

1 EXECUTIVE SUMMARY

The objectives of this study, as defined by the Department of Trade and Industry (DTI), are as follows:

- inform UK government of the impacts of the proposal for a European Directive on Waste from Electrical and Electronic Equipment on the UK (proposed WEEE Directive).
- identify the net environmental 'benefits' and 'costs' of the collection, the reuse/recycling of a range of electrical and electronic products and the pre-treatment of components containing certain hazardous substances.
- estimate the financial costs (net of the revenue gained from the sale of the recycle or refurbished item) of these requirements to businesses, charities and local authorities.

This study has used a flexible Life Cycle Assessment (LCA) and cost model, which has been developed in consultation with ICER, many of its members and other organisations, trade associations and companies involved in the processing of WEEE. The model has been used to assess and compare the environmental impacts and associated economic costs for eight WEEE products; these being a washing machine, personal computer (PC), kettle, telephone, television, vacuum cleaner, lawnmower and refrigerator.

For each product, the following scenarios have been modelled:

- The current situation in the UK;
- A hypothetical 100% landfilling scenario;
- The Commission's second draft of the proposed European Directive on Waste Electrical and Electronic Equipment.

In the case of the latter, a further analysis has been undertaken which assesses the relative effects of the following scenarios:

- 100% recycling;
- 50% recycling and 50% refurbishment;
- 100% refurbishment.

In addition, sensitivity analyses have been carried out to address points of interest for individual products, where applicable.

The findings are as follows:

1. Results on the overall systems

- Current UK processing and disposal routes for the eight studied products result in less environmental impacts compared to 100% disposal to landfill. The Life Cycle Financial Analysis shows that the proposed WEEE Directive scenario and the

Current UK scenario are the most cost effective. This is for the overall system and includes additive costs and revenue.

- In general, the measures required by the proposed WEEE Directive result in a decrease in environmental impact compared to current UK practices, for six out of the eight products (washing machine, PC, vacuum cleaner, lawnmower, telephone and kettle) for life cycle inventory, problem and medium oriented impact methods used in the study.
- For the refrigerator and television, the results are more complicated with some environmental impacts giving a lower value for the proposed WEEE Directive whilst others give a lower environmental impact for the current UK situation. For the refrigerator this arises due to the use of CFCs as a blowing agent and refrigerant which is assumed to prevent refurbishment under the proposed WEEE Directive scenario, due to the will to remove use of CFCs through the Montreal Protocol conditions. In the case of the television, this arises because of the need to process the cathode ray tube (which is an important constituent of the television) to fulfil the proposed Directive requirements.
- All products (except the refrigerator) have a negligible effect on stratospheric ozone depletion, which is expected to continue to decrease as measures taken as part of the Montreal Protocol, continue to come into effect.
- Eutrophication and non renewable resource depletion are the two impacts for which the greatest gains under the proposed WEEE Directive are made (relative to the current UK situation). By contrast, global warming is (generally) the environmental impact which shows the least gains under a proposed WEEE Directive scenario.
- From the Life Cycle Financial Analysis it can be concluded that the Current UK scenario is generally the most cost effective scenario. This trend is most apparent for the kettle and refrigerator. Whilst it may appear that the proposed WEEE Directive scenario is more cost effective for the lawnmower, vacuum cleaner, personal computer and washing machine, it may be assumed that, in reality, sufficient markets do not currently exist for enforcement of the conditions under this scenario.
- By way of illustration, it should be noted that the proposed WEEE Directive produces net values for the overall systems of only £24 (11%) for the vacuum cleaner and £20 (1%) for the personal computer *higher* than those net values produced under the Current UK scenario. It is therefore reasonable to assume that as the current situation produces relatively high revenues and profitable net values for these two products, markets do not currently exist which would enforce the proposed WEEE Directive scenario.
- For the washing machine and lawnmower, the difference in overall system net value between the Current UK scenario and the proposed WEEE Directive scenario increases to £81 (93%) and £97 (75%) respectively. Whilst the proposed WEEE Directive scenario clearly results in the most profitable overall net values, it may again be concluded that such a scenario is not currently being adopted due to insufficient markets. For both products, the existing situation already produces relatively large disposal system revenues.
- None of the scenarios appear cost-effective for the telephone. This is due to the inclusion of significant processing costs (i.e. refurbishment costs) for the current situation and also for the proposed WEEE Directive scenario. The overall system net values is therefore negative for these two scenarios as well as for the 100% Landfilling scenario; the latter being due high additive system costs. For the

television, the overall system net value is only positive in the 100% Landfill scenario (£75) which is due to the inclusion of a high additive system revenue (£1,273). The current situation and the proposed WEEE Directive scenario, however, produce negative overall net values for the television for the same reasons as for the telephone.

- Overall, it can be concluded that for the overall system, the Current UK scenario is realistically cost-effective; that the proposed WEEE Directive scenario is also cost-effective but that sufficient markets will need to exist to enforce such a scenario; and that the 100% Landfilling scenario is less cost-effective due to the generation of lower disposal system revenue and inclusion of higher additive system costs. For the disposal system, the 100% Landfill does not produce any positive net values principally due to the exclusion of disposal system revenue.

2. How easy is it to reach the Proposed WEEE Directive targets?

- The targets set by the proposed WEEE Directive would appear to be more readily 'achievable' for some products compared to others, based on composition data and recovery technologies modelled in the study. On this basis, the telephone and kettle would appear to achieve the 70% target set by the proposed Directive more easily than other assessed products reach their targets.
- The washing machine, PC and lawnmower also reach their respective proposed WEEE Directive targets. However, this attainment depends on some crucial factors with respect to level of plastic (and other material) recovery, and markets being available for the recycle.
- The proposed WEEE Directive targets for the refrigerator, television and vacuum cleaner seem difficult to attain. In the case of the television, this is due to the dominance (by mass) of the CRT as a constituent of the television. This is not the case for the PC because the CRT is smaller and makes less of a contribution to the composition (which also consists of a control unit and auxiliary components¹).

3. Comparing recycling with reuse options

- Caution must be used in interpreting the figures generated by these scenarios which correspond to "extreme" conditions.
- Refurbishment of all products is environmentally preferable to recycling, when comparing the WEEE 'disposal' systems.
- However, when considering the WEEE 'disposal' system in the context of the 'additive systems', the results vary from one product to another.
- The Life Cycle Financial Analysis shows with the exception of the television and telephone, the 100% reuse scenario produces the most cost-effective results for all products. For the television and telephone, however, the 100% recycling scenario produces the greatest net values for the overall system due to the inclusion of significant refurbishment costs in the 100% reuse scenario.

¹ Auxiliary components include the keyboard and possibly the mouse. It should be noted that the inclusion of the mouse would not make a difference to the results.

4. Transportation

- Sensitivity analysis relating to collection distance for the washing machine and PC shows that the systems are not sensitive to this issue implying that variations in this parameter, as might be expected for equivalent systems in Scotland, Wales and Northern Ireland, will not produce major changes in environmental or cost impact.
- Transport costs make up a high proportion of total disposal system costs (excluding additive costs) for all the 100% Landfill scenario. The Current UK and proposed WEEE Directive scenarios have higher processing costs which affect the contribution of transport costs to disposal system costs. This contribution decreases for the current UK situation and the 100% Landfill scenario for the overall system due to the inclusion of additive system costs. The proposed WEEE Directive scenario's transport cost contribution, however, remains the same as no additive system costs are included in this scenario (with the exception of the refrigerator).