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# Trial to determine WEEE Protocol for category one large domestic appliances

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## 1.0 EXECUTIVE SUMMARY

The project objectives were to derive Protocols to assist in the recording and reporting of WEEE recycling in the UK. This is an additional protocol project examining Large Domestic Appliances (LDA) following recommendations with the small mixed WEEE protocol work. The composition for each of the 4 units, washing machine, dryer, cooker and dish washer were measured. The relative proportions of the units arising in the UK waste stream was determined based upon numbers of LDAs arising at CA sites and based upon UK sales of these items.

The relative proportions of LDA unit types based upon the CA site item count were:

- 44.8% - Washing machines,
- 12.4% - Dryers,
- 17.1% - Cookers,
- 13.4% - Dishwashers,
- 12.3% - Non-WEEE - gas cookers.

The Composition Protocol values for mixed LDAs, once the non-WEEE has been discounted (Non-WEEE = 13% in total, ~12% gas cookers plus 1% from residues within the units) were:

- 65% - Metals,
- 8% - Plastic,
- 27% - Other Materials.

## 2.0 INTRODUCTION

The EU Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), implemented into UK legislation by the Waste Electrical and Electronic Equipment Regulations 2006, requires producers to ensure separately collected WEEE is treated appropriately and recycled to target levels.

The Directive places different recycling targets on different categories of WEEE. In order to be able to calculate the achievement of these targets, it is essential to know the typical proportions of metal, plastic and other material within the category under consideration. In this report we are addressing the typical composition of Category 1 Large Domestic Appliances (LDAs) which includes washing machines, dryers, dishwashers and cookers.

The requirement for further investigation into the composition of LDAs was highlighted in the initial Small Mixed WEEE (SMW) protocol report. The composition for LDAs gained during this initial research work is reproduced here for comparison.

A sample of 100 units, 25 of each type (washing machine, dryer, cooker and dish washer) were collected and hand dismantled to determine the relative proportions of metal, plastic and other materials.

Once the composition of the LDA was determined it was then necessary to estimate the relative proportions of each of the unit types within the LDAs arising within the UK. This determination was undertaken in two ways. The first was to conduct an item count of WEEE arising at 8 Civic Amenity (CA) sites across the UK. The second was to look at UK Sales data for LDAs in the UK.

These data sources were used to estimate the relative portions of each unit type likely to arise within mixed LDAs. This information was then used to calculate the estimated metal, plastic and other material composition within a mixed LDA load overall.

The following protocols, which form the main objectives of the project, were developed using the information gained from these trials and data research:

- a protocol based on the proportions of the individual units within LDA arisings,
- protocols based on the proportions of metals, plastics and other materials within each of the LDA unit types, to provide an overall composition of LDA arisings.

The purpose of the protocols is to demonstrate how much WEEE has been recycled, whether received by the reprocessor/exporter as an individual category to be processed, or as a co-mingled load with materials from other wastes such as cars or packaging. The protocols are intended to reduce the need for excessive measurement and reporting.

## 3.0 ACKNOWLEDGEMENTS

The research work within this project has been undertaken with the assistance of several companies in the recycling industry, without whom the work would not have been possible to complete.

- AMDEA Ltd.
- European Metals Recycling Ltd.

- Coventry & Solihull Waste Disposal Company Ltd
- Waste Recycling Group Ltd
- Viridor Waste Management Ltd
- EWC (Environmental Waste Controls) Ltd
- Coopers Wholesale Ltd
- DSG Retail Ltd

## 4.0 WEEE CATEGORIES

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) introduces, amongst other things, a category listing of the various types of WEEE. The determination of whether a cooker falls within the definitions of WEEE was based upon the assumption that if it will operate without the need for electricity then it is not WEEE.

### 4.1 Category 1

This group contains large items such as refrigerators, freezers, fridge freezers, washing machines, dishwashers, dryers and cookers. It also includes smaller items such as microwave ovens, heaters, radiators, fans and air conditioning units. Within the initial SMW Protocol Report (January 2007) Category 1 materials were broken in to three sub-groups. These were fridges, which are processed as a separate waste stream, small category 1 materials including microwaves, heaters, radiators etc (which were processed and investigated as part of the small mixed WEEE trial) and LDAs including washing machines, dryers, cookers and dishwashers. It is the LDA fraction that is investigated in this report.

## 5.0 METHODOLOGY

### 5.1 Hand Dismantling of Large Domestic Appliances

Hand dismantling for this trial was chosen instead of processing through a shredder for several reasons. There was difficulty in securing a large enough sample of each item type; we estimated that so not to unduly influence the results, about 10 tonnes of each unit type would be required.

Secondly this sample would have to be stored along with the other four item types to a total of 40 tonnes on a shredding site. This storage requirement is difficult to achieve on busy sites where space is at a premium and control of the materials to maintain sample integrity would be difficult. Thirdly the shredding process would

require about a day to complete. Although the shred of about 40 tonnes could be easily completed in less than an hour, there would be a requirement to run the shredder empty to clear through residual materials on conveyor belts and processing chambers, and then to clean out all of the collection bays before the processing of a sample. Following processing all output streams need to be collected from each sample, and weighed off, before the next sample is processed. This is a very expensive process. Furthermore the mixed output materials would then require handsorting to segregate them into the required material types.

### 5.1.1 Source of Large Domestic Appliances

A total of 100 large domestic appliances, including washing machines, clothes dryers, dishwashers and cookers were secured from an electrical wholesaler. The origin of the appliances was a Retailer Take Back scheme. The items were intact and largely complete.

### 5.1.2 Hand Dismantling of the Appliances

The hand dismantling of the appliances took place in a designated covered workshop. Manual tools including wire cutters, hammers, crowbar, socket sets, spanners, screwdrivers and magnets were used to segregate and identify the different material types from each appliance. In addition, large weighing scales and a mass balance were also used.

Each unit was weighed on the large scales which recorded a total mass to the nearest 0.5kg. The appliance was identified by number and the manufacturer, and where possible, the model and serial number were also recorded.

The individual appliances were fully dismantled and segregated where possible into individual materials (e.g. metals, non ferrous & ferrous, plastics, glass, concrete, rubber, wood, foam & other). Each part of the appliance was assigned to an appropriate category bin.

At the end of the dismantling each bin was weighed off. For complex components, which could not be easily broken down, the individual component was recorded, weighed off separately and then assigned to the appropriate category. In certain appliances there was a significant amount of non-WEEE composition. This included water softening salt and its associated water, food debris and residual water in the dishwashers, food and grease debris in the cookers, water, detergents and limescale deposits in the washing machines and occasionally a small quantity of lint and fluff in the dryers.

The hand dismantling was undertaken by staff which were trained and overseen by consultants from Mayer Environmental Ltd (MEL). The recording and identification of components was undertaken by MEL consultants.

## 5.2 Issues Relating to the Hand Dismantling of LDA's

For the purpose of this report, individual components that were of a small mass but comprised of different materials (for example the program selector within a washing machine which is composed of metal and plastic) were weighed as a whole and then a proportion of the item's weight was assigned to either metal, plastic or other materials.

The dish washer's inner shells were found to have a dense black insulation/sound damping material bonded on to the interior stainless steel shell. This material was particularly difficult to separate from the interior shell. Separation was achieved by scraping and chipping the material off the item with a large scraper, and hammer and chisel. An average weight of the material was taken from four machines to apportion the mass of this product to the inner shell. This was applied to the remainder of the machines. As this material was not a typical plastic based material it was placed within the 'other' category of material.

The washing machines and particularly the dish washers were found to have water retained within sumps, reservoirs and the system/ pipe work. The dishwashers in particular have one or more reservoirs of water within the units. These also included the salt reservoir. Furthermore the items often had food waste/lime scale and cloth or fluff within them. These items where possible, were collected and weighed off to be designated non-WEEE. Often lime scale was not separated from the component to be weighed. It was not possible to collect the water from the units during dismantling. The amount of water within a unit was estimated based upon the change in mass balance of the unit during dismantling.

Cookers were also found to be contaminated to a lesser amount with fats and grease. Much of this was not separable from the main items once removed from the unit as a whole.

## 5.3 LDA's Data Collection

Once the relative composition of each of the four LDA unit types was broken down in to their metal, plastic and other material composition, the relative proportions of each type likely to arise in the waste stream was required. This relative proportion would therefore allow an average composition estimate for a mixed load of LDAs delivered to an AATF (Approved Authorised Treatment Facility) to be estimated. Should the

AATF decide to use the suggested protocol, this would remove the need for the site to sample and itemise the LDAs.

The relative proportion of the LDAs likely to arise was estimated in two ways. The first was an LDA item count at CA sites, the second was to use UK sales data supplied by AMDEA (Association of Manufacturers of Domestic Appliances).

### 5.3.1 LDA's Item Count

In order to establish the typical break down of LDAs arising in the waste stream, item counts were undertaken at Civic Amenity sites (CA sites). A total of eight sites were chosen across the UK, giving a good geographical spread and representing both urban and rural areas. These item count surveys were made possible by the kind co-operation of several companies within the industry allowing us access to undertake the work;

- Coventry & Solihull Waste Disposal Company Ltd
- Waste Recycling Group Ltd
- Viridor Waste Management Ltd
- EWC (Environmental Waste Controls) Ltd

The following sites were surveyed for two days, over a total of an eight week time period:

| *Site:* | Region: | *Operator:* |
|---|---|---|
| Coventry & Solihull HWRC | West Midlands | Coventry & Solihull Waste Disposal Company |
| Taunton HWRC | South West | Viridor Waste Management |
| Shoreham HWRC | South East | Viridor Waste Management |
| Blackburn & Darwen HWRC | North West | Environment Waste Control |
| Harrogate HWRC | North East | Environment Waste Control |
| Dowlais HWRC | South Wales | Environment Waste Control |
| Boston HWRC | East Midlands | Waste Recycling Group |
| Luton HWRC | South | Waste Recycling Group |

Table 1. CA Sites Visited.

Item counts were carried out over a two day period representing a week day and a weekend day (Friday and Saturday). During the site's operational hours all LDAs brought to the sites were recorded.

In addition, a total item count of all WEEE items entering the site for disposal was made. This data is made available in the appendices, although it is not required for this report and is included factually.

As the results were based upon items counted on a Friday and a Saturday, there is a natural bias in the results; a factoring of the data was required. Therefore, results for the Friday were assumed to be representative of a week day, and multiplied by 5. The results for the Saturday are also assumed to be representative of the weekend and are therefore multiplied by 2. This appropriately weighted the data to a week's collection.

The number of items was then converted into a total weight. The total weight was then calculated by multiplying the total no. of units by the average weight of the appliance type as determined during the trails.

### 5.3.2 LDA's Data Sales

AMDEA (The Association of Manufacturers of Domestic Appliances) sales figures were used to estimate the proportions of washing machines, dish washers, dryers and electrical cookers entering into the waste stream. The figures used in this trial related to those sales in 2006.

These figures presented the sales totals by item in the UK. Similarly to the CA item count the sales numbers were then converted in to weights using the average weight determined during the hand dismantling trials.

The assumption made is that the sales figures represent replacement items, and an equivalent ratio of items will appear within the waste arising. This may be adjusted based upon the numbers of new build properties which will have new appliances fitted. However, in this situation it is the ratio of the 4 appliances within the sales figures, and not the absolute sales, which is important and required for further calculations.

### 5.3.3 Non-WEEE

Within both of the above data sets non-WEEE in the form of gas cookers was identified. Gas Cookers were not hand dismantled to determine an average composition. However, an average weight based upon gas cookers received was

determined. This average item weight was used to convert the item count in to total weights.

The gas cookers were determined as non-WEEE if they performed their primary function without electricity. For example a gas cooker with an electric clock, or electric ignition powered from mains electricity would not be sufficient to qualify as WEEE. A gas cooker with an electric hob or grill would qualify.

These non-WEEE units, gas cookers, were then added to the non-WEEE components found during the hand dismantling. This included material such as water, and food. The sum of these items produced an estimate of non WEEE within the LDA waste arisings.

## 6.0 RESULTS

Assumptions have to be made regarding the samples and the data collected to enable interpretation of the results. For example, the length of time over which the CA site item count was undertaken, the number of days included and the time of year may all have a bearing on the results. The AMDEA data clearly demonstrates that dryer sales in the UK rise in the winter, therefore one may expect more dryers to appear within the waste stream in winter time. Furthermore the sample size may also be significant. The sample collected for dismantling was based upon items collected by a take back scheme. These items do represent those being replaced in the UK at this time.

### 6.1 Hand Dismantling Trials

The results of the hand dismantling trials for the individual appliances are shown below. Variation between the units selected for the dismantling presented below are the mean and the standard error for the unit weights, and the 95% confidence level. The 95% Confidence Interval states that if the trial was repeated over and over, that in 95% of the cases the mean would be expected to fall within the range provided.

| Unit Type | Mean Weight of unit<br><br>Kg | Standard Error<br><br>n | Confidence of the mean 95% (t) |
|---|---|---|---|
| Washing Machine | 69.55 | ± 1.44 | ± 2.96 |
| Dryer | 34.77 | ± 1.05 | ± 2.16 |
| Cooker | 56.35 | ± 2.19 | ± 4.51 |
| Dishwasher | 51.71 | ± 1.51 | ± 3.11 |

Table 2 : Results of hand dismantling trials average unit weights.

### 6.1.1 Washing Machines

Based upon the 25 unit sample of washing machines, the total sample weight equalled ~1740 kg. This produces an average weight of about 69.55 kg per item which was the heaviest of the 4 items. The graph included below illustrates the proportions of metal, plastics and other materials within the appliance category. The large percentage of 'other' material is attributed to the concrete ballast weights, which in some appliances weighed up to 29.5kg. On average the amount of non WEEE; water, clothes and dirt was about 0.25kg, and represented an average of ~0.4% / unit.

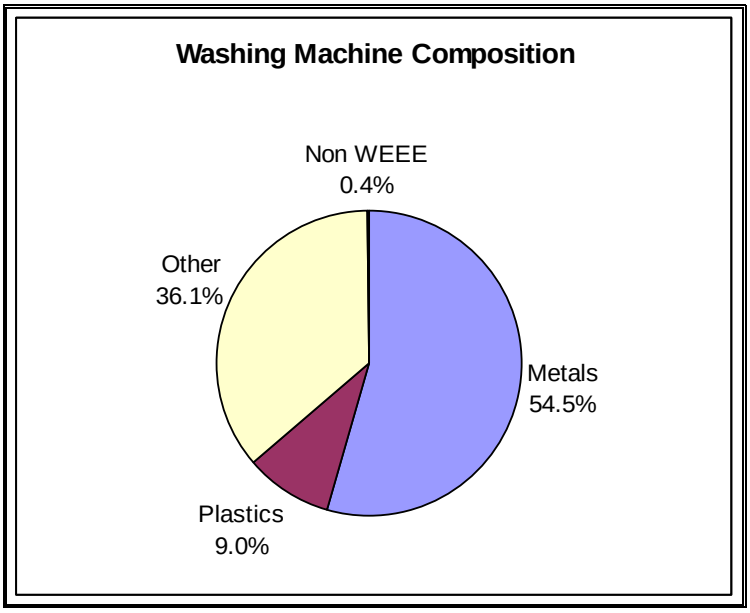


Figure 1 : Average Washing Machine composition.

### 6.1.2 Dryers

Dryers were the lightest of the items dismantled and less than half the average weight of a washing machine. As there was no water within the units and the amount of lint or residue from use was very low, there is no non-WEEE fraction associated with them. The 'other' fraction was made up of rubber hoses and chip board/formica tops and glass.

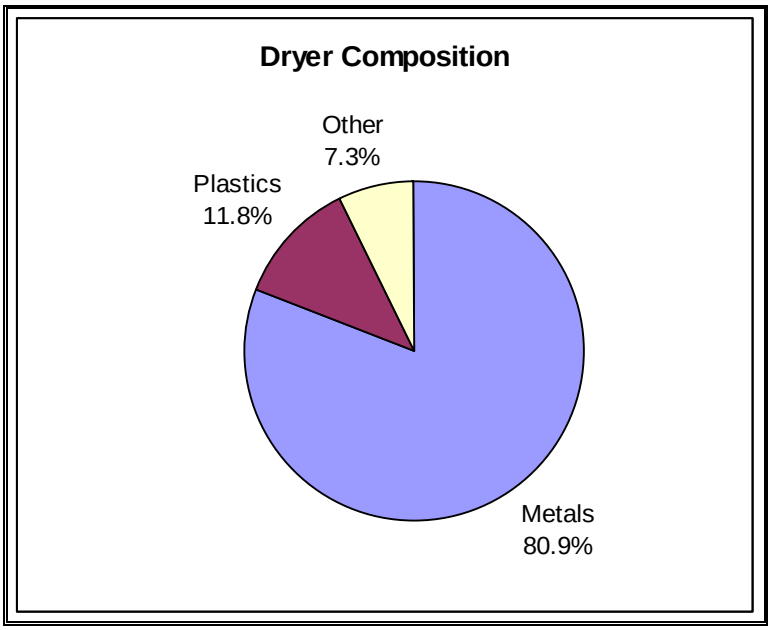


Figure 2 : Average Dryer composition.

### 6.1.3 Electric Cookers

The cookers were on average the second heaviest item, and contained the largest metal fraction of any of the items at ~85%. The 'Other' fraction was relatively large and was composed of materials such as insulation, rock wool, fibreglass and refractory brick/ceramic in hob tops. In addition, a large proportion of the weight was held with the glass either on the hob tops or oven doors. As may be expected the amount of plastic within the items was small and limited to the controls and some small finishes.

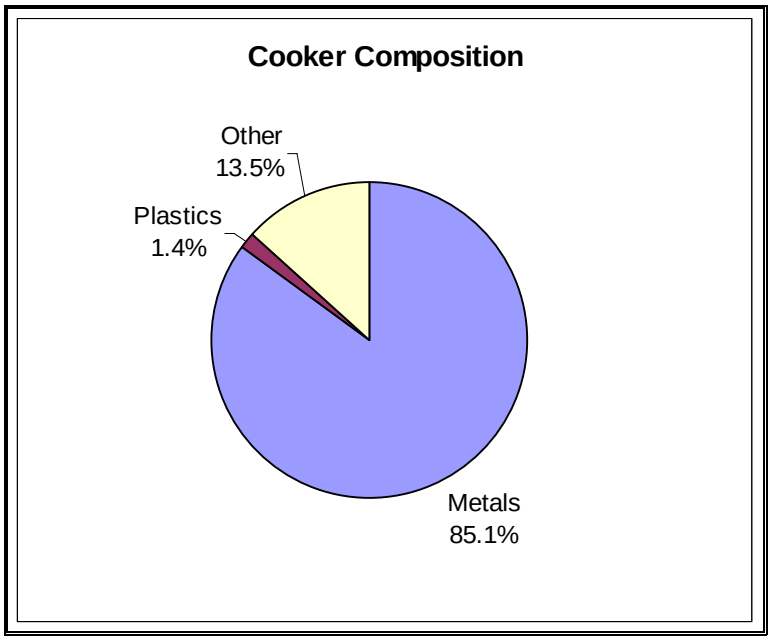


Figure 3 : Average Electrical Cooker composition.

### 6.1.4 Dishwashers

Dishwashers were the most complex of the items to dismantle; they also held the largest quantity of non-WEEE materials. The non-WEEE was mainly composed of water, water softening salts and food residues trapped within filters. Typically, the interior of the washers appeared to be stainless steel with a bonded layer of dense foam/plastic on the outer surface. This appeared to be a sound dampener and insulator. It was difficult to remove and required chipping with a hammer and chisel, and scraper to remove. This material was not considered to be a typical plastic and therefore it is included within the ‘other’ materials.

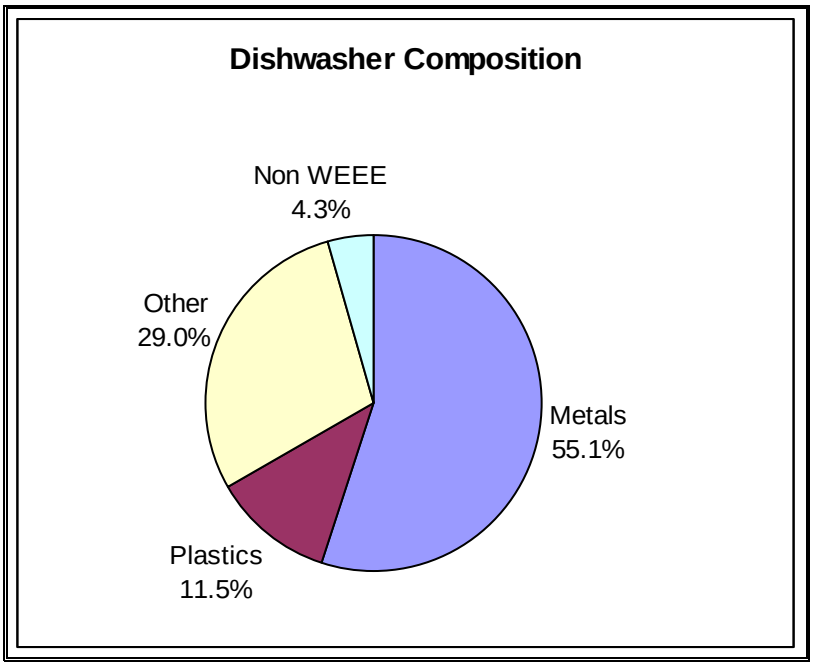


Figure 4 : Average Dishwasher composition.

## 6.2 Summary of Item Composition

The summary provided below displays the composition of each of the unit types. These are based upon a total of 100 units and 25 units of each type.

| Item Type | Metal % | Plastic % | Other % | Non WEEE % |
|---|---|---|---|---|
| Washing Machine | 54.5 | 9.0 | 36.1 | 0.4 |
| Dryer | 80.9 | 11.8 | 7.3 | / |
| Cooker | 85.1 | 1.4 | 13.5 | / |
| Dishwasher | 55.1 | 11.5 | 29.0 | 4.3 |

Table 3: Summary of average item composition. The values have been rounded to one decimal place, and take account of the non-WEEE fraction within each unit type.

## 6.3 Category 1 Large White Goods - SMW Protocol Project

The large white goods trial undertaken as part of the previous SMW trial was dominated by the presence of Washing Machines. We believe that this skewed the sample in respect of its composition. It is for this reason this additional work was proposed.

The large white goods displayed a predominance of metals and other materials. It is noteworthy that the concrete and glass within the washing machines appeared within the unallocated fraction and ultimately the 'other' component of the outputs.

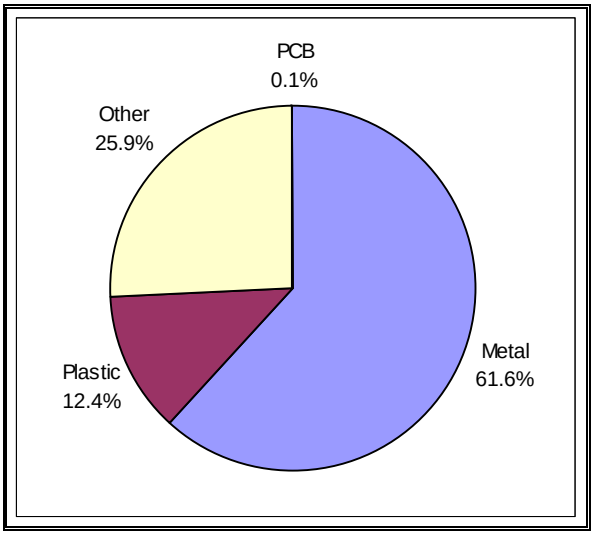


Figure 5 : Figure presented from initial trials - Category 1Large white goods dominated by ~85% Washing Machines.

### 6.4 Category Composition for Category 1 LDA

The unit compositions have been estimated and presented within table 3 above. The next stage is to determine what the relative proportions of each unit should be for general LDAs arising in the UK waste stream. This was undertaken in two ways; a Civic Amenity Item count, and UK Sales Data search.

#### 6.4.1 CA Item Count

All WEEE items arising at 8 sites across the UK were counted over a 2 day period (Friday and Saturday). The process of factoring of these numbers, and the conversion in to weight percent, is explained above in section 5.3.1.

The results are based upon 494 items (factored for the day of arrival) and a total weight of ~ 28 tonnes (based upon average unit weights). Gas Cookers, reported below, were considered as non-WEEE materials within the data.

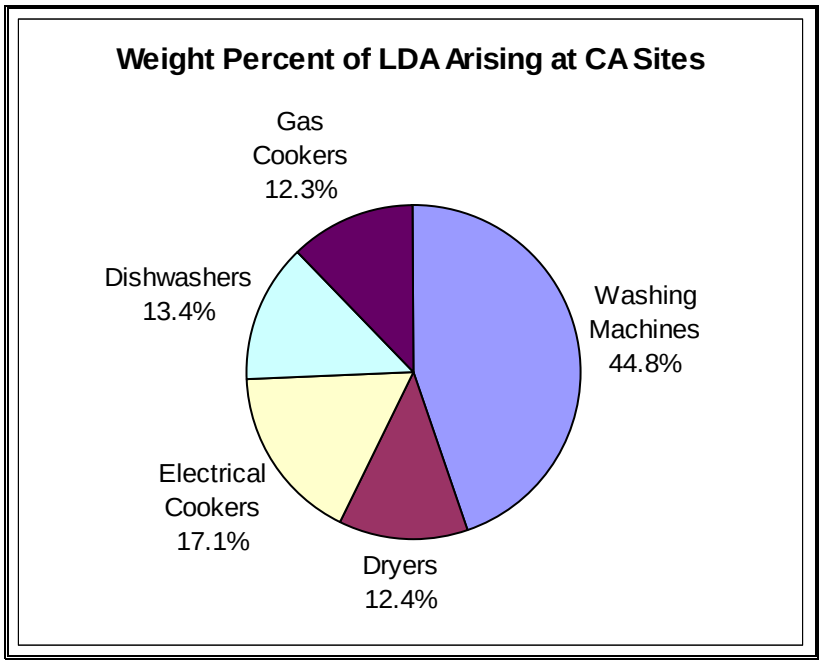


Figure 6 : Proportions of LDAs based upon CA site item count converted to weight percent.

### 6.4.2 Sales Count LDAs

Sales data on the number of items sold was provided by AMDEA (Sales Data). AMDEA data represents about 80% of the industry sales of LDAs. The number of items sold was multiplied by the average weight as determined in the dismantling trials. Gas cookers should be considered as non-WEEE within the data presented.

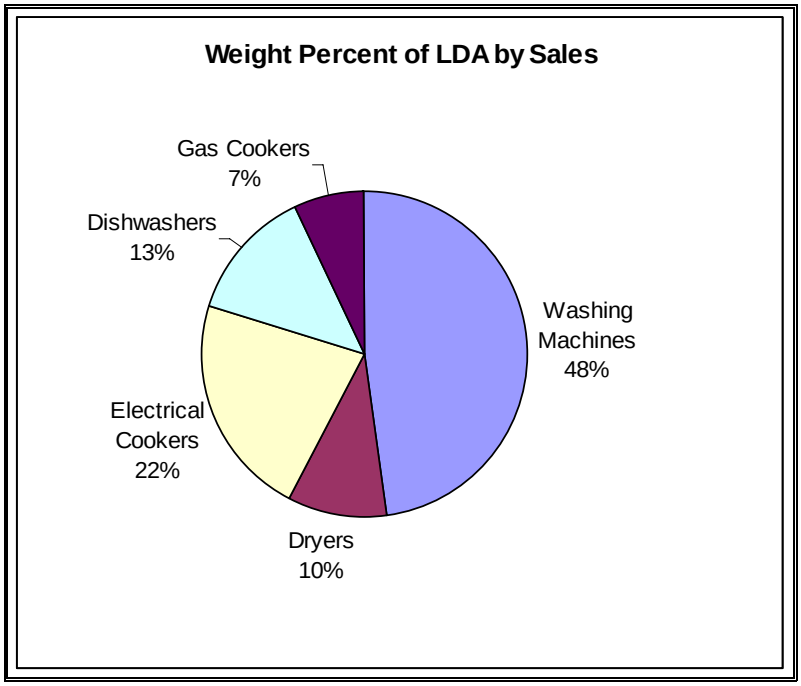

Figure 7 : Proportions of LDAs based upon 2006 UK sales figures provided by AMDEA converted to weight percent.

### 6.4.3 Comparison of data

Because the data has been based upon the average values of unit weights, values are reported to the nearest whole percentage point.

The two sets of data suggest a very similar distribution of unit types. The most significant difference in the data can be seen in the Gas Cookers (non-WEEE). The CA data suggests that there is about 12% by weight of gas cookers compared to the 7% provided within the Sales Data. In addition, the sales of electrical cookers are about 5% greater than those arising at a CA site.

Washing machines, the heaviest items of the four considered, were ~3% lower within the Sales Data than in the CA site item count.

All of the data used for these calculations, graphs and interpretations can be found within the appendices.

## 6.5 Calculation of the WEEE Composition

In order to calculate the metal, plastic and other material composition of mixed LDA arising it is first necessary to remove the non-WEEE fraction, and just look at the WEEE.

When the non-WEEE is removed from the data sets the relative proportions of metals, plastic and other materials within the remaining WEEE can be calculated. When the WEEE composition is calculated using the two different data sets (CA sites and Sales Data) the results derived are very similar, despite the different amounts of non-WEEE present within each data set. When these data are reported to the nearest whole numbers, from both data sets, they produce values of 65% metals, 8% Plastic and 27% other materials.

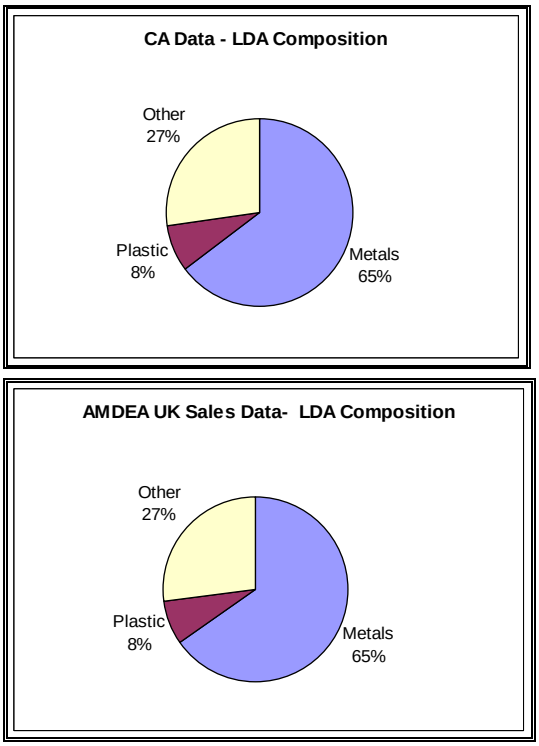


Figure 8: Comparison of LDA compositions calculated using CA derived data and AMDEA based sales data converted to weight percent.

The calculated compositions of the mixed LDAs appear to be very similar, suggesting that there is a good correlation between the CA site data and the AMDEA sales figures. Therefore, as this composition was calculated using two different data sets and produced very similar results, it is the CA Site composition which is proposed as the suggested make up of the mixed LDA WEEE for the protocol.

The major difference between the data sets falls within the gas cooker and other non-WEEE fractions. It was assumed that as the CA site is an actual point of waste arising, and the LDAs brought there for disposal will have been used and therefore contain water, water softening salt, food, which is also non-WEEE, the larger 12% non-WEEE fraction should be used for the mixed LDA protocol, rather than the Sales Data figure of 7%, plus the 1% within the units.

## 7.0 PROTOCOLS AND EVIDENCE

The use of protocols simplifies the reporting and evidence system for the requirements of the WEEE Regulations. Protocols are used in place of separate evidence gathered by individual operators.

Protocols are already used in other areas of evidence based recycling operations in the UK. These include the Packaging Recovery Note (PRN or PERN) system and the End of Life Vehicle (ELV) regulations.

In both cases, the requirement is to demonstrate that recycling and recovery in the UK has attained a certain minimum level. The measurement of the recycling/recovery rates is based upon nationally agreed protocol values.

Protocols also have an important role to play in the relationship between the recycling industry and the regulators. They help to reduce the cost burden on operators required to generate evidence demonstrating recycling and recovery. They allow for a 'light regulatory touch' in respect of auditing the process and the standard of proof required to demonstrate recycling and recovery; and they allow the regulators to focus on those areas of the recycling/recovery chain which will require improvement to demonstrate compliance.

The Protocol value presented in this report may not be relevant for all situations or processing operations. For example, if an operator wished to process LDAs as a discrete input protocols would not be required. However if LDAs were co-mingled for processing, then protocols could be used. Operators have a choice to use the agreed protocols or to use values derived by their own investigations and measurements; providing the method used is robust and the results are agreed with the regulators. The application and use of the protocols is suggested and discussed below. Protocol use will be further explained by considering the scenario below. This scenario explains how this protocol assists in the monitoring and data recording process. It also demonstrates how a protocol helps to measure performance.

This scenario and others were outlined in the SMW Protocol report. This report explains in more detail the issues relating to the protocols and their use.

### 7.1 Scenario – Co-mingled input to an AATF

WEEE is delivered to an AATF along with other non-WEEE materials. These materials are processed at the same time as non-WEEE material. This scenario is most likely to occur at an AATF Shredder/Fragmentiser site processing LDAs. The LDAs would be fed into the plant at the same time as other non-WEEE light iron. In this situation a protocol to confirm the make up of the LDA is required. This allows the AATF to calculate the amount of WEEE derived output present in the overall output streams. When these materials are sent to a reprocessor/exporter, evidence relating to the amount of WEEE in the overall output can be claimed. The maximum claimed is relative to the composition of the WEEE input. This will require the AATF to report the actual weight of LDAs processed.

In addition, differing types of WEEE may also be processed together, for example SMW and LDAs. There are protocols in place for both of these material streams, and providing the relative weights of each type are known the outputs can be calculated and apportioned to the appropriate category.

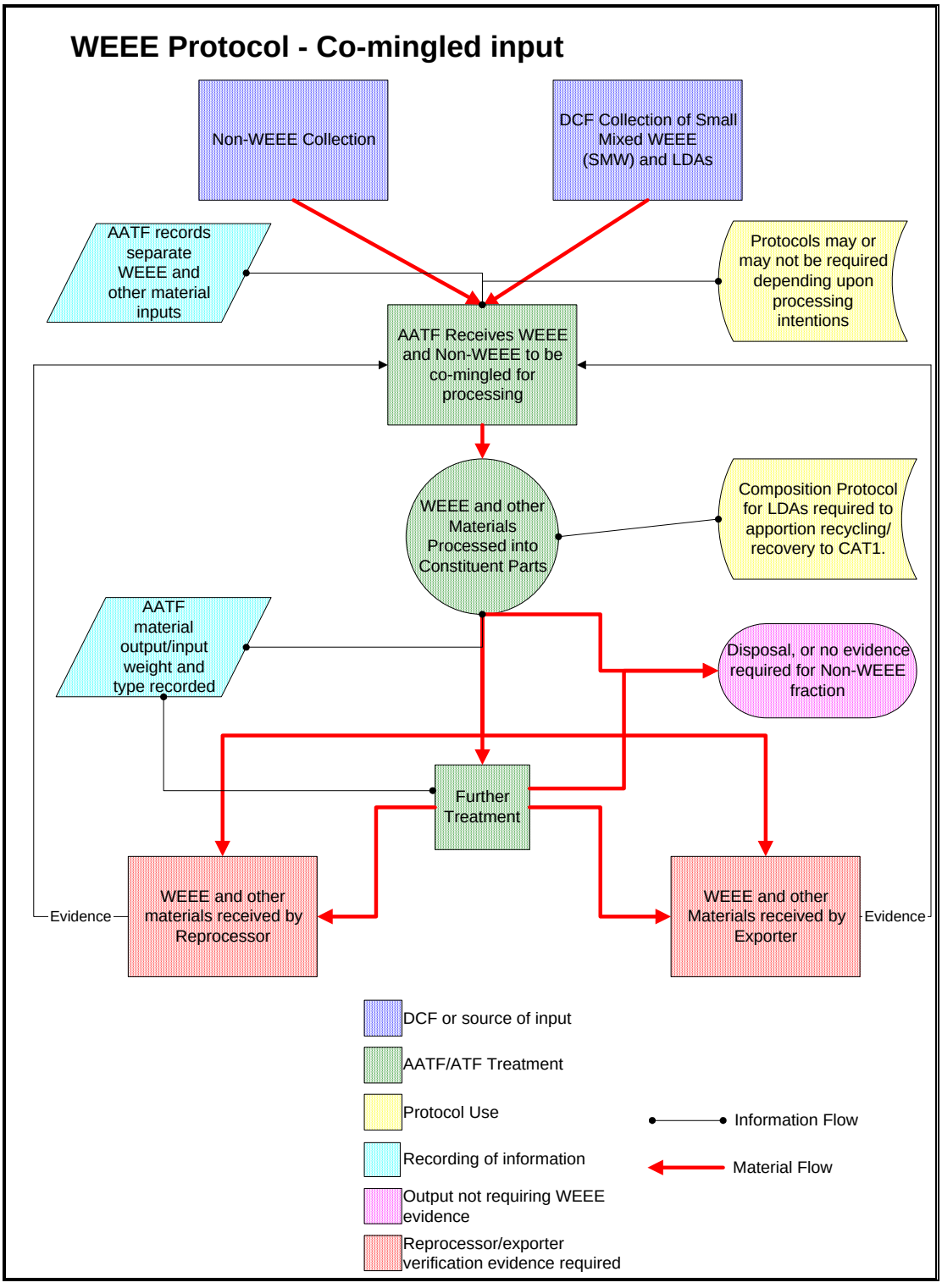


Figure 9 : Co-mingled processing of WEEE and Non-WEEE.

## 7.2 Summary of Protocol

The protocols are to be used to simplify the reporting and evidence requirements for the recycling and recovery of WEEE. They may not be relevant in all situations but

even when a protocol is not required it may be used to provide a useful ‘sense’ check within the system.

It should be noted that during the processing, WEEE will eventually lose its identity as WEEE, and will become its constituent parts, metal, plastic etc. Processing at an AATF may reduce all of the items into fragments of metals and plastic from which it will not be possible to determine what item they were derived from or even what category. These materials may be mixed with other similar grade material prior to dispatch. When delivered from an AATF to an exporter/reprocessor or even another ATF, they are unlikely to be stored and moved as a discrete load.

Protocols use input data to determine what the total amount of evidence is likely to be required; they use the output data to determine what may be secured and to track the material, and use the relative material composition to reapportion this evidence to the appropriate input. With a protocol in place, the loss of identity of the WEEE material and mixture with other materials can occur, whilst still retaining an understanding of what proportions of WEEE materials are being processed and moved through the system.

## 7.3 Alternative uses of the Protocol Values

It is clear that many operators will continue to receive, batch and dispatch LDAs within mixed loads of other metals from DCFs. In these situations it may also be possible to apply the values within the protocol to assist in the reporting of materials received. This section of the report provides suggestions for how the values within the protocol may be used to assist with these differing scenarios.

In general DCFs may pre-segregate the WEEE to remove the gas cooker non-WEEE fraction, they may place all the LDAs in a bin (with or without the gas cookers) and mix them with other metal arising at a site. As mentioned above the use of a protocol is down to the individual. Where a whole protocol is not to be used, then part application is possible, providing further monitoring and sampling is used to support it.

### 7.3.1 Scenario

In this scenario the AATF receives a bin of mixed metals and LDAs from a DCF. It is not possible to use the protocol directly as the load is not wholly LDA units. The DCF informs the AATF that they do not segregate gas cookers at source.

The AAFT accept the bin of metals, and count the number of LDA units within it, but does not identify the units. The total LDA item count is 15.

The operator then uses the protocol values to determine what will be non-WEEE (gas cookers and materials within the dish washers/washing machines). It should be noted that in the protocol the percentage mixture of LDAs is expressed as a weight percent. The LDA count from the bin needs to be first converted to a percent by unit type, and then in to a weight percent based upon the protocol values. The unit distribution values to make this calculation are presented in the appendices.

15 units counted in the bin:

11% non WEEE by unit count = 1.64 units

Of the other units:

36.7% washing machines (less non WEEE) = 5.51 units

17.24% Cookers = 2.59 units

20.28% Dryers = 3.04 units

14.8% Dishwashers (less non WEEE) = 2.22 units

There may be rounding of values, but this amounts to 15 units in total.

The estimated 5.5 washing machine units present within the bin is then multiplied by the average weight from the trial 69.55kg, the weight of washing machines is therefore estimated to be 383.2kg. This is repeated for each unit type and totalled to provide an LDA WEEE weight.

The total weight of LDA WEEE in the bin is therefore estimated to be 749kg. The composition protocol can then be applied 65% metal, 8% plastic and 27% other materials. Based upon this calculation 487 kg of metals, 60 kg plastic and 202 kg of other materials, rounded to whole kg, would be the total WEEE evidence available from this bin.

If the gas cookers are removed at collection the values are adjusted to reflect that there will be less Non WEEE in the bin.

It should be noted that not every bin/container of material entering a site will need to be sampled counted and reported upon. It is likely that a structured sampling programme agreed with the regulators would be sufficient to provide adequate data on the loads entering a site. As the data set builds over time the results become more robust.

### 7.4 Comments

The example scenario demonstrates how protocol values can be applied to a greater or lesser extent in respect of calculating evidence requirements. Operators are not obliged to use the protocol and they may derive their own values over time.

For example LDAs consistently arising from a source which is know to have a mixture of units different to that assumed in the protocol. Consistent monitoring and trials to determine the composition of these arisings will allow an operator to propose site specific values to the regulators, thereby negating the need for standard values.

Assumptions are made in using the data in this way the main assumption is that the LDA arisings are composed of units in the same way as they were for the protocol trials.

## 8.0 COMMENTS ON THE RESULTS

### 8.1 Changes to LDA composition

#### 8.1.1 Seasonality

The work undertaken at the CA sites represents a sample of LDAs appearing in the waste stream over the early spring period. Therefore it is expected that there may be some seasonal bias to the data. In addition the factoring increases the data for the CA site to that for the period of a week. Other cycles of material arising at a CA site may exist on a bi-weekly monthly or seasonal cycle. However, it should be noted that the AMDEA sales data, which represents sales for a whole year, was comparable to the results for the CA Site item count.

It should also be noted that the relative composition of LDAs arising from a take back scheme may vary in its composition when compared to that arising at a CA site.

### 8.2 Reproducibility

The methods used to generate the data and ultimately calculate the suggested protocols is provided in detail for two principal reasons: Firstly it lays out clearly the processes followed to generate the data, to provide confidence; secondly it enables the work to be repeated or added to, as required, using the same methods and procedures as adopted here.

Use of common methods enables direct comparisons to be made between data sets. If data were to be collected using other methods, they may not support direct comparison.

## 8.3 Recycling/Recovery - Making the Protocols Work

It is clear from the LDA data that the metals content of the WEEE fraction is ~65%. This is not enough on its own to reach the required recycling rate of 75% as stipulated under the WEEE regulations. This leaves a 10% shortfall from the target. To reach the required 75% level materials from within the 'other' and plastic fraction will have to be recovered and recycled. In a single input stream to a separation process this is easy to determine; what goes in must come out again. Therefore, in this example the plastic recovered in this way will only have been derived from the LDA input.

This situation is complicated if the materials are processed with non-WEEE material or other WEEE from different categories. For example it would not be possible to determine from where the plastics have been recovered.

However, a significant proportion of the overall material composition is due to the presence of glass and aggregate. On the whole these materials compose up to ~20% of the total. Light iron in feed to shredders is unlikely to contain concrete other than that found within LDAs and principally within washing machines. Therefore, it may be assumed that stone or aggregate recovered from a shredding process will have been derived from the LDAs (and primarily the washing machines).

Furthermore, the glass fraction within the LDAs will also appear in the outputs. However, glass may be present as a result of processing ELVs (end of life vehicles) or other glass containing metal items. Therefore, care will be required in claiming recovery of these materials to ensure double counting of glass for ELV recycling and WEEE recycling does not occur.

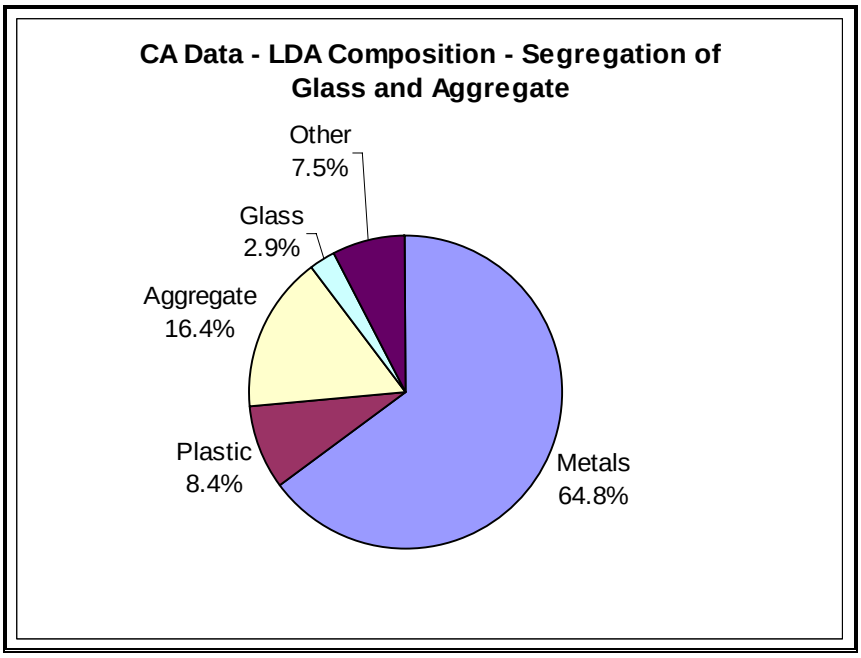


Figure 10 : Displays the relative proportions of Aggregate and Glass within the LDA composition once non-WEEE is removed. It should be noted that metal and plastic alone will not reach the 75% recycling target.

## 9.0 CONCLUSIONS

Trials were undertaken to establish the typical composition of four types of LDA units and the composition of the overall LDA waste stream arising in the UK.

Using the trial data, the following protocols have been developed:

- a protocol based on the proportions of LDA unit types within mixed LDA loads arising in the waste stream,
- protocol based on the proportions of metals, plastics and other materials within each of the four LDA unit types (Washing machine, dryer, cooker and dishwasher). Separate break downs are provided for each unit.
- a protocol for LDAs arising based on the proportion of metals, plastics, other materials within each unit type.

The protocols are capable of demonstrating how much WEEE has been recycled, whether received by the reprocessor/exporter as an individual category or as a co-mingled load with materials from other metal arisings.