Waste (England and Wales) Regulations 2011 (amended)

Compliance assessment – technical annex v2

Surrey Heath Borough Council

Introduction

New regulations under the Waste England and Wales Regulations 2011 (as amended) (the 'Waste Regulations'), which aim to promote high quality recycling and move us towards becoming a recycling society, have come into force. Surrey County Council has used the 'Route Map' prepared by a WRAP led consortium as a basis for completing a waste regulations compliance assessment for a number of the Surrey waste collection authorities, including Surrey Heath Borough Council (SHBC).

This technical annex supports the report 'Waste (England and Wales) Regulations 2011 (amended) - Compliance assessment: Surrey Heath Borough Council'. The purpose of this document is to outline and justify the assumptions made as part of the modelling.

Methodology

The Route Map advocates three key compliance tests. The first of which is the 'Necessity test' to test if each of the four key materials (glass, metal, paper and plastic) needs to be collected by separate collections in order to 'facilitate or improve recovery'

The second is the 'Practicability test' to test if separate collections are technically, environmentally and economically practicable for each of the four key materials.

Finally the 'Waste hierarchy test' is used to test if each material collected by the WCA is being managed as far up the waste hierarchy as possible.

There are many overlaps between the tests advocated by the Route Map, particularly around economic and environmental impacts. We have therefore undertaken comprehensive modelling work for SHBC that estimates the economic and environmental impacts of the current collection system and the following three hypothetical 'optimised' collection systems:

- **Separate** – a fully separate collection system, collecting each of the four key materials and food separately
- **Separate glass** – a two-stream collection system with comingled paper/card, plastics and metals, but separate glass and food
- **Comingled** – a fully comingled collection system with separate food

The results of the modelling produced data, which was used in the three Route Map tests to determine if optimised separate collections are required in SHBC. This was done by comparing the three optimised collection systems. The comparison provides a means of benchmarking the performance of separate collections and allows us to determine whether or not they are required.

The modelling takes a whole system approach, looking at the economic and environmental impacts right from the provision of bins through to the reprocessing of materials into new products. Figure 1 summarises the main areas where costs (in £ to the WCA and SCC) and environmental impacts (total CO_2 equivalent) were estimated during the modelling.

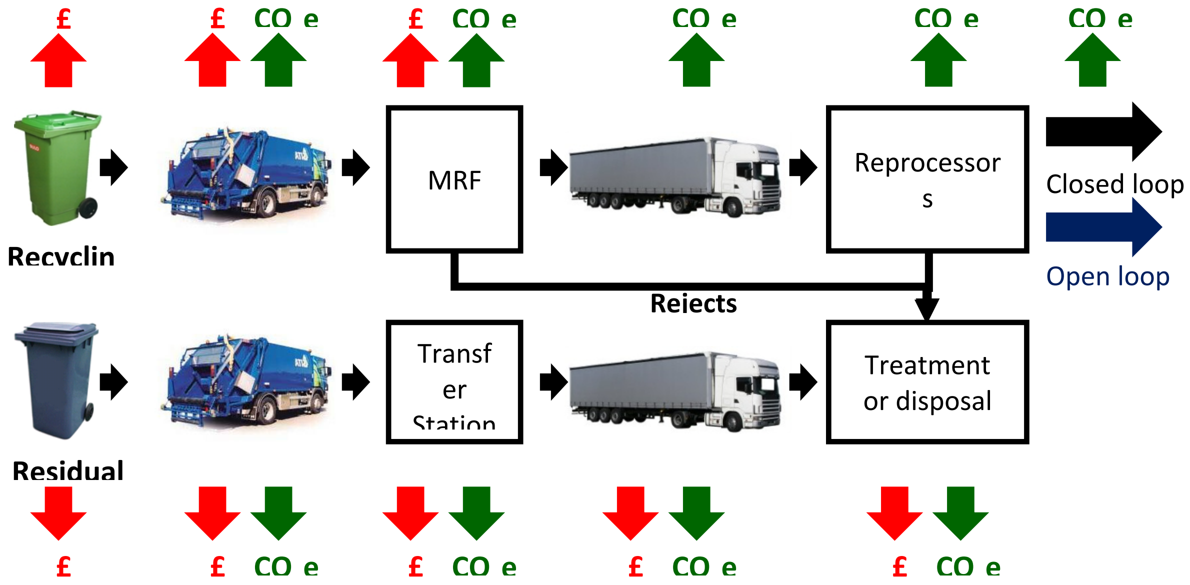

Figure 1: Summary of the variables modelled for a fully comingled collection system

The modelling work utilises two existing models, these are:

- WRAP's Kerbside Assessment Tool (KAT) to model collection systems
- DEFRA's Greenhouse Gas Emissions Tool to model environmental impacts

The structure of the modelling work is based around the quantities of waste that are generated and how these tonnages progress to ultimate disposal or are reprocessed into materials for further use.

At each stage of this journey the modelling work applies financial costs and environmental impacts around dealing with these waste materials. Assumptions must be made at each stage to allow this modelling work to take place. The report describes the assumptions that have been made at each of the following stages in order to estimate the costs and environmental impacts of each system:

- Production of waste
- Collection
- Bulking and sorting
- Onward transportation
- Reprocessing

- Treatment and disposal

Production

The production of waste sets the scope of the modelling work as it defines:

- Quantities of waste material produced by householders.
- Number of householders.
- Composition of the waste being collected.

This information flows into the collection and other subsequent stages to help define and set the boundaries for their activities. There are environmental impacts at this stage, these are the CO_2 equivalent emissions associated with producing the materials that make up the waste. However these are the same for all of the collection systems, so are not included in the modelling. There are some costs at this stage from providing the collection containers that householders use.

The 'setup of current arrangements for KAT' topic of Table 1 outlines the assumptions and sources of data behind these factors.

Collection

The collection stage is a critical stage in the modelling process as it defines the collection systems used to start managing the waste materials. It models two key elements:

- Defining how much of each material is captured by each part of the collection system – the quantities collected for recycling or residual waste.
- Developing the logistical arrangements, and subsequent costs and environmental impacts, required to achieve the collection system.

The quantities of current material capture have been provided by SHBC. The material captured by the optimised collection systems is calculated using material yield information provided by WRAP and their LA Portal. For each optimised system the upper quartile yield seen nationally is used and applied to the SHBC situation. The 'public participation in recycling' topic of Table 1 elaborates on the assumptions made.

Developing the logistical arrangements is a more complex process and WRAP's KAT tool is used to model this. There are a range of topics, shown below, that need to be considered with information needing to be sourced and assumptions made in setting up KAT. Table 1 details the topics below in more detail:

a. Operation of vehicles in scenarios
b. Containers selected for scenarios
c. Facilities chosen as tipping points
d. Vehicle/crew productivity
e. Capital costs
f. Operating costs
g. Vehicle mileage

The primary output from this stage is to define the quantities of each type of material that are passed onto the next stage for recycling or treatment/disposal. There are other important outputs from the modelling of this stage:

- Costs of collection scheme
- Fuel usage

Table 2 shows the outputs in more detail. However these two outputs are used to define the costs and environmental impact from fuel usage for the stage. A conversion factor was used to calculate the impact from fuel usage and is defined in the ‘carbon conversion’ topic of Table 3.

Bulking and sorting

The bulking and sorting stage is the point that waste materials are tipped by collection vehicles and bulked for onward transport to material reprocessors and treatment/disposal facilities. For some materials this stage may also involve a sorting process to separate mixed materials. The following aspects are modelled under this stage:

- The quantities of each material that are separated and forwarded to reprocessors and treatment facilities (including rejects from sorting processes).
- The costs of using the bulking and sorting facilities.
- Environmental impacts of using the bulking and sorting facilities.

A bespoke model has been developed to model the transfer of materials through these facilities. This model relies on operational information for these facilities particularly the following factors detailed in Table 3:

a. Treatment type and reprocessor
b. Reject rates
c. Reject material splits
d. Reject treatment type

This is an important stage for recycling as the onward reprocessor choice will determine if the material is send for closed or open loop recycled. Thus this stage will have a key bearing on the necessity test.

The costs element is based on the tonnage inputs to facilities and gate fees charged or income received. Any assumptions behind recyclables gate fees are provided in the ‘management costs’ topic of Table 1. The costs of treatment/disposal of residual waste is dealt with in the treatment and disposal stage.

The environmental impacts of this stage are modelled as the impacts of operating the facilities in question. Assumptions behind this calculation are provided in the ‘material specific treatment conversion’ factor of Table 3.

Outputs from the modelling of this stage are therefore:

- Destination and quantities of recyclables passed on for reprocessing
- Destination of bulked residual waste
- Cost or income from passing on recyclable materials

- Cost of bulking residual waste
- Environmental impacts at a facility and material level of operating bulking and sorting facilities

Onward transportation

This stage is relative simple in that it models the transport of materials to reprocessors or treatment and disposal facilities. The main aspect to this modelling is to model the journeys of each material to their destinations.

Costs are not considered at this stage as the ownership of recyclables has moved to the commercial sector while the cost of transporting residual waste is included in the bulking costs.

The modelling calculates the mileage incurred in the transportation then applies an environmental factor according to the distance and the mode of transport. The factors and assumptions used in this calculation are detailed in the 'transport' and 'carbon conversion' topics of Table 3. The output for this stage is environmental impacts from transportation.

Reprocessing

The reprocessing stage is where recyclables are processed into usable products and thus cease to be wastes. This is operated by the commercial sector and thus there are no costs to local authorities. There are a number of aspects that are of interest to the objectives of the modelling which have been examined:

- Does the facility produce open or closed loop recycling?
- The quantities of material that are turned into products or lost as rejects
- Environmental impacts from the operation of the facility

A bespoke model has also been developed to model each of the reprocessors used and how materials progress through them to become products. To develop this model a number of factors have been examined, as listed below. Table 3 details these factors along with any assumptions:

a. Treatment type
b. Reject rate
c. Reject treatment type
d. Reject material split
e. Material specific treatment conversion – the environmental impacts of each material being reprocessed

Two key outputs are provided by this part of the model:

- Quantities of material sent to closed loop recycled
- Environmental impacts of reprocessing material

Treatment and disposal

The treatment and disposal stage is the final stage where residual waste and rejects from sorting/reprocessing operations are managed. For residual waste there is still a cost element as gate fees have to be paid though these are not considered for the rejects as they are paid for by the commercial sector. There are several key aspects to this stage that are dealt with in the modelling:

- How much material is sent for treatment and disposal
- What is the cost of treatment and disposal activities
- What are the environmental impacts associated with disposal

A further bespoke model has been developed to consider these aspects. Again throughput of materials is a key consideration along with the type of facility being used. The factors that are considered are shown below and detailed in Table 3:

a. Residual material split
b. Reject material split
c. Residual Treatment method
d. Material specific treatment conversion

The results of this modelling are two key outputs that complete the whole system modelling:

- Cost of treatment and disposal of residual waste.
- Environmental impacts at a facility and material level of treating and disposing waste

Summary

The whole system approach sums all of the outputs described above to provide the headlines figures in the main report of:

1. Quantities of material sent for closed loop recycling
2. Cost of the collection and management of kerbside materials in a system.
3. Environmental impacts of a system in terms of CO_2 equivalent.

These findings are then examined within the process described in the Route Map in the main report.

Table 1: Data input and preferences for KAT setup

		Assumptions made		
Topic	**Factor**	**Current System**	**Optimised separate collection**	**Optimised comingled collection**
Setup of current arrangements for KAT background data	Number of households served	30,200 households on main collection rounds and 3,200 households on the tight access rounds have been modelled. The remaining bulk and difficult access rounds have not modelled as they do not easily fit with the KAT model. The main collection rounds and tight access rounds have been modelled separately in KAT with the results combined and presented in summary in the report		
	Current residual waste tonnages	Current residual calculated pro rata as 7,976 tonnes pa for the main collection rounds and 845 tonnes pa for the tight access rounds		
	% of households with wheeled bins	Assumed as 100% as no information is available		
	No. of collection crew (inc driver contribution)	2.2 based on pro forma		
	Average speed of vehicle collecting/travelling	Speed of vehicles when collecting and travelling set as 2mph and 30mph for the main rounds and tight access rounds by trial and error until results match the distances provided in pro forma for both types of collection rounds		
	Current composition of waste	Composition set as the % breakdown for kerbside waste for SHBC in the Surrey Composition Analysis 2013/14		
	Current recycling tonnages collected	9,293 tpa of dry recycling and 2,794 tpa of food for the main rounds and 985 tpa of dry recycling and 296 tpa of food waste for the tight access rounds calculated pro rata from the pro forma tonnages		
Scope of scenarios	Total waste to be managed	20,063 tpa for the main rounds and 2,126 tpa for the tight access rounds - the totals of the current recycling and residual tonnages. This remains constant for all scenarios to allow an equal comparison. Thus no scenario has any predicted reductions in waste.		
	Number of households served	30,200 households for the main rounds and 3,200 households for the tight access rounds - to allow a fair comparison all scenarios will be modelled on the same no. of households. It also provides a consistent approach with the numbers that have been used it setting up the KAT background data.		
Operation of vehicles in scenarios	Collection frequency	Current collection frequencies based on pro forma	Weekly separate recycling with separate food, fortnightly refuse.	Fortnightly commingled recycling and separate food and fortnightly refuse and separate food
	Sharing vehicles	Current sharing of vehicles for comingled and residual collections	No sharing	Sharing of comingled and residual collection vehicles
	Types of vehicles for recycling collection	RCV with pod (26t) for main rounds, RCV (11m3) for tight access recycling and RCV (7.5t) for tight access food	$30m^3$ stillage vehicle for main round, 10m3 stillage vehicle for tight access recycling and RCV (7.5t) for tight access food	RCV with pod (26t) for main rounds, RCV (11m3) for tight access recycling and RCV (7.5t) for tight access food
	Configuration of vehicle	Separate compartments with larger chamber used for comingled recycling and smaller portion for food. Tight access vehicles have to be single compartment due to limited size	Separate collection vehicle has 5 compartments including one for food waste. Tight access has a separate food vehicle to replicate current scheme size.	Separate compartments with larger chamber used for comingled recycling and smaller portion for food. Tight access vehicles have to be single compartment due to limited size
	Types of vehicles for refuse collection	Same vehicle as recycling collections	RCV (20m3) for main round, RCV (12m3) for tight access	Same vehicle as recycling collections
	Capacity utilisation (% of total space)	KAT determines this as part of modelling	70% for stillage vehicle - based on expected figure for Epsom & Ewell BC experience. Consultation with EEBC suggested that the addition of a food waste compartment would reduce space utilised to 70% of the total.	KAT determines this as part of modelling
Containers selected for scenarios	Containers used for recycling	240l wheeled bin for commingled and 23l caddy for food waste	3 x 40l boxes for separate collection material and 23l caddy for food waste	240l wheeled bin and 23l caddy for food waste
	Containers used for refuse	240l wheeled bins		
	Mix of materials in containers	Paper/card, cans, plastic and glass in wheeled bin. Food waste in 23l caddy	Paper/card, cans, plastic and glass in boxes. Food waste in 23l caddy	Paper/card, cans, plastic and glass in wheeled bin. Food waste in 23l caddy
Public participation in recycling	Set out rates of containers	90% as capture is already at a high level		
	Participation rates	95% as capture is already at a high level	95% - to achieve optimised material capture will require virtually all the population to participate. 95% has been set as the realistic upper level of participation rather than 100%	

	Tonnages of material captured	Current tonnages captured	Tonnages of material capture based on upper quartile performance for SHBC type LAs using separate collections sourced from the WRAP LA portal - data was provided by WRAP for the SE7 Waste Programme and represent yields of material per household observed in authorities operating similar collection systems. Yield of material provides clearly demonstrated capture of material using data that has ultimately been provided through the Wastedataflow system that is based on audited returns from LAs. Thus it is felt that these provide a fair benchmark to show upper quartile performance for the SHBC situation.	Tonnages of material capture based on upper quartile performance for SHBC type LAs using commingled collections sourced from the WRAP LA portal - data was provided by WRAP for the SE7 Waste Programme and represent yields of material per household observed in authorities operating similar collection systems. Yield of material provides clearly demonstrated capture of material using data that has ultimately been provided through the Wastedataflow system that is based on audited returns from LAs. Thus it is felt that these provide a fair benchmark to show upper quartile performance for the SHBC situation.
Facilities choices for collection system	Tipping point for recyclables	Comingled recyclables to SHBC, Camberley		
	Tipping point for refuse	Ash Vale - this is the current tipping point for refuse thus is modelled to continue to allow fair comparison		
	Journey time from the collection round to the tipping points	Existing journey times taken from pro forma	Journey times taken from pro forma for relevant facilities	
	Unloading times at the tipping points	Existing tipping times taken from pro forma	Existing tipping time for recycling at SHBC Depot has 15 minutes added to them and used as tipping times for separate recycling from a stillage vehicle on advice from Sita	Existing tipping times taken from pro forma are used
Vehicle/crew productivity	Length of working day	7:00 hrs for refuse and 7:45 hrs for recycling taken from pro forma	Working day for recycling and refuse crews assumed to be 7:45 hrs and 7:00 hrs, respectively, across all collection systems to allow fair comparison with current collection arrangements.	
	No. of collection crew (inc driver contribution)	2.2 based on Surrey Heath proforma to ensure a fair comparison		
	Crew loading times	KAT defaults used - these are well researched and tested thus represent best available data		
	Use of slave bins	Only for food		
	Fuel usage	Mpg default figures in KAT used		
	No. of runs to tip (loads) for refuse	KAT results used		
	No. of runs to tip (loads) of recycling	KAT results used		
Capital costs	Container costs	Current containers taken from pro forma	Taken from pro forma for similar bins, KAT default used for other containers	
	Container lifespan	10 years for wheeled bins and 5 years for boxes from KAT defaults		
	Container replacement rates	Taken from pro forma		
	Financing of container purchase	KAT default financing costs assumed		
	No. of vehicles	Number of vehicles for current service rounded to provision in pro forma – 6 vehicles for main round and 2 vehicles for tight access - where KAT vehicle provision does not match the existing service numbers in pro forma	KAT results used	KAT results used but rounded down to 6 vehicles for main round and 2 vehicles for tight access if the KAT results are equal to the KAT vehicle provision for current service.
	Cost of vehicle	KAT default vehicle costs used as not provided in pro forma		
	Depreciation period	KAT default of 5 years used		
	Financing of vehicle purchase	KAT default of 6% pa used		
Operating costs	No. of drivers	Number of drivers rounded down to current service provision in pro forma	KAT results used	KAT results used but rounded down to 6 drivers for main round and 2 drivers for tight access if the KAT results are equal to the KAT vehicle provision for current service.
	No. of loaders	Number of loaders rounded down to current service provision in pro forma	KAT results used	KAT results used but rounded down to 12 loaders for main round and 4 loaders for tight access if the KAT results are equal to the KAT vehicle provision for current service.
	Driver unit costs	Unit cost taken as KAT default as not provided on pro forma		

	Loader unit costs	Unit cost taken as KAT default as not provided on pro forma		
	Supervision costs	KAT default of 9% used		
	Vehicle standing costs	KAT defaults used		
	Vehicle running costs	KAT defaults used		
	Cost of fuel per litre	KAT default price of £1.12 per litre used		
	Overhead costs	12% - KAT default used as no info on pro forma		
Management costs	Gate fees (income) for recyclables	Taken from SHBC pro forma as £14 per tonne	Incomes for glass and cans taken from Epsom & Ewell BC pro forma. Additional incomes given by Sita for mixed paper and mixed plastics. A levy of £8 per tonne is added for the additional costs of handling recyclables tipped by a stillage vehicle	Gate fee assumed to be same as current gate fee
	Residual disposal costs	£113 per tonne (£93 for disposal, £20 for bulking & haulage) - average from SCC		
	Recycling credits	Recycling credits not considered - costs are calculated on the basis of 'taxpayer' rather than to the WCA. Thus payment of recycling credits is cancelled out by the cost of paying recycling credits for the WDA		
Vehicle mileage	Productive collection mileage	Taken from the SHBC pro forma - there are discrepancies between the pro forma collection mileages and the KAT calculated collection mileages. The pro forma mileages are the most accurate and thus have been used.		
	Non-productive mileage	Taken from KAT results by deducting KAT collection mileage from KAT total mileage per vehicle.		

Table 2: Key results from KAT for use in wider modelling and assessment work

		Scenarios modelled		
Topic	**Factor**	**Base Case**	**Optimised source segregated**	**Optimised commingled**
No. of households served		33,400	33,400	33,400
Tonnes of refuse		8,821	10,312	7,593
Tonnes of recycling captured	Newspapers and magazines	1,277	1,297	1,527
	Other paper	3,065	3,114	3,664
	Corrugated card	1,076	454	1,076
	Non corrugated card	1,130	478	1,130
	Plastic film	267	-	-
	Plastic bottles	509	610	719
	Plastic - other dense	455	500	587
	Glass flint	838	819	964
	Glass brown	300	293	345
	Glass green	879	860	1,012
	Steel cans	315	237	315
	Aluminium cans	167	125	167
	Foil containers	-	-	-
	Textiles	-	-	-
	Soil and other organic	-	-	-
	Non-compostable kitchen waste	-	-	-
	Compostable kitchen waste	3,090	3,090	3,090
	Compostable garden waste	-	-	-
	TOTAL	13,368	11,877	14,596
Kerbside recycling rate		60%	54%	66%
Recycling service logistics	No. of vehicles	5	14	6
	Total distance travelled	32,873	83,721	42,493
	Total fuel usage (litres)	40,469	34,040	54,032
Refuse service logistics	No. of vehicles	4	5	4
	No. of loads per vehicle per day	n/a	n/a	n/a
	No. of h/hlds collected per vehicle per day	629	628	639
	Total distance travelled	38,464	43,937	38,464
	Total fuel usage (litres)	55,419	61,640	55,419
Costs	**Gross annual collection cost**	**£1,199,413**	**£2,315,643**	**£1,357,525**
	Annual capital cost of containers	**£334,227**	**£260,628**	**£337,155**
	Gross annual management cost	**£1,279,714**	**£1,107,933**	**£1,158,142**

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Table 3: Assumptions used in the Environmental Assessment

			Assumptions made		
Topic	**Factor**	**Explanation**	**Current System**	**Optimised separate**	**Optimised comingled**
Materials	Material composition	Amount and type of recycled materials sent for each treatment method.	Surrey Heath provided the tonnage and split of recycled materials by primary and secondary categories.	Each system used the proportions of material from the 'current system' as provided by Surrey Heath BC in the proforma. Proportions were used as the outputs of KAT were not in the form that we required to allow a comparison of systems. For glass the split was 71:29 closed to open loop as per Epsom proforma. This was used because Epsom currently operate separate glass collections.	Each system used the proportions of material from the 'current system' as provided by Surrey Heath BC in the proforma. Proportions were used as the outputs of KAT were not in the form that we required to allow a comparison of systems. For plastic 50:50 split for PET and HDPE as this was the best estimate based on tonnage data from KAT.
				The proportions were calculated using the total material tonnes/ total tonnes sent for recycling. The proportions were then applied to the KAT output tonnages (Table 2) for each system. This provided input tonnages of each material that runs through the system.	
	Residual material split	The composition of materials sent to residual treatment.	This is the composition set as the percentage breakdown for kerbside residual waste for Surrey Heath BC in the Surrey Composition Analysis 2013/14.		
			This is the same in all cases.		
	Reject rate	The amount of materials that are rejected at the reprocessors (inc. MRF).	The amount of rejected material from the MRF used by Surrey Heath was provided by Surrey Heath in the proforma. This was given as 5%.	The amount of rejects for both MRF and reprocessors were calculated based on the proportions from the 'current system'. (The proportions were calculated using the total reject tonnes/ total tonnes sent for recycling). Where this data wasn't available reject information from Mole Valley and Epsom's Proformas. This is because it was the best available data.	
			For the reprocessing facilities rejects were also given as tonnages.	To calculate new tonnages the proportions from the Surrey Heath pro-forma were multiplied by new tonnages provided by KAT.	
	Reject material split	The composition of rejects from each facility type.	For all systems a composition of rejects was used. The split used was provided by Axion Consultancy, and had been previously used in work they completed for SCC on the SE7 work programme.		
	Tonnage	Tonnage data comes from the output of KAT (Table 2) and is proportioned based on information in the pro forma.	The output tonnage from KAT modelling (Table 2) was used for each of the three systems, proportioned to each material type.		
Treatment Facilities	Location	The physical location of each final treatment facility used to process the waste materials covered by the scope of the study, once they have been through the MRF or transfer station (see Table 1).	Surrey Heath provided the location of each treatment facility in their proforma.	For the recycled materials the closest reprocessor that produces closed-loop recycled outputs was chosen for each grade of material from the full range of reprocessors used by the Surrey WCAs that were involved in this compliance assessment.	
				Residual material was assumed to go to the same facilities that are used by the current system.	
	Distance between facilities	This is the journey between each treatment facility.	This was calculated using a route-mapping system from Google maps and sea transit mapper.		
			In all systems all routes were optimised and assumed to have no backhaul.		
	Treatment Type	Describes whether or not the material is recycled (open or closed loop) and also includes residual treatments (EfW and landfill).	Surrey Heath provided the type of recycling (e.g open or closed) carried out at each of the reprocessors, in most cases. Where recycling type was not specified in Surrey Heath's proforma an internet search was carried out to understand what type of recycling was carried out by each of the reprocessors. Follow up calls and emails were also sent to reprocessors where further clarification was required.		
	Recycling Bulking	Location at which the recycling material is bulked.	The locations used were as stated in the Surrey Heath BC proforma. For separately collected material this Camberley. For commingled material this was not applicable.		
	Residual Bulking	Location at which the residual material is bulked.	Residual material was assumed to be bulked the same facilities that are used by the current system (Ash Vale).		
	Reject treatment type	All rejects were assumed to be treated by EfW as informed by MRF operators.	All rejects from MRFs and reprocessors were assumed to be sent to EfW.		
			No transportation was included due to a lack of data from the reprocessors.		
	Residual Treatment	Residual waste is either treated by EfW, landfill, or a split between the two depending on the bulking facility.	Residual treatment used the SCC database of disposal destinations, which are specific to the bulking facility. This was given as % between different landfill and EfW facilities. This was 56% to EfW, and 44% to landfill.		

Transport	Annual Mileage	Is the total annual distance travelled with material between destinations.	This was calculated using material tonnages from KAT (Table 2), specific material densities provided by Grundons and mileages from the route mapping exercise.
	Collection	Fuel consumption data and output tonnes as provided by KAT (Table 2).	
	Haulage transport type	Is the transportation between reprocessing destinations.	For all road haulage, (excluding collection) a 44 tonne HGV was assumed, with a max. payload of 26 tonnes. For sea haulage to Asian destinations a deep-sea vessel was modelled with a 10,000t capacity. For European haulage a large container vessel with a 10,000t capacity was modelled.
	Road fuel consumption	Is the average fuel consumption for an HGV and was assumed based on data from the Department for Transport.	
	Sea fuel consumption	Data was not available.	
	Material density	Is the amount of each material that can be transported in a HGV at any one time.	This information was provided by colleagues at Grundons, as they responded to our request for this information.
Carbon Conversion	Material specific treatment conversion for total material quantity		To calculate carbon equivalent emissions for each of the treatment DEFRA (2011) carbon conversion factors were used. Primary data used for transfer stations, MRF and glass MRF as provided by colleagues at SITA and Recresso Herbert.
	Road transport fuel conversion		To calculate the carbon equivalent emissions for each of the material road haulage a DEFRA (2011) diesel conversion factor was used.
	Sea transport fuel conversion		To calculate the carbon equivalent emissions per kilometer for each of the sea vessel used Department for Transport (2013) conversion factor was used (as described earlier).