UNITED NATIONS
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2008 Review of Directive 2002/96 on

Waste Electrical and Electronic Equipment (WEEE)

Final Report

Contract No: 07010401/2006/442493/ETU/G4
ENV.G.4/ETU/2006/0032

05 August 2007

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EXECUTIVE SUMMARY

The Assignment

For the review of the WEEE Directive the European Commission (EC) has launched three research studies analysing the impact and implementation of the WEEE Directive and potential changes that might be required. This study is focusing on the total environmental, economic and social impacts of the WEEE Directive. Secondly, it aims at generating options that can improve environmental effectiveness, cost efficiency and simplification of the legal framework. This study aims to complete the information needed for review of the WEEE Directive in 2008. The information gathered and analysis made, is intended to form the basis for the legislative impact assessment of options for review of the WEEE Directive.

The primary aim of the study is to contribute to this review by listing and evaluating potential options with a two-step approach:

1. The evaluation of the current implementation of the Directive in the EU Member States, with particular attention to the societal aspects of environmental, economic and social impacts of the WEEE Directive,
2. Translation of the information gathered in step one into legislative and non-legislative options, in order to improve, further develop and simplify the WEEE Directive.

This work was conducted from September 2006 until August 2007 in accordance with the Terms of Reference set by the European Commission's Tender Invitation.

Data Gathering and Methodology

Over 183 different contacts were approached for interviews, questionnaires and specific data to gather a very complete data overview. The more than 183 contacts are a fair representation of the Member States (TAC members), Producers, Compliance Schemes, Industry Associations, NGO's, National Registers, Recyclers, Recycler Organisations, Refurbishers and Universities and are covering all relevant stakeholders involved in electronics take-back and recycling. This also includes 15 Member State outcomes of an SME panel procedure. This includes determining:

1. Quantities of WEEE put on the EU market, the amount of WEEE arising as waste and the amounts collected and treated (which are 3 different levels),
2. The technologies used with specific focus on plastics recycling,
3. The environmental parameters over the total recycling chain,
4. The costs of collection, transport, treatment and recycling as well as overhead and administrative burden of the Directive. This includes also an overview of the implementation status in the EU27.

As a result a large database with over 350 literature sources is derived as well as a fully updated environmental and economic assessment model that describes the 64 most relevant substances, their detailed fate over the recycling chain and the respective Life-Cycle Inventories and material prices over time, 15 different environmental impact indicators from the latest LCA methods available, the 31 most relevant recycling, recovery and final waste disposal processes and the main costs over the recycling chain for all individual stages from collection until all final destinations.

WEEE Amounts

Predictions made during the 1990's estimated the tonnage of EEE put on the EU15 market at 7 million tonnes. With the expansion from EU15 to EU27 and based on many sources and different estimation techyniques, this study points out that the amount of new EEE put on the EU27 market in 2005 is estimated at 10.3 million tonnes per year.

In the explanatory memorandum of the WEEE Directive, the amount of EEE arising as waste was estimated in 1998 for the EU15 at 6 million tonnes. The new estimate of the current WEEE arisings across the EU27 is between 8.3 and 9.1 million tonnes per year for 2005. This increase is due to expansion of the EU, growth in the number of households and inclusion of items that may have been excluded previously (B2B). A number of forecasting assumptions were applied which predict that by 2020, total WEEE arisings will grow annually between 2.5% and 2.7% reaching about 12.3 million tonnes. The average compositional breakdown for the EU has been calculated and shown in the figure below:

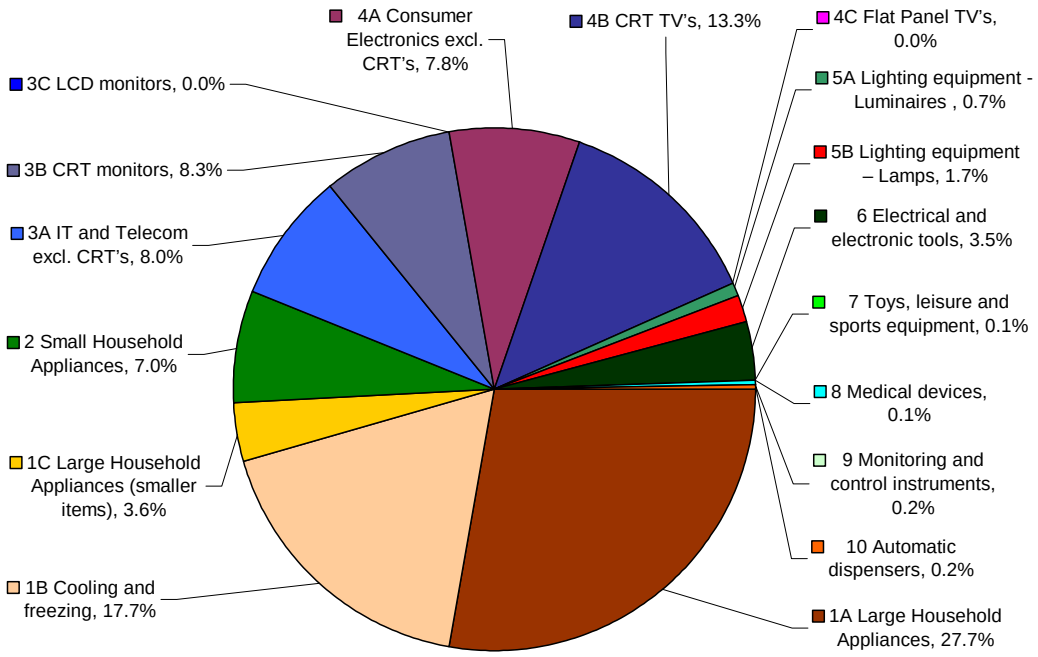

Figure i: Breakdown of WEEE arising 2005

The EU15 Member States' average collection performance is roughly half that of Switzerland and Norway. This is mainly due to lower performance in the

collection of categories other than category 1. In spite of this, the WEEE Directive collection target can be easily met by EU15 Member States, but remains a very challenging target for the New Member States.

The table below shows the estimated amount of WEEE currently collected and treated as a percentage of the amounts of WEEE arising for the EU27 in 2005. The current amounts are roughly in between 25% for medium sized appliances till 40% for larger appliances, showing substantial room for improvement. Based on our assessment of data from various compliance schemes, it must be possible to collect around 75% of the large and 60% of the medium sized appliances in the long-term future. The analysis shows that returns of appliances lighter than 1kg are very low for all systems. In addition, the composition of EEE put on the market currently is different from that of WEEE arising due to changing product composition over time. This is especially the case for flat panel displays instead of CRT screens as well as the phase out of CFC's from fridges, NiCd from battery packs and PCBs in capacitors.

#	Treatment category	Current % collected of WEEE Arising
1A	Large Household Appliances	16.3%
1B	Cooling and freezing	27.3%
1C	Large Household Appliances (smaller items)	40.0%
2,5A,8	Small Household Appliances, Lighting equipment – Luminaires and 'domestic' Medical devices	26.6%
3A	IT and Telecom excl. CRT's	27.8%
3B	CRT monitors	35.3%
3C	LCD monitors	40.5%
4A	Consumer Electronics excl. CRT's	40.1%
4B	CRT TV's	29.9%
4C	Flat Panel TV's	40.5%
5B	Lighting equipment – Lamps	27.9%
6	Electrical and electronic tools	20.8%
7	Toys, leisure and sports equipment	24.3%
8	Medical devices	49.7%
9	Monitoring and control instruments	65.2%
10	Automatic dispensers	59.4%

Table i: Current amount of WEEE collected & treated as percentage of WEEE Arising

The most interesting finding, however, is that there are very large differences in performance by different Member States per sub-category. This indicates that there is much room for improvement in collection performance. There were not enough data points to prove relationships between factors influencing high versus low collection amounts in different Member States. However the data available indicated that certain factors like availability of collection points, geographical location, culture, waste collection ways and importantly the

present financing mechanisms influence treatment performance. These various influencing factors are probably all relevant to a certain level and further influenced by the active role of different stakeholders involved, including public authorities and EU Member States.

Technologies and Market Developments

Companies providing treatment capacity have made, or will be making, significant investments in equipment which will enable WEEE items to be treated in a manner which meets the Annex II requirements of the Directive. Although very little information on WEEE treatment capacity in the EU27 Member States was obtained, it is likely that the EU15 Member States should have installed sufficient capacity to treat WEEE arisings by the middle of 2007. The situation in Central and Eastern Europe is likely to be different, and it currently appears that a regional approach by groups of Member States will be adopted.

Information on the plastic content of the different WEEE categories and the specific targets set in the WEEE Directive can be used to calculate that on average a recovery of 10% of total equipment weight could be achieved through the recovery of plastic polymers. As the average plastic content in electronic waste is about 20%, the fulfilment of the recovery targets may involve recovering half the plastic present in WEEE and recycling 25% of the plastics.

There are stable markets for metal recycling from WEEE given the ability to easily extract the metal and reuse to a comparable quality to virgin metal ores.

The main potential market for CRT glass is in the manufacture of new CRTs, but it is expected that current capacity will significantly decline over the next 5 years as flat panel displays replace CRTs in monitors and televisions. This means that other markets for the glass will be required for which potential capacity was only partially identified. For plastics, the role of the existence of secondary markets for energy and materials recovered from WEEE Plastics (WEEP) treatment is crucial in the successful application of such processes. In practice there are difficulties in environmental and cost efficient recovery of plastic fractions due to the heterogeneity of the polymers present in small volumes in each unit. Currently, targets for mixed metal and plastic dominated streams can discourage recyclers from trying to properly separate plastic parts for recycling.

Environmental Impacts

The figure below shows the contribution of each WEEE category to the total impacts of diverting WEEE arisings from disposal to default treatment.

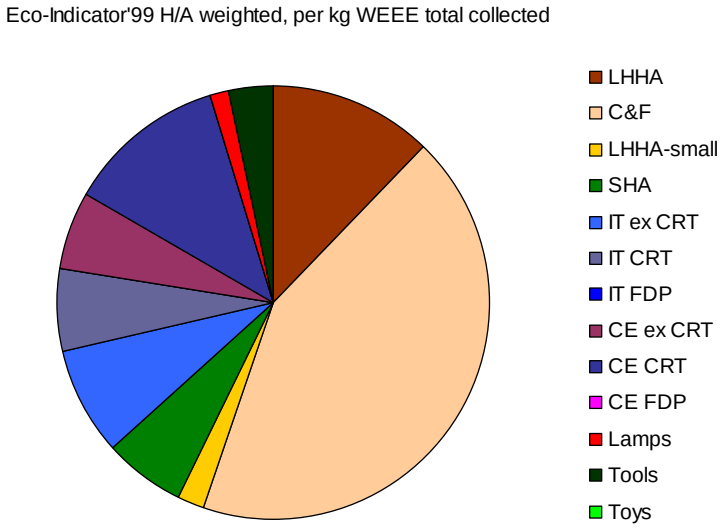

Figure ii: Contribution of categories to environmental impacts of WEEE total (EI99 H/A)

This figure demonstrates that under the Eco-Indicator'99 single indicators, the most relevant products to divert from disposal are the CFC containing fridges. Besides this, it was found that there is a considerable variety in environmental themes per treatment category due to different substances of environmental concern:

- Toxicity effects in various environmental impact categories are dominant for Category 3C LCD Monitors and Category 5B Lamps (especially in terrestrial ecotoxicity and ecosystem quality),
- Avoided ozone-layer depletion and global warming potential for Category 1B Cooling and Freezing,
- Cumulative Energy Demand and Resource Depletion for Category 1B Cooling and Freezing, 3B and 4B CRT screens, and
- Acidification for Category 3A IT excl. CRT and 3C LCD Monitors and Eutrophication for Category 3C LCD Monitors and Category 6 Tools.

The detailed data per environmental impact category grouped for all treatment categories is displayed in the table below illustrating the environmental benefits of the Directive for all WEEE per year in 2011 compared with 2005 (base year) levels. One important assumption here is that the 2011 values are based on the current 2005 impacts without taking into account the changes in product and thus waste stream compositions over time. This latter topic is recommended for further research as the sensitivity analysis showed large changes for displays and fridges over time.

Indicator	Environmental benefit	Number*	Unit
2005 WEEE: Arising: 8.3 Mt Collected: 2.2 Mt		**2011 WEEE: Arising: 9.7 Mt Collected: 5.3 Mt**	
Weight	Growth in WEEE arising	1,359	kt WEEE Arising
Eco-indicator 99 H/A v203**	Total environmental load per year of	643,591	Europeans
Idem, Human Health**	Total environmental load per year of	423,125	Europeans
Idem, Ecosystem Quality**	Total environmental load per year of	46,038	Europeans
Idem, Resource Depletion**	Total environmental load per year of	174,589	Europeans
Cumulative Energy Demand	Equivalent with:	-75	million GJ
Abiotic depletion	Equivalent with:	-40	kt Sb
Global warming (GWP100)****	Equivalent with:	-36****	Mt CO2
Ozone layer depletion (ODP)	Equivalent with:	-4.8	kt CFC11
Human toxicity	Equivalent with:	-4,047	kt 1,4-DB***
Fresh water aquatic ecotox.	Equivalent with:	-404	kt 1,4-DB***
Marine aquatic ecotoxicity	Equivalent with:	-3,551	Mt 1,4-DB***
Terrestrial ecotoxicity	Equivalent with:	-74	kt 1,4-DB***
Photochemical oxidation	Equivalent with:	-3.0	kt 1,4-DB***
Acidification	Equivalent with:	-50	kt SO2
Eutrophication	Equivalent with:	-1,493	t PO4---

Table ii: Estimated Environmental improvement due to the WEEE Directive 2011 versus 2005

Negative means avoided environmental impact, ** Meant as a rough illustration only: 1 Pt roughly equals 1/1000 of the environmental load of one European p.year (Goedkoop 1999) ***kg 1,4-dichlorobenzene ** Under the assumption of an unchanged 80% presence of CFC fridges in the WEEE stream over time*

Please note that there are a few important assumptions behind these calculations. A key aspect here is the changing waste stream composition over time is not taken into account here. There is not enough information available yet to assess the influence of the future decline in CFC appliances returning. From the estimated 36 million tonnes of avoided CO2 emissions, 34 million tonnes results from removing CFC based cooling agents. Without CFC fridges and LHHA (these are collected anyway due to a positive net value after collection) the benefits of the Directive equal 2.3 million tonnes of CO2 emissions prevented per year.

The two key environmental findings are that from an environmental point of view, it is beneficial to collect more WEEE and to treat it more effectively. The data in this report proves that this applies to all treatment categories

investigated. The environmental priorities such as toxicity control, resource and energy conservation and other environmentally relevant emissions (global warming and ozone layer depletion) per category vary substantially per category, making WEEE a very heterogeneous stream from an environmental perspective. This results in the fact that it might be better to differentiate in environmental targets per treatment category.

Economic Impacts - Administrative Burden

Our assessment of economic impact of the WEEE Directive on different stakeholders has highlighted a number of crucial aspects that need to be taken into account for the future development, simplification and improvement of policy measures for the WEEE Directive.

The Administrative Burden Survey highlighted a number of areas where the burdens experienced by stakeholders could be reduced. The main issues pointed out were referring to the achievement of a level playing field for all different stakeholders involved in the end-of-life chain by realising:

- Consistency in legislative requirements across Member States,
- Consistency in registering and reporting activities across Member States, and
- Increase stakeholder awareness of specific responsibilities. It was found that large numbers of small and medium-sized enterprises (SME's) are not even aware of their current legal obligations.

The two most crucial activities identified from the Administrative Burden Survey are registering to National Registers and reporting. Our assessment resulted in the following:

- Total Burden across EU27 for registering and reporting activities ranges from EUR 36.7 million to EUR 42.8 million under the baseline assumption of 8 hours needed per report,
- The potential number of reporting activities across EU27 sum up to at least 72 reports to be delivered every year per producer, and
- The potential threat of competition distortion due to deliberately reporting of B2C as B2B, empty reporting without further action, or simply not reporting is having unequal impact on those companies investing in realisation of full and EU-wide legal compliance.

The start-up effects on both technical costs and additional costs are still significant across different Member States. Differences in national legislative requirements, and the time required to come to agreement in the implementation phase are 'influencing factors' on costs structures and do contribute to high costs levels.

Economic Impacts – Technical Costs

Under the assumptions of actual recycling costs excluding start-up effects across the EU27, based on the average costs of five long running systems (since 2003) in the EU, estimation of the economic impact for take back and treatment of WEEE arising, ranges roughly from EUR 0.76 billion in 2005 for the current amount collected (above table) towards EUR 3.0 billion in 2020. The latter is for the maximum possible collection percentages, which are estimated at 75% for large, and 60% for smaller appliances. The technical costs shown below are for collection and recycling including revenues for secondary materials. The total costs include mainly guarantees, provisions and to a lesser extent overhead and administrative burden.

	Technical Costs [Million EUR]		Total Costs [Million EUR]	
Year	Current Collection%	Maximum collection%	Current Collection%	Maximum collection%
2005	**764**	1,692	**935**	2,045
2006	783	1,735	959	2,097
2011	889	**1,970**	1,089	**2,381**
2020	1,125	2,492	1,377	3,012

Table iii: Overall Economic Impact across EU27 assuming FULL implementation

The main factors influencing these numbers are:

- The impact of additional costs on total take back costs represents a considerable percentage across different categories,
- The impact of long running optimisation of systems, play an important role on the cost side. For the long running systems across EU, the gap between minimum and maximum cost levels is much lower, and
- The percentage of WEEE collected and treated versus potential WEEE arising in EU27 plays a crucial role in respect of overall economic impact on stakeholders responsible for financing,
- The impacts of costs along the chain depend on category compositions and recycling technologies used. They are further influenced by future developments of new technologies.

The figure below presents the breakdown of technical costs for 2005 (long running systems collecting 5 main categories):

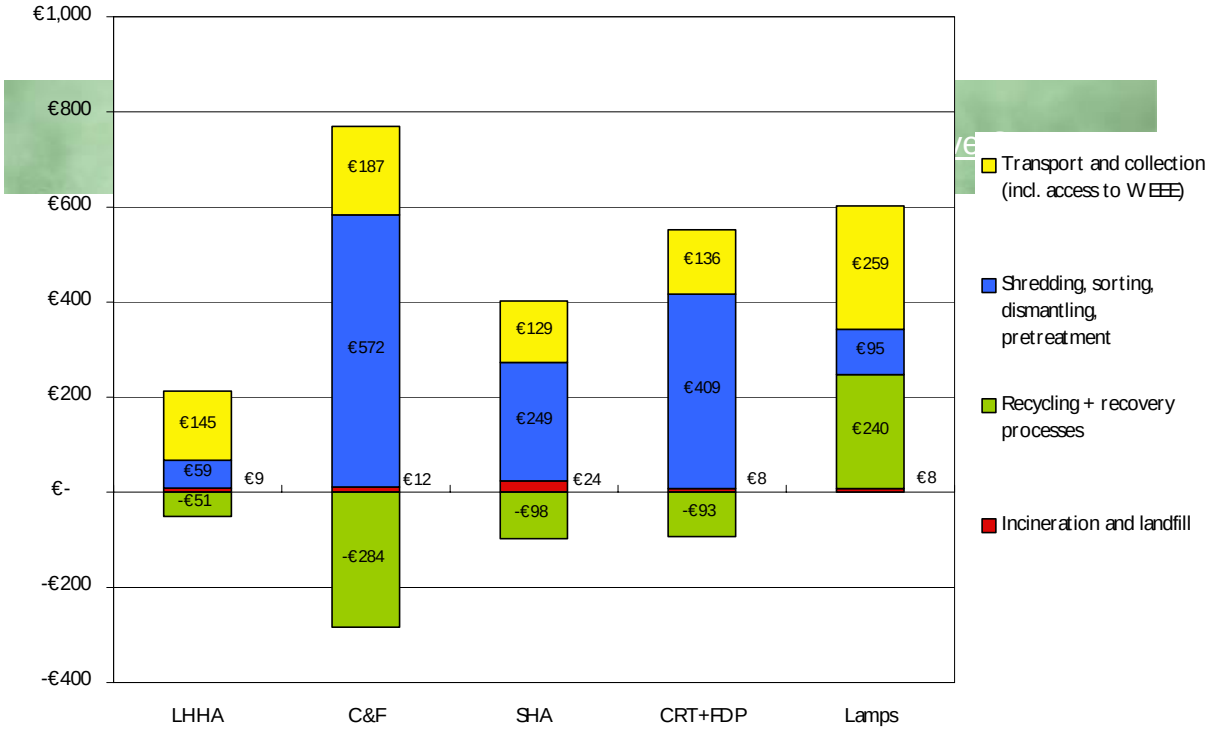

Figure iii: Breakdown of technical costs for the 5 main collection categories (2005 long running systems)

The above figure demonstrates that the technical cost breakdown in percentages is built-up very differently per category. For Category 1A, 10 Large Household Appliances, the main part is the transport costs. After these transport steps, the revenues are almost equal to the further processing costs. For Category 1B, Cooling and Freezing appliances, the treatment costs (CFC removal) are obviously a major portion of the total. This is also the case for the CRT containing appliances. Relatively high costs are in absolute numbers for Lamps Cat. 5B. After transport and pre-treatment, for the small appliances there is no net revenue from the remaining fractions at 2005 price levels.

These economic impacts of WEEE take back and treatment are influenced by:

- Prices for secondary materials. The sensitivity analysis showed that current 2007 market prices increase the revenues of the above categories by 50 – 100 EUR/tonne compared to 2005. This means a net revenue after collection and transport for some categories,
- Developments and availability of markets for downstream fractions and high-level re-application/valorisation of secondary raw materials, and
- Future developments of treatment technologies, as well as different treatment/dismantling requirements for particular product streams, which means that costs for CFC containing appliances are likely to decrease and flat panels are expected to cause an significant increase in total costs due to costly mercury removal steps.

Social Impacts

In summary, the consumers' role in guiding policies in the WEEE Directive to success must be further analysed. In the end, it is the consumer who has to return his e-waste and will also pay, no matter how the financing is arranged. This leads to the conclusion that increasing consumer awareness is a necessity

for an eco-efficient WEEE implementation with maximised environmental results (collect more) and increased costs efficiency (treat better).

Besides this important finding, the lack of available data and information did not allow for a systematic and quantitative assessment to be made of the Directive's impacts on the day-to-day quality of life of individuals and communities. The social screening of this study was carried out with a systematic gathering of existing knowledge and additional empirical surveys. However, necessary evidences on positive and negative social consequences, planned interventions and any social change brought about by those interventions were missing. Only certain tendencies became obvious, which will require further investigations for building a comprehensive assessment on such.

This study's research identified the relevant affected groups related to the collection, sorting, disassembly, treatment, recovery and disposal of WEEE. Their respective roles and effects of the WEEE implementation will require further in-depth research and assessment.

In the majority of EU Member States, the national transposition of the WEEE Directive only took place after 13 August 2004 – and for some countries it is still uncompleted in June 2007. As a consequence, it is simply too early for a comprehensive social monitoring and evaluation. The question 'What is the social result of the WEEE implementation and could it be reached better through other means' cannot be satisfactorily answered at this stage. Still, for the so-called ex-post policy evaluation, the social aspects are an essential element in the possible reformulation and reorganisation of the WEEE.

Moreover for a more comprehensive assessment of the implementation of the WEEE Directive taking the economic, environmental and social dimension integrally into account, methodological challenges must be addressed. One of such is certainly the necessity of very detailed information for each dimension which so far has not been applied in a systematic and integrative way for a cross-cutting field as WEEE.

Options for Improvement

From the analysis of all possible options for changing the scope, the collection target, the recycling targets, a target for reuse and the treatment requirements, it is obvious that there are many interrelations between these: When for example the scope would be changed, it would also influence all other targets and provisions. Therefore, conflicting choices and suboptimisation should be avoided. For this reason, only a grouping of options is summarised here. This is based on the key environmental issues connected with low collection rates and lacking reporting on the quality of treatment as well as the high variety found in environmental priorities per treatment category.

The most positive environmental improvements and highest cost-efficiency can be realised by rearranging the product oriented scope towards a treatment category oriented scope. This way there can be differentiated in target setting for collection amounts, recycling percentages and treatment requirements. The additional use of different criteria based upon the environmental aspects

related to the collection and treatment categories, can contribute to more environmentally relevant targets for collection, recycling and recovery and treatment and thus environmental effectiveness. The alternative ways of defining the scope of the WEEE Directive can include some of the main priorities that any determination of the scope should enable:

1. Environmental relevancy and material composition,
2. Achievement of a level playing field for different stakeholders across EU, and
3. Clarification and concurrent enforcement of harmonized approach across Member States.

In addition, different elements should be considered simultaneously with the above including a '95 character' to enable a harmonised application of the scope across EU. Due to the limited amounts of appliances covered by the Directive as real B2B, these categories can be removed without environmental drawbacks as the majority of these appliances are already taken care of by other means, regulations and existing take-back systems as well as due to its intrinsic (reuse) value. Without negative environmental effects, dual use' or grey areas products can fall under B2C (like for instance the consumer equipment in the medical category as an appliance in the Small Household Appliances treatment category), unless proof is provided that they are taken care of as B2B. This could then be deducted from overall obligations and/ or financially reimbursed to achieve 'fair' financing arrangements.

Besides collection targets, the definition of the scope will also influence the setting of recycling and recovery targets as well as treatment requirements per treatment category. These three items are discussed in more detail per treatment category:

- LHHA: For simplification reasons it is worth considering leaving these appliances out of the Directive, as they will be treated anyway due to their intrinsic value. There is also no need for recycling targets for this category,
- Cooling and Freezing appliances are very environmentally relevant in the impact assessment due to the presence of CFCs. The CFC removal is the most relevant environmental priority. They should be collected as much as possible and prevented from undergoing the same treatment as other LHHA, at least for the older CFC containing appliances in the stream. For this category, proper removal of CFC should be prioritised over high recycling percentages,
- SHHA: Small household appliances have a higher chance of leakage to domestic waste disposal. In the collection results from different Member States and systems, there are large differences in performance found. This indicates room for improvement in collection. The weight based recycling targets are the most difficult to achieve. The environmental outcomes demonstrate that increasing plastics recycling for sorted plastics does contribute to higher environmental performance. However, for smaller products and mixed plastics, the plastic recycling scenario is less eco-

efficient. The analysis showed that the most positive option is to develop BAT / Industry standards for what represents best practice for dealing with SHHA as multiple environmental concerns have to be balanced at the same time,

- CRTs and FDP: Over time, CRT amounts collected will go down to zero. Due to the lead content and concerns connected to illegal waste shipments, the collection should be maximised. A specific collection target should be made dynamic over time as these appliances are replaced by flat panel displays and therefore the total weight put on market will go down. For CRT recycling, environmental evidence demonstrates that the different types of recycling have very different environmental levels of re-application. A more specific focus on CRT-to-CRT glass recycling is environmentally beneficial (as long as possible in the secondary materials market). An important finding is that the lowest environmental preferences are also being accounted for as useful re-applications and thus as recycling operations (in the past), which can become environmentally counterproductive.

  For FDPs, the numbers placed on the market are rapidly increasing, however they hardly return as waste at the moment. For LCD screens, the main environmental concern is control over the mercury content. Due to the absence of proper recycling solutions, the high risk of mercury emissions from these panels point to a strict target setting for mercury removal without causing Health and Safety risk and proper control over treatment as the technical costs per piece or per ton will likely be very high. Recycling targets are of secondary priority,

- Lamps: Similar to LCD screens, collection and recycling is very relevant in order to prevent mercury emissions. The costs of collection are high and gas discharge lamps are classified as hazardous waste. Due to the high total amount of mercury present and place on the market, collection targets should be relatively high. Again, recovery of the mercury is to be prioritised over high recycling targets.

The above findings lead to the conclusion that differentiating in environmental priorities over the various treatment categories leads to the largest improvements. The above is summarised in the below table for each treatment category:

	Collection target	**Recycling target**	**Specific Treatment Requirement ***
Large Household (1A,10)	NO	NO	NO
Cooling and Freezing (1B)	YES	Maybe	YES: CFC's
Small Household: 2A,3A,4A,6,7 (plastic dominated part)	YES	YES: For plastic recycling	YES: NiCd from Cat. 6
Small Household: (1C, 3A) (metal dominated part)	NO	NO	NO
CRT containing (3B, 4B)	YES	YES: For CRT glass	YES: Control over PbO
Flat panels (3C, 4C)	YES	Maybe	YES:

			For LCD Hg removal
Gas discharge lamps	YES	Maybe for HQ glass	YES: Hg removal

Table iv: Differentiated targets for collection, recycling and treatment

Targets for reuse should be further researched outside of the WEEE Directive and preferably included in EuP to avoid rebound effects of higher energy consumption compared to newer appliances.

Conditions for Success

Besides, the more differentiated target setting displayed above, there are other conditions for success following from the discussed options that promote a higher level of simplification and realisation of implementing the WEEE Directive in practice beyond changing the legal text as such.

Currently, the extended producer responsibility principle (EPR) can work counterproductively as the most relevant environmental improvement potential is connected to higher collection amounts and improved quality of treatment, which in any case are more expensive. Therefore with WEEE being a societal problem, it demands a societal solution where all stakeholders contribute in line with their positive influence on the solutions side. This leads to the conclusion that:

- Either producers should remain primarily financially responsible and should be given the necessary means including better access to WEEE, combined with a more dynamic and higher collection target based on quantities put on market in the past, OR
- Another stakeholder, the Member States themselves, or Compliance Schemes as a more independent and separate entity (with producers as part of the board together with other stakeholders) can be made primarily responsible. This way, both an incentive for collecting more and treating better can be maintained together with competition between Schemes that can form a lasting incentive to improve cost-efficiency.

In any case, by clearly addressing the responsibilities of other stakeholders as well, the collection and treatment results can be improved.

For environmental reasons, EPR with respect to Design for Recycling should be removed from the Directive and placed in (i) RoHS for removability guidance for exempted components with severe environmental or toxic properties and (ii) other ecodesign incentives can be made part of EuP for overall balancing. This would avoid design activities with contradictive environmental effects in different life-cycle stages for instance due to higher energy consumption in the use phase or higher resource consumption due to more environmentally burdening primary raw materials.

Other conditions for success are identified as:

1. Better enforcement of the key provisions at EU and Member State level on all organisational and operational parts of the recycling chain and especially to reduce illegal waste shipments,

2. Split the basic legal framework and key responsibilities from (to be developed) operational standards,
3. Enable more simplification and harmonisation throughout the EU27 as current differences in interpretation within and between Member States and even regions, does delay implementation and subsequently causes considerable environmental drawbacks,
4. Increase consumer awareness in order to stimulate more collection.

Recommendations

It is recommended to determine the influence of newer products and especially the transition from CFC to HC fridges and from CRT to flat panel displays on the waste stream composition and thus on the overall environmental impacts and benefits of collecting and treating WEEE. Research on better treatment options for LCD TV's and monitors should be done, as there are no satisfactory recycling technologies identified so far. Further development of standards for recycling based on thorough environmental research is another next step for this as well as the other treatment categories.

For medium sized appliances, it is recommended to further research splitting high value products from the rest of the small appliances as is already done in practice in some countries. This could also be of relevance when prescribing recycling targets in order to improve treatment which is preferable to promote plastic recycling, but not a proper incentive when the main environmental aim is to recover high precious metal contents. Also collection alternatives for very small appliances (< 1kg) need to be researched as they are hardly handed in by consumers at the present.