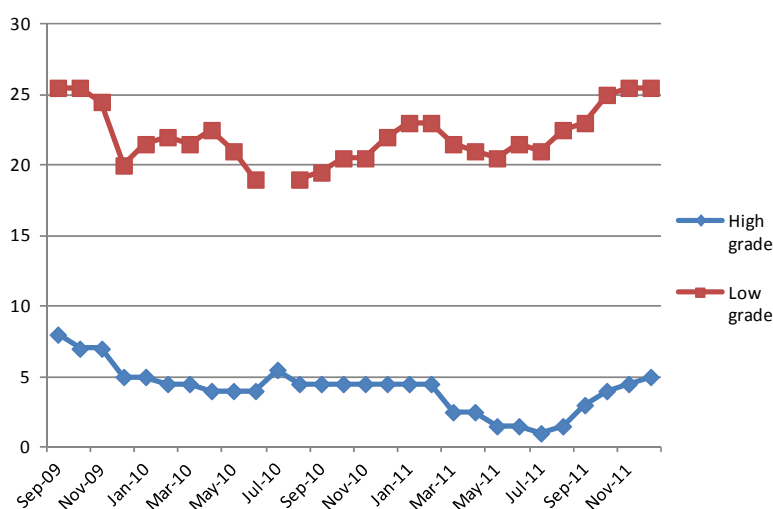


Figure 58: Gate Fee Trends – Wood²⁸

The reducing gate fee, especially for high grade material is consistent with the increasing market demand, as shown above.

Good Practice Added Value Approaches

Potentially attractive examples of good practice include:

¹²⁰ *Economic Assessment of the Zero Waste Plan for Scotland, Table 37: Reuse, Recycling and Recovery Rates for Commercial and Industrial Waste Streams, p.89 Zero Waste Scotland, 2011*

¹²¹ *Structure of the Scottish economy* - <http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Q/pno/2>

- Developing a secondary commodity market for trading wood, an initiative under development at The European Pathway to Zero Waste (EPOW) (similar to the London Metals Exchange in concept)

Issues And Barriers To Adding Value

As indicated above the market demand for wood is strong, driven in particular by the demand of biomass energy plants. This is underpinning a viable market where gate fees are becoming unnecessary to support business transactions.

A recent report projected that the Scottish demand for recovered wood (excluding co-firing) would increase by 1 million tonnes by 2017 (see figure below)

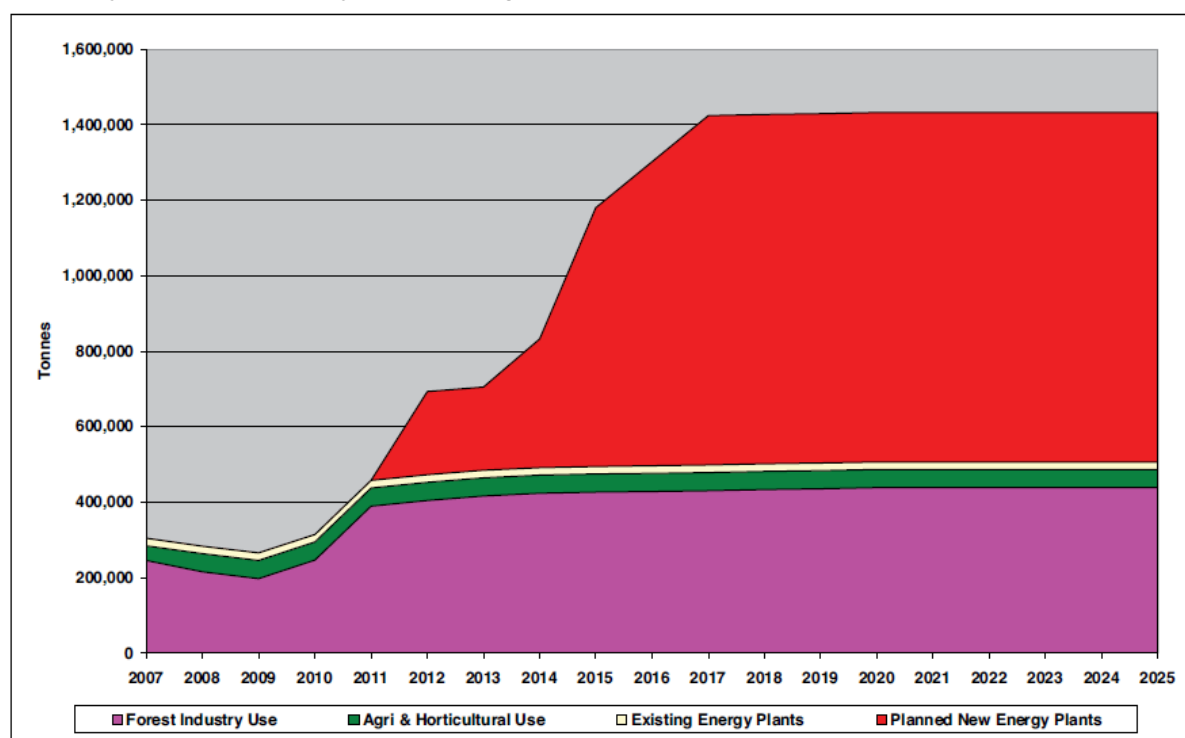


Figure 59: Projected Usage of, & demand for recovered wood in Scotland 2007 to 2025, excluding any used for co-firing¹²²

As a result the biomass energy market is attractive to the waste wood collection sector and is therefore a barrier to recycling. Current developments include the 50 MW biomass combined heat and power plant being built by RWE at the Tullis Russell paper plant in Markinch in Fife. If the Tullis Russell biomass plant runs at capacity, it would require 400,000 t/a wood fuel when fully commissioned in 2013¹²³. If all this tonnage was waste wood, this project could potentially consume the entire Scottish market for waste wood. What proportion of this will be forestry/sawmill co-product is not known but biomass buyers tend to prefer clean waste wood with its higher calorific values and lower moisture content.

Projections To 2025

The figure below shows the projected recycling (by weight) to 2025, by source:

¹²² Wood fibre availability and demand in Britain 2007 to 2025, John Clegg Consulting (for ConFor, UKFPA and WPIF), March 2010, p.37

¹²³ <http://www.letsrecycle.com/news/latest-news/wood/waste-wood-silos-for-biomass-plant-take-shape>

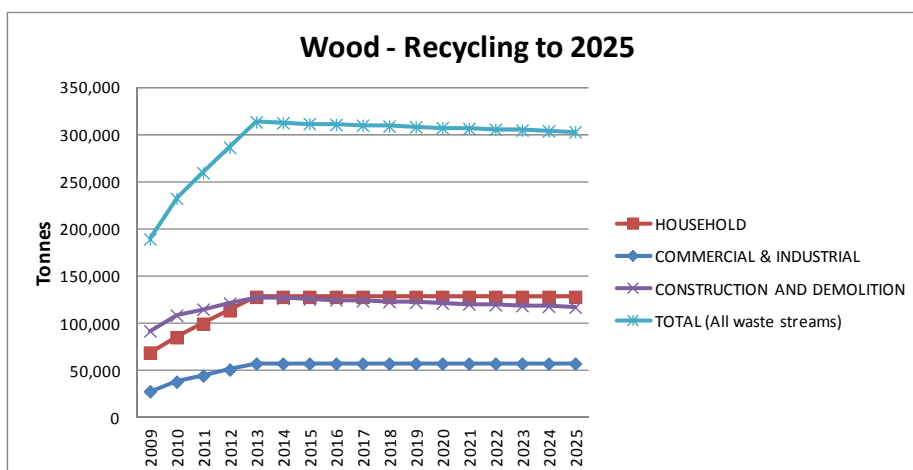


Figure 60: Projected recycling (by weight) to 2025, by source

Potential Opportunities for Scotland

The key issue is to ensure that recycling of waste wood is maximised with low grade wood only used for biomass. The waste wood quality protocol¹²⁴ will provide a mechanism to promote the demand for high grade waste wood from the panel board and landscaping industries. This, in turn, should incentivise waste wood collectors to encourage their customers to source segregate through the reduction in gate fee for high grade wood. Although this protocol is being developed by the Environment Agency there is SEPA representation on the Technical Advisory Group and it will be applicable to the market and suppliers in Scotland.

¹²⁴

PAS 111:2012, published by WRAP, April 2012

5.11 Summary – Identified Economic Opportunities to Increase Recycling Capacity

Based on the work carried out in this study, the options to increase the recycling capacity in Scotland can be summarised as follows:

■ Equipment for washing/drying textiles

Investment in industrial washing / drying facilities (e.g. an industrial laundry) may add value to textiles that would otherwise be landfilled and will help to ensure that further treatment is possible. This could be in the form of a grant scheme or loan funding that is focussed on improving the quality of material output, increasing the recyclability of the material and ensuring that it is diverted from landfill. A caveat to investment in this type of activity, however, is that local authorities do not perceive this as an alternative to separate collections of textiles from households. Keeping textiles out of comingled collections and MRF operations is key to increasing recycling rates and meeting Scotland's targets. A relatively large scale washing/drying facility could be set up in a strategic location to serve Scotland's key textile collectors/recyclers. There are implications for waste water that would need to be overcome with SEPA, but with support it might be possible to achieve a viable commercial opportunity (in a similar way to St Jude's third sector operation in Edinburgh). For example, investment of £1 million would allow around 20 tonnes of textiles to be treated each week (a labour intensive process), providing a turnover of around £450,000 per year, based on pricing to textile recyclers. This in itself, however, will not make the operation profitable. It will need to service local businesses, such as hotels, restaurants, nursing homes, etc. to bring the average income up to a level where the business was sustainable.

■ Carpet recycling plant

Invest in companies that are looking to set up carpet recycling facilities in Scotland, either as an additional service or a new business venture. There are different degrees to which organisations could process carpet waste, which it is assumed would initially be a mechanical process, for example:

- Collection/receipt and sorting for onward sale to other UK recyclers
- Collection/receipt, sorting, shredding and baling for onward sale to other recyclers
- Collection/receipt, sorting, shredding, baling and development of end market buyers (e.g. equestrian, filler, PP shred)

There may also be opportunities for companies to develop their own technologies or initiate trials for developing new outlets for the waste material for which funding and support could be made available from Zero Waste Scotland in the longer term.

The key to achieving a degree of success, however, is related to the previous suggestion, where local authorities need to be proactive in keeping waste carpet material clean and dry within local CA sites and through bulky waste collections. If material is left to get dirty and contaminated then it is more likely to end up in landfill. Local authorities should also ensure, through their waste management contracts, that carpet waste is treated and recycled where possible.

The type of equipment that would be needed to process carpet waste would include identification equipment, a granulator, a shredder and a baler as well as a forklift truck to move volumes of carpet waste. Basic calculations indicate that a carpet recycling operation, reprocessing modest volumes of material and selling into UK end user markets, could present a viable business opportunity in Scotland. It would provide added value reprocessing in Scotland and divert carpet waste (a material previously regarded as non-recyclable) from landfill.

■ Equipment to increase the quality of material for recycling (paper and board)

Investment in equipment to increase the quality of the output from their processes presents an opportunity to make otherwise low quality material fit for recycling/reprocessing and to ensure it is diverted from landfill. There are ways in which paper recyclers can process low quality material that would make it suitable for use in UK mills, rather than being exported or sent to landfill. A cleaning/polishing plant for paper and board would cost around £500,000 to set up but would have the capacity to divert around 30-40,000 tonnes of dirty/low quality paper from landfill each year.

■ Equipment for aluminium can crushing at source

The introduction of can crushers for 'on the go' and commercial arisings is a potential opportunity for Scotland – discussions with Alupro indicate that can crushers positioned in strategic locations (e.g. beaches, shopping centres, sporting events) can increase the capture rate of beverage cans. In fact, as already highlighted, a trial by Bournemouth Council in 2009 diverted six tonnes of metal from landfill in a ten week period by installing can crushers on the sea front. Each crusher holds 700 cans and costs around £800. The cost will inevitably be a barrier to many organisations introducing them as part of their service but there are a number of benefits from investment, including:

- Reduced volume of cans
- Increased interest levels in recycling
- Better quality (i.e. only cans being put in the bin)
- Increased value of the recyclate
- Lower collection costs

We estimate that at least 1 tonnes per annum could be collected in each can crusher, if placed in strategic locations.

■ Equipment to process WEEE plastics

Recovery and reprocessing of WEEE plastics, thus addressing the material highlighted as a concern by the industry. Evidence from existing facilities suggests a plant of 12,000 tonnes per annum can be a viable operation. Such a plant would require an initial investment in equipment in excess of £2M and it is estimated it would take several years to pay back this investment. Existing UK players considered it was not appropriate to provide more detailed commercial information

■ Facilities for cleaning and drying of mixed plastic film

This facility should use the WRAP report entitled "Cleaning and Recycling of Residual Mixed Plastic Film"⁴⁶ as a guide. This report identifies that a facility with an output of 7,000 tonnes should be viable, based on a £2.27 million investment in facilities and an end product price of £450 as shown in the basic financial model opposite. The expected growth in arisings in Scotland, as shown in Figure 33 suggests that almost three plants are required to deal with additional recycling requirements to 2025. The opportunity to process current arisings that are not suitable for existing recycling routes due to, for example, composition and contamination suggest that Scotland could support three of these plants at 7,000 tonne capacity

■ Plastic to oil refinery

This opportunity also addresses the problem of contaminated mixed plastic film. It is therefore an alternative to the above mixed plastic drying, cleaning and recycling facility. A number of proprietary technologies have been developed to manufacture oil based products from mixed plastics. There are four basic approaches, as follows:

- Plastic to fuels (P2F), including diesel, petrol and others from the refining family
- Plastics to refinery feeds (P2RF). This typically includes materials like:

- Pseudo crude oil for mixing with natural crude and running through the entire refining process
- Production of materials targeted on individual refining processes e.g. wax for use in steam crackers
- Pure monomers e.g. ethylene and propylene, terephthalic acid (from xylene)
- Plastic to other valuable bulk petro-chemicals. This includes the potential for cracking polymers to provide feedstock which will lead to materials such as solid waxes and industrial solvents (both aromatics and aliphatics)
- Plastics to functional specialities. Here the cracked polymer would be converted to specialities such as lubricants, surfactants, fatty acids, or functional intermediates used in their manufacture

There are a number of potential advantages and disadvantages to each approach, dependent on a number of factors including the composition of waste arisings and the development strategies of the investor (e.g. focusing on high or low added value markets).

The manufacture of biodiesel from low grade mixed waste plastic is currently the approach that is gaining most attention in the UK. SITA UK has recently secured planning permission to build the first UK waste plastic to diesel facility in Bristol (a 6,000 tonnes per annum plant). It is expected to be the first of 10 plants established by SITA in the UK. These plants will use process technology Cynar Technology process technology that is based on liquefaction, pyrolysis and distillation of mixed waste plastic. It is claimed that the process will provide diesel suitable for commercial vehicles and it is expected that full scale plants will be profitable within five years of operation¹²⁵. This “plastics to oil” technology and the scale of operation are attractive for implementation in Scotland – with at least three plants being required to address expected future arisings. Information on the financial details involved in setting up and operating these plants are commercially confidential.

■ PVC recovery facility

Development of an independent PVC recovery operation, rather than one linked to a window profile manufacturer (of which there are none in Scotland), is a potential opportunity for Scotland. Evidence indicates that an investment of £1.5m in materials processing equipment is sufficient for a 5,000 tonne per annum PVC recycling plant. The output material will be secondary raw material for window profile manufacturers (value of around £400 to £450 per tonne) thus achieving closed loop recycling. A simple financial model indicates that it is a profitable operation, assuming it is working at full capacity. Future projections of additional PVC arisings from the C&D industry suggest that several plants of this size would be viable. However it is important to note that the UK plants that currently offer this service are all operating below capacity so there would be an expected level of competition for additional materials available.

The estimated increase in recycling capacity and potential economic impact (measured using turnover as a proxy) from the interventions proposed can be presented as follows¹²⁶:

¹²⁵ <http://www.cynarplc.com/news-display.asp?action=change&ID=56>

¹²⁶ Detailed assumptions on equipment costs, potential capacity and estimated economic impact are included in the detailed analysis of each priority resource stream. The expected annual turnover achieved by the new capacity is used to estimate the economic impact.

Intervention Option	Equipment Costs (£) per Facility	No of Plants	Potential Capacity (tonnes per annum)	Estimated Economic Impact (£ per annum)
Washing and Drying Textiles	£1,000,000	1	1,040	£676,000
Carpet Recycling Plant	£75,000	5	7,500	£1,305,000
Paper Finishing Plant	£500,000	1	40,000	2800000
Aluminium Can Crushing at Source	£800	700	700	595000
Establish WEEE Plastics Facility	£2,000,000	1	5,000	£2,250,000
Cleaning and Drying of Mixed Plastic Film	£2,270,000	2	14,000	£6,300,000
Plastic Refinery	£7,000,000	2	12,000	£4,200,000
PVC Recycling Facility	£1,500,000	1	12,000	£5,400,000
TOTAL			92,240	£23,526,000

Note: Economic impact is based on turnover of new businesses based on these facilities

Figure 61: Increased capacity and potential economic impact of shortlisted intervention options

Note that in addition to the economic impact there is an environmental benefit from diversion from landfill and/or the substitution of virgin materials with secondary raw materials.

Of course, as highlighted earlier in this report, it is important that relevant initiatives are catalysed to support materials collection, segregation and quality improvement activities and thus support these recycling infrastructure development opportunities.

6. Conclusions

Based on the work carried out in this study we conclude that:

- The availability of robust data on waste arisings from the C&I waste stream in Scotland is limited and this introduces a level of uncertainty into the baseline and projected results presented
- The use of composition analysis data to decompose SEPA data on household and C&D arisings may also introduce a degree of uncertainty into the figures calculated for this project
- Households and the commercial sector have the most significant increases in annual recycling to achieve by 2025 (511,000 tonnes and 330,000 tonnes respectively) to meet the defined targets. They should be the focus of intervention efforts (Note: the projected additional recycling from C&D sources amounts to 76,000 tonnes)
- Five of the priority resource streams; paper & board (40%), aluminium cans & foil (18%), wood (14%), WEEE (11%) and textiles and footwear (8%) account for over 90% of the total (carbon-based) additional annual recycling required, across all sources, by 2025
- For households, the main contributors (carbon-based) to additional recycling are paper & board (31%) and aluminium cans & foil (18%)
- For C&I, the main contributor (carbon-based) to additional recycling is paper & board (61%)
- For C&D, the main contributors (carbon-based) to additional recycling are wood (49%), paper & board (28%) and PVC (22%)
- Although the projections carried out for this model are to 2025, the impact of the Zero Waste Regulations and increasing landfill tax mean that the vast majority of increased recycling should take place by 2013 – 2014. This introduces an element of urgency to the task of ensuring the waste management infrastructure is in place to process the additional materials
- The collection and segregation strategies typically used for recyclables are causing difficulties in obtaining materials of sufficiently high quality for use in added value opportunities

Based on the evidence collated in this study there is a major need to enhance the quality of resources segregated from mixed waste collections. This requires an understanding of the needs of the secondary materials markets by those making decisions on collection strategies. If this is achieved there is potential to increase recycling levels significantly. These observations are consistent with:

- The views of key stakeholders in the UK recycling industry¹²⁷
- A recent report published by the European Environment Agency¹²⁸ that state the importance of improving the quality of recyclables to increase the value of the material
- Initiatives to increase collection of recyclable materials present a significant opportunity for the resource management industry in Scotland. This is identified by the recovery and recycling sector as a key issue and is obviously a pre-condition to the commercial success of any proposed reprocessing/recycling infrastructure
- The Zero Waste Regulations acknowledge that the quality of collected materials is an issue and seeks to address it by providing guidance that co-mingled collections must achieve similar levels of quality to that achieved via source segregated collections. The Scottish Government will have

¹²⁷ "Quality not quantity the key to better waste", *Packaging Week*, October 2011

¹²⁸ *Earnings, jobs and innovation: the role of recycling in a green economy*, European Environment Agency, 2011. ISBN 978-92-9213-234-7

powers to introduce mandatory minimum quality standards should quality of the output of materials from co-mingled collections remain an issue

- Education and awareness-raising, among households in particular, is seen within industry as key to increasing the levels of recycling in Scotland. Often people are unaware of the ability to recycle material such as WEEE and carpets and the capabilities that lie within Scotland (or UK wide) to do so. Awareness is also low with regards to the value of the materials that can be recycled and the impact that recycling has on resource availability for the future
- Eight potential opportunities for the development of new recycling infrastructure have been identified. These are:
 - Equipment for washing/drying textiles
 - Carpet recycling plant
 - Equipment to increase the quality of material for recycling (e.g. paper and board)
 - Equipment for aluminium can crushing at source
 - Equipment to process WEEE plastics
 - Facilities for cleaning and drying of mixed plastic film
 - Plastic to oil refinery
 - PVC recovery facility
- As already indicated the importance of increasing collection activity and improving the quality of materials collected was identified as an important factor across all resource streams. Specific initiatives that address these issues for individual resource streams include:
 - Communication and Engagement with Textiles Sector Stakeholders
 - Engagement with the Carpet Recycling Sector/Households
 - Launch the Metalmatters Initiative in Scotland
 - Communication Programme for WEEE Recycling

In addition, the need to further investigate glass collection systems was identified

- Obviously the recommended intervention options focus on some of the priority resource streams. Key observations for resource streams for which there are no intervention options recommended are:
 - Batteries: The collection infrastructure has been established and significant processing capacity is already established elsewhere. Scottish arisings are very small compared to the scale required for economic operation.
 - Polystyrene: This material is recognised as a problem due to the volumes arisings. Low weights make collection and handling commercially unattractive and no current options for viable business operation could be identified.
 - Wood: There is strong demand for energy from waste markets that is catalysing collection and handling capacity growth.
- The additional materials recycling capacity expected from implementing the eight interventions is 92,240 tonnes per annum
- An increase in sector turnover of £23,526,000 per annum is expected once full capacity is achieved



Zero Waste Scotland
Ground Floor, Moray House, Forthside Way,
Stirling FK8 1QZ.
E-mail: helpline@zerowastescotland.org.uk
Helpline freephone 0808 100 2040
www.zerowastescotland.org.uk

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