



**SISTech**

Scottish Institute of Sustainable Technology  
Heriot Watt University, Riccarton, Edinburgh, EH14 4AS

Executive Director: Paul W. Jowitt

Research Report –  
Best Practice in Computer Equipment Recycling  
& the WEEE Directive.

Prepared for SISTech by: Karen Middleton & Fiona Sutherland  
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## Background

Companies across Scotland and the rest of the United Kingdom currently dispose of tens of millions of pounds worth of computer equipment every year. This is largely due to poor or non-existent information technology (IT) lifecycle management policies. Often equipment is disposed of to make way for newer, faster, more high tech systems when simple upgrading of components or software on current systems would suffice. As a result of such policies, there has been a huge growth in the volumes of computer equipment, and electronic waste more generally, being sent to landfill in the UK, with the same trend being observed across Europe. As a result of the increased demand for and manufacture of electronic equipment, coupled with the necessity to provide a coherent strategy for handling the volumes of electronic waste going to landfill, the European Union passed the Waste Electrical and Electronic Equipment<sup>1</sup> (WEEE) Directive on 27 January 2003. This piece of legislation, which utilises the polluter pays principle, requires producers of WEEE to pay for environmentally sound disposal of electronic waste in an attempt to divert the majority of this type of waste from landfill.

## The WEEE Directive

The Waste Electrical and Electronic Equipment (WEEE) Directive came into effect across Europe after being passed by the European Commission on 27 January 2003. All European Union member states, including the UK, are currently engaged in the process of transposing this into national law, a target that must be achieved by August 2004. The Directive sets collection, recovery and recycling rates for all types of electronic waste. Additional Directives, including the Restriction of Hazardous Substances (RoHS) Directive, are also being introduced to underpin the WEEE Directive. To support this Directive, member states are required to ensure that they have in place adequate collection, treatment and financing systems for WEEE before September 2005, with the first collection targets to be attained by December 2006. The key aims of the WEEE Directive are to reduce the volumes of toxic waste from WEEE going to landfill by encouraging a movement up the waste hierarchy (*Figure 1*) from poor environmental options such as disposal, to increased recycling and reuse of products wherever possible. Ultimately, the Directive should, by placing the responsibility for safe disposal on them, encourage manufacturers to produce equipment that is designed in a more environmentally sound way.

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<sup>1</sup> Electrical and Electronic Equipment is defined by the Directive as: "equipment dependent on electric current or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents..."

Figure 1 - The Waste Hierarchy and the WEEE Directive



Based on the polluter pays principle, the WEEE Directive will ensure that the costs of disposing of all electronic equipment, including computer equipment<sup>2</sup>, are borne directly by the producer, in this case, the manufacturer of the equipment. However, the manufacturer is not obliged to provide this service free of charge to business users and domestic users should not be charged for this service under the Directive. The Industry Council for Electronic Equipment Recycling (ICER) has estimated that around twenty-two million units of computer equipment, accounting for approximately three hundred and fifty seven tonnes of waste, was disposed of in the UK in 1998, most of this waste going to landfill. With volumes of WEEE rising at between three and five percent per annum, computer waste accounts for around thirty-nine percent of WEEE arisings. Current estimates of computer recycling rates are estimated at between twenty-four and twenty-six percent. Under the WEEE Directive, the UK will have to recover eighty-one percent of this waste by weight and reuse sixty-five percent by weight. This target must be reached by 31 December 2006.

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<sup>2</sup> Computer equipment can be considered to be personal computers, monitors, keyboards, mice, printers, fax machines, network servers and all cables and connectors and their constituent parts.

## **Key Responsibilities under the WEEE Directive**

The government is responsible for the regulation and monitoring of the implementation of the WEEE Directive. Under the terms of the legislation, EU member state governments are given the powers to impose any system of penalties and restrictions that they believe to be necessary to act as a sufficient deterrent to discourage WEEE producers from breaking the new laws. As there are no stringent guidelines contained within the legislation as to how the government should or could regulate the Directive, it is somewhat difficult to predict how the government at UK and Scottish levels may chose to do so. There are several possible methods that the government might utilise to regulate the disposal of WEEE including taxation, tradable permits and fines amongst others. The key responsibilities of equipment manufacturers, government and consumers are outlined below alongside suggestions as to how these may be enforced. It is worth noting that the responsibility for regulating the WEEE Directive at local level will rest with the Scottish Environmental Protection Agency (SEPA) in Scotland and the Environment Agency in England and Wales.

Manufacturers of electrical and electronic equipment (EEE) are required to finance the costs of WEEE management from August 2005. For products that were on the market prior to this time<sup>3</sup>, the financial burden of disposal may, with the exception of private households, be placed upon the user of the equipment. The exemption of private households from bearing the full costs of disposal holds, even for equipment placed on the market following August 2005, where the local council is obliged to provide collection of WEEE and dispose of it on behalf of the private individual. As has been stated, it is unclear as yet how the government at local and national level will enforce this legislation. However, recycling firm MIREC<sup>4</sup> has conducted some research into the Directive and has suggested that if companies fail to comply with the Directive in terms of environmentally responsible disposal, then the government may choose to fine the original manufacturer of the equipment, the company disposing of the equipment, the local council or all three of these groups for failing to adhere to the terms of the Directive. Companies would be ill advised to believe that they should adopt a "wait and see" policy with regards to the WEEE Directive. Those who put in place early procedures for sustainable IT procurement and disposal, and who monitor these to ensure that they are adhered to, will be best placed to avoid the potentially stringent financial penalties for failure to comply. Such companies will also save money through a policy of upgrading existing equipment where possible. Suggestions as to how a company may put in place more sustainable policies for computer equipment are contained in the section titled "What can businesses do?".

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<sup>3</sup> At present, a labelling scheme which will indicate when equipment was placed on the market is being developed to provide a "date stamp" to allow ease of identification of equipment.

<sup>4</sup> MIREC's UK operations are based in Dumfries and Gloucestershire with their parent company being in the Netherlands.

Concerns have been raised regarding the wording of Article Nine, which sets out this responsibility in relation to the possible effect on manufacturers' accounting position. As a result, changes to this Article have been agreed in principle that would mean producers would only be required to accept WEEE from the last business holder, free of charge on a one to one basis when supplying new equipment. One possible consequence of this change is that the costs of disposal where this is not the case may have to be borne directly by the business wishing to dispose of any equipment placed on the market prior to August 2005. It is very likely that the costs of disposal will be reflected in changing prices, especially for business customers. Furthermore, it is possible that supply agreements may be changed by suppliers stating that they will only accept responsibility for redundant equipment disposal on a one to one basis, leaving businesses with the responsibility of paying for disposal of equipment that they do not intend to replace. There are several possible mechanisms that the government may use to ensure that these obligations are met through various economic measures including the use of taxation, stringent regulatory measures, tradable permits, spending programmes and voluntary agreements. The Department for Trade and Industry (DTi) has indicated recently that the government will consider alternatives to taxation programmes to achieve compliance if the same deterrent effect can be achieved at a lower cost.

Manufacturers are also required to provide information regarding the different components and materials used in their equipment and the location of dangerous substances within the product within one year of the product coming on to the market. This provision is intended to facilitate the treatment and reuse of equipment and will be made available to all organisations involved in the treatment and refurbishment of WEEE. Manufacturers will not be required to disclose proprietary information or full dismantling instructions for all products, nor will they have to provide full lists for every component part. The government is responsible for ensuring that treatment sites and reprocessors have all the information required by them. However, the costs of producing these guides will fall to the manufacturer and it is likely that these will be passed on primarily to business customers.

### **The Cost of Recycling**

The DTi currently estimates that it would cost between £250 and £300 to dismantle, treat and process one tonne of personal computers to the required standards of the WEEE Directive. This translates to a cost of £5 to £6 for an individual computer and an estimated annual treatment cost of anywhere between £98 million and £207 million a year, not including collection costs. Dismantling and appropriate treatment is necessary as, of the one thousand plus materials of which computer equipment is composed, hundreds including brominated substances, gases, metals, acids and plastics are highly toxic. Table 1 below details some of the materials

*Table 1: Materials in IT Equipment by Component*

<b>Components</b>	<b>Materials</b>	<b>Potential Effects</b>
Keyboard/mouse	Thermoplastics PVC Aluminium	Contains hormone disrupting dioxins, dioxins that can cause cancer and neurotoxins.
Monitors	Raw glass - 100% recyclable with no ill effects. Leaded glass, metals including barium, strontium zinc, lead, cadmium and phosphor, cathode ray tube.	Contains substances that can cause cancer and may also contain neurotoxins.
Speakers	PVC Steel	Contains substances that can cause cancer and neurotoxins.
Processors/ memory chips	Various metals including, gallium, indium, thallium, silicon, germanium, arsenic, antimony, lead, selenium, tellurium, gold, aluminium.	Substances that can cause cancer, neurotoxins and heavy metals that contribute to liver and kidney disease.
Printed Circuit Boards	Precious metals, PVC coating, glass fibre, thermoset resin, brominated fire retardants, ethylene glycol, dimethylformamide, N-methylpyrrolidinone, aluminium, various solvents.	Cancer causing substances and neurotoxins.
Casing/printer	Plastics - antimony trioxide, thermoplastics (various), polycarbonate, PVC, ABS, HI polystyrene, polyethylene oxide. Metals - steel.	Cancer causing and hormone disrupting substances.
Cooling system	Steel and thermoplastics	Cancer causing and hormone disrupting substances.
Chassis	Steel and aluminium	Neurotoxins.
Storage media	Aluminium alloy and steel.	Neurotoxins.
Batteries	Nickel, cadmium and steel.	Cancer causing and neurotoxins. Also contains materials that are toxic to aquatic life.
Power supply/ surge suppressor	Steel, nickel, copper.	Contains materials that are toxic to aquatic life.
Cables/ power cord	Turned copper, PTFE, PE.	Cancer causing and hormone disrupting substances. Also contains materials that are toxic to aquatic life.

**Abbreviations:**

PVC - poly vinyl chloride  
 ABS - acrylonitrile butadiene styrene  
 HI polystyrene - high impact polystyrene  
 PTFE - polytetrafluoroethylene  
 PE - polyethylene

contained in different computer components and outlines the possible effects of exposure to these substances. Under the WEEE Directive, those substances detailed in Table 1 will have to be treated and disposed of in an environmentally friendly manner, it will no longer be possible for waste disposal agents to stockpile equipment containing these substances in landfill sites. This service will be costly, and manufacturers that have to utilise take back schemes and bear the burden of paying for this disposal will inevitably attempt to pass this cost on to customers, primarily business customers.

Not all components in computer equipment are toxic, some even have some value for recycling purposes and some may even have monetary value. Typically, a personal computer consists of various plastics, metals and glass - Table 2 below shows the typical composition of a personal computer base unit and monitor with respect to these materials. Printed circuit boards (PCBs), for example, contain elements that may be of value to a recycler or reprocessor of electronic equipment. PCBs contain, in very small amounts, precious metals that, if processed in sufficient bulk, can be very valuable to a firm. However, the process of stripping a PCB down to recover materials is very laborious and only worthwhile if it can be done in significant volumes - only one company in Scotland<sup>5</sup> currently processes PCBs to this level. Many recycling firms do operate a policy of refurbishing and reusing working equipment, with the owner's prior consent, and many offer financial incentives to companies to allow them to do so. Some recycling firms will offer a small fee for working monitors, which may be between £5 and £20 dependent on type, size and condition. Also, firms may pay for working base units or PCBs that contain working processors<sup>6</sup>. For most other equipment, including printers, obsolete base units and monitors, hard drives and cables, there will be a charge for recycling or refurbishment dependent on types and volumes. This will vary quite widely between firms and for anyone wishing to dispose of computer equipment it would be wise to obtain quotes from a few recyclers before obtaining their services. Appendix 1 contains details of the quotes obtained from three suppliers for the purposes of this research.

*Table 2: Typical Composition of a Personal Computer*

<b>Material</b>	<b>Weight (Kg)</b>
Steel	8.1
Aluminium	1.1
Copper	1.8
ABS (acrylonitrile butadiene styrene)	3.8
PP (polypropylene)	0.7
Other Plastics	1
Cathode Ray Tube & Other Glass	7.2

<sup>5</sup> CCL (North) in Irvine, Contact: Bruce McLean, Managing Director.

<sup>6</sup> Usually Pentium II 250MHz or above.

It should be noted here that the costs of recycling computer equipment at present do not accurately reflect the true cost of treating and disposing of equipment to WEEE standards. Consequently, as recyclers face tougher restrictions on how they handle and process WEEE, the costs to firms of recycling their redundant equipment may rise, making it even more important that firms put in place a strategy to assist in mitigating what could be rising costs associated with equipment disposal, including a "green procurement" strategy and a policy of upgrade and repair wherever possible.

### **What Can Businesses Do?**

At present it is a difficult task to assess exactly how much of the burden the government will place on businesses with regard to ensuring that their old computer equipment is disposed of in accordance to the WEEE Directive. One thing is however certain, - the Directive will be enforced strongly whether the onus falls mainly on the waste owner (i.e. the person wishing to dispose of the waste) or the original manufacturer, but in all probability both will share the responsibility, and all businesses will be affected. As has been stated, those companies that plan ahead and ensure that they put in place systems to handle computer equipment in a more environmentally sustainable and cost-effective way will be those that will be least affected by the Directive. There will be three key effects on businesses following the formal adoption of the Directive:

1. Businesses will pay more for new computer equipment due to the responsibilities placed on manufacturers.
2. Businesses without a strong asset management policy will suffer through high disposal costs.
3. Businesses caught scrapping computer equipment will likely incur severe financial penalties.

There is little a business can do about point one above since manufacturers will raise prices and businesses will be forced to pay in order to procure new equipment. However, points two and three can be avoided through the development of an IT asset management strategy. There are three main stages to the development of a strategy that could save businesses money and help them to comply with the WEEE Directive:

1. Appoint a person within the organisation who will be responsible for ensuring that a computer equipment recycling policy is developed and implemented. This should be a person with sufficient authority to ensure that the policy will be implemented and enforced, usually a representative of senior management. It is vital that the strategy has a champion, as without it, it could easily falter.
2. Develop an ongoing internal communications strategy with regards to computer equipment recycling. The IT strategy will never succeed if

people do not know about it and what it involves. It is also important for its success that the workforce feels some ownership of the strategy.

3. Devise a computer equipment management policy that takes into account:
  - a. Sourcing and procurement. This should take into consideration the future costs of equipment including penalties likely to be imposed on the company under the WEEE Directive at the point of disposal. Issues to include are:
    - i. Has the manufacturer designed the equipment to ensure upgradability?
    - ii. Has consideration been given to the recyclability of materials in the design of equipment?
    - iii. What initiatives are being undertaken by the manufacturer to design more environmentally friendly equipment in the future?
    - iv. What options do you have that will reduce the possible financial impact on your business at the point of disposal, such as:
      1. Does the company you are purchasing from have a take-back scheme? (Details of current take-back schemes are included in Appendix 2).
      2. Is a leasing option available?
  - b. Equipment disposal.
    - i. Decide at what stage should equipment be disposed of and when upgrades should take place?
    - ii. Determine how equipment should be disposed of? (i.e. disposal to landfill, resale, refurbishment)
    - iii. Decide with whom does the responsibility for ensuring equipment is disposed of in an environmentally responsible manner lie?
    - iv. Do you have a preferred contractor? What criteria must they meet?
    - v. Put in place an auditing procedure to check that equipment is being handled appropriately.

Whilst the above list is not exclusive, it does highlight some of the key issues for consideration. It should be remembered that in a medium to large sized organisation, development, communication, implementation and achievement of total compliance with a new strategy can take up to two to three years, and therefore companies must start now to be ready for the Directive coming into force in August 2005.

## **Recommendations**

Despite an extensive search, it was not possible to identify any pre-existing materials relating to best-practice with regard to the disposal of any type of electronic waste materials in the UK and very little from sources outwith the UK, a finding that has been supported by colleagues working on larger scale best practice studies. As such, the guidance contained herein must be based on existing knowledge of the waste industry and assumptions as to how the industry, the government and the local authorities may behave when the WEEE Directive comes into force. The research would have benefited from a thorough investigation into the current initiatives being undertaken by the local authorities and their future plans for WEEE handling, however this was not possible within the scope of the research. Furthermore, the researchers were keen to begin developing a decision support mechanism to assist companies both with green procurement practices and provide an aid to support IT managers in deciding the best route to take with regards to upgrade and disposal of equipment. Again, this was not possible within the scope of this research project but would be worthwhile undertaking given the absence of materials available elsewhere.

## Appendix 1 - Recyclers Quotes

<b>Company</b>	R M Easdale & Co
<b>Contact Name</b>	Martin
<b>Address</b>	67 Washington Street Glasgow G3 8BB
<b>Hard Drives</b>	Collected free of charge
<b>Monitors</b>	£4 per unit
<b>Motherboards/Printed Circuit Boards</b>	Credit of £1/kilo
<b>Batteries</b>	If not on motherboard, £600 per tonne
<b>Processors</b>	If not on motherboard, credit dependent on type
<b>Unstripped IT equipment</b>	£15 per tonne
<b>Accreditations</b>	ISO 9001 and ISO140001
<b>Handle Special Waste</b>	Yes
<b>WAMITAB CTCO Personnel</b>	Yes
<b>Collection</b>	Yes
<b>Minimum Volume</b>	None
<b>Maximum Volume</b>	None
<b>Collection Costs</b>	Chargeout at cost to company
<b>Recycle only</b>	Yes
<b>CD Roms</b>	
<b>Floppy Drives</b>	
<b>Battery Packs</b>	
<b>Notes</b>	All prices given by weight are adjusted fractionally to suit individual needs.

<b>Company</b>	Greenleaf	
<b>Contact Name</b>	Neil Fleming	
<b>Address</b>	10 Westgarth Place College Milton East Kilbride G74 5NT	
<b>Hard Drives</b>	Recycled/refurbished - £1 Data destroyed & then recycled - £12 Data destroyed, platter physically destroyed and then recycled - £15	
<b>Monitors (Purchase Price with DOA/Faulty on Arrival Warranty)</b>  <i>Will take good monitors in 'payment' for old/non working monitors if required</i>	<u>Good Condition:</u>  15" - £10 17" - £18 19" - £25 21" - £32	<u>Poor Condition/Non Working/Disposal etc:</u>  14" - £7 15" - £7.50 17" - £8.50 19" - £10 21" - £12
<b>Motherboards/Printed Circuit Boards</b>	Motherboards, PC add on cards, old memory modules etc in volume – Free Small quantities – Quoted based on volume/type etc	
<b>Batteries</b>	Don't process individual batteries. Batteries in or on products okay though.	
<b>Processors</b>	286, 386, 486, Pentium etc Pentium 2, Pentium 3, Celeron, Pentium 4 or AMD equivalents: Prices offered based on condition, history, quantity etc.	
<b>Unstripped IT equipment</b>	PC Base units 286, 386, 486, Pentium etc - £3 per unit (based on a complete system with the hard disk being recycled/refurbished) PC Base units Pentium 2 or above or AMD equivalents: Quoted based on specs, functionality, quantity etc  Printers: Old laser prints (eg HP Laserjet 3) - £10 Old Bubble Jet (eg HP Deskjet 500) - £5 Modern Bubble Jet (eg HP Deskjet 660C) - £1.50 Modern Laser Printers (eg HP Laserjet 5L) - £2.50  Fax Machines - £10  Laptops: May buy these or charge for disposal – quote on request	

<b>Accreditations</b>	
<b>Handle Special Waste</b>	
<b>WAMITAB CTCO Personnel</b>	
<b>Collection</b>	Dependent on volumes
<b>Minimum Volume</b>	Depends on the material. Not going to travel to collect a few processors – have a transit van and would look to fill it to a reasonable level.
<b>Maximum Volume</b>	In theory no maximum to the amount they would undertake – limiting factor is how much is wanted to be moved how quickly.
<b>Collection Costs</b>	For low volumes would charge £75 per van load (or part thereof) – potentially waive this if it was going to be a long term high volume project.
<b>Recycle only</b>	No recycle and refurbish.
<b>CD Roms</b>	
<b>Floppy Drives</b>	
<b>Battery Packs</b>	
<b>Notes</b>	Would like to visit McSense, see type of material looking at to dispose of and volumes involved to enable more accurate quotations.

<b>Company</b>	MGH Group
<b>Contact Name</b>	Pat Weir
<b>Address</b>	
<b>Hard Drives</b>	£5 / unit
<b>Monitors</b>	£4 / unit
<b>Motherboards/Printed Circuit Boards</b>	£35 per 15 kg
<b>Batteries</b>	£4 / unit
<b>Processors</b>	£35 / pallet
<b>Unstripped IT equipment</b>	£4 / unit
<b>Accreditations</b>	ISO 9002 and ISO140001
<b>Handle Special Waste</b>	
<b>WAMITAB CTCO Personnel</b>	Not at Scottish facility but do have at Chorley facility
<b>Collection</b>	
<b>Minimum Volume</b>	Unstripped – 50 items
<b>Maximum Volume</b>	
<b>Collection Costs</b>	£75 if under 20 items
<b>Recycle only</b>	
<b>CD Roms</b>	£35 / pallet
<b>Floppy Drives</b>	£35 / pallet
<b>Battery Packs</b>	£4 / unit
<b>Notes</b>	Large server cabinets £15 / unit

## Appendix 2 - Manufacturers Computer Equipment Take Back Schemes

### ACER

- No take back scheme operating at present and no plans to introduce one in the future.

### Apple

- Unable to locate any information to suggest that such a scheme exists. Could not identify a suitable contact from the website, no response to query sent through the corporate feedback link.

### Dell

- Will collect redundant equipment of any brand from a mutually agreeable location and will refurbish if possible. Where equipment is refurbished the business has the option to authorise Dell to remarket and return value to the business, donate the equipment on the behalf of the business or administer an employee purchase scheme.
- Dell guarantee that any equipment is disposed of in an environmentally responsible manner.
- Four programmes for IT disposal are offered:
  - Profit share - the redundant equipment from the business will be resold and the proceeds shared between Dell and the seller.
  - Guaranteed price - offers the business a guaranteed price for their redundant equipment prior to removal assuming all equipment is in working order.
  - Chargeable disposal - environmentally sound disposal handled by Dell for which the business is charged at cost price.
  - Social programme - equipment is fully refurbished and donated to schools, charitable organisations etc of the business' choice.

### Hewlett-Packard

- HP operate a Take-Back Service Hotline where an HP Take-Back Set can be ordered for £35 - if a return box is required then the price rises to £45. The return box can be filled to a maximum weight of 30kg.
- The HP preferred recycling partner who will send the set and arrange courier collection then raises an invoice.
- The service covers HP and all other brands of computer equipment.
- If more than 30kg of equipment or several items are to be disposed of then HP will quote a price dependent on volumes.
- HP will not assume any responsibility for data contained on the machines.

## IBM

- IBM does operate a Product Take-Back programme and will arrange transport and treatment of products by an approved IBM vendor.
- The customer must meet transport costs.
- Treatment of equipment is free of charge.

## Time

- Does not operate a take-back scheme but are planning to introduce one in the near future. In the meantime recommends that customers make use of schemes provided by local authorities.

## Toshiba

- Does operate a take-back scheme with the option to either resell or recycle equipment.
- Toshiba will ensure that all data is erased from machines to government-approved standards.
- No information given on costs.