Short to Medium Term Material

Recycling Facilities Requirements in Scotland

Report to

Scottish Government

April 2009

Contract Reference:

Submitted to: Scottish Government

Date: April 2009

By: Remade Scotland
                       Caledonian Environment Centre
                       School of the Built and Natural Environment
                       Glasgow Caledonian University
                       5th Floor, Buchanan House
                       Cowcaddens Road
                       Glasgow G4 0BA
                       T: 0141 273 1416
                       F: 0141 273 1430

Contact: T: 0141 273 1404

                       The Caledonian Environment Centre is part of the School of
                       the Built and Natural Environment, Glasgow Caledonian
                       University and is supporting environmental research and
                       policy development in Scotland.

                       Glasgow Caledonian University is a registered Scottish
                       charity, number SC02147

Contents

Short to Medium Term Material Recycling Facility Requirements in Scotland

Executive Summary

The purpose of the study was to provide good quality data on the likely tonnage of co-mingled recyclate material arising, in the short and medium term arising from anticipated changes in the Local Authority recyclate collection schemes in Scotland.

The purpose was also to provide a regional analysis of the potential level of investment required to process this tonnage if new, best practice MRFs are to be developed.

The study was conducted in three phases:

1. Local Authority survey to identify Councils considering changing their main scheme to a co-mingled scheme.
2. Modelling of total yields from the identified additional co-mingled schemes to quantify the potential tonnage of material requiring processing at MRF.
3. Calculation of the capital and ongoing operational costs for the new MRF facilities potentially required on a regional basis using the Remade MRF model. This has been reported as a cost per tonne.

The key results were:

- 11 Scottish Councils have identified that they will or may move to full co-mingled schemes in the future.

- The Councils identified are located within 4 regions of Scotland: East of Scotland, West of Scotland, Highlands and Islands, and Tayside.

- Based on the modelling undertaken, between 93,000 tonnes and 163,000 tonnes of MRF processing capacity is required in Scotland if all the Councils identified move to full co-mingled dry recyclate collection schemes.

- The majority of the additional material collected (approximately 70%) would be generated in the West of Scotland and Tayside.

- Approximately 50% of the treatment capacity requirement identified would be for those Councils who indicated they will *definitely* be changing scheme type

- The 'cost per tonne' to process the collected material at MRFs varies significantly depending on the income generated from the processed material.

- Cost to process the material is predicted to be between £6 and £67/tonne depending on scheme yield and location

- The analysis identifies a capital requirement of circa £10.4 million

- This analysis identifies a possible 103 jobs that could be created in these new facilities

- At the highest present yield from the maximum number of households there would be a modelled increase in recyclate recovered of 74,637 tonnes – an increase in the modelled group of 84%

- Private sector partners could offer solutions through modification to existing working practices or development of new MRF's

- However with private sector is profit margins that may mean gate fees of £0 - £67 per tonne depending on yield and material revenue are to be expected

- Should local authorities wish to contract with the private sector for the provision of these facilities then contract specification will be a significant factor in attaining comparable gate fees.

1. Introduction

1.1. Background

It has been indicated by Local Authorities in Scotland that there may be some alteration of recycling schemes in order to meet Local Authority objectives. To this end it has been indicated that some authorities could move to a comingled dry recyclate collection.

This comingled material will need to be sorted in materials recycling facilities (MRF's) in order to separate materials into saleable commodities for recycling.

The provision of additional MRF capacity is reliant on a number of critical factors. One such factor is the availability of high quality data to support the significant investment decisions; whether on the part of the private sector or as a part of a public procurement programme.

1.2. Purpose of Study

The purpose of this study is to provide good quality data on the likely tonnage of co-mingled recyclate material that could arise in the short to medium term from collection schemes in Scotland. The purpose is also to provide a regional analysis of the level of investment required to process this tonnage if new, best practice MRFs were to be developed.

2. Methodology

The study was conducted in three phases:

1. Local Authority survey to identify Councils considering changing their main scheme to a co-mingled scheme.
2. Modelling of total yields from the identified additional co-mingled schemes to quantify the potential tonnage of material requiring processing at MRF. Tonnages were established for average, lowest present and highest present yields from each local authority and were aggregated on a regional basis.
3. Calculation of the capital and ongoing operational costs for the new MRF facilities potentially required on a regional basis using the Remade MRF model. This was reported as a cost per tonne.

An overview of the methodology is set out in Figure 1.

Figure 1 Project Methodology

Short to Medium Term Material Recycling Facility Requirements in Scotland
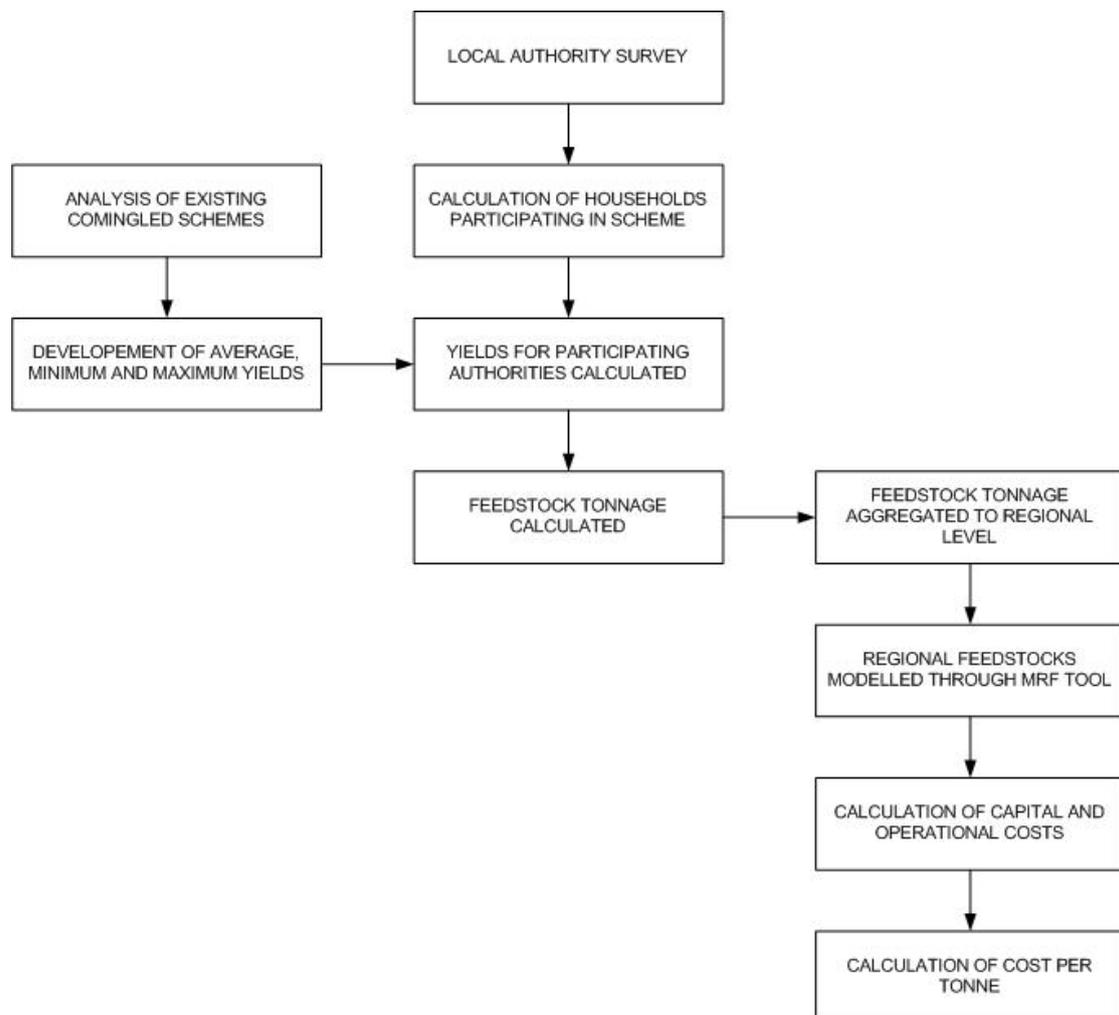
2.1. Local Authority Survey

Local authorities who currently operate source-segregated household collection schemes were identified from the 2008 survey carried out for Remade's 'Recyclate Recovery' report[1]. All 32 Scottish local authorities were surveyed to gather data on recycling at both kerbside and recycling centres/point for the financial year 2006/7.

These authorities were contacted in August-September 2008 to identify whether they were considering a move to a co-mingled collection for their main kerbside recycling scheme in the short to medium term future. The local authorities either identified that they were either definitely going to move to co-mingled collection or that they were considering such a scheme change.

11 Councils reported that they are considering a move to a co-mingled scheme. The results by council type are shown in Table 1 below.

Table 1 Number of Councils Considering a Move to Co-mingled Scheme in the Future

Council Type	Response to Survey	
	Yes	**Possibly**
Mixed Councils	4	2
Urban Councils	1	2
Rural Councils	2	0
TOTAL	**7**	**4**

2.2. Scheme Modelling

Data was taken from the Remade Recyclate Recovery report in kilograms of recyclate recovered per household per week (kg/hh/wk) for current co-mingled collection schemes.

There are presently eight fully co-mingled collection schemes in Scotland with three in urban Councils and five in mixed Councils. There are some significant differences in the yield per household of recyclate as shown in Table 2.

---

[1] Remade (2008). Recyclate Recovery – An Analysis of Scottish Recycling Schemes 2006/07. http://www.remade.org.uk/files/KerbsideReport2008%20Final.pdf

Table 2 Yields for Co-mingled Schemes in Scotland

	Yield (kg/hh/wk)		
	All	**Urban**	**Mixed**
Inverclyde	4.23		x
Falkirk	3.43	x	
West Lothian	2.78		x
South Ayrshire	2.66		x
South Lanarkshire	2.58		x
North Ayrshire	2.55		x
Glasgow	2.03	x	
West Dunbartonshire	2.03	x	

The present average, lowest and highest yields were calculated for all schemes, urban schemes and mixed schemes as shown in Table 3.

Table 3: Yields for Co-mingled Schemes in Scotland Summary

Council Type	Average Present Yield (APY)	Highest Present Yield (HPY)	Lowest Present Yield (LPY)
Mixed	2.96	4.23	2.55
Urban	2.50	3.43	2.03
All	2.79	4.23	2.03

A number of household participation scenarios were generated for the purposes of sensitivity analysis as shown in the table below.

Table 4 Scenarios Used to Generate Potential Tonnages for MRF Processing

	Yield (kg/hh/wk)		
	Average Present Yield (APY)	**Highest Present Yield (HPY)**	**Lowest Present Yield (LPY)**
Households –replace main scheme	x	x	x
Households – replace all schemes	x	x	x

2.3. Remade Scotland MRF Model

Building on work undertaken by WRAP on MRF infrastructure[2], Remade Scotland developed a Scotland specific MRF model to simulate the likely capital and operational costs of developing new infrastructure.

The model incorporates the recommendations from WRAP Report in terms of:

---

[2] WRAP "Recovering Value from MRF's" (2007)

- Best practice for optimal plant configuration

- Sorting infrastructure costs

- Sorting efficiency

- Manual sorting efficiency

The Remade model takes account of all aspects of the MRF profit and loss account including:

- Staff costs

- Transport costs for materials and waste

- Cost of disposal for contamination and process losses

- Revenues from material sales

- Water, electricity, rates, office costs

- Health and safety costs

- Maintenance and repair costs

- Insurance costs

The outputs of the model allowed a calculation of the overall capital costs of a MRF that is built to best practice and an outline of the likely ongoing annual operational cost.

A brief summary report on the development of the MRF model will be available at www.remade.org.uk and an overview of the MRF methodology and assumptions is presented in the Appendix to this report.

3. Feedstock and Recycling Rate Impact

3.1. Feedstock

The projections suggest that between 93,000 and 163,000 tonnes of MRF reprocessing capacity will be required to handle recyclate material collected through co-mingled collection schemes potentially coming online (Table 5). The actual tonnage available will depend on yield obtained and household participation rates.

Table 5 Total Annual Tonnage Generated from Additional Co-mingled Collection Schemes by Yield

	Feedstock per Annum (tonnes)		
	Average Present Yield (APY)	Highest Present Yield (HPY)	Lowest Present Yield (LPY)
Households - Main Scheme	106,189	142,527	92,521
Households – All Schemes	121,512	163,116	105,228

There are 4 regions within Scotland where this material will be generated; the regional distribution is shown in Table 6.

Table 6 Total Annual Tonnage Generated from Additional Co-mingled Collection Schemes by Region

ALL	Replace Main Scheme		
	Average Present Yield (APY)	Highest Present Yield (HPY)	Lowest Present Yield (LPY)
East of Scotland	17,609	24,349	14,496
West of Scotland	39,376	55,012	33,006
Highlands & Islands	12,892	14,609	12,375
Tayside	36,311	48,557	32,644
TOTAL	**106,189**	**142,527**	**92,521**

ALL	Replace All Schemes		
	Average Present Yield (APY)	Highest Present Yield (HPY)	Lowest Present Yield (LPY)
East of Scotland	27,554	37,993	22,571
West of Scotland	43,470	60,650	36,352
Highlands & Islands	13,959	15,688	13,442
Tayside	36,529	48,785	32,862
TOTAL	**121,512**	**163,116**	**105,228**

The regional distribution is relevant if the material is going to be treated within the region it is generated. The majority (approximately 70%) would occur in the West of Scotland and Tayside.

3.2. Impact on Recycling Rates

As a result of moving from the present schemes, which combined for the eleven local authorities modelled yielded 88,479 tonnes, there will be an inevitable impact on recycling rates.

If only the main recycling schemes were replaced then the minimum increase on the existing schemes would be 5% - with a possible 61% increase on existing schemes if the highest present yield was replicated across all participating local authorities.

Table 7 Recycling Rate Increase on Present Scheme Only

Present Scheme Only	Full Comingled Scheme	Increase Tonnes	% Increase on Existing Scheme
APY	106,189	17,710	20%
HPY	142,527	54,048	61%
LPY	92,521	4,043	5%

If all recycling schemes were to be replaced with comingled schemes however, the minimum increase on existing schemes would be 19% - with a possible 84% increase if the highest present yield were to be achieved.

Table 8 Recycling Rate Increase on All Schemes

All Schemes	Full Comingled Scheme	Increase Tonnes	% Increase on Existing Scheme
APY	121,512	33,033	37%
HPY	163,116	74,637	84%
LPY	105,228	16,749	19%

Based on the most recent SEPA figures this increase at the highest level would notionally contribute a 2% increase to the household recycling rate in Scotland.

4. Cost per Tonne

The Remade MRF model was used to generate both 'cost per tonne', and operation and capital costs, for processing at MRF the materials collected through the potential new co-mingled schemes.

4.1. East of Scotland

The minimum cost of providing a facility in the East of Scotland would be £9 per tonne with that figure based on achieving the highest present yield from replacing all schemes with a comingled collection. Cost variation between highest yield and lowest yield when replacing the main scheme is around 44% - whereas the cost difference in all scheme replacement between highest and lowest yield is only 22%.

Table 9 Cost per Tonne Scenarios East of Scotland

	APY	HPY	LPY
Replace Main Scheme - Baseline Cost	£48	£43	£52
Replace Main Scheme - Average Revenues	£18	£12	£22
Replace All Schemes - Baseline Cost	£41	£39	£44
Replace All Schemes - Average Revenues	£11	£9	£13

4.2. West of Scotland

The minimum cost of providing a facility in the West of Scotland would be £6 per tonne with that figure based on achieving the highest present yield from replacing all schemes with a comingled collection. Cost variation between highest yield and lowest yield when replacing the main scheme is around 14% - whereas the cost difference in all scheme replacement between highest and lowest yield is 13%.

Table 10 Cost per Tonne Scenarios West of Scotland

	APY	HPY	LPY
Replace Main Scheme - Baseline Cost	£39	£37	£41
Replace Main Scheme - Average Revenues	£8	£7	£10
Replace All Schemes - Baseline Cost	£38	£37	£39
Replace All Schemes - Average Revenues	£7	£6	£9

4.3. Highlands and Islands

The minimum cost of providing a facility in the West of Scotland would be £30 per tonne with that figure based on achieving the highest present yield from replacing all schemes with a comingled collection. The reason behind this high figure is the relatively high transportation costs for both materials reaching the market and waste to landfill. Cost variation between highest yield and lowest yield when replacing the

main scheme is around 20% - whereas the cost difference in all scheme replacement between highest and lowest yield is 17%.

Table 11 Cost per Tonne Scenarios Highlands and Islands

	APY	HPY	LPY
Replace Main Scheme - Baseline Cost	£65	£62	£67
Replace Main Scheme - Average Revenues	£35	£32	£36
Replace All Schemes - Baseline Cost	£63	£61	£64
Replace All Schemes - Average Revenues	£33	£30	£34

4.4. Tayside

The minimum cost of providing a facility in the West of Scotland would be £8 per tonne with that figure based on achieving the highest present yield from replacing all schemes with a comingled collection. Cost variation between highest yield and lowest yield regardless of scheme is around 10% due to the relatively similar tonnages collected in each scenario.

Table 12 Cost per Tonne Scenarios Tayside

	APY	HPY	LPY
Replace Main Scheme - Baseline Cost	£39	£39	£41
Replace Main Scheme - Average Revenues	£9	£8	£10
Replace All Schemes - Baseline Cost	£39	£39	£41
Replace All Schemes - Average Revenues	£9	£8	£10

4.5. Capital Costs

Capital costs in this modelling exercise have been based on the provision of an MRF that is comparable to the best practice design specified in the WRAP 2007 report "MRF's Comparison of Efficiency and Quality".

Capital costs have been banded for tonnage throughputs in tranches of>10,000 tonnes >20,000 tonnes, >40,000 tonnes and >60,000 tonnes. Capital costs calculated are exclusive of finance costs but are inclusive of elements such as equipment and electrical installations, platforms and chutes and required mobile plant.

Table 13 Baseline Capital Costs - Replacing Main Scheme Only

Replace Main Scheme - Baseline Cost	APY	HPY	LPY
East of Scotland	£1,605,000	£1,605,000	£1,605,000
West of Scotland	£2,227,500	£3,300,000	£2,227,500
Highlands and Islands	£1,605,000	£1,605,000	£1,605,000
Tayside	£2,227,500	£3,300,000	£2,227,500

Capital costs as expected as highest in West of Scotland and Tayside due to the relatively higher tonnage expected in those areas. Variation on capital requirements between replacement of all schemes and replacement of the main scheme only exists in the East of Scotland when the highest present yield is achieved.

Variation in capital expenditure is highest in West of Scotland and Tayside where, depending on whether the highest present yield is achieved could mean a potential difference of £1,072,500.

Table 14 Baseline Capital Costs - Replacing All Schemes

Replace All Schemes - Baseline Cost	APY	HPY	LPY
East of Scotland	£1,605,000	£2,227,500	£1,605,000
West of Scotland	£2,227,500	£3,300,000	£2,227,500
Highlands and Islands	£1,605,000	£1,605,000	£1,605,000
Tayside	£2,227,500	£3,300,000	£2,227,500

4.6. Job Creation

The potential for job creation in this project has also been evaluated. The job numbers presented here are based on the needs of the facilities and the sorting efficiencies of manual labour. In addition it has not been calculated how this may affect the overall balance of employment in recycling schemes where kerbside sorting is replaced with MRF sorting.

Table 15 Job Creation - Replacing Main Scheme

Replace Main Scheme	APY	HPY	LPY
East of Scotland	15	18	13
West of Scotland	25	33	22
Highlands and Islands	12	13	12
Tayside	24	30	22

Overall there is a potential to create, at maximum present yields where all recycling schemes were replaced a total of 103 jobs. The minimum number of jobs that would be created would be 69.

Table 16 Job Creation - Replacing All Schemes

Replace All Schemes	APY	HPY	LPY
East of Scotland	19	24	17
West of Scotland	27	35	24
Highlands and Islands	13	14	13
Tayside	24	30	22

5. Private Sector Development

It is possible that the materials recycling facilities required to process additional local authority collected tonnage may be provided by the private sector.

It is likely that the private sector will look to service this additional commingled tonnage in two ways:

- Create additional processing capacity at existing facilities through extension of working hours
- Development of new MRF infrastructure

5.1. Increasing Capacity at Existing MRFs

One option potentially available to private sector operated MRFs would be to varying their waste management licence conditions to accommodate an extension of operating hours. Extending operating hours could potentially increase the throughput capacity of the plant.

For example:	
Existing plant throughput:	20,000 tonnes per annum
Existing operating hours:	8 hours per day / 2,920 hours per annum
Existing tonnes per hour:	6.9 tonnes per hour
Existing tonnes per day:	55.2 tonnes per day
Extension to operating hours:	16 hours
Additional throughput per day:	110.4 tonnes per day
Additional throughput per annum:	***20,296 tonnes per annum***

Arrangements of this type could potentially deliver real additional capacity without the need for significant capital expenditure. This could be the case if existing facilities were only operating on a single shift basis – further research would be required to ascertain if additional shift capacity were possible in all areas.

Nevertheless material would continue to be processed using existing plant, but might not be capable of producing a similar standard of material to that of new purpose built facilities.

5.2. Private Sector Investment

If local authorities engage with the private sector to build and operate specific and purpose built MRFs gate fees will need to be set at a level at which operators are able to make a profit.

The economic profit margin of companies operating in the waste sector is often dependant on the nature of the activity and the length of time over which capital is invested.

A distinction should be drawn between the economic profits that may be applied across all projects of this nature and the optimum profit (i.e. profits above the normal competitive rate) that a company may enjoy due to market position, regional monopoly of services or other factors.

It is unlikely however that normal market rates for gate fees will be reflected in areas that suffer from lack of provision and regional monopoly. In this instance the optimum profit motive is likely to triumph and therefore profits and as a result, gate fees, will be higher.

5.3. Contracts

The value of gate fees and the capital costs applied in this modelling exercise are dependent on a number of factors that can be included within the specification element of any contract.

The capital element of this project has been calculated on the basis that any new MRF is built to the specifications of the best practice work undertaken by WRAP in 2007/2008.

To this end it may be an option for local authorities contracting with the private sector to specify in their contract that best practice in MRF design must be taken into account when developing this infrastructure.

The revenue element of the overall net gate fee is heavily based on the comingled material being sorted into news and PAMS grade material for use at newsprint mills. Our analysis of prices has shown this to be consistently the highest revenue material that comingled fibres from the household can be sorted into. The news and PAMS element of the revenue stream has been modelled to be circa 50% of all material revenue.

If any local authority were to contract on the basis of attaining prices similar to those shown here, it may be prudent to ensure that news and PAMS is specified as a required output from sorting activity.

6. Summary and Conclusions

A clear requirement for additional MRF reprocessing capacity in Scotland has been identified. The regions in which this capacity is required has been identified and indicative costs provide additional information to inform decision making by stakeholders.

The research has identified the following main findings:

- 11 Scottish Councils have identified that they will or may move to full co-mingled schemes in the future.

- The Councils identified are located within 4 regions of Scotland: East of Scotland, West of Scotland, Highlands and Islands, and Tayside.

- Based on the modelling undertaken, between 93,000 tonnes and 163,000 tonnes of MRF processing capacity is required in Scotland if all the Councils identified move to full co-mingled dry recyclate collection schemes.

- The majority of the additional material collected (approximately 70%) would be generated in the West of Scotland and Tayside.

- Approximately 50% of the treatment capacity requirement identified would be for those Councils who indicated they will *definitely* be changing scheme type

- The 'cost per tonne' to process the collected material at MRFs varies significantly depending on the income generated from the processed material.

- Cost to process the material is predicted to be between £6 and £67/tonne depending on scheme yield and location

- The analysis identifies a capital requirement of circa £10.4 million

- This analysis identifies a possible 103 jobs that could be created in these new facilities

- At the highest present yield from the maximum number of households there would be a modelled increase in recyclate recovered of 74,637 tonnes – an increase in the modelled group of 84%

- Private sector partners could offer solutions through modification to existing working practices or development of new MRF's

- However with private sector is profit margins that may mean gate fees of £0 - £67 per tonne depending on yield and material revenue are to be expected

- Should local authorities wish to contract with the private sector for the provision of these facilities then contract specification will be a significant factor in attaining comparable gate fees.

MRF Model Methodology

Simplified Method Flowmap

 A full description of the MRF Model is available at www.remade.org.uk

Short to Medium Term Material Recycling Facility Requirements in Scotland
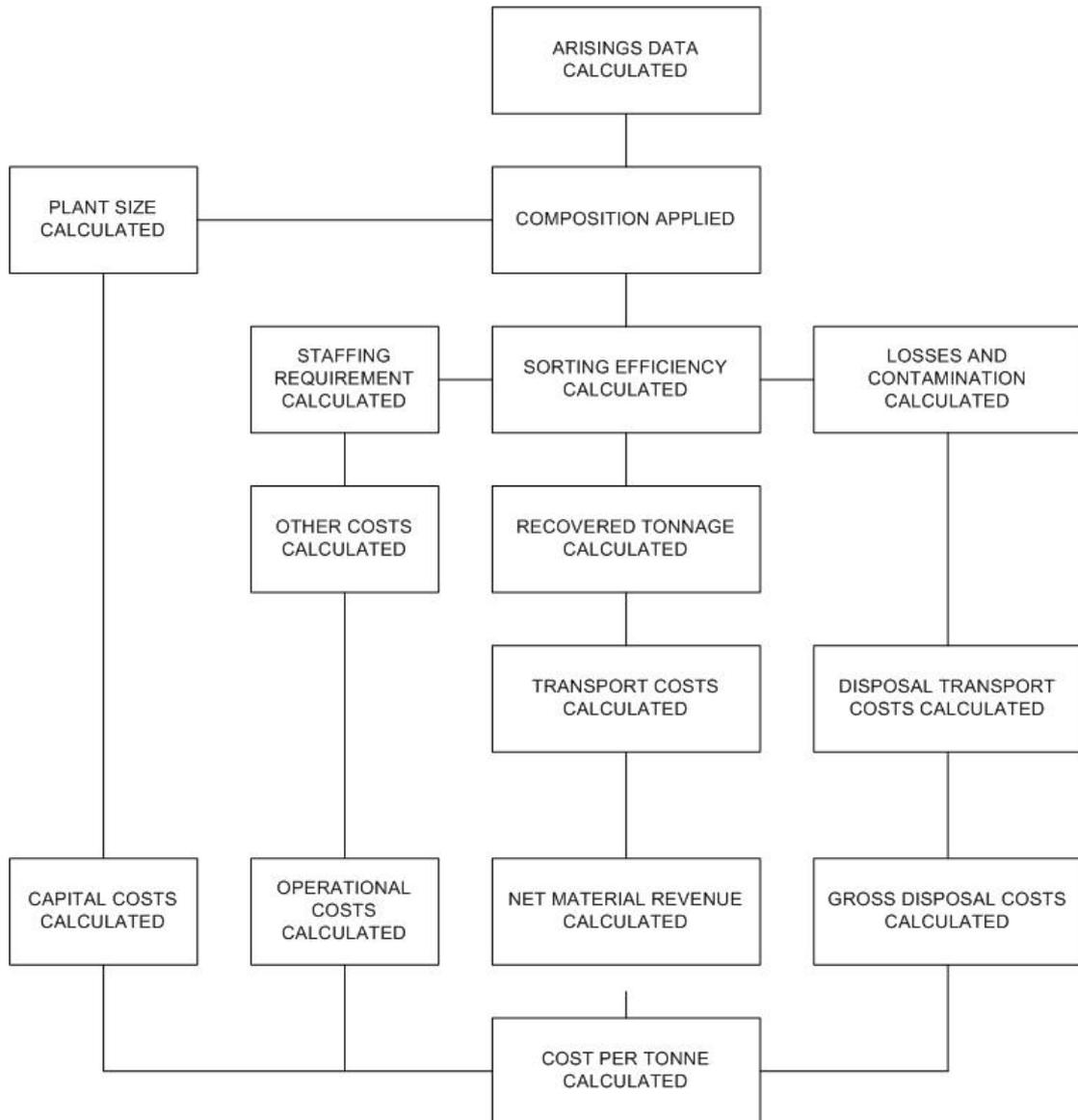
Key Assumptions

Staff Costs

Position	Basic	Superannuation	NI
Recycling Operative	£14,000	10%	10%
Senior Recycling Operative	£20,000	10%	10%
Class 1 HGV	£20,000	10%	10%
Forklift Operator	£20,000	10%	10%
Mobile Plant Operative	£20,000	10%	10%
Clerical Officer	£15,000	10%	10%
Administrative Assistant	£12,000	10%	10%

Transport Costs – Non Highland

Material	Maximum Load	Cost per Load
Paper	22	£200
Card	20	£150
Ferrous Metals	20	£150
Non Ferrous	20	£150
Plastic Bottles	20	£150
Waste	20.00	£150

Transport Costs – Highland

Material	Maximum Load	Cost per Load
Paper	22	£400
Card	20	£400
Ferrous Metals	20	£320
Non Ferrous	20	£320
Plastic Bottles	20	£400
Waste	20.00	£400

Revenues and Disposal Costs

Material Rates	£ / tonne
Paper	£28.00
Card	£15.00
Ferrous Metals	£90.00
Non Ferrous Metals	£700.00

Plastic Bottles	£90.00
Landfill Rate	£48.00

Note: Landfill rates increase to £56 per tonne and then £64 per tonne for duration of modelling period. Revenues from Remade Survey results in 2006/2007

Other Costs

Cost	Rate	Assumption
Non Domestic Rates	£0.46	Per £ rateable value
Rateable Value	£193,000	Compiled from Scottish Assessors'
Plant Maintenance	5%	Percentage estimate on annual capital
Plant Repairs	2%	Percentage estimate on annual capital
Vehicle Licenses	£750	Quote
Mobile Plant Maintenance	35%	Percentage estimate on annual capital
Fire Safety	£0.10	Per tonne of input
PPE	£500	Per employee per annum
Consultancy	£3,000	Estimate
Telephone	£1,500	Estimate
Computer Related	£1,500	Estimate
Miscellaneous Office	£2,500	Estimate
Insurance (Plant)	£10,000	Estimate
Insurance (Mobile Plant)	£5,000	Estimate
Fuel	£0.25	Per tonne of input
Electricity	£1.00	Per tonne of input
Water(Based on 0.25 m3 per tonne of input)	£3.40	Based on 0.25 m3 per tonne of input per m3 & £250 standing
Consumables	£0.25	Per tonne of input

Capital Costs

Capital costs vary in line with the tonnage throughput required. All capital is modelled for depreciation over a 10 year period. Capital costs do not include the cost of finance.

7. Typical MRF Model Screen Shots

7.1. Input

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Participant 1	39,376	40,164	40,967	41,786	42,622	43,474	44,344	45,231	46,135	47,058	47,999	48,959
Annual Increase	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Collected Recyclate	39,376	40,164	40,967	41,786	42,622	43,474	44,344	45,231	46,135	47,058	47,999	48,959
Projected Collected Tonnes	43,313.60	44,180	45,063	45,965	46,884	47,822	48,778	49,754	50,749	51,764	52,799	53,855
Waste Fraction	3,937.60	4,016	4,097	4,179	4,262	4,347	4,434	4,523	4,614	4,706	4,800	4,896
Paper — 77%	30,383	30,990	31,610	32,242	32,887	33,545	34,216	34,900	35,598	36,310	37,036	37,777
Card — 12%	4,890	4,988	5,088	5,190	5,294	5,400	5,507	5,618	5,730	5,845	5,961	6,081
Ferrous Metals — 3%	1,236	1,261	1,286	1,312	1,338	1,365	1,392	1,420	1,449	1,478	1,507	1,537
Non Ferrous Metals — 1%	248	253	258	263	269	274	279	285	291	296	302	308
Plastic Bottles — 7%	2,615	2,667	2,720	2,775	2,830	2,887	2,944	3,003	3,063	3,125	3,187	3,251
Actual Recyclate	39,372	40,160	40,963	41,782	42,618	43,470	44,339	45,226	46,131	47,053	47,994	48,954
Contamination at — 10%	3,938	4,016	4,097	4,179	4,262	4,347	4,434	4,523	4,614	4,706	4,800	4,896

The MRF Model allows the user to allocate input tonnage and composition of input tonnage for MRF recovery. A contamination rate can also be applied, as well as an identification of increase in comingled collection over a given time period.

7.2. Output

COST PER TONNE		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
The gross operational cost per tonne of dry recyclate processed is:	A	£16.28	£15.96	£15.65	£15.34	£15.04	£14.74	£14.46	£14.17	£13.89	£13.62	£13.35	£13.09
The capital cost per tonne of dry recyclate processed is:	B	£5.14	£5.04	£4.94	£4.85	£4.75	£4.66	£4.57	£4.48	£4.39	£4.30	£4.22	£4.14
The total cost per tonne of dry recyclate processed is:	A + B =	£21.42	£21.00	£20.59	£20.19	£19.79	£19.40	£19.02	£18.65	£18.28	£17.93	£17.57	£17.23
The cost benefit for material for the year is projected as:		£1,071,826	£1,031,605	£989,347	£1,009,134	£1,029,316	£1,049,903	£1,070,901	£1,092,319	£1,114,165	£1,136,448	£1,159,177	£1,182,361
The net contribution per tonne for the year is projected as:	C	£24.75	£23.35	£21.95	£21.95	£21.95	£21.95	£21.95	£21.95	£21.95	£21.95	£21.95	£21.95
THE NET COST PER TONNE IS THEREFORE:	A + B - C =	-£3	-£2	-£1	-£2	-£2	-£3	-£3	-£3	-£4	-£4	-£4	-£5

-£3

The key output of the MRF Model is a cost per tonne per annum of the MRF. This cost per analysis is split into:

- gross operational cost per tonne

- capital cost per tonne

- contribution of recyclate sales per tonne

- overall net cost per tonne

8. Glossary

APY	Average present yield in kilograms per household per week – the average yield at present obtained by local authorities operating comingled kerbside collections
HPY	Highest present yield in kilograms per household per week – the highest yield at present obtained by local authorities operating comingled kerbside collections
LPY	Lowest present yield in kilograms per household per week – the lowest yield at present obtained by local authorities operating comingled kerbside collections
MRF	Materials Recycling Facility, a facility that includes both manual and automated sorting technologies to separate comingled recyclate prior to sale into commodity markets
Comingled	Collection scheme where dry recyclate such as paper, cardboard, steel cans, aluminium cans, plastics and textiles can be collected together in a single container prior to sorting
Replace All Schemes	An assumption used in this modelling exercise where all present recycling schemes in a local authority are replaced with a comingled collection scheme
Replace Main Scheme	An assumption used in this modelling exercise where only the main recycling schemes in a local authority is replaced with a comingled collection scheme
Cost per Tonne	The overall cost per tonne of input to a MRF that combines the annualised capital cost, the annual operational cost taking into account net material revenues and gross disposal costs
Economic Profit	An economic profit is made when the revenues associated with an activity are greater than the costs of the activity itself.
Optimum Profit	An optimum profit is when the economic profit can be increased or maximised due to either market monopoly, market positioning or lack of competition

Remade Scotland

Short to Medium Term Material Recycling Facility Requirements in Scotland