

Integrated LCA and Financial Analysis of the Implications of Implementing the Proposed WEEE Directive

**Anne Landfield, Ecobalance-PricewaterhouseCoopers,
LLP**

InLCA, April 25-27, 2000

Outline

- ◆ Objectives of the Study
- ◆ System Boundaries
- ◆ Methodology
- ◆ Summary of Results
- ◆ Conclusion

Study Objectives (1/2)

- **Inform UK government of the impacts of the proposal for a European Directive on WEEE on the UK (proposed Directive).**
- **Identify the net environmental ‘benefits’ and ‘costs’ of collection, reuse/recycling of a range of electrical and electronic products, and pre-treatment of components containing certain hazardous substances.**
- **Estimate the financial costs of these requirements to businesses, charities and local authorities.**

Study Objectives (2/2)

Apply a scientifically rigorous and robust methodology to identify the environmental and financial costs and benefits of:

- the *2nd draft* of the proposed EC Directive requirements on WEEE
- the current UK situation
- 100% landfilling

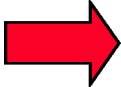
(plus several different scenarios defined by the UK Dept. of Trade and Industry (DTI) for i.e., the reuse/recycling targets)

Categories of WEEE Investigated (1/2)

1. PC (incl. monitor, processor, keyboard)
2. Washing machine
3. Refrigerator
4. Vacuum cleaner
5. Telephone
6. Television
7. Lawnmower
8. Kettle

 comprise almost 50% of the WEEE generated in UK

Categories of WEEE Investigated (2/2)

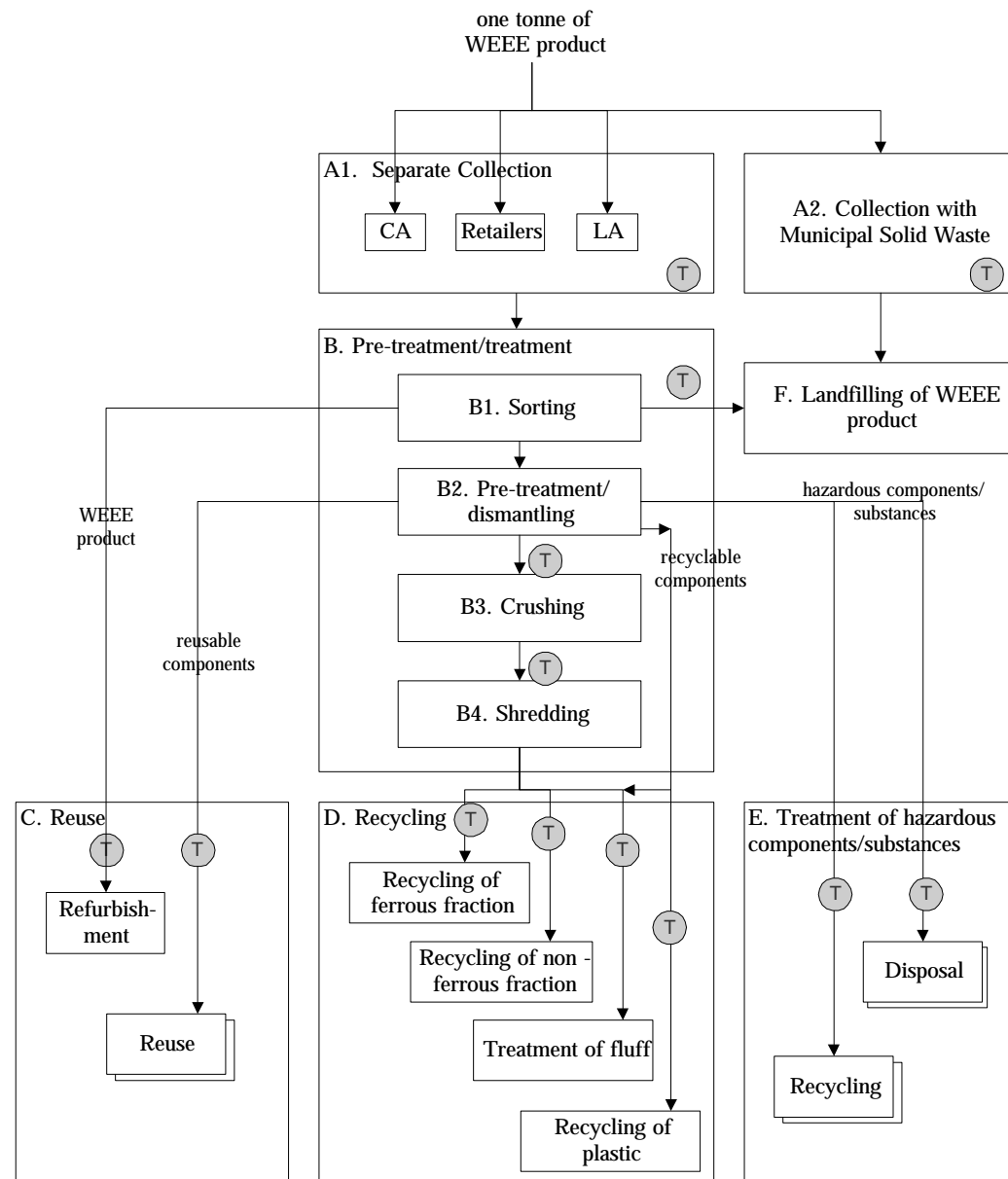
 The categories represent a broad range of potential problems due to hazardous substances, and treatment of the following hazardous substances were considered:

- ◆ Lead, mercury, hexavalent chromium, cadmium, PCBs, halogenated flame retardants, radioactive substances, asbestos, beryllium
- ◆ CRTs
- ◆ CFCs, HCFCs (foam and gas)
- ◆ Electrolyte capacitors

System Boundaries

Functional Unit =
1 MT of WEEE by
product category

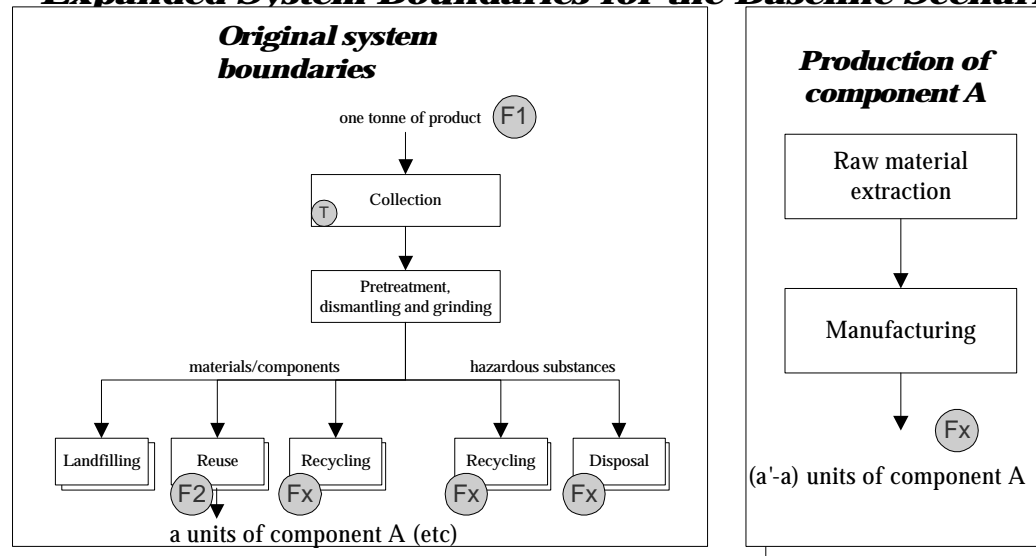
End of life Route for a generic WEEE product



Legends:
 Transportation steps (T)
 CA: Civic Amenity
 LA: Local Authority

System Boundaries Expansion Method

Expanded System Boundaries for the Baseline Scenario



(F1) disposing one tonne of product

(F2) additional functions provided by the expanded system :
 producing a' units of component A
 producing b' units of component B
 producing c' kg of material C
 producing d' kg of material D
 etc.

Sources of Environmental and Cost Data

- ◆ Telephone and face-to-face interviews
- ◆ Proprietary site data
- ◆ Averaged data from trade associations and other studies
- ◆ DEAMTM materials database: transport, fuel energy, electricity, production of metals, plastics, etc.
- ◆ EIMETM: DfE tool for electronic and electrical equipment, developed by Ecobilan with IBM, Alcatel, Schneider Electric, Legrand and Thomson (full list of data provided).
- ◆ WISARDTM: MSW in United Kingdom, developed for the Environment Agency- Waste Management
- ◆ Literature sources

Data Collected and Accounted for in the LCA

- ◆ **Material composition - WEEE products**
- ◆ **Proportion of WEEE:**
 - ❖ collected
 - ❖ refurbished
 - ❖ dismantled
 - ❖ shredded
 - ❖ recycled, etc ... *Current situation*
- ◆ **How hazardous materials are treated**
- ◆ **Energy & material consumption for each process - process releases**
- ◆ **Transport distances**
- ◆ **Process efficiencies**

Data Quality Examples

Personal Computer

- Comprehensive data on material breakdown.
- Detailed information on hazardous materials.
- High recycling/reuse potential owing to value attached to EoL machine.
- Owing to high economic value attached to a PC, it appears that none enter the MSW waste stream.

Lawnmower

- Good data on composition and refurbishment of average machine.
- Limited data on disposal route - poor recycling/recovery market;
- Assumed that majority at EoL are taken by car to civic amenity sites.
- Low recycling rate, owing to high proportion of “dirty plastic”

Financial Analysis Methodology

- ◆ **Definitions used for environmental data analysis were maintained for financial analysis where appropriate.**
- ◆ **UK system boundaries were used.**
- ◆ **Costs are separated between processing, transportation and “additive systems” / production.**
- ◆ **The net cost of each route is the difference between the cost and the value (= revenue).**

Calculation of Process Costs

- ◆ **Overhead, labour, operational costs associated with:**
 - ❖ **Pre-treatment and treatment**
 - ❖ **Reuse**
 - ❖ **Recycling**
 - ❖ **Treatment of hazardous components**
 - ❖ **Landfill**

Assumptions - Disassembly Times

Product	Time (min)	Labour cost (£/minute)	Total dismantling cost (£)
Monitor	12	0.14	1.66
PC base	4	0.14	0.55
Washing Machine	4	0.14	0.55
Fridge	4	0.14	0.55
Kettle	0	0.14	0
Telephone	4	0.14	0.55
TV	10	0.14	1.38
Vacuum Cleaner	10	0.14	1.38
Lawnmower	4	0.14	0.55

Calculation of Transport and Production Costs

Transport

- ◆ Included petrol consumption, vehicle depreciation, labour, overheads, etc.
- ◆ Calculated using average distances
- ◆ All collection costs classified under transport

Production

- ◆ Production costs used for “top up” in additive system
- ◆ Assumed, in agreement with industry, to be 85% of the value of the material or product being produced

Calculation of Revenues

- ◆ Calculations were made for
 - ❖ component parts
 - ❖ primary materials
 - ❖ refurbished products
- ◆ Revenue from the additive system has been separated from the disposal system revenue
- ◆ $(\text{Disposal System Revenue} - \text{Processing and Transport Costs} = \text{Net Value of Disposal System}) + (\text{Cost and Revenue of Additive System}) = \text{Net Value of Overall System}$

Environmental LCA Summary (1/2)

- ◆ **In general, the proposed WEEE Directive will result in a decrease in environmental impact compared to Current UK practice**
- ◆ **The results for refrigerators are more complicated owing to the potential for release of CFCs**
- ◆ **The results for televisions are more complicated owing to the need to process the cathode ray tube**

Environmental LCA Summary (2/2)

- ◆ **Current UK practice results in less environmental impact than 100% landfill**
- ◆ **The depletion of non-renewable resources and eutrophication shows the greatest environmental gains relative to the Current UK situation**
- ◆ **Global warming shows the least environmental gains relative to the current UK situation**

Financial Analysis Summary (1/2)

- ◆ The proposed WEEE Directive scenario and the current UK situation are generally more cost effective than 100% landfill
- ◆ 100% landfill is least cost effective due to the lack of generation of revenues and higher ‘additive system’ costs
- ◆ The Current UK scenario is *marginally more* cost effective than the WEEE Directive scenario for
 - ❖ kettle and refrigerator
- ◆ WEEE Directive scenario is *most* cost effective for
 - ❖ lawnmower, vacuum cleaner, PC and washing machine

Financial Analysis Summary (2/2)

- ◆ **None of the scenarios are cost effective for**
 - ❖ **telephone (because of high processing costs for Current UK and WEEE Directive scenarios and high additive costs for landfill)**
- ◆ **The 100% landfill scenario is the *only* cost effective for**
 - ❖ **television (because of high processing costs of the CRT)**
- ◆ **In general, the marginal difference between the Current UK and the WEEE Directive scenarios is unlikely to encourage a shift in behaviour by itself.**
- ◆ **It should be noted, our work assumes that end markets for recycled materials exist or will be created**

How easy would it be to meet the WEEE Directive targets?

- ◆ Based on material composition data and state of the art concerning recovery technologies, the targets appear to be ‘more easily achievable’ for the washing machine, PC and lawnmower
- ◆ The targets appear to be more difficult to reach for the refrigerator, television and vacuum cleaner

 These conclusions are dependent on the assumptions made concerning the level of plastics (and other material) recovery and markets existing for recyclate

Re-use versus Recycling

- ◆ **A direct comparison of re-use (which includes the refurbishment of products achieved by the re-use of components) versus recycling shows that re-use is environmentally preferable to recycling in all cases**
- ◆ **When considering the results in the context of the ‘additive system approach’, it is more difficult to make a generalised conclusion**

Conclusion: Integrated Financial Analysis and LCA

- ◆ **Enables an organization to identify the optimal investment option/to meet legislative targets in the most cost-effective and environmentally friendly manner.**
- ◆ **Helps an organization to demonstrate a pro-active position with respect to environmental issues and sustainable development with the incorporation of internal and external costs and benefits.**