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Study on RoHS and WEEE Directives

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CONTENT

LIST OF ABBREVIATIONS

RoHS Directive	Directive 2002/95/EC on the restriction on the use of certain hazardous substances in electrical and electronic equipment
WEEE Directive	Directive 2002/96/EC on waste electrical and electronic equipment
EEE	Electrical and electronic equipment
Pb	Lead
Cd	Cadmium
Hg	Mercury
Cr(VI)	hexavalent chromium
PBB	polybrominated biphenyls
PBDE	polybrominated diphenyl ethers
BFR	brominated flame retardants
PCB	printed circuit board
PWB's	printed wiring boards
RSM	Reflow soldering machines
WSM	Wave soldering machines
FTE	Full Time Equivalents
SME	Small and Medium Sized Enterprise
XRF analyses	X-ray fluorescence analyses
RAR	Risk Assessment Report
SAC	silver copper solder
R&D	Research and Development
FDA	Food and Drug Administration

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EXECUTIVE SUMMARY

By 2008 the Commission intends to present specific proposals for the review of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) and Directive 2002/95/EC on the restriction on the use of certain hazardous substances in electrical and electronic equipment (RoHS). The WEEE and RoHS EU Directives have been identified as presenting potential for simplification in Commission Communication COM(2005) 535 and are included in the simplification rolling programme for 2008. In line with article 4 point 3 and article 6 of the RoHS Directive a review of the scope and appropriateness is foreseen and DG-Environment is taking the lead in the review processes of both Directives.

With respect to the overall review of the WEEE Directive, a number of former initiatives and studies are completed and close co-ordination with some of them has been searched with respect to data collection and consultation with stakeholders. Whereas the former studies aim at investigating the modification of the targets, this study will help at closing certain gaps by covering the remaining issues. Remaining issues include the assessment of the impacts on innovation, competition and the assessment of the relationships with existing Directives and broader policy objectives.

The aim of the Study of the RoHS Directive consisted of identifying proposals to revise the Directive with a view to improving its cost effectiveness while maintaining the same level of environmental protection. The proposals need to make the legislation less burdensome, easier to apply and thereby more effective in achieving its goals.

A serious attempt has been made to quantify the impacts of the RoHS Directive on the economy and the environment. Whereas the economic impact analysis started from a broad view of all EEE subjected to the RoHS Directive, the study of the environmental impact focuses on a number of products which were selected according to the following criteria: presence of the RoHS substances, economic importance of the product, value of the product at the end-of-life, environmental impact over the different phases of its lifecycle and finally its innovative potential. Besides the impact assessment, inspiration for making the legislation more cost effective was found in a comparison of the RoHS approach with other approaches used inside and outside of the EU.

Study of the RoHS Directive

Environmental impact analysis

For the environmental impact analysis, a case approach was chosen according to which a number of specific products were investigated in detail:

- Refrigerators;
- PC and laptop, including spare parts;
- Printers and copiers;
- Cell phones;
- Television set;
- Clocks and watches;
- Fluorescent lamps (straight and compact);
- Lawn mowers and gardening equipment;
- Video games and handheld video games;
- Dispensers for hot and cold beverages.

These products and product categories have been selected according to the following criteria:

- The presence and quantity of the 6 hazardous substances covered by the RoHS Directive in the products: lead, mercury, cadmium, Cr(VI) or hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE);
- The economic importance of the products and the market structure;
- The value of the product at the end-of-life. The higher the value, the more profitable its recycling is and the less one could consider the need for regulation;
- The environmental impact of the products over the production, use and waste phases of the lifecycle;
- The innovation pace of the sector or the innovative potential of the products.

The environmental impact analysis starts with an overview of the product volumes of the selected products. Subsequently a range of minimum and maximum quantities of each RoHS substance is identified for the various products. Further, different scenarios have been calculated for the yearly amount of RoHS substances avoided in EU 25 in the selected product groups. By using this approach, it is possible to make an estimation of the overall environmental benefits of the different products and as a total for the different products in EU 25. Furthermore, more information is given on the dose-response relationships. The effects on a number of components of the Life Cycle Analysis (LCA) are touched. It was however not the purpose of this study to execute an extensive LCA for each of the selected products. Finally, the following environmental and human health effects due to RoHS are discussed: waste emissions to the environment, volatilisation of brominated flame retardants (Deca-BDE and Octa-BDE) and the effects of Pb substitution in soldering.

1. A **first environmental benefit** of RoHS consists of the total amount of avoided RoHS substances. From the analysis of selected products, it seems that:

- The environmental benefits for TV sets, PCs and refrigerators are the largest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS;
- The environmental benefits for cell phones, copiers and laptops are the largest when looking at the yearly amounts of Hg avoided due to RoHS;
- The environmental benefits for cell phones, dispensers for cold and hot beverages and fluorescent lamps are the lowest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS;
- Based on the analysis of the selected products, it was not possible to extrapolate general criteria to indicate in general product groups which have large or low overall environmental benefits due to RoHS.

Based on the results of the amounts of Pb avoided in EU 25 due to the implementation of RoHS, which are the highest among all RoHS substances, a more detailed literature review was performed to look into the effects of Pb substitution in solders. According to Hunter (2002), solders account for less than 0.5% of the world lead consumption.

Besides the positive environmental effects of Pb substitution, substitution of Pb in solders can also have negative environmental effects e.g. on photochemical smog and air particulates. However, there seems to be no consensus yet on important topics such as energy consumption of Pb-free soldering versus Pb soldering. As the discussion on the environmental impact of Pb-free soldering is very complex, ambiguous and still on-going, no definitive conclusion can be drawn on this topic in the scope of this report.

2. A **second environmental benefit** is the decrease in human toxicity potential and ecotoxicity potential through the different environmental compartments (air, fresh water, terrestrial) due to the implementation of RoHS. This is broadly assessed in this study for Pb, Cd, Cr(VI) and Hg, but has not been possible for the brominated flame retardants.

For the RoHS substances (especially Cd and Cr(VI)), it seems that the RoHS due impact has been the largest on the *human toxicity potential* via the air compartment. However, after the implementation of RoHS this remains relatively the most important compartment. The methodology used necessitated the assumption that all Cr(VI) is avoided through the implementation of RoHS. For Pb and Hg, the impacts on the human toxicity potential via the soil and fresh water compartment are also relevant.
With regard to the *ecotoxicity potential* via the air and terrestrial compartment, it seems that particularly for Cr(VI), Hg and to a minor extent also for Pb, the terrestrial ecotoxicity potential is the most important. For Cd and to a minor extent for Pb the fresh water sediment ecotoxicity potential is also important. For all RoHS substances primarily the fresh water sediment exotoxicity potential, and to a minor extent also the fresh water aquatic exotoxicity potential, are affected via the fresh water compartment. The terrestrial ecotoxicity potential seems to be relevant only for Hg.

The impact of the RoHS Directive in terms of the relative amount avoided human toxicity potential and ecotoxicity potential per RoHS substance as a share of the total amount before RoHS amounts to 100 % for Cr(VI) (due to the methodology used), 85% for Pb, 82% for Cd and 27 % for Hg.

3. A **third environmental benefit** consists of a decrease of the waste emissions being disposed to the environment. As a consequence of the methodology used, the amount of waste avoided being disposed to the environment of Deca-BDE will be zero. For the other compounds, it is estimated that the yearly amount of waste avoided being disposed to the environment will be ca. 89800 ton Pb, 12600 ton Octa-BDE, 4300 ton Cd, 500 ton Cr(VI), and 22 ton Hg. Expressed as a relative share, the percentage of waste avoided to be disposed to the environment due to the implementation of RoHS is 20% (Hg), 56% (Cd), 59 % (Pb), 68 % (Octa-BDE) and 71% Cr(VI) of the total amount of RoHS substances present in the selected products before RoHS (Deca-BDE = 0%).

4. Brominated flame retardants (BFR) such as Deca-BDE and Octa-BDE tend to volatilise from products during service life. The RoHS directive has a *fourth positive effect* on the Octa-BDE volatilisation losses, but has probably little or no effect on the Deca-BDE losses.

Economic impact analysis

It is clear that the economic impact analysis includes a lot of interesting findings. Below, we have concentrated on the facts that are specifically relevant for this simplification exercise: which findings could positively be influenced by a revision of the Directive?

The analysis does not so much focus on the past, but instead looks at the future costs which remain necessary to maintain RoHS compliance. In this way, there is a closer link with the analysis of proposals to revise the RoHS Directive, where we concentrate on trying to ease the remaining future economic impacts. It should be clear that we avoid questioning the general set-up of the RoHS Directive. One of the reasons is that most companies have completed the changes required for RoHS and are not requesting thorough revisions. This might introduce uncertainty over the requirements again, now that the legislation finally settled down to a workable form. Besides, it would not be advisable to remain focused on the efforts companies have made in the past, which are very significant but non-reversible.

1. **Total costs incurred by industry to comply with the RoHS Directive are high; a large part of the costs incurred to comply are spent in the past**

It is clear from the economic impact analysis that total costs incurred by industry to comply with the RoHS Directive are high. Generally, the average past and future one-off cost impact of RoHS lies between 1 and 2% of total turnover. For comparison, electronics companies spend on average 4-6% of their revenues to R&D.

The share of total average future yearly costs to maintain compliance amounts to approximately 10% of total costs. When weighted, this share decreases up to 3%. This indicates that a large share of the costs for RoHS compliance have already been borne in the past. Options for revising the RoHS Directive should therefore be concentrated on ways to lower annual future costs.

2. **The share of compliance costs in total costs to comply with RoHS is much higher compared to the share of technical costs**

Total costs to comply with RoHS can be split up into compliance costs and technical costs. Compliance costs consist of costs of training and information measures, costs of collecting and reviewing information, costs related to exemption procedures and monetary losses related to RoHS compliance (e.g. turnover loss, obsolete components). On the other hand, technical costs to phase-out RoHS substances consist of capital expenditure, R&D expenditure and operating expenditure.

Compliance costs make up 67% of all costs made to comply; the share of technical costs amounts to 33%. Within the future yearly costs to stay RoHS compliant, the share of technical costs drops to 12%, whereas compliance costs reach a level of 88% of total costs. As most technical costs (capital and R&D expenditure) are made in the past to comply with RoHS, the remaining future yearly costs consist mainly of the operating expenditure, such as increased purchasing costs of materials or higher energy costs, related to the substitution of RoHS substances.

Options for revising the RoHS Directive should therefore be concentrated on ways to lower annual future compliance costs, which is linked with options aimed at an efficient monitoring and enforcement regime to limit free-riders.

3. **The administrative burden related with RoHS is relatively large**

When concentrating on the yearly costs to remain RoHS compliant in the future, the administrative burden can not be underestimated. The administrative burden consists of the costs of training and information measures, the costs of collecting and reviewing information and the costs related to exemption procedures.

Almost 70% of the total future yearly costs are related with information and verification activities such as providing, collecting and validating RoHS compliance of components, testing procedures, maintaining records in new or updated (software) systems, adaptation of the company's quality system, including stock management, and performing quality audits.

Regarding the material declarations, existing standards, like the IPC1752[1] material declaration standard, are increasingly being used. Regarding the testing of supplied components to secure RoHS conformity, stakeholders state that a number of unanswered questions remain on how to conduct accurate verification testing. It is very difficult in practice to control the "homogeneous material" concept as a basis for checking compliance with the maximum concentration values.

Costs are identified on the level of stock management or segmentation of compliant and non-compliant products and components (RoHS and non-RoHS process or machines identification/labelling/isolation). Companies often deal simultaneously with different markets, like the EU-market, other markets with RoHS like legislation and markets without RoHS like legislation. It is also possible that they cope with products that are included in the RoHS regulation and products that are not included or are exempted.

Where training and information measures to learn and keep up with RoHS requirements made up 41% of the administrative burden in past and future one-off costs, they will in the future make up only a quarter of the administrative burden.

[1] IPC1752 is a standard for electronic data exchange for Environmental Data developed by IPC with participation from major OEMs, Contract Manufacturers, Component Manufacturers and Material suppliers.

An administrative burden (5%) is caused by the mechanism for exemptions which causes a lengthy exemption process. Trade associations mention the long waiting periods between a request for exemption and the decision. Furthermore, they mention the lack of communication to industry during this process. Products awaiting approval are not allowed to be put on the EU market, which hinders competitiveness.

As can be expected, monetary losses can in the future be considered negligible.

4. **A large part of the costs are personnel costs, but the vast majority of companies hired zero or one employee for RoHS compliance**

The share of personnel costs related with training & information activities and with collecting & reviewing information activities in the total past and future one-off costs amounts to 38%[2]. This share increases up to almost 50% when considering the yearly future costs to remain RoHS compliant.

In order to execute all activities to become and remain RoHS compliant, the vast majority of companies hired zero or one employee for RoHS compliance, relying instead in internal resources by reassigning existing personnel.

5. **The relative cost burden is higher for SMEs**

When weighted by company revenue, the average past and future one-off cost impact to comply with RoHS and the future yearly cost to remain compliant amount to respectively 0.05% and 0.003% of turnover. This indicates that SMEs are affected to a greater degree by compliance with the RoHS legislation compared to their larger or multinational competitors. The burden is higher for smaller companies compared to large or multinational companies. The relatively larger burden for SMEs holds for total costs to comply with RoHS in general as well as more specifically the administrative burden.

In the previous paragraph, it was mentioned that the vast majority of companies hired zero or one employee for RoHS compliance, relying instead on internal resources by reassigning existing personnel. SMEs have a smaller labour force but are obliged to carry out the same requirements as companies with a larger pool of labour. This means that the work pressure put on personnel in SMEs will be relatively higher.

6. **There is a lack of considering market reality in the exemptions process**

Exemption process may hinder innovation, but also offers an opportunity to innovate

The RoHS Directive might loose its impact as a driving force for innovation when industry has the choice between developing alternatives for certain products and proposing an amendment for legislation. As long as hazardous substances are still allowed under exemptions, it is difficult to ascertain how much effort and investment companies will put into the development of alternative products with less environmentally damaging substances. In this way, the process of granting exemptions could be considered as hampering innovation. Also, the exemption process itself, often taking more than a year to complete, is considered by some stakeholders to be a barrier to research and development for new innovations.

On the other hand, the RoHS ban itself could be a barrier to innovation. Researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder

[2] Unfortunately, companies did not indicate the share of personnel costs in R&D costs, which made it not possible to calculate personnel costs dedicated to R&D. This means that in reality, personnel costs will be somewhat higher.

the development of new technology, as fewer materials are considered and potential improvements and new products might not be developed. It might stimulate innovation to allow a time limited derogation for the specific aim of developing new products. In this way, the use of RoHS restricted materials could be allowed for a limited period of time in which companies can experiment in the development of new products.

Exemption process should consider market reality

Whereas the RoHS Directive bans or limits the use of hazardous substances in EEE products, the Directive allows for exemptions from its provisions where the benefits of retaining certain hazardous substances until an effective substitute can be identified outweigh the perceived drop in performance of certain products.

According to a number of stakeholders, not only the issue of technology availability is valid. There is a time gap between the availability of a substitute and the RoHS conformity of an EEE. When the substitute becomes available in the beginning of the supply chain, it takes considerable time before it arrives in the end product and the product is considered free of RoHS substances. Therefore, industry argues that there should be a sufficient buffer period between the arrival of a substitute and the abolishment of an item from the annex of exemptions. This period may however not be too long, because it is not intended for using up an existing stock of supplies containing RoHS substances.

Besides the mere presence of alternative technologies, economic and market circumstances can have a large influence on the implementation of new technologies. This is not taken into account during the exemption procedure and the exemption decisions. During the time an exemption holds, companies are working to eliminate the use of substances in applications that are exempted. However, even if alternative technologies are available, the implementation in product designs requires consideration of various business realities such as:

- Availability of the technology in the parts currently used in products;
- The functionality of the new technology (including reliability) compared to the current technology used;
- Design implications of using parts containing the new technology;
- Cost implications of the transition to the parts containing the new technology.

The process of implementing alternative technologies is complex and companies need to review:

- Whether the technology is fit for the particular use (i.e. whether the properties and quality/reliability aspects meet the demand);
- Whether the alternative is a direct replacement or that redesigns of EEE would be required;
- Whether parts using the new technology are available through the producers' current supply chain (i.e. adding new suppliers in case an existing supplier does not have access to the new technology).

Once a new technology is found acceptable, it needs to be implemented throughout the logistic process before it can be implemented in the manufacturing of EEE. In case the application of the new technology requires a re-design at the EEE level, the re-design process (including design verification, product testing) needs to be completed prior to the start of the manufacturing process.

The key factor in applying a new technology by EEE producers is the time required between the availability of a new technology up-stream in the supply chain and the ability to place EEE on the market after completing all tasks as described above.

The current experience with the application of the criteria of article 5 of the Directive leads to the conclusion that this provision requires modification to allow a more realistic process for the review and future withdrawal of exemptions, more in line with commercial reality. Stakeholders believe it is necessary for the decision-maker to take into account the following economic criteria when considering the removal of an exemption:

- The large scale availability of a new technology to meet the volume needs of the whole of industry;
- The necessary lead times for implementing changes in the manufacturing process to adapt to the new application;
- The highly technical matters of supply chain management, product re-design and reliability analysis.

Exemption process should consider balance between environmental and economic impact

Another aspect in the question whether or not to grant an exemption, could be the investigation of the balance between the environmental benefits of RoHS compliance and the economic costs of becoming compliant. It is possible that the costs to comply are extremely high, whereas the additional environmental impact of RoHS compliance for a certain application is very low.

From the results of this study based on specific products, it was not possible to generate general criteria determining cases in which a very high economic cost of compliance does not balance with an extremely low environmental impact. However, the analysis showed that Category 8 and 9 products of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material are at the limit regarding costs and benefits.

7. **A part of the burden is related to difficulties concerning the scope of RoHS**

According to the stakeholders, a burden comes from tracking the transpositions of the RoHS Directive in all 27 Member States, because of the large variation in transposition. This variety stems from a difference in enforcement methodologies as well as a difference in interpretation of the scope and applicability of the Directive. Trade associations have mentioned the lack of clear definitions in RoHS legislation, such as ‘put on the market’, ‘homogeneous material’ and what is ‘lead free’. This results in considerable confusion with regard to compliance.

8. **Market surveillance is fundamental to ensure a fair, competitive playing field**

Trade associations tend to believe that the burden of compliance is not being shared equitably among producers. They refer to the problem of free-riding and are convinced that many importers in the EU do not comply because of insufficient market surveillance. In this way, competition is likely to be distorted.

9. **Additional costs come from handling compliance with multiple RoHS directives**

From other literature sources we have learned that a large part of companies experience additional costs from handling compliance with multiple RoHS directives. China RoHS has by far given rise to the most costs. Multiple respondents suggested international standards or centralisation to simplify and streamline environmental behaviour.

Proposals for revision of the RoHS Directive

The environmental and economic analysis has resulted in the following set of proposals for revision of the RoHS Directive. For each proposal, an evaluation was made of the advantages and disadvantages as well as their impact. The proposals represent the vision of the consultant. A ranking of the options for future amendments was included, according to their preference. This ranking is the opinion of the consultant and in no way commits the Commission. It is based on the following elements:

- The efficiency of the solution to solve reported problems;
- The respect of the solution for the current level of environmental protection;
- The legal feasibility of the solution;
- The social basis and the acceptability of the solution by stakeholders;
- The short term, middle term or long term perspective for implementation of the idea, the degree of direct applicability and feasibility in a traditional review exercise on RoHS.

The ideas can be ranked into the following classes:

- A: advised by the consultant
- B: advised but more difficult to realise
- C: disadvised by the consultant

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
1	*Distributing the administrative burden across suppliers*				
2	Business as usual	None	No additional administrative burden for supplying industry	None of the reported problems is solved	C
3	Remove the concept of homogeneous material and replace it by a larger functional unit	Minor adaptation in the annex	Less burden for testing compliance No burden for suppliers	Non compliant minor parts will have no incentive for becoming compliant Lower level of environmental protection	C
4	Material or component supplier is obliged to prove RoHS compliance	Introduction of the concept of "component" in article 2 point 1 Abandoning the principle of focus on finished products Amendment on article 4 (1) to impose RoHS substances ban on suppliers	Easier data collection because closer to place of original production More equal distribution of burden Lesser burden for assemblers on compliance testing, SME friendly Working examples exist eg in Directive 89/336 on electromagnetic compatibility Offers more legal security for assemblers No inequity between the EU market and the world market Support for supply chain management Easy to check instrument for enforcement Applicable instrument in waste phase	Certification becomes more complicated Less transparency for end-user Application problems for imported final products Larger legal impact	C

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
4a	Application of information provision duty cfr art 11 EuP Directive	Additional article needed	Gentler version of idea 4 More equal distribution of burden but with respect of focus on finished products and producer responsibility Lesser legal impact In line with existing market evolutions	Less enforceable towards suppliers Difficulties to control for transaction happening outside Europe. Case-by-case decision process whether obligation is adequate or not, which is not applicable to the RoHS	C
5	Standardised compliance testing methods	Article on testing and reference to standards to be included	In line with New Approach concepts Applicable in different scenarios Availability of (draft) standards Applicability not limited to EU market Large stakeholder acceptability	No solution yet for testing CrVI in metallic surface conversion applications Democratic deficit for SMEs when applying international instead of European standards	A
	Efficient enforcement and market surveillance				
6	Business as usual	None		Administrative burden Uncertainty and lack of transparency for assembler and enforcement agencies	C
7	Certification through RoHS agency	Administrative body to be created Additional provisions in the Directive to be foreseen	Applicable in scenarios with or without distributed burden Strong credibility of an independant governmental third party control Centralised approach enables	Not applicable to each of the above mentioned scenarios Higher administrative costs for both EU and industry Low stakeholder acceptability for a new institute	C

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
			IMDS-like database services Possiblity to include represent-tatives from the stakeholders mentioned in article 5.2	Large trade associations prefer self-certification	
8	Certification through notified bodies	Additional provision to be foreseen	No administrative body needs to be created Certification can be included in the market In line with New Approach Open to any actor within or outside the EU CE mark available	Higher administrative costs for industry Less centralised services possible Large trade associations prefer self-certification New Approach fails in some other fields of application	C
9	Applying the RoHS enforcement guidance document	Additional provision to be foreseen	Welcomed by the TAC Broadly accepted Consistent application of exemptions Freedom of choice of the method to prove conformity SME friendly Use of producers or suppliers warranties or certificates	Voluntary instrument, no legal force Based on self-declaration Might be fraud-sensitive Presumption of compliance in a strong competitive and global market Less guarantees for a high level of environmental protection	B

	Bringing more market reality into the exemption process				
10	Business as usual: everything that is not allowed is forbidden	None	Covers all new and not yet known applications Transparency of TAC procedure, three moments of participation	Expanding annex, becoming more complex, causes problems to use and to interpret Delays in approval proces for exemptions perceived as long Economic and market conditions are not considered Less impact from NGOs Less driving force to innovation and alternative solutions Discussion on exemptions limited to technical issues	B
11	Add timeframes to the exemption process	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation process	More consideration of market and economic forces More time to ensure sufficient offer of compliant technologies	Driving force for innovation can decrease	A
12	Grant time limited derogation for developing new products	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation process	More consideration of market reality in businesses Stimulates innovation	Might be fraud-sensitive	A
13	Add criteria granting exemptions to applications for which economic costs outweigh environmental benefits	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation	More consideration of market reality in businesses	Difficult to generate general criteria because of product-specific conditions Impact analysis is necessary on a case-by-case base	A

		process			
14	Applying the REACH-compromise	Fundamental changes in article 4 point 1	Example operational under REACH Possibility to create a legal driving force for RoHS substances beneath the thresholds Reduction in legal uncertainty Possible future alternative for RoHS exemptions	Diminishing level of environmental protection when applied on RoHS substances above the thresholds Higher administrative burden Low stakeholder acceptability (NGO)	B
15	Restricted banning: everything that is not forbidden is allowed	New structure of article 4 point 2 and the annex	More flexible towards new products and applications	Large changes on the annex can re-open discussions No automatic coverage of new applications Danger of lower overall environmental performance Tendency towards more vague wordings	C
16	Copying the approach of the packaging Directive	New structure of article 4 point 2 and the annex	Benefits of current system maintained Easier exemption process within a limited timeframe More accessible for all stakeholders Proven concept in another field of environmental product policy Clearer approach by using positive and negative examples In line with New Approach Open to life cycle elements	Annexes only have exemplary value and arguments can be used to diverge from them	A

17	Installing a consultation forum	A new article	Proven concept in another field of environmental product policy Effective way of bringing together different points of view SME friendly	Possibly limited benefits compared to current TAC procedure	B
	Coping with unequal implementation in Member States				
18	Business as usual	None	Discussions on scope are not re-opened	Administrative burden Legal insecurity	A
19	Changing the legal ground and uniting RoHS and WEEE[3]	Large intervention in the legal ground of the Directive	Closer connection between RoHS and WEEE, or integration into one legal instrument Integration into one instrument is applied by several Member States in the local implementation of the Directives	Possibility of re-opening lengthy discussions on scope A less uniform application can become the result of more subsidiarity	C
20	Splitting up RoHS and WEEE definitions and exemptions: Solution 1: annex IA and IB of WEEE can be copied and added as an annex to the RoHS Solution 2: annex IA and IB of WEEE is used as a basis for a comparable annex to the RoHS Directive Solution 3: in the RoHS Directive articles are introduced to state which exemptions and definitions in the WEEE Directive are	Dependent on the solution chosen, changes in the annexes of RoHS and/or WEEE Possible new Commission Decision Possible new definitions and exemptions in the RoHS Directive	Full respect to the legal ground of both Directives Better and more logic connection between scope and exemptions/definitions	In solution 1, a double list that manually has to be kept identical In solution 2 lists may diverge In solution 3 more complicated wordings in the core of the RoHS Directive may be needed	Sol. 1 : B Sol. 2 : B Sol. 3 : B Sol. 4 : A

[3] Without prejudice to the type of change ; all under article 95, article 175(1) or a double ground 95+175(1)

	applicable to RoHS and which are not Solution 4: annexes IA and IB are taken out of WEEE and are introduced in a separate Commission Decision, comparable with the List of Waste Decision 2000/532/EC. Reference to this list can be made in the WEEE Directive, the RoHS Directive and in any possible future legal initiative				
	Clarifying definitions				
21	New definition of "putting on the market"	None	Possibility to bring definition in line with New Approach and EC proposal for a regulation setting out the requirements for accreditation and market surveillance related to the marketing of products (2007)	Necessary in case of certain other above mentioned ideas (idea 4)	B
22	New definition of "part of another equipment"	Change in definition in RoHS and/or WEEE Directives	Clarification Streamling implementation		A
23	New definition of "homogeneous material"	Change in definition in RoHS and/or WEEE Directives Change in annex	Clarification Streamling implementation Creates better testing conditions Definition from FAQ largely accepted		A
24	New definition of "large scale stationary industrial tools"	Change in definition in RoHS and/or WEEE Directives	Clarification Streamling implementation Definition from FAQ largely accepted		A

Study of the WEEE Directive

This component requires the study of the impacts of the WEEE Directive and its requirements with respect to:

- Innovation:
  - Estimating the share of R&D effort dedicated to fulfil WEEE requirements;
  - Assessing the extent to which the systems of producer responsibility maintain producers' incentives to improve eco-design;
  - Considering whether those systems as implemented by Member States are discriminatory against the most innovative products and companies;
- Competition:
  - Whether anti-competitive practices have been widespread;
  - Whether commercial relationships along the supply chain have been altered;
  - Whether systems of producer responsibility implemented have been discriminatory against SMEs, niche products and new entrants, whether dominant positions have been created in the waste management industry;
  - Whether free-riding has lead to increases in financing liabilities for compliant companies.

In parallel with the analysis of these impacts, the study requires to compare the approach taken under the WEEE Directive with respect to different waste streams and outside of the EU (and specifically in China, Japan and the US).

The study is then required to formulate and assess a number of proposals to revise the WEEE Directive with a view to improving its cost effectiveness in relation to the impacts analysed.

The approach to the study has been based on a review of the available literature and consultation with stakeholders through a questionnaire. Overall, however, the response to the questionnaire has been limited. Reasons for low response may be the fact that the other two ongoing studies were also involved in consultations with the same stakeholders at roughly the same time and difficulties in sharing information between the three studies due concerns over confidentiality of data.

The effects of the WEEE Directive on innovation

Overall, there are limited conclusions to draw with respect to the impact of the WEEE Directive on the share of company resources allocated to R&D. Information from direct consultations with industry stakeholders, whilst limited in its extent, has suggested that the Directive itself has had very limited influence over decisions to allocate resources (people, time and money) to R&D to meet with WEEE requirements. Existing reviews of the impacts of the WEEE Directive on innovation in EEE products have produced a mixed analysis of the direction of the impacts and whether indeed such impacts exist. The fact that there are a significant number of drivers for eco-design, of which the WEEE Directive may only be one if it is significant at all, further complicates the picture with respect to R&D allocations.

Some companies are of the view that eco-design issues are already being tackled outside of the scope of the WEEE Directive e.g. via the EuP Directive, and therefore do not necessarily refer to the requirements of the WEEE Directive when making economic decisions regarding R&D allocations.

Yet consultation with stakeholders has revealed an overall desire to implement Article 8(2) of the Directive more fully and evenly across Member States with respect to individual producer responsibility in order to strengthen the link between cost incentives for dealing with WEEE and eco-design decisions with respect to products' waste content and ease of recycling.

The effects of the WEEE Directive on competition

Consultation with stakeholders has overall revealed the current competition problems from the lack of clarity on the scope and hence harmonisation across MS, mainly categories covered and collection targets, provision of financial guarantees and reporting requirement.

The problem of free riders was also identified as a significant problem by stakeholders. Whilst it is difficult to quantify the problem, free-riding does appear to be a concern and places an unfair burden on compliant companies where it exists. It is likely that with significant differences in the market surveillance systems and capacities in different Member States, the problem of free-riders may be more of an issue in some countries than in others.

There appear to be issues on competition arising from exclusive agreements. These have been reported in some MS such as Estonia, as a result of exclusive agreements between waste management companies and WEEE collective schemes. It is uncertain however to which extent this problem can be dealt with by changes to the Directive alone or just action at MS level through court procedures.

WEEE outside the EU

Countries have approached WEEE differently over the last decades. The study identified a trend in some countries however towards IPR. Large companies are overall taking responsibility for own WEEE as well as creating new market opportunities for recycling companies.

In China, the demand for recycled materials and the potential new regulatory framework are contributing to industrial scaling-up and increased interest among companies in investing in WEEE processing. More formal recycling enterprises are also developing an interest in WEEE recycling and processing in China. New WEEE recycling and treatment facilities are planned and financed by both governments and private companies for Hangzhou, Wuxi, Nanjing and Beijing, despite the current lack of a regulatory framework for such enterprises.

In Japan, there is evidence of advances of eco-design, e.g. 'design for disassembly' and use of 'automated disassembly using smart materials' (ADSM). The Japanese system is viewed generally as providing more incentives for design changes as the EEE manufacturers are closely linked to recycling installations (Bio Intelligence Service, 2006)

In the US, some states have implemented measures to deal with electronic waste since 2001. California became the first state to impose an advance recovery fee (ARF) on the sale of electronic products (TVs, monitors (4'' or greater), CRTds, and laptops. Fees are collected by retailers, managed by the state, and used to fund the recycling programme. Other private initiatives include "product stewardship programmes".

The Options

A series of options are developed that could potentially address the above. These are:

- Measures related to Scope and Standards:
  - **Clarify scope** relating to categories of goods and products, finished products, use of goods in products not covered by the Directive etc. This would entail amending Article 2, providing unequivocal guidance through amended annex and FAQ.
  - **Careful monitoring** of the ability of schemes to collect specified amounts is required prior to changing targets, amending Article 5 to require Member States to monitor and report regularly to the Commission and also including a provision to set higher targets according to portfolio of products in-country.

- Measures related to IPR:
  - Ensure that producers have the opportunity to opt for individual producer responsibility.
  - Common approach across Member States to the nature of guarantees required. Amending Article 8.2 with description of types of guarantees that are permitted and obliging all companies to provide these.
- Measures related to harmonization:
  - **EuP – Eco-design**: deleting article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy using Products.
  - **Opening registers**: All registers should be opened to non-national companies without representation in-country. This measure will consist of amending Article 12 or introduce new Article specifying standard and open registration practice.
  - **EU centralised registration system**: Harmonisation of registration processes across Member States, moving towards centralized European registration system and introducing a new article in Directive on European Centralised Register.
  - **Reporting**: amending Article 12.1 with mandatory instructions re. content, timing etc. of reporting.
  - **Labelling and Information requirements**: amending Article 10 to define standardised labelling requirements across MSs as mandatory.
  - **Disassembly and recycling**: establishing standards for disassembly and recycling based on stringent scientific research and amending Article 7 to clearly establish process for developing standards.
- Measures related to Competition:
  - **Increased market surveillance:** Strengthening market surveillance systems within Member States to minimize free-riders and amending Article 16 Inspection and monitoring to specify inspection and monitoring obligations of Member States in greater detail and possibly introducing targets.
  - **Collective Compliance Schemes:** Ensuring that all transposition of the Directive does not impose any restrictions on the numbers of compliance schemes that can operate within a countrya and amending Articles 5, 6 and 7 or introduce new article on Producer Compliance Schemes which obliges Member States to avoid any restrictions (direct or indirect) on the numbers of schemes that can operate.
  - **Waste Trade:** Stronger enforcement of legislation on shipments of waste through increased monitoring also amending Article 6.6 to include strong monitoring requirements to be enforced by Member States.

The assessment of options

The options assessment has been informed by the EC Impact Assessment Guidelines, as concerning the selection of criteria.

It is clear that different issues require different types of measures. For instance, issues related to scope may help harmonisation but may not be as affective in spurring innovation. Alternatively, aspects related to IPR may encourage innovation but there may be issues relating to free-riding if other additional measures are not implemented, such as increased surveillance with the additional costs implications on public expenditure.

The final decision will depend on the weight assigned to the different problems, with the decision-maker having to assess the different trade offs between the impacts; but this is likely to require more than one measure and indeed a combination of measures.

In addition, there will be uncertainty surrounding the impacts. This is because although some impacts may be easy to predict there will also be compounding and unexpected factors affecting them that are not easy to foresee from the outset.

The following table summarises the impacts with the greatest positive impacts as assessed above according to the different impact categories. Some of the potential disadvantages or trade-offs are also highlighted.

Impacts of Measures – Overall assessment and trade-offs

	'Best Measure'	**Trade-offs associated with measure**
Strengthens IPR	Ensure that producers have the opportunity to opt for individual producer responsibility.	No significant trade-offs although it may increase the costs of authorities in terms of administering the registers and other monitoring arrangements.
Competitiveness, trade and investment flows	No clear best. The most positive impacts are expected from the options regarding the opening of registers and centralised European registration system. Also strengthening market surveillance systems within MS to minimise free-riders may have a significant positive impact on competitiveness.	These measures are likely to impose significant costs on public authorities. The impacts on innovation and research are unlikely to be significant.
Competition in the internal market	As above. In addition, other measures that are expected to have a significant positive impact include: Clarification of scope and standards; Standards for disassembly and recycling; Opportunity to opt for IPR.	As above. The trade offs associated with the additional measures are; Uncertain impacts, and potentially significant, on operating and administrative costs of businesses; Costs to authorities of monitoring; In addition, the impacts on innovation are not expected to be significant with the exception of the standards for disassembly and recycling and opting for IPR.
Operating costs and conduct of business	Overall, impacts from the measures are difficult to predict. The measures with a more likely positive impact are those related to harmonisation and competition. This is because it will remove barriers to trade and increase flexibility.	The downside of any measure related to harmonisation and competition is the administrative costs on authorities. Impacts on innovation and research are not always clear.
Administrative costs on authorities	Amend Article 12.1 with mandatory instructions regarding content, timing, etc. of reporting	No significant trade-offs. Indeed, other positive impacts could also be expected from harmonisation of reporting requirements (economies of scale)
Administrative costs on businesses	As above	No significant trade-offs.
Innovation and research	Delete Article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy Using Products. Also, ensure that producers have the opportunity to opt for IPR.	No significant trade-offs with the first measure. There may be cost implications for public authorities associated with the second measure in terms of administering the registers and other monitoring arrangements.
Waste production / generation /recycling	Establish standards for disassembly and recycling based on stringent scientific research, Amend Article 7 to clearly establish process for developing standards.	There may be some costs implications for businesses and authorities. It also likely to increase administrative costs of business from increased reporting.
Employment and labour markets	As above, as it may encourage employment in the recycling sector. Although impact is unlikely to be significant.	As above.

The following conclusions can be drawn by type of measure:

- There will be positive impacts from clarifying the scope and issues related to the categories of goods and products covered by the directive although the scale of impacts will finally depend on how the new scope is formulated and the clarity and acceptability of the guidance to be provided. The impacts on businesses are highly uncertain and will vary across Member States as current legislative frameworks are more stringent in some Member States than others;
- Ensuring that producers have the opportunity to opt for individual producer responsibility will have the greatest benefits on competition and innovation and research. This view has been voiced by some of the stakeholders consulted for this study and re-stated in some industry position papers;
- Opening registers seems to be the measure with regard to harmonisation with the largest positive impacts: as noted above, the largest positive impacts would be expected in terms of increased competitiveness and competition and will guarantee a level playing field for companies in the EU and outside the EU. The trade-offs were those related with the costs of administering the registers.
- Allowing collective compliance schemes with limited restrictions will be the measure with the greatest impacts on competition. No negative impacts can be foreseen with this measure; although the impacts on innovation and research are uncertain. Although more compliance schemes may help companies dealing with any type of waste minimising their cost, there is also scope for setting up exclusive agreements that may spur innovation.

1 INTRODUCTION

1.1 BACKGROUND

This study is framed within the context of the Commission's overall legislative simplification exercise. By 2008 the Commission intends to present specific proposals for the review of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) and Directive 2002/95/EC on the restriction on the use of certain hazardous substances in electrical and electronic equipment (RoHS). The WEEE and RoHS EU Directives have been identified as presenting potential for simplification in Commission Communication COM(2005) 535 and included in the simplification rolling programme for 2008. In line with article 4 point 3 and article 6 of the RoHS Directive a review of the scope and appropriateness is foreseen and DG-Environment is taking the lead in the review processes of both Directives. However, the review of the RoHS Directive in accordance with article 6, and the consideration of the inclusion of product categories 8 and 9 from the WEEE Directive in the scope of the RoHS Directive in particular, are not included in this study.

Simplification of legislation has been recognised by the Commission as being a necessity for obtaining legislation which is strong and more effective in achieving its goals. Through simplification, legislation will be more transparent, more focused, more cost effective and more accepted by the target groups. Therefore, in every simplification exercise the first question will always be to save and to promote the goals of the original instrument, but it will do this by using the most suitable, the least burdensome and most effective instruments. The economic principle, to achieve the best results with the least effort, is the guiding principle. A good simplification exercise should be neutral against the goals of the policy; it is merely an instrumental exercise. However, the argument of simplification will often be used to achieve shifts in the level of ambition or in the goals of the legislation, and this is a pitfall to be avoided, particularly in discussions with stakeholders. As described in the request for services, this simplification exercise will scrutinise the current legislative approach with a view to replacing or amending it with more efficient, less prescriptive, flexible and proportionate instruments while maintaining the same level of environmental protection. The proposals formulated in this study seek to maintain the environmental objectives at the least cost possible, including static costs such as administrative burden and dynamic costs such as any effects on innovation. The study does not attempt to discuss or to justify the overall need for the RoHS or WEEE Directives and as a result it does not evaluate its objectives, but it rather concentrates on the means of achieving these objectives.

With respect to the overall review of the WEEE Directive, a number of former initiatives and studies are completed and close co-ordination with some of them has been searched, with respect to data collection and consultation with stakeholders due to the number of overlaps and the need to avoid 'stakeholder fatigue'. For this Directive the former studies aim at investigating the modification of the targets. This current study will help at closing certain gaps by covering the remaining issues. For the RoHS Directive this is a stand-alone assignment and a thorough data collection and assessment exercise is made and can serve as the main basis for the possible adaptations to the Directive to be proposed. Therefore, main focus of the study has been laid on the RoHS Directive with a concentration on technical issues over policy questions.

1.2 GOALS

The study on RoHS and WEEE Directives consists of two separate studies: one on the RoHS Directive and one on the WEEE Directive. The study investigates the following issues:

- General issue: is this structure and approach the correct mechanism to obtain the objectives of the Directives at the least cost?
- Specific issues (RoHS):
    - Analysis of the impacts of the RoHS on the economy and the environment;
    - Comparison of the RoHS approach with other approaches used outside of the EU (and specifically in China, Japan, South Korea, and in some US states) highlighting advantages and disadvantages;
    - Formulation of proposals to revise the RoHS Directive with a view to improving its cost effectiveness while maintaining the same level of environmental protection.

    The following tasks were covered:

    - Execution of a (static) cost-benefit analysis for a number of product categories.
    - Assessment of the impact on the Internal Market.
    - Assessment of the impact on innovation.
    - Assessment of potential synergies and conflicts with other policies and impact on products and sectors not covered by the ban.
- Specific Issues (WEEE):
    - Assessment of the categories of impacts of the WEEE requirements as detailed below from both an economic and environmental point of view;
    - Identification of the factors and requirements with a critical positive or negative impact for each category of impact;
    - Comparison of the approach undertaken in the WEEE with respect to other approaches undertaken in the EU with respect to different waste streams (including end-of-life vehicles, batteries, packaging and packaging waste Directives) and outside the EU (and specifically in China, Japan, the US) identifying advantages and disadvantages with respect to the categories of impact;
    - Formulation of proposals to revise the WEEE Directive with a view to improving its cost effectiveness, while maintaining the same level of environmental protection, in relation to the categories of impact analyzed. .

    The following tasks were covered:

    - Assessment of the impacts on innovation.
    - Assessment of the impacts on competition.
    - Assessment of the relationships with existing Directives and broader policy objectives.

2 SCOPING OF THE STUDY

2.1 SECTOR PROFILE

An assessment of the number of companies involved in the fabrication of electrical and electronic equipment is made based upon the PRODCOM database of Eurostat, category 'Business demography indicators presented by size class'. Aggregates for the whole of the European Union are difficult to make, since some important countries (e.g. Germany) do not participate in the data collection exercise.

All EU-15 Member States and Norway participated in the 2002 harmonised data collection on business demography, with the exception of Germany, Greece and Austria. In 2003, Belgium and Ireland also did not participate.

In 2004, the following 16 Member States participated: Czech Republic, Estonia, Spain, France, Italy, Latvia, Lithuania, Luxembourg, Hungary, Netherlands, Poland, Portugal, Slovenia, Slovak Republic, Finland and Sweden. In addition Norway and Romania participated.

In 2005, the following Member states participated: Czech Republic, Denmark, Estonia, Spain, France, Italy, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Portugal, Slovenia, Slovak Republic, Finland, Sweden and the United Kingdom. In addition Romania participated.

Data are collected in Nace category DL, Manufacture of electrical and optical equipment. This includes the following sectors:

Table 2.1: NACE codes DL, manufacture of electrical and optical equipment

DL.	Manufacture of electrical and optical equipment
DL.30	Manufacture of office machinery and computers
DL.30.01	Manufacture of office machinery
DL.30.02	Manufacture of computers and other information processing equipment
DL.31	Manufacture of electrical machinery and apparatus n.e.c.
DL.31.10	Manufacture of electric motors, generators and transformers
DL.31.20	Manufacture of electricity distribution and control apparatus
DL.31.30	Manufacture of insulated wire and cable
DL.31.40	Manufacture of accumulators, primary cells and primary batteries
DL.31.50	Manufacture of lighting equipment and electric lamps
DL.31.60	Manufacture of electrical equipment n.e.c.
DL.31.61	Manufacture of electrical equipment for engines and vehicles n.e.c.
DL.31.62	Manufacture of other electrical equipment n.e.c.
DL.32	Manufacture of radio, television and communication equipment and apparatus
DL.32.10	Manufacture of electronic valves and tubes and other electronic components
DL.32.20	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy

DL.32.30	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
DL.33	Manufacture of medical, precision and optical instruments, watches and clocks
DL.33.10	Manufacture of medical and surgical equipment and orthopaedic appliances
DL.33.20	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
DL.33.30	Manufacture of industrial process control equipment
DL.33.40	Manufacture of optical instruments and photographic equipment
DL.33.50	Manufacture of watches and clocks

In Table 2.1 the number of companies, producers of EEE, that are accounted for in the PRODCOM database are summarised. Not all producers of EEE are included, e.g the producers of video games or lawn mowers, while some producers are included that are not covered by the RoHS Directive (medical instruments).

Table 2.2: Number of companies in NACE category DL, included in PRODCOM

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Belgium	*2948*	*2943*	*2934*	*2938*	*:*	*:*	*:*	*:*
Bulgaria	*:*	*:*	*:*	*:*	*:*	*:*	*:*	*1834*
Czech Republic	*:*	*:*	*:*	*27939*	*30862*	*31785*	*32246*	*32045*
Denmark	*2621*	*2553*	*2549*	*2580*	*2535*	*:*	*:*	*:*
Estonia	*:*	*:*	*:*	*303*	*283*	*295*	*439*	*481*
Spain	*11100*	*11584*	*11780*	*12147*	*12220*	*12040*	*12044*	*12218*
Italy	*54356*	*55401*	*54715*	*56094*	*54518*	*53416*	*51369*	*49667*
Cyprus	*:*	*:*	*:*	*:*	*:*	*:*	*:*	*153*
Latvia	*:*	*:*	*:*	*243*	*230*	*243*	*264*	*305*
Lithuania	*:*	*:*	*:*	*496*	*516*	*547*	*528*	*:*
Luxembourg (Grand-Duché)	*65*	*69*	*67*	*68*	*76*	*80*	*74*	*75*
Hungary	*:*	*:*	*:*	*6808*	*7162*	*7531*	*7463*	*7464*
Netherlands	*:*	*3550*	*3655*	*3721*	*3743*	*3806*	*3870*	*3873*
Portugal	*2577*	*2591*	*2547*	*2443*	*1279*	*1300*	*1307*	*1382*
Romania	*:*	*:*	*:*	*1499*	*1571*	*1890*	*2203*	*2424*
Slovenia	*:*	*:*	*:*	*1893*	*1829*	*1776*	*1724*	*:*
Slovakia	*:*	*:*	*:*	*7827*	*7661*	*7463*	*6652*	*6501*
Finland	*1972*	*1979*	*1985*	*1975*	*2020*	*2010*	*1978*	*1971*
Sweden	*4529*	*4513*	*4564*	*4675*	*4719*	*4665*	*4679*	*4744*
United Kingdom	*18570*	*18885*	*18875*	*18800*	*18915*	*18785*	*18840*	*18805*

When looking at demography, we could calculate that in the EU-15 countries in 2004 425 EEE manufacturing companies exists for every million inhabitants, while in the new member states 788 companies exists for every million inhabitants. Of cource this estimation is rather approximative because the number of companies depends on the way the economy is structured and on other elements not related to demography. Remarkable is the decreasing number of companies, mainly due to enlargement of the remaining companies.

In EU-27 about 250.000 companies are active as producers of EEE.

Table 2.3: Estimation of number of EEE companies in the EU

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Belgium	290	288	287	287				
Bulgaria								236
Czech Republic				2720	3015	3115	3159	3137
Denmark	496	481	479	483	473			
Estonia				221	207	217	324	356
Spain	280	292	295	302	300	291	287	286
Italy	955	973	961	985	957	935	892	854
Cyprus								207
Latvia				102	98	104	114	132
Lithuania				142	148	158	153	
Luxembourg	155	162	156	156	172	179	164	165
Hungary				667	703	741	737	738
Netherlands		226	231	234	233	236	239	238
Portugal	255	256	250	239	124	125	125	132
Romania				68	72	87	101	112
Slovenia				952	918	890	864	
Slovakia				1452	1424	1387	1237	1208
Finland	384	384	384	382	389	386	379	377
Sweden	512	510	515	527	530	523	522	527
United Kingdom	318	323	322	319	320	317	316	314
EU15	469	493	490	497	469	448	435	425
New member states				715	766	789	791	788
EU15	175.469	185.302	184.575	187.706	178.016	170.899	167.148	164.252
New member states				74.777	79.695	82.018	82.053	81.600
EU27				262.482	257.712	252.916	249.201	245.852

The distribution of companies involved in the production of EEE differs from country to country, but in general we can see that 90-95% of the companies have less than 20 employees.

Table 2.4: Size-class in number of employees

	Zero	*Between 1 and 4*	*Between 5 and 9*	*Between 10 and 19*	*20 or more*
Bulgaria	40,51 %	29,99 %	9,38 %	7,52 %	12,60 %
Czech Rep.	81,44 %	10,50 %	3,37 %	1,96 %	2,73 %
Estonia	33,06 %	35,76 %	10,40 %	5,41 %	15,38 %
Spain	39,14 %	34,66 %	9,62 %	6,99 %	9,59 %
Italy	55,36 %	24,51 %	8,20 %	6,26 %	5,66 %
Cyprus	36,60 %	37,91 %	13,73 %	8,50 %	3,27 %
Latvia	15,74 %	34,75 %	23,28 %	7,54 %	18,69 %
Luxembourg	13,33 %	28,00 %	21,33 %	17,33 %	20,00 %
Hungary	45,74 %	35,93 %	7,34 %	3,82 %	7,17 %
Netherlands	31,96 %	35,06 %	14,18 %	6,95 %	11,85 %
Portugal	1,30 %	52,75 %	18,74 %	10,35 %	16,86 %
Romania	10,73 %	54,62 %	13,12 %	6,60 %	14,93 %
Slovakia	56,27 %	32,01 %	4,97 %	2,68 %	4,08 %
Finland	39,57 %	31,91 %	9,59 %	7,10 %	11,82 %
Sweden	49,24 %	27,47 %	8,33 %	6,43 %	8,54 %
U.K.	9,12 %	57,14 %	11,89 %	8,03 %	13,83 %

2.2 SELECTION OF MEMBER STATES

2.2.1 Selection criteria

In cooperation with the Commission, at the start of the execution of this study, five countries have been selected for detailed study:

- Belgium,
- United Kingdom,
- Germany,
- Ireland,
- Lithuania.

The criteria used for the selection are to assure a mix of implementation systems, a mix of stronger and weaker economies, geographical spread and a mix of old and new member states. Besides this, the selection of countries was taken into account within two ongoing studies on WEEE by the Oekopol Institute and the UN University team, as close liaison was searched with these studies in order to ensure coordination.

However, the stakeholder consultation for the analysis of the RoHS Directive was not limited to these five countries. Therefore, the selection should be considered mainly relevant for the study of the specific impacts of the WEEE Directive.

Below, for each selected country a brief characterisation of the country, the state of development of its industry and trade of electrical and economic equipment, its situation with regards to the implementation of the Directive, its main policy instruments and availability of information is provided.

2.2.2 Implementation systems in the selected MS

2.2.2.1 Global parameters

IMPORT AND EXPORT OF EEE

The Eurostat COMEXT database provides information on import and export of EEE. Data are collected in euro for the whole of 2006.

The following groups of products are identified as relevant EEE, using the the data set EU27 trade by SITC ;

- 75: office machines and automatic data-processing machines
- 76: telecommunications and sound-recording and reproducing apparatus and equipment
- 774: electrodiagnostic apparatus for medical, surgical, dental or veterinary purposes, and radiological apparatus
- 775: household-type electrical and non-electrical equipment, n.e.s.
- 778: electrical machinery and apparatus, n.e.s.
- 885: watches and clocks
- 89426: toy musical instruments and apparatus
- 89431: video games of a kind used with a television receiver

The results in € million are summorised in the Table below.

Table 2.5: Import and export of EEE in the 5 selected member states, in million euro

	Import			*Export*			*export minus import*
	From outside EU27	From inside EU27	sum	From outside EU27	From inside EU27	Sum	
Belgium	*4,992*	*9,858*	*14,850*	*2,066*	*10,791*	*12,857*	*-1,993*
Germany	*43,268*	*33,342*	*76,610*	*26,989*	*46,368*	*73,357*	*-3,253*
UK	*27,122*	*40,385*	*67,508*	*12,248*	*55,474*	*67,722*	*214*
Ireland	*5,650*	*7,084*	*12,734*	*4,551*	*11,371*	*15,922*	*3,188*
Lithuania	*265*	*858*	*1,123*	*217*	*367*	*583*	*-539*

PREVAILING WASTE MANAGEMENT PRACTICES

According to the European Topic Centre on Resource and Waste Management from the European Environmental Agency, WEEE is one of the fastest growing waste streams in the European Union and makes up approximately 4% of municipal waste. An estimate of the composition of WEEE arising is shown in Figure 2.1. As can be seen, iron and steel are the most common materials found in electrical and electronic equipment and account for almost half of the total weight of WEEE. Plastics are the second largest component by weight representing approximately 21% of WEEE. Non-ferrous metals including precious metals represent approximately 13% of the total weight of WEEE and glass around 5%.

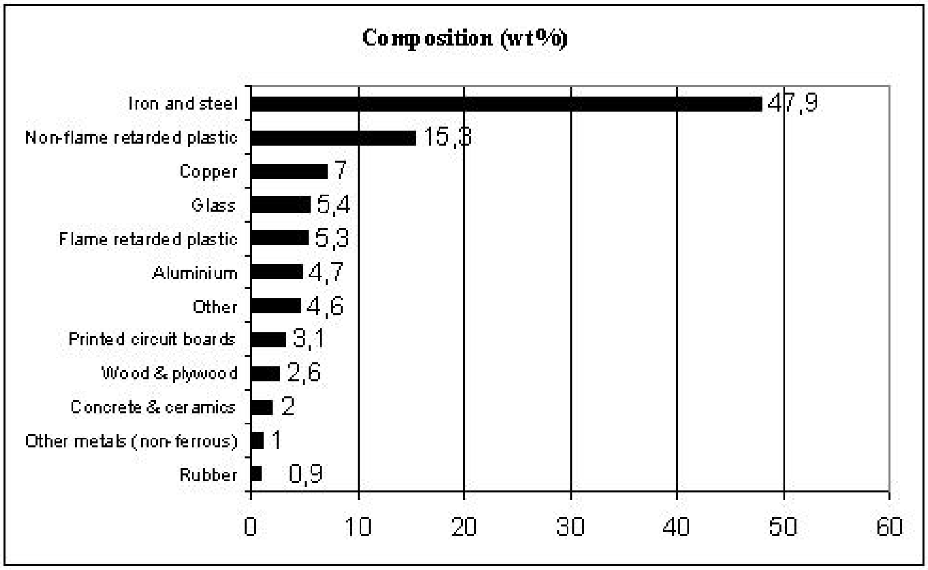


Figure 2.1: Composition of WEEE according to the ETC/RWM

Expected growth rates are between 3 and 5% each year. This means that in five years time, 16-28% more WEEE will be generated and in 12 years the amount is expected to double. This rapid growth rate is due to the fast pace of technological development, especially in information technology (IT) which have resulted in the more frequent replacement of electrical and electronic equipment by industry.

At present, a large proportion of WEEE is disposed of in landfills or incineration plants, depending on local or national practices. In some countries and regions, products such as fridges and freezers are collected separately and sent to recycling plants for dismantling and recycling.

Based on the results of the OECD/EUROSTAT joint questionnaire, the following percentages of treatment of hazardous waste are retrieved, for the last year with full data sets available:

	GE (2002)	*IR (2001)*	*LT (2003)*	*UK (2002)*
Recycling	*24.24 %*	*61.87 %*	*94.05 %*	*20.44 %*
Incineration	*11.06 %*	*22.15 %*	*5.95 %*	*4.43 %*
Landfill	*42.83 %*	*13.01 %*	*0.00 %*	*65.78 %*
Preparatory activities	*21.87 %*	*2.97 %*	*0.00 %*	*9.35 %*

For Belgium no reliable national figures are available, for Flanders figures for 2004 are available for the total amount of waste and for hazardous waste:

Flanders	All waste	Hazardous waste	% waste	% hazardous waste
Recycling	*13525.4*	*576.5*	*47.37*	*20.78*
Incineration	*1671.2*	*172.8*	*5.85*	*6.23*
Landfill	*2780.6*	*802.8*	*9.74*	*28.94*
Preparatory activities	*10574.1*	*1.221.90*	*37.04*	*44.05*
Total	*28551.3*	*2,774*	*100.00*	*100.00*

Especially for WEEE and for plastics waste (including flame retarded plastic) export of waste to non-OECD countries is an important issue. In Table 2.6 the quantities in kg of the export licences under application of Regulation 259/93 and 1013/06 were given for WEEE in Flanders for the period 1995 until November 2006.

Table 2.6: Quantities in kg of export licenses for WEEE under application of Regulations EC/259/93 and EC/1013/06

Year	*Destination*						
	China	*Germany*	*Spain*	*U.K.*	*Hong Kong* [4]	*Netherlands*	*Taiwan* [1]
1995	*5,000,000*					*100,000*	
1996	*20,200,000*					*100,000*	
1997	*16,500,000*					*1,200,000*	
1998	*7,000,000*					*1,550,000*	
1999			*600.000*			*1,100,000*	
2000		*500,000*				*7,100,000*	
2001	*200,000*	*23,700*				*13,354,000*	
2002		*170,000*				*10,500,000*	
2003		*1,250,000*				*13,000,000*	
2004		*50,000*				*32,502,500*	
2005	*23,950,000*	*50,000*		*1,600*		*28,023,000*	
2006 (nov)	*56,300,000*	*70,000*	*75,000*	*2,000*	*2,000,000*	*15,108,000*	*2,000,000*

[4] Possibly transit to other far east countries

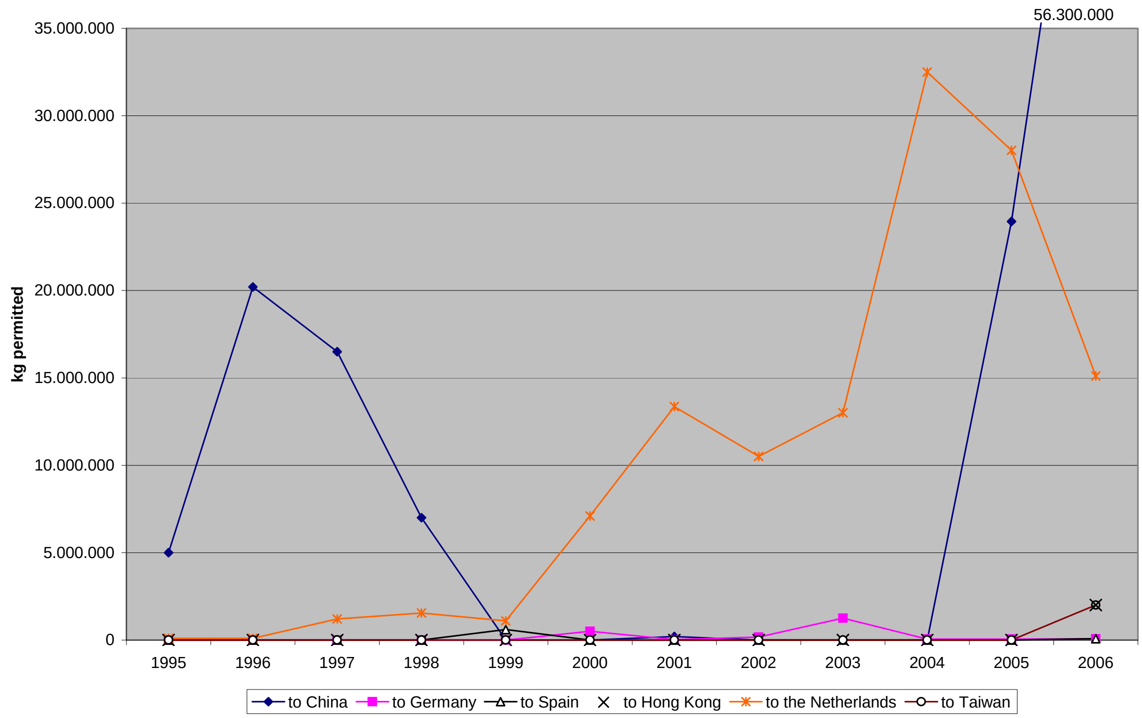


Figure 2.2: Export of WEEE licenced in Flanders

2.2.2.2 Belgium

Belgium is a small industrialised country, with a small market for EEE, and largely depends on import of EEE for its own consumption.

Belgium lies in the heart of the European Community, of which it is one of the founding countries. Therefore is has participated in the whole of the historical process of obtaining the current environmental acquis of the Community.

Belgium consists of three regions, all to a certain degree independent with regard to environmental policy: Flanders, the Walloon region and the Brussels capital region. Industry would benefit from and requests the same environmental policy for the whole of the small Belgian market. But due to the state structure, environmental policy has a tendency to differ. This makes Belgium an interesting case (as a model for Europe) in cross border converting of implementation measures. Although waste policy competence is regionalised and therefore WEEE has become the competence of the three regions, RoHS is classified under product policy and therefore remains a federal Belgian competence.

On October 20, 2004, well before the guidance document was published in May 2005, the Belgian law on RoHS has been established, as a Royal Decree of 21 december 1998 on product standards for the improvement of sustainable production and consumption patterns and the enhancement of the environment and public health. Through the Royal Decree of December 10 2007, the annex with exemptions was adapted.

The implementation decree was aligned on the EU law definition, except for the definition of "put on the market". Any banned product on the shelf of a store after July 1st. 2006 used to be liable of fines. The Belgian government has amended the implementation decree on 14 juin 2006, to allow products put on the market in another EU country before July 1, 2006 to be non-RoHS compliant.

Besides the content of the RoHS Directive, the legislation contains several obligations from the WEEE Directive as well. The annex from RoHS has been adopted as annex 3 in the implementation decree, but it has not been updated when the RoHS annex has changed.

Fines for breaking the law are considerable. Prison from 8 days to 3 years. Penalty fees approximately from 160 Euros to 4 Million Euros.

In order to be able and prepared to set up a performing monitoring and enforcement system, the Belgian government has financed a study on the market situation for EEE in Belgium, and on the use and the stocks of RoHS substances in the country. In this study, the more important alternatives for RoHS substances are detailed, as well as the applications where most probably, even after 1 July 2006, hazardous RoHS substances will remain present in products sold in Belgium. The study will help Belgian assemblers and product designers, and show them which components might require specific attention.

Belgium knows a far-going division of competences between the federal, Belgian, level of competence and the different regional (Flemish, Walloon or Brussels) levels of competence, especially on environmental issues. The regions are fully and exclusively competent for waste issues, therefore they are taking care of most of the provisions of the WEEE Directive. For Flanders the competent waste authority is OVAM, the Public Flemish Waste Agency in Mechelen, for Wallonia this is the DGRNE, the general Directorate on Natural Resources and Environment in Jambes, for the Brussels Capital Region this is BIM-IBGE, the Brussels Institute for Environmental Policy. Some articles from the WEEE Directive (art.4, art. 8, art. 9, art. 10 §1 en §3, en art. 11 §2) refer to marking and badging products and therefore remain federal Belgian competency. The federal government remains competent for product standards and access to the market. The RoHS Directive falls completely within the frame of these federal Belgian competencies.

The “ROHS enforcement Guidance Document”, issued on May 2006, has been developed through discussions within the “EU RoHS Enforcement Authorities Informal Network”, and will be used within the limits of Belgian federal and regional legislation.

Important stakeholders for RoHS enforcement are the federal police, the federal environmental inspection that focuses on a preventive and repressive approach and the regional environmental inspectorates. Administratively RoHS is followed up by the service ‘product policy’. One full time, permanent job has been created to cope with RoHS monitoring and review. Investments have been made in a XRF analyser and in the training of RoHS inspectors (information from the stakeholder consultation).

2.2.2.3 United Kingdom

APPROACH

The United Kingdom is a large country in Europe with a large market for EEE and a well developed EEE industry.

The implementation of the WEEE and RoHS Directives have been delayed. It has adopted a decentralised approach to the implementation of the Directive with the Department of Trade and Industry (DTI) being responsible for transposing the WEEE Directive into UK law, working in partnership with the Devolved Administrations of Scotland, Wales and Northern Ireland. The Environment Agency in England and Wales, the Scottish Environment Protection Agency in Scotland and the Environment and Heritage Service in Northern Ireland are responsible for enforcing the Directives.

The RoHS Directive and the UK RoHS regulations came into force on 1 July 2006. The National Weights and Measures Laboratory (NWML) has been awarded the contract to set up the UK’s national RoHS enforcement body.

The Department for Trade and Industry issued non-statutory guidance notes for the ROHS and the NWML, an executive agency of the DTI, was appointed as the UK's RoHS Enforcement Body on 1 July 2005, a year in advance of the Directive coming into effect. Enforcement is intelligence-led and based on a risk assessment.

NWML has been working closely with the UK Restriction of Hazardous Substances (RoHS) Conformity Assessment Group (URCAG) and other organisations to support the development of commercially deliverable compliance schemes for ROHS and until such time as an accreditation route is established, group members have agreed to self regulate through the group.

The DTI guidance note contains a non legal decision tree, with some additional exclusions for the RoHS Directive, not expressly provided for in the Directive. It is the DTI view that they apply, but it is stated that a definitive legal interpretation is only available from the court. Producers should therefore rely on independent legal advice on compliance.

Products are excluded from RoHS legislation when:

- They do not need electric currents or electromagnetic fields to work
- They do not fit within one of the 8 product categories
- They are covered by a specific exemption
    - Large-scale stationary industrial tool
    - Spare parts for repair of EEE placed on market before 1 July 2006
    - Exeptions listed in the annex of the RoHS Directive

The following additional exemption grounds are defined by DTI (partly referring to the WEEE Directive):

- Spare parts for the capacity expansion or upgrade of EEE placed on the market before 1 July 2006
- It forms part of equipment not included in product categories
- Intended for a specific national security and/or military purpose
- Main power source is not electricity
- Electricity is not needed for primary function
- It uses less than 1000v AC or 1500v DC

Contravening or failing to comply with the prohibition on hazardous substances in the RoHS Regulations could result in those held responsible facing a fine up to the statutory maximum (currently £5,000) on summary conviction or an unlimited fine on conviction on indictment.

The defence of ‘due diligence’ is available where a person can show he took all reasonable steps and exercised all due diligence to avoid committing an offence. The Regulations also provide for the ‘liability of persons other than the principle offender’ and allow a third party to be prosecuted as though they had committed the offence.

Where an offence by a corporate body is shown to have been committed with the consent, convivance or through the neglect of any director, manager or similar officer of the corporate body, they could be regarded as having committed the offence as well as the corporate body.

The NWML has developed a website (http://www.rohs.gov.uk) to provide stakeholders with information and help associated with RoHS compliance and enforcement. This includes a web version of the decision tree, a FAQ section which is continually updated, and a list of other useful resources that are available in a links section.

The competent department has conducted information campaigns, disseminated information and used various media (e.g. web based information) to provide industry with the latest information. The website is well used globally, taken into account the calls and queries the department received from companies, legal firms and independent consultancies from all over the world.

Enforcement is using the following basic principles: based on intelligence and risk, compliance through co-operation, minimum burdens on innovative industry, proportionate enforcement actions.

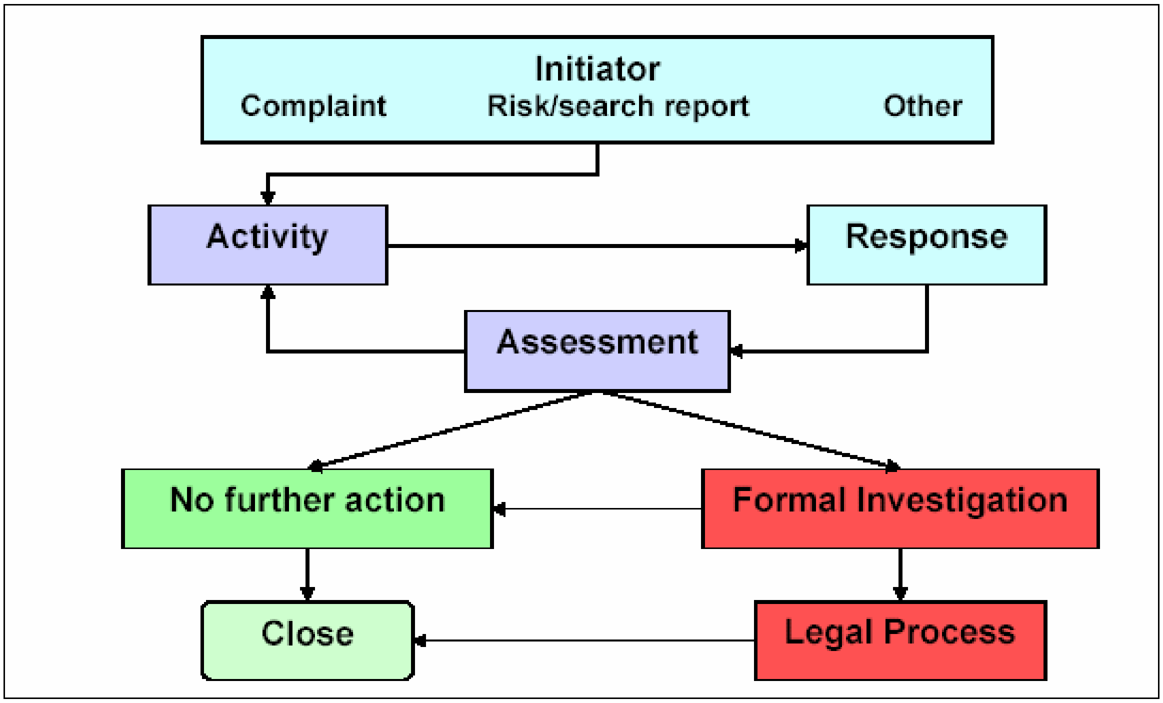


Figure 2.3: Schematic presentation of the general UK enforcement approach on RoHS

It is unlawful to put non-compliant EEE within the scope of the RoHS Directive onto the EEA market on or after 1 July 2006. There are no waivers or grace periods for RoHS. Products are first placed on the market at the point of first legal transfer (externally transparent). This may be to another legal entity or within the commercial chain of the organisation. Products available for sale on the manufacturer's warehouse shelves are not sufficient. Products are not put on the market if they are intended solely for export outside EU, when they are prototypes, demonstrators and samples not intended to be put into use, or when they are built for own use. To allow RoHS substances in products destined for export, when these products are forbidden for internal use, may give ground to some ethical discussion.

In the UK there are no certification requirements, no marking requirements, and at present no formal customs procedures on RoHS.

EVALUATION OF FIRST YEAR'S ENFORCEMENT ACTIVITIES

The NWML has evaluated its first year's enforcement activities in the report 'Enforcement of the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2006 (RoHS)' (2007). In the NWML 1 fulltime job has been created on RoHS enforcement (information from the stakeholder consultation).

Some highlights of the direct and indirect enforcement activities executed in the first year are:

- An enquiry service that has responded to and logged over 4000 individual enquiries from a broad range of sources;
- An information website providing information and support to industry that received over 9 million hits in the first year;
- Provided speakers for over 50 conferences raising awareness and providing support through intermediaries;
- Setting up and commissioning a screening test laboratory;
- Direct investigation of individual companies resulting in the serving of 10 to 20 improvement plans notices, 3 EU notifications, 5 Compliance notices, 1 warning letter and 1 case brought to justice.

The direct enforcement operated by the agency begins once a risk evaluation has been undertaken. This evaluation identifies a series of companies, a trade sector or a particular type of product that has a heightened risk of non compliance.

NWML has established a facility for the storage, safe mechanical disjointing and screen testing of EEE products. It incorporates the use of two Niton handheld XRF devices. The first is used for broad area screening to ascertain the presence of hazardous substances. The second is equipped with a significantly smaller target capability and a directional camera is used for more detailed location of the hazardous substance in the product.

NWML has three approaches to identifying samples for testing:

- Through identification of a potentially non-compliant product. Product may be identified through intelligence or through information provided where the substance of the complaint is traceable and sufficient to warrant a purchase.
- As part of intelligence gathering activities in support of an area targeted through Regulation 8 requests[5]. When NWML initiates a batch of requests for compliance under Regulation 8 they also purchase some product from the recipient organisations. This allows them to build better intelligence on the market sector under review. Where the response received from a Regulation 8 request raises concerns over the effectiveness of an organisation's processes or there has been a lack of response from a given organisation. Test purchase is also a suitable approach for confirming levels of compliance or non compliance.
- As part of NWML's building of market intelligence, NWML may sample from across a market sector. This is particularly suitable for building an understanding of levels of compliance where the sector is clearly defined and controlled and there is high market penetration.

In the first year of enforcement, NWML has mainly focussed on domestic product. Domestic product tends to have higher market penetration and less control on disposal.

In general terms, there have been high levels of compliance in the first year. Most products have had a few points where the results were uncertain or questionable as defined above. Identifiable non-compliance as defined above has been identified in less than 5% of points tested. The following is an overview of the results of testing:

- Most machine soldering has been compliant.
- The use of lead and cadmium in plastic as a pigment or stabilizer is now uncommon.

[5] Regulation 8 requires that technical documentation is prepared and submitted if required to the Secretary of State (in actuality the enforcing authority) showing that the equipment in question complies.

- In some cases, variable levels of lead contamination have been identified in machine soldered boards. This seems to normally be due to contamination of solder baths. Experience through engagement with producers has proved higher levels are to be where the baths are not regularly tested at the production facility.
- Most solder failures are on hand soldering and areas of rework. Contamination levels at less than 5% are most common. Discrete uses of 60/40 tin/lead solder are not uncommon on otherwise compliant product.
- Only one product has been tested where it was found that all the solder sampled was 60/40 tin/lead.
- The power cord flex is also still a source of lead in plastic.
- Lead is also being identified on components. Producers often claim the lead in glass of electronic parts. However, further tests for silicate may show this to be inappropriate.
- Hexavalent coatings are occasionally being found on bespoke adjustment tools, plated parts and screws.

2.2.2.4 Germany

Germany is the largest economy in the European Union, with intensive trade ties with countries both inside and outside the European Union. It has a large EEE industry and a large EEE market, depending partially on import.

West Germany was a founding member of the European Community, while East Germany used to be part of the COMECON. Thus, the unified Germany combines a powerful Western European economy with an economy in transition.

With the aim of integrating EU legislation into national law, Germany passed the Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment, known as the ElektroG, on March 23, 2005. The ElektroG is an amalgam of the WEEE and RoHS Directives.

The RoHS Directive has been adopted in part 2 point 5 of ElectroG. By doing so, its application has been limited to the application of the WEEE Directive. Exemptions of the WEEE Directive, such as an exemption for military equipment, are equally excluded from RoHS Directive.

The German ROHS implementing legislation is very short: *"The placing on the market of new electrical and electronic equipment containing more than 0.1 percent weight of lead, mercury, Cr(VI), polybrominated biphenyls (PBBs) or polybrominated diphenyl ethers (PBDEs) per homogeneous substance or more than 0.01 percent weight of cadmium per homogeneous substance is prohibited. Sentence 1 does not apply to electrical and electronic equipment in Categories 8 and 9 or to electrical and electronic equipment first placed on the market in an EU Member State prior to 1 July 2006. Nor does it apply to spare parts for the repair or reuse of electrical or electronic equipment first placed on the market prior to 1 July 2006. Paragraph 1 does not apply to the uses listed in the Annex (as amended) to Directive As of 23. March 2005 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (Official Journal L 37 p.19)."*

Germany is strict on penalties for violations of the national transposition law or other national laws pertaining to this subject. Regulatory offences are subject to fines of up to EUR 50,000, and in all other cases fines of up to EUR 10,000.

Referring to the federal organisation of Germany, the German "Länder" are in charge for legal execution and supervision of the prohibitions. Legal execution and supervision started on the first of July 2006.

Effective on 14 July 2006, authority to prosecute and penalize any regulatory offenses pursuant to Section 23 Para. 1 Nrs. 2, 4, 8 and 9 ElektroG was transferred to the Federal Environment Agency (Umweltbundesamt - UBA). The Laender are the competent authority for all matters governed by Section 23 ElektroG. Specifically, the responsibilities of the Federal Environment Agency concern dealing with lacking or untimely producer registration, placement of equipment on the market without producer registration, failure to collect, or untimely collection of, containers provided, and failure to submit a report (in a timely manner) on the volume of equipment on the market.

2.2.2.5 Ireland

Ireland is a small but quickly evolving economy, with a small market for EEE, and an export oriented EEE industry. It has participated in the historical process of obtaining the current environmental acquis of the Community since 1973.

Three sets of regulations were made, one of which amends the Irish Waste Management Act 1996 to provide enabling provisions for transposition and implementation, with separate sets of regulations laying down the implementation arrangements for WEEE and RoHS.

- Statutory instruments No. 290 of 2005 ; waste management (electrical and electronic equipment) regulations 2005
- Statutory instruments No. 340 of 2005 ; waste management (electrical and electronic equipment) regulations 2005
- Statutory instruments No. 341 of 2005 ; waste management (restriction of certain hazardous substances in electrical and electronic equipment) regulations 2005

The waste management (electrical and electronic equipment) regulations 2005 entered into operation on 1 July 2005, and amend the Waste Management Act 1996 for the purpose of giving legislative effect in Ireland to two EU Directives. These Regulations are designed to promote the recovery of waste electrical and electronic equipment. They will facilitate in particular the achievement of the targets for the collection, treatment, recovery and disposal of waste electrical and electronic equipment in an environmentally sound manner established by Directive 2002/96/EC on waste electrical and electronic equipment as amended by Directive 2003/108/EC. The Regulations impose obligations on persons who supply electrical and electronic equipment to the Irish market, whether as retailers, importers or manufacturers. An exemption from these obligations is available to persons who participate in a scheme for the collection, treatment, recovery and disposal of waste electrical and electronic equipment in an environmentally sound manner operated by an approved body.

The waste management (restriction of certain hazardous substances in electrical and electronic equipment) regulations 2005 are designed to minimise waste arisings of certain hazardous substances by prohibiting the use of certain heavy metals in electrical and electronic equipment as required by Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The Regulations impose obligations on persons who supply electrical and electronic equipment to the Irish market, whether as retailers, importers or manufacturers.

An interesting feature in this last statutory instrument N° 341 is an obligation for record keeping :

6. On and from 1 July 2006, each producer shall ensure that he or she or a third party acting on his or her behalf has access at all times, at an address in the State, to records of certification of

(a) compliance by the suppliers of any component utilised in the production, or, as appropriate,

(b) laboratory testing where such testing has been commissioned by the producer,

of electrical and electronic equipment, in order to verify that it complies with the requirements of article 5 and that such records be maintained for a period of six years, starting from the end of the year in which the electrical and electronic equipment concerned was last placed on the market.

In Ireland the WEEE take-back and recycling system is handled by two approved producer compliance schemes: "WEEE Ireland" and the "European Recycling Platform", set up by the electrical and electronics industry. These companies are financed through the system of Environmental Management Costs. They are required to operate on a not-for-profit basis. The visible Environmental Management Costs being applied currently were set by the approved producer compliance schemes and have been approved by an independent, industry based body, WEEE Register Society Ltd. This system ensures that the monies collected for recycling are currently assigned for recycling activity and are not diverted elsewhere. The registration of producers and the validation of EMCs is also undertaken by the WEEE Register.

The Environmental Protection Agency (EPA) has taken a dual approach to enforcement of the RoHS regulations both undertaking an awareness campaign to improve producer awareness and also conducting compliance inspections

The EPA started with a targeted producer awareness campaign. Activities initially consisted of attending relevant industry conferences, the establishment of a RoHS dedicated webpage and meeting with large manufacturers/producers face-to-face to discuss issues. Further actions included the issuing of notices explaining the RoHS requirements in national newspapers and the sending of RoHS Information e-mail fliers to approximately 300 producers in cooperation with the WEEE compliance schemes and the WEEE Register Society.

Prior to the introduction of the Directive, the EPA carried out RoHS compliance testing on some household goods on a trial basis. The experience gained from this exercise has been incorporated into future enforcement activities. The EPA is currently carrying out the first phase of inspections for RoHS compliance. The initial focus is on high-risk items, i.e. those associated with a high probability of non-compliance and/or those with a high probability of being disposed of in the general household waste stream.

The RoHS Enforcement Guidance Document as developed through discussions within the EU RoHS Enforcement Authorities Informal Network forms an important frame for directing the RoHS enforcement activities in Ireland. Ireland cooperated actively in the drafting of this guidance document.

There have been self-reported non-compliances, which were discovered by the producers at very early stages. Some of the infringements required remedial actions which have already been carried out.

Ireland has invested in a general information campaign towards industry associations and individual companies regarding the requirements of the RoHS Directive. One full time, permanent job has been created to cope with RoHS monitoring and review. The Member State has invested in trial monitoring of EEE by a contracted laboratory (XRF screening) prior to 01/07/2006. Monitoring costs amounted to € 10,000 in 2007 (information from the stakeholder consultation).

2.2.2.6 Lithuania

Lithuania is a small northern country at the extremities of Europe, with a small EEE market depending largely on import.

Lithuania has known a difficult transition from a centralised system focused on industrialisation to a liberal economy. Lithuania has one of the lowest standard of living in the EU. Its economy has one of the highest growth rates driven mostly by growth of domestic consumption, financed by increase of private debt, as well as a negative foreign trade balance.

Lithuania has a small market for EEE, and is depending largely on import of EEE for its own consumption.

Lithuania joined the European Union in 2004. Is has not participated in the historical process of obtaining the current environmental acquis of the Community, but had to adopt this acquis in a limited transition period.

Lithuania implemented the RoHS legislation through Order No V-258 of the Minister of Health of 22 April 2004.

The WEEE legislation has been adopted into Lithuanian national law via the following series of legislation:

- Amendment No. X-279 to the Law on Waste Management, adopted on 28 June 2005;
- Order of Minister of Environment No. D1-481 on Rules on Management of WEEE, adopted on 10 September 2004;
- Government Resolution No. 1252 on National Strategic Waste Management Plan, adopted on 5 October 2004;
- Order of Minister of Environment No. D1-555 on Rules on Registration of producers and importers, adopted on 17 November 2005;
- Government Resolution No. 61 on Rules on Financial Guarantees, adopted on 19 January 2006;
- Government Resolution No. 18 on Rules on Licensing of organisations of producers and importers, adopted on 11 January 2006;
- Order of Minister of Environment No. D1-57 on Rules on Annual reports of organisations of producers and importers, adopted on 30 January 2006.

An amendment to the Administrative Code, which deals with penalties, is still to be adopted.

The RoHS legislation was transposed and is to be enforced by the Ministry of Health. The Ministry of Environment is responsible for the transposition and enforcement of the Lithuanian WEEE legislation.

Under the Lithuanian WEEE legislation, producers are required to register with the Environmental Protection Agency. The Lithuanian RoHS legislation follows the requirements of the RoHS Directive.

The collective WEEE schemes in Lithuania have not yet been finalised. Compliance schemes which have indicated that they are preparing a collective scheme are INFOBALT, Zaliasis taskas and CECED. Laboratories which advertise RoHS testing facilities for Lithuania include ITS Caleb Brett Lithuania Laboratory.

Lithuania has a derogation of two years for the collection, recycling and recovery/reuse targets in the WEEE Directive. The deadline which now applies is 31 December 2008.

Ministry officials are not yet able to specify the applicable penalties for non-compliance with the RoHS regulations. The penalties under the Lithuanian WEEE legislation are also to be decided, as the draft Amendment to the Administrative Code is currently before Parliament and changes are expected. The well informed Hong Kong trade development council anticipates penalties include fines of EUR 300 - EUR 29,000 for breaches of the legislation, including failure to register, failure to comply with reporting requirements and failure to provide treatment for WEEE.

Lithuania, as some other Member States, interpret the concept of EEE being ‘put on the market’ as being put on the national market instead of the European free market, and is criticised for this.

Enforcement in Lithuania is the competence of the State Non Food Products Inspection, depending of the Ministry of economics, for internal market surveillance, and the customs for imports from third countries. An amendment to the Administrative Code, which deals with penalties, is still to be adopted.

Laboratories which advertise RoHS testing facilities for Lithuania include ITS Caleb Brett Lithuania Laboratory.

COMPONENT 1: STUDY OF THE ROHS DIRECTIVE

3 INTRODUCTION

The task specification for this component requires the analysis of the total impact of the RoHS Directive on the economy and the environment. In parallel with the analysis of these impacts, the study is required to compare the RoHS approach with other approaches used outside of the EU (specifically in China, Japan, South Korea, and in some US states) highlighting advantages and disadvantages. The study is then required to formulate and assess a number of proposals to revise the RoHS Directive with a view to improving its cost effectiveness in relation to the economic and environmental impacts analysed.

The study is broad in scope, except for the environmental impact analysis (see section 4), where a case approach was chosen to calculate the change in RoHS substances use in the situation before and after RoHS. In close cooperation with the Commission, a number of specific products were selected to be investigated in detail: refrigerators, PC and laptop, printers and copiers, cellphones, television sets, clocks and watches, fluorescent lamps (straight and compact), lawn mowers and gardening equipment, video games and handheld video games, dispensers for hot and cold beverages. A calculation of the environmental impact in the same detail for all EEE would go beyond the scope and budgetary restrictions of this study.

Section 5, the economic impact analysis, identifies the economic costs and benefits associated with the RoHS Directive. The impacts of the RoHS Directive on the Internal Market and on innovation are assessed. An assessment is also made of the potential synergies and conflicts with other policies (REACH and EuP legislation) and of the impact on products and sectors not covered by the ban. The analysis is based on extensive consultation with organisations, companies and individuals representing populations potentially affected by the Directive, in order to gather data on impacts, costs and benefits. This was complemented with a literature review, to obtain trends on the products affected by the RoHS Directive and to gather cost and benefit data as a check for the data provided during consultation.

The impacts identified in the environmental and economic impact analyses lead to the formulation of a number of proposals to revise the RoHS Directive with a view to improving its cost effectiveness while maintaining the same level of environmental protection (see Section 6). The advantages and disadvantages of each proposal were highlighted, resulting in a ranking of options for revision with a view to improving the cost effectiveness of the RoHS Directive, at the same time maintaining the high level of environmental protection.

4 ENVIRONMENTAL IMPACT ANALYSIS

4.1 METHODOLOGY

For the environmental impact analysis, a case approach was chosen according to which a number of specific products were investigated in detail.

Chapter 4 starts with an overview of the product volumes of the selected products. Then, the minimum and maximum quantity of each RoHS substance is identified in the various products.

Subsequently, different scenarios are calculated for the yearly amount of RoHS substances avoided in EU 25 in the selected product groups. By using this approach, it is possible to make an estimation of the overall environmental benefits of the different products and as a total for the different products in EU 25.

In the last sub chapter, more information is given on the dose-response relationships. To give an idea of the environmental effects of RoHS, a short introduction is given on the effects on some components of the Life Cycle Analysis (LCA). It is however not the purpose of this study to do an extensive LCA for each of the selected products.
Furthermore some environmental and human health effects due to RoHS are briefly discussed: waste emissions to the environment, volatilisation of brominated flame retardants (Deca-BDE and Octa-BDE) and the effects of Pb substitution in soldering.

4.2 SELECTION OF PRODUCTS

4.2.1 Selection criteria

The following criteria for the selection of the products and product categories to be studied in detail were proposed and agreed with the Commission:

- The presence and quantity of the 6 hazardous substances covered by the RoHS Directive in the products: lead, mercury, cadmium, Cr(VI) or hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).
- The economic importance of the products and the market structure.
- The value of the product at the end-of-life. The higher the value, the more profitable its recycling is and the less one could consider the need for regulation.
- The environmental impact of the products over the production, use and waste phases of the lifecycle.
- The innovation pace of the sector or the innovative potential of the products.

It was also considered of importance to include products from the grey area, as being investigated by the TAC Technical Adaptation Committee[6], because they are good examples of cases where clear indicators or criteria for inclusion in or exclusion from the RoHS Directive can be helpful. Some frequently returning issues regard the applicability of spare parts e.g. in computers or television sets. In the TAC a request for the definition of “spare parts” has been launched, as they are referred to in Article 2(3) of the RoHS Directive. The RoHS Directive does not apply to spare parts for the repair, or to the reuse, of electrical

[6] See “Grey area products” – draft - Discussion document – REV 9

and electronic equipment put on the market before 1 July 2006. Industry would welcome a definition of spare parts in order to justify their replacement practice.

Example: a computer covered by guarantee is broken and industry needs to replace the broken part e.g. PC screen or TV remote control with a non RoHS compliant product, because a remote control or a screen are parts of EEE and are not considered to be EEE. This practice may contradict the spirit of the Directive i.e. the phase-out of hazardous substances in EEE.

The following products have been selected for detailed study of the environmental impact in close cooperation with the Commission:

- Refrigerators;
- PC and laptop, including spare parts;
- Printers and copiers;
- Cell phones;
- Television set;
- Clocks and watches;
- Fluorescent lamps (straight and compact);
- Lawn mowers and gardening equipment;
- Video games and handheld video games;
- Dispensers for hot and cold beverages.

In the following paragraphs, an assessment is made of the product volumes brought on the EU market. Available existing information has been gathered through literature review, data base consultation, interviews with experts, stakeholder consultations and internet search. Besides these sources, useful information has been made available to the task holder by the European Commission.

4.2.2 Product volumes of the selected products

In the frame of Directive 2005/32/EC *(Directive of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council)* a set of relevant studies on ecodesign on energy-using products (EEUP) have been made or are being made. This chapter largely uses the results or preliminary results of these studies, or applies the techniques developed in these studies for the assessment of equipment not covered by the studies.

The main datasets used both in the EEUP studies and in the assessment for the other product categories are the Prodcom database and the Comext external trade database from Eurostat.

The legal basis for the Prodcom data is Council Regulation (EEC) No 3924/91 on the establishment of a Community survey of industrial production (Prodcom Regulation). This Regulation requires that production be recorded according to the product headings of the Prodcom list. The list is based on the Community's external trade classification, the Combined Nomenclature (CN). The list does not, however, cover all products. The list is divided into Divisions corresponding to the (2-digit) Divisions of NACE Rev1. Each Prodcom code is identified by an eight-digit code. The first six digits are the CPA code (Community Classification of Products by Activity). The last two digits normally provide a reference to the Combined Nomenclature (CN), although there are exceptions. The physical volume and the value of production are normally recorded for the products in the Prodcom list.

The particular physical units of the CN classification have been adopted for recording the volume of production. In exceptional cases a different and/or supplementary unit is recorded. All units belonging to the individual Prodcom headings are specifically indicated in the data set.

The Prodcom statistics cover all enterprises/local units which manufacture products contained in the Prodcom list. Among the rules on representativeness, the Regulation stipulates that all enterprises in Sections C, D and E of NACE Rev. 1 employing at least 20 persons must be included. In addition, at least 90% of production in each (4-digit) Class of NACE Rev. 1 must also be recorded.

EU external trade statistics are available in the Comext database and can be compiled according to a product classification (CPA). No estimates are made for external trade statistics, although it is possible that subsequent revisions may occur. The data are processed by summing the product statistics (using a conversion Table from CN to CPA). The data for EU 25 are reported in terms of trade flows with the rest of the world, in other words extra-EU trade.

4.2.2.1 Refrigerators

Based on the study “Preparatory Studies for Eco-design Requirements of EuPs (Tender TREN/D1/40-2005) LOT 13: Domestic Refrigerators & Freezers and LOT 14: Domestic Dishwashers & Washing Machines” the worldwide sales of large household appliances (white goods) can be assessed.

The worldwide sales of large household appliances (including refrigerators and freezers, and washing machines and dryers) reached 337 million units in 2005, against 197.8 million units in 1989, with an increase of 3.6%, almost constant in the last decade. With an estimated annual increase of 3.6-3.8% in 2009 the demand will reach 390 million units.

Table 4.1: Evolution of white goods sales (million units) worldwide in 1989-2009

1989	*1990*	*1993*	*1995*	*2000*	*2002*	*2003*	*2005*	*2009**
197.8	199.2	212.5	231.4	282	295	300	337	390

*estimates

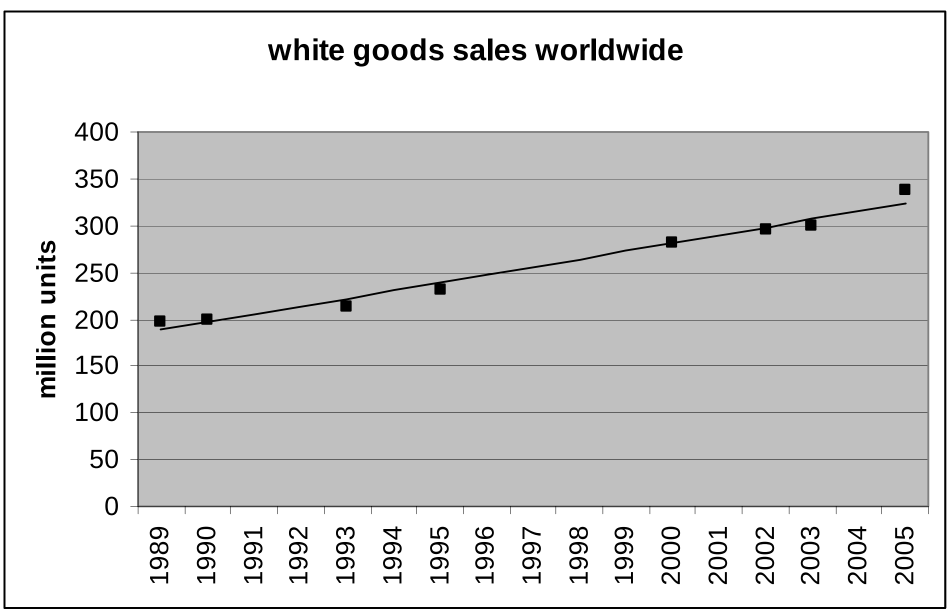


Figure 4.1: White goods sales worldwide

At present Asia absorbs 35% of sales and the EU 24%. North America markets are stable around 23-24%. Asia, Latin America, Africa and Middle East market are growing rapidly. An increase also prevails in Eastern Europe, while in the Japanese, the Western European and the North American markets the very high saturation level determines a lower increase.

The sales of white-goods in EU 25 can be assessed at 80,9 million units of white goods. This figure will increase, due to consumption increase in Eastern Europe.

The OECD study "Can Energy-Efficient Electrical Appliances be considered "Environmental Goods"? OECD Trade and Environment, Working Paper No. 2006-04" reports from different sources that global sales of refrigerators and freezers were approximately 90 million units in 2002, compared to about 14 million clothes dryers, about 17 million dishwashers, about 60 million clothes-washers and about 120 million cooking appliances, for a total of about 301 million units, which is very close to the data presented in Table 4.1 for the same year. This indicated that about 29.9 % of white goods consist of refrigerators and freezers.

The total amount of refrigerators and freezers in 2005 in EU 25 can be estimated at 24 million units/year.

The most important countries exporting refrigerators and freezers in 2004 were Italy, South Korea, China, Germany and USA. China is the fastest growing exporting country, going from 189 million USD in 1999 to 986 million USD in 2004. The larger importers are USA, United Kingdom, France, Germany and Spain.

4.2.2.2 PC and laptop, including spare parts

The study "EuP preparatory study, TREN/D1/40-2005, Lot 3, Task 2" on computers and computer screens states the difficulty to obtain reliable data from the Eurostat PRODCOM database, due to information lacks for several countries and due to confidentiality restrictions of certain production data. Therefore it is difficult to estimate the production of PC and laptops. The Eurostat database COMEXT on import and export can give more reliable figures on EU 25 scale.

Table 4.2: Import and export of PC and laptops

Product	*Year*	*Volumes (1,000 Units)*		*Value (M Euro)*	
		Export	*Import*	*Export*	*Import*
Laptop PCs and palm-top organisers	2003	1,605	11,401	1,284	7,201
	2004	2,118	14,413	1,378	9,176
	2005	3,704	21,325	2,271	11,499
Desktop PCs	2003	1,084	2,255	574	820
	2004	1,995	3,373	730	823
	2005	2,125	4,181	957	657
TOTAL	2003	2,689	13,656	1,858	8,021
	2004	4,113	17,786	2,108	9,999
	2005	5,829	25,506	3,228	12,156

The figures above show that EU is a large net importer of laptops, with a ratio of import 7 times higher than export. For Desktop PCs and systems, the figures are much more in balance: imports are about twice exports.

The above mentioned study is unable to assess real consumption as the sum of production and import minus exports, because of information lacking on production in some Member States. Through a survey of different stakeholders and the study centre from the industry EITO (European Information Technology Observatory) alternative figures were retrieved, largely differing from the official figures from PRODCOM and COMEXT.

A rough and approximate assessment has been made by comparing official and industrial data.

Table 4.3: Broad assessment of EU 25 sales of PC and laptops in million units

Year	*Desktops*	*laptops*
2000	24	6
2001	22	6.5
2002	22	8
2003	24	11
2004	26	15
2005	28	20

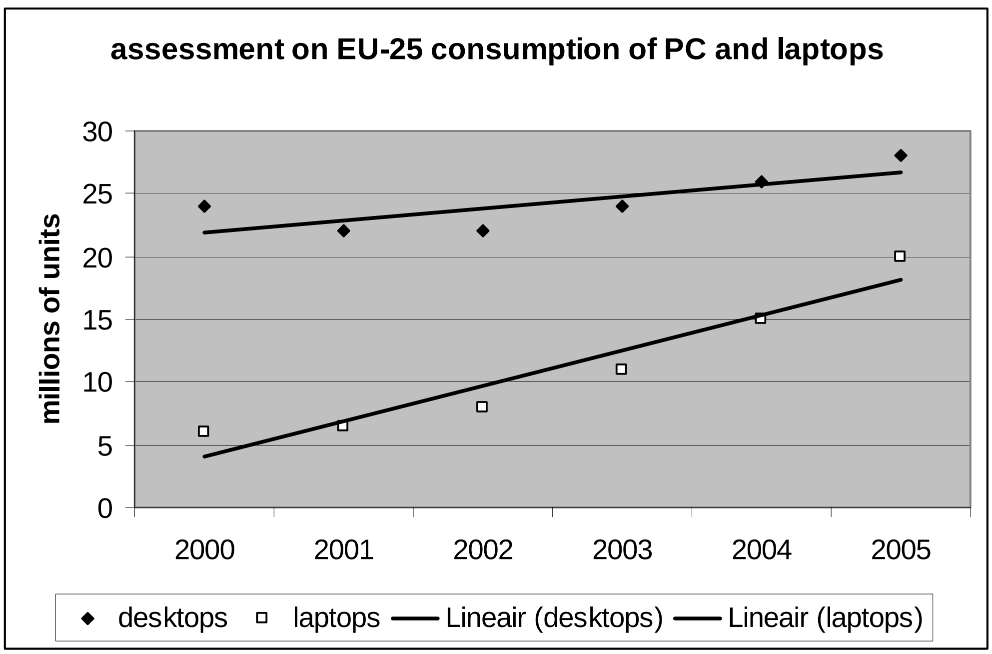


Figure 4.2: Assessment of EU 25 sales of PC and laptops

Total sales of PCs and laptops in EU 25 can be estimated at 48 million units/year.

4.2.2.3 Printers and copiers

The study "Preparatory Studies for Eco-design of Energy-using Products Task 2 Interim Report for EuP Preparatory Study Lot 4: Imaging Equipment" made a research on imaging equipment based on a selection of PRODCOM and CN-codes, which is only slightly larger than the product group as defined in the annex 1b of the WEEE Directive.

Table 4.4: Selection of imaging equipment in the relevant EEUP study

PRODCOM-Code	*Description of PRODCOM-Codes*	*Corresponding CN-Code*
30.01.21.70	Electrostatic photocopiers	9009.11.00
		9009.12.00
30.01.21.83	Blueprinters, diazocopiers and other photocopying apparatus of the contact type	9009.22.00
		9009.22.10
		9009.22.90
30.01.21.85	Photocopiers incorporating an optical system, thermocopiers (excluding electrostatic photocopiers and thermo-printers)	9009.21.00
		9009.30.00
30.02.16.30	Printers	8471.60.40
32.30.20.85	Fax machines	8517.21.00
30.01.13.70	Postage-franking machines, ticket-issuing machines and similar machines incorporating a calculating device	8470.90.00
30.01.23.30	Hectograph or stencil duplicating machines	8472.10.00

An assessment of apparent EU sales was traditionally made based on EU-production, import and export. Data on production were difficult to retrieve because the PRODCOM database was incomplete. France, Germany, Italy, United Kingdom, Lithuania and the Netherlands provided production data for printers and copiers in 2004, Czech republic also for sheet fed office type offset printing machinery. In general, recent production of imaging equipment seems to be on a rather small scale level in EU25 countries. The office imaging equipment market is clearly dominated by Japanese and US companies. The production of imaging equipment is continuously shifting to Asia, with only small manufacturing capacity remaining in Europe, for example Olivetti or CPG International in Italy, CAB, Triumph-Adler and Utax in Germany or Philips or Océ in Netherlands. A production volume of 220,000, for photocopiers incorporating an optical system, is reported. Other data are qualified as confidential in the PRODCOM database.

Table 4.5 provides Extra-EU import and export data of EU25 countries in 2003 and 2004, from Eurostat trade statistics. Printers play the most important role, both for exports and imports.

As data on production are limited to copiers with an optical system, it becomes difficult to estimate the total EU 25 sales of copiers and printers. The above mentioned study proves that figures calculated based on the PRODCOM data can differ strongly from data from industrial sources.

Table 4.5: Export and import of imaging equipment

Product categories	Volume (1000 units)			
	Export		Import	
	2003	2004	2003	2004
Electrostatic copiers	313	267	860	978
Blueprint/diazocopiers	9	7	6	0,2
Copiers, optical/thermo	437	519	1,335	1,844
Printers	7,916	8,279	29,165	33,194
Fax machines	238	399	2,398	3,329

Electrostatic copiers: CN-codes 9009.11.00/12.00; Blueprint/diazocopiers: optical/thermo: 9009.21.00/9009.30.00; Printers: 8471.60.40; Fax machines 8517.21.00

The apparent EU 25 sales will be more or less equal to the import minus the export, and the production for the EU 25 market of Olivetti, CPG International, CAB, Triumph-Adler, Utax, Philips and Océ.

The sales of copiers in EU 25 can be estimated at 1.5 million units/year. Total sales of copers and printers can be estimated at 30 million units/year.

4.2.2.4 Cellphones

No EEUP studies on cellphones are available. EU 25 sales of cellphones is based upon production, import and export and retrieves data from PRODCOM production statistics and the EUROSTAT international trade statistics. Cellphones are defined by PRODCOM code 32.201.170, Radio transmission apparatus with reception apparatus.

The total EU 25 production has been estimated by Eurostat at 273,976 thousand units. Data from several member states is considered to be confidential. In Table 4.6 the flag :C means confidential, :E means estimated, but the estimated value is not reported by PRODCOM.

Table 4.6: Production of cell-phones in EU25 in 2005

Country	Number	
Austria	966.456	
Belgium	:C	
Cyprus	0	
Czech Republic	:C	
Denmark	32.228	
Estonia	:C	
Finland	30,088.109	
France	:C	
Germany	:C	
Greece	0	
Hungary	83,449.709	

Country	*Number*	
Ireland	582.742	
Italy	62.424	
Latvia	:C	
Lithuania	0.644	
Luxembourg	0	
Malta	0	
Poland	:C	
Portugal	0.1	
Slovakia	:C	
Slovenia	0	
Spain	3,737.895	
Sweden	:C	
The Netherlands	:E	
The United Kingdom	2,046.404	
EU 25	:C	273,976

In addition to PRODCOM, Eurostat provides trade statistic (EU25 Trade Since 1995) whose classification is based on the Combined Nomenclature (CN). The following Table 4.7 shows the nomenclature corresponding to cell phones.

Table 4.7: CN nomenclature for cellphones

8525 Transmission apparatus for radio–telephony, radio–telegraphy, radio–broadcasting or television, whether or not incorporating reception apparatus or sound recording or reproducing apparatus; television cameras; still image video cameras and other video camera recorders; digital cameras :
8525 20 – Transmission apparatus incorporating reception apparatus :
8525 20 20 – – For cellular networks (mobile telephones)

The level of detail in the COMEXT datasets is limited to 8525 20, including also other transmission apparatus, but the quantity of the latter is considered negligible.

Table 4.8: Ex-EU import and export of cell phones in 2005 in 100 kg

Country	*Import*	*Export*
AUSTRIA	30,818	13,524
BELGIUM	34,593	1,870
CYPRUS	2,731	1,260
CZECH REPUBLIC	12,907	2,664
GERMANY	307,490	271,705
DENMARK	25,251	5,241
ESTONIA	814	655
SPAIN	44,208	17,809
FINLAND	6,161	143,209
FRANCE	119,923	117,062
UNITED KINGDOM	161,355	263,608
GREECE	6,243	1,852
HUNGARY	20,902	148,260
IRELAND	5,611	880
ITALY	85,149	24,183
LITHUANIA	849	448
LUXEMBOURG	26,507	114
LATVIA	1,676	527
MALTA	337	5
NETHERLANDS	15,954	36,770
POLAND	8,294	1,622
PORTUGAL	4,028	3,313
SWEDEN	36,829	171,323
SLOVENIA	429	1,465
SLOVAKIA	660	648
EU25	959,719	1,230,017

The average weight of a cell phone is estimated to be 113 grams, exclusive of batteries and charger. The total import and export of cell phones in thousand units can be assessed.

Table 4.9: Estimated yearly sales of cell phones in EU 25

	100 kg	*1000 units*
EU production		273,976
EU import	959,719	849,309
EU export	1,230,017	1,088,511
EU sales		34,774
average weight	0.113 kg/unit	

Total sales of cellphones in EU 25 can be estimated at 35 million units/year.

4.2.2.5 Television sets

The study "Eco-design of Energy-using Products – EuP Preparatory Studies "Televisions" (Lot 5)" examines the EU 25 sales of television sets. It is based upon production, import and export and retrieves data from PRODCOM and the international trade statistics. Data on production were difficult to retrieve because the PRODCOM database was incomplete. According to PRODCOM statistics in 2004, domestic production of televisions was reported only by Germany, Italy, United Kingdom, Denmark, Spain, Finland, Poland, Slovakia and Hungary. France and the Netherlands have not provided data on television production for the past years, although domestic companies like Thomson and Philips are strong market players.

The new member states Poland, Slovakia and Hungary have larger production sites within the EU but also the United Kingdom, Spain, Denmark, France, the Netherlands and to a lesser extent Germany remain important production locations. PRODCOM does not give an indication if television production consists of the display panel production as well. In general, the television production in the EU is less important, as advanced display panels are mostly produced in Asia (Japan, Korea, Singapore, China), and in Europe products are mainly finished.

Table 4.10 provides Extra-EU import and export data of EU25 countries in 2003 and 2004, from Eurostat trade statistics.

Table 4.10: Export and import of television sets

Product categories	*Volume (1000 units)*			
	Export		*Import*	
	2003	*2004*	*2003*	*2004*
Projection TV	431	598	1,317	2,250
Colour TV/video	112	168	2,692	3,749
CRT TV	6,837	7,608	22,554	26,139
Flat Panel TV	1,010	407	746	2,051
Monochrome TV	91	72	2,780	2,708

In general, there is approximately a four to one ratio in import numbers compared to exports.

As data on production are incomplete, it becomes difficult to estimate total EU 25 sales of television sets. Only for a limited set of countries more or less reliable figures can be calculated, but an extrapolation to the whole of EU 25 is not possible, due to the fact that industrial structure is too heterogeneous.

The sales figures for 2004 are limited to cathode ray tube colour TV and flatscreen colour TV in certain member states with existing production data.

Table 4.11: Calculated consumption of TV sets in selected EU-member states

Country	*Production*		*import*		*export*		*sales*		
	CRT	*flatscreen*	*CRT*	*flatscreen*	*CRT*	*flatscreen*	*CRT*	*flatscreen*	*total*
Germany	423	79	6,439	805	1,789	324	5,073	560	5,633
UK	3,655	190	3,449	822	2,072	258	5,032	754	5,786
Finland	85	0	463	35	257	17	291	18	309
Poland	6,481	526	769	35	6,085	241	1,165	320	1,485

Only by making broad assumptions, a reasonable estimation on total EU sales of TV sets might be made. It is given with the necessary statistical reserve. The basic assumption is that the consumption in EU-15 countries will be comparable to the weighed consumption in the three countries with available data (Germany, United Kingdom and Finland) and that sales in the new member states will be comparable with sales in Poland. In Table 4.12 the calculation is drafted.

Table 4.12: Broad estimation of total EU sales of TV sets

	sales (1000)	*population (1000)*	*sales/inhabitant*
Germany	5,633	82,468	0.0683
United Kingdom	5,786	58,789	0.0984
Finland	309	5,223	0.0592
Poland	1,485	38,635	0.0384
	population (1000)	*average sales/inhabitant*	*sales*
Eastern Europe	107,406	0.0384	4,128
Western Europe	382,565	0.0801	30,630
EU Total			34,759

Total sales of TV-sets in EU 25 can be estimated at 35 million units/year, with an unknown uncertainty factor.

4.2.2.6 Clocks and watches

No EEUP studies on clocks and watches are available. EU 25 sales of clocks and watches is based upon production, import and export and retrieves data from PRODCOM production statistics and the EUROSTAT/COMEXT international trade statistics.

Clocks and watches are defined by the PRODCOM codes quoted in Table 4.13. Only for some of the categories EU 25 production figures could be estimated. Data from several member states are considered to be confidential or are very small, which sometimes makes the EU 25 total confidential as well. Only for Italy a complete set of data is more or less available. The flag :C means confidential, :E means estimated, but the estimated value is not reported in PRODCOM.

These data are too uncomplete to base assessments of total EU-production figures on.

Table 4.13: PRODCOM categories and available production data for clocks and watches

PRODCOM Code	*Description*	*Value EU25*	*Value Italy*
33501413	Electrically operated clocks with watch movements (excluding vehicle clocks; pendulum clocks; clocks with movements without a regulating system (synchronous motor))	:C	0
33501419	Clocks with watch movements (excluding electrically operated; pendulum clocks; clocks with movements without a regulating system (synchronous motor))	:C	0
33501433	Electrically operated alarm clocks (excluding with watch movements)	:C	1,408
33501439	Alarm clocks (excluding with watch movements; electrically operated)	:C	:C
33501443	Electrically operated wall clocks (excluding with watch movements)	:E 663	484
33501450	Wall clocks (excluding with watch movements; electrically operated)	:C	8
33501460	Electrically operated clocks including time distribution and unification system clocks excluding secondary clocks with only minute and/or seconds hands alone; alarm clocks; wall clocks	: E 221	74
33501475	Table-top or mantelpiece clocks (excluding with watch movements; electrically operated)	:C	2
33501479	Clocks (excluding alarm clocks; wall clocks; mantelpiece or table-top clocks; clocks for vehicles; aircraft; spacecraft or vessels; with watch movements; electrically operated)	:C	0
33502133	Electrically operated watch movements; complete and assembled; with mechanical display only or with a device to which a mechanical display can be incorporated	937	0
33502135	Electrically operated watch movements; complete and assembled; with opto-electronic display only	0	0
33502137	Electrically operated watch movements; complete and assembled excluding with mechanical display only or a device in which incorporated - with opto-electronic display only	:C	0
33502150	Watch movements; complete and assembled (including with automatic winding) (excluding electrically operated)	0	0
33502235	Electrically operated alarm clock movements; complete and assembled	:C	0
33502239	Electrically operated clock movements; complete and assembled (excluding of alarm clocks)	:C	0
33502290	Non-electrically operated clock movements; complete and assembled	1,515	1,171
33502330	Complete unassembled or partly assembled watch movements; with balance wheel and hairspring	:C	0

PRODCOM Code	*Description*	*Value EU25*	*Value Italy*
33502350	Complete unassembled or partly assembled watch movements (excluding those with balance wheel and hairspring)	:C	0
33502370	Incomplete assembled watch movements	0	0
33502400	Rough watch movements	0	0
33502500	Unassembled complete; incomplete and rough clock movements	(301 kg)	0
33502613	Watch cases of precious metal or of metal clad with precious metal	:C	1,128
33502615	Watch cases of base metal; whether or not gold or silver-plated	:C	2,697
33502619	Watch cases (excluding of precious metal or of metal clad with precious metal; of base metal)	0	0
33502630	Parts of watch cases (including case bodies; pendants; watch bowes; bushings; domes; bezels; grooves; lugs; bars; claws and bottoms)	-	-
33502654	Cases for clocks and other goods of HS 91	:E 81	
33502657	Parts of clock cases and cases for other goods of HS 91	-	
33502700	Watch straps; bands and bracelets of precious metal/metal clad with precious metal; or base metal and parts thereof excluding neck chains; pendant bands; watch chains; rings and brooches	-	
33502810	Clock or watch springs (including hair-springs)	:C	
33502830	Clock or watch jewels (excluding unworked or roughly sawn jewels)	:C	
33502850	Clock or watch dials	:E 3,505	
33502870	Other watch or clock parts	-	
33502910	Time-registers and time-recorders	:E 2,492	

Information from the federation of Swiss watch industry highlight the main market and production trends for clocks and watches. In 2005, Switzerland consolidated its position as the world's leading exporter of horological products. In volume terms, China was the biggest exporter of finished watches in 2005. But with 880 million units the quantities concerned were 15% down compared to 2004. In second place, Hong Kong experienced a similar reduction with timepiece exports worth over 600 million units. Ranking first in value terms, Switzerland came third on volume. It was far behind the Asian manufacturers with 24 million timepieces exported, 3% down year on year.

Table 4.14: Export figures for watches and clocks in 2005

Country	*Units in millions*	*Changes in % towards 2004*
China	884.6	-15%
Hong Kong	627.3	-15%
Switzerland	24.3	-3%
Germany	10.8	+2%
USA	10.7	-7%
UK	7.7	+86%
France	6.3	+5%

The figures quoted illustrate watch exports by the main countries concerned. They do not represent data for world watch production, which may be estimated at around 1.2 billion timepieces. The sum of the export figures is in fact higher because a product may be re-exported after import (as is the case in Hong Kong) and therefore stated twice. However, the data does clearly reflect the forces involved and highlights the global trends of the branch.

Main watch and clocks producing countries can be identified as the seven countries, mentioned production in other countries can be neglected. We could assume that the Hong Kong export is mainly depending on import from China and on a certain amount of home production. Export from China is largely depending on production in China. Export from other countries might partially depend on import from China, but as the export fractions from third countries is very small compared with the total Chinese export, we might neglect this figure and assume that total export depends on home production. The fraction of home production in Hong Kong can be assessed by making the difference between total production of 1,2 billion and total export minus the Hong Kong export.

Worldwide production of watches might be assessed as follows:

Table 4.15: Estimation of worldwide production of watches and clocks

	export : million units	*production : million units*
China	884.6	884.6
Hong Kong	627.3	255.6
Switzerland	24.3	24.3
Germany	10.8	10.8
USA	10.7	10.7
UK	7.7	7.7
France	6.3	6.3
other	0	0
total	1,571.7	1,200
total export minus Hong Kong	944.4	
total production	1,200	
Hong Kong production	255.6	
asia		1,140.2
Switzerland		24.3
EU 25		24.8
USA		10.7
total		1,200

In addition to PRODCOM Eurostat provides trade statistic (EU25 Trade Since 1995) whose classification is based on the Combined Nomenclature (CN). The following Table 4.16 shows the nomenclature corresponding to watches and clocks.

Table 4.16: CN nomenclature for watches and clocks

CN code	*Description*
9101	Wristwatches, pocket–watches and other watches, including stopwatches, with case of precious metal or of metal clad with precious metal :
	– Wristwatches, electrically operated, whether or not incorporating a stopwatch facility :
9101 11 00	With mechanical display only
9101 12 00	With opto–electronic display only
9101 19 00	Other
	– Other wristwatches, whether or not incorporating a stopwatch facility :
9101 21 00	With automatic winding
9101 29 00	Other .
	– Other :
9101 91 00	Electrically operated
9101 99 00	Other .
9102	Wristwatches, pocket–watches and other watches, including stopwatches, other than those of heading 9101 :
	– Wristwatches, electrically operated, whether or not incorporating a stopwatch facility :
9102 11 00	With mechanical display only.
9102 12 00	With opto–electronic display only
9102 19 00	Other.
	– Other wristwatches, whether or not incorporating a stopwatch facility :
9102 21 00	With automatic winding
9102 29 00	Other.
	– Other :
9102 91 00	Electrically operated
9102 99 00	Other.
9103	Clocks with watch movements, excluding clocks of heading 9104 :
9103 10 00	Electrically operated.
9103 90 00	Other
9104 00 00	Instrument panel clocks and clocks of a similar type for vehicles, aircraft, spacecraft or vessels.
9105	Other clocks :
	– Alarm clocks :
9105 11 00	Electrically operated
9105 19 00	Other.
	– Wall clocks :
9105 21 00	Electrically operated
9105 29 00	Other.

CN code	*Description*
	– Other :
9105 91 00	Electrically operated
9105 99	Other :
9105 99 10	Table–top or mantelpiece clocks
9105 99 90	Other.
9108	Watch movements, complete and assembled :
	– Electrically operated :
9108 11 00	With mechanical display only or with a device to which a mechanical display can be incorporated.
9108 12 00	With opto–electronic display only
9108 19 00	Other.
9108 20 00	With automatic winding
9108 90 00	Other
9109	Clock movements, complete and assembled :
	– Electrically operated :
9109 11 00	Of alarm clocks.
9109 19 00	Other.
9109 90 00	non electrically operated clock movements
9110	Complete watch or clock movements, unassembled or partly assembled (movement sets); incomplete watch or clock movements, assembled; rough watch or clock movements :
	– Of watches :
9110 11	Complete movements, unassembled or partly assembled (movement sets) :
9110 11 10	– With balance wheel and hairspring
9110 11 90	– Other.
9110 12 00	Incomplete movements, assembled. –
9110 19 00	Rough movements. –
9110 90 00	Other
9111	Watch cases and parts thereof :
9111 10 00	Cases of precious metal or of metal clad with precious metal
9111 20 00	Cases of base metal, whether or not gold– or silver–plated.
9111 80 00	Other cases.
9111 90 00	Parts
9112	Clock cases and cases of a similar type for other goods of this chapter, and parts thereof :
9112 20 00	Cases
9112 90 00	Parts
9113	Watch straps, watch bands and watch bracelets, and parts thereof :

CN code	*Description*
9113 10	Of precious metal or of metal clad with precious metal :
9113 10 10	Of precious metal
9113 10 90	Of metal clad with precious metal
9113 20 00	Of base metal, whether or not gold or silver–plated
9113 90	Other :
9113 90 10	Of leather or of composition leather
9113 90 80	Other
9114	Other clock or watch parts :
9114 10 00	Springs, including hairsprings
9114 20 00	Jewels
9114 30 00	Dials
9114 40 00	Plates and bridges
9114 90 00	Other

In COMEXT, import and export figures are summed in Table 4.16, expressed in 100 kg but not in number of items. The figures confirm the observation that import is much more important than export. Germany and France are important exporters, but also Italy is more prominent than expected, while the UK export is less pronounced. It may not possible to find an average weight for clocks and watches, thus an assessment in number of items is not possible.

Table 4.17: Import and export in 2005 of clocks and watches in EU-15 in 100 kg

Country	*Import*	*Export*
Austria	16,296	1,552
Belgium	29,818	727
Cyprus	2,799	98
Czech Republic	6,639	496
Germany	161,898	18,741
Denmark	7,054	765
Estonia	267	18
Spain	73,565	3,623
Finland	3,807	291
France	65,854	10,679
United Kingdom	150,371	5,156
Greece	14,777	101
Hungary	7,624	474
Ireland	2,916	878
Italy	79,096	15,940
Lithuania	980	26

Country	*Import*	*Export*
Luxembourg	698	2
Latvia	1,180	5
Malta	477	1
Netherlands	82,946	3,401
Poland	20,461	635
Portugal	4,584	255
Sweden	16,509	2,408
Slovenia	1,396	567
Slovakia	648	125
EU 25	752,660	66,964

When assuming that

- the average balance between import and export is roughly 90/10;
- this reflects an internal demand of 9 times the internal production;
- the total EU 25 production is assessed around 25 million units.

Total sales of clocks and watches in EU 25 can be estimated at 225 million units/year, with an unknown uncertainty factor.

4.2.2.7 Fluorescent lamps (straight and compact)

No EEUP studies on fluorescent lamps are available. A study on office lighting is ongoing but no documents or draft documents are available. EU 25 sales of fluorescent lamps is based upon production, import and export and retrieves data from PRODCOM production statistics and the EUROSTAT/COMEXT international trade statistics.

Fluorescent lamps are defined by the following PRODCOM codes:

Table 4.18: PRODCOM codes for fluorescent lamps

31501510	Fluorescent hot cathode discharge lamps; with double ended cap (excluding ultraviolet lamps)
31501530	Fluorescent hot cathode discharge lamps (excluding ultraviolet lamps; with double ended cap)
31501553	Mercury vapour discharge lamps (excluding ultraviolet lamps; dual lamps)

The total production of fluorescent lamps in 2005 in EU 25 is estimated at 582.879.000 units. Table 4.19 gives an overview over the different member states and product types. A lot of countries only have a small and negligible production, or keep their production confidential. Only very limited individual data are available, but reliable estimations for EU 25 are made by Eurostat.

Table 4.19: Production of fluorescent lamps in 2005 in EU 25 in 1000 units

PRODCOM Code	*31501510*	*31501530*	*31501553*
	1000 units		
Value EU25	462.405	95.674	24.800
Belgium	0	0	:C
Czech Republic	0	:C	:C
Denmark	0	0	0
Germany	236.521	:C	:C
Estonia	0	:C	0
Ireland	0	:C	0
Greece	0	0	0
Spain	:C	:C	:C
France	:C	:C	:C
Italy	:C	822	:C
Cyprus	0	0	0
Latvia	0	0	0
Lithuania	0	0	0
Luxembourg	0	0	0
Hungary	0	:C	0
Malta	0	0	0
The Netherlands	:C	:C	:C
Austria	0	0	0
Poland	0	0	:C
Portugal	0	0	:C
Slovenia	0	0	0
Slovakia	:C	0	:C
Finland	:C	0	:C
Sweden	:E	0	0
The United Kingdom	8.633	:C	:C

In addition to PRODCOM, Eurostat provides trade statistic (EU25 Trade Since 1995) whose classification is based on the Combined Nomenclature (CN). The following Table 4.20 shows the nomenclature corresponding to fluorescent tubes.

Table 4.20: CN nomenclature for fluorescent lamps

8539	Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infra–red lamps; arc lamps :
	– Discharge lamps, other than ultraviolet lamps :
8539 31	Fluorescent, hot cathode
8539 31 10	With double ended cap
8539 31 90	Other

The maximum level of detail in COMEXT is 8539. This category also includes sealed beam lamp units, tungsten halogen lamps, reflector lamps, sodium vapour lamps, metal halide lamps, ultraviolet or infra–red lamps, arc lamps and lamp bases.

Table 4.21: Import and export in 2005 of electric filament or discharge lamps in EU-15 in 100 kg

Country	*Import*	*Export*
Austria	6,300	2,988
Belgium	32,576	29,717
Cyprus	3,351	3
Czech Republic	6,277	1,084
Germany	135,250	93,530
Denmark	6,176	1,299
Estonia	823	168
Spain	54,422	36,521
Finland	3,706	965
France	62,181	36,935
United Kingdom	122,122	30,133
Greece	10,933	5,366
Hungary	16,308	258,480
Ireland	705	590
Italy	67,647	25,082
Lithuania	4,191	190
Luxembourg	236	0
Latvia	990	145
Malta	1,203	22
Netherlands	55,497	15,3051
Poland	85,015	166,799
Portugal	2,834	1,666
Sweden	17,408	12,925
Slovenia	913	840

Country	*Import*	*Export*
Slovakia	3,468	5,552
Eu25	700,532	864,051

The average weight of a discharge lamp is assessed by the public Flemish waste agency at 0,12 kilograms. In Table 4.22 an estimation of the EU 25 sales is made.

Table 4.22: Estimated yearly sales of discharge lamps in EU 25

	1000 units	*100 kg*
EU production	582,879	699,455
EU import		700,532
EU export		864,051
EU sales	446,613	535,936
average weight	0.12 kg/unit	

Total sales of discharge lamps in EU 25 can be estimated at 446 million units/year.

4.2.2.8 Lawn mowers and gardening equipment

No EEUP studies on lawn mowers and gardening equipment are available. EU 25 sales of lawn mowers and gardening equipment is based upon production, import and export and retrieves data from PRODCOM production statistics and the EUROSTAT/COMEXT international trade statistics.

Lawn mowers and gardening equipment are defined by the following PRODCOM codes in Table 4.23. Bigger equipment that has to be installed on a tractor has been excluded. No specific codes for other gardening equipment (like electrified garden moss removal tools or hedge shears) have been identified. Hand tools like spades and shovels, forks of a kind used in agriculture; horticulture or forestry, mattocks; picks; hoes and rakes, axes; bill hooks and similar hewing tools, secateurs and similar one-handed pruners and shears, , saws for gardening, hedge shears; two-handed pruning shears and similar two-handed shears and other hand tools for agriculture; horticulture or forestry are not included. Chain saw blades have been included.

Table 4.23: PRODCOM codes for lawn mowers and gardening equipment

29321500	Agricultural... forestry machinery; n.e.c.; lawn or sports-ground rollers
29322010	Electric mowers for lawns; parks; golf courses or sports grounds
29322033	Self-propelled powered mowers with a seat and with the cutting device rotating in a horizontal plane; for lawns; parks; golf courses or sports grounds (excluding electric mowers)
29322035	Self-propelled powered mowers with the cutting device rotating in a horizontal plane; for lawns; parks; golf courses or sports grounds (excluding those with a seat)
29322037	Powered mowers with the cutting device rotating in a horizontal plane; for lawns; parks; golf courses/sports grounds (petrol hover/rotary) (excluding electric mowers; self-propelled)
29322053	Self-propelled motorized mowers with a seat; for lawns; parks; golf courses or sports grounds (excluding with the cutting device rotating in a horizontal plane; electric mowers)

29322055	Self-propelled motorized mowers for lawns; parks; golf courses or sports grounds (excluding with the cutting device rotating in a horizontal plane; electric mowers; with a seat)
29322057	Motorized mowers for lawns; parks; golf courses or sports grounds (excluding with the cutting device rotating in a horizontal plane; electric mowers; self-propelled)
29322070	Non-motorized mowers for lawns; parks; golf courses or sports grounds (such as push cylinder mowers) (excluding with the cutting device rotating in a horizontal plane)
29323130	Motor mowers (excluding for lawns; parks; golf courses or sports grounds)
28622091	Chain saw blades (excluding morticing chain cutters)

The availability of relevant production data in PRODCOM, as summarised in Table 4.24 is rather limited for these categories, because of lacking data and confidentiality. Data is lacking for self propelled mowers without a seat, for most mowers with the cutting device rotating in a horizontal plane, and for chain saws is lacking. More or less full datasets are available for Italy.

Table 4.24: Production in 1000 units of lawn mowers and gardening equipment

PRODCOM Code	*29321500*	*29322010*	*29322033*	*29322035*	*29322037*	*29322053*	*29322055*	*29322057*	*29322070*	*29323130*	*28622091*
Unit	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*p/st*	*Kg*
flag EU25	:C	:E	:E	:C	:C	:E	:C	:E	:E	:E	
Volume EU25		3,417	341			7		28	239	154	0
Belgium	:C	0	0	:C	:C	0	0	0	0	0	0
Czech Republic	1	:C	:C	0	0	0	0	:C	CE	0	0
Denmark	31	0	0	0	0	0	0	5	40	0	0
Germany	:C	:C	:C	73	85	:C	0	:C	:C	:C	0
Estonia	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0
Greece	2	0	0	0	0	0	0	0	0	0	0
Spain	3	0	0	:C	:C	0	:C	0	:C	:C	0
France	43	14	:C	199	34	:C	0	0	:C	0	0
Italy	236	625	178	2,407	824	:C	4	0	35	144	0
Cyprus	0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	:C	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0	0	0
Hungary	17	:C	0	0	328	0	0	:C	0	:C	0
Malta	0	0	0	0	0	0	0	0	0	0	0
The	9	0	:C	0	0	:C	0	0	:C	0	0

PRODCOM Code	29321500	29322010	29322033	29322035	29322037	29322053	29322055	29322057	29322070	29323130	28622091
Unit	p/st	p/st	p/st	p/st	p/st	p/st	p/st	p/st	p/st	p/st	Kg
Netherlands											
Austria	150	:C	:C	0	:C	0	0	0	0	:C	0
Poland	15	:C	0	0	:C	0	0	0	0	:C	0
Portugal	3	0	0	0	0	0	0	0	0	0	0
Slovenia	:C	0	0	0	:C	0	0	:C	:C	0	0
Slovakia	:C	0	0	0	0	0	0	0	0	0	0
Finland	1	0	0	0	0	0	0	2	0	0	0
Sweden	:C	0	:C	:C	:C	0	0	0	:C	0	0
The United Kingdom	:E	:E	:E	:E	:E	:E	:E	:E	:E	:E	0

In addition to PRODCOM, Eurostat provides trade statistic (EU25 Trade Since 1995) whose classification is based on the Combined Nomenclature (CN). The following table shows the nomenclature corresponding to lawn mowers.

Table 4.25: CN codes for lawn mowers

8433	Harvesting or threshing machinery, including straw or fodder balers; grass or hay mowers; machines for cleaning, sorting or grading eggs, fruit or other agricultural produce, other than machinery of heading 8437
	– Mowers for lawns, parks or sports grounds :
8433 11	– – Powered, with the cutting device rotating in a horizontal plane :
8433 11 10	– – – Electric
	– – – Other :
	– – – – Self–propelled :
8433 11 51	– – – – – With a seat
8433 11 59	– – – – – Other
8433 11 90	– – – – Other
8433 19	– – Other :
	– – – With motor :
8433 19 10	– – – – Electric
	– – – – Other :
	– – – – – Self–propelled :
8433 19 51	– – – – – – With a seat
8433 19 59	– – – – – – Other
8433 19 70	– – – – – Other
8433 19 90	– – – Without motor

Only for smaller countries like Malta, Luxembourg, Cyprus some data are lacking for some categories. Total EU 25 figures can be estimated by Eurostat, as summarised in Table 4.26.

Table 4.26: Import and export of lawn mowers for EU 25 in number of items

		EU25
8433 11 10	IMPORT	1,176,853
	EXPORT	441,720
8433 11 51	IMPORT	186,272
	EXPORT	25,445
8433 11 59	IMPORT	400,181
	EXPORT	226,098
8433 11 90	IMPORT	269,105
	EXPORT	118,430
8433 19 10	IMPORT	129,621
	EXPORT	4,707
8433 19 51	IMPORT	18,301
	EXPORT	1,367
8433 19 59	IMPORT	10,391
	EXPORT	2,782
8433 19 70	IMPORT	38,868
	EXPORT	13,165
8433 19 90	IMPORT	162,342
	EXPORT	32,175

Total import is estimated at 2,391,934 items, and the export at 865,889 items. No reliable figures for production are available. The sum of the EU 25 estimates for certain categories are augmented with the sum of available non confidential data from individual member states for the other categories. The real production figure is not lower than this sum of 8,649,857 items.

Sales can be estimated as the production plus the import minus the export, but this figure will be an underestimation.

Total sales of lawn mowers in EU 25 can be estimated at 10.2 million units/year.

4.2.2.9 Video games and handheld video games

No EEUP studies on video games are available. EU 25 sales of video games and handheld video games is based upon production, import and export and retrieves data from PRODCOM production statistics and the EUROSTAT/COMEXT international trade statistics. Video games are defined by the PRODCOM code 36504200: Video games of a kind used with a television receiver. This only includes game consoles but not handheld video games.

Only the estimated EU 25 volume of 20,000 and the Italian production volume of 18,000 units are reported in the PRODCOM database. These figures are very low, even in a market dominated by American and Asian producers. Nintendo (Gameboy), Sony (Playstation) and Microsoft (Xbox) dominate the market, both on handheld consoles as on video games to be connected to a television set.

Sony reports the following production figures for 2005:

Table 4.27: Production figures for Sony PlayStation in 2005, in million units

Product	*Total*	*Japanese market*	*USA market*	*European market*
Playstation Portable	15.03	4.20	5.81	5.02
Playstation	102.49	21.59	40.78	40.12
Playstation 2	101.37	22.83	40.99	37.55
Total	218.89	48.62	87.58	82.69

Microsoft reports the launch of Xbox 360 in November 2005. In the Second Quarter Results, published in January 26, 2006, Microsoft Corporation gives the following figures:

Table 4.28: Production figures for Microsoft Xbox 360 in Q2 2006, in million units

Product	*Total*	*North America*	*Europe and Middle East*	*Japan*
Xbox 360	1.5	0.9	0.5	0.1

Nintendo reports the following production figures for 2004:

Table 4.29: Production figures for Nintendo hardware products in 2004, in million units

Product	*Total*	*Japanese market*	*The America's*	*Other regions incl. European market*
Game Boy	118.69	32.47	44.06	42.16
Nintendo 64	32.92	5.54	20.63	6.75
Game Boy advance	66.79	15.55	33.37	17.87
Nintendo GameCube	18.50	3.80	10.46	4.24
Nintendo DS	5.26	2.12	2.19	0.95
Total	242.16	59.48	110.71	71.79

We can conclude that Europe sales make out about one third of the worldwide production of video games and handheld video games, and that European production is of no importance. European sales correspond to the European import of the video game consoles and handheld consoles.

The COMEXT database does not include the right entries to select video games. Figures on “video games for use with a television receiver” are by far incomplete.

The best estimation for EU sales is obtained by dividing the world production by three. Sony is the biggest player in the category of video games to be connected to a television set. Nintendo is the biggest player in the category of hand held video games. As Sony controls about 70% of its market, the world production can be estimated at 310 million units, and the European yearly sales at 100 million units. The market share of Nintendo on handheld video consoles is +50% , the world production can be estimated at 500 million units, and the European yearly sales at 150 million units.

Total sales of video games and handheld video games in EU 25 can be estimated at 100 million units/year for video games and 150 million units/year for handheld video consoles, with an unknown uncertainty factor.

4.2.2.10 Dispensers for hot and cold beverages

An EEUP study on Commercial Refrigerators and Freezers exists. In the draft document "Commercial Refrigerators and Freezers, Interim Report Task 2: Economic and Market Analysis" data from PRODCOM are analysed, for the following items:

Table 4.30: Refrigerators included in the EEUP study on commercial refrigerators

29.23.13.33	Refrigerated show-cases and counters incorporating a refrigerating unit or evaporator for frozen food storage
29.23.13.35	Refrigerated show-cases and counters incorporating a refrigerating unit or evaporator (excluding for frozen food storage)
29.23.13.40	Deep-freezing refrigerating furniture (excluding chest freezers of a capacity <= 800 litres, upright freezers of a capacity <= 900 litres)
29.23.13.50	Refrigerating furniture (excluding for deep-freezing show-cases and counters incorporating a refrigerating unit or evaporator)

EU 25 sales, based on statistics for production, import and export, for the total of commercial refrigerators and freezers is assessed at 2.89 million units. This result is not being taken into account as the EEUP study is not including dispensers for cold beverages, although they are commercial refrigerators. Dispensers for hot beverages are of course not included either.

PRODCOM code 29.24.33.30 describes "automatic goods-vending machines incorporating heating or refrigerating devices".

Table 4.31: EU 25 production in 2005 of dispensers of hot and cold food and beverages

Country	*Thousands of units*
Volume EU25	446.173
Belgium	0
Czech Republic	0
Denmark	:C
Germany	15.5
Estonia	0
Ireland	0
Greece	0
Spain	:C
France	:C
Italy	305.896
Cyprus	0
Latvia	0
Lithuania	0

Country	*Thousands of units*
Luxembourg	0
Hungary	0
Malta	0
The Netherlands	:C
Austria	:C
Poland	0
Portugal	0
Slovenia	0
Slovakia	0
Finland	0
Sweden	:C
The United Kingdom	41.822

In the COMEXT database dispensers of hot and cold beverages and food are identified by the following CN codes:

Table 4.32: CN codes for dispensers of hot and cold beverages and food

8476	Automatic goods–vending machines (for example, postage stamp, cigarette, food or beverage machines), including money–changing machines :
	– Automatic beverage–vending machines :
8476 21 00	– – Incorporating heating or refrigerating devices
	– Other machines :
8476 81 00	– – Incorporating heating or refrigerating devices

Table 4.33: ex-EU 25 import and export of dispensers of hot and cold beverages in 2005, in items

Country	*84762100*		*84768100*	
	import	*Export*	*import*	*export*
Austria	70	577	2	9
Belgium	605	326	14	:
Cyprus	121	:	18	:
Czech Republic	2,122	61	2,075	1
Germany	218	830	283	1,442
Denmark	318	13,527	:	4
Estonia	68	2	:	:
Spain	2,783	2,218	3,382	1,160
Finland	101	351	4	120

Country	*84762100*		*84768100*	
	import	*Export*	*import*	*export*
France	552	898	39	434
United Kingdom	5,962	22,441	23,361	815
Greece	33	1	77	:
Hungary	1,256	155	572	0
Ireland	387	:	20	200
Italy	757	33,293	1,184	7,063
Lithuania	:	63	:	:
Luxembourg	:	:	:	:
Latvia	4	:	:	:
Malta	10	:	204	:
Netherlands	6,214	9,648	138	11
Poland	609	67	28	1
Portugal	12	9	:	3
Sweden	275	326	5	145
Slovenia	130	164	:	:
Slovakia	50	33	:	:
EU 25	22,657	84,990	31,406	11,408

The total import is estimated at 54,063 items, and the export at 96,398 items. The EU 25 production figure is estimated at 446,173 items.

Sales can be estimated as the production plus the import minus the export.

Total sales of dispensers of hot and cold beverages and food in EU 25 can be estimated at 404 thousand units/year.

4.2.2.11 Summary

In Table 4.34 the conclusions of the research on product volumes are summarised.

Table 4.34: Summary of sales of selected goods in EU 25 in 2005

Category	*million units/year*
Refrigerators	*24*
PC and laptop	*48*
Printers and copiers	*(30)*
Cellphones	*35*
Television sets	*(35)*
Clocks and watches	*(225)*
Fluorescent lamps (straight and compact)	*446*
Lawn mowers and gardening equipment	*10*
Video games and handheld video games	*(250)*
Dispensers for hot and cold beverages	*0.4*

Data within brackets have an unknown degree of uncertainty.

These product volumes are used in the calculations of the following chapters.

4.3 QUANTITY OF THE HAZARDOUS SUBSTANCES IN THE SELECTED PRODUCTS

4.3.1 Presences of RoHS substances in the selected product categories

This chapter gives an overview of RoHS substances present – for the moment or in the past – in the selected product categories. Starting from the main use of the different RoHS substances, their probable actual or past presence in the different product groups is assessed. The information is based on different literature sources (COWI, 2005; OECD, 2006; US EPA, 2007) and expert judgement.

4.3.1.1 Lead

The use of lead can be inventorised as follows:

- lead acid batteries (about 58% of use share of lead)
- Construction uses: Lead sheet and pipe. Lead sheet is used in building and construction industry. Other uses are for roofing and cladding of walls, and furthermore for radiation shielding, noise attenuation and damp proofing. Lead pipe is not used for domestic water supplies for 10 years. However, in some countries considerable amounts of lead pipe work are still in service. (about 14% of use share of lead)
- Lead shot, weights, application in bullets.
- Alloys. Tin-lead alloys are most widely used (solder). Major use is in electronics industry.
- Leaded glass and ceramics: Lead oxide is used as an additive. Crystal glass contains 24-36% of lead oxide.
- Radiation shielding glass, cathode ray tubes, fluorescent tubes and electrical glass.

- Lead pigments and paints. e.g. lead chromate. Also used as drying agents in paints, but the use has declined since 1960's.
- PVC stabilisers. Second most important application of lead compounds (after cathode tubes), (i.e. excluding metallic applications). For PVC, lead salts are most cost effective stabilisers and are used for around three-quarters of PVC applications.
- Petrol additives (drastically reduced). Used are tetraethyl lead and tetramethyl lead. Now account only for 1% of lead consumption. The use of leaded petrol was banned in the EU from 1 January 2000
- Cable sheathing. Extruded into a continuous covering to prevent water penetration of underground or underwater power and telecommunication cables.
- Occasional use of lead as raw material for synthesis, in electrolyses and in stabilisers.

For the selected product categories, lead is important in:

- Lead acid batteries, when present as a compound in some lawn mowers. Conform annex II, point 1 remark 3 batteries need to be removed from separately collected WEEE.
- Tin-lead alloys in solder in electronical compounds; PC and laptop, printer and copier, cell phone, video games and in electronical compounds in television sets and probably in high-tech beverage dispensers.
- Cathode ray tubes in television sets
- PVC in electrical cable insulation, refrigerator racks, cell phone housing, keyboards and computer monitor housing, …
- Cable sheathing in external or internal electric cables. Conform annex II, point 1 remark 12 external electric cables need to be removed from separately collected WEEE.

4.3.1.2 Cadmium

Cadmium or cadmium oxides are used for:

- Electrode material in nickel-cadmium batteries. The main use of cadmium oxide is in the manufacture of nickel-cadmium batteries. (about 72% of use share of cadmium)
- Pigments in plastics, glasses, ceramics, paints, papers, inks. The pigments are based on cadmium sulphide, which produces a yellow colour. Raw material is either cadmiumoxide or cadmium metal. (about 14% of use share of cadmium)
- Stabilisers for PVC. Used to retard degradation on exposure to heat and UV light. Raw material is cadmium oxide or metal. The European PVC industry, as part of its Vinyl 2010 sustainability programme, has already phased out the use of cadmium stabilisers and is committed to replace all use of lead stabilisers by 2015.
- Plating of metals i.e. protection of iron against corrosion. Raw material is cadmium metal.
- Component for various alloys e.g. solders. Cadmium metal is a common component of many alloys which have uses related to their melting temperatures, e.g. tin-lead-bismuth-cadmium alloy (for joining heat sensitive metal parts), silver-cadmium-copper-zinc-nickel (joining tungsten carbide to steel tools). Most of the Cd alloys are copper-cadmium alloys.
- Solar cells (CdTe and CdS).

For the selected product categories, cadmium is important in:

- Nickel-cadmium batteries in cell phones, toys, clocks, older laptops. Conform annex II, point 1 remark 3 batteries need to be removed from separately collected WEEE.
- PVC in older electrical cable insulation, refrigerator racks, cell phone housing, keyboards and computer monitor housing, …
- Cadmium plating or solder in semiconductors in computers, toys, cellphones.

4.3.1.3 Mercury

Mercury is used in:

- Dental amalgams
- Pesticides. The production, storage and sale or supply of pesticides containing mercury was banned in 1992.
- Batteries
- Thermometers, thermostats
- Measuring and control instruments
- Lighting
- Older switches in some electrical equipment
- Laboratory chemical and pharmaceuticals
- Gold and silver recovery
- Chlorine production (as a cathode)
- Paints. Anti-fouling in ship paints and coating on paper or film in photographic applications. Such applications are no longer permissible and EC Member States had to implement appropriate controls

For the selected product categories, mercury is important in:

- Fluorescent tubes
- Mercury bottom cells in watches

4.3.1.4 Cr(VI)

Cr(VI) or chromium VI is used in:

- Chromate passivate coatings on various metals used to protect metal parts from corrosion.
- Corrosion protective paints
- Chromium in glass, to achieve emerald green coloured glass
- Chromium pigments

For the selected product categories, chromium VI is important in:

- Coating on electrical contacts and fasteners (screws, nuts, bolts, etc.) in aluminium, in all electrical equipment
- Coating on cooling systems in refrigerators
- Coating on copper foil in lithium ion batteries in laptops and portable electronics: cell phones and video games
- Coating on copper foil on printed circuit boards, in all electronic equipment

4.3.1.5 Polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDEs)

PBB and PBDE are used in different plastics and textiles, always as a flame retardant.

For the selected product categories, the following brominated flame retardants are important:

- Deca-BDE in housings of TV sets, mobile phones, wire and cable, connectors in electrical and electronic equipment
- Octa-BDE in housings of TV sets, PC monitors, mobile phones.
- In connectors, switches, circuit breakers in most electric equipment
- Some types of circuit boards
- Plastic parts in copiers
- Lamp socket

4.3.2 Estimation of quantities

To measure the effectivity of the RoHS Directive in avoiding the use of the RoHS substances in EEE, we need to assess the quantity of the hazardous substances that would be present in the selected products in the absence of the RoHS Directive, and to compare these quantities with the quantity of the hazardous substances present in the selected products now, taking into account that RoHS entered into force in July 2006.

4.3.2.1 Compare actual with past situation?

A structural problem for this assessment consists of the fact that the actual situation cannot be compared with the situation before the implementation of the RoHS directive, because without RoHS a lot of countries would have introduced local, non harmonized legislation with the same goal of avoiding hazardous substances. It is difficult to guess what kind of policy decisions the different Member States would have taken. Some countries wouldn’t have taken any measures at all, while other countries would have taken different measures with different exemptions and different degrees of efficiency. Based upon the perception of the local sense of urgency and the local analysis of the problem of the presence of hazardous substances in EEE, in the different Member States choices could have been made on:

- The kind of hazardous substances to be banned or avoided
- The selection of covered EEE, a fixed or loose relation with the WEEE-directive
- The definition of exemptions and of applicable threshold values
- The choice of an administrative approach
- The date on entry into force
- Transitional measures
- Aspects of import and export
- Etc.

Therefore it is much easier to compare the actual situation with the real situation before RoHS-Directive, in stead of comparing it with a theoretical situation on how it could have been today. But this created some conceptual problems because the past situation is only into a certain and unknown degree approximate for a theoretical situation without RoHS Directive.

4.3.2.2 Absence of RoHS-directive and presence of WEEE directive?

The RoHS directive is focussing directly on the presence or the absence of substances and therefore effects only the phase of design of the products. The obligations connected to the RoHS directive are very simple and straightforward. The use of a substance is either permitted or prohibited, sometimes under certain minimum values.

The WEEE directive is focussing on a much broader objective: the prevention of waste electrical and electronic equipment, and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment. The instruments used to obtain these objectives are:

- Support of eco design in order to obtain easily recyclable or reusable waste;
- Separate collection and take back obligations, with a collection target of 4 kg/inhabitant/year;
- Treatment using best available techniques, minimum quality standards and recovery targets;
- Financing and information/reporting obligations;
- Penalties, inspection and monitoring.

Without RoHS Directive, the effects of the implementation and the application of the WEEE directive on the quantity of RoHS substances in certain products will be limited.

If the presence or absence of a certain hazardous substance has an effect on the recycling potential and the costs for recycling or treatment, the WEEE-directive will have effect on the presence or absence of RoHS-substances. If the presence of a RoHS-substance in certain fractions of WEEE makes recycling more costly, then other treatment options would to be applied for these fractions, and extra measures have to be taken to achieve the over-all recycling threshold of the WEEE-directive. In this case the WEEE-directive could lead, without the existence of RoHS-directive, to a diminishing application of a certain RoHS-substance as a raw material, or to lesser import of products containing this RoHS-substance. Of course when the RoHS Directive forbids the use of RoHS-substances in recycled products, this effect becomes more strong, and it is not limited until a market equilibrium has been reached.

It is concluded that the presence or absence of a RoHS-directive certainly has effects on the application of the WEEE-directive through the recyclability of products. Vice versa the presence or absence of a WEEE-directive has however little to no effect on the presence or absence of RoHS-substances in products.

4.3.2.3 Effectivity of RoHS Directive

Under different scenarios different quantities of RoHS-substances can be found in electrical and electronic equipment.

Quantity	Scenario
Q1	Actual situation 2007 with RoHS Directive entered into force
Q2	Situation 2007 without a RoHS Directive, but with different strategies of member States on hazardous substances in EEE
Q3	Passed situation ‘before’ implementation of RoHS (and before Member States or industrial sectors took anticipative actions)

Q1 is difficult to measure but this is conceptionally possible. Q3 is equally difficult to measure but the anticipative actions are not easy to exclude, because the discussion on the possibilities of a RoHS Directive were already ongoing during a certain time. Q2 is not to assess because of the large degrees of freedom Member States would have on the issue if and how they would prevent hazardous substances in EEE. However, The difference between Q3 and Q1 will be larger than between Q2 and Q1. It is uncertain but probable that the absolute amount of prevented hazardous substances is larger in Q1 than in Q2, because when no uniform and imposed ban on RoHS-substances was realised, at least some Member States could choose for an international competitive advantage, and thus more than neutralise the efforts of progressive Member States that would have gone further that the actual ban.

4.3.2.4 Generalisation of the quantities of RoHS substances in the selected products

METHODOLOGY

The generalisation of the presence of RoHS substances in the selected products has been calculated, based mostly on the available information in literature (DEFRA, 2004; COWI, 2005; EC, DG ENV, 2006; OECD, 2006; DEFRA, 2006) and expert judgement, as mostly no information was provided by the stakeholders (e.g. producers, sectoral organisations, etc.). However, it should be clear that this gives in the first place a rough estimation of the quantities in the different components of the selected products. Differences in quantities can occur when comparing different literature sources, reference years, components, products, etc. The total quantity of RoHS substances per selected product was then calculated by summoning the quantities of RoHS substances in the different components of the selected products.

Furthermore, it should be kept in mind that the generalisation of the quantities of RoHS substances will not be fully visible at this moment. A large number of EEE in people's possession dates from the time before the RoHS Directive and is therefore not designed yet according to the RoHS standards. Therefore, as a baseline scenario, the assessment of the quantities of RoHS substances in the selected products after the implementation of RoHS has started from the hypothetical future scenario with all EEE being replaced by RoHS compliant equipment.

For the situation **BEFORE** the implementation of the RoHS directive, different scenarios have been taken into account as a result of the availability of absolute maximum quantity values for some components on the one hand, and a range of quantities for some components on the other hand:

- "minimum" concentration of a RoHS substance present in (a component of) the selected product, taking into account the minimum quantity values for some components and the absolute maximum quantity values for other components if only this was available;
- "maximum" concentration of a RoHS substance present in (a component of) the selected product, taking into account the maximum quantity values for some components and the absolute maximum quantity values for other components if only this was available.

For the situation **AFTER** the implementation of the RoHS directive different scenarios have been taken into account:

- for Cr(VI), it was assumed that it is not present anymore, as most of the Cr(VI) in the selected products is present in passivation coatings. Cr(VI) in passivation coatings can mostly easily be subsitued by other solutions like Cr(III).
- for Octa-BDE, it was assumed that is not present anymore, as the use of Octa-BDE is completely banned in Europe.
- for the other RoHS substances:
  - for (components of) the selected product with exemption:
    - ~ minimum concentration of a RoHS substance present in (a component of) the selected product as mentioned in the situation before RoHS.
    - ~ maximum concentration of a RoHS substance present in (a component of) the selected product as mentioned in the situation before RoHS.
  - for (components of) the selected product without exemption:
    - ~ maximum concentration of 0.1 % by weight for Pb, Hg, Deca-BDE; and of 0.01 % by weight for Cd present in (a component of) the selected product;
    - ~ minimum concentration of 0 % by weight for Cd, Pb, Hg, Deca-BDE present in (a component of) the selected product.

A distinction for the latter (0.1% (or 0.01%) vs. 0%) was made as the following is mentioned in the amendment of the RoHS directive (2005/618/EC) for products without exemption:
"For the purposes of Article 5(1)(a), a maximum concentration value of 0.1 % by weight in homogeneous materials for lead, mercury, hexavalent chromium (or Cr(VI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) and of 0.01 % by weight in homogeneous materials for cadmium shall be tolerated."

The distinction for (components of) the selected products without exemption was made, as it was not possible to make estimations on the quantities in the homogenous materials, but only possible to make estimations on the quantities in (components of) the selected products.

Although commercial Deca-BDE can contain also Nona-BDE (e.g. 3 %), next to Deca-BDE (e.g. > 97 %), it should be noted that for the purpose of this study, it is assumed that 100 % Deca-BDE is being used.

It should be noted that technology changes or changes in the demand of product type after the implementation of RoHS are mostly not taken into account in the determination of the quantities and the further calculations, because most of the time there was no detailed information on this subject. Only for PCs and TV sets the technology change from a cathode ray tube before RoHS to a flat screen after RoHS was included.

RESULTS

An overview of the quantities of hazardous substances in the selected products before RoHS and after RoHs is given in the following tables:

- situation before RoHS: “minimum” and “maximum” concentration of a RoHS substance in the total of the product.
- Situation after RoHS: “min”; “0% max” and “0.1% max” concentration of a RoHS substance in the total of the product:
  - “min” concentration:
    - ~ for components of the selected products with exemption the minimum concentration was used;
    - ~ for components of the selected products without exemption the minimum concentration of 0 % by weight for the different RoHS substances was used;
  - “0% max” concentration:
    - ~ for components of the selected products with exemption the maximum concentration was used;
    - ~ for components of the selected products without exemption the minimum concentration of 0 % by weight for the different RoHS substances was used;
  - “0.1% max” concentration:
    - ~ for components of the selected products with exemption the maximum concentration was used;
    - ~ for components of the selected products without exemption the maximum concentration of 0.01 % by weight for Cd and 0.1 % by weight for the other RoHS substances was used.

Table 4.35: Estimation of the quantities of RoHS substances in the selected products before RoHS

	before RoHS	Total content per substance per product (g/product)											
		Pb	Pb	Cd	Cd	Cr(VI)	Cr(VI)	Hg	Hg	Deca-BDE	Deca-BDE	Octa-BDE	Octa-BDE
	Product	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
1	Refrigerator	845	1343	57	207	10	10	2	9	250	1150	-	-
2	PC	463	972	25	88	4	4	0.001	0.01	105	483	210	630
2	laptop	50	80	4	13	1	1	1	4	15	69	-	-
3	Printers	251	401	18	63	3	3	0.0	0.5	75	345	-	-
3	copiers	716	1549	95	346	17	17	5	401	419	1925	837	2511
4	cell phones	2	3	0.1	0.5	0.02	0.02	1	1	2	6	1	3
5	TV set	2131	5743	125	125	6	6	-	-	452	1597	301	904
6	Watch, clock	4	7	0.3	1.0	0.05	0.05	-	-	4	13	-	-
7	Fluorescent (double end) lamp	3	5	0.1	0.5	0.02	0.02	0.005	0.023	2	3	-	-
8	Lawn mowers + gardening equipment	251	401	18	63	3	3	-	-	75	345	-	-
9	Video games and handheld video games	5	8	1	2	0.06	0.06	-	-	5	16	3	9
10	Dispensers for hot and cold beverages	168	267	12	42	2	2	1	5	50	230	-	-

Table 4.36: Estimation of the quantities of RoHS substances in the selected products after RoHS

after RoHS	Total content per substance per product (g/product)												
	Pb			Cd			Cr(VI)	Hg			Deca-BDE		Octa-BDE
Product	Min(*)	0%Max(**)	0.1%Max(***)	Min(*)	0%Max(**)	0.1%Max(***)		Min(*)	0%Max(**)	0.1%Max(***)	Min(*)	Max(****)	
Refrigerator	93	93	243	11	11	21	0	2	9	9	250	1150	-
PC (*****)	147	447	510	5	5	9	0	0.001	0.01	0.01	105	483	0
laptop	5	5	14	0.6	0.6	1.5	0	0.001	0.01	3	15	69	-
Printers	26	26	71	4	4	7	0	0.005	0.5	0.5	75	345	-
copiers	143	143	326	18	26	35	0	0.006	1	84	419	1925	0
cell phones	0.2	0.2	1	0.02	0.02	0.05	0	0.0	0.0	0.1	2	6	0
TV set (*****)	172	472	562	7	7	13	0	-	-	-	452	1597	0
Watch, clock	0.4	0.4	1	0.05	0.05	0.10	0	-	-	-	4	13	-
Fluorescent (double end) lamp	2	2	2	0.02	0.02	0.05	0	0.005	0.008	0.008	2	3	-
Lawn mowers + gardening equipment	26	26	71	4	4	7	0	-	-	-	75	345	-
Video games and handheld video games	0.5	0.5	1.4	0.06	0.06	0.15	0	-	-	-	5	16	0
Dispensers for hot and cold beverages	17	17	47	3	3	5	0	1	5	5	50	230	-

(*):“min” concentration: for components of the selected products with exemption the minimum concentration was used; for components of the selected products without exemption the minimum concentration of 0 % by weight for the different RoHS substances was used

(**):“0% max” concentration: for components of the selected products with exemption the maximum concentration was used; for components of the selected products without exemption the minimum concentration of 0 % by weight for the different RoHS substances was used

(***):“0.1% max” concentration: for components of the selected products with exemption the maximum concentration was used; for components of the selected products without exemption the maximum concentration of 0.01 % by weight for Cd and 0.1 % by weight for the other RoHS substances was used

(****): the same concentration is applicable after RoHS in scenario “0%Max” and “0.1%Max”

(*****): the Pb quantities in PCs and TV sets after RoHS are calculated by taking into account the changes of the type of PCs and TV sets from a cathode ray tube to a flat screen

The tables show that:

- before RoHS:
  - TV sets, copiers and refrigerators had the highest Pb content per product, with a minimum content of > 0.7 kg Pb (> 2 kg for TV sets); and a maximum content of > 1 kg Pb (> 5 kg for TV sets) per product;
  - Copiers, refrigerators and TV sets had the highest Cd content per product, with a minimum content of > 0.06 kg Cd; and a maximum content of > 0.1 kg per product;
  - Copiers, refrigerators and TV sets had the highest Cr(VI) content per product, with a minimum content of > 6 g Cr(VI); and a maximum content of > 6 g Cr(VI) per product;
  - Copiers, refrigerators, dispensers and laptops had the highest Hg content per product, with a minimum content of > 1 g Hg; and a maximum content of > 4 g Hg per product;
  - TV sets, copiers and refrigerators had the highest Deca-BDE content per product, with a minimum content of > 0.25 kg; and a maximum content of > 1.1 kg Deca-BDE per product;
  - Copiers, TV sets and refrigerators had the highest Octa-BDE content per product, with a minimum content of > 0.2 kg; and a maximum content of > 0.6 kg Octa-BDE per product;
- after RoHS:
  - TV sets, PC and copiers have the highest Pb content per product, with a minimum content of > 0.14 kg Pb; and a maximum content of > 0.3 kg Pb (ca. 0.6 kg for TV sets) per product;
  - Copiers, refrigerators and TV sets have the highest Cd content per product, with a minimum content of > 0.007 kg a maximum content of > 0.010 kg Cd per product;
  - Copiers, refrigerators and dispensers have the highest Hg content per product, with a minimum content of > 0.006 g Hg; and a maximum content of > 3 g Hg per product;
  - TV sets, copiers and refrigerators have the highest Deca-BDE content per product, with a maximum content of > 1.1 kg Deca-BDE per product;
  - For the quantities of Cr(VI) and Octa-BDE in the different products, there was no difference in the different scenarios “min”, “0% max” and “0.1% max” after the implementation of RoHS. The estimation of the amount of Cr(VI) and Octa-BDE in the selected products is reduced with 100% due to the RoHS directive based on the used methodology. As Octa-BDE was already banned by a previous directive 76/769/EC, it can however be concluded that this environmental benefit is not entirely attributable to the RoHS directive alone. The same conclusion can be drawn for Cr(VI), as also other directives have an influence on the reduction of the quantity of Cr(VI) in the selected product groups.
- The estimation of the minimum and maximum amount Deca-BDE in the selected products before and after RoHS remain on the same level. It should be noted that for the purpose of this study, it is assumed that 100 % Deca-BDE is being used, although commercial Deca-BDE can contain also Nona-BDE (e.g. 3 %) as an impurity, next to Deca-BDE (e.g. > 97 %).

4.4 AMOUNTS OF ROHS SUBSTANCES AVOIDED IN THE SELECTED PRODUCTS DUE TO THE IMPLEMENTATION OF THE ROHS DIRECTIVE

4.4.1 Scenarios

Different scenarios have been worked out to estimate the amounts of RoHS substances avoided in the selected products due to the implementation of the RoHS directive:

- Average maximum benefit scenario 1:
  - maximum concentration before RoHS and
  - maximum concentration after RoHS for the items with exemption; and 0.1 % by weight concentration for Pb, Hg, Deca-BDE; 0.01 % by weight concentration for Cd and of 0 % by weight concentration for Cr(VI) and Octa-BDE after RoHS for the items without exemption;
- Maximum benefit scenario 2:
  - maximum concentration before RoHS and
  - maximum concentration after RoHS for the items with exemption and 0% concentration after RoHS for the items without exemption;
- Minimum benefit scenario 3:
  - minimum concentration before RoHS and
  - minimum concentration after RoHS for the items with exemption; and 0.1 % by weight concentration for Pb, Hg, Deca-BDE; 0.01 % by weight concentration for Cd and of 0 % by weight concentration for Cr(VI) and Octa-BDE after RoHS for the items without exemption;
- Average minimum benefit scenario 4:
  - minimum concentration before RoHS and
  - minimum concentration after RoHS for the items with exemption; and 0% concentration after RoHS for the items without exemption.

4.4.1.1 Basic data

For the calculation of the amount of RoHS substances avoided due to the implementation of the RoHS directive, the following basic data was used (see also Table 4.37):

- Average weight per selected product is based on different literature reviews (MEEUP cases reports by VHK, 2005b; Bio-intelligence service, 2006; United Nations University et al., 2007) and assumptions by Arcadis Ecolas (expert judgement).
- The total number of sales of products in a product group in EU 25 in 2005: see 4.2.2.

The amounts of a RoHS substance before and after RoHS in the selected products (see 4.3.2.4), were multiplied by the average weight and the total number of sales of products in a product group in the countries of EU 25 in 2005 (see also Table 4.37).

It is stressed that these are broad estimations based on the available information as mentioned in this report.

Table 4.37: Basic data used in the calculation of the amounts of RoHS substances avoided

		average weight/product		*Sales products in EU 25*
	Product	*(kg/product)*	*(g/product)*	*Total number in 2005*
1	Refrigerator	50,0	50000	24000000
2	PC	21,0	21000	28000000
2	laptop	3,0	3000	20000000
3	Printers	15,0	15000	28500000
3	copiers	83,7	83700	1500000
4	cell phones	0,11 (1)	113 (1)	35000000
5	TV set	30,1	30124	35000000
6	Watch, clock	0,25 (1)	250 (1)	225000000
7	Fluorescent (double end) lamp	0,12	120	446000000
8	Lawn mowers + gardening equipment	15,0	15000	10200000
9	Video games and handheld video games	0,30	300	250000000
10	Dispensers for hot and cold beverages	10,0	10000	404000

(1) without battery, because this is subject of the so-called "battery directive"

4.4.1.2 Average maximum benefits scenario 1

Table 4.38: Difference in total content per RoHS substance per product (g/product) due to implementation of RoHS (average maximum benefits scenario 1)

	Difference in total content per substance per product (g/product) before RoHS - after RoHS					
Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
Refrigerator	1100	186	10	0	0	-
PC	3612	78	4	0	0	630
laptop	66	12	0.6	1.0	0	-
Printers	330	56	3	0	0	-
copiers	1223	311	17	316	0	2511
cell phones	2	0.4	0.02	0.9	0	3
TV set	5181	112	6	-	0	904
Watch, clock	6	0.9	0.05	-	0	-
Fluorescent (double end) lamp	3	0.4	0.02	0.02	0	-
Lawn mowers + gardening equipment	330	56	3	-	0	-
Video games and handheld video games	7	1.4	0.06	-	0	9
Dispensers for hot and cold beverages	220	37	2	0	0	-

Table 4.39: Yearly amount of RoHS substance avoided in products (ton/substance) due to RoHS in EU 25 (average maximum benefits scenario 1)

	Yearly amount of substances in products avoided due to RoHS (ton/substance)					
Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
Refrigerator	26400	4464	240	0	0	-
PC	101136	2187	118	0	0	17640
laptop	1320	237	12	20	0	-
Printers	9405	1590	86	0	0	-
copiers	1835	467	25	474	0	3767
cell phones	87	15	1	31	0	119
TV set	181346	3922	211	-	0	31630
Watch, clock	1238	209	11	-	0	-
Fluorescent (double end) lamp	1177	199	11	7	0	-
Lawn mowers + gardening equipment	3366	569	31	-	0	-
Video games and handheld video games	1650	347	15	-	0	2250
Dispensers for hot and cold beverages	89	15	1	0	0	-
TOTAL	**329049**	**14222**	**760**	**532**	**0**	**55405**

Table 4.40: Relative amount of RoHS substance avoided in products (%) due to RoHS in EU 25 (average maximum benefits scenario 1)

		Relative amount of substances in products avoided due to RoHS (%) - EU25					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	82%	90%	100%	0%	0%	-
2	PC	88%	89%	100%	0%	0%	100%
2	laptop	82%	89%	100%	25%	0%	-
3	Printers	82%	89%	100%	0%	0%	-
3	copiers	79%	90%	100%	79%	0%	100%
4	cell phones	82%	90%	100%	89%	0%	100%
5	TV set	90%	90%	100%	-	0%	100%
6	Watch, clock	82%	90%	100%	-	0%	-
7	Fluorescent (double end) lamp	57%	90%	100%	67%	0%	-
8	Lawn mowers + gardening equipment	82%	89%	100%	-	0%	-
9	Video games and handheld video games	82%	90%	100%	-	0%	100%
10	Dispensers for hot and cold beverages	82%	88%	100%	0%	0%	-

4.4.1.3 Maximum benefits scenario 2

Table 4.41: Difference in total content per RoHS substance per product (g/product) due to implementation of RoHS (maximum benefits scenario 2)

		Difference in total content per substance per product (g/product) before RoHS - after RoHS					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	1250	196	10	0	0	-
2	PC	3675	82	4	0	0	630
2	laptop	75	13	0.6	4	0	-
3	Printers	375	59	3	0	0	-
3	copiers	1406	320	17	400	0	2511
4	cell phones	3	0.4	0.02	1.0	0	3
5	TV set	5272	118	6	-	0	904
6	Watch, clock	6	1.0	0.05	-	0	-
7	Fluorescent (double end) lamp	3	0.5	0.02	0.02	0	-
8	Lawn mowers + gardening equipment	375	59	3	-	0	-
9	Video games and handheld video games	8	1.5	0.06	-	0	9
10	Dispensers for hot and cold beverages	250	39	2	0	0	-

Table 4.42: Yearly amount of RoHS substance avoided in products (ton/substance) due to RoHS in EU 25 (maximum benefits scenario 2)

		Yearly amount of substances in products avoided due to RoHS (ton/substance)					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	30000	4704	240	0	0	-
2	PC	102900	2305	118	0	0	17640
2	laptop	1500	255	12	80	0	-
3	Printers	10688	1676	86	0	0	-
3	copiers	2108	480	25	600	0	3767
4	cell phones	99	16	1	35	0	119
5	TV set	184510	4133	211	-	0	31630
6	Watch, clock	1406	221	11	-	0	-
7	Fluorescent (double end) lamp	1338	210	11	7	0	-
8	Lawn mowers + gardening equipment	3825	600	31	-	0	-
9	Video games and handheld video games	1875	369	15	-	0	2250
10	Dispensers for hot and cold beverages	101	16	1	0	0	-
	TOTAL	**340349**	**14983**	**760**	**722**	**0**	**55405**

Table 4.43: Relative amount of RoHS substance avoided in products (%) due to RoHS in EU 25 (maximum benefits scenario 2)

		Relative amount of substances in products avoided due to RoHS (%) - EU25					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	93%	95%	100%	0%	0%	-
2	PC	89%	94%	100%	0%	0%	100%
2	laptop	94%	95%	100%	100%	0%	-
3	Printers	94%	94%	100%	0%	0%	-
3	copiers	91%	92%	100%	100%	0%	100%
4	cell phones	94%	95%	100%	100%	0%	100%
5	TV set	92%	94%	100%	-	0%	100%
6	Watch, clock	94%	95%	100%	-	0%	-
7	Fluorescent (double end) lamp	64%	95%	100%	67%	0%	-
8	Lawn mowers + gardening equipment	94%	94%	100%	-	0%	-
9	Video games and handheld video games	94%	96%	100%	-	0%	100%
10	Dispensers for hot and cold beverages	94%	93%	100%	0%	0%	-

4.4.1.4 Minimum benefits scenario 3

Table 4.44: Difference in total content per RoHS substance per product (g/product) due to implementation of RoHS (minimum benefits scenario 3)

		Difference in total content per substance per product (g/product) before RoHS - after RoHS					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	650	41	10	0	0	-
2	PC	1323	17	4	0	0	210
2	laptop	39	3	1	0	0	-
3	Printers	195	12	3	0	0	-
3	copiers	470	69	17	0	0	837
4	cell phones	1	0.1	0.02	0.9	0	1.1
5	TV set	1898	112	6	-	0	301
6	Watch, clock	3	0.2	0.05	-	0	-
7	Fluorescent (double end) lamp	2	0.1	0.02	0	0	-
8	Lawn mowers + gardening equipment	195	12	3	-	0	-
9	Video games and handheld video games	4	0.5	0.06	-	0	3
10	Dispensers for hot and cold beverages	130	8	2	0	0	-

Table 4.45: Yearly amount of RoHS substance avoided in products (ton/substance) due to RoHS in EU 25 (minimum benefits scenario 3)

		Yearly amount of substances in products avoided due to RoHS (ton/substance)					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	15600	984	240	0	0	-
2	PC	37044	482	118	0	0	5880
2	laptop	780	63	12	0	0	-
3	Printers	5558	351	86	0	0	-
3	copiers	705	103	25	0	0	1256
4	cell phones	51	3	1	31	0	40
5	TV set	66423	3922	211	-	0	10543
6	Watch, clock	731	41	11	-	0	-
7	Fluorescent (double end) lamp	696	44	11	0	0	-
8	Lawn mowers + gardening equipment	1989	125	31	-	0	-
9	Video games and handheld video games	975	129	15	-	0	750
10	Dispensers for hot and cold beverages	53	3	1	0	0	-
	TOTAL	**130605**	**6251**	**760**	**31**	**0**	**18468**

Table 4.46: Relative amount of RoHS substance avoided in products (%) due to RoHS in EU 25 (minimum benefits scenario 3)

		Relative amount of substances in products avoided due to RoHS (%) - EU25					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	77%	71%	100%	0%	0%	-
2	PC	87%	70%	100%	0%	0%	100%
2	laptop	78%	72%	100%	0%	0%	-
3	Printers	78%	69%	100%	0%	0%	-
3	copiers	66%	72%	100%	0%	0%	100%
4	cell phones	78%	73%	100%	89%	0%	100%
5	TV set	89%	90%	100%	-	0%	100%
6	Watch, clock	78%	64%	100%	-	0%	-
7	Fluorescent (double end) lamp	45%	73%	100%	0%	0%	-
8	Lawn mowers + gardening equipment	78%	69%	100%	-	0%	-
9	Video games and handheld video games	78%	81%	100%	-	0%	100%
10	Dispensers for hot and cold beverages	78%	67%	100%	0%	0%	-

4.4.1.5 Average minimum benefits scenario 4

Table 4.47: Difference in total content per RoHS substance per product (g/product) due to implementation of RoHS (average minimum benefits scenario 4)

		Difference in total content per substance per product (g/product) before RoHS - after RoHS					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	753	46	10	0	0	-
2	PC	1366	19	4	0	0	210
2	laptop	45	4	0.6	1.0	0	-
3	Printers	226	14	3	0	0	-
3	copiers	573	77	17	5	0	837
4	cell phones	2	0.1	0.023	1.0	0	1.1
5	TV set	1960	118	6	-	0	301
6	Watch, clock	4	0.2	0.05	-	0	-
7	Fluorescent (double end) lamp	2	0.1	0.02	0	0	-
8	Lawn mowers + gardening equipment	226	14	3	-	0	-
9	Video games and handheld video games	5	0.6	0.1	-	0	3
10	Dispensers for hot and cold beverages	151	9	2	0	0	-

Table 4.48: Yearly amount of RoHS substance avoided in products (ton/substance) due to RoHS in EU 25 (average minimum benefits scenario 4)

		Yearly amount of substances in products avoided due to RoHS (ton/substance)					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	18060	1110	240	0	0	-
2	PC	38249	544	118	0	0	5880
2	laptop	903	76	12	20	0	-
3	Printers	6434	395	86	0	0	-
3	copiers	859	116	25	8	0	1256
4	cell phones	60	4	1	35	0	40
5	TV set	68585	4133	211	-	0	10543
6	Watch, clock	847	52	11	-	0	-
7	Fluorescent (double end) lamp	805	50	11	0	0	-
8	Lawn mowers + gardening equipment	2303	142	31	-	0	-
9	Video games and handheld video games	1129	144	15	-	0	750
10	Dispensers for hot and cold beverages	61	4	1	0	0	-
	TOTAL	**138294**	**6768**	**760**	**63**	**0**	**18468**

Table 4.49: Relative amount of RoHS substance avoided in products (%) due to RoHS in EU 25 (average minimum benefits scenario 4)

		Relative amount of substances in products avoided due to RoHS (%) - EU25					
	Product	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	89%	81%	100%	0%	0%	-
2	PC	90%	79%	100%	0%	0%	100%
2	laptop	90%	86%	100%	100%	0%	-
3	Printers	90%	77%	100%	0%	0%	-
3	copiers	80%	81%	100%	100%	0%	100%
4	cell phones	90%	82%	100%	100%	0%	100%
5	TV set	92%	94%	100%	-	0%	100%
6	Watch, clock	90%	82%	100%	-	0%	-
7	Fluorescent (double end) lamp	52%	82%	100%	0%	0%	-
8	Lawn mowers + gardening equipment	90%	77%	100%	-	0%	-
9	Video games and handheld video games	90%	90%	100%	-	0%	100%
10	Dispensers for hot and cold beverages	90%	75%	100%	0%	0%	-

4.4.2 Conclusions

- One should keep in mind that the generalisation of the amounts avoided due to RoHS will not be fully visible at this moment. A large number of EEE in people's possession dates from the time before the RoHS Directive and is therefore not designed yet according to the RoHS standards. Therefore, as a baseline scenario, the assessment of the quantities of RoHS substances in the selected products after the implementation of RoHS has started from the hypothetical future scenario with all EEE being replaced by RoHS compliant equipment.
- It should be noted that technology changes or changes in the demand of product type after the implementation of RoHS are mostly not taken into account in the determination of the quantities and the further calculations, because there was often no detailed information available on this subject. Only for PCs and TV sets the technology change from a cathode ray tube before RoHS to a flat screen after RoHS was included.
- An overview of the results of the total yearly amount of substances avoided due to RoHS in EU25 in the selected product groups and calculated according to the different scenarios is given in the table below.

Table 4.50: Estimation of the yearly amount of RoHS substances avoided in EU25 due to the implementation of RoHS and according to different scenarios

Scenario	Estimation of yearly amount of substances in products avoided due to RoHS (1000 ton/substance) - EU25					
	Pb	Cd	Cr(VI)	Hg	Deca-BDE	Octa-BDE
Average maximum benefit scenario 1	329(*)	14 (***)	0.8	0.5	0	55
Maximum benefit scenario 2	340(*)	15 (***)	0.8	0.7	0	55
Minimum benefit scenario 3	131(*)	6 (***)	0.8	0.03	0	18
Average minimum benefit scenario 4	138(*)	7 (***)	0.8	0.06	0	18
According to information from ERA Technology	<7.8 (**)	<0.04 (****)	0.3	<0.025	-	-

(*) taking into account technology changes and possible presence in pigments
(**) not taking into account technology changes and possible presence in pigments
(***) taking into account possible presence in pigments and stabilisers
(****) not taking into account possible presence in pigments and stabilisers

- The estimation based on the information available, show that the implementation of RoHS has the highest effect on the yearly total amounts of **Pb** avoided in the selected products (131 – 340 kiloton):
  - ~ This is however mainly due to the technology changes of the cathode ray tubes (CTR) in PCs and TV sets before RoHS to a flat screen after RoHS. It can not be estimated how much this change is market driven or can be linked to the RoHS directive. If it is assumed that before RoHS no CTR would be available, but only flat screens, the yearly amount avoided of Pb due to RoHS is between 48 and 94 kiloton.
  - ~ Furthermore, the use of Pb in several applications was already restricted by other directives (e.g. 76/769/EC). As it is not clear what the effect of other directives on the amount in the selected products was, this was not fully taken into account in the calculations. Ignoring both technology changes and possible presence in pigments, it was calculated that between 15 and 38 kiloton Pb is yearly avoided in the selected products.
  - ~ It can be concluded that the environmental benefit as mentioned in Table 4.50 is not entirely attributable to the RoHS directive alone. Based on comments on the draft final report (personal communication, ERA Technology, 2008), it could be that the yearly amount of Pb avoided in the EU is < 7.8 kiloton. This is figure is however not completely taking into account all the components of products which are used for the calculation of this report.
- According to the estimations, between 6 and 15 kiloton **Cd** per year is avoided due to RoHS:
  - ~ this environmental benefit as mentioned in Table 4.50 is not entirely attributable to the RoHS directive alone, as also other directives have an influence on the reduction of the quantity of Cd in the selected product groups. Ignoring the possible presence in pigments and stabilisers, it was calculated that between 0.16 and 0.20 kiloton Cd is yearly avoided in the selected products.
  - ~ Based on comments on the draft final report, it could be that the yearly amount of Cd avoided in the EU is < 0.04 kiloton (personal communication, ERA Technology, 2008).
- The estimation of the amount of **Cr(VI)** in the selected products is reduced with 100% (ca. 0.8 kiloton per year) due to the RoHS directive based on the used methodology.
  - ~ this environmental benefit as mentioned in Table 4.50 is not entirely attributable to the RoHS directive alone, as also other directives have an influence on the reduction of the quantity of Cr(VI) in the selected product groups and as the substitution of Cr(VI) was already ongoing before the implementation of RoHS.

  - ~ Based on comments on the draft final report, it could be that the yearly amount of Cr(VI) avoided in the EU is about 0.3 kiloton (personal communication, ERA Technology, 2008).
  - According to the estimations, between 0.03 and 0.5 kiloton **Hg** per year is avoided due to RoHS:
    - ~ this environmental benefit as mentioned in Table 4.50 is not entirely attributable to the RoHS directive alone, as also other directives have an influence on the reduction of the quantity of Hg in the selected product groups.
    - ~ Based on comments on the draft final report, it could be that the yearly amount of Hg avoided in the EU is < 0.025 kiloton (personal communication, ERA Technology, 2008).
  - The estimation based on the information available, show that the implementation of the RoHS directive probably has little or no effect on the presence of **Deca-BDE**.
    - ~ It should be noted that for the purpose of this study, it is assumed that 100 % Deca-BDE is being used, although commercial Deca-BDE can contain also Nona-BDE (e.g. 3 %) as an impurity, next to Deca-BDE (e.g. > 97 %).
    - ~ However, it could be possible that the RoHS directive creates a limited increase of the presence of Deca-BDE, as a substitution product of Octa-BDE.
  - The estimation of the amount of **Octa-BDE** in the selected products is reduced with 100% due to the RoHS directive based on the used methodology.
    - ~ As Octa-BDE was already restricted by other directives (e.g. 76/769/EC), it can however be concluded that this environmental benefit as mentioned in Table 4.50 is not entirely attributable to the RoHS directive alone.
- Looking at the selected products, it seems that:
  - the environmental benefits for TV sets, PCs and refrigerators are the largest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS and compared with the other selected product groups;
  - the environmental benefits for cell phones, copiers and laptops are the largest when looking at the yearly amounts of Hg avoided due to RoHS and compared with the other selected product groups;
  - the environmental benefits for cell phones, dispensers for cold and hot beverages and fluorescence lamps are the lowest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS and compared with the other selected product groups;
  - except for the amount of RoHS substance per product and the yearly sales of the total number of products in EU 25, it is not possible to define other criteria to clarify which products groups have the biggest and the lowest overall environmental benefits due to RoHS.

4.5 DOSE-RESPONSE RELATIONSHIPS

4.5.1 Introduction

In this sub chapter, more information is given on the dose-response relationships. To give an idea of the environmental effects of RoHS, a short introduction is given on the effects on some components of the Life Cycle Analysis (LCA). It is however not the purpose of this study to do an extensive LCA for each of the selected products.

Furthermore some environmental and human health effects due to RoHS are briefly discussed: waste emissions to the environment, volatilisation of brominated flame retardants (Deca-BDE and Octa-BDE) and the effects of Pb substitution in soldering.

4.5.2 Life cycle assessment (LCA)

4.5.2.1 Introduction

Life Cycle Assessment (LCA) is a method developed to evaluate the mass balance of inputs and outputs of systems and to organize and convert those inputs and outputs into environmental themes or categories relative to resource use, human health and ecological areas. The quantification of inputs and outputs of a system is called Life Cycle Inventory (LCI). At this stage, all emissions are reported on a volume or mass basis (e.g., kg of CO_2, kg of cadmium, m^3 of solid waste). Life Cycle Impact Assessment (LCIA) converts these flows into simpler indicators.

While LCA characterizes emissions and waste over a product's life cycle, it does not allow for a complete assessment of a product's potential impacts (e.g. Figure 4.4), also sometimes referred to as its risk assessment. This is because LCA reports emissions on a chosen functional unit basis (i.e.1 kg finished product).

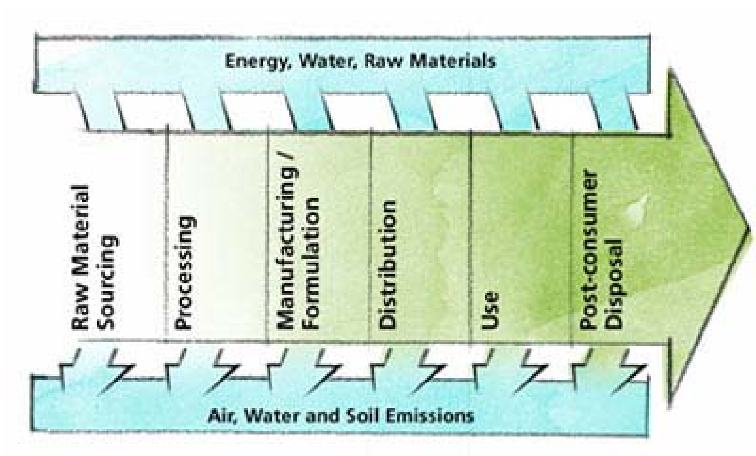


Figure 4.3: Life Cycle Assessment: Schematic representation of the flow of energy and raw material consumption and air, water and soil emission associated with the whole life cycle of a product (P&G, 2007)

A. Baseline impact categories	B. Study-specific impact categories	C. Other impact categories
Depletion of abiotic resources	Impacts of land use loss of life support functions loss of biodiversity	Depletion of biotic resources
Impacts of land use land competition	Ecotoxicity freshwater sediment ecotoxicity marine sediment ecotoxicity	Desiccation
Climate change	Impacts of ionising radiation	Odour malodourous water
Stratospheric ozone depletion	Odour malodourous air	...
Human toxicity	Noise	
Ecotoxicity freshwater aquatic ecotoxicity marine aquatic ecotoxicity terrestrial ecotoxicity	Waste heat	
Photo-oxidant formation	Casualties	
Acidification		
Eutrophication		

Figure 4.4: Schematic overview of potential impacts of a product (CML SSP, 2001)

The exposure and hazard assessments, required as input for the risk assessments, are not part of the LCA. For each type of emission, the probability of adverse impacts can be quantified by risk assessment, taking into account all sources of exposure.
LCA was not designed to do that, but rather it was designed to understand the relative contribution of each stage of the life cycle to certain environmental impact categories. LCA also allows comparisons between equivalent stages of life cycles (i.e., the consumer stage of product A and the consumer stage of product B), provided that the LCIs rely on the same databases and the same assumptions.

Thus, even though LCA cannot tell us whether the use of a product is "safe," it does provide us with indicators concerning impact assessment scores of the relative contributions of entire or partial product life cycles to specified impact categories. Depending on the goal of the study, the level of detail of an LCA may vary considerably. If it is for internal and screening purposes, the quality of the data may be less scrutinized (or less important) than if the work is going to be used for external claims. Full compliance with ISO guidelines is however recommended.

One of the first steps before starting an LCA is to define the "functional unit" which is related to the function that a product or service will deliver. The definition of a functional unit is actually very much linked to the question asked. There is nothing like one functional unit, but many, depending on the type of questions we want to answer. Energy and raw materials consumption as well as associated environmental emissions are calculated on the basis of this functional unit (see also next paragraph).

To construct a full life cycle, which involves many different processes, the requirement for data is very important. The range goes from the making of the raw materials, which can take place in different parts of the world, to the making of the product, which takes place in a few, well identified, locations. Usage and disposal are critical data to collect in order to analyse and understand the life cycle impact of a product.

Comparing products between countries involves more than just comparing two boxes of products. Different use patterns of the product, boundary conditions, etc. are important aspects.

All of these factors affect the results of a Life Cycle Assessment.

4.5.2.2 LCA functional units for the different hazardous substances

As mentioned before, it is possible to define different functional units (related to different impacts) in the LCA. As an example, different functional units for the different hazardous substances are given in Table 4.51, Table 4.52 and Table 4.53 (Guinée, 2002). No information was found in this reference about the brominated flame retardants. By comparing the results for the different hazardous substances (without the brominated flame retardants), one can see the following:

- the environmental burden (expressed in environmental load units (ELU)) on:
  - the natural resources is the highest for Hg and Cd, and to lesser extent (ca. factor 100 – 1000 lower) also Pb and Cr(VI);
  - the air emissions is the highest for Pb and Hg, and to lesser extent (ca. factor 10 – 100 lower) also Cd and Cr(VI);
- the human toxicity potential (HTP, expressed in 1,4-dichlorobenzene (1,4-DCB) equivalent):
  - the HTP is different for the different environmental compartments and mostly only slightly different for the different time horizons;
  - out of the different hazardous substances, there is no hazardous substance that has always the highest HTP for the different environmental compartments (e.g. air, fresh water, etc.);
  - it seems that Pb has never the highest HTP, comparing the HTP of the different hazardous substances within an environmental compartment;
- ecotoxicity potential (expressed in 1,4-dichlorobenzene (1,4-DCB) equivalent):
  - with regard to the different hazardous substances, it seems that Hg has always the highest ecotoxicity potential, both for all the different environmental compartments, as for the different types of ecotoxicity (fresh water, sediment and terrestrial);
  - it seems that Pb has always the highest ecotoxicity potential, both for all the different environmental compartments, as for the different types of ecotoxicity (fresh water, sediment and terrestrial).

Table 4.51: Total environmental burden expressed in environmental load units (ELU) for used resources and air emissions (Guinée, 2002)

hazardous substance	*natural resources*	*emission in air*
	ELU/kg resource used	*ELU/kg emitted*
Cd	23000	21.2
Cr(VI)	33	0.8
Pb	240	291
Hg	40000	177
brominated flame retardants (PBB, PBDE)	-	-

ELU = Environmental load units

Table 4.52: Human toxicity potential (HTP) factors for characterising human toxic releases in different environmental compartments, for 100- en 20-year time horizons and global scale expressed in 1,4-dichlorobenzene (1,4-DCB) equivalent (Guinée, 2002)

hazardous substance	*Human toxicity potential (HTP) expressed in kg 1,4-DCB equivalents/kg*									
	air		*fresh water*		*seawater*		*agricultural soil*		*industrial soil*	
	100 years	*20 years*	*100 years*	*20 years*	*100 years*	*20 years*	*100 years*	*20 years*	*100 years*	*20 years*
Cd	150000	150000	11	9.4	6.9	2.4	2800	610	8.7	1.8
Cr(VI)	3400000	3400000	1.8	1.5	1.4	0.44	49	9.9	2.9	0.57
Pb	29	24	5.2	4.1	7.1	2.1	27	5.5	2.4	0.48
Hg	260	210	100	80	120	40	130	27	9.5	1.5
brominated flame retardants (PBB, PBDE)	-	-	-	-	-	-	-	-	-	-

HTP = Human toxicity potential

1,4-DCB equivalent = 1,4-dichlorobenzene equivalent. The expression in the same unit (1,4-DCB) makes a comparison between the different hazardous substances possible

Table 4.53: Different factors for characterising ecotoxic releases in different environmental compartments, for infinite time horizon and globale scale, expressed in 1,4-dichlorobenzene (1,4-DCB) equivalent (Guinée, 2002)

hazardous substance	*Ecotoxicity potential expressed in kg 1,4-DCB equivalents/kg*											
	air			*fresh water*			*Agricultural soil*			*Industrial soil*		
	FAETP	*FSETP*	*TETP*	*FAETP*	*FSETP*	*TETP*	*FAETP*	*FSETP*	*TETP*	*FAETP*	*FSETP*	*TETP*
Cd	290	740	81	1500	3900	1.40E-20	780	2000	170	780	2000	170
Cr(VI)	7.7	20	3000	28	71	2.30E-19	21	54	6300	21	54	6300
Pb	2.4	6.2	16	9.6	25	4.80E-22	6.5	17	33	6.5	17	33
Hg	320	810	28000	1700	4400	930	850	2200	56000	850	2200	56000
brominated flame retardants	-	-	-	-	-	-	-	-	-	-	-	-

FAETP = fresh water aquatic ecotoxicity potential; FSETP = fresh water sediment ecotoxicity potential; TETP = terristrial ecotoxicity potential

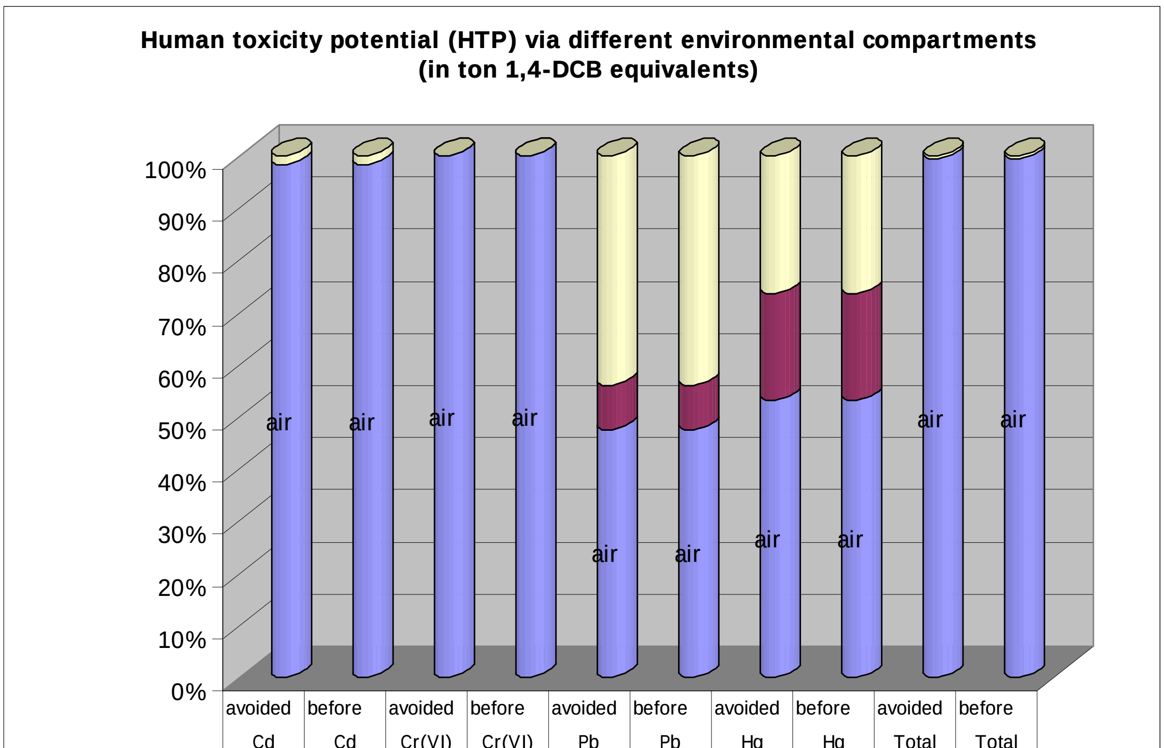
4.5.2.3 Effects on LCA quantification due to the implementation of RoHS directive

The effects on the LCA quantification due to the implementation of RoHS directive have only been estimated fore the minimum benefit scenario 3 (see also 4.4.1). As only LCA functional units were available for Pb, Cd, Cr(VI) and Hg (see also 4.5.2.2), the estimation of effects were limited to these compounds.

The purpose of this study is not to do a full LCA for each product, but to give a broad insight into the environmental and human effects due to implementation of RoHS for the different RoHS substances.

HUMAN TOXICITY POTENTIAL

Figure 4.5 shows the human toxicity potential HTP (life time of 100 years) avoided due to RoHS and before RoHS for the different RoHS substances and for 3 different environmental compartments (air, fresh water, agricultural soil), according to the minimum benefit scenario 3. To compare the different RoHS substances, the potential is standardised against another chemical compound 1,4-DCB.



	avoided Cd	before Cd	avoided Cr(VI)	before Cr(VI)	avoided Pb	before Pb	avoided Hg	before Hg	avoided Total	before Total
agricultural soil	17502	21465	37	37	3526	4129	4	15	21070	25646
fresh water	69	84	1	1	679	795	3	11	752	892
air	937603	1149923	2584798	2584798	3788	4435	8	29	3526197	3739186

Figure 4.5: Human toxicity potential (HTP) via different environmental compartments

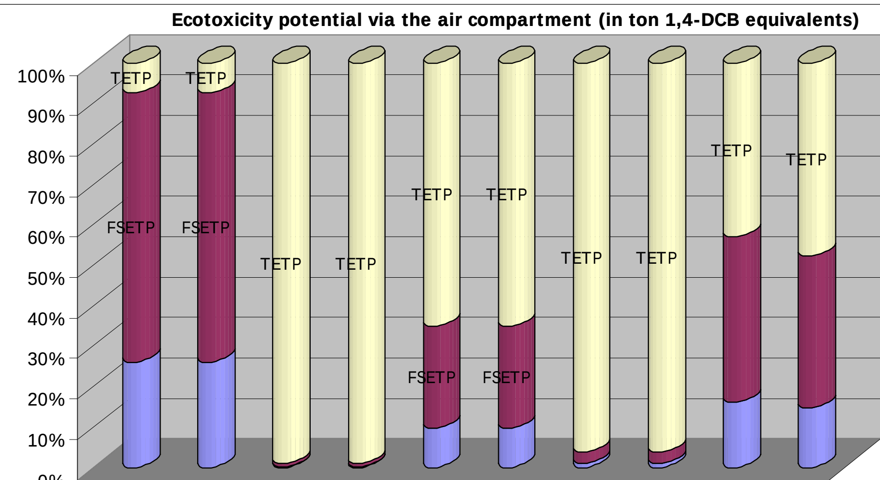
For the different RoHS substances (and especially for Cd and Cr(VI), it seems that the impact via the air compartment on the human toxicity potential is the largest and remains relatively the most important compartment after the implementation of RoHS. Due to the used methodology (see also 4.4.1), it assumed that all Cr(VI) will be avoided by the implementation of RoHS.
For Pb and Hg, also the impacts via the soil and fresh water compartment on the human toxicity potential are relevant.

ECOTOXICITY POTENTIAL

In the following figures, the ecotoxicity potential (fresh water, sediment and agricultural soil) avoided due to RoHS and before RoHS via the different environmental compartments (air, fresh water and terrestrial) are shown, according to the minimum benefit scenario 3. To compare the different RoHS substances, the potential is standardised against another chemical compound 1,4-DCB. Due to the used methodology (see also 4.4.1), it assumed that all Cr(VI) will be avoided by the implementation of RoHS.

For the air and terrestrial compartments, the relative ratio from the different ecotoxicity potentials is more or less the same: see homogenous bars for the different RoHS substances in Figure 4.6 and Figure 4.8). The absolute amounts of ecotoxicity potential via these 2 compartments are however different.

With regard to the ecotoxicity potential via the air and terrestrial compartment (Figure 4.6 resp. Figure 4.8), it seems that particularly for Cr(VI), Hg and to a minor extent also for Pb, the terrestrial ecotoxicity potential is most important. For Cd and to a minor extent Pb also the fresh water sediment ecotoxicity potential is important.

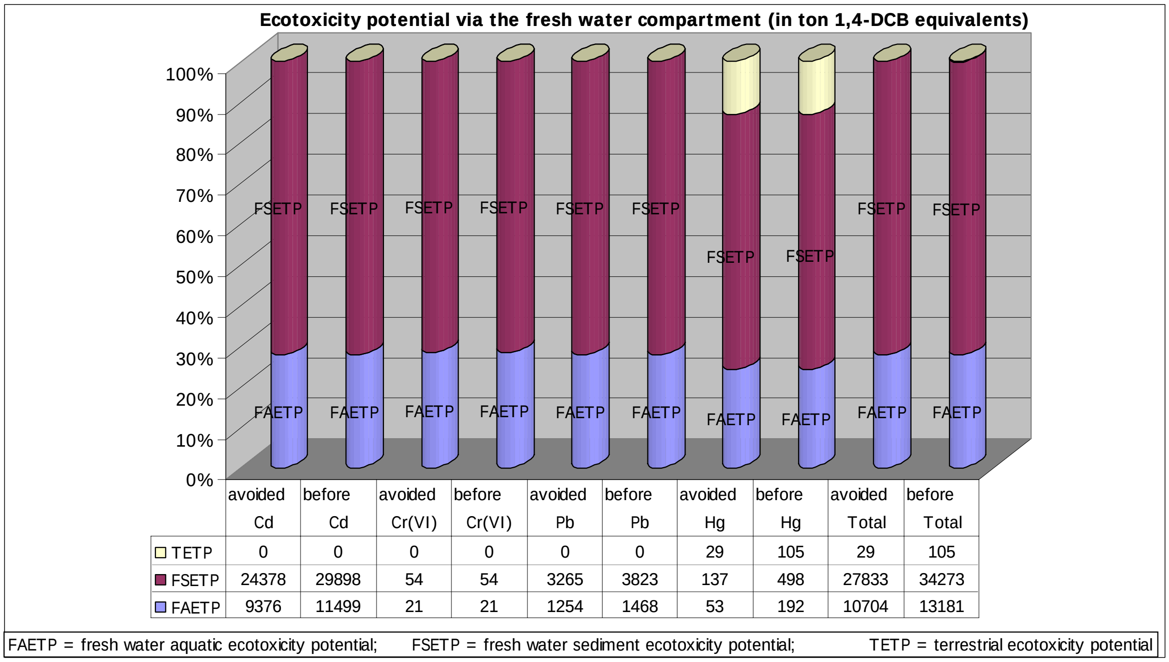


	avoided Cd	before Cd	avoided Cr(VI)	before Cr(VI)	avoided Pb	before Pb	avoided Hg	before Hg	avoided Total	before Total
TETP	506	621	2281	2281	2090	2447	869	3169	5746	8518
FSETP	4626	5673	15	15	810	948	25	92	5476	6728
FAETP	1813	2223	6	6	313	367	10	36	2142	2632

FAETP = fresh water aquatic ecotoxicity potential; FSETP = fresh water sediment ecotoxicity potential; TETP = terrestrial ecotoxicity potential

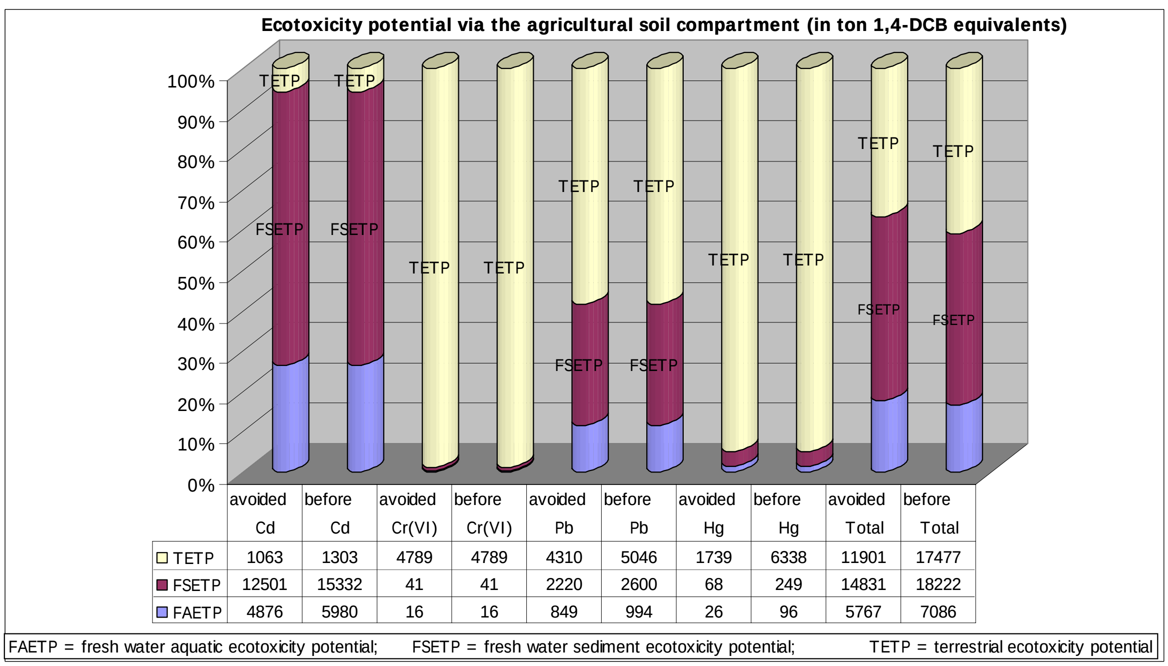
Figure 4.6: Ecotoxicity potential via the air compartment (in ton 1,4-DCB equivalent)

In Figure 4.7, it is shown that for all RoHS substances mostly (and for obvious reasons) the fresh water sediment exotoxicity potential (ca. 63 – 72 %), and to a minor extent also the fresh water aquatic exotoxicity potential are affected via the fresh water compartment. The terrestrial ecotoxicity potential seems only to be relevant for Hg.



	avoided Cd	before Cd	avoided Cr(VI)	before Cr(VI)	avoided Pb	before Pb	avoided Hg	before Hg	avoided Total	before Total
TETP	0	0	0	0	0	0	29	105	29	105
FSETP	24378	29898	54	54	3265	3823	137	498	27833	34273
FAETP	9376	11499	21	21	1254	1468	53	192	10704	13181

Figure 4.7: Ecotoxicity potential via the fresh water compartment (in ton 1,4-DCB equivalent)



	avoided Cd	before Cd	avoided Cr(VI)	before Cr(VI)	avoided Pb	before Pb	avoided Hg	before Hg	avoided Total	before Total
TETP	1063	1303	4789	4789	4310	5046	1739	6338	11901	17477
FSETP	12501	15332	41	41	2220	2600	68	249	14831	18222
FAETP	4876	5980	16	16	849	994	26	96	5767	7086

Figure 4.8: Ecotoxicity potential via the agricultural soil compartment (in ton 1,4-DCB equivalent)

The relative amount avoided human toxicity potential and ecotoxicity potential per RoHS substance with regard to the total before RoHS due to the implementation of the RoHS directive is 100 % for Cr(VI) (due to the methodology used), 85% for Pb, 82% for Cd and 27 % for Hg.

4.5.3 Environmental and human health effects due to the implementation of RoHS

The purpose of this sub chapter is to give insight in some positive and negative environmental effects due to the implementation of RoHS. It is not the purpose of this study to go into detail on the environmental effects of RoHS.

4.5.3.1 Waste emissions to the environment

Due to decreases in amounts of RoHS substances in the selected products (see also 4.4), it can be concluded that the amount of waste emissions will decrease as well (except for Deca-BDE because of the methodology used). A part of this will be of the recyclable fraction. How much of the specific RoHS substance can be prevented from being disposed as waste in the environment, depends of the waste treatment type. This is however not subject to the RoHS directive, as it is a consequence from the WEEE directive.

BASIC DATA

For the calculation of the waste emissions disposed to the environment per RoHS substance and per product a simplified methodology was used, as no information on the waste emission factor was directly available per RoHS substance and per selected product. The following basic data were used:

- Amount per RoHS substance before and after RoHS according to the minimum benefit scenario 3 (see 4.4.1);
- Number of sales of products in EU 25 in 2005 (see 4.2.2 and Table 4.54);
- Amount of waste collected per treatment category as the % of the total WEEE arising per treatment category in EU-27(situation in 2005) as mentioned in the 2008 WEEE review report of United Nations University et al. (2007).
  - For some products, it was necessary to take averages of percentages (PC, laptop, TV sets), as % were available for parts of the products.
  - It is assumed for this study that the remaining percentage is the maximum amount of waste which is disposed to the environment (see also last column of Table 4.54). This percentage is probably overestimated as not all the waste is disposed to the environment. However, a part of the collected waste can also have effects on the environment. It is assumed that the overestimation is larger than the underestimation, and the results will probably reflect a worst case scenario.

Table 4.54: Basic data for the calculation of the waste emissions to the environment

	Product	*products in EU-25*	*Current % collected of WEEE Arising*	*Maximum current % of WEEE arising disposed to environment*
		Total number		
1	Refrigerator	24000000	27.3%	72.7%
2	PC	28000000	31.6%	68.5%
2	laptop	20000000	34.2%	65.9%
3	Printers	28500000	27.8%	72.2%
3	copiers	1500000	27.8%	72.2%
4	cell phones	35000000	27.8%	72.2%
5	TV set	35000000	32.8%	67.2%
6	Watch, clock	225000000	26.6%	73.4%
7	Fluorescent (double end) lamp	446000000	26.6%	73.4%
8	Lawn mowers + gardening equipment	10200000	20.8%	79.2%
9	Video games and handheld video games	250000000	24.3%	75.7%
10	Dispensers for hot and cold beverages	404000	59.4%	40.6%

RESULTS

As mentioned before, the results in Table 4.55 will reflect a minimum benefit scenario for the estimation of the minimum yearly amounts disposed to the environment. As mentioned before, the amount of waste avoided being disposed to the environment of Deca-BDE will be zero, due to the methodology used. For the other compounds, it is estimated that the minimum yearly amount of waste avoided being disposed to the environment will be ca. 89800 ton Pb, 12600 ton Octa-BDE, 4300 ton Cd, 500 ton Cr(VI), and 22 ton Hg.

Table 4.55: Estimation of minimum yearly amount waste disposed in environment in EU 25

	Product	*Minimum yearly amount not collected as WEEE, but disposed in the enviroment in EU-25*										
		Pb	*Cd*	*Cd*	*Cr(VI)*	*Cr(VI)*	*Hg*	*Hg*	*Deca-BDE*	*Deca-BDE*	*Octa-BDE*	*Octa-BDE*
		after RoHS	*before RoHS*	*after RoHS*	*before RoHS*	*after RoHS*	*before RoHS*	*after RoHS*	*before RoHS*	*after RoHS*	*before RoHS*	*after RoHS*
1	Refrigerator	3402	1001	286	174	0	35	35	4362	4362	-	-
2	PC	3641	473	143	80	0	0	0	2012	2012	4025	0
2	laptop	149	58	16	8	0	13	13	198	198	-	-
3	Printers	1161	369	115	62	0	0	0	1543	1543	-	-
3	copiers	266	103	29	18	0	5	5	453	453	906	0
4	cell phones	11	3	0.9	0.6	0	25	3	43	43	29	0
5	TV set	5492	2946	309	142	0	-	-	10633	10633	7089	0
6	Watch, clock	155	47	17	8	0	-	-	619	619	-	-
7	Fluorescent (double end) lamp	622	44	12	8	0	2	2	550	550	-	-
8	Lawn mowers + gardening equipment	456	145	45	24	0	-	-	606	606	-	-
9	Video games and handheld video games	213	121	23	11	0	-	-	852	852	568	0
10	Dispensers for hot and cold beverages	6	2	0.7	0.3	0	0.2	0.2	8	8	-	-
	TOTAL waste disposed to the environment	**15574**	**5311**	**997**	**537**	**0**	**81**	**58**	**21879**	**21879**	**12616**	**0**
	TOTAL waste avoided being disposed to the environment due to RoHS	**89811**		**4314**		**537**		**22**		**0**		**12616**

The results of the amounts of RoHS substances avoided being disposed as waste to the environment due to RoHS (see Table 4.55, minimum benefit scenario 3) are set out in Figure 4.9 and Table 4.56 against the amounts of RoHS substances being present in the selected products before RoHS and the amount of RoHS substances avoided being present in the selected products due to the implementation of RoHS (see also 4.3.2.4 and 4.4, minimum benefit scenario 3).

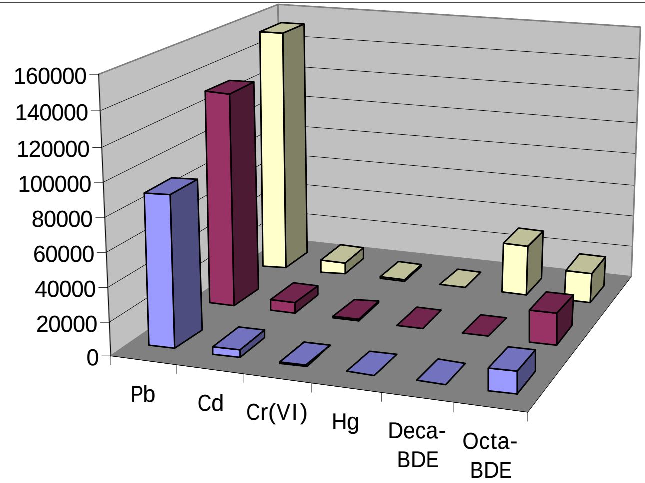
Table 4.56: Overview of waste avoided being disposed to the environment due to RoHS (as % of total present before RoHS and avoided in products due to RoHS)

Situation EU-25	*Pb*	*Cd*	*Cr(VI)*	*Hg*	*Deca-BDE*	*Octa-BDE*
% waste avoided being disposed to the environment as total avoided being present in products due to RoHS	69%	69%	71%	72%	0%	68%
% waste avoided being disposed to the environment as total being present in products before RoHS	59%	56%	71%	20%	0%	68%

The percentage of waste deriving from the RoHS substances in the selected products and avoided being disposed to the environment due to the implementation of RoHS is:

- about 70% of the total amount of RoHS substances avoided due to the implementation of RoHS for all RoHS substances (except Deca-BDE = 0%);
- 20 % (Hg), 56% (Cd), 59 % (Pb), 68 % (Octa-BDE) and 71% Cr(VI) of the total amount of RoHS substances being present in the selected products before RoHS (Deca-BDE = 0%).

As mentioned in the 2008 WEEE review report (United Nations University, 2007), the WEEE directive will also further prevent the RoHS substances being disposed in the environment by changing treatment technologies.



	Pb	Cd	Cr(VI)	Hg	Deca-BDE	Octa-BDE
TOTAL waste avoided being disposed to the environment due to RoHS (in ton)	89811	4314	537	22	0	12616
TOTAL amount avoided being present in products due to RoHS (in ton)	130605	6251	760	31	0	18468
TOTAL amount being present in products before RoHS (in ton)	152921	7666	760	113	31383	18468

Figure 4.9: Estimation of waste avoided being disposed to the environment; amount avoided being present in selected products due to RoHS and amount being present before RoHS

GLOBAL PERSPECTIVE

In its 2008 report 'Toxic Tech: not in our backyard' Greenpeace tackles the problem of hidden flows of e-waste which escapes responsible collection, reuse and recycling systems and as such is unaccounted for. Some of this waste is exported, often illegally, for dumping in Africa or for rudimentary recovery by Asian informal recyclers. There, workers at scrap yards (some of whom are children) are exposed to a cocktail of toxic chemicals when the products are broken apart, and as water, air and soil are polluted.

The RoHS Directive has had a considerable beneficial impact on the cleaning up of EEE by eliminating hazardous substances, replacing harmful ingredients through use of safer alternatives or design changes. However, it was not possible to quantify this impact in the framework of this study.

4.5.3.2 Volatilisation of BFR (Deca-BDE and Octa-BDE) during service life

Brominated flame retardants (BFR) tend to volatilise from products during service life (EC, JRC, 2002; EC, JRC, 2003; Kemmlein et al., 2003; Watanabe & Sakai, 2003). In this sub chapter, the amount of BRF volatilised has been estimated per product/year; over the total lifetime of a product and for the number of products in the EU 25.

BASIC DATA

For the calculation of the amount of brominated flame retardants (BFR) volatilised during service life, the following basic data was used (see also Table 4.57);

- Average weight per selected product is based on different literature reviews (MEEUP cases reports by VHK, 2005b; Bio-intelligence service, 2006; United Nations University et al., 2007) and expert judgement.
- The total number of sales of products in a product group in EU 25 (see 4.2.2);
- service life of products:
  - MEEUP cases reports (VHK, 2005b): refrigerator, PC, copiers, TV set and fluorescent lamp;
  - assumptions by Arcadis Ecolas: laptop (= service life of PC); printers (= service life of copiers); the other products: based on expert judgement.
- Losses during service life of product (weight %/year): based on the European Union risk assessment reports (RAR) of the EC for:
  - Deca-BDE: bis(pentabromophenyl) ether, CAS No: 1163-19-5 (EC, JRC, 2002);
  - Octa-BDE: diphenyl ether, octabromo derivative, CAS No: 32536-52-0 (EC, JRC, 2003).
  - It should be noted that according to the RAR, these emission factors and the approach used, were considered to be highly uncertain and conservative. Therefore, a new emission factor was suggested in the updated version of the RAR Deca-BDE. The new data on volatile emissions during use of electrical and electronic equipment indicate that the emissions of Deca-BDE are low, but not necessarily zero, e.g. the emission figure of 0.28 ng/m^2/hour for TV casings. Although some illustrative calculations have been done with this factor, it is not included in this study, as the estimate is based on relatively few experimental data (the general applicability of which is unclear) and a number of assumptions. Therefore, the initial emission factors were used for this study.
- Amount of BFR in the selected product before and after RoHS: see also 4.3.2.4.

Table 4.57: Basic data used in the calculation of the amounts of BFR volatilised during service life

	Product	*average weight/product*		*sales of products in EU-25*	*service life of product*	*Volitilisation losses during service life (weight %/year)*	
		(kg/product)	*(g/product)*	*Total number in 2005*	*year*	*Deca-BDE*	*Octa-BDE*
1	Refrigerator	50	50000	24000000	15	0.038	0.054
2	PC	21	21000	28000000	6	0.038	0.054
2	laptop	3	3000	20000000	6	0.038	0.054
3	Printers	15	15000	28500000	8	0.038	0.054
3	copiers	83.7	83700	1500000	8	0.038	0.054
4	cell phones	0.113	113	35000000	2	0.038	0.054
5	TV set	30.124	30124	35000000	12	0.038	0.054
6	Watch, clock	0.25	250	225000000	5	0.038	0.054
7	Fluorescent (double end) lamp	0.12	120	446000000	1.4	0.038	0.054
8	Lawn mowers + gardening equipment	15	15000	10200000	10	0.038	0.054
9	Video games and handheld video games	0.3	300	250000000	5	0.038	0.054
10	Dispensers for hot and cold beverages	10	10000	404000	5	0.038	0.054

RESULTS

As a consequence of the methodology used for the estimation of the concentration of Deca-BDE and Octa-BDE after the implementation of RoHS, it is assumed that Deca-BDE use will remain at the same level and no Octa-BDE will be used anymore in the products. Therefore the volatilisation losses after RoHS are assumed to be negligible for Octa-BDE. As a consequence of the methodology used, the amount of volatilisation losses is the highest by products with the highest weight.

As shown in Table 4.58, the RoHS directive has a positive effect on the Octa-BDE volatilisation losses, but has no effect on the Deca-BDE losses.

Table 4.58: Estimation of amounts of BFR volatilised during service life before and after RoHS in EU 25

	Product	*volatilisation losses (g/product/year)*			*volatilisation losses during service life (g/product)*			*volatilisation losses during service life (ton) - EU25*		
		Deca-BDE	*Octa-BDE*		*Deca-BDE*	*Octa-BDE*		*Deca-BDE*	*Octa-BDE*	
		before & after RoHS	*before RoHS*	*after RoHS*	*before & after RoHS*	*before RoHS*	*after RoHS*	*before & after RoHS*	*before RoHS*	*after RoHS*
1	Refrigerator	0.10	-	-	1.4	-	-	34	-	-
2	PC	0.04	0.11	0	0.6	1.7	0	17	48	0
2	laptop	0.006	-	-	0.09	-	-	2	-	-
3	Printers	0.03	-	-	0.4	-	-	12	-	-
3	copiers	0.16	0.45	0	2.4	6.8	0	4	10	0
4	cell phones	0.001	0.001	0	0.01	0.01	0	0.3	0.3	0
5	TV set	0.17	0.16	0	2.6	2.4	0	90	85	0
6	Watch, clock	0.001	-	-	0.02	-	-	5	-	-
7	Fluorescent (double end) lamp	0.001	-	-	0.01	-	-	4	-	-
8	Lawn mowers + gardening equipment	0.03	-	-	0.4	-	-	4	-	-
9	Video games and handheld video games	0.002	0.002	0	0.03	0.02	0	6	6	0
10	Dispensers for hot and cold beverages	0.02	-	-	0.3	-	-	0.1	-	-
	TOTAL							**179**	**150**	**0**

4.5.3.3 Effects of Pb substitution in solders

Based on the results of the amounts Pb avoided in EU 25 due to the implementation of RoHS, which are the highest among all the RoHS substances, a more detailed literature review was performed to look into the effects of Pb substitution in solders (as one of the most important Pb compounds in products).

It can be concluded that substitution of Pb in solders by other substances (lead-free solders) can also have negative environmental effects, besides the positive environmental effects of Pb substitution (Kindesjö, 2002; Schoenung, 2003; US EPA, 2005; Deubzer, 2007). Only the relevant end results are mentioned in the paragraphs below.

TOXICITY, ENERGY CONSUMPTION AND RESOURCE VALUE LOSSES

As shown in the figure below, lead-free soldering substantially reduces the worldwide potential toxicity and the risk of toxic impacts of metal emissions into the environment from soldering wastes and from printed wiring boards at the end-of-life stage. The RoHS Directive therefore achieves its intention to reduce the toxicity of the WEEE. Collection and recovery of WEEE further on reduce the toxicity. Silver as the main toxicity driver in lead-free soldering material use can be recycled to more than 95 % in the copper smelters. As lead-toxicity as well benefits from higher recovery rates, the SnPb-normalized toxicity of the emissions decreases with increasing recycling rates, but moderately only, from around 23 % down to around 20 % for 60 % WEEE recovery (Deubzer, 2007).

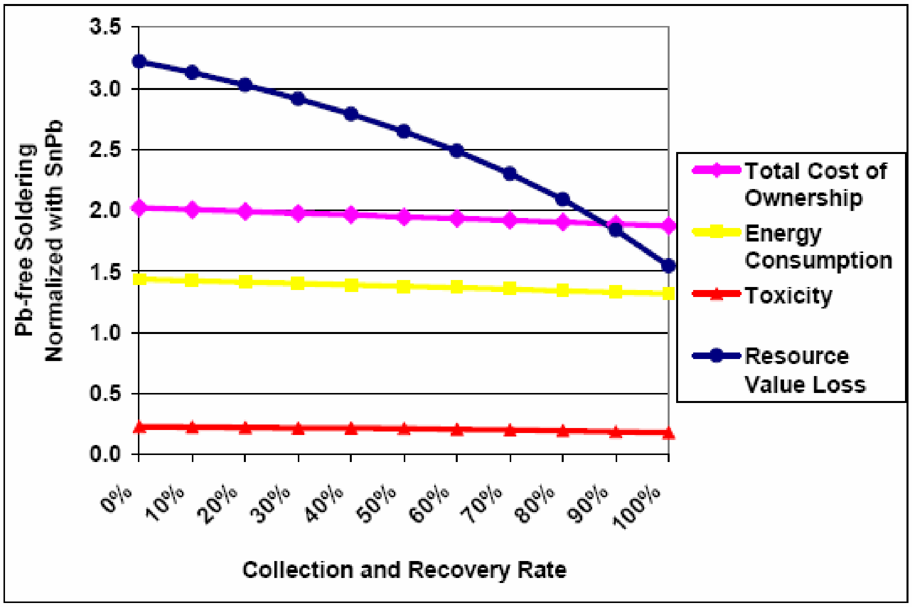


Figure 4.10: Environmental, resource and economical impacts of lead-free soldering material use normalized with impacts from tin-lead soldering material use (tin-lead soldering = 1) (Deubzer, 2007)

It was found that lead-free soldering increases energy consumption with around 40 % (Deubzer, 2007). It requires an additional electricity output corresponding to 4 to 10 % of the capacity of a nuclear power plant, or around 20 % of a hard coal power plant. Higher WEEE recovery rates moderately improve the situation, from around 43 % down to 36 % for 60 % WEEE recovery (Deubzer, 2007).
The main drivers of energy consumption both for tin-lead and for lead-free soldering are the soldering processes, in particular the wave soldering processes. The higher melting points of most lead-free solders aggravate the energy consumption problem. The increased energy consumption for the metal mining and smelting, in particular of silver and of tin, add to the problem. More efficient soldering ovens and effective recycling are necessary to reduce the energy consumption (Deubzer, 2007).

In addition to the higher energy consumption, lead-free soldering causes substantially higher losses of resource value, despite of the fact that lead-free soldering reduces the metal releases into the environment. Higher recycling rates, however, reduce the resource loss considerably (Deubzer, 2007).

On the other hand, it should be mentioned that there is also an alternative point of view with regard to the energy consumption of some types of Pb-free soldering. According to US EPA (2005), the energy consumption for some types of Pb-free solders is lower than Pb solders.

LIFE CYCLE IMPACTS SCORES PB AND PB-FREE SOLDERING

Basic data

The different types of solders which are discussed in the results below are mentioned in the following table (US EPA, 2005). A distinction is made between paste and bar application types.

Table 4.59: Overview of different solder types (US EPA, 2005)

Solder alloys	Composition	Density (g/cc)	Melting Point (°c)	Application type
Tin-Lead (SnPb) (baseline)	63 Sn /37 Pb	8.4	183	Paste and Bar
Tin-Copper (SnCu)	99.2 Sn /0.8 Cu	7.3	227	Bar
Tin-Silver-Copper (SAC)	95.5 Sn /3.9 Ag /0.6 Cu	7.35	218	Paste and Bar
Bismuth-Tin-Silver (BSA)	57 Bi /42 Sn/1.0 Ag/	8.56	138	Paste
Tin-Silver-Bismuth-Copper (SABC)	96 Sn /2.5 Ag /1.0 Bi /0.5 Cu	7.38	215	Paste

Results

Figure 4.11 and Figure 4.12 display the relative differences of the 16 environmental and human health impact categories considered for paste solders resp. bar solders. The values derived for the figure are the log of the ratio of the alternative solder impact score to that of the SnPb baseline solder score for each impact category. Log ratios reported as a positive number reflect a favorable comparison (lesser relative impacts) to the baseline SnPb solder for the alternative; a negative number represents an unfavorable result (greater relative impacts) as compared to the baseline solder. Note that comparisons should only be made within not across impact categories (US EPA, 2005).

As can be seen in the figures below, some environmental and human health impact categories are scoring negative for the Pb-free solders. The landfill space use for Pb-free solders is substantially higher then the SnPb solder (Figure 4.11; US EPA, 2005).

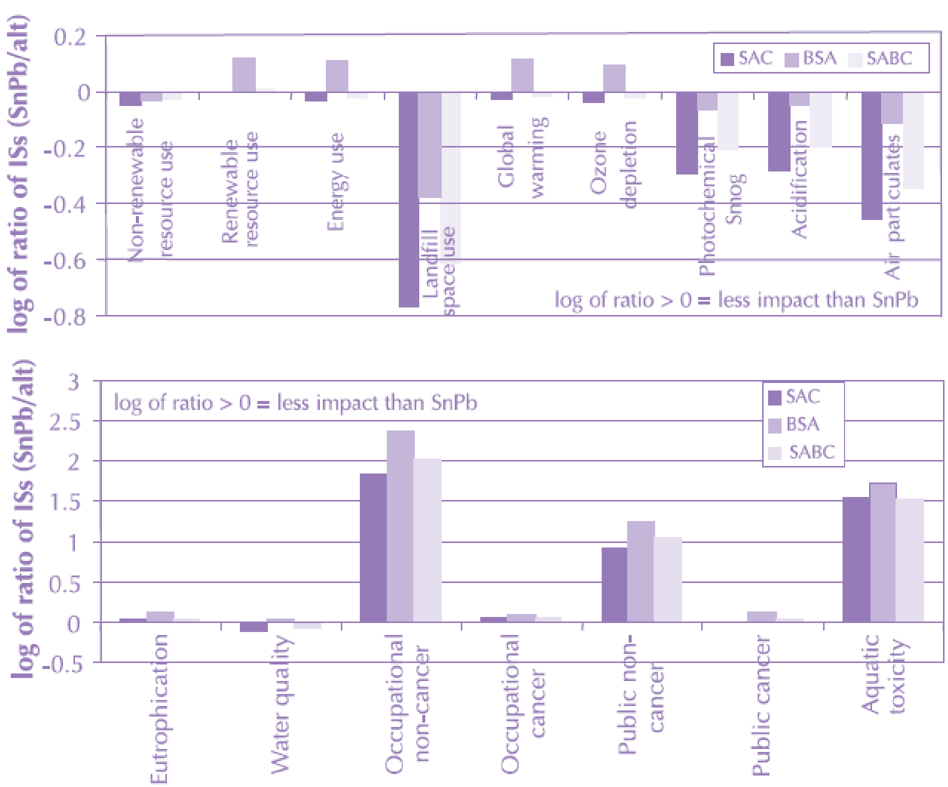


Figure 4.11: Relative comparison of paste solder life-cycle impact scores

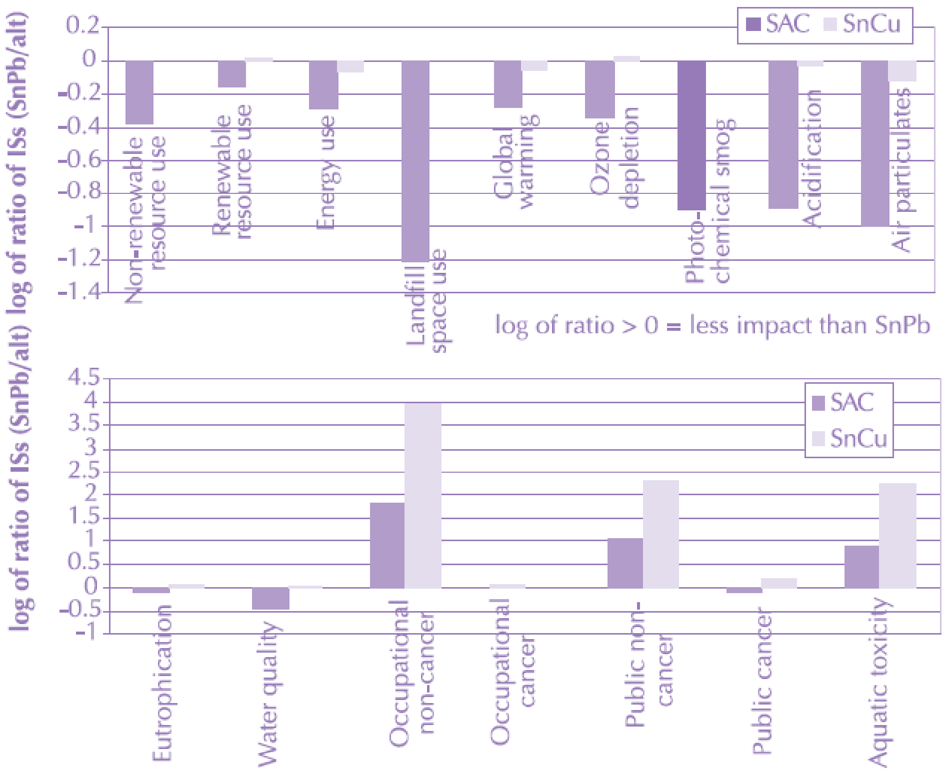


Figure 4.12: Relative comparison of bar solder life-cycle impact scores

As the discussion on the environmental impact Pb-free soldering is very complex, ambiguous and still on-going, one is referred to the reports of Kindesjö (2002); Schoenung (2003); US EPA (2005); Deubzer (2007).

5 ECONOMIC IMPACT ANALYSIS

5.1 APPROACH

5.1.1 Key Steps

Identifying the economic costs and benefits associated with the RoHS Directive involved the following steps:

- Extensive consultation with organisations, companies and individuals representing populations potentially affected by the Directive, to gather data on impacts, costs and benefits;
- A literature review, to obtain base data on the products affected by the RoHS Directive, to gather cost and benefit data as a check for the data provided during consultation;
- Calculation of the economic costs and benefits of the Directive.

Each of these steps is described further below.

One of the main concerns with cost benefit analysis, where the aim is to obtain an overall effect in monetary terms, is that qualitative impacts can be lost, and potentially significant benefits and/or costs can be excluded from the final analysis. In this report, all qualitative data are given, together with the quantitative data, to avoid such problems occurring. Care has also been taken in drawing conclusions to ensure that qualitative data are taken into account.

5.1.2 Literature Review

An extensive literature review was conducted using sources identified both by the Commission and by the contractor. The information assembled and analysed during this review is presented in the results below.

5.1.3 Stakeholder consultation

5.1.3.1 The Stakeholders

Stakeholders involved with the RoHS Directive were initially consulted through detailed written questionnaires focusing on the Directive and adapted for each stakeholder group. Questions were directed to a range of individuals and organizations in the following stakeholder groups:

- National Authorities responsible for implementing the Directive in Member States;
- Individual producers of electrical and electronic equipment;
- Trade Associations representing the interests of EEE producers;
- Consumer organisations.

The Commission supplied the study team with a set of e-mail addresses for key consultees coming from the trade associations and individual producers groups across the European Union. The trade associations were asked to forward the questionnaires meant for individual companies to their members. A lot of trade associations confirmed that they have done this. Individual companies were asked to forward the questionnaires meant for individual companies to their suppliers and some companies confirmed us that they have done so.

A number of organisations took the inititative to make the questionnaires downloadable at the following websites:

- EE Times Europe site http://www.eetimes.eu/201202269
- US Commercial Service website http://www.buyusa.gov/europeanunion/weee_rohs_revisions.html
- Soldertec Global, part of Tin Technology Ltd, http://www.soldertec.com/pooled/articles/BF_NEWSART/view.asp?Q=BF_NEWSART_292188
- Orgalab, an analytical laboratory in the field of service analysis for RoHS at www.orgalab.de

From our knowledge, the questionnaires were spread to some 350 contacts. However, this number is considered highly underestimated, as we do not know which trade associations or individual companies have forwarded it further and how many people have downloaded it from the available websites. We may conclude that the study and the consultation process were highly known within the relevant interest groups, a statement which is also confirmed by several trade associations.

5.1.3.2 The Consultation Process

WRITTEN QUESTIONNAIRES SENT IN APRIL 2007

By the end of April 2007 written questionnaires were sent by e-mail to all the above mentioned contacts:

- A separate RoHS questionnaire was sent to EU-27 relevant national, regional and European authorities.
- A separate RoHS questionnaire was sent to individual companies involved in the RoHS consultation organised by the EC.
- A combined RoHS/WEEE questionnaire was sent to relevant trade associations.
- A combined RoHS/WEEE questionnaire was sent to consumer organisations.

Respondents were asked to send their answers by 11 May (authorities) and by 25 May (trade associations and individual companies).

Questionnaire dedicated to authorities

The questionnaire dedicated to authorities is structured around the following topics:

- Communication costs e.g. training of industry associations or individual companies w.r.t. the requirements of the Directive;
- Monitoring and review costs e.g. investment in XRF analysers for testing;
- Costs related to exemption procedures e.g. assessment of the exemption requests by a consultant;
- Enforcement costs e.g. prosecution of non-compliant companies.
- Social impacts in the form of gain/loss of jobs.

Questionnaire dedicated to trade associations

The combined RoHS/WEEE questionnaire dedicated to trade associations is structured around the following topics:

- Section seeking information on awareness of the Directives amongst their members and the source of their information;
- Section exploring the degree of compliance with the Directives' requirements and the issue of 'free-riders';
- Section looking at issues surrounding Research & Development and Innovation;
- Section including questions covering any effects that the means of implementing the Directives might have had on competition.

The consultant was invited by a number of organisations to clarify the goals of the study and the content of the questionnaires:

- Combined meeting with EICTA/AeA;
- Meeting with JBCE and their member organisations;
- the UK Electronics Regulatory Group, a government/industry group which on the industry side is made up of most of the electronics trade bodies based in the UK
- Department for Business, Enterprise and Regulatory Reform, Electronics and IT Services Unit

In general, the organisations welcomed the questionnaire, as companies for the first time are given the opportunity to substantiate their concerns with hard cost data. Stakeholders took the opportunity to give input on the economic impacts of the Directive, which already provided relevant information.

Questionnaire dedicated to individual companies

The questionnaire dedicated to companies was structured around the following topics:

1. Details of the organisation, e.g. activities, turnover, export countries
2. Compliance costs and benefits:
   - Resource costs and time or staffing requirements of:
     - Training or information measures e.g. information campaigns, organisation of meetings;
     - Collecting and reviewing information e.g. collecting, providing or validating material/RoHS declarations;
     - Costs related to or resulting from exemption procedures e.g. exemption design, time of exemption treatment;
     - (Temporary) monetary losses or gains of RoHS compliance e.g. increase or decrease in turnover, costs of discontinuation of non-compliant products, costs of delayed introduction of new products;
   - Main activities causing administrative burden.
3. Technical costs of phasing out the RoHS hazardous substances:
   - Capital expenditure e.g. upgrade or replacement of existing machinery incl. investment costs, start-up costs;
   - Operating expenditure e.g. costs or benefits of material substitution, costs of higher failure rates;
   - R&D expenditure;
   - Other expenditure;
   - Ability of passing costs to customers.

4. Social impacts:
   - Gain/loss of jobs;
   - Implementation of new health and safety measures.

Information from companies is utilised anonymously in this report and is treated as confidential. A lot of companies made use of the opportunity to sign a non-disclosure agreement.

WORKSHOP

The response to the written questionnaires was limited. Timing bottlenecks were raised by the stakeholders as well as comments that the request for quantitative information caused problems for some companies and organisations in completing the questionnaire.

In cooperation with the Commission a workshop was organised on July 3 2007. The workshop was organised at the EC and was aimed at the following:

- Presentation and discussion of the response to the written questionnaires;
- Presentation and discussion of the remaining data gaps;
- Presentation and discussion of preliminary options for revision of the RoHS Directive.

The programme, presentations and list of participants of the workshop are provided as Annex 1. The public of almost 50 participants consisted of a mix of Member State representatives, trade associations and individual companies.

A lot of attention was given to the following data gaps, which are essential to come to valuable conclusions on the costs and benefits of the RoHS Directive:

- Profile of the sector in terms of the number of companies in EU27 by size
- Economic profile of the sector and its subsectors in terms of turnover, R&D expenditure, etc.
- Lack of environmental impact data for the selected product groups:
  - Historic evolution of quantities of Pb, Hg, Cd, Cr, flame retardants (PBB, PBDE) per product/kg for each product group;
  - Emission factors per phase in the life cycle, per product, per environmental compartment;
  - LCA functional units on PBB, PBDE.
- Lack of SME involvement in response
- Lack of economic indicators per company in response e.g. turnover

The sectors presented useful views during the discussions. However, they stated not to be able to solve the specific data gaps raised above.

During the workshop it was agreed that a second round of written questionnaires would be opened. The questionnaires needed to be simplified and more time for responding needed to be allocated.

WRITTEN QUESTIONNAIRES SENT IN JULY 2007

By the end of July 2007 simplified questionnaires were sent by e-mail to the same above mentioned contacts:

- A combined RoHS/WEEE questionnaire was sent to relevant trade associations.
- A combined RoHS/WEEE questionnaire was sent to individual companies.

The quantification of costs/benefits needed for the economic analysis was combined into a single table. All other questions were set up in a yes/no format or asked for qualitative information. Respondents were broadly given the opportunity to provide examples in order to emphasize their statements.

Relevant stakeholders having attended the workshop were asked to provide comments on the simplified version of the questionnaires. Their comments were taken into account where possible.

A supporting letter from the Commission accompanied the questionnaire. Respondents were asked to send in their answers by 30 September.

5.2 RESULTS OF THE STAKEHOLDER CONSULTATION

5.2.1.1 Authorities

Belgium, Finland, Ireland, Sweden, United Kingdom and Estonia have given specific answers on monitoring and enforcement costs. The information of Belgium, UK and Ireland is given in the paragraphs 2.1.2.2, 2.1.2.3 and 2.1.2.5.

Sweden and Finland mention that they have invested in XRF analysers or Gas Chromatography Mass Spectrometer analysis for testing and in additional training. Estonia states that it has invested in training fro monitoring activities. In Finland, one FTE is dedicated to RoHS monitoring and enfrcement; in Sweden and Estonia no new jobs have been created.

Some new MS (Croatia, Slovakia, Slovenia and Hungary) have sent general comments which largely say that it is too early to give reliable figures because legal execution and supervision has only just now started or will start in the near future or because budgets have not been dedicated yet.

5.2.1.2 Trade associations

Completed questionnaires have been received from:

- AEA-Europe (Electronics Association)
- JBCE (Japanese Business Council in Europe)
- CECED Conseil Européen de la Construction d'appareils Domestiques (European Committee of domestic equipment manufacturers)
- ASSOGIOCATTOLI (Italian industry association for a.o. toys and games)
- CELMA federation of National Manufacturers Associations for Luminaires and Electrotechnical Components for Luminaires in the European Union
- ELCF (European Lamp Companies Federation)
- Foundation of Taiwan Industry Service
- Three Japanese associations involved in EEE from category 8 and 9:
  - JAIMA (Japan Analytical Instruments Manufacturers Association),
  - JEMIMA (Japan Electric Measuring Instruments Manufacturers' Association),
  - JIRA (Japan Industries Association of Radiological Systems).

Position papers have been received from:

- ORGALIME, the European Engineering Industries Association
- Australian Electrical and Electronic Manufacturers' Association (AEEMA)
- American Chamber of Commerce to the European Union (AmCham EU)

- European Information & Communications Technology Industry Association (EICTA)
- Test & Measurement Coalition
- Eurometaux (largely on WEEE)

These papers have a wider scope than this present study, and include remarks on the scope itself of RoHS and WEEE Directives, but still they contain a lot of remarks which are relevant for this study.

COCIR has sent general comments.

5.2.1.3 Individual companies

PROFILE OF RESPONDENTS

In total, response was obtained from 36 companies. 21 companies responded to the first questionnaire and 19 to the simplified questionnaire. 4 out of the 36 companies responded to both questionnaires:

- 32 large enterprises with more than 250 employees and more than € 50 million turnover;
- 1 company employs less than 250 emplyees, with a turnover over € 50 million;
- 3 companies with less than 50 employees and a turnover inferior to € 10 million.

The lion part of the respondents are multinational companies, having research and development facilities, manufacturing sites and retail networks in place all over the world.

In order to partly overcome the lack of SMEs in our sample, the results of 4 case studies from the GreenRose project were added to our sample, leading to a total number of 40 companies in the analysis. The European funded GreenRose programme was set up to provide European SMEs of the electronics sector with the knowledge and tools to produce electronic equipment free of hazardous substances. In the framework of this project, 40 Polish SMEs were investigated regarding their efforts for RoHS compliance.

The majority (27 companies) of the respondents are manufacturers of EEE, as can be seen from the figure below. A substantial part of these manufactures are integrated businesses and therefore also act as component suppliers, product assemblers, importers and/or distributors of EEE. Three companies only act as a professional importer and/or distributor of EEE and in this way are not producing. Three companies are mainly focusing on assembling EEE. Two companies manufacture components as their sole activity. Finally, the sample also comprises two companies providing specially tailored services to the different actors in the supply chain.

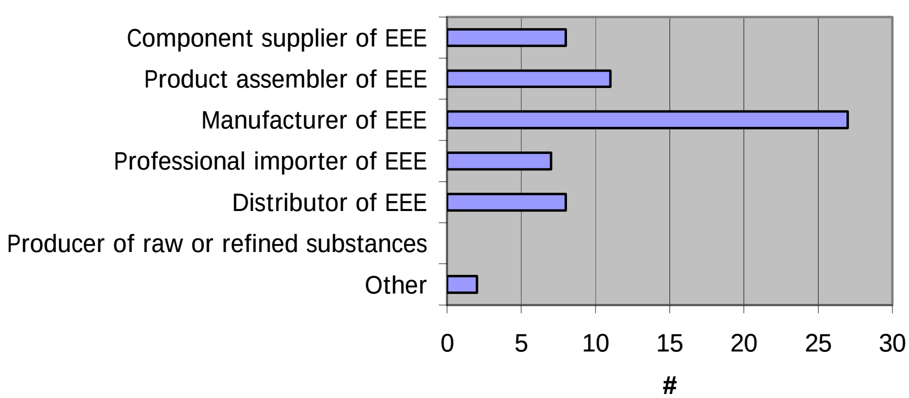


Figure 5.1: Type of organisation (sample of 35 companies)

More than 60% of the respondents is working in the field of IT & telecommunications equipment (category 3). As appears from the figure below, other product categories are covered to a lesser extent. About 25% of the companies operates in the production chain of large and small household appliances (categories 1 and 2), consumer equipment (category 4), medical devices (category 8) and monitoring and control instruments (category 9). The coverage of lighting equipment is insignificant, as there is only one lighting manufacturer that has returned the questionnaire. The product categories toys, leisure & sports equipment and automatic dispensers are not represented in the sample at all.

Because of the low overall, and of SMEs in particular, response rate it is clear that the sample is not representative for the EEE sector. As was described in paragraph 2.3, the distribution of companies involved in the production of EEE differs from country to country, but in general we can see that 90-95% of the companies have less than 20 employees.

Table 5.1: Classification of the companies in our sample

Company	SME	Type of organisation	RoHS categories covered	Home region	Positioning letter	Questionnaire			GreenRoSE
						Qualitative info	Limited quantitative info	Comprehensive quantitative info	
1		M	LHA, SHA	-		x			
2		A, M, D	MD	US		x	x		
3		M	MD	US		x		x	
4	x	I, D	IT	EU		x	x		
5	x	M	IT	US		x		x	
6		I, D	SHA, IT	EU		x			
7		A	LHA	EU		x		x	
8		M	LHA, SHA	EU		x		x	
9		A, M, I	IT	EU		x	x		
10		CS	SHA, LHA, IT, CE, EET, MD, M&C	US		x		x	
11		M	IT	US		x		x	
12		M	IT, CE	US	x	x		x	
13		CS, A, M	LHA, SHA, IT, CE, EET, MD	US		x	x		
14	x	D	IT, M&C	EU		x			
15		CS, A, M, I, D	IT, CE, MD, M&C	JAPAN		x			
16		M	LE	EU		x		x	
17		M	LHA, SHA	EU				x	
18		M	LHA, SHA	EU			x		
19		M	IT	EU			x		
20		A	IT	UK		x		x	

21		CS, M, I	SHA, IT	US		x		x	
22		A	LHA	JAPAN		x		x	
23		M	IT	US		x	x		
24		M, I, D	IT	US-EU		x		x	
25		M	LHA	JAPAN		x		x	
26		CS, A, M	EET	JAPAN		x		x	
27		CS, A, M	IT, M&C	JAPAN		x		x	
28		A, M, I, D	IT	EU		x			
29		M	IT, EET,	US		x		x	
30		CS, A, M	LHA, IT, CE, M&C	JAPAN		x		x	
31		M	IT, CE	JAPAN		x		x	
32		M	IT	JAPAN		x			
33		M	MD, M&C	JAPAN		x		x	
34		A, M, D	IT, CE, EET, MD, M&C	US		x		x	
35		CS, M,	MD, M&C	JAPAN		x			
36	x	CS	IT, CE, EET, MD, M&C	EU			x		x
37	x	CS, A, M	IT, CE, EET, MD, M&C	EU			x		x
38	x	M	IT, CE, M&C	EU			x		x
39	x	M	IT	EU			x		x
40		M, D	MD	EU	x				

Type of organisation: **CS** - Component Supplier / **A** - product Assembler / **M** - Manufacturer / **I** - professional Importer / **D** - Distributor

RoHS categories covered: **LHA** - Large Household Appliances (cat. 1) / **SHA** - Small Household Appliances (cat. 2) / **IT** - IT and telecommunications equipment (cat. 3) / **CE** - Consumer Equipment (cat. 4) / **LE** - Lighting Equipment (cat. 5) / **EET** - Electrical and Electronic Tools (cat. 6) / **T** - Toys, leisure and sports equipment (cat. 7) / **MD** - Medical Devices (cat. 8) / **M&C**- Monitoring and Control instruments (cat. 9) / **AD** - Automatic Dispensers (cat. 10)

Eleven companies or 58% of the companies having responded to this part of the questionnaire indicated all RoHS substances to be relevant for their activities. Lead is relevant for all respondents. Cadmium and Cr(VI) are relevant RoHS substances for 84% of the companies. Mercury and PBB/PBDE are relevant for 58% of the companies.

Eleven companies or 58% of the companies having responded to this part of the questionnaire indicated that all RoHS substances are relevant for their activities:

- Lead is relevant for all respondents.
- Cadmium and Cr(VI) are relevant for 84% of the companies.
- Mercury and PBB/PBDE are relevant for 58% of the companies.

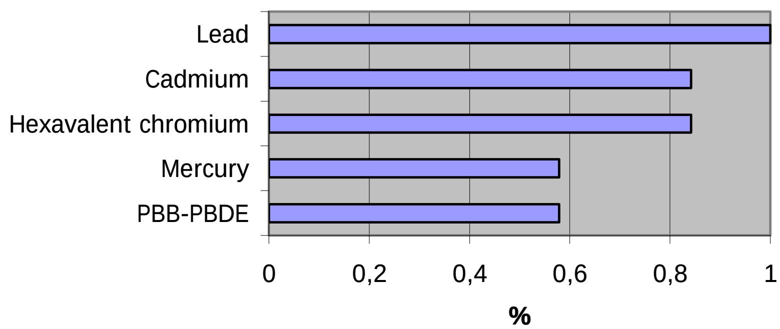


Figure 5.2: Relevance of the different substances covered in the sample (19 companies)

Twenty-one companies provided detailed information about their number of suppliers. The number of suppliers varies from 7 to over 10,000, with an average number of 2,252 suppliers.

ANALYSIS AND COMPLETION OF INFORMATION PROVIDED

The quality of the responses differs among the respondents:

- 1 company has written a positioning letter, but did not return the questionnaire;
- 1 company has written a positioning letter and tried to give a comprehensive image of the costs involved;
- 7 companies gave qualitative answers, but did not give any figures;
- 7 companies gave one figure, referring to overall costs or to one aspect of compliance costs;
- 20 companies tried to give a more comprehensive image of the costs involved.

In the questionnaire and during the workshop, the importance was stressed of the provision of turnover and employment data in order to relate these with cost information from RoHS compliance. However, only a limited number of companies have provided turnover or employment figures. These figures are essential for scaling up responses to provide overall population estimates.

Moreover, the interpretation of the data was complicated by the fact that the provided figures in many cases were incoherent e.g. it was not indicated whether a certain cost needed to be considered as a one-off cost or as a recurring cost.

For the reasons mentioned, individual contact needed to be taken with the majority of the respondents. Cost interpretation issues were discussed and more information was trying to be obtained on both RoHS compliance/technical costs and on general turnover/employment figures. Efforts were also put in investigating year reports of the companies who responded in order to complete gaps on turnover and other data which are essential to put the RoHS compliance costs in perspective.

It is clear that the sample predominantly consists of a large number of multinational companies which undertake their research and development activities on a worldwide basis and produce EEE in complex supply chains. In the framework of the GreenRose programme, 8 SMEs documented their experiences (successes, problems and continuing concerns) in moving towards RoHS compliance. We decided to include the relevant experiences of 4 companies in the sample, allowing us to better document the situation of SMEs and to partly overcome the lack of small companies in the sample. So when discussing the cost factors below, quantitative and qualitative information from the GreenRose project was activitly exploited to provide a better coverage of the impact of RoHS on SMEs. Besides taking into account the GreenRose results, the cost data from the survey were also checked against results from literature sources.

REASONS FOR LOW RESPONSE RATE

During discussions with trade associations at the start of the stakeholder consultation, these organisations welcomed the survey, as companies for the first time were given the opportunity to substantiate their concerns with hard cost data. It seems that these organisations have put considerable efforts in trying to convince their members of the importance of participation and have reminded them repeatedly of the initiative.

However, a number of reasons can be identified why the response rate to the questionnaires is lower than anticipated. These include:

- The key reason might be the fact that most companies have completed the changes required for RoHS and are not requesting revisions. They may even be concerned about the possibility that the review will introduce uncertainty over the requirements again, now that the legislation finally settled down to a workable form after many years of uncertainty.
- The complexity of the information being sought;
- Confidentiality issues related with providing quantitative cost information and turnover data;
- The existence of other opportunities for affected populations to comment on the Directive;
- Difficulty in estimating the cost impacts because a large part of the costs have been made in the past;
- Confusion caused by overlap with other consultation processes (other ongoing studies and the consultation organised by the Commission itself);
- Etc.

The European Lead Free soldering NETwork (ELFNET), a European research network of national organisations, technical experts and industrial bodies in micro-electronics, has published three annual reports on the implementation status of lead-free soldering technology in Europe. The analysis in these reports is largely based on information gathered through surveys. The ELFNET questionnaire also suffered from low response. Only 18 European participants took part in the first ELFNET survey in 2004. In 2005, participation almost doubled to 32 respondents. From its last survey sent end 2006 115 questionnaires were returned. The last questionnaire intentionally was kept short so that it could be filled out completely in a maximum of 15 minutes. No quantitative information has been asked for. This experience also indicates how difficult it is to obtain active participation on the subject (ELFNET, 2007a and b).

For the study on the 2008 Review of the WEEE Directive, the Institute of Environment and Human Security of the United Nations University obtained a response from 64 companies to a survey investigating the administrative burden from the WEEE Directive. However, the survey had a largely qualitative design, whereas in this RoHS survey quantitative information and cost data needed to be provided.

The web survey and telephone interviews executed within the Consumer Electronics Association/Technology Forecasters Inc. study of the economic impact of the EU RoHS on the electronics industry (2008) lead to a significant result of 205 responses. Some 130 companies (64%) comes from Noth America, 31 companies (15%) from Europe, 18 companies (9%) from Asia and the remaining part from the rest of the world.

Although in this study, the response rate that was lower than that experienced in similar consultations we have undertaken in the past, we are confident that the impacts described are a reflection of the real situation. Indeed, the stakeholder consultation and literature investigations have given insight in a significant amount of ideas and trends in the sector with respect to RoHS. This information has been very useful, although it did not give rise to absolute cost or benefit figures.

5.2.2 Economic costs related to RoHS

5.2.2.1 Economic cost framework

The economic cost framework is provided in Figure 5.3. The costs for companies to comply with RoHS are broken down into compliance costs and technical costs of substance phase-out. The latter contain capital investments, operational expenditures and R&D efforts directly related to the phase-out of RoHS substances. The compliance or non-technical costs are related with facilitating the practical implementation of the technological changes in the production chain. In practice, the compliance costs are the costs of getting acquainted with the Directive's requirements, the costs incurred by the provision of training and information to the different actors in the chain and the costs of collecting, organising and reviewing information. Besides this, compliance costs also comprise the costs related to exemption procedures and a number of organisational implications causing monetary losses.

Cost components 1 to 4 in Figure 5.3 add up to total compliance costs, the same goes for cost components 6 to 10 adding up to the total technical costs of substance phase-out. It was, however, not always possible to attribute cost information to a specific cost component in the case a company provided aggregate figures of total compliance costs or total technical costs. Therefore costs components 5 and 11 were introduced to allow an overall evaluation of the total costs of RoHS and the relative importance of compliance and technical costs herein.

For reasons of confidentiality, individual company results are not published in this report. Below, we provide indications of the composition of costs and of relative cost margins.

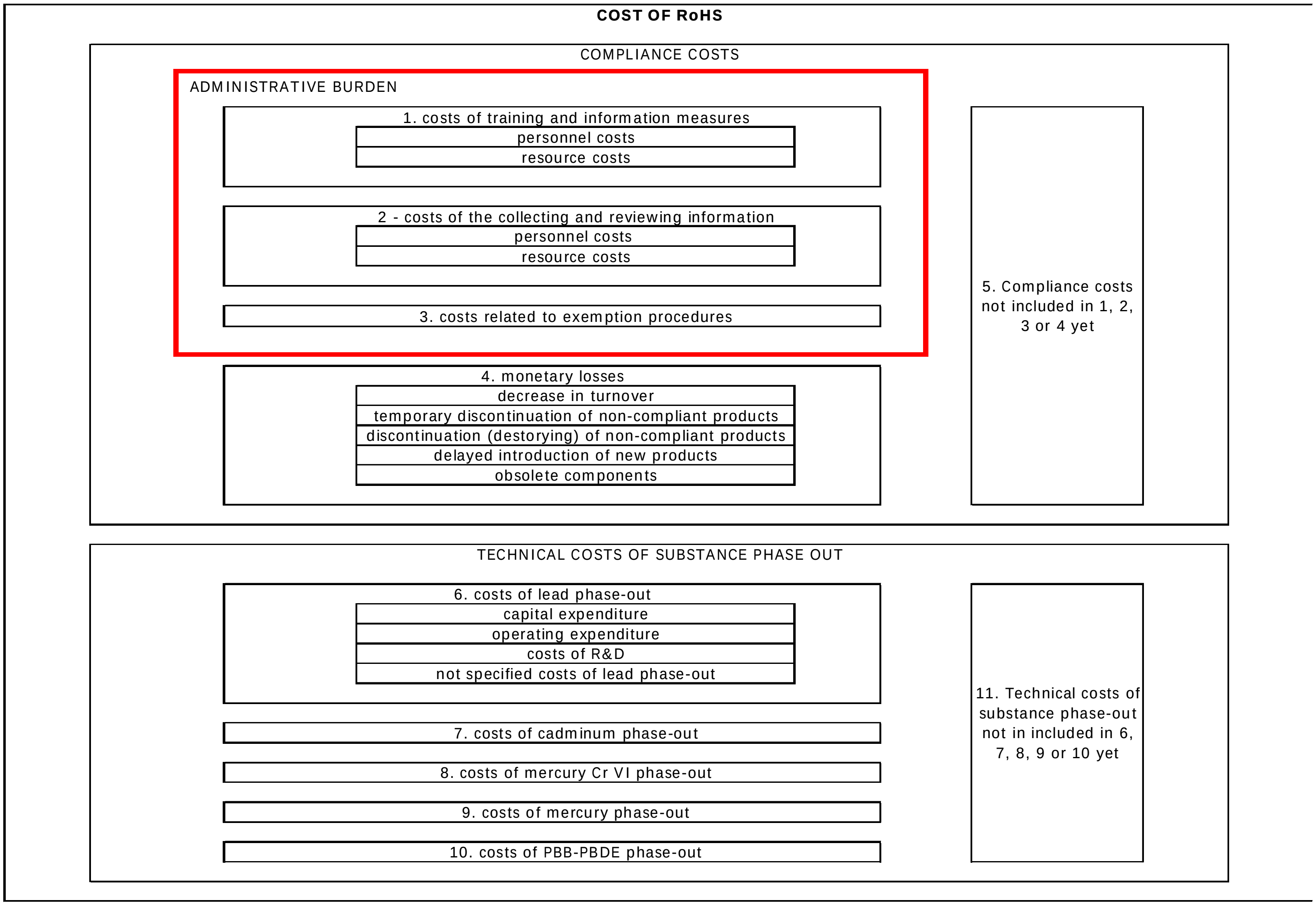


Figure 5.3: Framework of cost components of RoHS compliance

5.2.2.2 Total costs related to RoHS

Total past costs and one-off future costs incurred by 30 companies (26 companies through the survey and 4 SMEs from GreenRose) to comply with the RoHS Directive amount to a maximum of € 59.6 million, with an average of € 10 million and a weighted average[7] of € 21 million. These figures include all costs incurred up till now, increased with one-off costs companies project to face in the near future.

The same analysis can be made for yearly costs companies are expecting in the future. Future yearly costs amount to a maximum of € 4.7 million, with an average of € 950,000 and a weighted average of € 660,000. The table clearly shows that the future yearly costs are low compared to the amount of past costs and one-off future costs made. This supports the statement already made that most companies have completed the changes required for RoHS and are not requesting revisions because of limited RoHS ‘maintenance’ costs.

Companies started thinking and working on RoHS related matters as early as 1999. Costs of complying with RoHS gradually increased and peaked in 2006. This trend can be observed for EU, US as well as Japanese companies. After 2006, costs declared by EU companies fell strongly. Costs for Japanese and US companies also decreased, but not to the same degree. Cost projections for 2008 onwards are higher for US and Japanese companies than for EU companies. This observation confirms the finding of the Technology Forecasters (2006) study that US companies lag with regard to the implementation of EU RoHS. Concerning the financial burden of RoHS compliance, no meaningful regional differences can be observed.

Table 5.2 puts the costs in perspective of the companies’ yearly turnover. At the high end of the margin, we find a US manufacturer and distributor of medical devices stating that it already has incurred costs within a margin of 16% of its current turnover. On the other end, we find a Japanese manufacturer of large household equipment stating that total costs of RoHS compliance made in the past amount to only 0.005% of its turnover. On average, the past cost impact of RoHS amounts to 1.9% of turnover of the companies in our sample.

In the Consumer Electronics Association/Technology Forecasters Inc. study of the economic impact of the EU RoHS on the electronics industry (2008) (later mentioned as ‘CEA/TFI study’), a distinction is made between total compliance costs and annual maintenance costs. The total compliance costs of the CEA/TFI study can be regarded equal as the past and future one-off compliance costs in this study. The total compliance cost for the industry on average amounts to 1.1% of industry revenue (based on a 171 sample size). In this study, the weighted average impact, correcting the average impact for company size, amounts to 0.047% of turnover. This indicates that the burden of RoHS is higher for smaller companies compared to large or multinational companies. For comparison, electronics companies spend on average 4-6% of their revenues to R&D (CEA/TFI study, 2008).

The average future yearly costs make up 0.04% of total turnover, whereas in the CEA/TFI study this figure amounts to 0.12%. The weighted average future yearly costs make up 0.0026% of total turnover, again indicating that the burden to maintain RoHS compliance is higher for smaller companies compared to large or multinational companies.

[7] By using a weighted average, abstraction is made of very high costs to comply with RoHS which certain companies (SME's) might have when these costs are related to their turnover. Through the weighted average, the absolute costs of RoHS for these companies do not put relatively more weight on the conclusions, as they are levelled off in the sum of turnover of all companies (including very large companies).

The total costs have also been related to the number of employees. Costs made in the past amount to € 32,590 per employee for the US manufacturer mentioned above. The average past cost amounts to € 3,185 per employee. The weighted average of € 191 per employee shows again the larger burden for SMEs.

Table 5.2: Cost ratios – total costs related to RoHS in the sample (30 companies)

	% of turnover		*€ per employee*	
	Past costs and one-off future costs	*Future yearly costs*	*Past costs and one-off future costs*	*Future yearly costs*
High	16%	0.2%	32,590	225
Low	0.005%	0.0005%	9	0.57
Average	1.9%	0.04%	3,185	65
Weighted average	0.047%	0.0026%	191	22

The share of the seperate cost components in the total costs incurred is indicated in the figure below, showing that the compliance costs make up 67% of all costs made in the past.

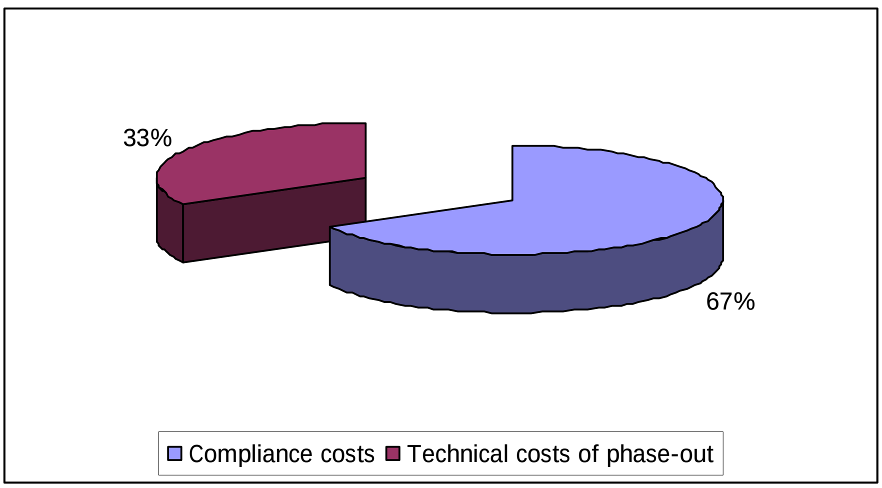


Figure 5.4: Composition of total costs related to RoHS compliance in the sample (30 companies)

Past and future one-off compliance costs amount to a maximum of € 42.7 million, with an average of € 6.7 million and a weighted average of € 16.3 million. When we look at the yearly recurring costs from 2008 on, the share of compliance costs in total costs increases to 88%. Future yearly costs amount to a maximum of € 4.7 million, with an average of € 1.3 million and a weighted average of € 675,000. Indeed, most technical capital costs have already been made in order to comply with RoHS; remaining technical costs mainly consist of increased operating costs e.g. energy costs, purchasing costs of materials.

The CEA/TFI study has calculated a total average compliance cost of $ 2.64 million or € 1.8 million. This is considerably lower than the € 10 million average result of this study. The weighted average cost of the CEA/TFI study was approximately $ 6 million or € 4 million, whereas the figure in this study is € 21 million. One of the reasons for this difference is the fact that in our sample, multinational companies are overrepresented and results in both studies show that costs increase with increasing company revenues.

On the other hand, from the individual contacts in the framework of this study it seems that many companies only provided a partial picture of their costs. E.g. companies reporting higher operating costs of lead phase-out in the past often do not take these into account anymore when reporting their expected future technical costs.

The CEA/TFI study has calculated a total average annual maintenance cost of $ 0.5 million or € 330,000, wich is well below the results of this study (€ 950,000). The weighted average annual maintenance cost of the CEA/TFI study was approximately $ 1.44 million or € 1 million, which is somewhat higher than the result of this study (€ 660,000).

The share of total average annual maintenance costs in compliance costs of the CEA/TFI study amounts to 18%, whereas the share in this study amounts to 10%. When weighted, this share even increases up to 24% in the CEA/TFI study, whereas the share in this study decreases to only 3%. This indicates that a large share of the costs for RoHS compliance have already been borne in the past.

5.2.2.3 Administrative burden

In the EC Guidelines of Impact Assessment (2005) the following definition of administrative costs is given:

Administrative costs are defined as the costs incurred by enterprises, the voluntary sector, public authorities and citizens in <u>meeting legal obligations to provide information</u> on their action or production, either to public authorities or to private parties. Information is to be taken in a broad sense, <u>including costs of labelling, reporting, monitoring to provide the information and registration</u>.

In this analysis, the assessment of the administrative burden covers:

- Efforts made to become familiar with the RoHS scope and its obligations and to spread awareness and knowledge to staff, suppliers and customers;
- Activities focused on collecting and reviewing information (information flow from Member States/associations to individual companies and from individual companies within their supply chain);
- Administrative activities related with exemption procedures.

We are aware of the fact that for any new environmental legislation, there is a need for trade associations and individual companies to inform themselves of the legislation and its specific requirements. However, the stakeholder consultation has made it clear that in the case of the RoHS legislation, this process has been relatively more timeconsuming due to the perceived lack of a clear scope of RoHS and, resulting from this, a variety in interpretations and applications across Member States.

One can discuss whether some of the activities defined above can be regarded as inevitable procedures in any environmental legislation or as specifically attributing to the administrative burden. Our approach is to define them all as activities causing administrative burden, because a standard of efforts necessary in the framework of other environmental legislation is not available. If we were able to compare the efforts made for RoHS compliance to a standard effort made in the framework of other legislation, we could have calculated the additional net administrative burden to be attributed to RoHS.

Because of this uncertainty, the total administrative burden resulting from the activities mentioned above can lead to an overestimation. On the other hand, this division does not have an impact on the total absolute costs related to RoHS.

Past costs and future one-off administrative costs amount to a maximum of € 42.7 million, with an average of € 5.9 million and a weighted average of € 13.2 million. Future yearly administrative costs amount to a maximum of € 4.7 million, with an average of € 265,500 and a weighted average of € 675,000.

The following table gives an overview of the ratios of the administrative costs related to turnover and to the number of employees. On average, the yearly administrative costs in the future will make up 0.04% of total turnover. The weighted average of 0.014% shows the larger burden for SMEs.

Table 5.3: Total administrative burden in the sample (25 companies)

	% of turnover		*€ per employee*	
	Past costs and one-off future costs	*Future yearly costs*	*Past costs and one-off future costs*	*Future yearly costs*
Highest	1.233	0.150	1,450.001	176.471
Lowest	0.001	0.0001	0.992	2.046
Average	0.184	0.042	272.809	56.575
Weighted average	0.024	0.014	96.481	23.828

BURDEN RELATED WITH THE SCOPE OF ROHS

According to the trade associations, a large burden comes from tracking the transpositions of the RoHS Directive in all 27 Member States, because of the large variation in transposition. This variety stems from a difference in enforcement methodologies as well as a difference in interpretation of the scope and applicability of the Directive.

Trade associations mention the lack of clear definitions in RoHS legislation, such as ‘put on the market’, what is ‘lead free’ and ‘homogeneous material’[8]. This results in considerable confusion with regard to how the terms are to be interpreted and applied.

Considering the definition of to be ‘put on the market’, Belgium, the Czech Republic, France, Ireland, Latvia, Lithuania, Poland, Portugal and Spain have interpreted this as ‘put on their national market’. Other Member States read this in line with the single market principal.

The RoHS Enforcement Guidance Document Version 1, issued in May 2006 by the EU RoHS Enforcement Authorities Informal Network, offers a guidance that is followed by several Member States. The document aims to provide non-binding guidance, but as it is merely informative and advisory, individual Member State RoHS enforcement authorities are bound by their own national legal structures and can only apply this guidance within the confines of those structures. As this approach is not obligated, some Member States use other enforcement instruments.

[8] A homogeneous material, as defined by the European Union Technical Adaptation Committee, is a material that cannot be mechanically disjointed into different materials; homogenous materials are materials “of uniform composition throughout.” Ceramics, glass, metals, alloys, paper, board, resins, coatings are provided as examples. The term “mechanically disjointed” would mean “that the materials can be, in principle, separated by mechanical actions such as for example: unscrewing, cutting, crushing, grinding and abrasive processes.”

Tracking the different transpositions requires a lot of legal counselling and staff working time. The U.S. Commercial Service from the U.S. Mission to the European Union, and TDC-trade, the global marketing arm and service hub for Hong Kong-based manufacturers, traders and service exporters are two examples of international organisations keeping up an overview of RoHS interpretation and application in all Member States.

BURDEN RELATED WITH INFORMATION AND VERIFICATION ACTIVITIES

Trade associations

It is clear from individual contacts with trade organisations and information available on the internet that a lot of effort is put in providing information on the RoHS Directive. Trade organisations both inside and outside the EU, the latter with members exporting EEE to the European Union, keep their members well informed on RoHS by means of:

- Regular general information campaigns (yearly or even more frequently);
- Continuous direct communication with member companies upon request;
- Regularly placing new legislation developments on the internet or the intranet;
- Regular training workshops/meetings with industry;
- Informative staff meetings (to a lesser extent);
- Publication of leaflets on new legislation developments (to a lesser extent)
- Other activities e.g. AeA Europe supports an online compliance website produced by an associate law firm, providing information on key aspects of all 27 transpositions of the WEEE and RoHS Directives.

Some associations had to indicate additional staff functions for the support of their members of WEEE and RoHS issues e.g. 3 permanent jobs at JBCE since 1999; 2 temporary jobs at JEMIMA since 2004. In most cases, permanent new jobs were created dedicated to these activities. Some associations could cope with RoHS and WEEE without additional staff. Often they had to make use of consultants.

Companies

The figures below make clear that the most important compliance cost consists of compliance verification, which is an ongoing expense.

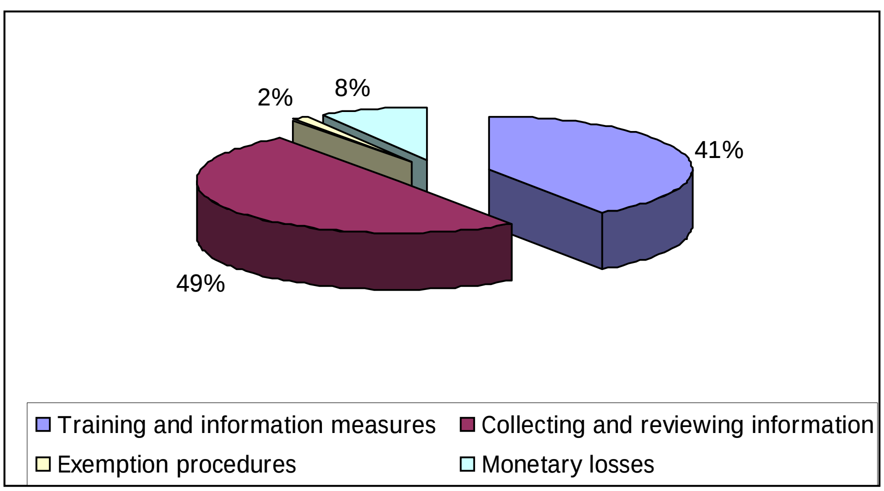


Figure 5.5: Composition of past compliance costs in the sample (30 companies)

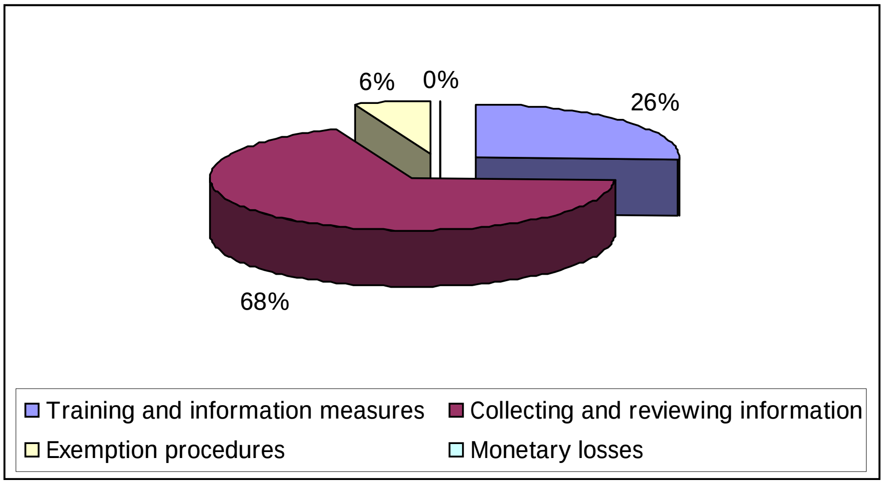


Figure 5.6: Composition of expected future yearly compliance costs in the sample (30 companies)

RoHS training and information costs

Final producers or importers are informed through trade associations, law firms, online compliance services, official information on the Directives and on national implementation measures. In the framework of the GreenRose programme, 40 Polish SMEs were investigated regarding their efforts for RoHS compliance. The most important channels of getting RoHS related information are the internet, magazines and working groups/seminars. SMEs often mentioned that they have a core group in place intensively preparing the transition process. The issues covered in such groups are very diverse, impacting almost all aspects of the organisaton.

The figure below gives an overview of the different training and information measures companies made use of as well as the importance attached to these measures by the respondents.

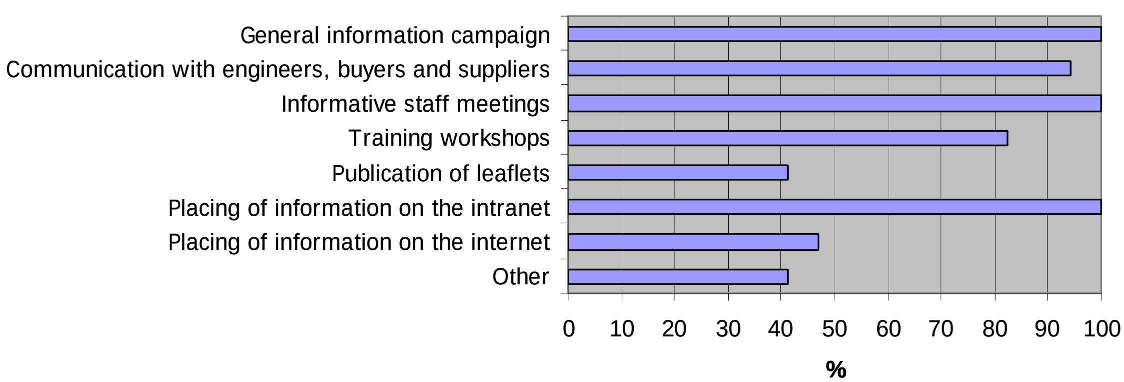


Figure 5.7: Detail of RoHS training and information measures in the sample (20 companies)

More than 90% of the costs of RoHS training and information measures are personnel costs. The remainder consists of resource costs for the organisation of training and information sessions, meetings, workshops, active customer and supplier education and the development of special information packages and courses.

Twenty companies explicitly documented the costs incurred for RoHS training and information dissemination. Past costs and future one-off costs amount to a maximum of € 7.4 million, with an average of € 1.6 million and a weighted average of € 1.9 million. Future yearly costs amount to a maximum of € 900,000; with an average of € 425,500 and a weighted average of € 681,000.

The following table indicates that if all personnel time made in the past for RoHS RoHS training and information activities is summed, this on average leads to an equivalent of 0.18% of total personnel per company. This average drops to 0.11% when the expected yearly costs in the future are assessed.

Table 5.4: FTE's dedicated to RoHS training and information activities in the sample (22 companies)

	Absolute number of FTE's		*Share of personnel dedicated to RoHS compliance*	
	Past costs and one-off future costs	*Future yearly costs*	*Past costs and one-off future costs*	*Future yearly costs*
Highest	100.00	15.00	0.88	0.29
Lowest	1.30	0.10	0.005	0.004
Average	30.42	7.17	0.18	0.11
Weighted average			0.23	0.004

Costs of collecting and reviewing information

Final legal responsibility for RoHS compliance rests with the final producer or importer. Producers of EEE generally act as assemblers of components produced by different suppliers. This makes it difficult and technically and administratively burdensome to check RoHS compliance of the finished products. A large administrative burden is caused by the producer's obligation to request for RoHS conformity throughout the whole supply chain of components from suppliers and sub-suppliers.

RoHS compliance can only be achieved by addressing firstly internal processes to ensure that the offending substances are not added to the product during stages of in–house manufacture and secondly, and most critically, the compliance of components and materials down the supply chain. Two basic strategies are available for determining and assuring supply chain compliance with RoHS: supplier declarations and material/substance level data. In the first case, the suppliers confirm that the products they supply are compliant. This is the simplest and lowest cost approach but companies should still verify these statements, e.g. by means of questionnaires consisting of declarations plus supplementary questions or through supplier audits or by having chemical analysis done in cases where the risk of non-compliance or lack of veracity of information is considered high.

The second approach requires suppliers to provide details of what their products contain at the homogeneous material level, in the form of material/substance level declarations. By definition this approach gives added confidence as in order to provide these data, suppliers must dig deeper into their supply chains. This will add significant cost and effort in terms of collecting and handling the data. Substance level data has to be collected, collated and transmitted in an accurate way up the supply chain. This can be done manually with spreadsheets or electronically with software (Clements, 2005).

In the framework of the GreenRose programme, 40 Polish SMEs were investigated regarding their efforts for RoHS compliance. Less than 15% of the companies required full material declarations, certified analytical results or audits of their suppliers. This reflects the fact that SMEs tend to choose more cost effective and practical methods, like partial material declarations or written statements of conformity, for demonstrating of RoHS compliance. In order to reduce non-compliance risks, about half of the companies in the survey is willing to change its supply chains. After the RoHS Directive has entered into force, 18% of respondents were still struggling with the availability of RoHS compliant components (Liu et al., 2006).

The figure below provides an overview of the information gathering and reviewing activities companies do, as well as the importance attached to these activities by the respondents. The activities related to materials declarations' collection are faced by almost all companies. The review and adaptation of record keeping and procedures, as well as the change of the company's quality system (e.g. reviewing manufacturing standards of products), are also deemed important.

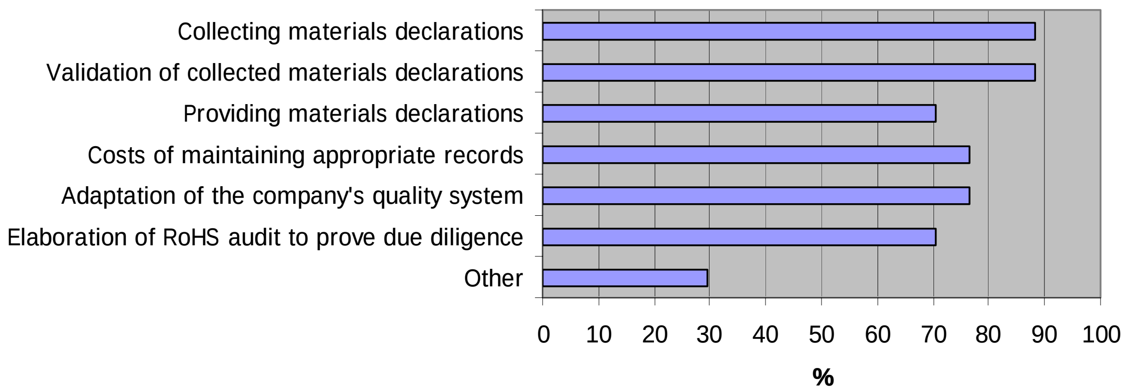


Figure 5.8: Detail of activities related to collecting and reviewing of information in the sample (20 companies)

The collection, organisation and reviewing of information often requires investment in a number of tools or applications of which the most important are listed in the following figures. The qualitative indication of the importance of the various tools and applications is complemented by the related cost information. However, existing standards like the IPC1752 material declaration standard are increasingly being used to organize the large amount of information. IPC1752 is a standard for electronic data exchange for Environmental Data developed by IPC with participation from major OEMs, Contract Manufacturers, Component Manufacturers and Material suppliers.

Compliance is not really measurable at the finished product level. In order to do this properly and accurately the product would need to be disassembled then broken down, separated and ground up into all its constituent homogeneous materials which could number in the thousands. Each one of these would then need to be analysed to determine the concentration values of the restricted substances. Any single homogeneous material exceeding the limits would result in a non-compliant product.

There is a lack of standardisation of supplied components testing and sample disjointment for assessing the concentration of the restricted substance within a homogenous material. Where producers need to rely on produced test results or certification presented by second parties to ensure compliance, this uncertainty in process continues to challenge industry in its ability to confirm the levels of compliance in their products (NMWL, 2007).

From the survey results it seems that the cost of handheld or desktop XRF analysers for testing is by far the most important cost item in the information collection and reviewing process.

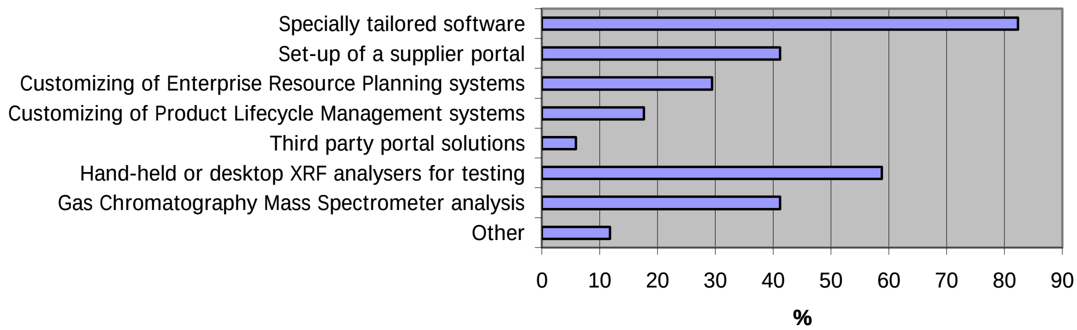


Figure 5.9: Detail of tools and applications for collecting, organising and reviewing information in the sample (17 companies)

Furthermore, companies often deal simultaneously with different markets, like the EU-market, other markets with RoHS like legislation and markets without RoHS like legislation. It is also possible that they cope with products that are included in the RoHS regulation and products that are not included or are exempted. This generates difficulties on the level of stock management or segmentation of compliant and non-compliant products and components (RoHS and non-RoS process or machines identification/labelling/isolation). Some companies specifically mention additional stock management costs as a result of RoHS regulation.

As often many components are assembled, considerable inventories have to be kept for each final product:

- From a cost saving viewpoint, these components are preferred to be used as spare parts for existing products;
- From an environmental viewpoint, non-RoHS compliant components are preferred not be disposed.
- From a component procurement viewpoint, it is a heavy burden to manage as many component suppliers being in different status in terms of the progress of RoHS compliance (category 8 and 9 products).

Twenty-three companies explicitly documented the costs incurred for the review and collection of information. Past costs and future one-off costs amount to a maximum of € 35 million, with an average of € 5.5 million and a weighted average of € 11.5 million. Future yearly costs amount to a maximum of € 3.5 million, with an average of € 1.1 million and a weighted average of € 550,000.

The following table indicates that if all personnel time made in the past for RoHS collecting and reviewing information activities is summed, this on average leads to an equivalent of 0.20% of total personnel per company. This average drops to 0.03% when the expected yearly costs in the future are assessed. In absolute figures, on average approximately 8 FTE’s per company will be dedicated globally in the future to collecting and reviewing information activities.

The company facing the highest burden per employee is a UK based SME manufacturing category 3, 8 and 9 products. This company uses a computerised inventory management system. The huge number of modifications and additions to this database require an investement of € 148,000 plus personnel working on it for at least 2 years.

Table 5.5: FTE's dedicated to RoHS collecting and reviewing information activities in the sample (23 companies)

	Absolute number of FTE's		Share of personnel dedicated to RoHS compliance	
	Past costs and one-off future costs	Future yearly costs	Past costs and one-off future costs	Future yearly costs
Highest	180,00	13,00	0,36	0,05
Lowest	1,30	0,10	0,003	0,01
Average	46,51	8,07	0,20	0,03
Weighted average	-	-	0,08	0,004

Share of personnel costs

Several trade associations mention the fact that member companies dedicate much time to RoHS compliance, depending on the company size. In the larger companies there is often a responsible working full time on the coordination of the transition process. A large multinational enterprises quoted the following: *"Our company created a ROHS compliance team, which at its peak involved more than 100 people in order to make the design changes and communicate with our upstream and downstream supply chain. Due to the pervasiveness of the impact of ROHS, it is difficult to quantify the resources needed in terms of time and money. However, it impacted every single part of the organization, from top management, to designers, operations distribution, sales, after-sales and marketing."*

Generally, job creation for RoHS compliance consists of a mix of permanent and temporary jobs. In some cases a separate job was created e.g. staff for database maintenance & operation, corporate RoHS Program Manager, new contractor to manage transition of materials supply and stock from non-RoHS to RoHS compliant. In other cases, additional adminstrative tasks have been added to existing jobs e.g. control of production processes to ensure RoHS compliance. It is also mentioned that engineering efforts focused on the introduction and improvement of new RoHS compliant processes where they instead could have been dedicated to improve functionality of existing products or to innovation (opportunity cost). Finally, additional auditing activity is mentioned to ensure RoHS compliance.

From individual contacts with respondents it seems that in a large number of cases personnel dedicated to RoHS compliance has been sourced internally. Companies state that existing staff working on RoHS constitutes an opportunity cost for them and often did not report these personnel costs in their response to the questionnaire. This would mean that companies incur opportunity costs, as personnel is given up for more essential activities, potentially leading to increased pressure on a company's normal operations.

Results of the CEA/TFI study show a similar trend i.e. the vast majority of companies hired zero or one employee for RoHS compliance, relying instead on internal resources by reassigning existing personnel.

On top of the above mentioned job creation, some companies specifically mention having contracted freelancers/consultants. In the framework of the GreenRose project SMEs also worked in partnerships with universities and research organisations. One SME also called on a private consultant.

All personnel costs related with training and information activities and with collecting and reviewing information activities were totalled. The share of personnel costs in the total past and future one-off compliance costs amounts to 38% and to 20% in total costs. Unfortunately, companies did not indicate the share of personnel costs in R&D costs, which made it not possible to calculate personnel costs dedicated to R&D. As these can be significant, the share needs to be considered conservative. The share increases up to 48% when considering the yearly future costs to remain RoHS compliant.

BURDEN RELATED WITH EXEMPTION PROCEDURES

An administrative burden is caused by the mechanism for exemptions which causes a lengthy exemption process. Trade associations mention the long waiting periods between a request for exemption and the decision. Furthermore, they mention the lack of communication to industry during this process. Products awaiting approval are not allowed to be put on the EU market, which hinders competitiveness. In some cases, uncertainty remains, despite the complete handling of an exemption request.

Respondents indicate the design of a request for exemption as the most important activity related to exemption procedures, as can be seen from the following figure. The length of the decision-making process and the withdrawal of an existing exemption are perceived as much less important. Furthermore, facing the need to provide technical evidence, it was highlighted that dealing with exemption procedures requires a lot of internal communication as well as the management of legal uncertainty on definitions for which legal services may need to be used.

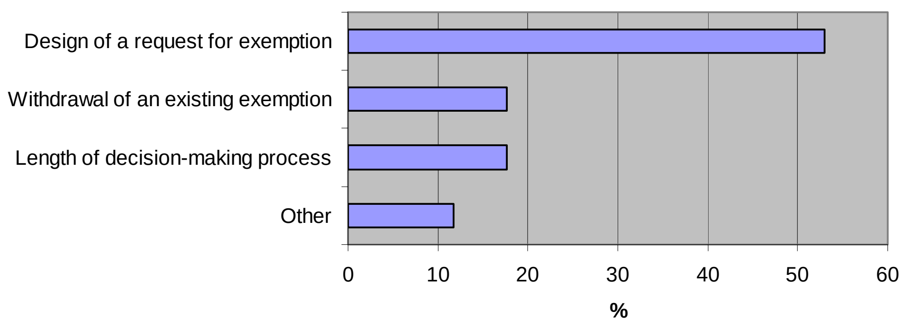


Figure 5.10: Detail of the burden related to exemption procedures in the sample (17 companies)

Ten companies have given quantitative information on costs and/or time spent for exemption procedure activities. Costs made for exemption procedures make up only about 1% of total costs related to RoHS.

However, absolute figures can be important. Concerning the costs related to or resulting from exemption measures, two different cost margins can be distinguished. On the one hand, costs are given in a range of € 100 - 1000. Other companies state having incurred costs between € 20,000 - 2,000,000 spread over several years. We tend to believe that the first group of companies only refers to the costs of the exemption handling, without the process of technical evidence collection which is included in the second range. Unfortunately, this could not be confirmed through individual contacts.

5.2.2.4 Technical costs of phase-out of RoHS substances

The technical costs of substance phase-out constitute of about 33% of total costs made in the past. Past costs and future one-off technical costs amount to a maximum of € 39 million, with an average of € 6.9 million and a weighted average of € 8.7 million.

The technical costs only make up 12% of the total costs which are expected to continue yearly. Future yearly costs amount to a maximum of € 500,000; with an average of € 183,000 and a weighted average of € 10,000. As already mentioned, this may be explained by the inaccurate reflection of operating expenditure of substance phase-out in the responses.

The technical costs related to RoHS compliance mainly consist of:

- Capital expenditure to either upgrade/modify or replace existing equipment;
- Operating expenditures related to:
  - The purchase of potentially more expensive alternative materials and substances;
  - Potentially greater energy costs;
  - Expenditure to demonstrate compliance with regulations.
- Research and development to find, test and employ substitutes to replace restricted materials and substances.

OVERVIEW OF THE COSTS OF LEAD PHASE-OUT

Technical costs of substance phase-out mainly occur as a result of the phase-out of lead. The use of lead in solder has been widely established for many years, and its substitution raises a number of technical isues. The use of mercury, cadminum and Cr(VI) has been, and is more limited in the manufacture of EEE. These materials are either used for more specific specialist applications and/or have been declining in use because of industry itself moving towards the use of less hazardous materials and substances.

Fifteen companies have given cost information on the phase-out of lead. This information is complemented by costs of 3 SMEs provided in the GreenRose project. The costs of the phase-out of lead can be broken down into three major components, as can be seen from the following figure. The major part, almost half of the costs, consists of capital expenditure.

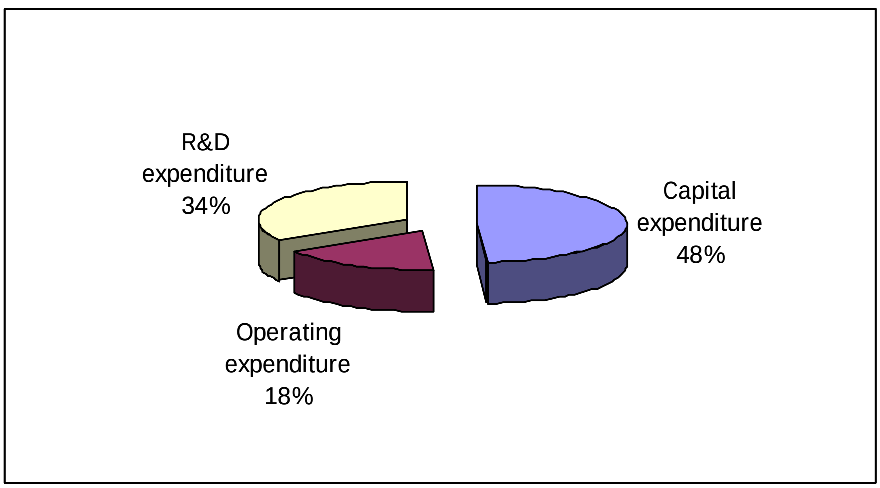


Figure 5.11: Composition of costs of lead phase-out in the sample (18 companies)

Most costs are bourne in the past; the weighted average of the past costs and one-off future costs of lead phase-out related to turnover amounts to 0.03%.

Capital expenditure of lead phase-out

The phase-out of lead in solder has an impact on the soldering machinery in place. Most lead-free solder alloys have a higher melting point than their substitute tin-lead solder alloys. The melting points of the most popular lead-free solders are 19 to 24% higher. Besides the fact that these higher melting points cause higher energy use and problems with some materials and components, the soldering process, and thus the soldering machines, must be adapted (Deubzer, 2007).

The adaptation of soldering machines actually implies either the replacement or the upgrading/modification of existing equipment, requiring capital investments of those companies fixing electrical and electronic components to the printed wiring boards (PWB's). Reflow and wave soldering ovens are the standard technologies for interconnecting the electrical and electronic components on PWB's (UK DTI, 2006 and Deubzer, 2007).

In order to assess the investment costs stemming from the phase-out of lead in solder, the companies were enquired about:

- The use of reflow and wave soldering machines (RSM's and WSM's);
- The strategy for the premature (before the end of the economic lifetime of old equipment) adaptation (modification/refurbishment or replacement) of the installed soldering machinery;
- The cost relatedto the modification/refurbishment and/or replacement of soldering marchines.

Eight companies provided some information on the capital costs incurred from the adaptation of their soldering ovens. Only 3 companies provided a fairly comphrensive answer on all of the above enquiries.

Seven companies provided information on the total capital costs for the premature replacement and/or modification/refurbishment of soldering equipment. The costs range between € 14 million and € 25 million.

Concerning wave soldering machines (WSM's):

- One company mentions that all WSM's were modified/refurbished, but none needed to be replaced;
- One company stated that half of the WSM's needed to be replaced and the other half needed to be modified/refurbished;
- In two companies, the share of WSM's to be modified/refurbished was 38% and 84% respectively.

Two companies give an idea of the average cost of a new WSM: € 80,000 (indicated as average between € 50,000 and € 100,000) and more than € 200,000.

The range of the costs of modification/refurbishment of a WSM varies largely:

- Within one company, the costs can vary with a factor ten between € 27,000 and 236,000.
- Three companies gave average costs of € 21,184; € 30,000 and € 300,000.

Concerning reflow soldering machines (RSM's):

- One company mentioned that all RSM's were modified/refurbished, another company mentioned that all RSM's were replaced;
- One company mentioned that 8% (25 out of 300) of the RSM's was replaced, but no information was given on what happened to the remaining RSM's;
- One company mentioned one third (4 out of 12) of the RSM's needed to be replaced and that no machinery was modified/refurbished.

Four companies gave an idea of the average cost of a new RSM: € 60,000; € 80,000 (indicated as average between € 50,000 and 100,000); € 121,488 and € 200,000. One company indicated similar purchasing costs for WSM's and RSM's.

Costs of the modification/refurbishment of RSM's vary even more than for WSM's:

- Within one company, the costs varies between 20,000 € to 50,000 €, with an average of 30,000 €;
- One company stated an average cost of € 600,000 for the refurbishment of an RSM.

The ELFNET Lead-free soldering status survey of 2006 provides insight in the effect lead-free soldering has had on soldering equipment and thus capital expenditure. Analysis of the results indicated that some 36% of respondents only using lead-free solders, had purchased new wave soldering equipment. Another 41% had upgraded their equipment and 23% of the respondents had not changed their wave soldering ovens at all. Concerning the reflow soldering process, around 31% of the lead-free solder users purchased new reflow soldering equipment. Around 45% had upgraded it. The latter 24% had not changed their reflow soldering equipment at all (ELFNET, 2007a).

The lower rate of replacement of reflow ovens relates to the fact that most ovens manufactured after 1996 can meet the specific requirements of lead-free soldering. For wave soldering equipment the situation is different, as only from 2004 onwards wave soldering ovens are able to cope with the specific process requirements of lead-free soldering. The share of 23% which does not replace or adapt its wave soldering equipment may be surprising. However, it can be explained by the fact that wave soldering equipment can still be used under moderate operating conditions. Nevertheless, within a few years severe problems with the equipment are expected and equipment will have to be replaced anyway (ELFNET, 2007a).

In the Full Regulatory Impact Aassessment of the UK DTI it was assumed that 50% of the WSM's that would be affected – and thus not been used for activities that are exempt – by the regulation may need to be refurbished and 50% may need to be replaced to accommodate lead-free soldering. For what concerns RSM's it was assumed that only 10% may need to be replaced and 90% refurbished to accommodate lead-free soldering (UK DTI, 2006).

We contacted SEHO, the leading manufacturer of soldering machines, several times in order to obtain market data on the number of machinery in place in EU companies. However, these contacts have not led to concrete results.

Neither the results of the ELFNET-study nor the assumptions of the UK DTI-study are in line with any possible trend in the information gathered through our survey. It is clear that our sample is too limited compared to the observations cited above. Moreover, in the simplified questionnaire detailed information was not asked anymore on the type of machinery used in the firm. In the simplified version, it was asked to assess capital costs of lead phase-out as a total figure.

The cost of new soldering machinery depends on the specifications of the machinery, which are developed to meet the diverging needs of industry. In the Full Regulatory Impact Aassessment of the UK DTI and the Preliminary Environmental and Economic Assessment of Australian RoHS Policy costs by Hyder Consulting (which is based on the UK DTI impact study), the following average estimates are given:

- Refurbishment of a WSM: € 14,800
- Replacement of a WSM: € 37,000
- Refurbishment of an RSM: € 14,800
- Replacement of an RSM: € 44,000

As a comparison, the costs quoted in our questionnaire are several times higher:

- Refurbishment of a WSM: 1.25 – 20 times higher
- Replacement of a WSM: 1.35 – 6.4 times higher
- Refurbishment of a WSM: 1.25 – 40 times higher
- Replacement of a WSM: 1.35 – 5.5 times higher

This may be due to the overrepresentation of multinational companies, trying to realise economies of scale and thus using the largest or specially designed ovens. From a confidential source, we obtained an assessment that a basic lead-free compatible oven costs around 30,000 € and may range up to 165,000 €, which already shows the large variation.

The SMEs within the GreenRose project also indicated to have replaced and/or modified soldering equipment. One company explicitly stated to have invested in a small oven for 20,000 €. A company that refurbished its soldering machinery mentioned it probably would have been less troublesome if it had purchased new equipment instead of modifying its existing machinery.

In order to deal with quality assurance issues whilst complying with RoHS, a medium-sized IT company in our survey needed to buy equipment for reliability testing of finished products. The investment amounted to 200,000 €, corresponding to 2% of the annual turnover.

Operating expenditure of lead phase-out

Besides the additional costs of the shift to lead-free solder, lead-free soldering itself can give rise to higher operating expenditures e.g. higher direct material costs for lead-free solders and finishes and higher energy costs.

Seven companies indicated that they incurred additional direct material costs related to the phase-out of lead. Six of them provided a monetary estimate of the additional direct material costs. The reasons stated were:

- Alternative materials used in the process are more expensive (4 companies);
- Alternative materials used in the components are more expensive (4 companies);
- The potential for lower yields and higher failure rates, as a consequence of a number of technical issues with lead-free soldering (4 companies);
- The expectation of larger levels of re-work and repair, as a consequence of technical issues to do with lead-free soldering (3 companies);
- One company adds the requalification and identification of alternative sources as an additional operational cost.
- One company mentions a 10% increase in energy required and another company specifically says that there is no increase.

The yearly additional direct material costs mentioned vary between € 10,000 - 500,000 in absolute terms and between 0.0005% and 0.04% of yearly turnover.

Below, these results are compared to findings in literature and other projects.

Higher purchasing costs of substitutes

Tin-lead solders will be replaced by the same volume of lead-free solders, but not the same mass. This means that less mass is needed to replace the tin-lead solder if the lead-free alternative has a lower density. The lower densities of the lead-free alternatives thus reduce the demand (in tonnes) for reflow and wave solders. The lead-free solders for PWB’s, however, contain metals like silver and gold with a higher economic value. The higher cost – and thus value – of lead free solder may change recycling practises of the conventional lead-tin solder (Deubzer, 2007).

When expressing the additional direct material costs relative to the tonnes of lead that were phased out, for one company an additional cost per tonne was calculated of € 7,500 and for another company this amounted to € 62,500.

In Deubzer (2007), a price increase is indicated of € 13,215 per tonne (or a price increase of 28% per tonne) for lead-free reflow solder and an increase of € 12,107 per tonne (or an increase of 186% per tonne) for lead-free wave solder. Because of the lower density of lead-free solder, the additional direct material cost of solder is somewhat lower per unit of output. The cost increase for lead-free reflow solder is relatively small as the metal cost makes up a smaller part of the cost of reflow solder paste.

On a global scale, corrected for recycling, the costs of lead-free solder would be € 660 million higher than for lead solder. The cost of solder approximately doubles. The costs of lead-free finishes are also expected to add significantly to the operational costs of substance phase-out (Deubzer, 2007).

The companies involved in GreenRose state that their costs of base material have increased. Solder prices became more expensive. One company indicates a price increase of 30% and 200%, with the former probably referring to reflow solder paste and the latter to solder for wave soldering. A designer-manufacturer of niche or specialised products on a business-to-business basis estimates a modest increase in operational costs (i.e. solder prices).

Higher component costs

Furthermore, material input can also increase because of higher component costs. Prices for lead-free solder are clearly dependent on competition and on the level of demand and have the tendency to reduce over time. Components, on the other hand, often constitute of a much larger proportion of product cost than solder. Components may have to be adapted because of changes in the solder process and in particular the higher process temperatures, requiring other materials to be used in components. These changes open up the potential for higher failure rates in the manufacturing of components and the expectation of greater levels of re-work and repair of components (UK DTI, 2006).

The companies involved in GreenRose state that the costs of bare boards, which are able to withstand the heat, increased. One contract manufacturer, however, stated that prices of component did not rise.

Higher energy costs

Because of the higher melting temperatures of lead-free solders, the energy use is expected to rise. Deubzer calculated energy costs would rise by € 11 million or 19%. However, the additional use of energy is judged to be only a minor factor in the total costs increase (Deubzer, 2007).

More than half of the SMEs in the GreenRose project explicitly stated that their energy costs increased by 3.6%; 10%; 13%; 27% and 30%.

In the framework of the GreenRose programme, 3 out of 8 SMEs indicated they suffered from a decreased throughput. One company stated production capacity decreased by 7% whereas another company believed the throughput decreased by 2.5%. The reason for this it that the heat transfer rate can only to a minor degree be increased via higher peak temperatures. The number of soldered PWB's per unit of time thus has decreased. The lower throughput and the higher energy consumption are closely related and partly overlap (Deubzer, 2007).

R&D expenditure of lead phase-out

Restrictions on the use of lead in solder and different process conditions for lead-free soldering require substantial reseach and development efforts. In the UK DTI Full Regulatory Impact Assessment it was indicated that a number of, principally Japanese based, multinational companies had undertaken significant R&D efforts long before RoHS came into force as they voluntarily agreed to phase out the use of lead in a range of consumer electronics. However, much reseach was still required, especially in the more specialised EEE sectors (UK DTI, 2006).

R&D expenditure varies a lot in absolute terms in the results of our survey. The same goes for the percentage share of RoHS related R&D in total R&D expenditure.

One large household manufacturer stated that R&D expenditure for RoHS made up about 0.5% of total R&D expenditure. R&D efforts remain stable, at least until 2008. The same trend, but for a yearly share of 1% of total R&D expenditure, has been mentioned by a Japanese multinational manucturer and component supplier of category 3 and 9 products. However, two other companies stated to have attributed about 80% of their yearly R&D expenditures to RoHS related activities up to restrictions came into force. This expenditure is reduced to zero afterwards. Our own calculations indicate RoHS specific R&D efforts are well below 1% of annual R&D efforts for a multinational component manufacturer and a multinational category 3 and 4 manufacturer.

In the UK DTI Full Regulatory Impact Assessment it was assumed, based on survey results and discussions with the sector, that R&D expenditure in relation to lead-free soldering may, at its peak, represent 5 % of total R&D expenditure. R&D expenditure will decrease in the years after the restrictions enter into force (2.5% in 2007 and 0.5% in 2008). For the category 8 and 9 products efforts will most probably not decrease, but even strengthened (UK DTI, 2006).

JEMIMA mentions that although their members covering category 8 and 9 products are still out of the scope of RoHS, many companies are already (in the process of) preparing for RoHS. A lot of these companies have established lead-free soldering processes. During the design of new products, RoHS requirements are taken into account. These products typically have a long life, resulting in a research cost for existing products to replace non RoHS compliant components with RoHS compliant alternatives being a few times more costly than research for new product design.

Testing the technical conversion in medical applications still needs additional innovations to take place and demands more tests to assess quality related issues. Because of their smaller scale, necessary developments and repeated quality testing may consitute a relatively more important burden for SMEs compared to larger enterprises.

Five SMEs taking part in the GreenRose project explicitly mentioned their R&D costs to make up a substantial part of the financial burden of the RoHS Directive. Most SMEs do not have an R&D department to conduct the technology adaptation and therefore rely to a greather extent on cooperation projects and related dissemination activities set up for them. The assistance of knowledgeable research organisations is often critical, but not always easily accessible.

One company stated R&D work has been undertaken over 9 years now, though efforts increased substantially in the last years. The company states it is difficult to document the R&D costs of the implementation, as a large part of the work was done alongside general product development. Nearly € 100,000, or 0.7% of annual turnover for a period of 7 years, has been spent on RoHS. Besides, a consultant was hired and some people of the existing staff were heavily involved. The set-up of a sort of RoHS-working group has also been used in another company. Personnel costs were stated to make up the lion part of R&D expenses.

OVERVIEW OF THE COSTS OF PHASE-OUT OF OTHER ROHS SUBSTANCES

As SMEs depend to an important degree on available knowledge, the burden related to the phase-out of other substances is probably relatively more important for SMEs than for large and multinational companies.

Cost information on other RoHS substances is much more limited. Three companies reported costs of cadmium phase-out. Total costs per company are between € 21,000 - 500,000 and are limited in time.

Five companies reported on costs of Cr(VI) phase-out. Total costs per company are between € 20,000 and 3,000,000. The companies concerned are 3 US manufacturers of category 3 products, of which one is also manufacturer of category 4 equipment, a European and a Japanese manufacturer of large household appliances, with the European manufacturer also producing small household appliances.

Two companies reported costs of mercury phase-out. Total costs per company are € 500,000 and € 1,300,000. One is a US manufacturer of category 3 and 4 products and incurred related expenses from 2003 onwards. The other company is a European manufacturer of lighting equipment and started related activities from 2000 on.

Two companies reported on costs of PBB-PBDE phase-out. Total costs per company are € 105,850 and € 500,000. One company is a US manufactuere of category 3 and 4 products. The other company is a European manufacturer of category 1 and 2 products.

Three companies specifically mention that the phase-out of cadmium, Cr(VI), mercury and PBB/PBDE does not entail a cost increase. This may be explained by the fact that most EEE producers act as assemblers of components produced by different suppliers, which handle the technical phase-out. But even then, operational costs could have increased as a result of a price increase of components. We might conclude that the phase-out of these substances does not lead to considerable costs. In its Regulatory Impact Assessment, the UK government also suggested that R&D investment to replace CrVI and cadmium are relatively small (UK DTI, 2006).

ABILITY OF PASSING COSTS TO CUSTOMERS

Two companies of the survey in which the lead phase-out caused increasing capital and operational expenditure, state that increased purchasing costs of materials and components can be passed on to the customer. All other companies state that they are not able to pass costs on to consumers, because of competitiveness pressures in the market. This point was also clearly taken in stakeholders discussions during the workshop.

Some SMEs in the GreenRose programme also extended on this issue. Two companies indicated that they take full responsibility of the increased costs. A third company says to pass on about half of the additional costs down the chain. One conctract manufacturer, at least, tries to fully pass on the increased costs to its customers.

These results should be nuanced by some other literature and sector survey findings.

In the ERA (2006) review of RoHS categories 8 and 9, it is stated that in most cases, increased costs would eventually be passed on to users as all manufacturers in the sector will incur the same costs and so competition will not significantly inhibit price rises. Moreover, residual number of future sales to support these additional costs will be less than for a new design, as it occurs part way through the lifecycle of an existing design. This would inevitably be passed on to consumers, rising health costs substantially.

In the CEA/TFI sector survey (2008), companies indicate the following solutions to recoup costs:

- Introduce new products (increase revenues) (more than 30%);
- Raise prices (more than 30%);
- Nothing = absorb increased costs (more than 30%);
- Workforce reduction (more than 10%);
- Other

5.2.2.5 Other monetary losses of compliance

Besides the compliance costs and the technical costs of substance phase-out, respondents were also equired about the importance of the possible wider monetary losses of RoHS compliance such as:

- Decrease in turnover and/or sales volume;
- Temporary discontinuation of non-compliant products;
- Delayed introduction of new products;
- Costs of dealing with pre-mature product reliability failure;
- Lost revenue due to diverting internal resources from new design/innovation to working on substitutes;
- Discontinuation (destroying) of non-compliant products.

The costs of the various monetary losses amount to 5.5% of the total costs of RoHS of the companies in our sample. Nine companies explicitly documented the costs incurred for one or more of these aspects. Costs of monetary losses range from 2.5% to 0.002% of turnover with an average of 0.42%. As for the total burden of RoHS, smaller companies face a disproportionate burden of RoHS training and information. No recurring costs were provided.

In the CEA/TFI study, other monetary losses were reported by approx. 30% of respondents, with an average loss of $ 1.84 million (€ 1.25 million). Causes of these losses are delayed introduction of new products (47%), discontinuation (destroying) of non-compliant products (22%), lost revenue due to diverting internal resources (8%), decrease in turnover and/or sales volume (7%), other reasons (15%).

More than 60% of the respondents declared not to have incurred a decrease in sales volume from complying with RoHS, see also the figure below. Three companies specified the height of the costs incurred. Costs ranged from € 500,000 to 2,005,700.

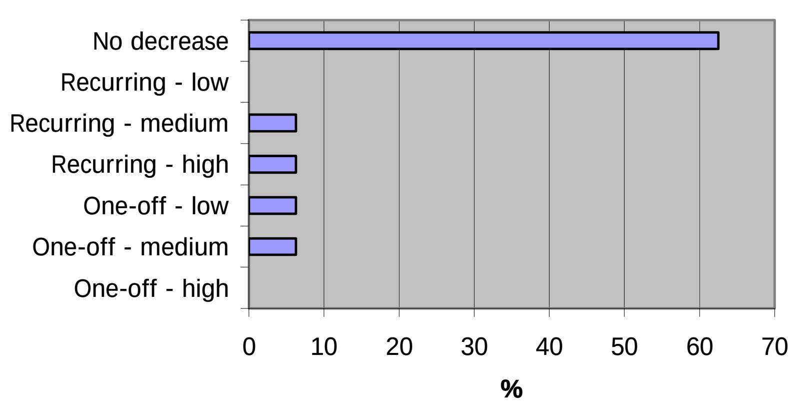


Figure 5.12: Indication of the nature of the costs of the possible effect on sales volume experienced from RoHS compliance in the sample (16 companies)

TEMPORARY DISCONTINUATION OF NON-COMPLIANT PRODUCTS

The following figure provides an overview of the respondents' qualitative assessment of costs related to the discontinuation of non-compliant products. More than 30% of the respondents qualified these costs as being high. One company stated that the temporary discontinuation of non-compliant products resulted in a loss of € 300,000.

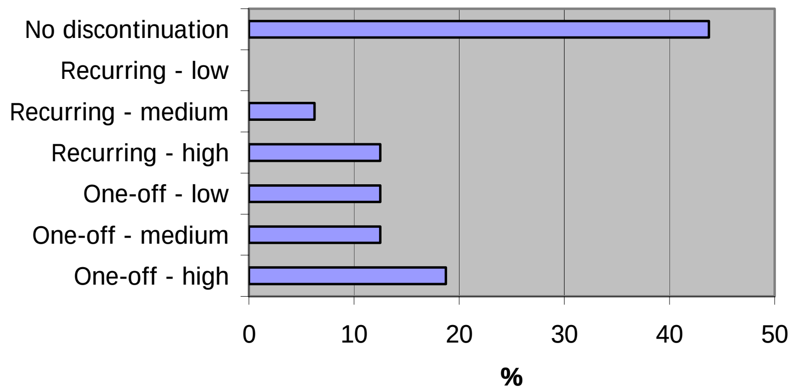


Figure 5.13 Indication of the nature of the costs of the possible effect on the provison of non-compliant products as a result of RoHS compliance in the sample (16 companies)

DELAYED INTRODUCTION OF NEW PRODUCTS

Less than half of the respondents stated to have incurred not any costs from the delayed introduction of new products. One company stated that the delayed introduction of new products has costed € 200,000.

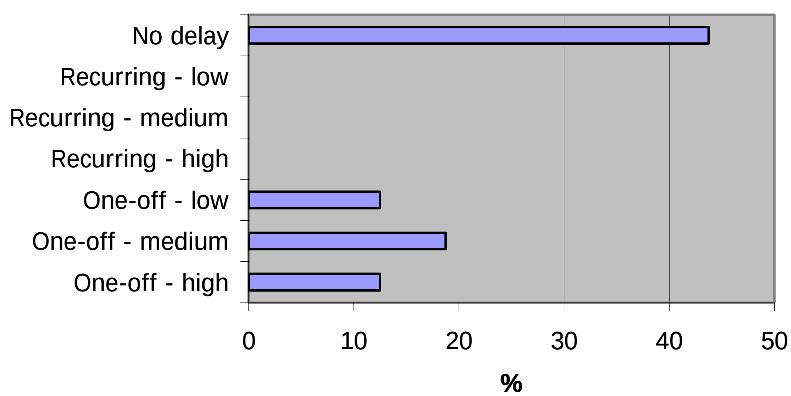


Figure 5.14: Indication of the nature of the costs of the possible effect on the timing of the introduction of new products stemming from RoHS compliance in the sample (16 companies)

Additional Comments provided:

- Some manufacturers gave examples of the delayed introduction of products due to one or more components not being compliant with the RoHS Directive. This included motor components, water-filters and printer components. This appears to indicate a transitional timing issue in the supply chain for many companies as they need to ensure each supplier is compliant by the same time; however, in a small number of cases, responses indicated that the long design cycle for some components created the delay.
- A number of companies highlighted that this was a one-time issue during transition to RoHS-compliant parts near the RoHS implementation deadline, but created no ongoing issues, as new products currently released are RoHS-compliant.
- Estimates of delay costs provided were $1m for 6 month and $5m for a year, relating to a single product delay in each case.

COSTS OF DEALING WITH PRE-MATURE PRODUCT RELIABILITY FAILURE

As appears from the following figure, about 25% of the respondents indicated to have suffered costs related to dealing with pre-mature product reliability failure. Those companies having pointed out to have suffered increased costs, do not categorise these costs as high. This is contrary to the findings that companies indicated the evolution towards RoHS compliance as being complicated by higher failure rates and the need for specific design changes and long validation cycles.

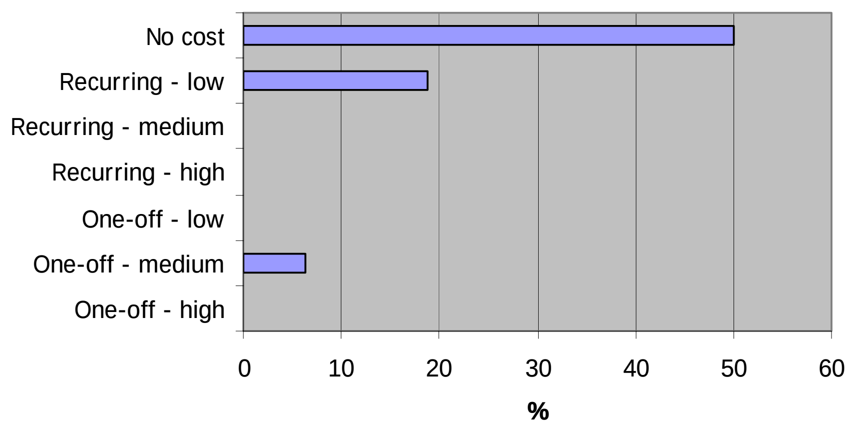


Figure 5.15: Indication of the nature of the costs of dealing with pre-mature product reliability failure as a result of RoHS compliance in the sample (16 companies)

LOST REVENUE DUE TO DIVERTING INTERNAL RESOURCES FROM NEW DESIGN / INNOVATION TO WORKING ON SUBSTITUTES

30% of the respondents indicated to have incurred losses from diverting internal resources for design and innovation to working on substitures, see the following figure. This result may correspond with the fact that personnel working on RoHS related activites are mainly people already working for the firm. People are sourced internally, often from the product development department, thereby abandoning other research efforts.

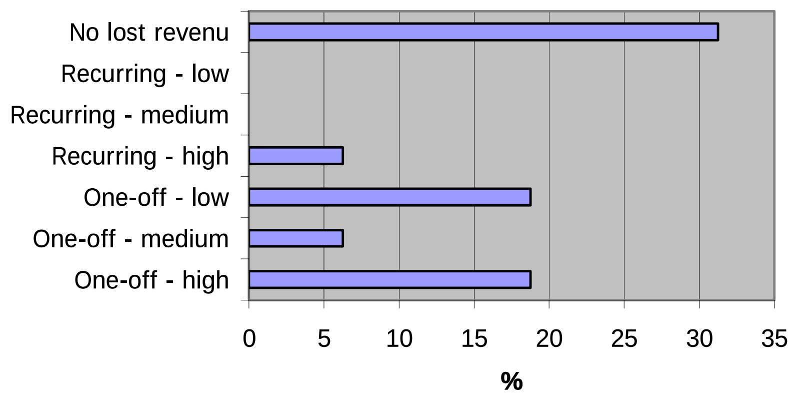


Figure 5.16: Indication of the nature of the costs due to diverting internal resources from new design/innovation to working on substitues as a result of RoHS compliance in the sample (16 companies)

Whilst 19% of responding companies indicated that they had allocated additional budgets to RoHS compliance, the clear majority were either unwilling or unable to do so. Significantly, only larger companies answered that they were doing so, with those SMEs responding indicating that they had not.

DISCONTINUATION (DESTROYING) OF NON-COMPLIANT PRODUCTS

The discontinuation of non-compliant products, possibly requiring the destruction of those products, is another cost factor. Seven companies documented related losses, ranging from € 60,000 to 7,000,000 with an average of € 2,409,821. One company also declared to have incurred losses to the amount of € 90,000 from obsolete components.

5.2.2.6 Insecurity of meeting the products' requirements

Category 8 and 9 products, currently stil out of scope, concern specific high market value products and a large degree of customisation to meet the specific performance and reliability requirements of customers. They are produced in low volumes but with a wide range of applications and they have a long product life (up to 30 years). This category is in contrast to consumer electronics producers, who typically have smaller product ranges, lower unit prices and a decreased expectation of reliability. Unlike consumer goods, these products are not subject to fast-paced changes in market patterns, as they are in a slow moving market.

Reliability is a key requirement of products with a long lifetime. The reliability requirement is one of the most fundamental drivers of its design and service activities. The redesign work necessary to be RoHS compliant will require retesting and re-qualification under a large number of conditions. Considerable time is needed to evaluate available substitutes against the demanding requirements as compared to consumer products.

Even if all the parts are RoHS compliant, there is still a big question about the long-term reliability of non-lead solder assemblies. There have been no substantiated studies which allow predicting product reliability 8-12 years into the future, while there are studies that show the possibility of tin whisker growth well within that time (Test & Measurement Coalition, 2006).

5.2.2.7 Burden related to the exemption process

EXEMPTION PROCESS MAY HINDER INNOVATION

Whereas the RoHS Directive bans or limits the use of hazardous substances in EEE products, the Directive allows for exemptions from its provisions where the benefits of retaining certain hazardous substances until an effective substitute can be identified outweigh the perceived drop in performance of certain products.

Whilst these hazardous substances are still allowed under exemptions, it is difficult to ascertain how much effort and investment companies will put into the development of alternative products with less environmentally damaging substances. In this way, the process of granting exemptions can be considered as hampering innovation. Also, the exemption process itself, often taking more than a year to complete, is considered by some stakeholders to be a hindrance to research and development for new innovations.

On the other hand, on its website documenting the progress of the study on Category 8 and 9 products, ERA Technology presented the conclusion that researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder the development of new technology, as fewer materials are considered and potential improvements and new products are not developed. The ERA Technology final report on the Category 8 and 9 study provides a number of examples of products developed using banned substances (MRI scanners, semi-conductor X-ray detector arrays, improved control systems for detecting hazards such as pollutants) which simply would not have been available if the materials had been banned from research.

<u>Exemption process should consider balance between environmental and economic impact</u>

Another aspect in the question whether or not to grant an exemption, could be the investigation of the balance between the environmental benefits of RoHS compliance and the economic costs of becoming compliant. It is possible that the costs to comply are extremely high, whereas the additional environmental impact of RoHS compliance for a certain application is very low.

From the results of this study, it was not possible to generate general criteria determining cases in which a very high economic cost of compliance does not balance with an extremely low environmental impact. However, the analysis showed that Category 8 and 9 products of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material are at the limit regarding costs and benefits.

LACK OF ECONOMIC CRITERIA IN EXEMPTIONS WITHDRAWAL PROCESS

Producers of electrical and electronic equipment (EEE) are well aware that exemptions will not last forever and are therefore actively working to eliminate the use of substances in applications that are currently exempted. However, even if alternative technologies are available, the implementation in product designs requires consideration of various business realities such as:

- Availability of the technology in the parts currently used in products;
- The functionality of the new technology (including reliability) compared to the current technology used;
- Design implications of using parts containing the new technology;
- Cost implications of the transition to the parts containing the new technology.

Where alternative technologies for the restricted substances were not (yet) available, exemptions were granted. Since then producers working in the framework of these exemptions are working with their supply chain to review alternative technologies. The process of implementing alternative technologies is highly complex and in the process producers need to review:

- whether the technology is fit for the particular use (i.e. whether the properties and quality/reliability aspects meet the demand);
- whether the alternative is a direct replacement or that redesigns of EEE would be required;
- Whether parts using the new technology are available through the producers' current supply chain (i.e. adding new suppliers in case an existing supplier does not have access to the new technology).

Once a new technology is found acceptable, it needs to be implemented throughout the logistic process (such as supplier approvals, contracting, parts ordering) before it can be implemented in the manufacturing of EEE. In case the application of the new technology requires a re-design at the EEE level, the re-design process (including design verification, product testing) needs to be completed prior to the start of the manufacturing process.

The key factor in applying a new technology by EEE producers is the time required between the availability of a new technology up-stream in the supply chain and the ability to place EEE on the market after completing all tasks as described above.

According to some stakeholders, the current experience with the application of the criteria of article 5 of the Directive leads to the conclusion that this provision requires modification to allow a more realistic process for the review and future withdrawal of exemptions, more in line with commercial reality. Today's practise creates high levels of uncertainty for producers every time the removal of an exemption is considered. In addition, it is possible for one upstream player in the supply chain to put at risk the placing on the market of a whole range of EEE across the industry by notifying the Commission of the availability of a new technology. The Commission should recognize the competitive advantage and, indeed, potential monopoly due to an unbalanced market availability that a supplier can reap due to premature elimination of a key exemption on which the industry has relied. Premature withdrawal of an exemption can have severe implications for the EEE sector and consumers.

In conclusion, stakeholders believe it is necessary for the decision-maker to take into account the following economic criteria when considering the removal of an exemption:

- the large scale availability of a new technology to meet the volume needs of the industry;
- the necessary lead times for implementing changes in the manufacturing process to adapt to the new application;
- the highly technical matters of supply chain management, product re-design and reliability analysis (EICTA, 2007).

5.2.2.8 Who's at the limit regarding costs?

SPECIFIC BURDEN ON SMES

On average, the burden of total past and one-off future costs of complying with RoHS amounts to 5.2% of SMEs turnover. For the other companies in the sample, mostly being multinational companies, the burden of total past and one-off future costs on average amounts to 1.1% of their turnover. The weighted average, which amounts to 4.2% for SMEs and to 0.062% for large and multinational companies, shows the fundamentally different burden which SMEs are facing.

CELMA represents 1200 companies involved in luminaries (excluding lamps). 80% of their members are medium-sized, 10% are small and 10% or large companies. CELMA strongly agrees that SMEs are affected to a greater degree by compliance with the RoHS legislation compared to their larger competitors. Companies having a smaller labour force are obliged to carry out the same requirements as companies with a larger pool of labour.

This means that the indicator stating the share of FTE's dedicated to RoHS regulatory compliance within the total number of employees will be much larger in SMEs compared to larger companies. Unfortunately, we cannot to prove this statement with the sample results. As already mentioned and following from individual contacts with SMEs, they tend to source personnel from inside the company and have underestimated time dedicated to RoHS activities.

CATEGORY 8 AND 9 PRODUCTS OF THE WEEE DIRECTIVE AND EQUIPMENT WHICH IS CONNECTED WITH THE PROTECTION OF THE ESSENTIAL INTERESTS OF THE SECURITY OF MEMBER STATES, ARMS, MUNITIONS AND WAR MATERIAL

Categories 8 and 9 are currently excluded from the scope of the RoHS Directive. The Commission's own interpretation is that military equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material, is also exempt[9]. The vast majority of EEE and prior use of hazardous substances falls within categories 1-7 and 10 and, with the Directive having come into force on 1st July 2006, industry has already been forced to adapt its products to comply with the Directive's provisions. Materials and components suppliers are often suppliers to companies manufacturing products in categories 1-7 and 10, as well those in categories 8 and 9; they are also often suppliers of manufacturers of equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material. Consequently, as these suppliers have moved towards producing materials and components which are RoHS compliant and have possibly phased out use of the banned substances, the potential exists for shortages of these items for companies which are producing products not covered by the RoHS restrictions.

The stakeholder consultation indicated that Category 8 and 9 products specifically would suffer from the RoHS regulation. They concern specific components by custom design, produced in low volumes but with a wide range of applications and have a long product life (7 to 30 years).

COCIR, representing the Medical Device sector (category 8), mentions that although the Medical Device sector is exempted, their companies are gradually changing the individual electro-medical devices towards RoHS compliance as a result of the changes within the electronics industry. The companies also are impacted by RoHS through the ongoing changes in their supply chain.

JEMIMA mentions that although their members covering category 8 and 9 products are still out of the scope of RoHS, many companies are already (in the process of) preparing for RoHS. A lot of these companies have established lead-free soldering processes. During the design of new products, RoHS requirements are taken into account (because of the typical long product life).

Article 6 of the RoHS Directive required the Commission to carry out a review of the Directive and present proposals for including Categories 8 and 9 EEE within the scope of the Directive. ERA Technology was contracted by the Commission to conduct the review and the findings were presented in 2006. In the ERA review of RoHS categories 8 and 9, it is stated that modification of more complex existing products

[9] P.5 Frequently Asked Questions on Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) at http://ec.europa.eu/environment/waste/pdf/faq_weee.pdf

to comply with RoHS add considerable large costs to the originally spent costs, hereby doubling costs during the lifetime of a product. Additional costs per product of modification could be as high as 20%, although most will be less and in the range from 1 to 10%. As this cost increase needs to be spread over a limited number of units sold, the cost per unit will change considerably. If manufacturers are not able to increase prices outside the EU due to the presence of non-RoHS compliant products in these markets, the sales price increase in the EU only would have to fund this cost.

From the results of our sample, on average, the burden of total past and one-off future costs is higher for the companies involved in the production chain of category 8 and 9 equipment compared to other sectors. The average burden in terms of turnover for the companies directly or indirectly dealing with medical devices amounts to 4.7%; 2.45% for those dealing with monitoring and control equipment and 1.16% for other sectors. However, the weighted average burden provides a different insight, as it amounts to 0.04%, 0.19% and 0.06% respectively. The companies active in category 8 and 9 equipment of the sample do not state different future, neither one-off nor recurring costs compared to companies involved in the production of other EEE categories.

The ERA (2006) report concludes "It is possible to include categories 8 and 9 in the scope of the RoHS Directive but manufacturers will need sufficient time to comply and some sectors will need more time than others".

This overall conclusion was caveated with the condition that, if these categories were to be included early, there would need to be a significant number of exemptions in order to ensure the safety and functionality of a number of pieces of equipment and that the exemption process would need to be speeded up significantly. In the situation where these products have to comply with RoHS without a reasonable transition period, many older products will need to be obsoleted. This means that in many cases it will not be possible to get a return on investment from redesigning older products because of the resources involved.

On its website documenting the progress of the study, ERA Technology also presented the conclusion that researchers and designers often do not consider using RoHS restricted materials for new products. As a result, this may hinder the development of new technology as fewer materials are considered and potential improvements and new products are not developed.

Perhaps the most sensitive product category is formed by Category 9 products: monitoring and control instrumentation. While medical, aerospace and military products are critical sectors with human life often depending on their equipment, these products are only as good as the testers verifying their performance and permitting them to leave the lab for the field.

The monitoring and control instrumentation category sector covers a large range of different products (each company is producing 1,600 product types on average), which have a high market value (product prices range from € 100 to € 1,000,000, with an average price of € 5,400) and a large degree of customisation to meet the specific performance and reliability requirements of customers. This category is in contrast to consumer electronics producers, who typically have smaller product ranges, lower unit prices and a decreased expectation of reliability.

Unlike consumer goods, test & measurement equipment is not subject to fast-paced changes in market patterns, in a slow moving market. Quantities sold are minor (350 units on average per product per year in the EU total). Some systems are sold in very small quantities (2-10) whereas the highest volume products may reach 5,000-10,000 per year. Products are primarily sold to laboratories, universities, government and industry rather than to private consumers.

The products placed on the market typically last for many years - between 7-30 years and 10 years on average. The lifetime of any given unit can often be extended through regular maintenance and servicing.

The quantities and long lifetimes of test & measurement equipment are closely related to the design cycle. The products do not undergo frequent re-design, because there is little market demand for such changes. Whereas a mobile telephone's existence on the market may last for approximately two years, monitoring and control instrumentation are only redesigned every 5 to 15 years with an average of 7 years.

Forced obsolescence will have a significant impact on companies who have invested in modular T&M systems. A modular T&M system consists of individual products residing in a rack/chassis to create a modular system. A modular system can be continually upgraded as application needs change or as individual parts fail and need to be replaced. Because many older products will become obsolete, a customer will no longer be able to replace only the portion of his system that fails to meet new requirements. The entire system will need to be scrapped and a new system purchased causing two effects. First, more equipment than necessary will become waste having an environmental impact. Second, the customer will have a significant financial burden due to:

- The cost to replace an entire system which could easily exceed the cost of a single product by many times;
- The additional testing time required to qualify an entirely new system;
- The impact of system downtime on research, development or production.

Reliability is a key requirement of products with a long lifetime. The reliability requirement is one of the most fundamental drivers of its design and service activities. The market requires much more in-depth testing of the technology in order to ensure reliability. A new design in this type of industry frequently borrows heavily from core technology developed and proven over a long period of time. The redesign work necessary to be RoHS compliant will require retesting and re-qualification under a large number of conditions. Considerable time is needed to evaluate available substitutes against the demanding requirements as compared to consumer products. This has been limited by the non-availability of RoHS compliant critical components, and material processes.

There are three categories of difficulty with regard to replacing non-compliant components:

- 60%-80% of purchased components are off the shelf and most suppliers are introducing RoHS compliant replacement versions. However, e.g. higher lead-free processing temperatures will reduce component lifetimes as well as cause drift in specifications making the design of precision instrumentation needing PPM (Parts per Million) performance difficult to achieve. Moreover, some of the off the shelf parts are difficult to find in a RoHS compliant version. This would require a complete redesign of the part. The parts that are not available include some of the most critical Integrated Circuits. Many instruments are designed around these components, so to use alternates would in essence mean redesigning the product from the beginning.
- 10%-20% are specialized custom parts where alternative compliant materials are known to be available for similar uses. These components are not normally validated by a component manufacturer with a very large client base. Cost and resources are involved to completely evaluate a new design before taking it to production.
- A final 10%-20% are custom parts where no alternatives are known with all the required properties.

Even if all the parts are RoHS compliant, there is still a big question about the long-term reliability of non-lead solder assemblies. There have been no substantiated studies which allow predicting product reliability 8-12 years into the future, while there are studies that show the possibility of tin whisker growth well within that time (Test & Measurement Coalition, 2006).

There are a number of other articles and reports that point to difficulties being faced by companies producing products not currently covered by the RoHS ban. Whilst the majority of these are US based, concentrating on American companies exporting to the EU and/or relying on parts sourced from the EU, there is no reason to expect that similar companies within the EU will not be experiencing similar issues.

In an article on how exempt industries are coping under the RoHS Directive[10], it is suggested that the aerospace, defence, medical and portions of the telecommunications sector are having difficulties in sourcing high-reliability leaded parts for their products. The article argues that the exempt industries were buying components off-the-shelf prior to the implementation of the Directive but are now unable to source the high reliability military grade products required. With suppliers producing lead-free products for the higher volume and value consumer market, the article concludes that component suppliers can be expected to shut down their production of leaded parts, with some “end-of-life” notices already beginning to appear for some parts.

Wilson[11] in an article on the review of category 8 equipment similarly points to difficulties faced by the medical device industry due to parts obsolescence and rising prices. He states that the widespread move across industry to RoHS compliant parts, particularly to lead-free devices, *“is beginning to drive up component prices for the leaded parts that medical manufacturers critically require. Moreover, RoHS will most likely make some leaded components uneconomical to produce and therefore obsolete.”* The article cites examples of companies having to re-engineer proprietary devices and having to re-design circuit boards as a result of incompatibility with lead-free circuit boards, and in some cases, of medical equipment manufacturers having purchased several years’ supply of a component to ensure availability.

Another Green SuplyLine article (Roos, 2006) quoted a company representative as complaining that the rising price of leaded parts is another problem: “Component suppliers are aggressively migrating their products to compliant versions, and in some cases, they are starting to increase pricing for non-compliant versions or they are adding non-return or non-cancel provisions.”

Parts obsolescence has also been an issue for the military and aerospace industries with increasingly limited availability of some leaded parts and materials. In an article on the Military and Aerospace Electronics website[12], the author cites military component suppliers as experiencing difficulties in procuring the leaded components required by their customers. Examples are provided of regular and increasing numbers of notifications that certain leaded parts are on “last-time-buy” status and will become obsolete due to dwindling supply. The article highlights the fact that suppliers are discontinuing component lines rather than running two processes, one lead-free and one leaded.

This has also caused problems with respect to labelling of parts, with some suppliers switching to producing lead-free components but without changing part numbers and the potential for equipment manufacturers to build equipment thinking they are using leaded components (with associated performance values) when they are in fact utilising pure-tin ones. As a result, companies have had to increase the resources allocated to receiving and checking inventories and increased performance and reliability testing of equipment. As lead based parts become harder to come by, their prices are also beginning to increase and under these circumstances, the potential for counterfeit parts is highlighted.

[10] “Exempt Industries Struggle with RoHS”, Rob Spiegel, Electronic News, 5/11/2006 http://www.edn.com/index.asp?layout=article&articleid=CA6333338

[11] “RoHS exemption for medical devices is under review”, D. Wilson, Green SupplyLine, 25/8/2006, http://www.greensupplyline.com/howto/192300282

[12] The cost of compliance: A RoHS retrospective, by Courtney E. Howard at http://mae.pennnet.com/display_article/302861/32/ARTCL/none/none/The-cost-of

Consultation Responses

The examples illustrated above serve to highlight the potential difficulties for companies producing equipment not covered by the current scope of the RoHS Directive. It has not been possible within the scope of this study to quantify such difficulties due to the low response rate to the consultation exercise carried out. However, the significant number of anecdotal examples and the responses provided by those companies that did respond to a number of questions relating to the continued (or otherwise) availability of components which are not covered by the RoHS ban do highlight the fact that availability of components is a real issue for some manufacturers.

Individual companies were asked whether, as a result of the RoHS Directive, they had segmented their product lines to cater for the different requirements across the different sectors they are supplying. The responses are provided in the following Table.

Table 5.6: Segmentation of product lines into RoHS compliant and non-compliant

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	4	25%	No differentiation between small/large, no cross-product lines in some sectors so no impact
No	12	75%	
Total	**16**	**100%**	

Some companies provided further details on their supply of non-compliant parts:

- to support different customer requirements rather than different geographies (e.g. exempt products or applications vs. non-exempt products/applications);
- for the automotive industry (car electronics); and
- because we could not secure all RoHS parts in a timely fashion, we need to continue to buy non-RoHS parts. Now, we must continue to produce and sell non-RoHS products to the non-EU world until inventory of non-RoHS parts are depleted.

Whilst some companies have obviously continued to supply non-compliant parts, the following table confirms that some companies are experiencing difficulties in sourcing the non-compliant parts required for their business. Companies were asked if they had experienced any difficulties (which might be attributable to the RoHS Directive) in obtaining supplies of components for products currently outside the scope of the RoHS Directive e.g. shortages of supplies, sharp increase in price.

Table 5.7: Companies experiencing difficulties in sourcing non-compliant components

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	8	62%	No differentiation between small/large or different sub-sectors
No	5	38%	
Total	**13**	**100%**	

Further comments made by companies providing responses were as follows:

- difficult to obtain power supplies, transducers and specialised components;
- difficult to obtain parts where manufacture has ceased due to RoHS and where the alternative is more expensive;
- even with products that were inside the RoHS Directive, some suppliers were too slow and some suppliers were too fast. Therefore, besides managing the whole product conversion, companies often had to manage incremental changes to a product. This is very disruptive to a company's operations;
- supply issues with circuit board components. In addition, reliability issues have arisen with supplied components that were modified to be RoHS compliant; and
- parts are in general moving to lead free while we need older versions for e.g. servers.

Finally, companies were asked if they had been forced to segment product lines in order to meet with different RoHS-type requirements in different countries outside the EU. Responses are provided below.

Table 5.8: Segmentation of product lines to meet with variations in different RoHS-type regulations

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	3	21%	No differentiation between small/large or different sub-sectors
No	11	79%	
Total	**14**	**100%**	

Additional comments provided were as follows.

Segmentation is required:

- for China RoHS labelling and disclosure;
- not for products produced within the EEA area, but there is segmentation for products produced outside the EU. However, this is due to local requirements (safety, energy rating, etc) rather than requirements due to RoHS; and
- China requires marking and information, but has the advantage of setting requirements through standards.

Segmentation has not been required:

- however, industry trade associations have been working with various regulatory authorities to show the importance of aligning RoHS-type requirements. This could become an issue if the legal requirements are not harmonised since the electronics industry has a global supply chain and sells to a global marketplace. It will not be cost effective to design products for only one geographic area instead of the international marketplace; and
- one company has introduced a worldwide common policy for the substances in its products.

5.2.3 Economic benefits related to RoHS

According to Roland Sommer, a New Zealand consultant, the introduction of RoHS created some strong economic drivers. Economically a country without RoHS legislation faces far greater risks, as innovative companies that seeded their business in the domestic market would face a barrier to growth when looking at the export market. Non compliant imported products would drop in price as the global market for non compliant products shrunk, putting further pressure on locally produced products.

Environmental Supply Chain Management improved a great deal because of RoHS. Communication massively increased across the supply chain, e.g. on materials data. This high level of communication is needed anyway as a platform for REACH, M&S retailer initiatives, etc. This means that some of the communication costs necessary in the framework of these initiatives are already covered for in the framework of the RoHS Directive.

The RoHS Directive has also give rise to business process improvements. Because of RoHS, attention has increasingly been given to a tight process control. The focus on equipment development and reducing the presence of new defects has lead to an increasing knowledge of solders, interfaces, processing and reliability. This resulted in an overall reduced number of defects, an increased production efficiency and functionality to consumers. Existing standards, like IPC1752, are increasingly being used.

Besides, RoHS has given rise to a lot of training and continuing education across the company. The global skill level has benefited from the retraining of operators in new technology, new educational tools and infrastructure. Data management processes have been improved, new product lifecycle management systems have been bought or were reconfigured. This necessitated to update processes to enable use of the data in the company, often with the implementation of new part numbering systems. There has been/is an increased movement of people and knowledge to Asia and less well-developed countries; Japanese people and knowledge are seeking inspiration in Europe and the US.

Linked to the WEEE Directive, RoHS gives rise to improved recycling. The decreased presence of hazardous material in scrap benefits uncontrolled recycling, with less leaching to landfills as a result. The increased use of Ag/Sn leads to more value incentives for recycling, increasing the chance of meeting WEEE targets.

RoHS has certainly stimulated a change in recycling practices. Tin-lead solders will be replaced by the same volume of lead-free solders, but not the same mass. This means that less mass is needed to replace the tin-lead solder if the lead-free alternative has a lower density. The lower densities of the lead-free alternatives thus reduce the demand (in tonnes) for reflow and wave solders. The lead-free solders for PWB's, however, contain metals like silver and gold with a higher economic value. The higher cost – and thus value – of lead free solder may change recycling practices of the conventional lead-tin solder (Deubzer, 2007).

RoHS has created pressure on other sectors (e.g. aerospace, IT industrial controls), even though they are exempt from the RoHS, and countries to move to cleaner processes. RoHS has certainly initiated a global revolution in hazardous materials reduction (China RoHS, Korea RoHS, US RoHS).

Four companies of our survey mentioned monetary gains. One company states that it produces the same product for the world market as a result of RoHS. Due to early RoHS compliance in the EU market, the company now has an advantage in other regions where RoHS like regulations are in sight. A second company experienced an initial boost in sales by becoming RoHS compliant ahead of many of its competitors, this adavantages has now tapered off. A third company mentions the additional services it can offer to evalate customer products for compliance. The last company thinks it may experience monetary gains in the long run, but only aginast competitors outside of Europe. The argument is that it is no use to set high quality standards of products for the European market when goods entering Europe form foreign counties are not checked at all. If necessary action on this point is not taken, profitability will be reduced, not increased.

In the CEA/TFI study, half of the respondents indicated at least one advantage of being RoHS compliant. Important advantages were the improvement of the supply chain process, product line pruning, the gain of market share and the improvement of the supply base.

5.2.4 Impact on the Internal Market

5.2.4.1 Introduction

The legal basis of the RoHS Directive is Article 95 of the EC Treaty, which states:

"The Council shall, acting in accordance with the procedure referred to in Article 251 and after consulting the Economic and Social Committee, adopt the measures for the approximation of the provisions laid down by law, regulation or administrative action in Member States which have as their object the establishment and functioning of the internal market."

Furthermore, the Commission document on "Frequently Asked Questions on Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)" stresses that:

> *"The RoHS Directive is based on Article 95 of the Treaty. The purpose of this Directive is to approximate the laws of the Member States on restrictions of the use of hazardous substances in electrical and electronic equipment,"*

As such, the RoHS Directive aims to ensure the functioning of the internal market by requiring that Member State legislation relating to hazardous substances in electrical and electronic equipment is implemented in a way that does not introduce or support any existing barriers to trade between Member States.

The literature review and stakeholder consultation has highlighted three main areas which are considered as being of particular concern with respect to potential barriers to trade in the internal market:

- Scope of the RoHS regulations as they apply in different Member States (which products fall within the scope of the Directive and which do not);
- The process for deciding on exemptions to the provisions of the Directive; and
- The compliance and enforcement systems which have been introduced in Member States.

The issues arising under these three aspects of the implementation of the Directive are discussed in this section. The section concludes with a presentation of selected views of industry stakeholders on the overall impact of the implementation of the RoHS Directive on the internal market.

5.2.4.2 Scope of RoHS Regulations in different Member States

The scope of the RoHS Directive is defined in Article 2 of the legislation which confines the applicability of the Directive's provisions to categories 1-7 and 10 of Annex 1A of the WEEE Directive and also to electric light bulbs, and luminaires in households. The Directive does not apply to spare parts for the repair, or to the reuse, of electrical and electronic equipment put on the market before 1 July 2006.

Article 4 then sets out the substances that will be banned from inclusion in EEE under the Directive and a list of application exemptions are provided in an Annex to the Directive. Whilst the substances which are to be banned from EEE are clear and there are no current issues relating to their inclusion in the Directive's scope, there are issues around the scope of the Directive vis-à-vis the products that fall within the scope in different Member States and also around the definitions of various terms such as 'put on the market', spare parts, fixed installations etc.

The following sections briefly set out any significant references to these issues of scope within the national legislation from the case study countries followed by an analysis of the issues presented by various stakeholders and industry position papers.

IRELAND

The Department of the Environment, Heritage, and Local Government, which was responsible for the transposition of the RoHS Directive into legislation in Ireland has provided a guidance document on their website to clarify their position regarding interpretation of the term "placed on the market". The guidance states that the Irish RoHS Regulations are to follow the European Commission's definition of the term. Producers should note that while products which were placed on the Community market prior to 01/07/2006 can continue to be placed on the market in Ireland, written confirmation may be required by the Irish authorities to confirm that the products were indeed placed on the Community market prior to that date.

Guidance is provided with respect to the category that various types of EEE falls into but stresses that this is not an exhaustive list. The fact that any type of equipment is not included in the list does not exclude it from the scope of the regulations.

Sub-article 3 of the Irish legislation confirms that these Regulations shall not apply to spare parts for the repair of EEE put on the market prior to 1 July 2006 or to the reuse of EEE originally placed on the market prior to 1 July 2006.

BELGIUM

Belgium transposed the RoHS Directive by means of the Royal Decree on the use of hazardous substances in electrical and electronic equipment on 12 October 2004 (through the Royal Decree of December 10 2007, the annex with exemptions was adapted).

The legislation considered, for the purpose of the definition of "put on the market", the relevant market to be the Belgian market. The legislation was amended on 14 June 2006 to allow products put on the market in another EU country before 1st July 2006 to be non-RoHS compliant.

The RoHS Directive was transposed by two bodies: the Federal Public Service for the Economy, SMEs, Self-employed and Energy and the Federal Public Service for Health, Food Chain Safety and the Environment. The Belgian RoHS legislation is being enforced by the second of these bodies. This legislation is consistent with the RoHS Directive, and imposed a ban on the use of six hazardous substances (in appropriate concentrations) in EEE where an exemption does not apply, from 1 July 2006.

LITHUANIA

Lithuania implemented the RoHS legislation via Order No V-258 of the Minister of Health of 22 April 2004. The RoHS legislation was transposed and is enforced by the Ministry of Health.

The Lithuanian RoHS legislation generally follows the requirements of the RoHS Directive.

As of March 2006, however, Ministry officials were not yet able to specify the applicable penalties for non-compliance with the RoHS regulations.

GERMANY

The German implementing law for the RoHS Directive is the "Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment" of 23 March 2005, known as the ElektroG. The ElektroG outlines the responsibility of producers for their EEE products once they become waste, and incorporates the substance bans and exempted applications of the RoHS Directive.

National enforcement falls within the competence of the Federal States, to be decided by each State individually (e.g. in Bavaria the local trade supervisory office carry out this task).

Surveillance of the substance bans under RoHS forms part of the competences of the German Federal States. At the end of June 2006, the German Ministry of the Environment (BMU) published replies to frequently asked questions (FAQs) in relation to the WEEE & RoHS legislation on its website. However, the BMU's position is that the replies provided to the FAQs are not legally binding but merely describe its position.

As regards the term "placed on the market" under RoHS, the BMU explains that this is supposed to mean new EEE which is made available for the first time on the Community market with the purpose of distribution. This occurs generally when the goods are handed over by the producer from the producing factory to the first trading level in the Community market whereby the goods have to be ready to be traded (i.e. packed etc.). In the case of an importer importing goods, they are generally "made available" when the goods are customs cleared and transported to the first importer warehouse in the Community market.

As regards the interpretation of the term "spare part" for the purpose of the exemption from RoHS (spare parts for the repair or reuse of EEE placed on the market for the first time before 1 July 2006), the BMU stresses that the exact wording of the Directive has been reproduced in the German law. It is therefore decisive whether the part is actually used as a spare part for the repair or reuse of a complete EEE which had already been placed on the Community market for the first time before 1 July 2006. The BMU underlines that the German interpretation follows the FAQ questions on WEEE & RoHS published by the EU Commission.

UNITED KINGDOM

On 07/10/2005, The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2005 was adopted and the national enforcement body designated with the responsibility for enforcing the Directive is the National Weights and Measures Laboratory.

The UK's Department for Trade and Industry non-legally binding guidance notes on RoHS (which are based on the Commission's non-legally binding FAQs) were re-issued in July 2007 and provide an example of a 'decision tree' that could be used by producers to help determine whether their products might come within the scope of the RoHS Regulations. However, the guidance goes on to advise firms that they may need to seek independent advice to come to a final decision as to whether a product is within scope of the regulations or not. The following advice is provided:

> *"It should be noted that this guidance represents the Department's view and, as with all EC Directives, a definitive view may only be obtained through the courts. Producers must rely on their own legal advice on all questions of scope."*

The UK RoHS Regulations have been updated to include exemptions agreed since they were first laid down in October 2005 and will be revised in due course to incorporate any new exemptions.

DIFFERENT INTERPRETATIONS OF SCOPE ACROSS MEMBER STATES

Whilst the details presented above are brief, they illustrate the different and often unclear information being presented to producers with respect of the products falling within the scope of the Directive. Industry associations and representative groups have cited a range of examples of identical products being treated within and outside the scope of the Directive in different member states.

The American Chamber of Commerce to the EU (AMCHAM EU), in its response to the DG Environment questionnaire on the revision of the RoHS Directive dated May 22nd 2007, states that CCTV is considered as being category 9 equipment in some countries (UK, Germany) and therefore currently exempt from the RoHS Directive; whereas it is considered as being part of Category 4 (and therefore within the scope of the Directive) equipment in other countries (Belgium, the Netherlands).

Orgalime, the European Engineering Industries Association points to the fact that car radios only designed to be built into cars are exempted from RoHS according to the explanations of the European Commission in the FAQs on WEEE and RoHS published in the Commission website. In the Netherlands, however, Orgalime states that only car radios and navigation systems built in during a car's production are exempted, in contrast to identical car radios installed elsewhere at a later date.

Orgalime further provides the example of Estonia where all products registered under the Waste Electrical and Electronic Equipment (WEEE) Directive must comply with RoHS, even though these products have different exemptions (i.e. Categories 8/9 are currently exempt form the RoHS Directive), in contrast to the treatment of Categories 8/9 in other Member States.

As well as Member States interpreting the Directive differently in terms of whether or not a product comes under an applicable category, or whether or not it is to be considered as part of another type of equipment, EICTA (the European Information & Communications Technology Industry Association) highlight the fact that the definition of fixed installations (which are out of scope of the RoHS Directive) has been interpreted differently in different Member States. EICTA argue that although the definition of fixed installations in the Commission FAQ is clear and well defined, this definition is not legally binding and that more legal certainty is required. Without identifying the specific Member States concerned, EICTA state that *"a number of Member States have voiced an opposite opinion, which is putting industry in a difficult position as some products may be allowed in certain Member States while being banned in others."*

A further issue of concern with respect to the scope of products falling under the RoHS Directive relates to the definition of 'put on the market'. The RoHS Directive states:

> *"Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, Cr(VI), polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE). National measures restricting or prohibiting the use of these substances in electrical and electronic equipment which were adopted in line with Community legislation before the adoption of this Directive may be maintained until 1 July 2006."*

DG Environment has issued clear guidance on the interpretation of "put on the market" as meaning:

> "Placing on the market is the initial action of making a product available for the first time on the Community market, with a view to distribution or use in the Community."

However, in spite of this guidance, the term 'put on the market' has been subject to varying interpretation across Member States. Through studying national legislation and holding telephone interviews with government officials, Martin et al provide examples of countries which interpreted the term as meaning "the first transfer of a product onto the European Community Market" (e.g. UK, France, Spain, Netherlands, Belgium, Germany, Czech Republic, Italy, Lithuania, Ireland etc.). Slovakia, however, has adopted the interpretation "the first transfer of a product onto the national market". Whilst legislation appeared to suggest the definition 'the first transfer of a product onto the European Community Market" was being used in countries such as Cyprus, Greece, Hungary and Latvia, officials interviewed in these countries, when interviewed, were unable to confirm whether or not they would be following the DG Environment interpretation.

EICTA have also argued in their position paper relating to the review of the RoHS Directive that a clearer definition of "put on the market" is required within the RoHS Directive and would be beneficial to companies and authorities alike.

In addition to the selected industry positions on issues of scope highlighted above, individual companies have also been consulted for their views as part of this study on the differences in implementation across Member States. Companies were asked if they were aware of any difference in implementation across Member States that had prevented one or more of their products being placed on the market in a specific Member State. Company replies are presented in the following table.

Table 5.9: Differences in Member State legislation affecting products being placed on the market

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	1	7%	No differentiation between small/large or different sub-sectors
No	13	93%	
Total	**14**	**100%**	

Whilst only 7% had experienced any difficulties, further comments received were as follows:

- A manufacturer was aware that Denmark was discussing potential differences, although was not aware of any differences for its business;
- Since RoHS is based on Article 95, we presume that Member States implement it in a uniform way, in line with the provisions of the Directive; and
- For one large manufacturer, the differences in product scope interpretations in Member States has cost $3m.

Companies were also asked to rank the factors which might influence where they choose to place products on the market on a scale of 1-10, where 1 indicates the most important, with the results being as follows:

Table 5.10: Ranking of factors influencing where to place products on the market

Response	Range of Responses	Modal Response	Comment
Lack of enforcement	4-10	10	Rank of 10 for many responses indicates low importance
Potential for free riders	5-10	10	Rank of 10 for many responses indicates low importance
Cost of product compliance testing	1-7	1-2	A company indicated that this factor is very important when market potential is very small for the product. Generally ranked high importance
Clarity of scope for regulations	1-10	2	Generally ranked of high importance, except one manufacturer who ranked it at 10
Documentation requirements	3-7	3	Generally ranked of medium importance by all companies
Customer base	-	-	Highlighted by one company

Whilst the cost of product compliance testing was deemed the most important factor, clarity of the scope of products covered by the national regulations was rated as the second most important factor (considering modal responses), which clearly indicates that producers are very concerned that they are clear as to whether or not their products are considered subject to the provisions of the Directive in different Member States.

One company followed up with the following comment:

> *"Unclear definition of 'Putting on the market' and incorrect implementation in certain MS caused unnecessary disturbance and workload for some manufacturers. Generally, global players adopt strategies according to the situation in the markets of all EU Member States. Unharmonised implementation is therefore not helpful."*

5.2.4.3 Exemptions

The issue of exemptions is clearly an important factor for industry since whether or not a particular application receives an exemption determines whether or not it remains within the scope of the Directive and therefore subject to its provisions.

Since the list of exemptions included in the original Directive has been added to since its entry into force, and some efforts have been made to remove some applications from the exemptions list, the process by which exemptions can be granted and subsequently retained or withdrawn, has come under scrutiny.

In the context of the review of the RoHS Directive, the issue was raised at the meeting of the Technical Adaptation Committee (TAC) on the WEEE & RoHS Directives in Brussels on the 20th June 2007 by the United Kingdom. The unofficial note to the meeting highlighted three key areas of concern:

- *the length of time it takes to process exemption requests: some were still unresolved after nearly two years;*
- *continuity: the rejection of an exemption request through receipt of insufficient information. A revised checklist or template would help to ensure that a sufficient level of information was provided by the applicant at the start of the process; and*
- *the role of Member States: Member States did not have the opportunity to raise questions on those requests that the technical consultants had recommended be rejected.*

Overall since the RoHS Directive came into force, 120 exemption requests have been made to the Commission (33 are outstanding) with only 21 of them having been approved. Numerous stakeholders have complained that the exemption process is overly long and drawn out, as well as lacking in transparency and clear deadlines for the process. A Checklist for Requests for Additional Exemptions was issued by the Commission in 2004 in response to the number of requests for exemptions from industry that the Commission services felt were not substantiated by scientific and technical advice. The purpose of the checklist was to enable the TAC to carry out a first screening of the requests received, with those passing the screening stage being considered for a possible exemption.

However, despite the issuing of the Checklist, the number of requests for exemptions has continued to grow, hence the suggestion to amend it. As a consequence of the expanding list of exemptions and the potential for withdrawing exemptions, the list of exemptions is no longer stable leading to a situation of uncertainty. Furthermore, there have been a number of repeat requests for exemptions which have already been denied, as well as requests for more specialised applications which cover limited numbers of products. This constant submission of applications for exemptions makes the Directive less effective in achieving its environmental objectives and could reduce the level of incentives for industry to concentrate on research and development of alternative products.

The checklist also acts as guidance to those submitting requests for exemptions as a step to easing the process and making the criteria against which the requests will be assessed more transparent. The Commission has also enlisted the services of an external company to assist with the evaluation of requests; between July 2005 and July 2006, four sets of exemptions requests were submitted to the Commission (which included a total of 88 applications of substances covered by the provisions of the Directive) and were evaluated under a contract issued by the Commission to Öko Institut e.V. The detailed report issued on the evaluations has contributed to increasing transparency, but the issue remains of concern to industry (in particular to trade associations and other representative groups) and to Member States, as is demonstrated by the discussion in the TAC meeting in June 2007.

Further concerns over the exemption process have been raised by EICTA in relation to the fact that time is required between a new technology becoming available in the supply chain and the ability of EEE producers to incorporate that technology into their products and bring the new products to market. In their position paper for the RoHS review, EICTA state:

> *"….in their conclusions the Oeko Institute has clearly indicated that market realities and supply issues are not of importance, or of secondary importance at the most, according to the criteria of article 5, and that only the issue of technology availability is valid."*

EICTA's point is that once new technologies become available, producers of EEE are required to consider a number of critical aspects of their products:

- whether the technology is fit for the particular use (i.e. whether the properties and quality/reliability aspects meet the demand);
- whether the new technology is a direct replacement for non-compliant part or whether a redesign of the product(s) would be needed; and
- the availability of parts using the new technology through their current supply chain (i.e. will they need to identify new suppliers where existing suppliers do not have access to the new technology).

This is of particular importance when considering withdrawal of an exemption and EICTA argues that a supplier of a new technology can gain significant competitive advantage (potentially even a monopoly position) if an exemption is withdrawn too early and prior to the widespread availability of the technology. Issues over patents attached to and licensing of new technology are of key importance and EICTA suggests that these should be disclosed along with any applications to withdraw exemptions from the RoHS Annex in order to ensure availability of the technology in sufficient numbers/quantities to support the industry's requirements. Such disclosures would also assist the TAC to determine any potential negative effects on competition that might arise from withdrawing the exemption.

In addition to reviewing the availability of new technologies across the supply chain before deciding on whether or not to withdraw an exemption, EICTA also argue that sufficient time should be allowed between withdrawing an exemption and the obligation for producers to bring their products into compliance in order to allow them to deal with associated re-design (where required) and testing issues, as well as amending or setting up new supply chains for components and materials.

The EICTA position is supported, though in less detail, in the ORGALIME 'Comments to the Commission Stakeholder Consultation', Brussels, 22nd May 2007, which support the Commission's proposal to review the exemptions procedures:

> *"Orgalime particularly supports the Commission's proposal to look into the procedure and criteria for granting exemptions with a view to examining the exemption requests in a quicker, more cost effective and comprehensive manner (including cost benefit considerations and taking into account innovation, competition and intellectual property issues)."*

and

> *"...when the Commission analyses exemption requests, it should cover the technical, economic and international implications in order to ensure that the proposal is feasible."*

5.2.4.4 Compliance Systems in Member States

The RoHS Directive does not set down procedures for demonstrating compliance with its provisions and, consequently, there are no formally established procedures for Member States to monitor and enforce compliance. This has been identified by Martin *et al* as a potential barrier to trade across the internal market as Member States are able to introduce different requirements and procedures for companies to demonstrate compliance. Interviews with representatives of Member States indicated differences in the expectations of officials responsible for enforcement with respect to evidence that producers will be expected to provide in order to demonstrate compliance. Martin *et al* concluded that countries such as Portugal, Ireland, Germany, the Netherlands and Scandinavian countries have adopted stricter approaches than in other Member States, with officials indicating that producers are expected to compile and retain a variety of technical documents for their products.

This being the case, they may also be obliged to produce different documentation and undergo different market surveillance procedures in each of the Member States where they are placing products on the market. For example, officials in Ireland indicated that producers would need to provide documented self-certifications from their materials and component suppliers confirming that they were RoHS compliant. In Greece, Hungary and Latvia, producers are expected to provide corporate commitments to RoHS compliance in their registrations under the WEEE Directive. In Germany and Portugal, those officials interviewed for the study indicated that technical documentation in national languages will be required and producers are expected to use laboratories certified to international standards when they undertake destructive testing of their products to demonstrate RoHS compliance. Officials in Denmark, the Netherlands, Estonia, Finland, France, Hungary, Slovakia, Slovenia and the UK indicated that they would be adopting the approach of checking documentation in the first instance with testing being considered as a last resort.

Similarly, differences exist across Member States in RoHS enforcement strategies as regards statutory offences and penalties for legal infringements. Whilst the main infringement (placing products on the market which do not meet with the Directive's restrictions on various substances) is the main statutory offence in all Member States, in Greece, Ireland, Latvia, Portugal and UK, a lack of appropriate documentation is also registered as an offence, and the amount of time allowed for producers to respond to requests for technical documentation varies from between one and four working weeks.

A wide range of penalties exists for legal infringements, with the penalty for the same offence often differing from Member State to Member State. Fines are the predominant method of penalising non-compliant companies, ranging from €1,270 in Poland (2006) to an unlimited fine in the UK, but Martin *et al* identify Member States including Belgium, Cyprus, Denmark, Finland, Luxembourg, Malta and Sweden as having introduced prison sentences for non-compliance into national RoHS legislation. Portugal also allows for notices to be issued by enforcement authorities for companies to stop trading.

The Martin *et al* study concludes that barriers to trade such as those illustrated above would be less likely to occur or be reduced if the RoHS Directive were to be based on the New Approach to technical harmonisation and standardisation. Directives based on the New Approach involve the development of harmonised standards which producers can follow in order to demonstrate compliance with the requirements of the Directive. The study points to the fact that whilst a number of standards have been developed for electrical and electronic equipment, RoHS enforcement officials in Member States still have the flexibility to choose which, if any, will apply in their own jurisdiction, thereby creating the possibility of technical barriers to trade. This will, of course have an influence over the technical documentation that producers may be required to produce to accompany their products in demonstrating compliance.

EU-WIDE APPROACH

An EU-wide approach to developing a harmonised compliance and enforcement system for RoHS regulations has been developed through discussions within the EU RoHS Enforcement Authorities Informal Network comprising representatives from Member States. The network issued a Guidance Document in 2006 which aims to:

- assist Member State with national enforcement of the RoHS Directive; and
- provide clarity to industry on how producers may demonstrate compliance with its requirements.

The document sets out a recommended approach to enforcement based on the principles of consistent and common interpretation across Member States, a presumption that products conform to the requirements of the Directive and self declaration by producers. It sets out an overall sequential approach to enforcement including the selection of products for further investigation, compliance assessments using documentation and routes for enforcement actions. The Guidance suggests typical document lists and formats and highlights screening, sampling and testing issues and recommended approaches to these.

The document appears to have received widespread support from Member States and interviews with enforcement officials conducted by Martin et al revealed that Denmark, The Netherlands, Estonia, Finland, France, Hungary, Slovakia, Slovenia and UK all intended to fully or partially follow the document when implementing market surveillance systems. (At the time of interviewing by Martin *et al*, officials from other countries were unable to confirm whether or not they would be following the guidance document.)

Some problems have, however, been identified with the guidance document. As in the Directive itself, there is no clearer definition of 'put on the market' and, as a result, the issue over what is included within the scope of the RoHS Directive is still open to interpretation across Member States with the consequent implications for the functioning of the internal market outlined above.

In addition, enforcement authorities in all Member States do not have limitless budgets to carry out market surveillance activities and, as a result, selective targeting will be the main method to verify the compliance status of products. The precise nature of implementation and criteria used in targeting strategies will be very influential in determining a level playing field at the Member State level, whereas significant differences may well have implications across the EU for the operation of the internal market. This is also concern over the availability of infrastructure to carry out any detailed testing that might be required for targeted products, and high costs for testing in countries which place a larger emphasis on testing will prove a disincentive for companies to operate/enter in that market. As noted in the table above, producers identified the cost of product compliance testing as one of the most significant factors in influencing where they choose to place products on the market in a given country.

A further issue is that the guidance itself is not compulsory. The title page of the Guidance Document makes this clear in stating:

> *"It should be noted that the document is informative and advisory, but has no legal authority.*
>
> *Individual Member State RoHS enforcement authorities are bound by their own national legal structures and can only apply this guidance within the confines of those structures. "*

As long as the advisory actions and procedures included remain as guidance, it is argued that the scope for different implementation of market surveillance and conformity assessment procedures will maintain the potential for variations across Member States which could lead to distortions of the internal market.

CECED (European Committee of Domestic Equipment Manufacturers), in a critique of the Guidance Document, generally welcomed the effort but stated that it would like to see a stronger emphasis on co-operative dialogue between national enforcement authorities and producers in establishing market surveillance procedures, arguing that such co-operation is essential for effective and uniform market surveillance.

CECED further stressed the guidance should make clear that that requests for detailed documentation should only be made when enforcement authorities have *"substantiated indications that a particular product does not comply with the requirements."* The document list described should be indicative only, CECED argues, since it may not be necessary in all cases to produce the complete set of documents in order to demonstrate conformity.

An area of particular concern to CECED is that of testing and the fact that the Guidance Document leaves significant scope for *'enforcement authorities in different member states to apply different methods of testing and analysis in relation to the composition of "homogenous materials"'*. This is a potential area for internal market distortions since it might be possible that the same product being tested under different methods in different countries might be deemed in compliance in one Member State but not in the other.

Orgalime has welcomed suggestions that there could be a greater harmonisation of compliance procedures across Member States and is in favour of *"integrating a uniform mechanism for demonstrating compliance, including alternative mechanisms on the basis of accomplished work to minimize the risk of diverging interpretation practices in member states."* It also promotes the view that market surveillance procedures and tools cross Europe should also take into consideration work ongoing at the IEC[13] level, since producers of EEE are operating in global markets which are highly competitive.

The Guidance document itself also seems to exacerbate the issue of standards referred to above in the context of New Approach Directives. The document suggests that both producers and RoHS enforcement officials keep up to date with the different standards developed across the world in deciding which ones to apply. This inevitably creates administrative burden for producers and officials and will likely still lead to, and could even exacerbate, a situation where different standards are applied across the Community.

Examining the conformity systems established in different Member States reveals that there are definite differences in the approach taken by different authorities. Telephone interviews were held with available enforcement officials in the case study countries and the following information has been gathered on the current status of development of enforcement systems in Belgium, Germany and UK. Information on Ireland has been pulled together from secondary sources.

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[13] International Electrotechnical Commission, which deals with International Standards and conformity assessment for government, business and society for all electrical, electronic and related technologies.

BELGIUM

The implementation of the RoHS Directive in Belgium is, as in many other Member States, at a relatively early stage.

The Federal Public Service for Health, Food Chain Safety and the Environment as the competent authority for overseeing the implementation of the Directive has recently completed a study (July 2007) on the technical aspects of determining compliance and which focused on products and components which were perceived to be at the greatest risk of failure.

This study will be reviewed and provide the basis for developing a global Belgian RoHS compliance enforcement and monitoring system from which annual action plans and budgets will be developed. It is hoped that the strategy for enforcement will be finalised in 2008.

The study revealed a number of non-conforming products and the authority's intention at this stage is to take a collaborative approach with companies by contacting them and discussing routes to compliance rather than prosecution. Belgian law has a wide range of provisions for financial sanctions for non-compliance depending on the severity of non-compliance issues; but as yet, these have not been utilised. Belgian law also provides for different criminal sanctions, depending on the nature and the gravity of the infringement. Fines may vary between EUR 40 and EUR 4,000,000 and imprisonment may be imposed in lieu of a fine or in combination and ranges from three days up to three years.

Article 102 of the Belgian law of 14/07/1991 on Trade Practices and Information to and Protection of the Consumer provides that a trader omitting to provide the information imposed by law may be punished by a fine ranging between approximately EUR 6 and EUR 250. Depending on the circumstances, other sanctions may also be applied and higher fines may be imposed where the breach of the relevant provisions is deemed sufficiently serious or in light of aggravating circumstances.

UNITED KINGDOM

The UK RoHS regulations came into force on 1st July 2006. The National Weights and Measures Laboratory (NWML) is the enforcing authority for the RoHS regulations and the NWML can request paperwork from companies to demonstrate that their products are compliant or buy products to test them for compliance. Once information is requested, companies have 28 days to prepare and submit it. Furthermore, companies are required to keep paperwork that shows products are RoHS-compliant for four years after placing them on the market.

NWML is working closely with a group of conformity assessment bodies to support the development of commercially deliverable compliance schemes. Although NWML is not able to officially endorse such schemes or take compliance with a scheme as being a demonstration of product compliance, it is possible to use membership of such a scheme as supporting evidence of the validity of any presented information if the scheme is identified as suitably robust.

Members of the conformity assessment bodies agree to self-regulate through the group, ensure the group is not exclusive and co-operate with NWML to investigate complaints and raise any significant issues.

The UK compliance system is based on "self-declaration" by producers and industry has been encouraged to develop its own voluntary marking standards to indicate compliance. NWML policy is to base enforcement on intelligence and risk assessments, striving to keep administrative burden to a minimum through a "light touch" with respect to form-filling and data requests. The policy also targets those that intend to flout compliance and assist those that are working towards it.

The national legislation sets out requirements for keeping technical documentation, details penalties for breach of the regulations including liability for persons other than the principal offender, sets out a limitation period for bringing an action, provides a statutory defence and states what constitutes the service of documents. Penalties include a fine of up to £5,000 for summary conviction, an unlimited fine for conviction on indictment and a fine of up to £5,000 for failing to submit compliance documentation upon request.

Non-compliant products can be taken off the market and where the offence is committed with the consent, connivance or through neglect of any director, manager or similar officer of the corporate body, they will also be regarded as having committed the offence.

Higher fines may be invoked where the breach of the relevant provisions is deemed sufficiently serious or in light of aggravating circumstances.

GERMANY

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety has overall oversight of the implementation of the RoHS Directive with the country's regional authorities (16 Länder) holding legal responsibility for enforcement of the national regulations. Germany participated in the first meeting of the EU RoHS Enforcement Authorities Informal Network but a change in the representative of the 16 Länder to the body has meant that they have not participated since. A copy of the Guidance Document on RoHS Enforcement has been distributed to each of the Länder.

RoHS regulations came into force on 1st July 2006 and the Federal Ministry has provided detailed information on its website for producers including definitions of "put on the market" and treatment of "spare parts". The Ministry has received a number of questions relating to definitions and has referred enquirers to definitions detailed under the "New Approach".

The Federal Ministry is of the view that, in general, users of EEE are not generally aware of the RoHS Directive but that producers were informed sufficiently to make the necessary adjustments in good time for the implementation of the Directive on 1st July 2006.

The 16 Länder had already been responsible for the implementation of chemicals policy and regulations prior to 1st July 2006 and most are now utilising systems and infrastructure set up for this purpose to implement and enforce the RoHS Directive. They will only initiate investigations into products if they receive information that a particular product might not be compliant with the Directive; to date, only one such piece of information has been received, with subsequent testing of the product confirming that it was actually compliant.

Each of the Länder has its own policy and procedures with respect to selecting products to examine documentation required to confirm RoHS compliance and the Länder meet on a 6-monthly basis to exchange experience on RoHS and WEEE implementation.

As regards penalties, placing on the market of non-RoHS compliant EEE constitutes an administrative offence which can attract a fine of up to €50,000. Higher fines may be invoked where the breach of the relevant provisions is deemed sufficiently serious or in light of aggravating circumstances.

IRELAND

The Waste Management Acts make provision for penalties of up to €15 million or ten years' imprisonment (or both) for failure to comply with the regulations. Higher fines may be invoked where the breach of the relevant provisions is deemed sufficiently serious or in light of aggravating circumstances.

Legislation requires producers, i.e. manufacturers, importers, exporters, brand owners etc. to have access at all times at an address in the State to records of any documentation issued by any person including suppliers of components and/or parts that can be used to verify that EEE placed on the market complies with the requirements of the RoHS directive.

5.2.4.5 Overall views on competition in the internal market

CONSULTATION RESPONSES

As well as being asked for their views and experience, individual companies were consulted as to whether or not the fact that different Member States had different national regulations for RoHS had any significant bearing on where the decided to place their products on the market. Figure 1 below indicates the answers of fourteen responding companies.

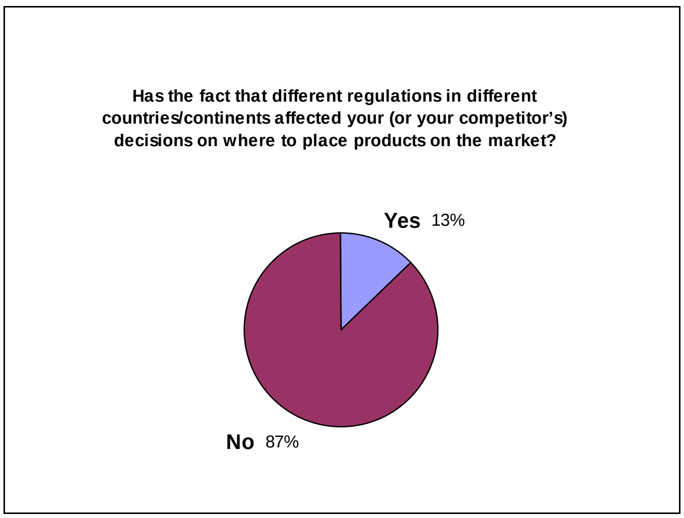

Figure 5.17: Effect of national regulations on decisions over where to place products on the market

One large enterprise responded that as a result of the RoHS Directive, it had retired some products in Europe that they are still supplying to the rest of the world.

When asked for their opinions on the effects of the RoHS Directive on competition overall in the EEE market, a similar response was given with 14% believing that it had affected it and 86% believing that it had not. It was felt by some companies that there was a short term decrease in competition for a six month period as many competitors were not RoHS compliant in time to meet with the Directive's deadline. The issue of market surveillance and the need to ensure that all companies complied with the Directive's provisions (including both EU and non-EU companies) was also highlighted by these companies.

However, companies indicating that they felt there was no real impact on competition overall pointed to the fact that all companies had to comply with RoHS and therefore there was no real competitive advantage to individual companies. A lack of enforcement was felt by some as an indicator of the fact that the Directive has not had any major effects on competition.

When asked if they felt that the RoHS Directive could be improved to ensure that conditions for fair competition exist in all EU markets, 79% of companies did not really think that it could be improved upon. Of the 21% who did think it could be improved, a variety of suggestions and viewpoints were put forward including:

- "Assure consistent enforcement to level the playing field";
- "More clarity on definitions (e.g. homogenous material), compliance requirements (e.g. expected documentation and product testing – including approved methodology, product labelling or marking, etc.), transparent enforcement (e.g. better identification of expectations and testing methodologies used, etc.)"; and
- "It seems that it has been the issues not mentioned in the RoHS but inherently required that have caused most problems such as how to show compliance".

Interestingly, a number of the companies indicating that they felt that the RoHS Directive did not need amending made similar comments to those expressing the opinion that it did with respect to the issue of compliance and enforcement:

- "The issue is the insurance of consistent enforcement, which is up to the Member States, as well as the elimination of free riders. Because of the complexity of the issue, a well-defined procedure on enforcement issued from the Commission could be helpful (because of the internal market)";
- "The problem of competition does not lay in the RoHS text itself, but on the fact that RoHS in reality is not enforced by national market control authorities. European legislation is very often very well spelled out but is not effectively enforced giving free riders the possibility not to comply without problems".

Market surveillance is fundamental to ensure a fair, competitive playing field in Europe. The trade associations consulted are convinced that a reduction in the number of free-riders might be obtained by giving more detailed and accurate information to the smaller companies, especially to companies outside the European Union, because they are not always aware of the obligations in the two Directives. Other elements are:

- Improved market surveillance with adequate resources for it in Member States, with no bureaucratic procedures and dissuasive sanctions; and
- Clear legal requirements and enforcement of legislation, harmonisation of registration rules, definitions (e.g. distance seller responsibility), etc.

Trade associations (CELMA, ELCF, CECED) tend to believe that the burden of compliance is not being shared equitably among producers. They refer to the problem of free-riding and are convinced that many importers in the EU do not comply because of insufficient market surveillance. In this way, competition is likely to be distorted. However, they state that it is very difficult to determine the extent to which free-riding is occurring with respect to RoHS compliance. (Based on 2003 data, the European Commission's Institute for Prospective Technological Studies estimated free riders represented "between 10-20% by volume of product placed on the market, although the percentage of non compliant firms is often higher, the smaller ones falling through the net".)

Many associations representing larger companies (e.g. AeA Europe) generally feel that producers are meeting obligations under the RoHS Directive. AeA Europe mentions the share of free riders as being below 5% for the companies producing printers and copiers, but does not indicate an assessment of the situation for their other product groups (refrigerators, PC and laptop, cellphones, video games).

CECED, covering 98% of the total capacity of large producers of refrigerators, assumes the level of non-compliance for WEEE in the range between 0 and 10%; however, they do not have/cannot give information on RoHS non-compliance.

5.2.5 Impact on innovation: cost and benefit of RoHS

5.2.5.1 Environmental regulation and innovation

The RoHS Directive's ban on certain heavy metals and brominated flame retardants in electrical and electronic equipment is a general ban and, apart from the exemptions, applies to any type of application including those involving very small amounts of hazardous substances. In these cases, the costs of enforcement and administration may outweigh the potential environmental benefits that might arise from eliminating the banned substances. However, the fact that these substances may not be used in electrical and electronic equipment potentially places a limitation on products that might be developed through innovation since certain materials are excluded from use.

The debate as to whether or not environmental legislation in general either inspires or hinders innovation is one that has continued without conclusion over many years. A Commission Staff Working Document, argues that

> *"The effects of legislation could be positive, as well-designed regulatory instruments generally encourage companies to seek innovative solutions that otherwise would remain unexplored. Available evidence broadly supports the conclusion that in the long term, environmental policy will tend to encourage innovation in environmentally-friendly products and processes provided there is enough legal clarity and security."*

The difficulty in ascertaining whether or not the RoHS Directive has stifled or acted as a driver for innovation stems from the complexity of ascertaining which market variable has prompted an innovative change. For example, the banning of a substance through legislation or the implementation of a green strategy by sectors or companies, will force manufacturers to substitute a particular hazardous substance or face losing out to competitors that offer products that comply with the green strategy. In sectors where a hazardous substance may not have been considered for substitution because of its prolonged and successful application in its current use, the RoHS may be a driver of innovation by forcing the sector to look at its product and processes in a different way, including the investigation of alternatives. The development of tin solders as an alternative to leaded ones in the manufacture of a large number of EEE components provides a good example.

However, whether or not the increased use of tin solders has had any effect on the global market for tin is debateable. Prices of tin have risen significantly in recent years in response to both supply-side and demand-side factors. Stundza notes that the price of tin has surged in the past four years, pointing to bans on exports from unlicensed tin mines in Indonesia on the supply side and both the increased use of tinplated steel in China and the stimulation in demand for tin as a result of the ban on lead in electrical components enforced by the RoHS Directive on the demand side. He further claims that "analysts believe solders soon will outpace tin-plated as the nonferrous metal's major end use."

The marked increase in prices between 2003 and 2007 can be seen in the following graph (Source: London Metals Exchange).

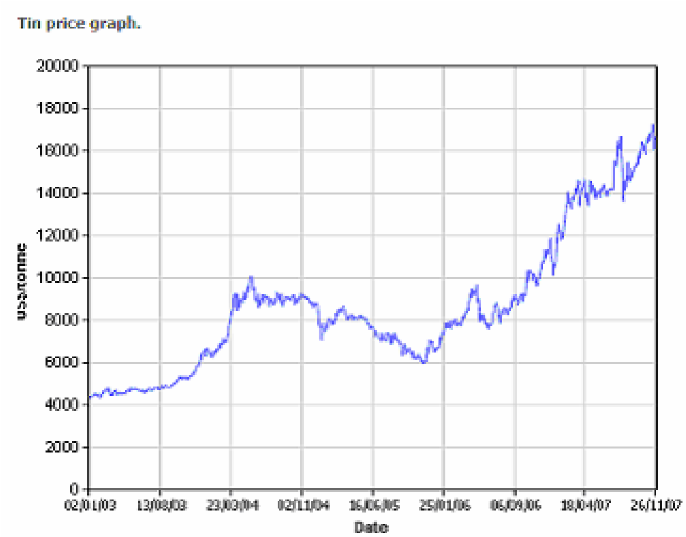

Figure 5.18: Tin price evolution

However, one stakeholder consulted argues that the increase in the price of tin was mainly the result of supply side factors, particularly the actions by the Indonesian authorities, as opposed to demand side ones. The increased imports of tin by China and speculative buying by investment funds are highlighted as being the main demand side influences and the fact that most of the rises in the price of tin have occurred after the RoHS ban came into effect (1 July 2006) is cited as an indication that the ban has not been a predominant factor in rising tin prices. Overall, the contributor was of the opinion that although RoHS clearly contributed to increased use of tin in the period coming up to the ban coming into effect, it was not responsible for subsequent price rises.

The development of tin solders as a replacement for leaded ones is an example of innovation being undertaken by companies for chemical substitution. Since the RoHS places bans on difference materials, companies are obliged to find alternatives and are, in the main, doing so. However, if research and development is concentrated on chemical substitution for the RoHS Directive only, at the expense of developing new and innovative products and hazardous substances policies generally, this could have a negative impact on the ability of EU industry to compete at the global level.

It is impossible to measure exactly the degree to which products have not been developed as a result of the introduction of the RoHS Directive. However, it has been argued that the level of applications for patents relating to innovations in electrical and electronic equipment could act as a good proxy indicator for the level of innovations ongoing in the sector. Further indicators explored by Masaru at the University of Tokyo is “the intangible outputs like the formation and functioning of networks linking scientists and technologists in the private as well as public sectors”, as well as the publication of scientific papers on technological developments and innovations since these would be expected to have an “equally significant impact on the long-term capacity for innovation.”

Masaru provides an analysis of patents issued in the United States relating to lead-free solders and issued to applicants from the United States, Japan and Europe between January 1, 1976 and the end of 2005. The following graph illustrates the trend in patents over this period.

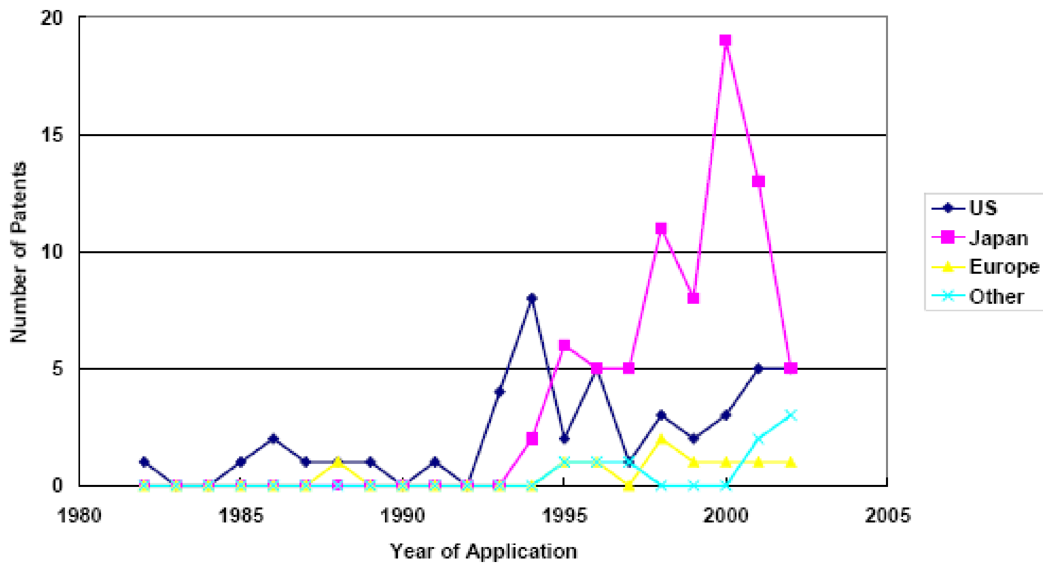

Figure 5.19: US Patents on Lead-Free Solders with Assignees in the United States, Japan, and Europe

Source: Masaru, 2006

Masaru suggests that "the early start in Japan in establishing collaborative networks for R&D activities on lead-free solders in the middle of the 1990s resulted in successful patent applications related to lead-free solders" and that the number of patents for US firms jumped significantly in the early 1990s, when the possibility of regulation was raised and then declined when the move towards regulation was subsequently reversed. The graph does, however demonstrate, that successful patent applications (and therefore the level of innovation if patents are accepted as a proxy) by companies in Europe have remained low.

When the publication of scientific papers on lead-free solders is examined, the picture is somewhat different. Masaru utilised the database of the Science Citation Index, maintained by Thomson Scientific, to analyse trends in the publication of scientific papers by authors in the United States, Europe, and Japan and Figure 5.20 below illustrates the results.

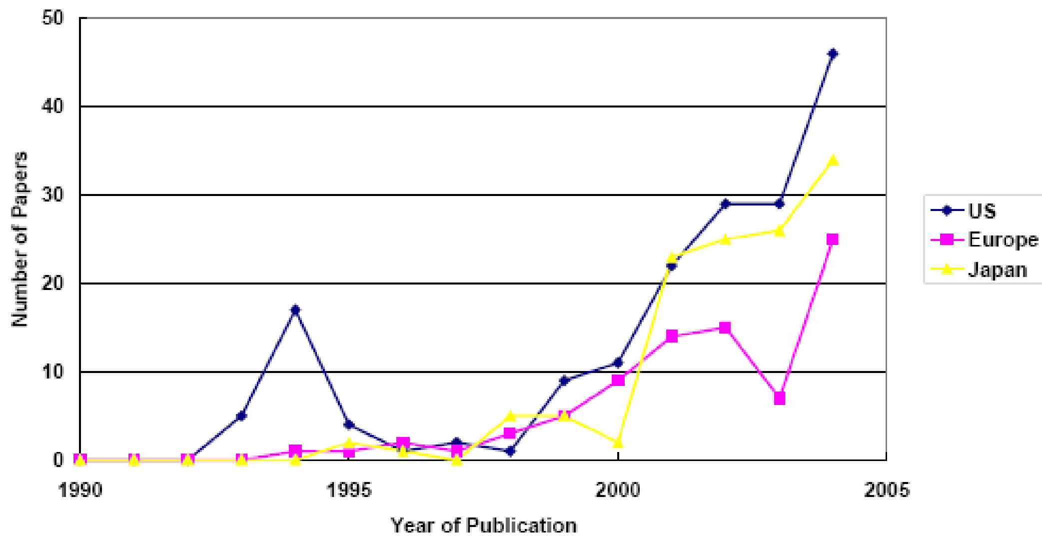

Figure 5.20: Publication of Scientific Papers on Lead-Free Solders in the U.S., Europe, and Japan (1990-2004)

Source: Masaru, 2006

Whilst the Science Citation Index will not have captured all scientific papers published in the US, Europe and Japan, the graph clearly shows a significant increase in scientific papers being produced in all three countries around the time of preparation for the entry into force of the RoHS Directive. As a proxy indicator for levels of innovation, the level of publication of scientific papers also suggests that innovation too was also on the increase around that time.

5.2.5.2 Arguments in favour of the view that innovation has been stifled by the RoHS Directive

A number of articles and company websites reviewed as part of this study revealed strong industry positions arguing that the pressure to comply with the RoHS Directive was putting pressure on their ability to develop innovative products.

SourceESB, a company providing services for sourcing electronic components, products and services, in it's article "RoHS Hampers Product Innovation", June 29th 2006 argues that companies face an ongoing battle to deal with RoHS compliance for existing products, particularly as different regulations are being put in place in other parts of the world. The article quotes comments from a Director of a company providing tools to support the design process in the United States who argues that designers are having to design new products for compliance which involve more work and time since *"as they spec each component, they have to see if it is compliant"*. The article goes on to state:

> *"A further deterrent to new product development for design teams is the work they have to do to redesign existing products for compliance. Manufacturers have generally not hired new design engineers to cope with the task of revamping existing bills of materials (BOMs) to make sure they are compliant. Under these conditions, design teams have not been able to focus on new product design to the extent they have been able to in the past."*

It is claimed that this situation exists under circumstance where design teams are smaller than they were some years ago. The article argues that many US manufacturers have been outsourcing design functions as a result and are sometimes using the services of outside design teams. The trend apparently began with low-end laptops and cell phones, but has expanded to include a wide range of consumer products and the article concludes that:

> "The outsourced design trend affects innovation greatly, since it means that OEMs may be giving up their product knowledge as they give up their design work. While it is hard to judge whether RoHS had directly impacted new product design (we can't count products that haven't been created), it is also hard to imagine that the pressures from environmental compliance haven't severely hampered innovation."

A strong case from the side of industry is made by the trade website Global SMT and Packaging:

> *"Adding insult to injury is the fact that true innovation has been purloined with a substantial percentage of the global electronics manufacturing engineering talent having been diverted to solving the lead-free implementation problem…….Lead free has caused the electronics manufacturing industry to delay exploration, research and development of new interconnection concepts in favour of meeting the requirements of meaningless legislation. One highly negative result of RoHS is that manufacturing and process development engineers are sounding more and more like back room lawyers than scientists as they struggle with interpretations of the often vague and murky language of the promulgated legislation in an effort to make certain their company's products will comply".*

ZVEI, the German Electrical and Electronic Manufacturers' Association, which represents the economic, technological and environmental policy interests of the German electrical and electronics industry at national, European and international levels, argues strongly that environmental regulations have a negative effect on innovation in one of its publications:

> *"Even in the electrical engineering and electronics industry over regulation and unnecessary rules hinder the growth of our companies and establishment of new businesses. Detailed regulations far away from practice prevent solutions achieved by the market and competition, quick reactions to market opportunities and competent people working on innovations. The current quickly growing flood of new taxing, inconsistent and restricting regulations are particularly critical, for example in the area of the protection of the environment and consumers. Detailed regulations at national and European level slow down innovation competition."*

Whereas the RoHS Directive bans or limits the use of hazardous substances such as lead, cadmium, and mercury in EEE products, the Directive allows for exemptions from its provisions where the benefits of retaining certain hazardous substances until an effective substitute can be identified outweigh the perceived drop in performance of certain products. For example, mercury to be used in straight fluorescent lamps is exempted from the RoHS as it performs well and there are no known substitutes at present. Whilst these hazardous substances are still allowed under exemptions, it is difficult to ascertain how much effort and investment companies will put into the development of alternative products with less environmentally damaging substances.

On its website documenting the progress of the study on Category 8 and 9 products, ERA Technology presented the conclusion that researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder the development of new technology as fewer materials are considered and potential improvements and new products are not developed. The ERA Technology final report on the Category 8 and 9 study provides a number of examples of products developed using banned substances (MRI scanners, semi-conductor X-ray detector arrays, improved control systems for detecting hazards such as pollutants) which simply would not have been available if the materials had been banned from research.

The exemption process itself, often taking more than a year to complete, is also considered to be a hindrance to research and development for new innovations. Given the fact that research carried out by universities is often undertaken on short-term contracts, the study argues that the length of time required to gain an approval for an exemption will deter researchers from embarking on the research in the first place as there will be no guarantee that an exemption would be granted in a short space of time.

Individual companies were asked during the consultation exercise for the study if they had been affected in these ways in terms of allocating research and development budgets for product development in addition to funds allocated for ensuring product compliance with the Directive. The results are set out in Table 5.11 below.

Table 5.11: Allocation of R&D budgets beyond RoHS compliance

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	3	19%	Those responding yes were large enterprises, producing a wide variety of products in different categories
No	13	81%	
Total	**16**	**100%**	

Whilst 19% of responding companies indicated that they had allocated additional budgets, the clear majority were either unwilling or unable to do so. Significantly, only larger companies answered that they were doing so, with those SMEs responding indicating that they had not.

Companies were also asked if they had introduced any innovations with respect to hazardous substances policies since dealing with the RoHS Directive; the results are presented in Table 5.12 below:

Table 5.12: Companies introducing innovations after dealing with RoHS

Response	No. of Responses	% of Responses	Enterprise Distribution
Yes	5	33%	All small companies responded no.
No	10	67%	
Total	**15**	**100%**	

Additional comments received in response to this question were as follows:

Innovation has been introduced:

- to develop and implement a halogen-free program to remove halogenated flame retardants from products;
- to develop and apply low mercury dosing technology in production at high cost;
- to unify components in the EU with those brought in from non-EU Member States, specifically from the US where a product had FDA approval;
- to modify a company's own green supplier scheme and technical standards

Innovation has not been introduced, because:

- the implementation of the RoHS Directive was already the largest challenge many companies have faced in recent years. Therefore, no further budget could be devoted to additional activities related to hazardous substances;
- many companies have already searched for the lowest hazardous substances and developed appropriate policies before the RoHS Directive as they follow their own environment and design programmes;
- RoHS and similar legislation determine the substances and the timeframe for dealing with hazardous substance issues and, depending on how these fit with internal timeframes, special actions can be needed.

5.2.5.3 Arguments in favour of the view that innovation has been inspired by the RoHS Directive

The study has not been able to identify quantitative data to support one side of the argument or the other apart from that produced from the limited responses of companies consulted in this study. However, in addition to the various positions presented above arguing that the Directive has hindered wider innovation, the study has also identified numerous examples of claims that the RoHS Directive has actually stimulated innovation in the EEE sector and provided competitive advantages for those firms that have invested in product development, with particular respect to wider hazardous substance policies.

An article in Electronic News refers to claims from industry analysts that "…*constant innovation is furthered by growing environmental concerns from authorities such as the European Union's Restriction of the Use of Hazardous Substances (RoHS) Directive. End-user demand for technically superior low-cost products, fuelled by the influx of Southeast Asian companies, is also prompting European participants to step up innovation, the firm said."*

Hewlett Packard on their website http://www.hp.com/hpinfo/globalcitizenship/gcreport/products/dfe.html say that "*Customer demand increasingly influences environmental product design. As a result, DfE (Design for the Environment) innovation provides competitive advantage."*

CISCO Systems Product Stewardship policy states:

> *"Cisco supports regulatory development to restrict hazardous materials and has worked with regulators, customers, and suppliers to help ensure that our products adhere to European Union and worldwide substance restrictions. Further, we are working on solutions beyond the stated regulatory compliance, focusing on alternative materials where they do not adversely affect our customers' safety and the reliability of our products."*

Cisco also argues in favour of "using regulatory compliance as a platform for materials innovation".

The Consumer electronics Association, in an article by Taylor in the July/August issue of its VISION magazine highlighted the fact that some companies are viewing the implementation of the RoHS Directive as an opportunity for developing their competitiveness rather than it being a restriction on product development:

> *"The global impact of RoHS highlights the pinnacle of a cultural change that has been underway in the electronics industry for several years. One company's executive described this change as his organization's "new religion"-an amalgam of concern for the environment and a ripe opportunity for increased competitiveness and efficiency. "*

HALMA, a UK company specialised in producing electronic, safety and environmental technologies, in their Preliminary Results for the Year to 31 March 2007, stated:

> *"Our ability to innovate and respond rapidly to frequent regulatory changes maintains competitive advantage. In addition to new technical standards, during the past year we accommodated new regulations covering: safe disposal and recycling of waste electrical products (WEEE Directive); restrictions on the use of hazardous substances in electrical products (RoHS Directive); and enhanced electromagnetic compatibility standards (CPD Directive)."*

Another article, published by CMP, a media and marketing solutions company serving the technology industry in 2006, examines the innovation effects of the RoHS Directive in the wider context of eco-design, arguing that manufacturers are dealing with RoHS compliance as part of a broader move towards designing products which are more environmentally friendly. As such, the author claims that *"in highly competitive markets, some observers insist, ecodesigned products could provide the needed edge to outsell conventional rivals with a similar price and features"*. Fujitsu Siemens Computers is provided as an example of a company producing computers which are RoHS compliant but also halogen-free, with virtually no screws and designed with snap-to parts to ease upgrading and recycling. The design team in Germany apparently continually review the equipment to find a balance between production cost and softer environmental impact.

Early preparation for the Directive's provisions seems to be a key factor and the article argues that:

> *"RoHS has shown that manufacturers with integrated eco-design cultures can more easily absorb conversion costs. While some companies are racing to understand and comply with RoHS, large European and Japanese companies have been aware of materials-restriction laws for years and have spent time preparing."*

Nokia is provided as an example as having prepared for RoHS well in advance of the deadline and is now able to produce phones at the same production cost as for previous non-compliant versions.

Supply chain management is also highlighted as having been radically changed by the Directive through deeper information exchange, closer interaction between customers and suppliers and tighter control of materials. The consequences of this are that as enforcement activities by national authorities become more embedded and developed, compliance will be tested and companies will be forced to look at eco-design activities. This will apply to all companies, including SMEs who, the author argues, are especially slow to adapt to eco-design.

A further article, by AMR Research, a company which provides advisory services and peer networking opportunities to operations and IT executives in the consumer products, life sciences, manufacturing, and retail sectors, identified that compliance with the RoHS and WEEE Directives "can be treated as a competitive advantage rather than simply as a cost of doing business" through the following examples:

- Branding — General Electrics, with its $1.5B spending on Ecomagination, is addressing its questionable past and transforming itself into an environmental player;
- New service offerings — IBM's multibillion-dollar GARS unit collects 20,000 end-of-lease machines each week and then resells, refurbishes, and dismantles them, contributing less than 2% to landfill;
- Product redesign — Sun's new CoolThreads technology increases the performance of its servers fivefold while reducing energy consumption, thus creating ROI for its customers;
- Enhancing relationships — Fujitsu Transaction Systems uses environmental regulations as an opportunity to educate and solidify relationships with its customer base, effectively turning it into a trusted advisor rather than simply a supplier;
- Lobbying — A large electronics manufacturer is keenly aware of the impact of some of the nuances of regulations, such as spending money on lobbying to protect its interests;
- Internal infrastructure — In preparation for ELV, a Tier 1 automotive supplier significantly updated its processes and enabling technology. Spending for RoHS regulations is less than 1% revenue, where companies of similar size are spending between 2% and 4%.

In the article's conclusion, AMR Research highlights the fact that "*a plethora of additional compliance mandates are affecting companies in the electronics supply chain worldwide. Understanding the regulations and tracking the differences add complexity, and those that assess processes and make the correct investments up front can create long-term competitive advantages.*"

5.2.5.4 Conclusions

It is clear from the above examples that the introduction of the RoHS has created many opportunities and just as many challenges for manufacturers in financing R&D activities and undertaking innovation, understanding the constraints throughout the supply chains and in identifying effective substitutes and their limitations on product design and performance. The literature is inconclusive as to whether or not companies' ability to innovate has been hampered by the provisions of the Directive, with claims being made on both sides; the consequent impact on EU companies' competitive position is also similarly inconclusive.

5.2.6 Comparison of RoHS legislation with other approaches used outside the EU

The RoHS Directive in the EU can be considered as a frontrunning environmental legislation that gave rise to several comparable initiatives on RoHS substances in electrical and electronic equipment around the world. Most of the major world markets are or will be covered by RoHS like initiatives. Except for California, the US is the one main absent party in this global tendency.

Major RoHS like initiatives can be found in California, Norway, China, South Korea and Japan. Australia, New Zealand. Thailand, Malaysia, Taiwan, Canada and Brazil and probably more countries show interest in introducing concrete RoHS like initiatives.

Roland Sommer, Consultant from New Zealand, describes the driving forces created by the EU RoHS initiative as follows: Countries that did not implement some restriction based on RoHS ran the risk of becoming a dumping ground for non RoHS compliant products. As more and more countries adopt RoHS this driver grows in strength. The introduction of RoHS also created some strong economic drivers. Economically a country without RoHS legislation faced far greater risks. Innovative companies that seeded their business in the domestic market would face a barrier to growth when looking at the export market. Non compliant imported products would drop in price as the global market for non compliant products shrunk putting further pressure on locally produced products. And last but not least, loss of export sales due to lack of knowledge of RoHS amongst the exporters which is more prevalent amongst SMEs.

The CEA/TFI study (2008) on the economic impacts of the EU RoHS mentions that according to almost 70% of the respondents handling compliance with multiple RoHS directives has brought additional costs. China RoHS has by far given rise to the most costs. Multiple respondents suggested international standards or centralisation to simplify and streamline environmental behaviour.

5.2.6.1 Entry into force

The RoHS Directive was approved on 27 January 2003 and entered into force on 13 February 2003. It should have been transposed by Member States no later than 13 August 2004 and its ban was entered into force from 1 July 2006.

These are the dates of RoHS like legislation in other countries:

- The first phase of China RoHS took effect from 1 March 2007, a second phase is planned to take effect very soon.

- The Korea RoHS WEEE ELV legislation will enter into force from 1 January 2008, although some executionary legislation still needs to be approved.
- The Norwegian POHS Prohibition on Certain Hazardous Substances in Consumer Products is as well foreseen for 1 January 2008. On 1 July 2006 an amendment has been realised in the Japanese Law for the promotion of Effective Utilization of Resources, introducing RoHS like provisions.
- On 4 June 2007 the California assembly passed a comprehensive RoHS Bill, expanding the scope the California RoHS that entered into force on 1 January 2007.
- In 2004 the Australian Environment Protection and Heritage Council directed officials to ‘investigate mechanisms for adopting equivalent measures and timing to those set out in EU RoHS’. Stakeholder consultation has taken place but no legislation has been approved until now.
- New Zealand is very much dependent of EU-market and other markets that have introduced RoHS legislation, and therefore New Zealand industry is organising itself to comply with EU RoHS legislation.

5.2.6.2 Focus of the legal instruments

The RoHS Directive is a stand alone legal instrument but is very much connected with the WEEE Directive and focuses exclusively on hazardous substances in electrical and electronic equipment. This focus or limitation can be found in most other RoHS initiatives:

- The South Korea RoHS is embedded in an initiative on electrical and electronic equipment combined with ELV and focuses on waste or equipment “that generates high volumes of waste”,
- the Japan RoHS provisions are also embedded in a larger waste legislative instrument.
- The Norwegian POHS however has the largest scope and focuses on all consumer products. It is more focused on the hazardous substances and their hazards in whatever application of product they are used.

Simplification can be enhanced by a more integrated vision, and would prevent the current discussions on e.g. car radios or on the definition of EEE and the coverage of the scope. The use of RoHS substances in vehicles and in EEE can be comparable and would deserve a comparable approach.

5.2.6.3 Substances and concentration limits covered

All RoHS initiatives have taken over the EU list of six RoHS substances, except for the Norwegian POHS. Only two of the RoHS substances (lead and cadmium) are taken into consideration, as well as some other bromium containing flame retardants not mentioned in the EU RoHS. In total, POHS covers 18 substances, of which some are present in EEE. The California RoHS covers the same EU substances but uses an alternative classification based on prior Californian legislation. The EU concentration limits have been taken over, except in POHS which has more strict limits.

The idea of homogeneous substances has been introduced worldwide. China RoHS has introduced the idea of treating very small components, with a size smaller that 4 mm^3, in the same way as homogeneous substances. The EU RoHS Enforcement Authorities Informal Network suggests taking over this China approach for reasons of practicability. The presence of CrVI in metallic surface conversion applications creates problems of measuring the concentration limits. China RoHS has introduced the concept of banning all intentionally added Cr(VI) in metal treatment, without imposing concentration limits.

The worldwide harmonisation of concentration limits is advantageous for creating worldwide level playing fields. The approach in China RoHS can be helpful to diminish the administrative burden if it can be guaranteed that it has no negative impact on the environmental performance of the RoHS provisions.

5.2.6.4 Products covered

EU RoHS uses eight rather general product categories and a collection of exemptions of more detailed applications. Different types of exemptions (often based on definitions or provisions on scope) are included as well in the RoHS and the WEEE Directives.

Unlike this, China RoHS has a large list of products which are covered. The China RoHS however does not include a large fraction of white-good electrical equipment. Medical equipment is included. China uses the approach of ‘everything not covered is allowed’, while EU RoHS uses the approach ‘what is not allowed in the exemptions, is forbidden’. China RoHS has, until now, not introduced exemptions.

The Korea RoHS focuses on a limited set of 10 specific items (TVs, refrigerators, air conditioners, laundry machines, personal computers, audio devices, cellular phones, printers, copy machines and fax machines) and this list can be enhanced by new executive legislation.

California RoHS used to focus merely on EEE with a screen wider than 4 inches measured diagonally, but has broadened its scope until it has covered all EU RoHS equipment.

Japan RoHS, like Korea RoHS, uses a limited set of products: computers, televisions, refrigerators, washers & dryers, microwaves and air conditioners.

A lack of harmonisation in the products covered can cause difficulties in supply chain management for companies active on different markets.

5.2.6.5 Restriction or disclosure

EU RoHS is banning the use of RoHS substances above certain limit values, for certain product categories and notwithstanding certain exemptions. The same approach can be found in the Norwegian POHS and the Californian RoHS.

Japan RoHS and Korea RoHS are merely obliging producers and importers to disclose presence of RoHS substances in their products. Disclosure means that companies still have to collect all the material composition data on their components, but instead of designing out non compliant components they have to declare where any of the restricted substances are. Until now, also the China RoHS (in its first phase) is using the same approach. However, China is preparing a second phase with a more limited list or a ‘key administered catalogue’ for which compulsory product certification will be administered by the Certification and Accreditation Administration (CNCA). The second phase comprises the actual restriction of materials. The catalogue will define which products are restricted, the timeline of the restriction, and the substances to be restricted. It will be subject to annual review and revision, meaning that products previously approved to incorporate RoHS substances may be subject to future restrictions.

Disclosure instead of restriction can be considered as a soft introduction for industry. Whereas the effect on ecodesign is less pronounced, it has an equal impact on administrative burden, labelling and supply chain management.

5.2.6.6 Worldwide RoHS harmonization

The World Electronics Forum has identified the spread of RoHS as a significant challenge to the industry, because all of the implemented RoHS approaches are substantially different and the burden on industry seems likely to increase. De facto harmonisation can be reached on the substances targeted because most versions of RoHS have taken over the EU list. Limit values and the principle of homogeneous materials are more or less accepted by all, notwithstanding some differences in the Chinese approach. Greater differences arise on scope and product groups, on disclosure, marking and testing requirements and on applied exemptions e.g. on medical devices (EU RoHS) or on white-good consumer articles (China RoHS).

It is clear that it would be in industry's best interests to have one global RoHS standard available. There are aspects of the different RoHS legislations that could give rise to a "best practice" approach for a global standard. A minimal standard could be easier to obtain, leaving freedom to subscribers to go further if they like to do so (e.g. Norwegian POHS, Korean ELV/RoHS …) but this would not diminish administrative burden.

A world RoHS standard, apart from being interesting for industry, should guarantee a high level of environmental performance. A level playing field can be created and administrative burden can greatly be tackled even when a world standard respects the high level of environmental performance already reached by several RoHS like legislative initiatives. It should be prevented that a world RoHS standard would level down initiatives taken by countries. The introduction of the EU RoHS Directive has created a stimulating effect worldwide on taking care of hazardous substances. This has been realised through its effects on economic mechanisms, as described above, and the effect is spreading across the world. Countries could envisage adopting EU RoHS in its entirety, but it would be imprudent for one country to bind itself to the laws of another country over which they have no control. In the future, the same market mechanisms and policy strategies as applied today could cause application on a larger collection of substances, (e.g. as declared in the IPC1752 material declaration standard) or on a larger group of equipment or products (as in Norwegian POHS).

5.2.7 Potential synergies and conflicts with other policies and impact on products and sectors not covered by the ban

Table 5.13: Comparison of RoHS with relevant other EU Directives

Directive	*Lead*	*Mercury*	*Cadmium*	*Cr(VI)*	*Polybrominated biphenyls (PBB)*	*Polybrominated diphenyl ethers (PBDE)*
76/769/EEC (Marketing and Use Restrictions)	Restrictions on uses of various compounds of lead in paints	Restricted to less than 0.0005% by weight in batteries and 2% in button cells	May not be used to give colour to finished products manufactured from the substances and preparations listed. In any case, cadmium content (expressed as Cd metal) must not exceed 0.01 % by mass of the plastic material.	N/A (Controls in relation to cement)	May not be used in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin	May not be placed on the market or used in concentrations higher than 0,1 % by mass. Articles may not be placed on the market if they, or flame-retarded parts thereof, contain this substance in concentrations higher than 0,1 % by mass.
94/62/EEC (Packaging and Packaging Waste Directive)	Member States should ensure that the sum of concentration levels of lead, cadmium, mercury and Cr(VI) present in packaging or packaging components shall not exceed 100 ppm by weight after 30 June 2001.				N/A	N/A

Directive	*Lead*	*Mercury*	*Cadmium*	*Cr(VI)*	*Polybrominated biphenyls (PBB)*	*Polybrominated diphenyl ethers (PBDE)*
2000/53/EC (End-of-Life Vehicles Directive)	In accordance to this Directive, Member States shall ensure that materials and components of vehicles put on the market after 1 July 2003 do not contain lead, mercury, cadmium or Cr(VI) other than in cases listed in Annex II under the conditions specified therein. Exceptions: Cadmium The following exemptions were included in Annex II to the Directive: 1. Thick film pastes (expired on 1 July 2006). 2. Batteries for electrical vehicles (after 31 December 2005, the placing on the market of NiCd batteries shall only be allowed as replacement parts for vehicles put on the market before this date). Cr(VI): - Corrosion preventive coatings (expired on 1 July 2007). - Absorption refrigerators in motor caravans				N/A	N/A
2006/66/EC (Batteries and Accumulators)	Recycling processes shall achieve 65% recycling rates for lead-acid batteries and accumulators including recycling of the cadmium content to the highest degree that is technically feasible while avoiding excessive costs	Limit on mercury content by weight of 0.0005%, and exemption for button cells, which must have a mercury content of less than 2%	Portable batteries or accumulators, including those incorporated into appliances, that contain more than 0.002% of cadmium by weight shall not be placed on the market	N/A	N/A	N/A
Overall relevance of Directives to the RoHS Directive	There is some synergy between the RoHS and the End-of-Life Vehicles Directive where the latter includes exemptions for specific uses of lead, which are also mentioned in the Annex to	As the chlor-alkali industry phases out mercury cells, dental amalgam will become the EU's major mercury use. Out of the estimated 440 tonnes of mercury consumption in the EU (in	The vast majority of consumed cadmium relates to Ni-Cd batteries; coatings and minor uses which may be relevant to the RoHS account for only a small % of consumption	It appears that a significant tonnage of chromium trioxide is used in metal applications that may find uses in EEE. The current status of Risk Reduction Strategies under the Existing Substances Regulation has not been	It appears that PBB are of little relevance to the EU at present, as it is not produced any more. In any case, the RoHS will target and restrict new applications of PBBs in EEE	It appears that octa-BDE and penta-BDE are of little relevance to the EU at present as they are now restricted for all uses under Directive 76/769/EEC. On the other hand deca-BDE is allowed for use in plastics which in the early 2000s

Directive	*Lead*	*Mercury*	*Cadmium*	*Cr(VI)*	*Polybrominated biphenyls (PBB)*	*Polybrominated diphenyl ethers (PBDE)*
	the RoHS Directive. The percentage of lead consumption represented by the uses exempted from the provisions of the RoHS Directive is quite small but not insignificant	2005), a total of 105 tonnes is used for measuring and control equipment and electrical control equipment, with lighting using around 35 tonnes		finalised. However, it is not expected to result in restrictions on the marketing and use that may conflict with the implementation of RoHS		accounted for 80% of European consumption of the substance

Overall, Table 5.13 above does not provide any clear instances of conflicts between the various pieces of legislation. This is not unexpected since the use of most of the banned substances in EEE represents only a small percentage of the global market in these substances. The exceptions to this are mercury, 25% of the total consumption of which is used in monitoring and control equipment, and Deca-BDE which is widely used in electronics equipment. However, since Category 9 (Monitoring and Control Instruments) is currently exempt from the roHS Directive, there will be no effect on the overall mercury market.

5.2.7.1 The RoHS Directive and Directive Regulation (EC) No 1907/2006 of the Council and of the Parliament of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

BACKGROUND

The Regulation on the Registration, Evaluation and Authorisation of Chemicals (REACH) came into force on 1st June 2007. The aim of REACH is to ensure a high level of protection of human health and the environment as well as the free movement of substances. An important objective of REACH is to encourage and in certain cases to ensure that substances of high concern are eventually replaced by less dangerous substances or technologies where suitable economically and technically viable alternatives are available.

Under REACH, substances that are manufactured or imported in quantities above 1 tonne per year per manufacturer/importer will have to be registered:

- manufacturers and importers of substances will have to gather hazard information, assess risks (based on use information), classify and label all chemicals;
- the amount of information required will increase in line with the annual tonnage per manufacturer/importer with thresholds of 1 tonne, 10 tonnes, 100 tonnes and 1000 tonnes per year;
- for substances that are manufactured or imported in quantities above 10 tonnes per year, a chemical safety report (CSR) must be produced. The CSR must include use scenarios, human and environmental exposure assessments and recommended risk management measures; and
- relevant exposure information must be communicated to downstream users via safety data sheets.

REACH will apply to all chemical substances, except:

- substances that are radioactive, subject to customs supervision or non-isolated intermediates;
- substances that occur in nature, such as minerals, ores and ore concentrates, cement clinker etc. as long as these are not chemically modified in any way;
- waste: by-products are exempt from registration as long as they are not imported or placed on the market themselves. If they are imported or placed on the market, substances within the by-products will need to be registered for that use;

Member States may exempt substances used in the interest of defence

Substances with properties of very high concern will require authorisation. These include CMRs (category 1 and 2 carcinogens, mutagens and substances that are toxic to the reproductive system); PBTs (persistent, bio-accumulative and toxic); vPvB (very persistent and very bio-accumulative); and substances of equivalent concern (e.g. endocrine disruptors). There is therefore likely to be some overlap with the substances prohibited under RoHS. Under the authorization system:

- the European Chemicals Agency (ECHA) will prepare and publish by June 2009 a list of candidate substances to which authorisation may apply. It will then assess the substances (over a period of time) and recommend which should be included in Annex XIV;
- anyone who wants to use substances included in Annex XIV will have to demonstrate that the risk associated with the use of the substances is adequately controlled, or that the socio-economic benefits of the use outweigh the costs; and
- applications for an authorisation have to include an analysis of alternatives and a substitution plan.

If a substance poses unacceptable risks, it may be either partially restricted (for specific uses) or completely banned:

- Member State competent authorities or ECHA prepare restrictions dossiers;
- the dossiers will include: risk assessment, assessment of alternatives, assessment of effectiveness of proposed restriction, socio-economic analysis (although not mandatory); and
- stakeholder consultation is recommended in the guidance but not required.

Potential Synergies Between RoHS and REACH

REACH and RoHS have similar objectives, to ensure protection of health and the environment whilst ensuring the free movement of goods and encouraging substitution of substances of high concern by less dangerous substances. As REACH applies to all substances placed on the EU market, not only the specific substances targeted by RoHS, it will:

- help to provide scientific evidence on other substances which could be subject to regulation under RoHS, through the dossiers submitted for registration of substances and through the authorisation process. This will place the onus on generating information on manufacturers/importers of substances rather than on the Commission;
- provide evidence to assist the Commission in the review of exemptions under RoHS, as the safety of all uses of substances will need to be addressed in the registration process;
- provide information on available substitutes for substances of high concern, through the authorization process (which includes a mandatory substitution plan);
- ensure that proposed substitutes for substances restricted under RoHS are safer than the substances they replace, as they will also be subject to registration and thus information will be available on the risks that they pose;

- provide an alternative method for addressing the risks posed by substances in WEEE, through the restrictions process. This may allow for more focused controls on particular EEE uses of substances, rather than the prohibitions introduced by RoHS;
- ensure that all substances used in EEE are safe for that use, through the registration process and particularly the preparation of chemical safety reports. Such reports will assess the risks posed by substances throughout their life-cycle, including disposal and specify the conditions of use (including risk management measures) that need to be followed in order to ensure safe use. Substances can only be used outside the conditions of use specified if the user carries out his own assessment or, if he uses less than 1 tonne per year, if the ECHA is informed;
- provide better information to manufacturers of EEE on the properties of substances that they use, and on how to use them safely, to ensure that risks to the environment and to health, including to the safety of users, are minimized.

POTENTIAL CONFLICTS BETWEEN REACH AND ROHS

There is some potential for conflict between REACH and RoHS, or at least a reduction of the potential synergies, mainly resulting from the different timescales and exemptions from registration and the different requirements under the authorization process:

- REACH will come into force gradually, over the period to 2018. Registration will apply initially to substances manufactured or imported in the highest tonnage bands. Information on substances used in EEE may therefore not be available in time for the four-yearly review of exemptions under RoHS;
- for substances manufactured or imported in amounts below 10 tonnes per year per manufacturer or importer, a chemical safety report does not need to be prepared. This may apply to some of the more specialist substances used in EEE, therefore limiting the information benefits of REACH for RoHS;
- the authorisation process under REACH will be implemented gradually over a period of time. Depending on which substances are selected first for inclusion in Annex XIV, this may or may not tie in with timescales under RoHS;
- whilst RoHS lists exemptions and maximum tolerated concentrations for prohibited substances in an Annex, under REACH a separate application will need to be made for authorisation of a use of an Annex XIV substance. Each application may have separate conditions and limitations, depending on what is judged necessary to ensure safe use. There could thus be a conflict between the conclusions under REACH and the exemptions in the Annex to RoHS;
- under REACH, authorisations are reviewed on a time-limited basis, with the time limit set separately for each authorisation. There is thus potential for a conflict between the timescales set under REACH and the review period for exemptions under RoHS.
- REACH allows authorisations to be granted where the socio-economic benefits of a particular use of a substance outweigh the costs, even where safe use cannot be demonstrated. There is no such provision in RoHS; instead exemptions apply only where substitution is not possible from a scientific or technical viewpoint. It is thus possible that REACH could allow a use prohibited under RoHS.

5.2.7.2 The RoHS Directive and Directive 2005/32/EC of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products

The EuP Directive is aimed at improving the eco-design of energy using products as a means of improving energy efficiency and also at reducing waste and pollution produced across the whole lifecycle of such products. Article 1(4) states that:

> *"This Directive and the implementing measures adopted pursuant to it shall be without prejudice to Community waste management legislation and Community chemicals legislation…"*

The above sub-article clearly requires the development of implementing measures to take into consideration the provisions of the RoHS Directive and the obligation to cater for the limitations on the inclusion lead, mercury, cadmium, Cr(VI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

This will need to be in spite of point (12) in the preamble to the Directive, which states:

> *"Although a comprehensive approach to environmental performance is desirable, greenhouse gas mitigation through increased energy efficiency should be considered a priority environmental goal pending the adoption of a working plan."*

The requirement to ensure that the provisions of the RoHS Directive concerning regulated substances are met will potentially have implications for the eco-design of energy using products. The EuP Directive states that whilst the best-performing products or technologies are to be taken as reference points, these alone will not necessarily determine the implementing measures for products since it is also be necessary to consider the technical, economic and environmental analysis of products as well. This analysis will therefore be required to examine technologies' compliance with RoHS provisions, with potential economic and technical costs.

Preamble (33) to the EuP Directive makes clear the linkages between the two Directives:

> *"This Directive is complementary to existing Community instruments such as….. Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment…… Synergies between this Directive and the existing Community instruments should contribute to increasing their respective impacts and building coherent requirements for manufacturers to apply."*

as does the section on ecodesign parameters for EuPs set out in Annex I 1.3:

> *"In particular, the following parameters will be used, as appropriate, and supplemented by others, where necessary, for evaluating the potential for improving the environmental aspects mentioned in the previous paragraph:*
>
> *(d) use of substances classified as hazardous to health and/or the environment... and taking into account legislation on the marketing and use of specific substances, such as Directives 76/769/EEC or 2002/95/EC;"*

However, the fact that there is a growing number of exemptions for certain applications under the Annex to the RoHS Directive will complicate the development of implementing measures under the EuP Directive. Where products using these applications are to be considered for implementing measures under the EuP Directive and performance is strongly related to the inclusion of the banned substance in the product, it will either be difficult to develop appropriate implementing measures, or it may be necessary to update them at an unspecified time in the future if and when the exemption is withdrawn.

Finally, the EuP Directive is a “New Approach” Directive in that it deals with an approach to technical harmonisation and standards and products are required to make reference to those standards. The Directive also sets out the various means by which producers can demonstrate compliance with the provisions of the Directive and any subsequent implementing measures in Annex IV - *Internal design control* and Annex V - *Management system for assessing conformity*. The Martin *et al* study referenced in section 4.2.3.4 argues that adopting such an approach for the RoHS Directive would produce benefits in terms of reducing technical barriers to trade and adopting such an approach might be more straightforward given that producers of EEE will be required to adopt the new approach to conformity assessment under the EuP Directive. Both Directives are based on Article 95 of the EC Treaty with the aim of ensuring the free movement of those products within the internal market.

5.3 LESSONS LEARNED FROM THE ECONOMIC IMPACT ANALYSIS IN THE VIEW OF REVISING THE ROHS DIRECTIVE

It is clear that the economic impact analysis includes a lot of interesting findings. Below, we have concentrated on the facts that are specifically relevant for this simplification exercise: which findings could positively be influenced by a revision of the Directive? The reader will notice that the findings are not so much focused on the past, but instead look at the future costs which remain necessary for RoHS compliance.

The next chapter consists of an analysis of proposals to revise the RoHS Directive, where we will concentrate on trying to ease these remaining future economic impacts. It should be clear that we want to avoid questioning the general set-up of the RoHS Directive. One of the reasons for this is that most companies have completed the changes required for RoHS and are not requesting thorough revisions. This might introduce uncertainty over the requirements again, now that the legislation finally settled down to a workable form. Besides, it would not be advisable to remain focused on the efforts companies have made in the past, which are very significant but non-reversible.

1. Total costs incurred by industry to comply with the RoHS Directive are high; a large part of the costs incurred to comply are spent in the past

It is clear from the economic impact analysis that total costs incurred by industry to comply with the RoHS Directive are high. Generally, the average past and future one-off cost impact of RoHS lies between 1 and 2% of total turnover. For comparison, electronics companies spend on average 4-6% of their revenues to R&D.

The share of total average future yearly costs to maintain compliance amounts to approximately 10% of total costs. When weighted, this share decreases up to 3%. This indicates that a large share of the costs for RoHS compliance have already been borne in the past. Options for revising the RoHS Directive should therefore be concentrated on ways to lower annual future costs.

2. The share of compliance costs in total costs to comply with RoHS is much higher compared to the share of technical costs

Total costs to comply with RoHS can be split up into compliance costs and technical costs. Compliance costs consist of costs of training and information measures, costs of collecting and reviewing information, costs related to exemption procedures and monetary losses related to RoHS compliance (e.g. turnover loss, obsolete components). On the other hand, technical costs to phase-out RoHS substances consist of capital expenditure, R&D expenditure and operating expenditure.

Compliance costs make up 67% of all costs made to comply; the share of technical costs amounts to 33%. Within the future yearly costs to stay RoHS compliant, the share of technical costs drops to 12%, whereas compliance costs reach a level of 88% of total costs. As most technical costs (capital and R&D expenditure) are made in the past to comply with RoHS, the remaining future yearly costs consist mainly of the operating expenditure, such as increased purchasing costs of materials or higher energy costs, related to the substitution of RoHS substances.

Options for revising the RoHS Directive should therefore be concentrated on ways to lower annual future compliance costs, which is linked with options aimed at an efficient monitoring and enforcement regime to limit free-riders.

3. The administrative burden related with RoHS is relatively large

When concentrating on the yearly costs to remain RoHS compliant in the future, the administrative burden can not be underestimated. The administrative burden consists of the costs of training and information measures, the costs of collecting and reviewing information and the costs related to exemption procedures.

Almost 70% of the total future yearly costs are related with information and verification activities such as providing, collecting and validating RoHS compliance of components, testing procedures, maintaining records in new or updated (software) systems, adaptation of the company's quality system, including stock management, and performing quality audits.

Regarding the material declarations, existing standards, like the IPC1752[14] material declaration standard, are increasingly being used. Regarding the testing of supplied components to secure RoHS conformity, stakeholders state that a number of unanswered questions remain on how to conduct accurate verification testing. It is very difficult in practice to control the "homogeneous material" concept as a basis for checking compliance with the maximum concentration values.

Costs are identified on the level of stock management or segmentation of compliant and non-compliant products and components (RoHS and non-RoHS process or machines identification/labelling/isolation). Companies often deal simultaneously with different markets, like the EU-market, other markets with RoHS like legislation and markets without RoHS like legislation. It is also possible that they cope with products that are included in the RoHS regulation and products that are not included or are exempted.

Where training and information measures to learn and keep up with RoHS requirements made up 41% of the administrative burden in past and future one-off costs, they will in the future make up only a quarter of the administrative burden.

An administrative burden (5%) is caused by the mechanism for exemptions which causes a lengthy exemption process. Trade associations mention the long waiting periods between a request for exemption and the decision. Furthermore, they mention the lack of communication to industry during this process. Products awaiting approval are not allowed to be put on the EU market, which hinders competitiveness.

As can be expected, monetary losses can in the future be considered negligible.

[14] IPC1752 is a standard for electronic data exchange for Environmental Data developed by IPC with participation from major OEMs, Contract Manufacturers, Component Manufacturers and Material suppliers.

4. A large part of the costs are personnel costs, but the vast majority of companies hired zero or one employee for RoHS compliance

The share of personnel costs related with training & information activities and with collecting & reviewing information activities in the total past and future one-off costs amounts to 38%[15]. This share increases up to almost 50% when considering the yearly future costs to remain RoHS compliant.

In order to execute all activities to become and remain RoHS compliant, the vast majority of companies hired zero or one employee for RoHS compliance, relying instead on internal resources by reassigning existing personnel.

5. The relative cost burden is higher for SMEs

When weighted by company revenue, the average past and future one-off cost impact to comply with RoHS and the future yearly cost to remain compliant amount to respectively 0.05% and 0.003% of turnover. This indicates that SMEs are affected to a greater degree by compliance with the RoHS legislation compared to their larger or multinational competitors. The burden is higher for smaller companies compared to large or multinational companies. The relatively larger burden for SMEs holds for total costs to comply with RoHS in general as well as more specifically the administrative burden.

In the previous paragraph, it was mentioned that the vast majority of companies hired zero or one employee for RoHS compliance, relying instead on internal resources by reassigning existing personnel. SMEs have a smaller labour force but are obliged to carry out the same requirements as companies with a larger pool of labour. This means that the work pressure put on personnel in SMEs will be relatively higher.

6. There is a lack of considering market reality in the exemptions process

Exemption process may hinder innovation, but also offers an opportunity to innovate

The RoHS Directive might loose its impact as a driving force for innovation when industry has the choice between developing alternatives for certain products and proposing an amendment for legislation. As long as hazardous substances are still allowed under exemptions, it is difficult to ascertain how much effort and investment companies will put into the development of alternative products with less environmentally damaging substances. In this way, the process of granting exemptions could be considered as hampering innovation. Also, the exemption process itself, often taking more than a year to complete, is considered by some stakeholders to be a barrier to research and development for new innovations.

On the other hand, the RoHS ban itself could be a barrier to innovation. Researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder the development of new technology, as fewer materials are considered and potential improvements and new products might not be developed. It might stimulate innovation to allow a time limited derogation for the specific aim of developing new products. In this way, the use of RoHS restricted materials could be allowed for a limited period of time in which companies can experiment in the development of new products.

[15] Unfortunately, companies did not indicate the share of personnel costs in R&D costs, which made it not possible to calculate personnel costs dedicated to R&D. This means that in reality, personnel costs will be somewhat higher.

Exemption process should consider market reality

Whereas the RoHS Directive bans or limits the use of hazardous substances in EEE products, the Directive allows for exemptions from its provisions where the benefits of retaining certain hazardous substances until an effective substitute can be identified outweigh the perceived drop in performance of certain products.

According to a number of stakeholders, not only the issue of technology availability is valid. There is a time gap between the availability of a substitute and the RoHS conformity of an EEE. When the substitute becomes available in the beginning of the supply chain, it takes considerable time before it arrives in the end product and the product is considered free of RoHS substances. Therefore, industry argues that there should be a sufficient buffer period between the arrival of a substitute and the abolishment of an item from the annex of exemptions. This period may however not be too long, because it is not intended for using up an existing stock of supplies containing RoHS substances.

Besides the mere presence of alternative technologies, economic and market circumstances can have a large influence on the implementation of new technologies. This is not taken into account during the exemption procedure and the exemption decisions. During the time that an exemption holds, companies are working to eliminate the use of substances in applications that are exempted. However, even if alternative technologies are available, the implementation in product designs requires consideration of various business realities such as:

- Availability of the technology in the parts currently used in products;
- The functionality of the new technology (including reliability) compared to the current technology used;
- Design implications of using parts containing the new technology;
- Cost implications of the transition to the parts containing the new technology.

The process of implementing alternative technologies is complex and companies need to review:

- Whether the technology is fit for the particular use (i.e. whether the properties and quality/reliability aspects meet the demand);
- Whether the alternative is a direct replacement or that redesigns of EEE would be required;
- Whether parts using the new technology are available through the producers' current supply chain (i.e. adding new suppliers in case an existing supplier does not have access to the new technology).

Once a new technology is found acceptable, it needs to be implemented throughout the logistic process before it can be implemented in the manufacturing of EEE. In case the application of the new technology requires a re-design at the EEE level, the re-design process (including design verification, product testing) needs to be completed prior to the start of the manufacturing process.

The key factor in applying a new technology by EEE producers is the time required between the availability of a new technology up-stream in the supply chain and the ability to place EEE on the market after completing all tasks as described above.

The current experience with the application of the criteria of article 5 of the Directive leads to the conclusion that this provision requires modification to allow a more realistic process for the review and future withdrawal of exemptions, more in line with commercial reality. Stakeholders believe it is necessary for the decision-maker to take into account the following economic criteria when considering the removal of an exemption:

- The large scale availability of a new technology to meet the volume needs of the whole of industry;
- The necessary lead times for implementing changes in the manufacturing process to adapt to the new application;
- The highly technical matters of supply chain management, product re-design and reliability analysis.

<u>Exemption process should consider balance between environmental and economic impact</u>

Another aspect in the question whether or not to grant an exemption, could be the investigation of the balance between the environmental benefits of RoHS compliance and the economic costs of becoming compliant. It is possible that the costs to comply are extremely high, whereas the additional environmental impact of RoHS compliance for a certain application is very low.

From the results of this study, it was not possible to generate general criteria determining cases in which a very high economic cost of compliance does not balance with an extremely low environmental impact. However, the analysis showed that Category 8 and 9 products of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material are at the limit regarding costs and benefits.

7. A part of the burden is related to difficulties concerning the scope of RoHS

According to the stakeholders, a burden comes from tracking the transpositions of the RoHS Directive in all 27 Member States, because of the large variation in transposition. This variety stems from a difference in enforcement methodologies as well as a difference in interpretation of the scope and applicability of the Directive. Trade associations have mentioned the lack of clear definitions in RoHS legislation, such as 'put on the market', 'homogeneous material' and what is 'lead free'. This results in considerable confusion with regard to compliance.

8. Market surveillance is fundamental to ensure a fair, competitive playing field

Trade associations tend to believe that the burden of compliance is not being shared equitably among producers. They refer to the problem of free-riding and are convinced that many importers in the EU do not comply because of insufficient market surveillance. In this way, competition is likely to be distorted.

9. Additional costs come from handling compliance with multiple RoHS directives

From other literature sources we have learned that a large part of companies experience additional costs from handling compliance with multiple RoHS directives. China RoHS has by far given rise to the most costs. Multiple respondents suggested international standards or centralisation to simplify and streamline environmental behaviour.

6 PROPOSALS TO REVISE THE ROHS DIRECTIVE

Simplification of legislation can lead to a more transparant, more focused legislation which is more easily accepted by the target groups. Every simplification exercise looks at ways to save and promote the goals of the original instrument, by using the most suitable, the least burdensome and the most cost effective instruments. The exercise is guided by the economic principle to achieve the best results with the least effort.

A simplification exercise should be neutral against the goals of the policy; it is merely an instrumental exercise. This simplification exercise will scrutinise the current legislative approach with a view to replacing or amending it with more efficient, less prescriptive, flexible and proportionate instruments while maintaining the same level of environmental protection. The proposals formulated seek to maintain the environmental objectives at the least possible economic cost, including static costs such as administrative burden and dynamic costs such as effects on the Internal Market. The study does not attempt to discuss or justify the overall need of the RoHS Directive, and as a result it does not evaluate its objectives. It rather concentrates on the means of achieving these objectives.

The environmental and economic analysis result in the following set of proposals for revision of the RoHS Directive. For each proposal, an evaluation is made of the advantages and disadvantages as well as their impact. The proposals represent the vision of the consultant.

6.1 DISTRIBUTING THE ADMINISTRATIVE BURDEN ACROSS THE SUPPLIERS

6.1.1 Issue

The economic impact analysis has shown that the administrative burden related to RoHS compliance can not be underestimated. Almost 70% of the total future yearly administrative costs are related with information and verification activities such as providing, collecting and validating RoHS compliance of components, testing procedures, maintaining records in new or updated (software) systems, adaptation of the company's quality system, including stock management, performing quality audits, etc.

A large burden is related to introduce and update RoHS compliance tracking systems, to collect suppliers' conformance data and to establish integrity of suppliers' data and the required follow-up actions. Most producers of EEE are acting as assemblers at the end of an extended supply chain, consisting of a large number of suppliers of hundredths of components. This characteristic of the EEE market makes it difficult and technically and administratively burdensome to check RoHS compliance of the finished products.

Costs are identified at the level of stock management or segmentation of compliant and non-compliant products and components (RoHS and non-RoHS process or machines identification/labelling/isolation). Companies often deal simultaneously with different markets, like the EU-market, other markets with RoHS like legislation and markets without RoHS like legislation. It is also possible that they cope with products that are included in the RoHS regulation and products that are not included or are exempted.

6.1.2 Current situation

Supply chain management and the issue of homogeneous material

Many respondents state that a large administrative burden is caused by the collection of material declarations or the acquisition of data on RoHS compliant parts. EEE assemblers have to invest largely in data collection, both resource and personnel costs. By the nature of their business, producers of EEE are mainly involved in the assembly of products out of components produced by third parties. These suppliers are often found worldwide in a non-universal market. Companies having their supply chain management within the European Union have less difficulty in reaching the objectives of the RoHS Directive compared to bigger players having suppliers in Asia or other continents. Suppliers are not always aware of RoHS compliance requests and need specific education. Moreover, they are not always able or willing to share information on RoHS substances in their components.

A strong supply chain management is necessary to guard RoHS compliance, certainly from the viewpoint of the scope that “homogeneous materials” (see also 6.5) should comply with RoHS. The total content of RoHS substances may be below the threshold values, but if the product contains a single component that does not comply with the RoHS thresholds, the assembled product is considered non-compliant.

Regarding the *material declarations*, existing standards, like the IPC1752 material declaration standard, are increasingly being used. Regarding the *testing* of supplied components to secure RoHS conformity, stakeholders state that a number of unanswered questions remain on how to conduct accurate verification testing. It is very difficult in practice to control the “homogeneous material” concept as a basis for checking compliance with the maximum concentration values.

Testing procedures

Testing instruments to check RoHS compliance can be time and money consuming. A notified problem is the fact that there are no agreed standards available to demonstrate RoHS compliance e.g. on sample disjointment or testing methodology.

International Electrotechnical Commission Standards are being developed, such as IEC 62321 Ed.1, 111/54/CD (procedures for determination of RoHS regulated substances), including mercury and lead. This draft test procedure for determining hazardous substances to support RoHS compliance was rejected by IEC National Committees in 2006. A total of 395 comments and amendments have been forwarded to IEC. International Electrotechnical Congress Technical Committee 111 Working Group 3 recently announced that member nations voted unanimously to approve the latest committee draft of document 62321 as a Final Draft International Standard (FDIS). FDIS 62321 Electrotechnical Products - Determination of Levels of Six Regulated Substances (Lead, Mercury, Cadmium, Cr(VI), Polybrominated Biphenyls, Polybrominated Diphenyl Ethers) will undergo revision in early 2008 to incorporate accepted comments submitted by voting nations. Following that process, FDIS 62321 will be submitted for a final ballot.

The document recommends screening with ED-XRF but warns of potential inaccuracies in inexperienced hands. Screening can result in a clear pass, a clear fail or a borderline result. Additional testing is required for a borderline result, or if bromine or chromium is found above the clear pass limit. The final version of IEC62321 could solve current problems on CrVI[16] and PBB/PBDE procedures for determination. Whilst publication can now only be during late 2008 at the earliest, IEC 62321 is subject to parallel voting which means that it can simultaneous become a European Harmonised Standard without further delay.

IEC 62321 will provide some, but not all, of the test methods needed for RoHS. The current version of the document contains normative methods for elemental analysis, i.e. screening by X-ray fluorescence and quantification of total Cr, total Br, Cd, Hg, and Pb by atomic spectrometric methods. Test methods for hexavalent Cr in coatings and polymers and for brominated flame retardants are included as

[16] Especially for metallic surface conversion problems occur on testing CrVI. Stakeholders suggest that the easiest way to enforce the ban on Cr(VI) in surface conversions is to create an additional category for this with the limit of “Not Intentionally added”.

informative annexes. The scopes of the methods are limited due to the limited resources available to validate them, including few certified reference materials, few experienced laboratories, and resistance of some sample matrices to sample preparation by digestion. Interlaboratory validation was accomplished for a fraction of the wide variety of materials found in products covered by RoHS.

In IEC parlance, *normative* indicates the methods are valid within their published scopes and can be used for product specifications. In contrast, *informative* documents have not been demonstrated to be valid and are presented only for guidance. IEC TC111 will continue to improve the standard and has requested an accelerated review schedule forcing TC111 to ballot an improved version of 62321 within two years of its publication.

Experts at the National Institute of Standards and Technology participate in IEC TC111 activities, including development of FDIS 62321. NIST is developing Standard Reference Materials for RoHS applications including lead-free solder, free-cutting brass, plastics, and flame retardants in solution and other matrices (U.S. Mission to the EU WEEE/RoHS Update, January 18 2008).

The procedures in the draft could be used by industry and others, but the rationale to do should be documented. The Institute of Reference Materials and Measurements of the European Commission (www.irmm.jrc.be) and other reference material producers are developing specific reference materials suitable for testing RoHS substances. A major problem is that the concepts of homogeneous material and the sampling method are deliberately left out of the standard. Sampling strategies are advised in the RoHS Enforcement Guidance Document (see paragraph 6.2). However, it should be noted that this document is not legally binding and Member States are currently free to develop their own sampling criteria and strategies. Small and medium sized enterprises are not active in standardisation. Their sector organisations seem to be in favour of EU standards instead of ISO international standards, on which the European Union lacks control.

6.1.3 Possible scenarios

Three situations can be compared:

- Business as usual
- Remove the concept of “homogeneous material”
- Request from the producer of the homogeneous materials to prove RoHS compliance. Each compliant component could be recognisable by its certificate. The value of the certificate could be officially guaranteed and can therefore work as a proof of compliance.

Besides these possibilities, a general advice, applicable in all scenarios, is given on standardised compliance testing procedures.

6.1.4 Analysis and evaluation

6.1.4.1 Business as usual

“Business as usual” would mean “burden as usual” and also distribution of the burden as usual. None of the problems reported above in the chapter on the current situation would be solved. Differences would remain in terms of the burden placed on different actors across the supply chain and the systems will remain different in different Member States.

6.1.4.2 Remove the concept of homogeneous material

The issue of an alternative definition of the concept of homogeneous material is discussed in chapter 6.5. A solution to reduce the administrative burden could be found in an alternative use of the concept.

Because the thresholds of the RoHS Directive (maximum concentration value of 0.01% by weight for cadmium and 0.1 % by weight for each of the other RoHS substances) are applicable to homogeneous materials within the component and not in the component or EEE as a whole, there is no possibility to outweigh unfavourable results of one component with favourable results of other components. Some organisations mention that the efforts to assess very small homogeneous parts are disproportionate compared to the total product and its environmental impact.

When the thresholds of the RoHS Directive would be applicable on larger identifiable functional units such as components or on the whole of the EEE, it would be easier to perform tests and to prove compliance. On the other hand, it would create a real risk that the pressure on smaller parts to become RoHS compliant would drop, which might have a negative impact on the overall environmental performance of the product. This is in contrast with the goals of the RoHS Directive. It is clear that the situation in which the removal of the concept of homogeneous materials leads to an environmentally less performing Directive is unacceptable. Therefore, we advise not to remove the concept of "homogeneous materials".

Because it is for technical reasons difficult to perform tests on very small components or to decompose them further into homogeneous materials, China RoHS has introduced a limit value of 4 mm^3. Any component smaller than this limit value needs to be treated as a homogeneous material. The EU RoHS Enforcement Authorities Informal Network has suggested to take over this China approach for reasons of practicability. The presence of CrVI in metallic surface conversion applications creates problems of measuring the concentration limits. China RoHS has introduced the concept of banning all intentionally added Cr(VI) in metal treatment, without imposing concentration limits. The approach in China RoHS can be helpful to diminish the administrative burden if it can be guaranteed that it has no negative impact on the environmental performance of the RoHS provisions. However, it is not possible to make a general conclusion, as this will depend of the specific product.

6.1.4.3 RoHS compliance to be proved by material or component supplier

As EEE producers are obliged to to check RoHS compliance, they face a large administrative burden to introduce and update RoHS compliance tracking systems, to collect suppliers' conformance data and to establish integrity of suppliers' data and the required follow-up actions. Most producers of EEE are acting as assemblers at the end of an extended supply chain, consisting of a large number of suppliers of hundredths of components. This characteristic of the EEE market makes it difficult and technically and administratively burdensome to check RoHS compliance of the finished products.

It might be administratively less burdensome to formally oblige the *producer of homogeneous materials to prove RoHS compliance* for the materials supplied. Data collection will be easier when executed at the source of production. Producers or importers of any component to be included in EEE could be obliged to show a certificate of RoHS compliance. Any producer of EEE could be legally entitled to use these components and does not have to check their RoHS compliance. This would solve the following problems:

- The administrative burden for retrieving data and testing components of EEE producers would decrease;
- The enforcement can focus on an instrument which is easy to check;
- Certificates can be of help when organising stocks or when setting up a supply chain management.

Moreover, certification and labelling of components can become interesting when the equipment enters the waste phase. As WEEE is always considered as hazardous waste (except LoW codes 16.02.14, 16.02.16, 20.01.36), a disassembly of WEEE can help to split up the waste in a hazardous and non-hazardous fraction, allowing these two waste streams to be dealt with separately in an efficient manner.

The increased administrative burden for the suppliers would be compensated largely by the advantage of easier data gathering and lesser administrative burden for the EEE producers. The total administrative burden will not merely be split up, but it will diminish as a whole. This is caused by the fact that data gathering of a limited number of components or raw materials at the source will be technically and administratively easier.

As the ‘producer responsibility' principle should remain the basic principle[17], the burden should remain with the producer or assembler of the final EEE who has to prove the conformity of the finished product to the authorities or market surveillance agencies. This means that the only difference with the current situation consists of the fact that suppliers would be legally obliged to prove RoHS compliance to any producer.

An amendment could be developed which obliges producers or importers of any component that will be included in EEE to obtain a certificate of RoHS compliance from an official or registered independent agency. The amendment could also include the statement that a producer of EEE is legally entitled to use these components and does not have to validate compliance. The amendment should at least include:

- A reference to scientific standards to demonstrate compliance with RoHS. The industry standard being developed can be a valuable instrument (see the following paragraph)
- A change in article 4 point 1; suppliers of components should also not produce components containing lead, mercury, cadmium, Cr(VI), polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE), even if they are not directly ‘put on the market'.

An alternative approach can be found in the EuP Directive, article 11:

Requirements for components and sub-assemblies

Implementing measures may require manufacturers or their authorised representatives placing components and subassemblies on the market and/or putting them into service to provide the manufacturer of an EuP covered by implementing measures with relevant information on the material composition and the consumption of energy, materials and/or resources of the components or subassemblies.

A reflection of this article in the RoHS Directive would involve the suppliers and distribute the administrative burden without obliging them to get a certificate for <u>all</u> homogeneous components. “Relevant information” could be any information that can help the assembler to assess in a simple and reliable way RoHS compliance of the components. Reliability of the information in the supply chain will in this case be guaranteed by the assembler, who still holds a larger responsibility. Standards (as discussed further) could be agreed upon communication between assembler and supplier.

However, in practice this obligation is not being imposed because of difficulties to control for transaction happening outside Europe. Furthermore, the EuP acts by implementing measures that decide on a case-by-case basis whether this obligation is adequate or not. The RoHS does not have this case-by-case decision making process.

[17] If focus would be placed exclusively on suppliers, problems can occur with imported final products.

A comparable supply chain problem where a practicable solution was established can be found in the way the issue of electromagnetic compatibility of different parts is dealt with under the New Approach Directive 89/336/EEC on Electromagnetic Compatibility. Systems to collect conformity declarations have been realised. A distinction between the Directive on Electromagnetic Compatibility and the RoHS Directive is that in the former, industry benefit, most e.g. by ensuring quality and opening markets, whereas the environment is the first beneficiary from the ban on RoHS substances.

6.1.4.4 Standardised compliance testing procedures

Stakeholders state that if the concept of homogeneous materials is retained, Member States should agree on how producers can demonstrate compliance using an agreed upon sample disjointment and testing methodology.

All above discussed scenarios would benefit from standardised compliance testing procedures. The final version of standard IEC 62321, to be expected in 2008, can be a part of the solution. An international standard has the advantage of covering a larger part of the market outside the European Union. An EU standard has the advantage of more democratic control and less dominance by larger market players, and is therefore preferred by SMEs.

Laboratory examinations of elements and substances could be done in ISO 17025 certified laboratories (with scope of certification covering RoHS regulated substances), which should prevent that RoHS compliance checks lead to different results in different countries.

6.2 EFFICIENT ENFORCEMENT AND MARKET SURVEILLANCE

6.2.1 Issue

The costs for companies to comply with RoHS were broken down into compliance costs and technical costs of substance phase-out. The latter contain capital investments, operational expenditures and R&D efforts directly related to the phase-out of RoHS substances. The compliance or non-technical costs are related with facilitating the practical implementation of the technological changes in the production chain. In practice, the compliance costs are the costs of getting acquainted with the Directive's requirements, the costs incurred by the provision of training and information to the different actors in the chain and the costs of collecting, organising and reviewing information. Besides this, compliance costs also comprise the costs related to exemption procedures and a number of organisational implications causing monetary losses.

Starting from the assumption that a large part of industry is compliant at the moment, the economic impact analysis showed that compliance costs (in contrast with the technical costs) make up a very large part of the future yearly costs to stay compliant.

Options for revising should therefore be concentrated on ways to lower annual future compliance costs, which is linked with options aimed at an efficient monitoring and enforcement regime to limit free-riders. Stakeholders are experiencing difficulties in the field of enforcement and market surveillance. This issue is closely related to the topic of burden distribution, as described in paragraph 6.1.

6.2.2 Current situation

Labels and standardised conformity assessment schemes for components can be of use. Nowadays, the market introduces private certification systems and labels to be used in the RoHS compliance testing procedures and for stock management and supply chain management.

In the United Kingdom a.o. the following labels are in use:

Figure 6.1: UK RoHS Conformity Assessment Bodies scheme providers

Some stakeholders are pleading for an official product mark for RoHS compliant product, which can be used voluntary. The multitude of different marks in current use can cause confusion and can lead to misrepresentation of products being RoHS Compliant.

6.2.3 Possible scenarios

The following situations can be compared:

- Business as usual ;
- Certification could be organised through a “RoHS agency”;
- Certification of components through a “notified body” following the ‘New Approach’. A ‘New Approach’ Directive is a Directive of which the requirements are drafted in generic terms with further details provided in a series of European harmonised standards developed by standardisation bodies;
- Searching parallellisms with REACH;
- Applying the RoHS Enforcement Guidance Document;

6.2.4 Analysis and evaluation

6.2.4.1 Business as usual

Sticking with the business as usual would mean holding on to a situation where every assembler of EEE has to investigate separately the origin and RoHS compliance of each component and material he uses, utilising a wide variety of systems and documentation that have been adopted in different Member States or he has to work with individual and variable agreements with suppliers inside or outside the European Union. This is a situation which creates administrative burden, uncertainty and lack of transparency both for the EEE producer and the enforcement authorities.

6.2.4.2 Certification and RoHS agency

We propose two possible ways in which the enforcement and market surveillance on labels (either issued by suppliers or by assemblers) could be implemented. In the scenario on distributing the administrative burden, an independent RoHS Agency could be attributed two basic functions:

- Certify components and raw materials;
- Distribute information on RoHS compliant components and raw materials to EEE-producers, by the establishment of a database and online registration of certificates. This database can become an instrument comparable to the IMDS, the International Material Data System or the automotive industry material data system where all materials used for car manufacture are archived and maintained. In this way it is possible to meet the obligations placed on car manufacturers, and thus on their suppliers, by national and international standards, laws and regulations.

The RoHS agency could be an EU body, or a body financed by the EU, dedicated to providing sound, independent information on RoHS compliance, as a main information source for those involved in developing, adopting, implementing and evaluating EEE, and also the general public. The realisation of an agency would require a permanent public investment in the form of an international RoHS agency, which could ease the work for industrial federations in distributing information, without leading to state aid to industry. The agency cannot be considered as illegal state aid, because by providing services for conformity assessment, it gives a service to the manufacturers but in an area of public interest.

The agency could act as:

- An independant agency able to provide third party certification;
- An independant information provider;
- An analyst and assessor;
- A builder of bridges between science, industry and policy;
- An institution depending upon strong networks to carry out its work.

The RoHS agency could include representatives of producers of EEE, recyclers, treatment operators, environmental organisations and employee and consumer associations. These are all stakeholders mentioned in article 5.2 of the RoHS Directive.

A third party certification might be appropriate instead of self-declarations when large economic interests are at stake, although larger trade organisations are more in favour of self-certification under application of the principles of the New Approach.

However, there are a number of disadvantages related with third party certification. It is clear that this is cost increasing, not only for the European Commission to manage the system, but also for the companies which will need to contribute a fee. However, additional costs for industry should be avoided, as the economic impact analysis has already shown that testing and conformity checking already represents a considerable yearly cost for companies to remain compliant.

6.2.4.3 Certification under New Approach and Global Approach

The European Union has developed instruments to remove the barriers to free circulation of goods. Among these, the New Approach to product regulation and the Global Approach to conformity assessment are gaining importance. The common thread in these complementary approaches is that they limit public intervention to what is essential and leave business and industry maximum freedom on how to meet their public obligations.

New Approach Directives are based on the following principles.

- Harmonisation is limited to essential requirements (the RoHS Directive could be considered as merely containing these essential requirements).
- Only products fulfilling the essential requirements may be placed on the market and put into service.
- Harmonised standards, which reference numbers are published in the Official Journal and which have been transposed into national standards, are presumed to conform to the corresponding essential requirements.
- Application of harmonised standards or other technical specifications remains voluntary and manufacturers are free to choose any technical solution that provides compliance with the essential requirements.
- Manufacturers may choose between different conformity assessment procedures provided for in the applicable Directive.

These principles might be applicable to a new RoHS Directive. Especially the obligations for products, components included, that are put into service or put on the market, can be useful.

The role of a RoHS agency, as discussed in the previous paragraph, can be taken over by ‘notified bodies’ as defined under the Global Approach. The primary task of a notified body is to provide services for conformity assessment on the conditions set out in the Directives. This is a service to the manufacturers in an area of public interest. Notified bodies are free to offer their conformity assessment services, within their scope of notification, to any economic operator established either inside or outside the Community. They may carry out these activities on the territory of other Member States or of third countries. Manufacturers are free to choose any notified body that is designated to carry out the conformity assessment procedure in question according to the applicable Directive.

- An important instrument in the New Approach and the Global Approach is the CE mark, which could be used as well for proving conformity with the provisions of the RoHS Directive.

Figure 6.2: CE mark

Some important trade associations are in favour of adapting the RoHS Directive to the new Approach, as they have experienced that it works well in the field of safety regulations. When regarding the EuP Directive (Directive 2005/32/EC establishing a framework for the setting of ecodesign requirements for energy-using products), the majority of industry falls under module A from Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonization Directives. This means self assessment.

Self-declaration is the recommended solution under the New Approach, of which can be diverged only for specific reasons. Third party assessment is not considered necessary by the larger trade associations. However, when large economic interests are at stake, third party assessment within the frame of the New Approach could be recommended. As already mentioned in the previous paragraph, third party assessment would raise costs for both the EU and industry.

6.2.4.4 Parallellisms with REACH

REACH is the new European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances and entered into force on 1 June 2007.

REACH includes the following concepts:

- Duty to communicate information down the supply chain;
- Duty to communicate information on substances in articles;
- Use of a label: Holders of an authorisation, as well as downstream users (including the use of substances in a preparation), shall include the authorisation number on a label before they place the substance or a preparation containing the substance on the market for an authorised use. An important difference with RoHS is that labelling in REACH focuses on substances, whereas RoHS is concentrated on substances in products.
- A REACH agency (= European Chemicals Agency) has been established. The Agency shall be responsible for coordinating the substance evaluation process and for carrying out technical, scientific and administrative aspects.
- A classification and labelling inventory shall be established and maintained by the Agency in the form of a database.

A lot of these concepts have been discussed above, like information of substances present in articles, information going down the supply chain, use of a certified label, a RoHS agency that could resemble the Reach agency, dealing with

- Coordination of the evaluation process;
- Technical, scientific and administrative issues;
- A database with labelling inventory.

Industrial stakeholders argue that REACH is not always a good example to follow, because it is supply-chain based whereas in the RoHS Directive situation the supplier does not always know where the component will end up. The administration and enforcement is regarded too complex. Consistency with REACH, and with the EuP Directive as well, would however be greatly welcomed by the industry[18], provided that it is taken into account that REACH explicitly excludes application on substances that are regulated elsewhere, and that not all substances fall under REACH.

6.2.4.5 RoHS enforcement guidance document

A Guidance Document has been developed through discussions within the “EU RoHS Enforcement Authorities Informal Network” of which a first version was issued on May 2006. It was welcomed by the Commission on the Technical Adaptation Committee on the WEEE and RoHS Directives in Brussels at June 26 2006. The document aims to provide non-binding guidance on RoHS Enforcement, but as it is merely informative and advisory, individual Member State RoHS enforcement authorities are bound by their own national legal structures and can only apply this guidance within the confines of those structures.

[18] Some progressive statements can be heard on the possibility to integrate RoHS completely into REACH, as well as the ELV Directive, the Batteries Directive and other comparable Directives. However, RoHS already existed when REACH was agreed upon. At that moment, RoHS was not integrated into REACH, which means that the decision has already been taken by the Regulator that RoHS should exist separately.

The Guidance Document has two primary intentions:

- To assist Member States in national enforcement of the RoHS Directive;
- To provide clarity to industry on how producers may demonstrate compliance with its requirements.

The document is also intended to become part of a wider, voluntary initiative to develop administrative co-operation between those Member State enforcement authorities being responsible for the implementation of the RoHS Directive.

The document starts from the following principles:

- A consistently applied and common interpretation across Member States regarding those products which are considered falling within the scope of the RoHS Directive (for this issue see paragraphs 6.4 and 6.5);
- A presumption that products falling within the scope of the Directive conform with its requirements;
- Self-declaration by producers.

Whilst the overall approach to RoHS compliance is based on a Presumption of Conformity, it is recognised that national authorities will require self-declaration from producers as the key principle underlying the enforcement process.

A step-by-step approach to RoHS compliance investigations includes initial self-declaration, followed by a more detailed assessment in those cases where evidence from producers does not assure compliance. In cases of concern, detailed sampling and testing may or could be required.

The proposed enforcement process provides two initial routes to self-declaration, taking into account the fact that in some organisations (small and medium-sized enterprises in particular) the process may be facilitated by the initial provision of compliance documentation for homogeneous materials in products/parts. However, documentary evidence of more structured internal systems (based on quality assurance processes) could be the initial step in assessing a producer's ability to manage RoHS compliance for organisations having these systems in place.

Companies that are submitted to RoHS enforcement can choose to proove that either there is an active supply chain RoHS management process in place and being followed, or that all homogeneous materials are RoHS compliant. The enforcement action itself, in case of infringement, is largely based upon consult with producer and agreement on remedial actions to make products conform.

Documentary proof of compliance can be given by:

- An "approach to compliance": this should be a general overview of any compliance systems that the company has in place and which are suitable for assisting to compliance with the RoHS Directive.
- An overview of the data quality systems (in those cases where the producer significantly relies upon supplier information to demonstrate compliance). These could include risk assessments, acceptance criteria, purchasing procedures and any other relevant documentation and may be a combination of both process-based and product/part-based documentation.

A process-based compliance assurance system (CAS) consists of:

- A definition of the purpose of the system, its essential requirements and specification. This specification should cover compliance both within the company and within the supply chain.
- A formally defined process which implements the requirements of the system and is integrated within the organisation's quality and management systems.

- A technical documentation system (paper and/or electronic) to support the process and measures to assure conformity with the requirements of the system together with necessary training, tools and infrastructure.

The CAS has to be flanked by a system for evidence of active control:

- Results of internal and supplier audits to validate the CAS and/or processes i.e. the supplier's ability to assure compliance.
- Evidence that the system is being followed, including results of product specific conformance assessments comprising items such as product assessments (including justification of RoHS categorisation and use of exemptions), materials declarations, procurement, inventory and production controls and substance analysis where appropriate.
- An overview of any internal data system used for the management of RoHS compliance data.

The product oriented compliance assurance system (e.g. for SMEs) consists of typical information relating to a product's/part's physical attributes that ensures RoHS compliance of a specific product:

- Producers' or suppliers' warranties/certificates declaring that the use of the restricted substances is within the permitted levels.
- Producers' or suppliers' completed materials declaration for each part (including revision for revised parts) and justification of RoHS categorisation and use of exemptions. These declarations would be limited to the list of RoHS substances, not full materials declarations.
- Analysis report for homogeneous materials in parts/components (which could be the producer's or supplier's own internal or external test results). The test results should refer to homogenous materials in parts/components.
- SMEs must also provide evidence that procedures are being followed to show that materials declarations have been assessed to determine if they can be trusted. Enforcement authorities will also need to see documented compliance procedures.

The advantage of the RoHS Enforcement Guidance document is its growing acceptance by the Member States. The RoHS Directive could be amended with a reference to the RoHS Enforcement Guidance and a paragraph could also be included on the obligations of Member States, rewritten in a stronger way, such as "Member states should establish enforcement authorities and anchorage networks for enforcement." Care would need to be taken with wording in order to ensure that enforcement measures are introduced in a consistent manner across member states in order to ensure there are no technical barriers to trade.

6.3 BRINGING MORE MARKET REALITY INTO THE EXEMPTION PROCESS

6.3.1 Issue and current situation

6.3.1.1 Granting exemptions

EXEMPTION PROCESS

The current system contains an article banning the use of certain substances, adding a list of exemptions. The exemptions are summed up in an annex which is regularly changed after a comitology procedure within the Technical Adaptation Committee. The application of the criteria of article 5 of the Directive requires modification to allow a more realistic process for the review and future withdrawal of exemptions, more in line with commercial reality.

During the stakeholder consultation process, remarks on the exemption process were seldom made by individual companies, but almost all consulted industrial associations included comments. It is stated that the list of exemptions from a technical point of view is not perfect, and that the delays in the exemption process can be long and can cause uncertainty, which is harmful in a quickly evolving and competitive high-tech market. Sometimes this criticism has to be understood as disappointment on a non-successful exemption request. Nevertheless, requests for a transparant process (e.g. notice of when and how decisions are taken by the TAC with publicly available agendas and minutes) backed up by clear deadlines for decisions need to be taken into account. This need to speed up the process is also supported by the views of some that the long period currently required to secure an exemption effectively rules out certain R&D projects for products that might be of sginificant value but might necessarily involve the use of banned materials.

Besides, more clarifications on the content of the exemptions (producers read exemptions in various ways) are requested, which could reduce the burden on technical advisors and on the Commission. The current administrative and legal approach of using and amending the annex leads to some stakeholder remarks on userfriendliness, comprehensiveness, transparency and flexibility.

Another aspect in the question whether or not to grant an exemption, could be the investigation of the balance between the environmental benefits of RoHS compliance and the economic costs of becoming compliant. It is possible that the costs to comply are extremely high, whereas the additional environmental impact of RoHS compliance for a certain application is very low.

From the results of this study, it was not possible to generate general criteria determining cases in which a very high economic cost of compliance does not balance with an extremely low environmental impact. However, the analysis showed that Category 8 and 9 products of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material are at the limit regarding costs and benefits.

EXEMPTION PROCESS MAY HINDER INNOVATION, BUT ALSO OFFERS AN OPPORTUNITY TO INNOVATE

The process of granting exemptions could be considered as hampering innovation. As long as hazardous substances are still allowed under exemptions, it is difficult to ascertain how much effort and investment companies will put into the development of alternative products with less environmentally damaging substances. Also, the exemption process itself, often taking more than a year to complete, is considered by some stakeholders to be a barrier to research and development for new innovations.

On the other hand, the RoHS ban itself could be a barrier to innovation. Researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time.

6.3.1.2 Withdrawing exemptions

Article 5 considers the following criteria in granting an exemption. A material or component of EEE can be exempted from the application of the RoHS Directive if:

- Their elimination or substitution via design changes or materials and components which do not require any of the materials or substances referred to therein is technically or scientifically impracticable.
- The negative environmental, health and/or consumer safety impacts caused by substitution are likely to outweigh the environmental, health and/or consumer safety benefits thereof.
- Producers of electrical and electronic equipment, recyclers, treatment operators, environmental organisations and employee and consumer associations are consulted on this issue.

Concerning the withdrawal of exemptions, industry needs sufficient time between a new technology becoming available in the supply chain and the ability of EEE producers to incorporate that technology into their products and bring the new products to market. There should be a buffer period between the arrival of a substitute and the abolishment of an item from the annex of exemptions. This period may however not be too long, because it is not intended for using up an existing stock of supplies containing RoHS substances.

Whereas the RoHS Directive bans or limits the use of hazardous substances in EEE products, the Directive allows for exemptions from its provisions where the benefits of retaining certain hazardous substances until an effective substitute can be identified outweigh the perceived drop in performance of certain products.

Besides the mere presence of alternative technologies, economic and market circumstances can have a large influence on the implementation of new technologies. This is not taken into account during the exemption procedure and the exemption decisions. During the time that an exemption holds, companies are working to eliminate the use of substances in applications that are exempted. However, even if alternative technologies are available, the implementation in product designs requires consideration of various business realities such as:

- Availability of the technology in the parts currently used in products;
- The functionality of the new technology (including reliability) compared to the current technology used;
- Design implications of using parts containing the new technology;
- Cost implications of the transition to the parts containing the new technology.

Once a new technology is found acceptable, it needs to be implemented throughout the logistic process before it can be implemented in the manufacturing of EEE. In case the application of the new technology requires a re-design at the EEE level, the re-design process (including design verification, product testing) needs to be completed prior to the start of the manufacturing process.

The key factor in applying a new technology by EEE producers is the time required between the availability of a new technology up-stream in the supply chain and the ability to place EEE on the market after completing all tasks as described above.

The current experience with the application of the criteria of article 5 of the Directive leads to the conclusion that this provision requires modification to allow a more realistic process for the review and future withdrawal of exemptions, more in line with commercial reality. Stakeholders believe it is necessary for the decision-maker to take into account the following economic criteria when considering the removal of an exemption:

- The large scale availability of a new technology to meet the volume needs of the whole of industry;
- The necessary lead times for implementing changes in the manufacturing process to adapt to the new application;
- The highly technical matters of supply chain management, product re-design and reliability analysis.

6.3.2 Possible scenarios

The following scenarios could be considered:

- Business as usual;
- Add timeframes to the exemptions;
- Allow a time limited derogation for the specific aim of developing new products;
- Add criteria granting exemptions to applications for which economic costs outweigh environmental benefits;
- Amend the criteria in the current process, in line with the REACH-compromise;
- Restricted banning and additional banning in annex;
- Change the process in line with the packaging Directive;
- Using a consultation forum.

6.3.3 Analysis and evaluation

6.3.3.1 Business as usual

The RoHS Directive works with an overall ban of six substances, which is dynamised by a list of exemptions and by concentration values. The advantage of this approach consists of the fact that no new or unknown applications escape from the banning of the use of the six RoHS substances. In this way, the Directive works proactively and prevents the development of new applications requiring the use of a RoHS substance. The disadvantages are described above, such as the exemption procedure and its timeframe, a tendency for an expanding annex, etc.

6.3.3.2 Add timeframes to the exemptions

Market players are preparing themselves well in advance on coping with the exemptions and with the situation when exemptions would be withdrawn. It is well perceived by the EEE producers and assemblers that exemptions are to be considered as temporary situations. Sometimes the main problems experienced with exemptions or withdrawal of exemptions are not caused by the stipulations in the RoHS Directive and in its annex, but with the timeframe for implementation. The new provisions enter into force, or requested changes do not enter into force, from the moment the exemption procedure has been concluded and the amendments have been approved and published. This does not take into account the degree of availability of alternatives on the market, the time it takes to implement the new technology in the production processes, the time needed for product re-design, the effects on the supply chain and the time it takes before new solutions filter through the supply chain … In theory a front-running supplier of an alternative without RoHS substances can have a large market benefit when the technique is new and the exemption is lifted, which is a strong driving force towards ecodesign.

Nevertheless it is necessary to take economic and market aspects into account to ensure a correct and realistic application of shifts in the RoHS exemptions which better reflects market reality. This does not in the first place affect the exemption procedures or the used criteria itself, but could be realised by adding detailed and motivated dates of entry into force for each approved exemption.

6.3.3.3 Time limited derogation for developing new products

The RoHS ban could be a barrier to innovation. Researchers and designers often do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder the development of new technology, as fewer materials are considered and potential improvements and new products are not developed.

It might stimulate innovation to allow a time limited derogation for the specific aim of developing new products. In this way, the use of RoHS restricted materials could be allowed for a limited period of time in which companies can experiment in the development of new products. This would give companies the time to investigate the feasibility of new products. When regarded feasible, additional budgets could be reserved for investigating substitutes for the RoHS restricted substances.

6.3.3.4 Add criteria determining whether environmental benefits outweigh economic costs

From the results of this study, it was not possible to generate general criteria determining cases in which a very high economic cost of compliance does not balance with an extremely low environmental impact. The environmental impact on the one hand depends on the presence of RoHS substances in a certain product and on the other hand on the yearly consumption, conditions which are product-specific.

This means that impact analysis is necessary on a case-by-case base. In this study, the analysis showed that of all products considered, Category 8 and 9 products of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material are at the limit regarding costs and benefits.

6.3.3.5 REACH-compromise

The European Community Regulation on chemicals and their safe use (EC 1907/2006) REACH has been created after a long and difficult process of stakeholder debate, lobbying and discussions within the European Commission, Member State Governments and the European Parliament.

The REACH-compromise includes an authorisation of the use of carcinogens and mutagenic chemicals (CMRs) when producers can show that the risk they pose can be "adequately controlled" (= beneath a scientific "safe threshold"):

- If a safer alternative exists, producers need to submit a substitution plan so that they could be replaced.
- If a safer alternative is not readily available, companies will need to produce an R&D plan for substitution at a later stage.

For substances of very high concern (like CMR's), an authorisation is required for their use and their placing on the market. Substances falling into these categories will be fed into the authorisation system. Their uses will not be banned as such. Once a substance is included in the system, the second step of the procedure requires those using or making available the substance to apply for an authorisation for each use of the substance within the deadline, including an analysis of possible substitutes. If this analysis would show that suitable alternatives are available, the application should also include a substitution plan. If not, information on relevant research and development activities must be provided, if appropriate. An authorisation will be granted if the applicant can demonstrate that the risk from the use of the substance is adequately controlled. If not, it may also be granted if the socio-economic benefits outweigh the risks and if there are no suitable alternative substances or processes.

An application of the REACH-compromise to the RoHS Directive would mean that exemptions on the ban are possible with the commitment for substitution or for investment in R&D even when concentration exceed the threshold and introducing, potentially, the principles of “adequately controlled risks” into article 5.1. Application of the REACH-compromise could be thus a basis for allowing applications to be exempted from the ban on the use of RoHS substances provided that REACH related criteria for authorisation applies. It could even lead to a replacement of the annex with a more general provision in line with the REACH-compromise.

Adherence to the REACH commitment could entail that any application for a RoHS exemption in the future may make use of information available from REACH procedures related documentation. Thus, although there could be originally conflicts with regard to the timing of implementation at the present time, any review procedure for an exemption under the RoHS Directive in the future could take into account substitution plans by the applicants or information under a restriction dossier on the availability of alternatives in line with Art. 6 of the RoHS Directive. Moreover, information which will be generated by REACH may lead to the identification of risks associated with other substances used in EEE, which may need to be covered by RoHS in future, because Chemical Safety Reports (which have to be prepared for all substances manufactured or imported in quantities over 100 t/y per manufacturer/importer) will need to consider potential risks at all stages, including use and disposal.

This could also avoid legal uncertainty and, in turn, conflict between the conclusions under REACH and the exemptions in the Annex to RoHS.

In addition, the guidance on substances in articles now means that there will be very few "articles with deliberate release of substances". Where articles contain substances of very high concern which are not intended for release, but where release cannot be ruled out, the only obligation will be to provide information. There may still be potential for inconsistency between authorisation provisions in REACH and RoHS, but as authorisation is some way off and we still do not know what will be covered, how or when, it may just be best to drop the issue of conflicts between REACH and RoHS.

6.3.3.6 Restricted banning

An alternative approach could start from a more restricted scope and bring in additional bans for specific product categories. This alternative approach does not need to cover every small new or unknown application of RoHS substances, because everything that is not forbidden will be allowed. The current approach covers more, because everything that is not allowed is forbidden. To reach the same coverage as the current Directive, and so to respect the current level of environmental protection, the list of additional bans in the alternative approach would be much longer and would need to contain vague and comprehensive entries covering unknown or new applications. There is a real risk that an approach of restricted banning would reduce the scope of the RoHS Directive.

6.3.3.7 Strategy modelled on the Packaging Directive

In this strategy, the current system with a ban and exemptions is retained, but the process for granting exemptions is altered in a way to respond to the reported disadvantages for the stakeholders. Based on the example of Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste the following system could be used. In the body of the Directive, criteria could be described for products excluded from the application of the Directive, and in annex illustrative positive and negative examples of the application of these criteria could be foreseen. All products covered by these criteria are excluded. The Commission could, as appropriate, in accordance with the procedure referred to in Article 7 (Comitology) examine and, where necessary, review the illustrative positive and negative examples for the excluded products given in annex.

The criteria should at least contain the following elements from article 5:

- A material or component of electrical and electronic equipment can be exempted from the application of the RoHS Directive if :
  - Their elimination or substitution via design changes or materials and components which do not require any of the materials or substances referred to therein is technically or scientifically impracticable.
  - The negative environmental, health and/or consumer safety impacts caused by substitution are likely to outweigh the environmental, health and/or consumer safety benefits thereof.
  - Producers of electrical and electronic equipment, recyclers, treatment operators, environmental organisations and employee and consumer associations are consulted on this issue.
- The producer or applicant carries the burden of proof, and should re-examine the application of these criteria each 4 years.

The advantages of this proposed option are:

- A clearly defined administrative procedure for exemptions, with limited timeframe and higher accessibility;
- A more flexible system, while maintaining the same level of scope, with a second line of control by the Technical Adaptation Committee;
- A stable set of criteria;
- The annex would fulfil the need for more clarifications;
- The option would be opened to other stakeholders than the producers e.g. recycling or treatment operators, environmental organisations, employee and consumer associations, etc. They could ask for the adoption of negative examples using the same procedures;
- In the current version of the RoHS Directive the criteria are merely scientific and technical. The drafted approach would include the possibility to amend these criteria and thus introduce additional or non-technical criteria e.g. on the relevance of access to the market of a RoHS containing EEE application in relation to its environmental impact. Life cycle elements could also be included in the criteria.

The strategy consisting of basic exemption criteria in an article in the Directive, instead of a limited list in annex, is in line with the New Approach, as harmonisation is limited to essential requirements. Only products fulfilling the essential requirements are allowed to be placed on the market and put into service.

6.3.3.8 A consultation forum

The Directive on Energy Using Products contains an article 18 on consultation. A same article could be included into the RoHS Directive, establishing a consultation forum instead of reactions in writing or a communication instrument complementary to reactions in writing.

Consultation Forum

The Commission shall ensure that in the conduct of its activities it observes, in respect of each implementing measure, a balanced participation of Member States' representatives and all interested parties concerned with the product/product group in question, such as industry, including SMEs and craft industry, trade unions, traders, retailers, importers, environmental protection groups and consumer organisations. These parties shall contribute, in particular, to defining and reviewing implementing measures, to examining the effectiveness of the established market surveillance mechanisms, and to assessing voluntary agreements and other selfregulation measures. These parties shall meet in a Consultation Forum. The rules of procedure of the Forum shall be established by the Commission.

This would enhance the transparency of the decision process in the Technical Adaptation Committee and could contribute to the quality and the social support of the decisions taken. Some stakeholders complain of a lack of electrotechnical expertise within the TAC.

The current procedure knows three moments of consultation: when a proposal is introduced and before a consultant starts the analysis of the proposal, during the work of the consultant and at the end when the Technical Adaptation Committee is preparing its decision. Sometimes the procedure is hindered by a lack of facts and data when a proposal is introduced. The TAC activities are publicly communicated. The comitology assessment cannot go faster because of the scrutiny of the European Parliament which was extended from 1 to 3 months. A reasonable timeframe is however requested by several stakeholders.

To enlarge the participation of SMEs in the comitology process, the SME Advisory Group could be enlarged, as was the case in the stakeholders' consultation in revision of the Waste Framework Directive.

6.4 COPING WITH UNEQUAL IMPLEMENTATION AND TRANSPOSITION IN MEMBER STATES

6.4.1 Issue

The RoHS Directive implements article 95, aiming at harmonisation (Member States cannot impose more stringent requirements) and being focused on hazardous substances. The scope is defined by the WEEE Directive which implements article 175, aiming at environmental goals and being open to additional measures by Member States based on their local situation and policy and the subsidiarity principle. In this way, the situation is possible that an enlargement of the scope of the WEEE Directive is translated into an enlargement of the scope of the RoHS Directive, which in theory is not allowed.

Furthermore, exemptions made in the WEEE for certain products can be motivated by the choice of strategies and instruments and can make deliberately free space for locally adapted solutions in the Member States. Problems rise when these exemptions are transposed to RoHS where the focus is on banning substances and where the free space of movement for Member States is limited. The reasons to make an exemption under WEEE can be invalid or useless when focusing on hazardous substances in RoHS.

The way the RoHS Directive is implemented and enforced differs between Member States. This has lead to companies facing different compliance obligations in different Member States and different obligations as regards demonstrating that the compliance obligation is being met. This not only adds administrative burden to companies but can potentially act as technical barriers to trade for companies wishing to enter other Member State markets in contradiction to the principles of the free internal market.

6.4.2 Current situation

Differences in the transposition of the Directive in local legislation and in the administrative implementation of the Directive can cause administrative complications and a need for additional juridical support. As the RoHS Directive does not prescribe any enforcement procedures or detail how compliance should be demonstrated, some federations are concerned that this leaves room for differing enforcement decisions and potentially creates uncertainty over the type of compliance information that companies may be expected to provide. Although the RoHS Directive is an Article 95 Directive, the lack of enforcement procedures potentially leads to Member States enforcing RoHS differently.

A related topic is associated with the fact that RoHS is strongly connected with WEEE. While RoHS implements article 95 of the EC Treaty (measures for the approximation of the provisions laid down by law, regulation or administrative action in Member States which have as their object the establishment and functioning of the internal market), WEEE implements article 175 (1) (preserving, protecting and improving the quality of the environment, protecting human health, prudent and rational utilisation of natural resources, promoting measures at international level to deal with regional or worldwide environmental problems).

The RoHS Directive refers in its article 2 on the scope to the WEEE Directive:

Without prejudice to Article 6, this Directive shall apply to electrical and electronic equipment falling under the categories 1, 2, 3, 4, 5, 6, 7 and 10 set out in Annex IA to Directive No 2002/96/EC (WEEE) and to electric light bulbs, and luminaires in households.

In article 6 a reference is made as well to the categories in the annex of the WEEE Directive:

In particular the Commission shall, by that date, present proposals for including in the scope of this Directive equipment which falls under categories 8 and 9 set out in Annex IA to Directive 2002/96/EC (WEEE).

Article 2 of the WEEE Directive describes its scope as follows:

1. This Directive shall apply to electrical and electronic equipment falling under the categories set out in Annex IA provided that the equipment concerned is not part of another type of equipment that does not fall within the scope of this Directive. Annex IB contains a list of products which fall under the categories set out in Annex IA.

3. Equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material shall be excluded from this Directive. This does not, however, apply to products which are not intended for specifically military purposes.

Although in RoHS no reference is made to this article, but only to the annexes of the WEEE Directive, these annexes cannot be seen apart from the body of the WEEE Directive. If an equipment does not fall under the scope of the WEEE Directive, then it falls as well not under the scope of the annexes of this Directive, and therefore also not under the scope of the RoHS Directive. The same argument can be made using the exemptions or specifications that are introduced in the definitions in article 3 of the WEEE Directive (e.g. on EEE). Also the exeptions and definitions introduced in the annexes itself are directly applicable to the RoHS Directive (e.g. large scale stationary industrial tools in point 6 of annex IA or luminaires in households or filament bulbs in chapter 5 of annex IB).

Luminaires in households and filament bulbs are hovever re-introduced in RoHS, thus overruling the exemption made in the WEEE Directive.

6.4.3 Possible scenarios

In order to create a global level playing field, the legal and administrative implementation of the Directive could be harmonised as much as possible in all 27 Member States. The following scenarios are analysed:

- Business as usual;
- Expanding the content of the RoHS Directive;
- Bringing RoHS and WEEE under the same legal basis of the Treaty;
- Splitting RoHS and WEEE exemptions and definitions.

6.4.4 Analysis and evaluation

6.4.4.1 Business as usual

The business as usual scenario would mean to hold on a situation where every Member State can continue to introduce or apply its own administrative strategy e.g. for prooving compliance. This is a situation that creates administrative burden, uncertainty and lack of transparency both for the EEE producer and the enforcement authorities. However, the issue of the legal basis in the treaty has been discussed for long, and a compromise has been reached. Whereas the Batteries Directive (2006/66/EC) has a double legal base for one Directive, the RoHS and WEEE Directive could be seen as one Directive split up in two to cope with the issue of a double legal base. Reopening this discussion could create some insecurity and lengthy discussions.

6.4.4.2 Bringing RoHS and WEEE under the same legal basis of the Treaty

It might be difficult to introduce new details that are necessary to implement the above mentioned options 1 and 2, which go further than the establishment of the single market, but have a clear environmental purpose. It should be examined legally if the scope of article 95 of the EC Treaty would allow this. It could be envisaged to change the scope to article 175 (1) of the EC Treaty or to add the scope 175(1). The Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators includes such a double reference to both articles.

When doing so, the RoHS Directive might be incorporated as a chapter into the WEEE Directive which would clarify some issues on the coherence between both Directives.

The implementation of Directives referring to article 175(1) can change from country to country, because Member States have the freedom to go further than what is prescribed in the Directive if they judge these measures necessary for the local waste and product policy. Directives referring to article 95 are much more strict and do not allow Member States to go further e.g. by adding substances to be excluded or by limiting the list of exemptions.

It could be a topic for discussion which of both strategies would be the most appropriate in order to maintain the same level of environmental protection while enhancing a level playing field and introducing measures for a simplified administration.

Table 6.1: Advantages and disadvantages of implementing treaty articles 175(1) and 95

	175 (1)	95	175(1)+95
Equal transposition		X	X
Integration in WEEE	X		X
Measures for environmental policy resulting in administrative simplification	X	(?)	X
Subsidiarity principle	X		
New approach		X	X

There are a number of difficulties in bringing the RoHS or WEEE Directive under another treaty article. The RoHS Directive includes a ban on dangerous substances, a subject which clearly benefits from a harmonised approach. In this view, the RoHS would be considered well placed under Article 95.

In case the WEEE Directive would be brought under Article 95, this would mean that Member States are denied the possibility to set up their own take-back system. This might be considered as a less favourable situation then is the case today.

6.4.4.3 Splitting up RoHS and WEEE exemptions and definitions

As analysed above, the exemptions introduced in WEEE are (except for filament bulbs and luminaries) directly applicable to RoHS. This causes some average effects beause the WEEE exemptions were developed under application of article 175 of the Treaty and do take into account the administrative compliance instruments described in WEEE, while RoHS implements article 95 and is merely focused on hazardous substances. The reasons to make an exemption under WEEE can be invalid or useless when focusing on hazardous substances in WEEE.

RoHS and WEEE are splitted up because of their different legal ground, but still they are sharing definitions and exemptions. This link between WEEE and RoHS can be diminished by several legal techniques (Solution 1 to 4):

1. The annex IA and IB of WEEE can be copied “as is” and is added as an annex to the RoHS Directive. By doing so the list is kept harmonised between RoHS and WEEE, but the exemptions in WEEE are not copied into RoHS. Exemptions can be introduced in the body of the RoHS, focusing merely on the scope and the legal ground of the RoHS Directive. Care should be taken to keep both lists in WEEE and RoHS identical.
2. The annex IA and IB of WEEE is used as a basis for a comparable annex to the RoHS Directive. However, these lists can know their own evolution and can be adapted separately. This means that a reference in article 2 of RoHS to e.g. electric light bulbs and luminaires in households should not be made, but that these equipments can simply be added to the new annex of products to the RoHS Directive. This approach could be interpreted, at first sight, as a multiplication of lists and causing administrative complification.
3. The reference to annex IA and IB of WEEE in the RoHS Directive stays as it is, but in the RoHS Directive articles are introduced to state which exemptions and definitions in the WEEE Directive are applicable to RoHS and which are not.
4. The annexes IA and IB are taken out of WEEE and are introduced in a separate Commission Decision, comparable with the List of Waste Decision 2000/532/EC. Reference to this list can be made in the WEEE Directive, the RoHS Directive and in any possible future legal initiative. In this way the exemptions and definitions for WEEE are not having impact on RoHS or vice verca.

6.5 CLARIFYING DEFINITIONS

6.5.1 Issue

Clear definitions enhance a transparant and univocal legislation. A harmonisation of definitions across various Directives would be welcomed as an effective way to create simplification as well as to ensure the smooth functioning of the internal market.

6.5.2 Current situation

A number of definitions are lacking in the RoHS Directive and lead to different interpretations and administrative practices in the Member States. There are arguments to stick to the sense and the spirit of the definitions in the FAQ. However, it should be assessed what is the best place for definitions, as a definition will only have a strong legal basis for enforcement when it is part of the legal text itself. Different stakeholders prefer local legislation over the European FAQ. Therefore, inclusion of the definitions in the RoHS Directive, with the Treaty article 95 as a legal ground, could be helpful for obtaining a maximal level playing field.

These are some examples of situations in which Member States can have different views:

- When speaking about a part of another type of excluded equipment cfr article 2.1 of the WEEE Directive. Car radios only designed to be built into cars are exempted from RoHS according to the FAQs of the European Commission. In the Netherlands however, only car radios and navigation systems built in during the production phase of the car are exempted, in contrast to identical car radios installed by a service station. However, there is no technical reason why these radios should be excluded as the moment of instalment in the car does not influence the quantity or the hazardous properties of the RoHS substances which are present. Other Member States do not follow the same interpretation as the Netherlands.
- When something is a large scale stationary industrial tool, like quoted in annex IB, header of category 6, in the WEEE Directive
- What is considered to be ‘put on the market’? Nine Member States have interpreted it as “put on their national markets”. Other Member States read this as access to the unified European market.
- Other so-called “grey area products”, where discussion on coverage by the RoHS Directive exists.

6.5.3 Possible scenarios

In order to obtain a more uniform application of the RoHS Directive, univocal definitions for the following terms (which determine the scope of the Directive and the products that fall under it in different Member States) should be included, either in the RoHS or the WEEE Directives:

- Putting on the market;
- Equipment which is part of other equipment;
- Homogeneous materials;
- Large scale stationary industrial tools.

6.5.4 Analysis and evaluation

6.5.4.1 Putting on the market

Article 4.1 states that: “Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment *put on the market* does not contain lead, mercury, cadmium, Cr(VI), polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).” Important in this article are on the one hand the concept ‘equipment’ suggesting that the RoHS Directive covers full EEE and not its components, and on the other hand the fact that these EEE have to be put on the market.

The New Approach already contains some definitions:

Placing on the market is the initial action of making a product available for the first time on the Community market, with a view to distribution or use in the Community. Making available can be either for payment or free of charge.

Putting into service takes place at the moment of first use within the Community by the end user. However, in the framework of market surveillance the need to ensure that products are in compliance with the provisions of the Directives when being put into service, is limited.

Placing on the market is considered not to take place in the following situations:

- A product is transferred from the manufacturer in a third country to an authorised representative in the Community whom the manufacturer has engaged to ensure that the product complies with the Directive;
- A product is transferred to a manufacturer for further measures (for example assembling, packaging, processing or labelling);
- A product is not (yet) granted release for free circulation by customs, or has been placed under another customs procedure (for example transit, warehousing or temporary importation), or is in a free zone;
- A product is manufactured in a Member State with a view to exporting it to a third country;
- A product is displayed at trade fairs, exhibitions or demonstrations;
- A product is integrated in the stocks of the manufacturer, or the authorised representative established in the Community, where the product is not yet made available, unless otherwise provided for in the applicable Directives.
- A product offered in a catalogue or by means of electronic commerce is deemed not to have been placed on the Community market until it is actually made available for the first time. In order to respect the rules and principles aiming to prohibit misleading advertising, a non-compliance of a product intended for the Community market should be clearly indicated.

The definition as proposed in the New Approach is not fit to serve the purposes foreseen in option 1, the distribution of administrative burden over de suppliers.

A possible solution could be an adaptation of article 4.1: "*Member States shall ensure that no new electrical and electronic equipment or components or raw material intended to use in electrical and electronic equipment are produced or imported that contain lead, mercury, cadmium, Cr(VI), polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)*".

Another solution would be to bring the definition in line with the EC proposal for a regulation setting out the requirements for accreditation and market surveillance related to the marketing of products (2007) proposes that the following definition shall apply to "placing on the market": the first making available of a product on the Community market. This is also used in the Frequently Asked Questions document.

6.5.4.2 Equipment which is part of other equipment

Article 2 point 1 of the WEEE Directive states: "This Directive shall (not apply to) equipment (that is) part of another type of equipment that does not fall within the scope of this Directive." Member States use different interpretations or implement this clause differently.

When introducing a more distributed responsibility, entangling the suppliers of components, the suppliers of equipment to be built in EEE or in other non-EEE equipment should ensure RoHS compliance. A clear definition should delimit which equipment is included in the RoHS Directive and which is not. Included could be:

- Any equipment that is designed to be a part of EEE;
- Any equipment that is identifiable as a replaceable stand alone application, even when it is a part of other equipment.

A possible solution could be: "*Equipment means any stand alone apparatus or any apparatus that is identifiable as a replacable stand alone apparatus even when it is connected to or included in another apparatus*."

6.5.4.3 Homogeneous materials

The amendment 2005/618/EC of 18 August 2005, entering into force on 1 July 2006, states: "For the purposes of Article 5(1)(a), a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, Cr(VI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) and of 0.01% by weight in homogeneous materials for cadmium shall be tolerated." It would be useful to include a definition stimulating the development of test procedures and test standards to demonstrate conformity.

The FAQ, last updated on August 2006, contains the following definition of homogeneous materials:

"Homogeneous material" means a material that can not be mechanically disjointed into different materials.

The term "homogeneous" means "of uniform composition throughout". Examples of "homogeneous materials" are individual types of: plastics, ceramics, glass, metals, alloys, paper, board, resins and coatings. The term "mechanically disjointed" means that the materials can, in principle, be separated by mechanical actions such as: unscrewing, cutting, crushing, grinding and abrasive processes.

The definition of homogeneous material in the FAQ is largely accepted and could be included in the legal base of the RoHS Directive. It might be rewritten in the following concise form: "*a material of uniform composition throughout that cannot be disjointed by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes*."

When introducing the limit value of 4 mm³ (China RoHS, see paragraph 6.1.4.2) the provision on limit values becomes: "*For the purposes of Article 5(1)(a), a maximum concentration value in homogeneous materials or in separate components smaller than 4 mm³ of 0,1 % by weight for lead, mercury, Cr(VI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) and of 0,01 % by weight in homogeneous materials for cadmium shall be tolerated.*"

6.5.4.4 Large scale industrial tool

Annex IB of the WEEE Directive in point 6 excludes the "large scale stationary industrial tools" from "electrical and electronic tools". They are excluded from application of RoHS. In the FAQ the following definition is suggested:

"Large-scale stationary industrial tools" are machines or systems, consisting of a combination of equipment, systems, finished products and/or components, each of which is designed to be used in industry only, permanently fixed and installed by professionals at a given place in an industrial machinery or in an industrial building to perform a specific task. They are not intended to be placed on the market as a single functional or commercial unit."

This definition is fit to be incorporated either in the WEEE or in the RoHS Directive (see also paragraph 5.2.4.4.).

7 CONCLUSIONS AND RECOMMENDATIONS

By 2008 the Commission intends to present specific proposals for the review of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) and Directive 2002/95/EC on the restriction on the use of certain hazardous substances in electrical and electronic equipment (RoHS). The WEEE and RoHS EU Directives have been identified as presenting potential for simplification in Commission Communication COM(2005) 535 and are included in the simplification rolling programme for 2008. In line with article 4 point 3 and article 6 of the RoHS Directive a review of the scope and appropriateness is foreseen and DG-Environment is taking the lead in the review processes of both Directives.

With respect to the overall review of the WEEE Directive, a number of former initiatives and studies are completed and close co-ordination with some of them has been searched with respect to data collection and consultation with stakeholders. Whereas the former studies aim at investigating the modification of the targets, this study will help at closing certain gaps by covering the remaining issues. Remaining issues include the assessment of the impacts on innovation, competition and the assessment of the relationships with existing Directives and broader policy objectives. The conclusion of the Study on the WEEE Directive can be found further in the second component of this report.

The aim of the Study of the RoHS Directive consisted of identifying proposals to revise the Directive with a view to improving its cost effectiveness while maintaining the same level of environmental protection. The proposals need to make the legislation less burdensome, easier to apply and thereby more effective in achieving its goals.

A serious attempt has been made to quantify the impacts of the RoHS Directive on the economy and the environment. Whereas the economic impact analysis started from a broad view of all EEE subjected to the RoHS Directive, the study of the environmental impact focuses on a number of products which were selected according to the following criteria: presence of the RoHS substances, economic importance of the product, value of the product at the end-of-life, environmental impact over the different phases of its lifecycle and finally its innovative potential.

Besides the impact assessment, inspiration for making the legislation more cost effective was found in a comparison of the RoHS approach with other approaches used inside and outside of the EU.

7.1 ENVIRONMENTAL IMPACT ANALYSIS

7.1.1 Approach

For the environmental impact analysis, a case approach was chosen according to which a number of specific products were investigated in detail. The environmental impact analysis starts with an overview of the product volumes of the selected products. Then, the range of minimum and maximum quantities of each RoHS substance is identified in the various products.
Subsequently, different scenarios are calculated of the yearly amount of RoHS substances avoided in EU 25 in the selected product groups. By using this approach, it is possible to make an estimation of the overall environmental benefits of the different products and as a total for the different products in EU 25.
Furthermore, more information is given on the dose-response relationships. The effects on a number of components of the Life Cycle Analysis (LCA) are touched. It is however not the purpose of this study to execute an extensive LCA for each of the selected products.
Finally, the environmental and human health effects due to RoHS are discussed: waste emissions to the environment, volatilisation of brominated flame retardants (Deca-BDE and Octa-BDE) and the effects of Pb substitution in soldering.

In the paragraphs below, insight is given in some positive and negative environmental effects due to the implementation of RoHS.

7.1.2 Amount of RoHS substances avoided due to RoHS

A first important environmental benefit is the amount of RoHS substances avoided being present in the selected products. Different scenarios were taken into account (minimum average, maximum average, maximum and minimum benefits of RoHS):

Table 7.1: Estimation of amount of substances avoided due to RoHS

Scenario	Estimation of yearly amount of substances in products avoided due to RoHS (1000 ton/substance) - EU25					
	Pb	Cd	Cr(VI)	Hg	Deca-BDE	Octa-BDE
Average maximum benefit scenario 1	329(*)	14(***)	0.8	0.5	0	55
Maximum benefit scenario 2	340(*)	15(***)	0.8	0.7	0	55
	38(**)	0.20(****)				
Minimum benefit scenario 3	131(*)	6(***)	0.8	0.03	0	18
	15(**)	0.16(****)				
Average minimum benefit scenario 4	138(*)	7(***)	0.8	0.06	0	18
According to ERA Technology	<7.8(**)	<0.04(****)	0.3	<0.025	-	-

(*) taking into account technology changes and possible presence in pigments
(**) not taking into account technology changes and possible presence in pigments
(***) taking into account possible presence in pigments and stabilisers
(****) not taking into account possible presence in pigments and stabilisers

- As a result of the methodology, the calculations of the different scenarios do not (or only partly) take into account the effects of restrictions by other directives. It can be concluded that the calculated environmental benefits as mentioned in the table above (scenario 1 – 4) are not entirely attributable to the RoHS directive alone.
- Based on the calculations on the one hand and the information provided by ERA Technology on the other hand, it can be concluded that the amounts avoided due to RoHS are probably within between the results of this study (minimum benefit scenario 3) and the results from ERA Technology.
- The table shows that the implementation of RoHS has the highest effect on the yearly total amounts of Pb avoided in the selected products. Ignoring both technology changes from cathode ray tubes to flat screens and the possible presence of Pb in pigments, it was calculated for the minimum benefit scenario 3 resp. the maximum benefit scenario 2 that between 15 and 38 kiloton Pb is yearly avoided in the selected products. These figures are still higher (min. factor 2 – 4) than the figure provided by ERA Technology.
- Ignoring the possible presence of Cd in pigments and stabilisers, it was calculated for the minimum benefit scenario 3 resp. the maximum benefit scenario 2 that between 0.16 and 0.20 kiloton Cd is yearly avoided in the selected products. These figures are still higher (min. factor 4 – 5) than the figure provided by ERA Technology.
- The estimation of the amount of Cr(VI) and Octa-BDE in the selected products is reduced with 100% due to the RoHS directive based on the used methodology.

- The estimation based on the information available, show that the implementation of the RoHS directive probably has little or no effect on the presence of Deca-BDE:
  - It should be noted that for the purpose of this study, it is assumed that 100 % Deca-BDE is being used, although commercial Deca-BDE can contain also Nona-BDE (e.g. 3 %) as an impurity, next to Deca-BDE (e.g. > 97 %).
  - However, it could be possible that the RoHS directive creates a limited increase of the presence of Deca-BDE, as a substitution product of Octa-BDE.

A first environmental benefit of RoHS consists of the total amount of avoided RoHS substances. From the analysis of selected products, it seems that:

- The environmental benefits for TV sets, PCs and refrigerators are the largest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS;
- The environmental benefits for cell phones, copiers and laptops are the largest when looking at the yearly amounts of Hg avoided due to RoHS;
- The environmental benefits for cell phones, dispensers for cold and hot beverages and fluorescence lamps are the lowest when looking at the yearly amounts of Pb, Cd and Cr(VI) avoided due to RoHS;
- Based on the analysis of the selected products, it was not possible to extrapolate general criteria to indicate in general product groups which have large or low overall environmental benefits due to RoHS.

7.1.3 Human ecotoxicity and ecotoxicity potential

A second environmental benefit is the decrease in human toxicity potential and ecotoxicity potential through the different environmental compartments (air, fresh water, terrestrial) due to the implementation of RoHS. This is broadly assessed in this study for Pb, Cd, Cr(VI) and Hg, but has not been possible for the brominated flame retardants.
For the RoHS substances (especially Cd and Cr(VI)), it seems that the RoHS due impact has been the largest on the *human toxicity potential* via the air compartment. However, after the implementation of RoHS this remains relatively the most important compartment. The methodology used necessitated the assumption that all Cr(VI) is avoided through the implementation of RoHS. For Pb and Hg, the impacts on the human toxicity potential via the soil and fresh water compartment are also relevant.
With regard to the *ecotoxicity potential* via the air and terrestrial compartment, it seems that particularly for Cr(VI), Hg and to a minor extent also for Pb, the terrestrial ecotoxicity potential is the most important. For Cd and to a minor extent for Pb the fresh water sediment ecotoxicity potential is also important. For all RoHS substances primarily the fresh water sediment exotoxicity potential, and to a minor extent also the fresh water aquatic exotoxicity potential, are affected via the fresh water compartment. The terrestrial ecotoxicity potential seems to be relevant only for Hg.

The impact of the RoHS Directive in terms of the relative amount avoided human toxicity potential and ecotoxicity potential per RoHS substance as a share of the total amount before RoHS amounts to 100 % for Cr(VI) (due to the methodology used), 85% for Pb, 82% for Cd and 27 % for Hg.

7.1.4 Waste emissions disposed to the environment

A third environmental benefit consists of a decrease of the waste emissions being disposed to the environment. As a consequence of the methodology used, the amount of waste avoided being disposed to the environment of Deca-BDE will be zero. For the other compounds, it is estimated that the yearly amount of waste avoided being disposed to the environment will be ca. 89800 ton Pb, 12600 ton Octa-BDE, 4300 ton Cd, 500 ton Cr(VI), and 22 ton Hg. Expressed as a relative share, the percentage of waste avoided to be disposed to the environment due to the implementation of RoHS is 20% (Hg), 56% (Cd), 59 % (Pb), 68 % (Octa-BDE) and 71% Cr(VI) of the total amount of RoHS substances present in the selected products before RoHS (Deca-BDE = 0%).

7.1.5 Volatilisation losses of brominated flame retardants during service life

Brominated flame retardants (BFR) such as Deca-BDE and Octa-BDE tend to volatilise from products during service life. The RoHS directive has a positive effect on the Octa-BDE volatilisation losses, but has probably little or no effect on the Deca-BDE losses.

7.1.6 Effects of Pb substitution in solders

Based on the results of the amounts of Pb avoided in EU 25 due to the implementation of RoHS, which are the highest among all RoHS substances, a more detailed literature review was performed to look into the effects of Pb substitution in solders. According to Hunter (2002), solders account for less than 0.5% of the world lead consumption.

Besides the positive environmental effects of Pb substitution, substitution of Pb in solders can also have negative environmental effects e.g. photochemical smog, air particulates. However, there seems to be no consensus yet on important topics such as energy consumption of Pb-free soldering versus Pb soldering. As the discussion on the environmental impact of Pb-free soldering is very complex, ambiguous and still on-going, no definitive conclusion can be drawn on this topic in the scope of this report.

7.2 ECONOMIC IMPACT ANALYSIS

7.2.1 Approach

The identification of the economic costs and benefits associated with the RoHS Directive has involved an extensive consultation process with organisations, companies and individuals representing populations potentially affected by the Directive in order to collect quantitative and qualitative impact data. This was followed by an extended literature review to check and complete this cost and benefit information.

Stakeholders involved with the RoHS Directive were initially consulted through detailed written questionnaires adapted for each stakeholder group (national authorities responsible for implementing the Directive in Member States, individual producers of EEE, trade organisations representing the interests of EEE producers and consumer organisations). Meetings were held with trade organisations to discuss the goals of the study and the content of the questionnaires.

The questionnaires were spread to at least 350 contacts. However, trade associations and individual companies were asked to forward it further and it was made downloadable on several stakeholder websites. From the overflow of comments and questions and from reactions of contacts in relating sectors, we may conclude that the study and the consultation process were highly known in the sector.

However, the response to the first written questionnaires sent in April, was limited. Timing bottlenecks were raised by the stakeholders as well as comments that the request for quantitative information caused problems for some companies and organisations in completing the questionnaire.

In July, a workshop was organised for key stakeholders at the EC in order to present the preliminary results of the study and to discuss the limited response to the questionnaires and the remaining data gaps. The public of some 50 participants consisted of a mix of Member State representatives, trade associations and individual companies. The sectors presented useful views during the discussions, but stated not to be able to solve all data gaps raised. Therefore, it was agreed to open a second round of written questionnaires. Following the concerns of the stakeholders, the questionnaires were simplified and more time was allocated for responding.

7.2.2 Results of the stakeholder consultation

Belgium, Finland, Ireland, Sweden, United Kingdom and Estonia have given specific answers on monitoring and enforcement costs. Some new and candidate accession MS (Croatia, Slovakia, Slovenia and Hungary) have sent general comments which largely say that it is too early to give reliable figures because legal execution and supervision has only just now started or will start in the near future or because budgets have not been dedicated yet.

36 companies responded to the 1st and 2nd round of questionnaires, most of them are large companies. In order to partly overcome the lack of SMEs (3) in our sample, the results of 4 case studies from the GreenRose project were added, making up a total sample of 40 companies. The majority of respondents are EEE manufacturers/assemblers, two companies manufacture components as their sole activity. More than 60% is working in the field of IT & telecommunications equipment (RoHS category 3). About 25% of the companies operates in the production chain of large and small household appliances (categories 1 and 2), consumer equipment (category 4), medical devices (category 8) and monitoring and control instruments (category 9). The coverage of lighting equipment is insignificant, as there is only one lighting manufacturer that has returned the questionnaire. The product categories toys, leisure & sports equipment and automatic dispensers are not represented in the sample at all. Because of the low overall, and of SMEs in particular, response rate it is clear that the sample is not representative for the EEE sector.

A lot of relevant comments were received from eighteen trade organisations. The organisations have put considerable efforts in trying to convince their members of the importance of participation and have reminded them repeatedly of the initiative. They welcomed the given opportunity to substantiate their concerns with hard cost data. However, they also put question marks to the technical feasibility for companies to provide the necessary quantitative cost information. Important drawbacks were formed by the complexity of the information being sought and the relating confidentiality issues. The questionnaires asked considerable efforts from companies to look up costs made in the past, with available figures spread over several departments and even countries divisions. Another reason for low response could be that most companies have completed the changes required for RoHS and may be concerned that the review will introduce uncertainty over the requirements, which might entail new costs.

The quality of the responses was diverse. Some companies only gave qualitative information. The interpretation of the data was often complicated by the fact that the provided figures in many cases were incoherent. Moreover, only a limited number of companies have provided turnover or employment figures. However, in the questionnaire and during the workshop a lot of attention was given to the importance of these data, as they are essential for scaling up responses to provide overall population estimates. Therefore, individual contact was taken with the majority of the respondents. Cost interpretation issues were discussed and more information was trying to get hold of on both RoHS compliance/technical costs and on general turnover/employment figures. Efforts were also put in investigating year reports of the companies who responded in order to complete gaps on turnover and other data which are essential to put the RoHS compliance costs in perspective. This means that it has not been possible to split off turnover dedicated to the specific product categories relevant for RoHS legislation.

7.2.3 Economic costs related to RoHS

The economic cost framework is provided in the following figure. The costs for companies to comply with RoHS are broken down into compliance costs and technical costs of substance phase-out. The latter contain capital investments, operational expenditures and R&D efforts directly related to the phase-out of RoHS substances. The compliance or non-technical costs are related with facilitating the practical implementation of the technological changes in the production chain.

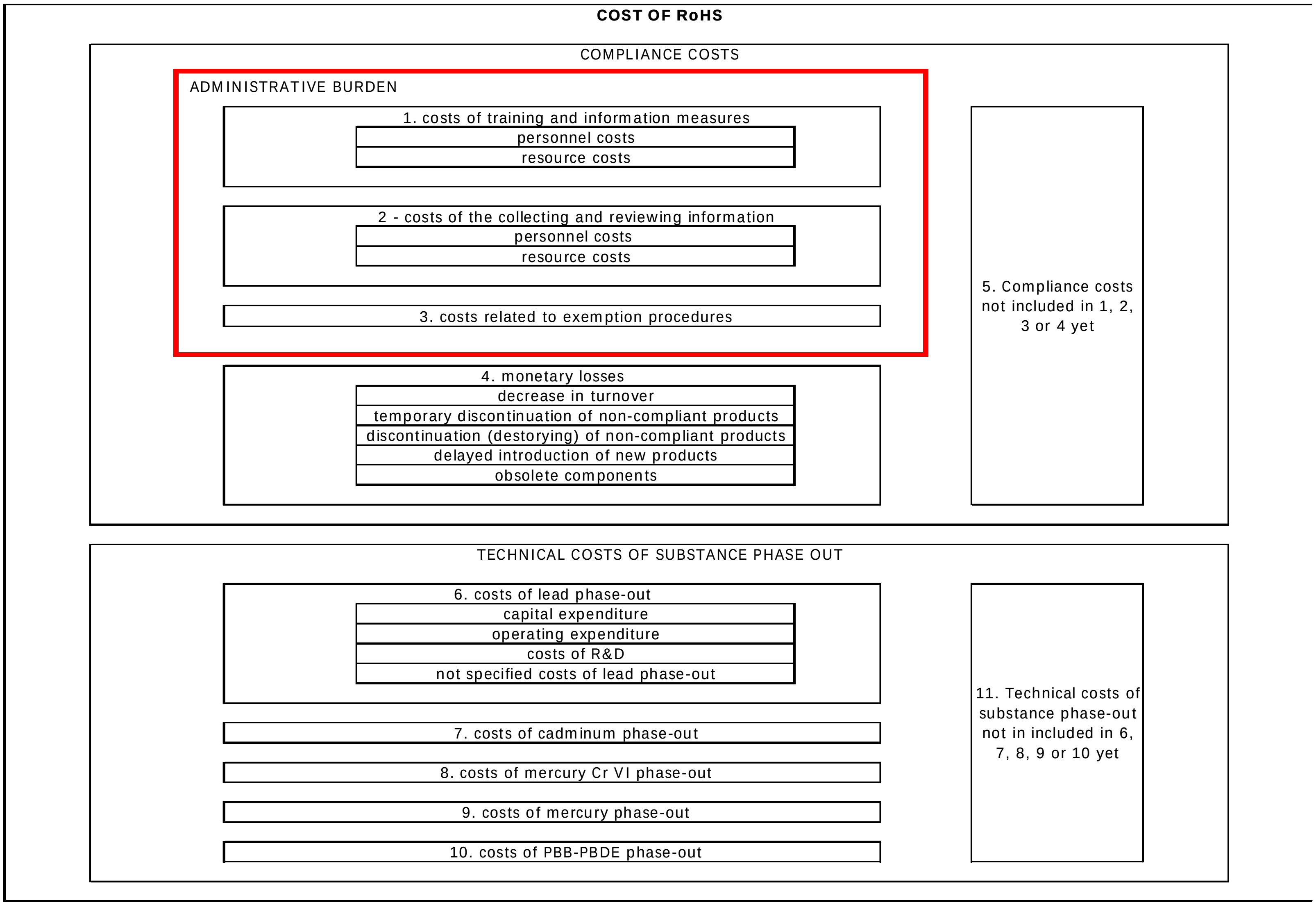

Figure 7.1: Costs of RoHS

Total incurred costs to comply with the RoHS Directive amount to a maximum of € 59.6 million, with an average of € 10 million and a weighted average of € 21 million. These figures include all costs incurred up till now, increased with one-off costs companies project to face in the near future. Yearly costs companies are expecting in the future amount to a maximum of € 4.7 million, with an average of € 950,000 and a weighted average of € 660,000. The future yearly costs are low compared to the amount of past costs and one-off future costs made.

When the costs are related to the companies' yearly turnover, the average past cost impact of RoHS amounts to 1.9% of turnover. However, a different picture becomes clear when splitting off SME results. The average burden of total past and one-off future costs of complying with RoHS amounts to 5.2% of SMEs turnover. For the other companies in the sample, mostly being multinational companies, the burden of total past and one-off future costs on average amounts to 1.1% of their turnover. The weighted average, which amounts to 4.2% for SMEs and to 0.062% for large and multinational companies, shows the fundamentally different burden which SMEs are facing.

7.2.3.1 Total compliance costs

The compliance costs are

- The costs of getting acquainted with the Directive's requirements;
- The costs incurred by the provision of training and information to the different actors in the chain;
- The cost of collecting, organising and reviewing information (e.g. material declarations);
- The costs related to exemption procedures;
- Costs related to organisational implications causing monetary losses.

Past and future one-off compliance costs amount to a maximum of € 42.7 million, with an average of € 6.7 million and a weighted average of € 75,000. Compliance costs make up 67% of all costs made to comply; the share of technical costs amounts to 33%. Within the future yearly costs to stay RoHS compliant, the share of technical costs drops to 12%, whereas compliance costs reach a level of 88% of total costs. Future yearly costs amount to a maximum of € 4.7 million, with an average of € 1.3 million and a weighted average of € 2.8 million.

The most important compliance cost consists of compliance verification, which is an ongoing expense. When taking into account all compliance costs made in the past, almost half of it is dedicated to collecting and reviewing information activities. 41% of compliance costs is dedicated to training and information activities. 8% is dedicated to organisational implications causing monetary losses and 2% relates to exemption procedures. When only looking at the yearly recurring costs expected in the future, the share of costs dedicated to compliance verification increases from 49% to 68%. The share of compliance costs dedicated to training and information activities falls from 41% to 26%.

7.2.3.2 Administrative costs

In the EC Guidelines of Impact Assessment (2005) the following definition of administrative costs is given: *Administrative costs are defined as the costs incurred by enterprises, the voluntary sector, public authorities and citizens in meeting legal obligations to provide information on their action or production, either to public authorities or to private parties. Information is to be taken in a broad sense, including costs of labelling, reporting, monitoring to provide the information and registration.*

In this analysis, the assessment of the administrative burden covers:

- Efforts made to become familiar with the RoHS scope and its obligations and to spread awareness and knowledge to staff, suppliers and customers;
- Activities focused on collecting and reviewing information (information flow from Member States/associations to individual companies and from individual companies within their supply chain);
- Administrative activities related with exemption procedures.

Past costs and future one-off administrative costs amount to a maximum of € 42.7 million, with an average of € 5.9 million and a weighted average of € 13.2 million. Future yearly administrative costs amount to a maximum of € 4.7 million, with an average of € 265,500 and a weighted average of € 675,000. The ratios of the share future yearly recurring administrative costs in total turnover amount to 0.042 % on average and 0.014% as a weighted average.

7.2.3.3 Technical costs of phase-out of RoHS substances

The technical costs related to RoHS compliance mainly consist of:

- Capital expenditure to either upgrade/modify or replace existing equipment;
- Operating expenditure related to:
  - Potentially more expensive alternative materials and substances;
  - Potentially larger energy costs;
  - Expenditure to demonstrate compliance with regulations.
- Research and development to find, test and employ substitutes to replace restricted materials and substances.

The technical costs of substance phase-out constitute of about 33% of total costs made in the past. Past costs and future one-off technical costs amount to a maximum of € 39 million, with an average of € 6.9 million and a weighted average of € 8.7 million.

The technical costs expected to continue yearly only make up 12% of total costs. Indeed, most technical capital costs have already been made to comply with RoHS. Remaining technical costs mainly consist of increased operating costs e.g. energy costs, purchasing costs of materials. Future yearly costs amount to a maximum of € 500,000 with an average of € 183,000 and a weighted average of € 10,000. This may be explained by the inaccurate reflection of operating expenditure of substance phase-out in the responses.

Technical costs of substance phase-out mainly occur as a result of the phase-out of lead. Cost information on other RoHS substances is much more limited. Literature sources (e.g. UK RIA) also suggest that technical costs to replace e.g. CrVI and cadmium are relatively small.

Capital costs make up almost 50% of the costs of lead phase-out, R&D expenditure makes up 34% and additional operating expenditure makes up 18%. When we compare the capital costs with literature sources, it seems that the costs quoted in our questionnaire are considerably higher. This may be due to the overrepresentation of multinational companies, trying to realise economies of scale by using very large or specially designed ovens.

Lead phase-out increases operating expenditure:

- Higher purchasing costs of substitutes. Deubzer (2007) estimates that the costs of lead-free solder approximately doubles, corrected for recycling. The costs of lead-free finishes are also expected to add significantly to the operational costs of substance phase-out.
- Higher component costs. Prices for lead-free solder are clearly dependent on competition and on the level of demand and have the tendency to reduce over time. However, components often constitute of a much larger proportion of product cost than solder. Components may have to be adapted because of changes in the solder process and in particular the higher process temperatures, requiring other materials to be used in components. These changes open up the potential for higher failure rates in the manufacturing of components and the expectation of greater levels of re-work and repair of components.
- Higher energy costs. Because of the higher melting temperatures of lead-free solders, the energy use is expected to rise. Deubzer (2007) calculated that energy costs would rise by € 11 million or 19%. However, the additional use of energy is judged to be only a minor factor in the total costs increase.

R&D expenditure for lead phase-out varies a lot in absolute terms in the survey, the same goes for the percentage share of RoHS related R&D in total R&D expenditure. When we compare RoHS R&D expenditure with total R&D efforts found in company year reports, we become a share well below 1% of annual R&D efforts.

Besides the compliance and technical costs of substance phase-out, respondents were also enquired about the importance of the possible wider monetary losses of RoHS compliance (e.g. decrease in turnover and/or sales volume, temporary discontinuation of non-compliant products, delayed introduction of new products, costs of dealing with pre-mature product reliability failure, lost revenue due to diverting internal resources from new design/innovation to working on substitures, discontinuation (destroying) of non-compliant products). These costs are made in the past and amount to 5% of the total costs of RoHS of the companies in our sample.

7.2.3.4 Personnel costs

The share of personnel costs related with training & information activities and with collecting & reviewing information activities in the total past and future one-off costs amounts to 38%[19]. This share increases up to almost 50% when considering the yearly future costs to remain RoHS compliant.

In order to execute all activities to become and remain RoHS compliant, the vast majority of companies hired zero or one employee for RoHS compliance, relying instead on internal resources by reassigning existing personnel. SMEs have a smaller labour force but are obliged to carry out the same requirements as companies with a larger pool of labour. This means that the work pressure put on personnel for RoHS compliance in SMEs will be relatively higher.

7.2.4 Selection of economic benefits related to RoHS

In addition to a potential positive impact on innovation (discussed further on), a number of specific economic benefits can be attributed to RoHS legislation.

[19] Unfortunately, companies did not indicate the share of personnel costs in R&D costs, which made it not possible to calculate personnel costs dedicated to R&D. This means that in reality, personnel costs will be somewhat higher.

RoHS legislation has a large influence on the Environmental Supply Chain Management. Communication massively increased across the supply chain e.g. on materials data. This high level of communication consists as a platform for REACH, M&S retailer initiatives, CLEARSKIES project, etc. This means that some of the communication costs necessary in the framework of these initiatives are already covered for in the framework of the RoHS Directive.

Because of RoHS, attention has increasingly been given to a tight process control. The focus on equipment development and reducing the presence of new defects has lead to an increasing knowledge of solders, interfaces, processing and reliability. This resulted in an overall reduced number of defects, an increased production efficiency and functionality to consumers.

The global skill level has benefited from the retraining of operators in new technology, new educational tools and infrastructure.

The decreased presence of hazardous material in scrap benefits uncontrolled recycling, with less leaching to landfills as a result. The increased use of Ag/Sn leads to more value incentives for recycling, increasing the chance of meeting WEEE targets.

Tin-lead solders will be replaced by the same volume of lead-free solders, but not the same mass. This means that less mass is needed to replace the tin-lead solder if the lead-free alternative has a lower density. The lower densities of the lead-free alternatives thus reduce the demand (in tonnes) for reflow and wave solders. The lead-free solders for PWB's, however, contain metals like silver and gold with a higher economic value. The higher cost – and thus value – of lead free solder may change recycling practices of the conventional lead-tin solder (Deubzer, 2007).

RoHS has stimulated other sectors (e.g. category 8 and 9 products) and countries to move to cleaner processes. RoHS has initiated a global revolution in hazardous materials reduction (China RoHS, Korea RoHS, US RoHS). Economically a country without RoHS legislation faces far greater risks, as innovative companies that seeded their business in the domestic market would face a barrier to growth when looking at the export market. Non compliant imported products would drop in price as the global market for non compliant products shrunk, putting further pressure on locally produced products (Sommer, 2006).

7.2.5 Assessment of the impact on the Internal Market

The main impacts on the functioning of the internal market stem from the differences in implementation of the Directive by Member States in the areas of scope definition and systems being adopted for enforcement and market surveillance. These differences are creating both administrative burden for companies as well as exposing them to technical barriers to trade as they are being treated differently in different Member States with regards to which of their products are being defined as within the scope of the Directive, as well as how they are required to demonstrate compliance, be it through testing, self-declaration, provision of documentation etc.

Amendments to the RoHS Directive are required to address these barriers to trade in accordance with the internal market principles of free trade. Clear definitions of the term 'put on the market', 'equipment which is part of other equipment', 'homogeneous materials' and 'large scale stationary industrial tools' are all required to ensure consistency across member states in respect of which EEE will be considered within the scope of the Directive and which will not.

A harmonised approach to dealing with compliance and market surveillance is also required in order to assure producers that they are being treated fairly and that they are fully aware of and understand their obligations across all Member States so that they can in fact comply with the regulations provisions and not unknowingly fall foul of the legislation. This will help to ensure fair competition across the internal market.

7.2.6 Assessment of the impact on innovation

The question whether or not the RoHS Directive has inspired or hindered innovation is strongly contested on both sides of the divide. With respect to compliance, it is clear that manufacturers of EEE and component suppliers have been forced to develop and implement a range of innovations and technologies in order to ensure that products are in compliance with the Directive's provisions.

Where the question is more difficult to answer is whether or not the focus on R&D to meet the compliance requirements of the Directive has been at the expense of other broader R&D for product development. Besides this, it is also possible that researchers and designers do not consider using RoHS restricted materials for new products, particularly where there is no guarantee that those materials can be used over an extended period of time. As a result, this may hinder the development of new technology, as fewer materials are considered and potential improvements and new products are not developed. It is however not clear if this lack of innovation in EU products puts Europe at a competitive disadvantage vis-à-vis the rest of the world.

The answers to these questions do not appear clear cut at the present time. There is no clear indication at this time that European producers are in any worse position with respect to their international counterparts than prior to the entry into force of the Directive. A lot of R&D time and resources has been put into compliance, but the years around the entry into force of the Directive also saw a significant increase in applications for patents in compliance related areas in the US, Japan and Europe, suggesting that the legislation might have had some overall positive impact on innovation. The corresponding strengthening of the wider environmental agenda over the same period with global warming, energy efficiency, materials use and sustainable development all becoming hot issues for consumers and producers alike has meant that it is even more difficult to attribute any changes in the R&D and innovation fields to one driver or another. The RoHS Directive is certainly a driver for innovation with respect to the specific materials it bans and the uses for which they have been used in the past. It may also contribute along with many other drivers to a wider move towards ecodesign of electrical and electronic equipment.

7.3 EVALUATION OF OPTIONS ACCORDING TO IMPACTS

In Table 7.2 the ideas mentioned in this chapter are highlighted, their main advantages and disadvantages are summorised as well as their legal and administrative impact or consequences, and a ranking of the options for future amendments is included, according to their preference. This ranking is the opinion of the consultant and in no way commits the Commission. It is based on the following elements:

- The efficiency of the solution to solve reported problems;
- The respect of the solution for the current level of environmental protection;
- The legal feasibility of the solution;
- The social basis and the acceptability of the solution by stakeholders;
- The short term, middle term or long term perspective for implementation of the idea, the degree of direct applicability and feasibility in a traditional review exercise on RoHS.

The ideas can be ranked into the following classes:

- A: advised by the consultant
- B: advised but more difficult to realise
- C: disadvised by the consultant

Table 7.2: Evaluation of the proposals to revise RoHS

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
1	*Distributing the administrative burden across suppliers*				
2	Business as usual	None	No additional administrative burden for supplying industry	None of the reported problems is solved	C
3	Remove the concept of homogeneous material and replace it by a larger functional unit	Minor adaptation in the annex	Less burden for testing compliance No burden for suppliers	Non compliant minor parts will have no incentive for becoming compliant Lower level of environmental protection	C
4	Material or component supplier is obliged to prove RoHS compliance	Introduction of the concept of “component” in article 2 point 1 Abandoning the principle of focus on finished products Amendment on article 4 (1) to impose RoHS substances ban on suppliers	Easier data collection because closer to place of original production More equal distribution of burden Lesser burden for assemblers on compliance testing, SME friendly Working examples exist eg in Directive 89/336 on electromagnetic compatibility Offers more legal security for assemblers No inequity between the EU market and the world market Support for supply chain management Easy to check instrument for enforcement Applicable instrument in waste phase	Certification becomes more complicated Less transparency for end-user Application problems for imported final products Larger legal impact	C

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
4a	Application of information provision duty cfr art 11 EuP Directive	Additional article needed	Gentler version of idea 4 More equal distribution of burden but with respect of focus on finished products and producer responsibility Lesser legal impact In line with existing market evolutions	Less enforceable towards suppliers Difficulties to control for transaction happening outside Europe. Case-by-case decision process whether obligation is adequate or not, which is not applicable to the RoHS	C
5	Standardised compliance testing methods	Article on testing and reference to standards to be included	In line with New Approach concepts Applicable in different scenarios Availability of (draft) standards Applicability not limited to EU market Large stakeholder acceptability	No solution yet for testing CrVI in metallic surface conversion applications Democratic deficit for SMEs when applying international instead of European standards	A
	Efficient enforcement and market surveillance				
6	Business as usual	None		Administrative burden Uncertainty and lack of transparency for assembler and enforcement agencies	C
7	Certification through RoHS agency	Administrative body to be created Additional provisions in the Directive to be foreseen	Applicable in scenarios with or without distributed burden Strong credibility of an independant governmental third party control Centralised approach enables	Not applicable to each of the above mentioned scenarios Higher administrative costs for both EU and industry Low stakeholder acceptability for a new institute	C

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
			IMDS-like database services Possiblity to include represent-tatives from the stakeholders mentioned in article 5.2	Large trade associations prefer self-certification	
8	Certification through notified bodies	Additional provision to be foreseen	No administrative body needs to be created Certification can be included in the market In line with New Approach Open to any actor within or outside the EU CE mark available	Higher administrative costs for industry Less centralised services possible Large trade associations prefer self-certification New Approach fails in some other fields of application	C
9	Applying the RoHS enforcement guidance document	Additional provision to be foreseen	Welcomed by the TAC Broadly accepted Consistent application of exemptions Freedom of choice of the method to prove conformity SME friendly Use of producers or suppliers warranties or certificates	Voluntary instrument, no legal force Based on self-declaration Might be fraud-sensitive Presumption of compliance in a strong competitive and global market Less guarantees for a high level of environmental protection	B
	Bringing more market reality into the exemption process				
10	Business as usual: everything that is not allowed is forbidden	None	Covers all new and not yet known applications Transparency of TAC procedure, three moments of participation	Expanding annex, becoming more complex, causes problems to use and to interpret Delays in approval proces for exemptions perceived as long Economic and market conditions	B

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
				are not considered Less impact from NGOs Less driving force to innovation and alternative solutions Discussion on exemptions limited to technical issues	
11	Add timeframes to the exemption process	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation process	More consideration of market and economic forces More time to ensure sufficient offer of compliant technologies	Driving force for innovation can decrease	A
12	Grant time limited derogation for developing new products	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation process	More consideration of market reality in businesses Stimulates innovation	Might be fraud-sensitive	A
13	Add criteria granting exemptions to applications for which economic costs outweigh environmental benefits	Changes in article 4 Changes in annex Economic arguments to be considered in the evaluation process	More consideration of market reality in businesses	Difficult to generate general criteria because of product-specific conditions Impact analysis is necessary on a case-by-case base	A
14	Applying the REACH-compromise	Fundamental changes in article 4 point 1	Example operational under REACH Possibility to create a legal driving force for RoHS substances beneath the thresholds Reduction in legal uncertainty	Diminishing level of environmental protection when applied on RoHS substances above the thresholds Higher administrative burden Low stakeholder acceptability	B

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
			Possible future alternative for RoHS exemptions	(NGO)	
15	Restricted banning: everything that is not forbidden is allowed	New structure of article 4 point 2 and the annex	More flexible towards new products and applications	Large changes on the annex can re-open discussions No automatic coverage of new applications Danger of lower overall environmental performance Tendency towards more vague wordings	C
16	Copying the approach of the packaging Directive	New structure of article 4 point 2 and the annex	Benefits of current system maintained Easier exemption process within a limited timeframe More accessible for all stakeholders Proven concept in another field of environmental product policy Clearer approach by using positive and negative examples In line with New Approach Open to life cycle elements	Annexes only have exemplary value and arguments can be used to diverge from them	A
17	Installing a consultation forum	A new article	Proven concept in another field of environmental product policy Effective way of bringing together different points of view SME friendly	Possibly limited benefits compared to current TAC procedure	B

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
	Coping with unequal implementation in Member States				
18	Business as usual	None	Discussions on scope are not re-opened	Administrative burden Legal insecurity	A
19	Changing the legal ground and uniting RoHS and WEEE[20]	Large intervention in the legal ground of the Directive	Closer connection between RoHS and WEEE, or integration into one legal instrument Integration into one instrument is applied by several Member States in the local implementation of the Directives	Possibility of re-opening lengthy discussions on scope A less uniform application can become the result of more subsidiarity	C
20	Splitting up RoHS and WEEE definitions and exemptions: Solution 1: annex IA and IB of WEEE can be copied and added as an annex to the RoHS Solution 2: annex IA and IB of WEEE is used as a basis for a comparable annex to the RoHS Directive Solution 3: in the RoHS Directive articles are introduced to state which exemptions and definitions in the WEEE Directive are applicable to RoHS and which are not Solution 4: annexes IA and IB are taken out of WEEE and are	Dependent on the solution chosen, changes in the annexes of RoHS and/or WEEE Possible new Commission Decision Possible new definitions and exemptions in the RoHS Directive	Full respect to the legal ground of both Directives Better and more logic connection between scope and exemptions/definitions	In solution 1, a double list that manually has to be kept identical In solution 2 lists may diverge In solution 3 more complicated wordings in the core of the RoHS Directive may be needed	Sol. 1 : B Sol. 2 : B Sol. 3 : B Sol. 4 : A

[20] Without prejudice to the type of change ; all under article 95, article 175(1) or a double ground 95+175(1)

	Idea	Consequences for implementation	Advantages	Disadvantages	Ranking
	introduced in a separate Commission Decision, comparable with the List of Waste Decision 2000/532/EC. Reference to this list can be made in the WEEE Directive, the RoHS Directive and in any possible future legal initiative				
	Clarifying definitions				
21	New definition of “putting on the market”	None	Possibility to bring definition in line with New Approach and EC proposal for a regulation setting out the requirements for accreditation and market surveillance related to the marketing of products (2007)	Necessary in case of certain other above mentioned ideas (idea 4)	B
22	New definition of “part of another equipment”	Change in definition in RoHS and/or WEEE Directives	Clarification Streamling implementation		A
23	New definition of “homogeneous material”	Change in definition in RoHS and/or WEEE Directives Change in annex	Clarification Streamling implementation Creates better testing conditions Definition from FAQ largely accepted		A
24	New definition of “large scale stationary industrial tools”	Change in definition in RoHS and/or WEEE Directives	Clarification Streamling implementation Definition from FAQ largely accepted		A

COMPONENT 2: STUDY OF THE WEEE DIRECTIVE

8 INTRODUCTION

The task specification for this component requires the study to examine the impacts of the WEEE Directive and its requirements with respect to various aspects of innovation[1] and competition[2]. In parallel with the analysis of these impacts, the study is required to compare the approach taken under the WEEE Directive with respect to different waste streams and outside of the EU (and specifically in China, Japan and the US).

The study is then required to formulate and assess a number of proposals to revise the WEEE Directive with a view to improving its cost effectiveness in relation to the impacts analysed.

The section begins with an overall comparison of the WEEE Directive with other existing Directives relating to waste streams in Section 1.2 in order to identify areas of potential overlap and synergy between different pieces of legislation and highlight areas of mutual concern. The section also provides the background to the waste management context into which the WEEE Directive was introduced and is currently operating.

Section 1.3 sets out the study's approach to data collection and Section 1.4 then sets out the information gathered during the study with an analysis of the impacts on competition and innovation identified (actual in some cases and potential in most due to the limited time that the Directive has been in force in a number of EU countries). This section also identifies a number of competitiveness and trade issues associated with the Directive for both the internal market and global trade.

Section 1.5 provides an overview of WEEE related legislation in third countries for comparison with EU implementation of the WEEE Directive and a long-list of options for revising the WEEE Directive has then been developed in Section 1.6 and assessed in Section 1.7 with respect to their potential impacts on innovation and competition.

[1] Inter alia the share of R&D effort dedicated to innovation to fulfil WEEE requirements and whether or not the systems of collective responsibility as implemented by Member States are discriminatory against the most innovative products and companies.

[2] Inter alia whether or not anti-competitive practices have been widespread, commercial relationships along the supply chain have been altered, whether systems of producer responsibility implemented have been discriminatory against SMEs, niche products and new entrants, whether dominant positions have been created in the waste management industry and whether free-riding has lead to increases in financing liabilities for compliant companies

9 COMPARISON OF APPROACH UNDER THE WEEE DIRECTIVE WITH OTHER EXISTING DIRECTIVES COVERING WASTE STREAMS

9.1 INTRODUCTION

This Section provides an analysis of the relationships between the Waste Electrical and Electronic Equipment Directive 2002/96/EC (the WEEE Directive) and other Directives, policies and Regulations. The section also provides a brief description of the legislation and systems for managing WEEE in different countries which has then been used to inform the process for developing options described at the end of this report.

The first part of this section seeks to assess the synergies and overlaps between the various pieces of legislation currently in place, as well as identify areas of conflict or contradiction. While each document has a specific focus, they all agree with the objective stated in the preamble to the Waste Directive (2006/12/EC):

> "The essential objective of all provisions relating to waste management should be the protection of human health and the environment against harmful effects caused by the collection, transport, treatment, storage and tipping of waste."

One constraint of the study is that the constant evolution or creation of new legislation has resulted in out-dated or contradictory cross-referencing between old and new Directives. For example, the WEEE Directive (2002/96 EC) refers to the Council Regulation (EEC) No 259/93 on the supervision and control of shipments of waste within, into and out of the EC. This has been rewritten and amended into Regulation (EC) No 1013/2006 on shipments of waste, with revised Annexes and Articles which do not match those referred to originally in the WEEE Directive.

This section assesses the following:

- The Energy Using Products Directive 2005/32/EC
- The Batteries Directive 91/157 and 2006/66
- The IPPC Directive 96/61/EC and amending acts
- The Waste Shipment Regulation 259/93 and 1013/2006
- The End of Life Vehicles Directive 2000/53.

Other approaches to dealing with electrical and electronic waste management adopted in other countries are examined later in Section 1.5. As in the EU, these systems in China, Japan and USA are all at a relatively early stage in their development

9.2 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT DIRECTIVE 2002/96/EC AND DIRECTIVE 2005/32/EC ESTABLISHING A FRAMEWORK FOR THE SETTING OF ECO-DESIGN REQUIREMENTS FOR ENERGY USING PRODUCTS

Both Directives are synergistic in that they seek to influence the eco-design of energy using products in order to protect the environment from pollution through preventative measures (see also Annex 2). Directive 2005/32/EC (the EuP Directive) establishes a framework defining the principles, conditions and criteria for setting environmental requirements for energy using products with the objective of reducing the potential environmental impacts of these products. It focuses more on the producer than the consumer of EuPs and aims to ensure the free movement of goods and respect principles of fair competition and international trade, whilst ensuring conformity is maintained through assessments and safeguards (Articles 8, 10 & 7). The scope of Directive 2005/32/EC covers a wider range of goods than the Waste Electronic and Electrical Equipment Directive, including those that use electricity, fossil fuels, and renewable energy, solid, liquid and gaseous fuels. Directive 2005/32/EC is complementary to Directive 2002/96/EC (in particular Article 4), in that it proposes that:

> "Action should be taken during the design phase of EuPs, since it appears that the pollution caused during a product's life cycle is determined at that stage, and most of the costs involved are committed then."

Whilst Directive 2005/32/EC focuses more on the energy efficiency of the EuP during its design and life cycle, it does refer to ease of recycling and reuse under Annex I (in particular 1.3 f & g). Directive 2002/96/EC (Article 4), concentrates more on innovations in design and development which will facilitate dismantling and recovery, reuse and recycling of WEEE and its components, rather than energy efficiency aspects.

The Waste Electrical and Electronic Equipment Directive detail the implementation of the treatment and recovery process through free return to accessible facilities for private households or through collection and returnable products for non-private households (Articles 5 to 9). Directive 2005/32/EC does not cover the means of recycling but does facilitate this process of treatment and recovery through well defined eco design parameters for EuPs (Annex I, Part 1).

Both Directives ensure the participation of the consumer in environmentally safe product consumerism and disposal (Directive 2005/32/EC, preamble (10) and Article 14 and Directive 2002/96/EC, Article 10), although the trade-off in information provision lies where information for consumers and treatment facilities is paramount in the waste electrical and electronic equipment directive (Article 11), whereas in Directive 2005/32/EC (Article 13), information exchange on eco-design concentrates on producers of EuPs. This focus is strengthened in the preamble (Directive 2005/32/EC (25), which states:

> "The accumulation and dissemination of the body of knowledge generated by the eco-design efforts of manufacturers is one of the crucial benefits of this Directive".

9.3 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT DIRECTIVE 2002/96/EC AND THE DIRECTIVE ON BATTERIES AND ACCUMULATORS AND WASTE BATTERIES AND ACCUMULATORS 2006/66/EC (REPEALING DIRECTIVE 91/157/EC)

There is a fair degree of complimentarity between the two Directives in terms of their promotion of producer responsibility for the treatment of waste products, separate collection facilities, targets for recycling of waste products and the shared objective of minimising negative effects of substances harmful to the environment through the safe disposal and treatment of the products identified in each Directive. In addition, both Directives seek to influence the design of the products they refer to (Directive 2006/66/EC, Article 7 and Directive 2002/96/EC, Article 4), in order to reduce the waste and harmful substances generated once the products are no longer usable.

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) 2002/95/EC restricts or prohibits the use of certain substances in electrical and electronic products under Article 4 (1), although mercury, lead and cadmium are exempt from these restrictions for products where there are no alternatives. Directive 2006/66/EC prohibits the placing on the market of all batteries and accumulators that contain more than 0,0005% of mercury by weight and portable batteries or accumulators, including those incorporated into appliances that contain more than 0,002% of cadmium by weight, excluding security equipment, arms and munitions, war material and items sent into space. The restrictions of hazardous substances do not apply to batteries sealed into an electronic or electrical product (toothbrushes, power tools etc) which means that these hazardous chemicals may still pollute the environment and potentially affect human health and safety. In addition, there is some confusion as to the classification of certain batteries as to whether they are hazardous waste, subject to the Hazardous Waste Regulations, or dangerous goods, subject to the Carriage of Dangerous Goods Regulations.

Both Directives call for accessible, free separate collection facilities, which will facilitate the collection, treatment and recovery of substances from batteries contained in WEEE which will be separated from other waste in the same recycling facility. Both Directives set targets for the percentage amount by weight of goods collected for treatment and recovery, although Directive 2006/66/EC targets are set for 2011, and are based on weight by types of battery, whilst WEEE targets start in December 2006, and are categorised by the weight of different categories of appliance.

The two Directives concur that batteries and accumulators should be removed at the time of discarding from WEEE products. For example, Directive 2002/96/EC directs that waste electrical and electronic equipment consists of components, sub-assemblies and consumables of WEEE which are part of the product at the time of discarding. This includes batteries (Annex II (1)), which should be physically removed from WEEE and be disposed of or recovered in compliance with Article 4 of Council Directive 75/442/EEC.

> "Where batteries or accumulators are collected together with waste electrical and electronic equipment on the basis of Directive 2002/96/EC, batteries or accumulators shall be removed from the collected waste electrical and electronic equipment (Directive 2006/66/EC, Article 12. 3).
>
> After their removal from the waste electrical and electronic equipment, batteries and accumulators are subject to the requirements of this Directive, notably they count for achieving the collection target and are subject to recycling requirements. (Directive 2006/66/EC (Point 18 in the preamble)."

However, whilst both Directives instruct that batteries should be removed from WEEE products, the trade-off in environmental terms is that Directive 2006/66/EC still allows Member States to dispose of batteries and accumulators containing cadmium, lead and mercury in landfills or underground storage if there is no viable end market or if a socio-environmental assessment deems that recycling is not the best solution.

Producer Responsibility is the underlying principle for the implementation success of both Directives, both in terms of ensuring adequate and technologically efficient disposal and recovery schemes, but also in influencing the design of both WEEE and batteries and accumulators. Article 16 of the Waste Electrical and Electronic Equipment Directive outlines this principle, as does point 19 in the preamble to Directive 2006/66/EC:

> "Basic principles for financing the management of waste batteries and accumulators should be set at Community level. Producers should finance the costs of collecting, treating and recycling all collected batteries and accumulators minus the profit made by selling the materials recovered. "

However, the definitions of producer and product in each Directive may lead to complications in determining who is ultimately responsible for the treatment of waste products. For example, the collection of WEEE which contains a battery will be paid for by the WEEE producers, as it is considered an electrical good at its design stage, even if it needs a battery to operate. But the definition of a producer in Directive 2002/96/EC suggests that the appliance producer is no longer responsible once the batteries have been removed.

9.4 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT DIRECTIVE 2002/96/EC AND THE INTEGRATED POLLUTION PREVENTION AND CONTROL DIRECTIVE 96/61/EC (AND AMENDING ACTS)

Directive 96/61/EC aims to achieve an integrated pollution prevention and control system through a permit system where companies bear responsibility for the prevention and reduction of pollution into the air, water and land. It concerns installations whose potential for pollution is significant, such as energy, chemical and mineral installations, and for waste management of hazardous waste, incineration of municipal waste and landfills.

Although originally developed to deal with large scale waste, the future direction of end-of-life cycle waste disposal and recovery in the light of new Directives may require revisions and amendments to be made to Directive 96/61/EC. For example, Directive 96/61/EC was approved before a number of waste management and environmental Directives were created over the last ten years, and the targets for collection, treatment and recovery of WEEE have been determined in the years since Directive 96/61/EC was written.

The recovery targets under Directive 2002/96/EC (Article 7) will create the need for new waste recovery installations with specialist functions, either as large installations or as a number of SMEs with specialist areas of activities (perhaps with a capacity below 10 tonnes per day as mentioned in Directive 96/61/EC (Annex I, 5)). Many of these WEEE waste management facilities will have to deal with harmful, hazardous or dangerous substances, and should therefore be reviewed in consideration of IPC principles.

9.5 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT DIRECTIVE 2002/96/EC AND THE WASTE SHIPMENT REGULATION 259/93 AND 1013/2006

Regulation 1013/2006 sets out procedures and criteria for the disposal and recovery of shipments of waste within and outside the EC, according to the classifications of waste annexed in the Basel Convention and OECD revisions. Its objectives are to ensure that shipments of waste are covered by notification, contractual obligations and financial guarantees to cover the cost of disposal/recovery in a way which will not endanger human health or the environment. However, Regulation 1013/2006 does not focus on the reduction of waste or improvements to the environmental performance of all operators in the life cycle of WEEE as under Directive 2002/96/EC.

Areas of synergy between the two Directives include the separation of waste into disposal and recovery waste. Although Directive 2002/96/EC classifies electrical and electronic waste in detail, the Shipments of Waste Regulation classifies waste as ‘Green’, ‘Amber’ or ‘Red’ with various prohibitions or notification requirements for each category. In addition, Directive 2002/96/EC deals with waste from private households (and for other users from 13 August 2005), and specifies the selective treatment for materials and components of WEEE in accordance with Article 6(1), whereas Regulation 1013/2006 deals with all forms of waste from a variety of sources, and specifies the classification of waste according to the treatment (or not) it has received.

One major omission from Regulation 1013/2006 is the intention to reduce the amount of WEEE being produced and disposed. Directive 2002/96/EC focuses on the improvement in the life cycle of electronic and electrical equipment, in terms of product design (Article 4) or advances through science and technology (Article 13) in identifying alternatives to the hazardous chemicals identified under the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) 2002/95/EC.

The two Directives appear to conflict concerning the post disposal treatment of electrical and electronic waste. Responsibility for shipped WEEE under Regulation 1013/2006 lies with the consignee (i.e. a waste management company) or Competent Authority in the EC or country of dispatch (Article 49, 2 a&b and 3 a&b). These institutions are not the original producer of the electrical goods, but may acquire the waste through European separate WEEE collection facilities. Directive 2002/96/EC is based on the principle of producer responsibility which is a financial obligation of the producer to cover the cost of WEEE reuse, recycling or recovery. Regulation 1013/2006, Articles 6, 22, 33 and 24 states that the notifier of the shipment covers the cost of recovery or disposal, transport and where necessary, take-back of illegal shipments or those which cannot be treated according to EC standards. Thus producers may no longer be responsible for the recovery of WEEE and the principle of producer responsibility as defined under Directive 2002/96/EC are avoided.

9.6 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT DIRECTIVE 2002/96/EC AND THE END OF LIFE VEHICLE DIRECTIVE 2000/53/EC

These two Directives were developed and approved consecutively which has facilitated cross-referencing and synchronicity between them. The overall objectives are similar; both aim to reduce waste, promote reuse, recycling and recovery from end of life products, improve the environmental performance of all operators involved in the product's life cycle, and influence product design to facilitate these aims. Both have well-categorised products and both are affected by changes in legislation relating to the design and approval of the original products (for example a revision of the Approval Type For Vehicles Directive 70/156/EC will impinge on Directive 2000/53/EC).

Both Directives seek to restrict hazardous chemicals to facilitate recovery and protect human health and the environment. Since vehicle and EEE production utilises some similar substances, the exemptions and prohibitions under Annex I (WEEEE Directive) and Annex II (End-of-life Vehicles Directive) are practically the same. A number of reviews of these substances have been carried out since the approval of Directive 2000/53/EC (in 2002 and 2005) and are presented as amendments to the Directive and available on the Europa website. In contrast, the same degree of monitoring and reporting of the WEEE Directive has not been achieved. In terms of eco-design, both have Articles stipulating the aim of improving design to facilitate treatment, recovery, reuse and recycling of products and their components.

Collection systems are complimentary in that these should be free of charge, easily accessible and designed so that specific components can be segregated from others (i.e. hazardous substances, batteries). Both producer groups are required to offer free take-back schemes. The producer pays principle operates behind the implementation of both Directives, although the WEEE Directive gives specific examples of approaches to this under Articles 8 & 9, for example producers financing the collection, treatment, recovery and eventual disposal of WEEE through proportionate contributions from all producers. Producer responsibility arrangements are less clear in Directive 2000/53/EC which states that MS must ensure that vehicle producers meet all (or significant parts of) the costs of implementation of this Directive, and offer free take-back schemes through economic operators. Both Directives set standards and guidelines for implementation of treatment activities, such as stripping, removal of liquids and hazardous waste, and health and safety considerations.

In conclusion, the two Directives are largely complementary and offer practical solutions to legislative objectives through standardised treatment centres and guidelines, clear restrictions and prohibitions on substances in the design of products and safe conditions for the removal, storage and treatment of substances and components which are a threat to the environment and to human health. Furthermore, both Directives aim to reduce the amount of raw materials used in production and the waste generated from end of life disposal through recycling targets and supporting recycling opportunities for products and components used in both vehicle and electronic industries.

10 DATA COLLECTION

In the inception report for the study submitted at the end of January 2007, a detailed methodology was elaborated for data collection which included a review and analysis of existing literature which was to be complemented by a brief information gathering exercise involving a range of stakeholders to cover gaps identified from the literature review. The study team was also informed that it should be able to rely on data being collected from two other on-going studies which respectively were evaluating the implementation of the WEEE Directive with respect to its economic, environmental and social impacts and the systems of producer responsibility being established across the Member States.

10.1 LITERATURE REVIEW

An extensive literature review was conducted using sources identified both by the Commission and by the contractor. The information assembled and analysed during this review is presented in this report. In general, the literature review was hampered by the relatively limited material available specifically focusing on innovation and competition. Perhaps mirrored by the response to the consultation process, this may possibly be due to the sensitive nature of some of the information requested regarding effects on competition and the commercial confidentiality that is often associated with information related to research and development and new design.

10.2 STAKEHOLDER CONSULTATION

Stakeholders involved with the WEEE Directive were initially consulted through detailed questionnaires focusing on the Directive and adapted for each stakeholder group. Questions were directed to a range of individuals and organizations in the following stakeholder groups:

- National Authorities responsible for implementing the Directive in Member States;
- Individual producers of electrical and electronic equipment;
- Producer Compliance Schemes (or Organisations);
- Trade Associations representing the interests of EEE producers;
- Consumer organizations; and
- Recycling and waste management companies.

The Commission supplied the study team with a set of e-mail addresses for key consultees coming from the trade associations and individual producers groups across the European Union, and the study developed its own list of contacts for the other groups in the five sample countries chosen for the study; United Kingdom, Germany, Belgium, Lithuania and Ireland.

The response to the initial round of questionnaires in terms of replies received was particularly disappointing with only the following responses received:

Table 10.1: Consultation Responses

Respondents	*National Authorities*	*Individual Producers*	*Producer Compliance Schemes*	*Trade Associations*	*Consumer organisations*	*Recycling Companies*
Responses	3	10	3	6	1	1

The fact that the other two ongoing studies were also involved in consultations with the same stakeholders at roughly the same time and difficulties in sharing information between the three studies due concerns over confidentiality of data no doubt contributed to the poor response rate. However, some interesting and useful information did come out of the completed questionnaires. Consolidated summaries of the responses received from national authorities, individual producers, producer compliance schemes and trade associations are attached in the Annex to this report.

Due to the limited response and the limited amount of information available from existing studies and reports on the effects of the Directive on innovation and competition, it was decided to consult stakeholders a second time to try and obtain a greater number of responses. Since this study also involves examining the overall impacts of the RoHS Directive and consultation responses to a similar questionnaire on RoHS also returned a disappointing number of responses, the key questions requiring answers from both questionnaires were combined and simplified in a single questionnaire and re-sent to stakeholders.

Overall, 18 responses had been received to the WEEE parts of the second round of questionnaires. Of these 18 responses, 13 were from individual companies, 4 from trade associations and one from a national authority.

10.3 DATA FROM ON-GOING STUDIES

Two other major studies on the WEEE Directive contracted by the Commission overlapped with the conduct of this study as follows:

- Contract No. 07010401/2006/442493/ETU/G4 implemented by the United Nations University et al with the objective of reviewing the environmental, economic and social impacts of the Directive to date. Qualitative and Quantitative data were collected and reviewed to assess impacts and recommendations made for revising the Directive; and
- Contract No. 07010401/2006/449269/MAR/G4 implemented by Okopol et al which aimed at providing a thorough evaluation of the operation of the Directive's provisions relating to producer responsibility obligations for WEEE and providing recommendations for revisions to the Directive.

Reports emanating from these studies were comprehensively reviewed as they progressed and data analysed in respect to their relevance to issues relating to competition and innovation. Much of the literature reviewed along with these two studies has identified significant differences in the way the Directive has been transposed and implemented in the EU Member States. These differences have been highlighted by industry as being major sources of increased administrative burden in general, but also as being particularly significant in presenting barriers to competition in the internal market.

This report utilises outputs from the UNU and Okopol studies, focusing on the 5 countries selected for more detailed investigation but also using examples from other Member States, to identify the main areas in which differences in the implementation of the Directive in the Member States are having, or are likely to have, impacts on both competition and on the incentive for companies to produce innovative products with respect to their recyclability and overall waste content. Further information has been supplemented from the Perchards report 'Transposition of the WEEE and RoHS Directives in other EU Member States' produced for the UK government.

The information on Member State implementation of the WEEE Directive in these studies is also supplemented by information received from stakeholders during the consultation process.

11 ASSESSMENT OF SPECIFIC IMPACTS

11.1 INTRODUCTION

This Section assesses the impacts of existing frameworks in place in the Member States with special regard to competition and innovation. The information presented below is based on both secondary and primary sources of information.

11.2 INNOVATION

The Task Specification accompanying the Request for Services requires the study to 'assess the impacts (to date and potential) of the WEEE requirements on the pace of innovation'. This requirement involves:

- Estimating the share of R&D effort dedicated to fulfil WEEE requirements;
- Assessing the extent to which the systems of producer responsibility maintain producers' incentives to improving eco-design and considering whether those systems as implemented by Member States are discriminatory against the most innovative products and companies.

11.2.1 Share of R&D

The structure of the electric and electronic sector is quite uneven. Sectors such as producers of domestic appliances, computers and office equipment, telecom equipment, consumer electronics and light bulbs are dominated by just a few firms that typically account for a large percentage of turnover and jobs in the sector. Nevertheless, there are still over 100 000 companies in the electronics industry that employ less than 20 people each but account for 180 000 jobs out of total of 1.4 million jobs in the sector. The electronic components sub-sector is less concentrated than the other sub-sectors with a substantial proportion of jobs and turnover accounted for by SMEs.

A study conducted by the Centre for Sustainable Design in 2000 concluded that, despite the increasing pressure from legislation to improve aspects of eco-design, often SMEs are not aware of aspects related to eco-design. Moreover, there was lack of *customer and supply chain drivers for eco-design implementation as well as a lack of immediate legislative pressure at both national and EU levels;* and in relation to the proposed WEEE/ROHS Directives there was:

- a high level of uncertainty;
- a 'wait and see' attitude;
- a lack of awareness (outside of environmentally 'aware' electronics companies); and
- a perception of it being a long way off.

Six years after the study was concluded and with the sector still facing structural change with increasing outsourcing of manufacturing, information on R&D related to eco-design is not readily available. One would expect that SMEs have a lesser scope to undertake significant R&D on aspects related to eco-design and to the extent to which these are suppliers to assemblers, a similar situation would hold across the supply chain. Whilst many leading-edge companies have built-up good information systems and competence to improve aspects related to eco-design, the extent to which these are driven by the WEEE Directive alone is less than certain, with other drivers for eco-design including consumer demands and other environment related legislation often playing a more important role (these are described further in the following sections).

R&D expenditure has been suggested as a potential indicator of the level of effort put into meeting the objectives of the Directive with regard to eco-design. However, it would only be one of a number of indicators since there are multiple incentives for companies to engage in R&D, including cost reduction, new product development and differentiation, etc. In any event, it is very difficult to come by this type of data due to commercial confidentiality and frequently R&D is only reported by sector in the national statistics and not at the right level for this study.

The literature review conducted for this study has revealed little information on companies' R&D efforts in terms of eco-design and design for recycling in general and on R&D specifically to fulfil WEEE requirements. Since this is a sensitive area, with R&D for design and innovation being linked strongly with competitive advantage, this is not unexpected.

Because of this, industry stakeholders were asked through the questionnaire whether they had allocated specific research budgets to enhance the environmental characteristics of their products and, more specifically, whether this was to improve the design of products with respect to their recyclability or waste content and as a result of the WEEE Directive.

In the first consultation exercise, 60% of the companies that responded indicated that they had allocated a specific research budget for the eco-design aspects of their products, with 20% indicating that they had not and 20% not responding to this question. One of the companies pointed out the fact that although they did not allocate a specific budget for environmental characteristics of products, this was incorporated into the overall design process. When asked more specifically if companies had allocated any extra funding to improve the design of products with respect to their recyclability or waste content in direct response to the WEEE Directive, the response was split with 40% indicating that they had and 40% that they had not (with 20% not responding to the question).

In relation to the second consultation, only 2 of the 12 companies had specifically allocated a budget for R&D to improve their products' recyclability in response to the WEEE Directive and only 2 companies indicated that they had introduced innovations with respect to waste reduction or ease of recycling since the introduction of producer responsibility obligations for dealing with WEEE.

Unfortunately, no respondents provided any response when asked about the levels of any increased funding for research and development for product design for recyclability or waste content as a result of the WEEE Directive, often citing reasons of commercial confidentiality.

A factor to take into consideration is the time horizons for product re-design. Some sectors find it easier to adapt and have greater flexibility to incorporate changes. The questionnaire responses showed for instance that these are shorter for PCs and laptops as well as video games and handheld video games. Other product categories such as refrigerators, printers and copiers need longer than a year. The reasons could include, inter alia:

- More resources available for R&D;
- Greater flexibility of products to incorporate changes; and
- Economic/regulatory framework favouring R&D (centres of excellence, tax credits, etc).

A number of the individual companies consulted through the questionnaires indicated that the different producer responsibility systems put in place in the 5 focal countries have resulted in significantly different charges being faced in order to meet producer obligations. The overall effect of these different systems in terms of companies' ability to allocate resources to product innovation via increased research and development is, however, less clear since the cost of WEEE obligations needs to be set within the overall cost structures of companies' operations in the different countries. Since the multitude of costs associated with producing the different electrical and electronic products will also differ between countries, the overall burden of WEEE obligations may also differ significantly. Whilst Table 11.1 below (which has been derived from the first consultation responses) is unable to show the differences in the burden of WEEE obligations as a proportion of overall costs between different countries, it does show that different companies are feeling the cost burden in different ways.

Table 11.1: Cost of WEEE obligations

Year	*2003*	*2004*	*2005*	*2006*	*2007*
No. of companies indicating % overall costs represented by WEEE obligations					
0 – 0.25%	1	1	2	2	2
0.26 – 0.50%				1	1
0.51 – 0.75%			2	1	1
0.76 – 1.0%				1	
1.01 – 1.5%			1		
1.51 – 2%					
>2% (specify)	1 (10%)	1 (10%)	1 (10%)	1 (10%)	1 (10%)

2 out of the 10 companies stated that their 'WEEE costs' as a proportion of their overall costs had decreased between 2005 and 2006, in one case going from 0.51 - 0.75% in 2005 to 0.26 – 0.50% in 2006 and the other going from 1.01 – 1.5% in 2005 to 0.76 – 1.0% in 2006. Whilst this is statistically insignificant, it does reflect what might be expected in terms of recycling operations becoming more prevalent, efficient and advanced and overall WEEE systems 'bedding down' as companies become more familiar with their operation.

The impact of the WEEE Directive felt by companies on research and development in the first consultation is further explored in the Table 11.2 below which sets out the extent to which companies have felt the impact of the Directive in different areas of costs.

Table 11.2: Impact of the WEEE Directive on Costs

Cost Factor	*Impacts of WEEE Directive on Costs*					
	Very high	*High*	*Moderate*	*Low*	*Negligible*	*Score*
Research and development	1		1	3	2	16
Changes in manufacturing process			1	5	1	14
Changes in materials used in production		1		2	4	8
Product labelling	1		4	1	2	21
Product marketing		1	1	2	3	10
Other: Administration			2			6
Other: Set-up of operative take back systems		1				4
Manual change for information for consumers			1			3
Information for recyclers			1			3

By allocating a value of 5 for ‘Very High’, 4 for ‘High’, 3 for ‘Moderate’ and so on and multiplying by the number of companies which selected the respective level of impact for each of the cost factors, the score column in the table provides a relative indication of the importance of the different cost factors being affected by the WEEE Directive. Interestingly, product labelling comes out as the most significant factor, while Research and Development ranks as the second. Given the low sample, this is significantly affected by the fact that 1 company indicated a ‘Very High’ impact on both labelling and research and development. However, if these results are removed, labelling remains the highest ranked impact and research and development falls to third.

A further area explored during the consultation focused on job creation within companies in research and development for product design as a response to the WEEE Directive. The majority of companies (70%) indicated that they had not created specific positions in response to the Directive and only 20% stated that they had. Little information was provided by the respondents on either the number or nature of the jobs created meaning that it is not possible to draw any conclusions.

Conclusions

Overall, there are limited conclusions to draw with respect to the impact of the WEEE Directive on the share of company resources allocated to R&D. Information from direct consultations with industry stakeholders, whilst limited in its extent, has suggested that the Directive itself has had very limited influence over decisions to allocate resources (people, time and money) to R&D to meet with WEEE requirements. Existing reviews of the impacts of the WEEE Directive on innovation in EEE products have produced a mixed analysis of the direction of the impacts and whether indeed such impacts exist. The fact that there are a significant number of drivers for eco-design, of which the WEEE Directive may only be one if it is significant at all, further complicates the picture with respect to R&D allocations. The study ‘Implementation Of Waste Electric And Electronic Equipment Directive In Eu 25’ by AeA Technology highlights the fact that some companies are of the view that eco-design issues are already being tackled outside of the scope of the WEEE Directive e.g. via the EuP Directive, and therefore do not necessarily refer to the requirements of the WEEE Directive when making economic decisions regarding R&D allocations.

11.2.2 Incentives to Innovate and Implementation in Member States

Article 4 of the WEEE Directive states:

- *Member States shall encourage the design and production of electrical and electronic equipment which take into account and facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials. In this context, Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements.*

The Bio-Intelligence Synthesis report notes that it is difficult to monitor the implementation of Article 4 since there are no defined quantitative measures for product development/eco-design. Consequently, the only realistic measure of the impact of this particular part of the legislation might be those cases that come to light where design is actually used to prevent re-use in contradiction to Article 4 and the companies are required to amend the design of their products as a result. The literature review did not indicate that such cases have been at all widespread, but with the emphasis to date in Member State implementation of the WEEE Directive having been very much focused on establishing the take-back and producer responsibility systems for financing WEEE management, this does not mean to say that future monitoring and surveillance activities might not reveal more cases in the future.

In spite of this, Article 4 remains the main objective within the Directive with respect to improving the design of products with respect to their re-use and recycling

The literature review revealed that there are a number of views as to the extent of any influence that environmental legislation alone might have on eco-design. It seems likely there are a number of incentives and drivers which influence innovative eco-design and this makes it difficult to attribute any resulting changes in the design of products to any one piece of legislation in particular, not least the WEEE Directive. The literature appears mixed between providing examples of innovations inspired by environmental legislation and otherwise concluding that the WEE Directive has little impact on companies' incentives to design for recycling and waste management.

Figure 11.1 below sets out some of the main drivers for eco-design as set out in the literature.

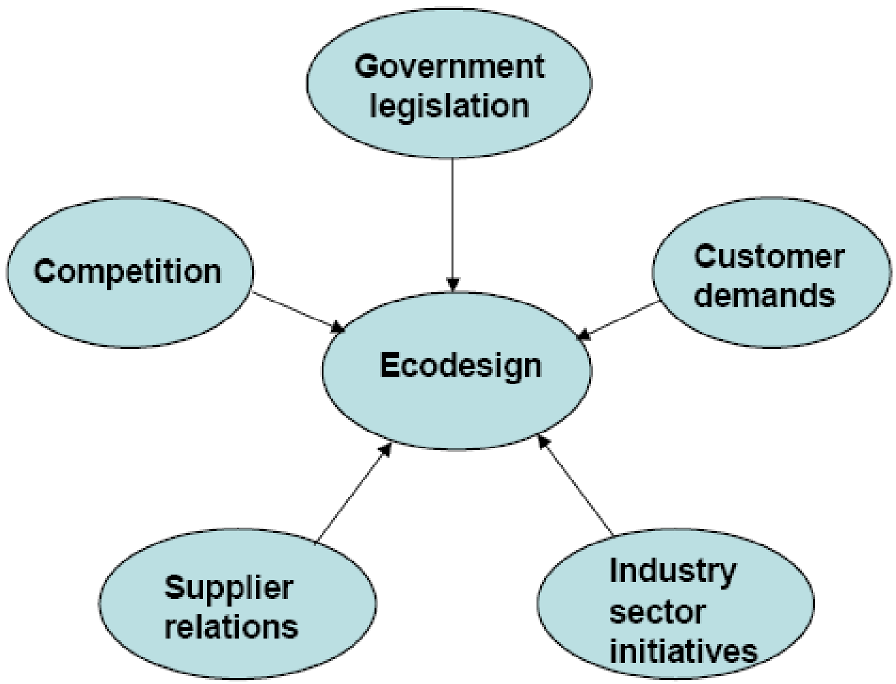

Figure 11.1: Main external influences on eco-design

Note: Extracted from Gottberg, A. (2003), in turn derived from McAloone, T.C. (1998) and van Hemel, C.G. (1998)

Gottberg highlights a number of studies coming down on the side of each of the drivers as being significant factors in driving eco-design along with other studies which indicate the opposite. For example, whilst Argument et al, Tojo N (2001) and Zoboli, R. (2000) highlight legislation as being the most significant driver, Naturvårdsverket (2002) and Trenchard & Gowland (2003) show that many companies in the EEE sector are not aware of their responsibilities as defined in Member States' legislation. Similarly, Dalhammar (2002) mentions supplier relations as a motivating factor for eco-design whilst McAloone (1998) concluded that supplier relations were more important as a source of information and influence as opposed to being a major driver of eco-design.

Gottberg, (2003) investigated the impacts from the WEEE Directive on both large companies and SMEs in the lighting equipments sector. The study included companies in EU Member States without individual producer responsibility for WEEE in order to see if there were any differences in waste-minimising product design among countries and if national policies have an impact beyond national borders. The study, based on 8 case study results, showed that the WEEE Directive was not a driver for eco-design. On the contrary, three cases specifically claimed that the WEEE legislation had not had an impact. Instead, the RoHS was mentioned as a more important regulatory driver. Walls (2006) argues that the reason why extended producer responsibility (EPR) has not been effective in encouraging changes in design is because of the plethora of collective take-back schemes and the way they operate.

However, other studies have shown the opposite. In a survey conducted in Norway from 20 October to 11 November 2003, entitled "Green" technological changes in the Norwegian EE sector", 71% of respondents agreed that there had been technological changes in the products or processes during the last 10 years to deal with environmental problems. The respondents identified the driving forces for this as:

- environmental regulations in EU (68%);
- environmental awareness and commitment in the organisation (59%); and
- environmental regulations in Norway (55%), and "market demand" (50%).

Hafkesbrink, J. (1998) also observed that companies' expectations of changes in legislation can provide an incentive to develop knowledge in areas that may possibly lead to actual innovation in the legislated field, but that actual innovation requires additional impetus in terms of market incentives. The author points to the fact that relatively high prices for such goods and limited willingness to pay additional amounts on the part of consumers are key constraining factors.

Individual examples of Innovation with respect to Eco-Design

Individual examples of innovations exist throughout the literature but it is invariably impossible to establish the direct drivers behind the decision to develop new products or adapt existing ones to reduce waste or make recycling easier. A number of such examples are set out below.

- Two studies conducted at the Centre for Sustainable Development at the University of Westminster in the UK provide examples of companies benefiting from the eco-design of products, suggesting that in certain cases, environmental legislation such as the WEEE Directive can have some specific positive effects on innovation:

  Cable & Wireless (C&W): By raising awareness of eco-design and environmental issues through out the supply chain, suppliers themselves responded by developing "cleaner" products and manufacturing processes. Knowledge flows were also improved throughout the supply chain enabling the downstream manufacturer or in this case the service provider (C&W) to gain competitive advantage (CfSD, 2007).

  Crawford, Hansford & Kimber (CH&K): Another study looked at a SME manufacturer of printed circuit boards employing some 30 people. It found that through eco-design in response to various environmental directives including WEEE, innovating to remove a substance from production added value to their business and therefore gave them a competitive advantage (CfSD, 2007a).

- As part of the ADSM (active disassembly using smart materials) project funded by the EU, researchers are evaluating materials to be used in fasteners that will be able to disassemble themselves at specific triggering temperatures. They have developed a simple cell phone that can disassembly itself in 1.5 seconds; mean disassembly time for all cell phones tested being 8 seconds. Researchers note that component recovery is key to reducing environmental impacts and that the current practise of dismantling by hand discourages recovery because of its high costs (Fishbein 2002, in Bio Intelligence Service, 2006).

- Work in the field of eco-design is also being undertaken by Delft University of Technology, in the Netherlands. The University is working with manufacturers of electronic goods under a Europe-wide Eureka project called CARE (Comprehensive Approach for the Recycling of Electronics) Vision 2000. The aim of this project is to recycle electronics scrap at the highest level of utilisation. In the CARE system, every electronic product will contain an information module. This module stores information from the producers that might be used by the recycler, such as the types of materials the product contains, the toxic substances that need to be removed etc. Another interesting possibility is to use the module to record information on the 'life history' of a product in order to determine its remaining 'life value'. For instance, the number of hours a cathode ray tube in a television has operated determines whether or not this part can be reused in a new product or as a repair part.
- In Germany, Siemens has designed a new eco-PC which facilitates product dismantling in response to German legislation, with the added benefit of lower production costs (Thorpe and Kruszewska, 1999).

Consultation

As a follow up to the literature review, this study sought to gain further insight into companies' motivations and incentives for eco-design and, during the consultation process, companies were asked to identify which drivers were the most significant in terms of affecting decisions on product design with regard to waste reduction and ease of recycling. Table 11.3 below illustrates the ranking given by numbers of companies responding to different innovation drivers.

Table 11.3: Innovation Drivers (Companies' Perspective)

Innovation Driver	*RANK*										*Score*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Company's own environmental policy	4	4	1	1		3					106
WEEE Directive	1	5	2		1	2			1		89
RoHS Directive	6		3	1		1	1	2		1	107
Other EU legislation	1	2	3		2	1		1	1		74
National environmental legislation	1	2	1	2	3	1	1				77
Consumer demand/preferences	6	3	1	5			1				134
Legislation from other countries outside EU	1	2	1	1	5	2					83
Reduction of costs of dealing with waste/recycling	3	1		5		1	2			1	78
Other	1	1	1		1						33

Note: Columns show numbers of companies allocating the different ranks to each driver. Among 'Other EU legislation' listed were Energy Using Products Directive, Toy Safety, REACH and Chemicals legislation. 'Other ' identified as "Innovations in the recycling sector" for the company rating it as 5 and "Ethical Policy" for the company rating it as 2. The company rating it at 1 identified "Reducing manufacturing costs" and the one rating it at 3 quoted "Reducing transport costs". The response were collated from both the first and second round of questionnaires.

By allocating scores to each of the drivers (where a rank of 1 achieves a score of 10, a rank of 2 scores 9 etc.), the final column shows that overall the companies consulted felt that consumer demand, their own environmental policies and the RoHS Directive were the most significant drivers as regards product design for waste reduction and recycling. However, the WEEE Directive, with its specific focus on waste reduction and recycling, comes out only 4th in the combined ranking and only just ahead of legislation from other countries outside the EU.

When asked about specific innovations made with respect to waste reduction or ease of recycling, only two companies responded that they had introduced such innovations, quoting "smaller products using less materials", "miniaturisation/weight reduction, vegetable based plastics and simplification of disassembly". However, one of the companies stated that these innovations would have taken place even in the absence of the WEEE Directive. The following comments received further serve to back up the lower ranking of the WEEE Directive against consumer preferences and wider company environmental policies as a major driver for innovation.

> "(The company) has had a programme for the eco-friendly design of products for many years which also incorporates requirements out of recycling. These requirements are applied when developing products." (from one company producing refrigerators)

> "Because Article 8.2 of the WEEE Directive has not been properly transposed by Member States, there is currently insufficient incentive for innovations leading to products which are easier to disassemble and recycle" (from one company producing PC and Laptops and Printers and Copiers)."

A similar analysis to that carried out for Table 11.3 above is reproduced in Table 11.4 below utilizing results of the consultation responses from National Authorities.

Table 11.4: Innovation Drivers (National Authority perspective)

Innovation Driver	*Rank*				*Score*
	Belgium	*UK*	*Germany*	*Ireland*	
Company's own environmental policy	2	5	3	2	32
WEEE Directive		3	4	3	23
RoHS Directive	4	1	1	4	34
Other EU legislation [EuP Directive]		4	2	7	20
In-country or National legislation		8		5	9
Consumer demand/preferences	3	7		8	15
Legislation from other countries outside EU		9		6	7
Reduction of costs of dealing with waste/recycling	1	6		1	25
Other		2			9

Note: 'Other' identified as 'Reduction of production costs and savings in material input'. 'Score' based on allocating 10 for rank of 1, 9 for rank of 2, 8 for rank of 3 and so on.

Interestingly, the analysis produces a similar result, with the WEEE Directive also achieving an overall rank of only 4th, this time behind the RoHS Directive (which in this case came out on top), companies' own environmental policies, and reduction of costs of dealing with waste/recycling.

National Authorities themselves identified a range of existing incentives and potential future incentives for companies to innovate in the areas of recycling and waste reduction. These are summarized in Table 11.5.

Table 11.5: Existing and Future Incentives for Innovation

Existing Incentives for Innovation	*Possible Future Incentives*
Article 4 of the WEEE Directive transposed by (national) WEEE regulations	Increased oil prices, increased energy prices, increased economic benefit of recycling and material recovery
The producers have to bear the costs of dealing with waste/recycling	Increased recycling targets
The durability of new EEE is accounted within the calculation of the producer's monetary recycling-guarantee	Standards for disassembly and recycling
Producers are allowed to collect and recover WEEE similar to their own products. This amount reduces their responsibility in relation to the amount calculated by the national register. This opportunity encourages the recovery of homogeneous composite materials and reduces the costs of the recovery	Dynamic labelling and swift implementation of eco-design directive
Working with less hazardous substances as per the RoHS Directive	Individual as opposed to collective producer responsibility
Reduced Waste management costs	Greater consumer demand for 'design for life' products
Enhanced corporate social responsibility	Establish guidelines for life-cycle analysis
Getting established in a niche market	Greater waste management costs
Minimum thresholds for all manufacturers	Business assistance incentives

National authorities were also asked for their overall view on whether or not the WEEE Directive has been effective in providing incentives to companies to improve the design of their products with respect to reducing waste and/or making the products easier to recycle. Opinion was split on this with the results shown in Table 11.6 below.

Table 11.6: Effectiveness of WEEE Directive in providing incentives for design

Strongly Agree	*Agree*	*Neutral*	*Disagree*	*Strongly Disagree*
	1	2	1	

Trade associations were also consulted on their assessments of the importance of the different innovation drivers and the results of the analysis are presented in Table 11.7 below.

Table 11.7: Innovation Drivers (Trade Association perspective)

Innovation Driver	*Trade Associations*									*Score*
	TA1	*TA2*	*TA3*	*TA4*	*TA5*	*TA6*	*TA7*	*TA8*	*TA 9*	
Company's own environmental policy	1	1	1			2	5		1 or 2	55
WEEE Directive		2				5	1		3	33
RoHS Directive		1				1	2		3	37
Other EU legislation [Please specify]:		3				6			3	21
In-country or National legislation		4				7	3		3	27
Consumer demand/preferences		1	2		1	4	4	1	1	63
Legislation from other countries outside EU		5				5			3	20
Reduction of costs of dealing with waste/recycling		2				3			2	26

As with companies and National Authorities, Trade Associations perceive the influence of the WEEE Directive as an innovation driver as being lower than a company's own environmental policy, lower than the RoHS Directive and lower than consumer demand/preferences. Overall it ranked 4th out of the 8 drivers identified and the consistency of these results across the three groups of stakeholders appears significant, despite the low response rate in all groups.

A similar situation can be seen at the downstream end of the lifecycle of electrical and electronic products, in terms of incentives provided for producers to incorporate innovative design for recycling and waste reduction into their products. Consultation with Producer Responsibility Organisations (again, only limited to three respondents to the questionnaires) confirmed the low ranking of product recyclability when it comes to negotiation of contracts between producer responsibility schemes and recycling companies. Table 11.8 shows that ease of recycling is the lowest ranking factor for PROs when negotiating these contracts and, although only one recycling company responded to the questionnaire, that company rated ease of recycling 4th out of five categories, only above access to WEEE and below amount of recyclate (ranked 1), number of products (ranked 2) and weight of products (ranked 3).

Table 11.8: Factors of Importance for PROs negotiating contracts

Most significant factors for PROs when negotiating contracts with recycling companies	*Rank*					*Score*
	1	*2*	*3*	*4*	*5*	
Volume of products	1		1	1		10
Weight of products		2	1			11
Ease of recycling			1	1	1	6
Amount of recyclable material contained in the product	1	1				9

Note: Scores allocated on basis of Rank 1 = 5, Rank 2 = 4, Rank 3 = 3 etc. Table shows number of companies allocating respective ranks to factors.

Incentives in National Implementation of the WEEE Directive

With the exception of Article 4 and the limited effect that it might have on the objective of achieving eco-design in the absence of any targets or measures for product development/eco-design, the other main tool within the Directive for achieving this objective is the cost incentive to producers of EEE to reduce end-of-life management costs for WEEE through making them easier and cheaper to recycle and scrap.

A number of studies have pointed to the potential link between the costs of end-of-life management and innovation for eco-design. Gottberg (2003) states:

> *"Enforced through legislation, the re-allocation of costs for collection and treatment is a key mechanism for the operation of the WEEE policies. Some authors assumed that the costs imposed on producers would act as levers for product changes. However, a review of economic principles applied to producer responsibility for WEEE, indicated that the incentive of the costs may be limited, although potentially larger with individual solutions than collective schemes."*

Whilst other studies have shown that producer responsibility for different waste categories has had a positive effect on product development (these studies have mostly involved larger companies), the extent of the application of producer responsibility within national transposition of the WEEE Directive in Member States is seen as a key influencing factor on the level of cost incentives for producers to design products for easier recycling and reduced waste content at the end-of-life phase. The Synthesis Report on information collected for the review of the WEEE Directive published by Bio Intelligence Service (2006) concluded:

> *"…the disconnect that often exists between the design of products and the real costs of the end-of-life management due to collective schemes, seems to be a main obstacle to implementing design strategies that would lead to increased recycling rates and that could in many cases make recycling profitable."*

The WEEE Directive is clear in its aims to associate WEEE management costs with those responsible for producing WEEE in the first place by implementing the principle of the polluter pays through individual producer responsibility. Articles 8(2) and 8(3) of the WEEE Directive set out the producer responsibility approach of the Directive as follows:

- *8(2) For products put on the market later than 13 August 2005, each producer shall be responsible for financing the operations referred to in paragraph 1 relating to the waste from his own products. The producer can choose to fulfil this obligation either individually or by joining a collective scheme.*
- *Member States shall ensure that each producer provides a guarantee when placing a product on the market showing that the management of all WEEE will be financed and that producers clearly mark their products in accordance with Article 11(2). This guarantee shall ensure that the operations referred to in paragraph 1 relating to this product will be financed. The guarantee may take the form of participation by the producer in appropriate schemes for the financing of the management of WEEE, a recycling insurance or a blocked bank account.*

  8(3). The responsibility for the financing of the costs of the management of WEEE from products put on the market before the date referred to in paragraph 1 (historical waste) shall be provided by one or more systems to which all producers, existing on the market when the respective costs occur, contribute proportionately, e.g. in proportion to their respective share of the market by type of equipment.

The following section explores the implementation of producer responsibility in Member States from the perspective of its potential for creating incentives for innovation and eco-design.

Implementation of Producer Responsibility in Member States

Legislation

The OKOPOL et al (2007) study for DG Environment examined national legal texts for implementation of the WEEE Directive in relation to both historical and new WEEE and made an assessment of how each Member State had transposed the Directive in respect of the financing mechanisms for WEEE. The results of the analysis are shown in Table 11.9 below.

Table 11.9: Financing mechanisms for WEEE

Member State	*Financing of WEEE put on the market after 13 August 2005 (New WEEE)*	*Financing of WEEE put on the market before 13 August 2005 (Historic WEEE)*
	Content	*Content*
Austria	Choice of financing individual or collective	Proportion based on current market share
Belgium (Brussels)	Finance waste from own products	Proportion based on current market share
Belgium (Flanders)	Finance waste from own products	Proportion based on current market share
Bulgaria	Proportion based on current market share	Proportion based on current market share
Cyprus	Finance waste from own products	Proportion based on current market share
Czech R.	Finance waste from own products	Proportion based on current market share
Denmark	Proportion based on current market share	Proportion based on current market share
Estonia	Finance waste from own products	Proportion based on current market share
Finland	His own as well as proportion to the market share	His own as well as proportion to the market share
France	Proportion based on current market share	Proportion based on current market share
Germany	Choice of financing individually or collectively	Proportion based on current market share
Greece	Producer responsible, but no specific financing mechanisms	Producers responsible, but no specific financing mechanisms
Hungary	Defines new WEEE but no financial mechanism	Responsibility defined but not financial mechanism
Ireland	Finance waste from own products, but exemption from responsibility if members of approved bodies	Proportion based on current market share, but exemption from responsibility if members of approved bodies
Italy	Producers responsible but no mention of "own"	Proportion based on current market share
Latvia	Producers of waste are responsible	Producers of waste are responsible
Lithuania	Producers responsible but no mention of "own"	Proportion based on current market share
Luxembourg	Finance waste from own products	Proportion based on current market share
Malta	Finance waste from own products	Proportionate, market share as example
Netherlands	Finance waste from own products	Proportion based on current market share
Poland	Collection of own products mandated. No specific financing mechanisms. Responsibility could be delegated to collective systems.	Collection mandated based on market share. No specific financing mechanisms. Responsibility could be delegated to collective systems.
Portugal	Not mentioned	Proportion based on current market share
Romania	Finance waste from own products	Proportionate, market share as example
Slovakia	Finance waste from own products	Proportion based on current market share
Slovenia	Proportion based on market share.	Proportion based on market share
Spain	Producers responsible but no mention of own products	Proportional based in market share
Sweden	Defines new WEEE , but no explicit individual financial responsibility	Proportion based on market share
UK	Proportion based on current market share	Proportion based on current market share

Key aspects of the measures adopted for determining the financing mechanisms for WEEE in the five focal countries for this study are presented below.

Belgium

WEEE legislation is fully implemented in Belgium, and companies selling electric and electronic products on the Belgian market must be able to prove they are meeting their take-back obligations.

Article 18 of the national legislation only mentions that “The financing of the costs … originating from products put on the market after 13 August 2005 is provided by the manufacturers.”

As a result of RECUPEL having been established as the only collective scheme in Belgium, individual compliance in Belgium has not been common and has only started recently.

Ireland

Article 16 of the national legislation requires that for new WEEE (products placed on the market after 13 August 2005), producers will be responsible for financing the waste management costs of their own products. In contrast, Article 30 states that producers who are members of an approved body (compliance scheme) will be exempt from Article 16, which acts in contrast to the intention of Article 8(2) of the WEEE Directive, namely individual producer responsibility for new WEEE.

Germany

The ElectroG Law (Act Governing the Sale, Return and Environmentally sound Disposal of Electrical and Electronic Equipment) transposes the WEEE and RoHS Directives. The ElektroG maintains local authorities’ responsibility for separate collection of electrical and electronic waste from private households and provides for a neutral industry-managed Clearing House which accepts take back requests from municipal collection points and issues take back orders to obliged producers.

Producers and importers based in Germany, including distance sellers, must register with the Central Register before 24 November 2005. Responsibility for waste lies with the Länder governments, but to avoid a fragmented implementation of the ElektroG and to minimise bureaucracy both for the Länder and for producers, the Länder governments and the Federal Ministry for Environment agreed to assign this role to one competent authority, the Federal Environment Agency (Umweltbundesamt, UBA). The UBA acts under the legal and functional supervision of the Environment Ministry.

Producers are able to choose between meeting their obligations for financing WEEE according to their market share or by calculating the amount of WEEE arising from their own products via sorting or sampling. Producers are allowed to deduct any individually collected WEEE from their allocated share of WEEE collected from municipal collection sites. Article 8(2) of the WEEE directive clearly requires producers to be responsible for the WEEE from their own products and the fact that producers are given the choice of doing this by waste arising OR via market share appears to be in contradiction to the intention of the Directive.

Lithuania

Implementation in Lithuania represents a case where collective systems work without a strong involvement of coordinating bodies/government authorities. As found in many of the systems that take this approach, the Lithuanian system determines the amount of historical WEEE that producers need to collect and recycle based on the new EEE put on the market each year. In other words, the amount of products that producers must collect does not depend on what is actually coming back to the collection points. It is up to producers or their compliance scheme to achieve the required collection and recycling.

United Kingdom

Producer obligations are calculated on the basis of UK market share (by the categories detailed in the WEEE Regulations) and the level of household WEEE arising at designated collection facilities (DCFs[1]) or returned to producers as follows (UK Regulations, pp 12):

(A ÷ B) x C

where

"A" is the total amount in tonnes of EEE intended for use by private households and falling within one of the categories of EEE ("the relevant category") that has been put on the market in the United Kingdom by that producer in a particular compliance period[2], or part of a particular compliance period, ("the relevant compliance period");

"B" is the total amount in tonnes of EEE intended for use by private households and falling within the relevant category that has been put on the market in the United Kingdom by all producers in the same compliance period used in "A"; and

"C" is the total amount in tonnes of WEEE from private households which is waste from electrical or electronic products that fall within the relevant category and is deposited at a designated collection facility and returned under regulation 32 in the same compliance period used in "A".

The Okopol et al (2007) study identifies 3 patterns of implementing Article 8(2), each with varying degrees of interpretation and application of the principles of the legislation.

- Financing The Management Of Waste From Their Own Products For New WEEE (i.e. individual producer responsibility) – Member States in this group state explicitly in national legislation that companies are required to finance the waste from their own products placed on the market after 13 August 2005.
- Variations of 8(2) or Ambiguous Interpretation – legislation does not explicitly state that individual companies are responsible for the waste management costs of their own products and responsibilities are often referred to in the plural form for new WEEE. This makes the interpretation ambiguous and could be assumed to imply that producers are collectively responsible for financing WEEE. Producers are given the choice to decide between individual and collective financial responsibility for new WEEE in Austria and Germany, and in Ireland, membership of an "approved body" leads to an exemption are Article 16 on financing WEEE from private households which assigns an individual financial responsibility for new WEEE.
- Individual Financial Responsibility for New WEEE is omitted – in national legislation, individual producer responsibility is not mentioned and many countries use current market share at the time that WEEE costs arise as the basis for allocating responsibility, which mirrors the system for financing historical WEEE.

[1] In the UK, central collection facilities are referred to as Designated Collection Facilities (DCFs). All household WEEE which is separately collected at a DCF, other than that which has been removed for re-use as whole appliances, should be made available to producer compliance schemes (PCSs).

[2] The UK WEEE Regulations introduce annual compliance periods than run from 1 January to 31 December each year. The first compliance period will be shorter, from 1 July 2007 to 31 December 2007.

The table below groups the Member States' legislation falling into each of the above categories.

Table 11.10:Transposition of Article 8(2)

Financing waste management from own products	*Variations of 8(2) or ambiguous*	*Individual financial responsibility omitted*
Belgium (Brussels and Flanders)	Austria	Bulgaria
Cyprus	Belgium (Walloon)	Finland
Czech Republic	Germany	France
Estonia	Hungary	Greece
Luxembourg	Ireland	Latvia
Malta	Italy	Slovenia
Netherlands	Lithuania	UK
Romania	Poland	
Slovakia	Portugal	
Denmark	Spain	
	Sweden	

A joint industry and NGO group comprising individual companies, trade associations and environmental NGOs (available at http://www.greenpeace.org/raw/content/international/press/reports/joint-statement-by-a-group-of.pdf) has expressed the view that the legislation should fully support individual producer responsibility as the Directive's primary tool in achieving its objectives to finance WEEE and reduce the overall amount of WEEE. A number of the industry stakeholders consulted as part of this study concurred with this view stating that interpretations of the legislation which do not fully commit companies to paying for the collection and treatment of their own waste will not create sufficient incentives for producers to proactively improve the design of their products and will effectively hinder any link between end-of-life waste management costs and innovation mentioned above.

Moving to a model where WEEE management is based on a producer's share of the WEEE returned is advocated as a means of providing greater incentives to producers to either reduce the weight or increase durability and/or the recyclability of their products where return share is calculated according to weight of products. Further incentives could also be incorporated into the system if fees charged to producers were directly linked to the costs of dismantling and recycling their own products by incorporated charging structures that accounted for content of hazardous substances, time taken and ease of dismantling. Adopting such a system would imply the need to establish some form of sampling of the waste stream to determine the share of WEEE to be allocated to each individual producer. Clearly this would increase the cost of WEEE management overall to companies and national authorities in terms of the sampling itself and monitoring of WEEE management practices and outcomes to ensure all producers were meeting their obligations. Such a move would clearly have greater implications for countries appearing in the "Variations of 8(2) or ambiguous" and "Individual financial responsibility omitted" columns in Table 1.3.10 above. Indeed, it has been noted by one of the stakeholders that this could not be cost-efficient and thus treatment by type of product may be a more feasible option to encourage new technologies for treatment.

This is considered further under the Impact Assessment section later in this report.

Financial Guarantees

The existence or otherwise of individual producer responsibility is therefore considered important due to its establishment of the requirement for companies to pay for the real costs of their own WEEE and the assumed stronger link with incentives for eco-design that result. The same will be true in the future and therefore financial guarantees covering the future costs of dealing with WEEE are also important vis-à-vis their relationship to individual producer responsibility. The provision of financial guarantees attempts to ensure that finance is available to cover the future WEEE management costs of a producer's products, particularly where producers leave the market and/or go bankrupt. In this sense, financial guarantees provided by producers are an extension of the producer responsibility concept into the future.

Article 8(2) of the WEEE Directive provides the legal basis for the provision of financial guarantees as follows:

> *Member States shall ensure that each producer provides a guarantee when placing a product on the market showing that the management of all WEEE will be financed and that producers clearly mark their products in accordance with Article 11(2). This guarantee shall ensure that the operations referred to in paragraph 1 relating to this product will be financed. The guarantee may take the form of participation by the producer in appropriate schemes for the financing of the management of WEEE, a recycling insurance or a blocked bank account.*

The Okopol et al study on producer responsibility assessed the legislation and implementation of the various measures relating to financial guarantees as follows:

Table 11.11: Financial Guarantees

	Collective scheme membership is considered to be the Financial Guarantee	*Financial Guarantee Required from all compliers*	*Product Tax is considered to be the de facto guarantee if proof of compliance is not satisfied*	*Guarantee required from Collective scheme itself*
Austria	•			
Belgium	•[1]			
Bulgaria			•	
Cyprus			•[2]	
Czech R.	•			
Denmark	•[3]			
Estonia	•			
Finland	•			
France	•			
Germany		•[1]		

[1] Belgium: Collective scheme guarantee needs governmental approval
[2] Cyprus: Although required, little evidence to suggest proof of guarantee is being offered.
[3] [3] Denmark: producers, or the collective scheme on behalf of the producers, have to provide a financial guarantee. Exemptions may be provided where: 1) a collective scheme is subscribed by at least 10 producers and importers, or 30% of the registered producers and importers within one of the product categories, and the market share account for at least 30% of the toral marketed equipment within that category; and 2) collective scheme fulfils the specific guidelines laid down by the Danish EPA.

	Collective scheme membership is considered to be the Financial Guarantee	*Financial Guarantee Required from all compliers*	*Product Tax is considered to be the de facto guarantee if proof of compliance is not satisfied*	*Guarantee required from Collective scheme itself*
Greece	•			
Hungary	•			
Ireland	•[2]			
Italy		•		
Latvia			•	
Lithuania				•
Luxembourg	•			
Malta	•			
Netherlands	•			
Poland	•			
Portugal	•			
Romania			•	
Slovakia			•[3]	
Slovenia	•			
Spain	•			
Sweden	•[4]			
UK	•			

It is clear that, in the majority of countries, membership of a collective compliance scheme is considered as meeting the requirements of a financial guarantee as set out in the Directive. In this sense, producers are not being required to provide financial guarantees with respect to the future waste management costs of their own individual products and therefore any link between costs to producers for future WEEE management costs and eco-design would be compromised.

Key aspects of the implementation of the WEEE Directive with respect to the provision of financial guarantees in the selected 5 focal countries for this study are set out below (Source: Okopol et al, 2007).

Belgium

Belgium(Brussels): A financial guarantee must be provided and paid to the regional authority for both individual schemes and collective schemes. However, the sum is only required to cover a 6 months' contingency period.

Belgium (Flanders): Both business–to-business and business-to-citizens producers which comply through individual schemes are required to provide a financial guarantee.

[1] Germany: For producers who choose PAYG for new WEEE, there are collective guarantee solutions available on the market base don reciprocity.
[2] Ireland: legislation does require a contingency reserve for compliance schemes.
[3] Producers are required to pay into the Recycling Fund if not complying through individual or collective systems.
[4] Swedish Environmental Protection Agency is presently not requiring financial guarantee from producers who are members of El-Kretsen.

Germany

Producers must provide an annual financial guarantee to cover the waste management costs of WEEE placed on the market after 13th August 2005 (i.e. 'new' WEEE) in the event that a producer becomes insolvent. Producers are required to provide documented evidence in the event that they claim EEE is supplied to establishments other than private households and in these cases, financial guarantees are not required.

Types of acceptable financial guarantees include an insurance policy or a frozen bank account. Alternatively, a producer can participate in an accepted collective system (based on reciprocity among members where remaining producers guarantee to meet the responsibilities of other member leaving the market) to fund WEEE disposal where their contribution is calculated according to a market-based share as follows:

Guarantee (€) = EEE placed on the market × Expected return rate in % × Expected WEEE costs (€/tonne)

The guarantee would be activated when the last producer of a collective system leaves the market. Under an individual guarantee, the guarantee would be required over the maximum product life cycle, being calculated in the same way as for the collective system and would be activated when the producer leaves the market.

Ireland

Article 16(2) of the national legislation requires producers to provide a financial guarantee which is able to demonstrate that the full cost of dealing with WEEE will be covered when it is disposed of by the final user. The permitted types of financial guarantees under the regulations are as follows:

- blocked bank account;
- an insurance policy;
- self insurance provided the producer maintains a minimum balance of 15 000 000 Euro or 10% annual turnover of EEE in Ireland; or
- a bond.

However, Article 30 states provides exemptions from Article 16(2) for producers that are members of approved compliance schemes which means that individual producers are not actually required to provide financial guarantees in this situation, even if the scheme itself is obliged to have a contingency reserve (which the legislation does not specify the size required).

Lithuania

Article 3 of the Rules 2006, Nr. 61, provide a range of opportunities for producers and importers of WEEE. When registering, they must submit to the regional department of the Environmental Protection Ministry where they are operating, one of the following documents guaranteeing the financing of his/her WEEE management :

- bank guarantee (Art. 3.1);
- warrant insurance agreement, produced between producer/importer and an insurer, ensuring the fulfilment of WEEE management goals for the current year (Art. 3.2);
- contract or other document witnessing that producer/importer is a member of a licensed organisation (Art. 3.3);
- warrant agreement between producer/importer and a waste managing organisation managing specific WEEE (Art. 3.4); and

- three-party agreement between B2B EEE producer/importer, the possessor of this EEE and a waste managing organisation managing specific EEE (Art. 3.5).

United Kingdom

In the UK legislation for the first compliance period in 2007, the only mention of financial guarantees is in fact in relation to the obligation of the operators of compliance schemes rather than for producers of EEE themselves. The operators are required to submit a report to the appropriate authority which will:

> *" (ii) provide a guarantee when placing a product on the market in the United Kingdom that ensures that the operations mentioned in sub-paragraph (b)(i) in relation to the waste from that product will be financed."*

The legislation is therefore uncertain as regards the financial guarantee system – it does not specify one particular system although there is a legal requirement to show capability for dealing with WEEE.

11.2.3 Conclusions on Incentives for Innovation

The literature on incentives for innovation is inconclusive as regards the effects of the WEEE Directive in maintaining incentives for product development and eco-design. Numerous studies conclude that environmental legislation has beneficial effects in terms of encouraging producers to design their products in an eco-friendly manner, but there are equal numbers which advocate the opposite conclusion. Conclusions are even harder to draw with respect to the WEEE Directive's influence in particular over producer decisions relating to the design of their products' waste content and recyclability.

Some stakeholders consulted have noted that WEEE regulation is unlikely to affect product innovation.

Consultation with stakeholders has revealed an overall desire to implement Article 8(2) of the Directive more fully and evenly across Member States with respect to individual producer responsibility to strengthen the link between cost incentives for dealing with WEEE and eco-design decisions with respect to products' waste content and ease of recycling. Implementation of individual producer responsibility across Member States is variable with national legislation being different in different Member States as regards the extent to which producers will be responsible for the waste management costs of their own products' WEEE. This situation is further reflected in the requirement for producers to provide financial guarantees for the future WEEE management costs of their products, which further weakens any potential linkage between a producer's waste management costs and any potential incentive to design products with less waste and which are easier to recycle.

11.3 COMPETITION

The Task Specification accompanying the Request for Services requires the study to assess the impacts (to date and potential) of the WEEE requirements on the fair competition both upstream (among EEE producers, their suppliers and distributors) and downstream (in the waste management industry). This requirement involves considering whether and to what extent:

- the exchange of sensitive information among competitors participating in collective schemes may induce anti-competitive practices;
- commercial relationships along the supply chain are altered thereby leading to limitation of competition such as restricting the choice of suppliers or inducing exclusive agreements;
- the systems of producer responsibility as implemented in Member States are discriminatory against SMEs, niche products and new entrants;

- the systems of producer responsibility as implemented in Member States are creating dominant positions in the waste management industry and assess the consequences on waste management costs; and
- free-riding leads to increases in the financing liabilities of compliant companies.

11.3.1 Exchange of sensitive information and altered commercial relationships along the supply chain leading to limitation of competition

The Directorate General for Competition (2007) in its paper on potential competition issues in the waste electrical and electronic sector highlights the potential for anti-competitive practises stemming from cooperation between waste management companies and producers (particularly when there are commonality of costs), e.g. spillover effects, bundling of demand for collection and recovery services, exclusive collection/treatment agreements, etc. It is of note that most of the existing frameworks aim to prevent the occurrence of anti-competitive practices. For example, the DG Paper on Competition states that in order to avoid concentration of waste collection and recovery, transparent and non-discriminatory tender procedures will ensure that the most efficient service providers are chosen.

Respondents to the first consultation questionnaire were asked for evidence of potential competition issues stemming from collaboration between companies in collective waste management schemes. The responses are summarized in Table 11.3

Table 11.3:. Competition Issues

Competition Issue	*No. countries answering*	
	Yes	*No*
Anti-competitive practices with respect to membership of Producer Responsibility schemes		3
Anti-competitive practices with respect to the conditions of membership of Producer Responsibility schemes		3
Restrictions in terms of choice of suppliers of recycling services	1	3
Restrictions in terms of choice of suppliers for product materials		3
Exclusive agreements		3
'Unfair' price setting on the part of Producer Responsibility schemes above the costs required for disposal	1	2
'Unfair' price setting on the part of producers for their products above the costs they might incur in Producer Responsibility schemes		3

The example given by the authorities for 'Restrictions in terms of choice of suppliers of recycling services' is presented below:

- *"For B2C, (the Producer Responsibility Scheme) sends out a tender to waste treatment companies. After the assignment is granted, only those companies then act for (the Producer Responsibility Scheme)."*

Under 'Unfair' price setting on the part of Producer Responsibility schemes above the costs required for disposal" an example provided was as follows:

- *"Some waste management enterprises tried to monopolize collection points within special geographic areas by providing them containers for WEEE without giving the necessary permission for third party service suppliers to transport these containers. The intent was s to force the third party suppliers to subcontract the provider of the container and to get the WEEE to the recycling facilities of the provider. The (country) Competition Authority has started an investigation about these matters."*

Whilst these are individual and anecdotal examples which do not at this stage provide any evidence of a more systematic problem relating to potential anti-competitive practices, it does highlight the risk factor involved and the need to put in place mechanisms to avoid such incidences arising. The risks have been higlihted by a stakeholder as follows:

- *"without competition between collective schemes there is a risk of poor service towards the individual producers. Also we see the risk of a slow development in waste management systems, e.g. due to the difficulty for new players to enter the market and offer innovative reverse logistics and waste treatment services"*

Stakeholders were asked to identify measures which they have put in place to reduce the risk of these types of anti-competitive practices as follows:

- *"An open process for becoming a producer compliance scheme ensures that multiple schemes exist and that there is a competitive market between them."*
- *"Conditions for producer compliance scheme approval require that schemes have viable plans to collect an amount of WEEE in line with their obligations in order to develop working relationships with operators of collection facilities."*
- *"As the orders of the national register for transport and recycling of WEEE are addressed to the individual producer and all the waste management enterprises compete for the contacts to help these producers fulfilling their obligations, there is competition between the producer for the best price and competition between the waste management enterprises for the contracts with a lot of actors on both sides."*
- *"Within the terms of Government approval, compliance schemes are prohibited from engaging in anti-competitive or discriminatory practices. Competition in the WEEE sector ensures that other practices are de facto excluded."*
- *Eliminate high entry or annual fees and open up cooperation between collective schemes and companies avoiding exclusive agreements between trade associations and collective schemes.*

Further examples of actions potentially resulting from anti-competitive practices or resulting from altered relationships along the supply chain which may lead to a limitation of competition were found in the literature review and are highlighted below.

Huisman, J et al (2006) observed the following:

- Retail outlets and municipalities have been observed demanding disproportionate compensation for usage of collection space and their services;
- Retailers charging producers/compliance schemes extra for service/ high fees to make profit on collection or even earning twice;
- Receiving part of the ARF (Advance Recycling Fee) on the one hand and selling waste to brokers instead of the compliance schemes on the other hand. The opposite also occurs: retail and municipalities are refusing to collect discarded appliances;
- Individual or collective Compliance Schemes having 'substantial' overhead costs or using the ARF for building up funds for after the ARF period, or having 'heavy management boards' in place steering single or even multiple compliance schemes with sometimes also overlapping treatment categories;
- Governments (especially those without own producers) imposing high penalties on all kind of compliance details, plus sometimes having contradicting obligation dates;
- Creation of competition differences between producers, e.g. due to different accounting standards between EU, Asian and US producers, or between recyclers due to different environmental standards per member state;

- Recyclers not complying with all strict environmental rules or even engaging in illegal waste exports (through brokers) to non-OECD countries thus lowering the costs of recycling and treatment; and
- The use of an ARF is in some countries not allowed, restricted, only for certain categories, left to choice, or mandatory leading to asymmetry in the compliance cost across industry sectors and potential competition distortion.

The early stage of implementation of the WEEE Directive in many Member States will inevitably mean that the body of evidence for the existence of such practices and impacts on competition is limited. However, the examples above point to the need to ensure that strong monitoring and surveillance systems are put in place by all Member States in order to keep such occurrences to a minimum. Additional information received since the first consultation, in particular from Estonia, highlights the potential for anti-competitive practices, in particular exclusive agreements also between waste management companies operating the public WEEE collection facilities and WEEE compliance systems, thus excluding access to WEEE for competing WEEE compliance system. Indeed, in Estonia a waste management company has been taken to the Competition Board as a result of an exclusive agreement between a waste management company and a collective system.

11.3.2 Systems of producer responsibility vis a vis SMEs, niche products and new entrants

In 2001, RPA in its report to the Commission on the Employment Effects of Waste Management Policies, identified that:

> *...there are over 100 000 small and medium sized enterprises involved in the manufacture and supply of electrical and electronic equipment. The sector, though, is dominated by a small number of large companies that typically account for 80% of turnover and employment. Total employment is estimated at around 1.4 million. Manufacturers are located primarily in Germany, the UK, France, Italy, the Netherlands and Sweden. However, the majority of goods are imported and there are estimated to be several thousand importers. As in the overall EU situation, a small number of manufacturers or importers (30 for white goods and 33 for brown goods) cover 85% to 90% of the market.*

Although the market is characterised by the domination of a small number of large firms, the significant number of small companies involved in the sector, particularly as importers who in many cases take on the WEEE responsibilities of producers, requires the effects of the Directive's implementation on SMEs to be assessed.

Given both the complexity of national level WEEE regulations and their variability across Member States, SMEs are faced with significant challenges in meeting their compliance obligations.

The necessity for a producer to register for WEEE in all Member States where he sells has been highlighted in both the literature as well as by many of the industry stakeholders consulted.

This necessity can cause significant problems as many SMEs are active in distance selling and the administrative burden involved with registering in many different countries, often in different languages, with different procedures and regulations can be extremely high. The burden will be less for the producer when he/she is not an importer. For example, in Portugal, companies need to declare their products by the number of units whilst in others it is based on weight. Such significant differences between registration systems in different Member States can also make it difficult to exchange information across boundaries.

With very limited resources to carry out such tasks in comparison with their larger counterparts which dominate the sector, SMEs carry a proportionately higher burden from having to complete and maintain multiple registrations. The IPTS (2006) study has referred to the 'WEEE Directive overhead' experienced by producers operating in multiple countries as being regarded as unacceptably high, pointing out that "for organisations operating at an EU level, the burden would equate to multiple full time resources whether at central European level and/or in countries to insure proper compliance". The ability of SMEs to allocate comparable resources is clearly limited.

The IPTS (2006) study goes on to quote the example provided by one producer:

> *"Considering 25 Member States plus Switzerland and Norway and multiplying this by 3 (WEEE, packaging, batteries) we have to provide data to 81 recycling compliance schemes. It is therefore essential, especially for SMEs selling in different Member States, that the type of data to be provided to recycling compliance schemes is harmonized throughout Europe wherever possible."*

Given the relatively lower access to information on registration requirements in different countries that SMEs are likely to have relative to their larger globally-operating counterparts, it is quite likely that many SMEs will simply be unaware of the full range of obligations they may have under national level legislation in the different Member States where they operate. The result of this is that they may simply be forced to cease operating in a number of countries or may even end up becoming free-riders.

As well as the administrative burden associated with the differing registration requirements across Member States, SMEs can be disproportionably affected by the existing requirements in several other ways. For example, the relatively higher level of actual registration costs, high annual fees, high levels of financial guarantee, excessive reporting requirements, and so on. These in turn could affect the market structures of niche markets or limit the number of new entrants to the EEE market as highlithed earlier by some of the stakeholders consulted.

The scale of impacts will very much depend on how the schemes have been set up. In the UK for instance, joining a collective compliance scheme minimises the financial impacts on SMEs from registration, since the compliance schemes are required to register and pass on costs to their membership; costs are therefore shared across a greater number of producers. In some countries, registration fees are determined by the turnover of individual companies and for most of the case study countries, the impacts of registration fees on small companies seem to be minimised by a fee structure based on company size (Ireland) or number of products in the market (Germany).

Similarly, the financing systems based on market share for historic WEEE would take into account company size, thus minimising the risk of disproportionate costs. When visible fees are allowed this would also reduce the costs to small companies.

More disproportionate costs could be expected from reporting requirements. The UNU Report assessed the administrative burden from reporting according to the size of producers. The study noted that, based on figures currently being provided by different stakeholders in the same country, both a large multinational having to report on more than 73 sub categories and a medium producer reporting on 2 categories spend the same amount of hours in reporting (about 5). Thus the impact on SMEs is likely to be greater than on big companies owing to their more limited human resources.

Details on the differences in reporting requirements for the focal countries included in this study are elaborated in the section below which focuses on potential barriers to trade arising from the varying implementation of the WEEE Directive across Member States.

As for niche markets, these seem more likely to occur at the end of the process, i.e. in the waste collection and recovery as well as the markets for secondary materials. One of the potential causes of problems for niche markets is through technological externalities related to products. In other words, the complexity of recycling due to the technical characteristics of the recyclable material and products can give rise to specialised markets for recycling and, potentially, anti-competitive practices such as exclusive agreements that limit new entrants.

The low response level from individual companies from the consultation made it hard to ascertain the effects of the Directive on SMEs, niche products and new entrants. Of the companies that did respond in the first consultation, only two companies employed 50 or less people with the remaining companies employing more than 250 employees, and all but three (with a turnover of <€10m) indicated a turnover of more than €50m. Eight of these respondents stated that they had made structural changes to their companies to accommodate environmental legislation and examples of the costs incurred are illustrated in the following table. Larger companies, with their increased personnel and management support resources appear to be in a better position than SMEs to introduce such changes, which gives them an advantage over SMEs in meeting the obligations of the Directive.

Table 11.12: Company Structural Changes made in response to WEEE Directive

Changes Made	*Associated Costs*
Establishment of dedicated WEEE office	
5 additional staff members engaged	
WEEE Administration	10 person years p.a.
IT reporting for WEEE reporting	More than $2 million IT investment, plus 2 people ongoing plus ongoing IT costs
Communications to customers, channel partners, sales teams and other external facing employees	150 person days p.a.
Visible fee administration	90 person days p.a.
Foundation of Producer Responsibility Organisation	90 person days p.a. (more effort during initial set-up and establishment of country entities)
B2B Take back operations	10 person days p.a. Systems in place since 1987

Note: The information above was provided by one company producing refrigerators and one producing PCs, Laptops, Printers and Copiers.

The UK Regulatory Impact Assessment (RIA) concluded that the costs of the statutory instrument should not impact disproportionately on any particular businesses amongst those affected given that producers will incur the majority of costs in relation to their market presence and the weight, type and number of EEE products they put on the UK market (DTI, 2006).

From the communication with some of the stakeholders, it has become evident that when the take back schemes are based on, say, quantities put on the market rather than own brand WEEE, producers lack incentives to innovate; thus, collective responsibility schemes based on market share do discriminate against most innovative products and companies. That is to say, when producers reap the benefits of innovation financially they will be more likely to innovate.

11.3.3 Systems of producer responsibility and effects on the waste management industry

The paper "Concerning Issues of Competition in Waste Management Systems" produced by DG Competition highlighted a number of areas of concern with respect to competition in the electrical and electronic equipment waste management sector:

- General considerations for the setting up of waste management systems for WEEE;
- Cooperation between obliged companies;
- Relationship between systems and obliged companies; and
- Relationship between systems and collection/treatment companies.

Waste Management Systems

Under the first area of concern, DG Competition notes that the Directive provides the possibility for producers to "set up systems on a collective basis to fulfil their collection, treatment, and recovery obligations". The paper further states:

- *"As a general principle, competition between several WEEE waste management systems should be possible. If collective systems are created, it is essential to ensure that they do not lead to unjustified restrictions of competition on the markets concerned."*

The varied implementation of the WEEE Directive across Member States has resulted in the situation where, in some countries, only one compliance system is in operation. This is the situation in Belgium, the Netherlands, Sweden, Luxembourg, Greece, Malta, and Cyprus, and also exists in a number of non-EU Member States in Europe as well (Norway and Switzerland). Okopol et al note that in the Netherlands, where there are actually two schemes operating (ICT Milieu and NVMP), there is actually no competition within product categories for the management of WEEE. These countries invariably had legislation in place to deal with waste electronic equipment prior to the introduction of the WEEE Directive and the compliance systems have been mostly initiated by producers collectively. Whilst there are a range of take-back, collection, treatment and recycling services operating in these countries, with tendering approaches being adopted for the contracting out of different services, the systems in place are the only options for collective compliance.

In other countries where there are multiple competing compliance schemes organised on a collective basis, the main driver has been a desire on the part of national authorities and producers to drive costs for WEEE management down through competition between the different schemes. Under the multiple collective compliance scenario, there is a degree of involvement required on the part of national authorities in the allocation of WEEE responsibilities (carried out in a multitude of ways) but the end result is a situation where at least two schemes are already in existence in Denmark (4), Ireland (2), Italy (6), France (7), Austria (5), Finland (4), Portugal (2), Spain (7), Slovenia (3), Czech Republic (5), Hungary (6), Latvia (4), Lithuania (21), Poland (5), Slovakia (4) and Estonia (3). In Germany, no take back system is permitted where its membership includes an entire product sector and the German Competition Authority has notified producers that that the market share by weight in one type of EEE of producers could not exceed 25%. As a result, logistic firms, waste management service firms and consortia of producers all compete for the WEEE management responsibilities of individual producers. In Estonia however one of the schemes is specialised in lamps (pers. Comm., 2008) although the other two deal with all WEEE categories.

Okopol et al note an emerging trend towards the establishment of multiple collective systems in competition across Europe. This being the case, the concern over the limited numbers of collection schemes leading to increased costs for producers might be one that is less pronounced in the future.

However, at the present time, a number of stakeholders have expressed the view that limited competition between compliance schemes in some countries has led to them facing higher WEEE management costs than might be necessary. Data included in Table 1.4.14 below was provided by one of the producers consulted during this study and shows the cost to producers of managing their WEEE in a range of EU countries.

Table 11.13: Cost of WEEE (in € per unit sold)

	No. of TB Schemes for IT	*PDA*	*Di-Cam*	*Laptop*	*PC*	*Inkjet printer*	*Flat Screen*
Belgium[1]	1	0.33€	0.25€	0.25€	0.50€	0.60€	2.47€
Sweden[1]	1	0.05€	0.10€	1.52€	3.80€	1.33€	3.42€
Netherlands[2]	1	0.03€	-	0.70€	1.08€	0.95€	2.43€
Ireland[2]	2	0.01€	2.00€ (0.02€)	0.21€	0.52€	0.18€	0.48€
Spain[2]	2	0.01€	0.01€	0.20€	0.50€	0.18€	0.48€
Austria[3]	4	0.01€	0.02€	0.39€	0.83€	0.34€	1.49€
France[3]	3	0.01€	0.03€	0.45€	1.00€	0.25€	1.00€
Germany[4]	>12	0.01€	0.01€	0.15€	0.38€	0.12€	0.33€

1: includes collection, treatment, communication and contribution to municipal costs

2: includes collection, treatment and contribution to municipal costs

3: includes collection, treatment, communication, clearing-house and contribution to municipal costs

4: includes collection, treatment and clearing house.

The table illustrates that the costs of dealing with WEEE seem to be higher in those countries with fewer take-back schemes and lower in those countries with a higher number of available take-back schemes. Germany, for example, has the lowest costs per unit. The figures do, however, need to be treated with caution since other factors in addition to competition between a number of take-back schemes may also provide contributory factors to the differences in costs, e.g. the availability of infrastructure, the fact that cost elements such as communication and contribution towards municipal costs are not included in some countries.

Elextrolux, in its response to the Information Gathering Exercise for the revision of Directive 2002/96/EC (WEEE) in 2006, also provided figures for varying costs of dealing with WEEE in different Member States in line with those provided above:

> *"Looking at the current cost structure for recycling services across Europe it might look as the common market didn't exist. As an example, the so-called visible fee for large domestic appliances (not including refrigerators and freezers) varies between Member States from 1,26€/appliance in Austria to 5,34 in Belgium to 16,50 in Ireland. For refrigerators and freezers the visible fee varies from 6,21 to 25,33 €/appliance"*

ERP (European Recycling Platform) in its submission to the Commission for the same information gathering exercise provided the example of NERA (Nordic Electronics Recycling Association) as illustrating, on the one hand, the advantages of a pan-European compliance system and, on the other hand, the importance of competition regarding costs. ERP stated that Setting up NERA as a competitor to the existing compliance scheme achieved clear cost reductions, with the take-back cost of NERA members being reduced significantly (e.g. Hewlett-Packard's cost are >65% lower than with the compliance scheme they used before).

Relationships between obliged companies, between systems and companies and between systems and collection/treatment companies

The DG Competition outlined a number of areas with respect to the relations between the different actors in the WEEE management chain, highlighting good practice and areas for concern. These are summarised below.

- *Relationship between systems and obliged companies:*
- *Collective systems should apply objective, transparent and non-discriminatory conditions as regards membership criteria and with regard to fees levied by the system. Fees should reflect the costs of the collection and recovery. The fee structure of a dominant system can be abusive if it offers rebates designed to attract the entire amount of packaging of an obliged company. Also, systems should not generally oblige companies with an "all or nothing" rule for tying what are severable services.*
- *Relationship between systems and collection/treatment companies:*
- *To the extent that systems contract with only one collection/treatment company, an exclusive contractual relationship in favour of the collection/treatment companies arises. In cases where exclusivity may be justified, tender procedures will have to be carried out.*
- *However, economies of scale for the collection and recovery of WEEE may play a more important role…….. Transparent and non-discriminatory tender procedures will ensure that the most efficient service providers are chosen.*
- *As a general principle, systems should not prevent collectors, treatment or recovery companies from deciding on the marketing of the reusable parts and the secondary material owned by them. However, limitations of their choice may be justified to ensure or improve recovery*

The IPTS study in 2006 identified a number of differences in the resulting implementation in Member States relating to the relationships between different actors along the overall WEEE management chain which have implications in the areas described above:

- The study noted that schemes tend to outsource the majority of their transport and treatment activities to commercial suppliers on the basis of 2-3 year competitively tendered contracts, but that the number of recycling and transport providers varies significantly by country. It provided the example of El Kretsen in Sweden which used at the time a total of 33 directly contracted service providers, while in contrast, ICT Milieu in the Netherlands was using a single supplier.
- Recupel in Belgium and NVMP in the Netherlands retained an in-house logistics capability where all WEEE entering the system is logged and co-ordinated via a central control point. Recupel has invested in a limited in-house transport and collection capability. Others, such as El-Retur in Norway and ICT Milieu have out-sourced all logistical, as well as transport and recycling functions.
- Several of the schemes, conscious of the growing concentration of power amongst recycling and transport service providers, insist on issuing separate contracts for recycling and transport/logistics. One scheme manager indicated that it would be cheaper to negotiate a single transport/recycling contract with one service provider for the entire country, but that this posed unacceptable dangers with regards to the competitive position in future tender negotiations. As a result, most use multiple recyclers and transport firms, chosen on the basis of regional and/or technical specialisation. Those schemes that use multiple recyclers and transport firms, and that have been through a process of competitive tendering, have managed to control and reduce costs substantially. Schemes such as ICT Milieu that operate through a single supplier have failed to deliver similar reductions in contract costs.

- Many countries allow a considerable level of autonomy for local authorities to decide the level of service that they provide to local households between the household and the municipal collection facilities. In Denmark, for example, the 'local communities' can define what level of service they provide, and whether small enterprises can also make use of municipal facilities designed for household WEEE.

Tojo (2003), referencing Gulvik (2003), provided the following example to illustrate the dangers associated with situations where a single compliance schemes exists for a certain product and its strong negotiating power can be used to prevent the development of other systems by producers:

> *"a company that provides services related to the collection and recycling of used ICT in Sweden, wishing to establish an alternative collection system, requested consultations with municipalities. The consultations were refused on the grounds that a PRO that represents the majority of EEE producers had already established collection depots. After 9 months of strenuous communication efforts to the municipalities, as well as consultation with the national environmental agency, some of the municipalities finally started to respond, and came to an agreement with the company. The company has now established 100 collection points where the products of their members can be returned, separated from the rest of the WEEE "*

Electrolux (2006) also provided the example of Portugal where it stated that national WEEE legislation requires producers to sign a 5 year contract with a recycling system. The consequence of this, Electrolux argued, was that producers would be saddled with the costs/prices set by the scheme for the whole 5 year period, even though they might be able to secure better terms and conditions in other schemes.

The DG Competition Paper notes, with regard to WEEE, that although in some cases there may be a single service market for the management of WEEE for the provision of collection, treatment and recovery services, it seems more likely that some of these services will be carried out by different operators (say collection by municipalities and treatment/recovery and sale of secondary products by specialised operators). The analysis from the different case study countries showed indeed that the different services tend to be quite divided up. The RIA by Defra (2006) noted, in its competition assessment, that albeit *there are some major businesses operating in the white and brown goods sectors, there appears to be a significant number of players, which has increased in recent times.*

Whilst the conclusions emanating from consultations with national authorities must be tempered with caution due to the low response rate and the fact that the WEEE Directive has only been in effect for a limited period of time, one authority has indicated that the market for recycling services does appear to have become more concentrated. Whilst this in itself is not a problem and may be the result of economies of scale, it is highlighted as a risk factor in terms of ensuring that there is a competitive market for recycling services. The table below shows the response from one of the National Authorities, which reveals a reduction in the number and increase in the size of recycling companies since the introduction of the Directive.

Table 11.14: Size and number of recycling companies

Changes in Size and numbers of recycling companies	*2003*	*2004*	*2005*	*2006*	*2007*
a) No. of companies has increased					
a) No. of companies is the same	X	X	X		
a) No. of companies has decreased				X	X
b) Size of companies has increased				X	X
b) Size of companies is the same	X	X	X		
b) Size of companies has decreased					

Three national authorities provided an overall indication of the extent to which the system of producer responsibility implemented in their countries had resulted in some waste management companies dominating the market. The results are presented in Table 11.15.

Table 11.15: Waste management companies dominating the market

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	1	1	1	

Note: The UK indicated that this question was not answerable since producer responsibility will only come into force from 1 July 2007

Again, whilst the low level of responses is inconclusive from a statistical point of view, the risk of market domination by a limited number of recycling companies was highlighted by a country with only one producer scheme which indicated that some waste management companies were felt to be dominating the market.

11.3.4 Free-riders

The question as to whether or not free-riding or non-compliance with the WEEE Directive has led to increases of the financing liabilities of compliant companies is a difficult one to answer since, by definition, free-riders are operating outside of the regulations and therefore their numbers and the degree to which they are free-riding (be it through non-registration, declaring fewer product types or lower levels of products being placed on the market) can only be estimated.

The IPTS study (2006) provided an estimate of the level of free-riding in some EU countries and the table below (reproduced from the IPTS report) suggests a figure of between 10% and 20% by volume of products placed on the market.

Table 11.16: Established compliance schemes in Europe: participating members and estimated free-riders1

Country	*Scheme*	*No. of participating members*	*Estimated Free-Riders (% Market Volume)*
Belgium	Recupel	900[2]	10%
Denmark	Targeted Tax	278[3]	n/a[4]
Netherlands	ICT Milieu	178	10-20%
	NVMP	400	10%
Norway	El Retur	675[5]	15-20%
Sweden	El Kretsen	500	10-15%
Switzerland	SWICO	250	10-20%

[1] As indicated by PROs in face to face interviews (2003 data)
[2] Several producers belong to more than one sector scheme. There are 1475 affiliations in total.
[3] Local Municipalities – No producer responsibility
[4] Denmark has recently made illegal for enterprises (distributors) to buy EEE products from producers/importers who have not registered with WEEE-system.
[5] Figures refer to Elektronikkretur (514) and Hvitevareretur (161) respectively

The countries included in Table 11.16 all had established schemes prior to the introduction of the WEEE Directive and it might be assumed that in being more established, they had wider knowledge of their sector and the operators within it. It is quite likely that with the introduction of producer compliance schemes in a delayed and often rushed manner in the rest of Europe with the advent of the WEEE Directive, and many schemes newly set-up without the experience of those in the countries examined in the table, free-riding today could well be higher than the figure of 10-20% suggested. Equally, the competent authorities in Member States where schemes had existed prior to the introduction of the WEEE Directive will also have had more experience in monitoring compliance of producers and in detecting free-riders. With the new systems operating in most European countries, one of the key issues regarding cost effectiveness and equity will be the ability of competent authorities to establish and operate effective enforcement systems. Poor enforcement will inevitably lead to a situation where some operators will be forced to cover the costs of those who do not which will contribute to a reduction in the competitive position of compliant companies.

The IPTS report also concludes that:

> *Member States will also need to ensure that financial guarantees for recycling are provided by all producers when placing a product on the market, as stipulated in the Directive. This is essential in avoiding the remaining producers financing the recycling of products from "free-riders" who have disappeared or cannot be identified.*

The majority of companies consulted indicated that there is currently a problem with free-riders either not registering or incorrectly declaring the amount of electrical and electronic equipment that they place on the market. 70% of respondents stated that they felt that there was a problem. Only one company was able to provide a very general estimate of the scale of the problem, suggesting that between 2% and 10% by volume of product, in the EU is placed on the market by freeloaders. This was qualified by saying that it depended on the country in question but no information was provided on a country by country basis. Another company stated that:

- *"It is a huge potential problem, fostered by and because of the different levels of WEEE implementation and enforcement throughout the EU."*

Another stated it was:

- *"Impossible to estimate with any level of accuracy."*

Consultation responses from National Authorities confirmed the difficulty in currently placing estimates on the levels of free-riding. Responses from those authorities providing responses are shown in Table 11.17.

Table 11.17: Free Riders

Country	% of free-riders
Belgium	5-10% for B2C and 10-15% incl B2B
United Kingdom	Unknown
Germany	Reliable information is not yet available; the estimates currently differ from 0-5% to >30%.
Lithuania	No response
Ireland	5-10%

With the large percentage of companies feeling that free-riders are a significant issue and this being a significant factor in the success of the legislation, measures will need to be enforced in Member States in order to ensure that the problem is kept to a minimum. The fact that the policing of free-riders is costly will need to be born in mind when assessing any proposals to be made for future revisions of the Directive. Companies were asked to identify potential solutions to the free rider issue and comments received were as follows:

- *"Improved market surveillance and enforcement of legislation."*
- *"Enforcement of WEEE on free-riders need to become a focus of the authorities to ensure fair cost allocation."*
- *"The real extent will only become visible when enforcement is strict and unified."*
- *"Increased market surveillance."*
- *"Revise the Directive to clarify the fundamental issues of Scope and the definition of 'Producer'. Once clarified, these definitions must be harmonized throughout the EU."*

The Bio-Intelligence Synthesis study suggested that one possibility for addressing the free-rider issue might involve attributing some obligations to the wholesalers and distributors to keep a check on registration to the national registry and that distributor based control has the advantage of "tracking" even producers originating from outside EU.

Okopol et al confirmed that in Ireland, *"retailers have been allocated a considerably large role in the EPR system through specific provisions in the legal text. Under the definition of producer, retailers are listed as obligated producers if they sell products from producers who are deemed as not to have registered. Moreover, they are not allowed to sell products from entities not registered as producers. This provides a mechanism in which retailers would play an important role in monitoring the registration of producers, and thus would contribute to the reduction of free-rider problems."*

11.4 COMPETITIVENESS AND TRADE ISSUES

The task specification requires the study to assess the impacts of the WEEE Directive on global trade flows, in particular to assess whether and to what extent the regulation is inducing a segmentation of the global market, as major world markets start to be regulated in different ways.

As with other parts of the study, the recent implementation of the Directive in Member States, combined with the fact that there are numerous other external factors influencing global trade (both legislative and economic) make the attribution of any observed changes in global trade flows to the Directive itself extremely difficult.

However, the available literature and consultation with stakeholders at industry and national authority levels on the Directive's different interpretation and implementation across Member States has identified a number of important issues which have the potential to influence global trade. As well as affecting trade between the EU and other countries, many of these issues are also deemed to have significant impacts on trade between Member States themselves i.e. on the internal market.

The IPTS study (2006) highlighted a series of areas of the WEEE Directive likely to have an influence on global and intra-EU trade as follows:

Market Distortion

Differences in legislation and WEEE operation between countries were highlighted as having the potential to distort competition in EEE between neighbouring countries. The potential for such distortions are higher where the number of products placed on the market is high and where the costs of meeting producer obligations under the Directive represent a significant proportion of the cost on the market.

However, as has been shown above, this may not affect all categories of EEE and is often not considered to be high by a number of producers.

Differences in implementation of the WEEE Directive, in terms of definition of scope etc. have also been identified as providing significant barriers to trade by stakeholders consulted during the study. The resulting costs associated with having to comply under multiple systems in a number of countries will likely be significant for smaller companies, but larger companies have indicated that overall WEEE costs (of which such costs only represent a very small part) are in themselves not sufficient to deter a company from placing products on the market in several countries or even a factor when deciding to operate in countries with more stringent, complicated or expensive systems of producer registration and responsibility.

This is demonstrated by company questionnaire responses in the first round of consultation. When asked to indicate the extent to which they agreed with the statement "National legislation on dealing with waste in different countries is a significant factor in influencing my company's decision on where to place products on the market", responses indicated that the different legislation in different countries did not significantly impact on decisions to put products on the market.

Table 11.18: Affects of national legislation on selection of markets

Strongly Disagree	4	**Disagree**	2	**Neutral**	2	**Agree**		**Strongly Agree**	

Four of the six companies responding in the second round of consultation similarly indicated that national legislation on dealing with waste in different countries had no influence on their decisions on where to place products on the market, with one of the remaining companies not providing a response and the other stating that the difference in regulations had affected their decision to operate in different countries due to the fact that there was a reluctance on the part of their customers to take on legal responsibility for placing products on the market.

Market for primary and secondary materials

The IPTS study notes that creating a market for reprocessed material and low grade WEEE depends on the standardisation and definition of graded materials and that this is essential to ensure intra EU competition for recycled products. It goes on to say that the bulk of WEEE (70%) is low grade plastic which has a low economic value (10% of reprocessed white good) and if sorting fees and registration fees are not set to reflect this, recycling facilities will not be encouraged to trade in and to recycle low grade material. It concludes by recommending that restrictions of the marketing of secondary materials should be kept to a minimum to ensure that the market functions adequately.

Overseas SME importers into EU

SMEs are unlikely to have the access to information resources that their larger counterparts have, with the likely possibility that a large number of SMEs remain unaware of the details of new legislation and their obligations there-under. This is particularly likely given the complex situation that has arisen with different interpretation and implementation of the Directive across Member States. The IPTS study suggests that this situation could lead to many overseas SMEs ceasing trading to the EU until they have identified and complied with the new requirements. The same can be said of SMEs within the EU as they struggle to identify and come to terms with the myriad of transpositions of the Directive in Member States national legislation.

Producer vs Distributor

IPTS notes that under the WEEE Directive, distributors can also be considered producers and have the same obligations to register in Member States as having the responsibility to take back and treat WEEE. Consequently, they may renegotiate their agreements to include cost sharing with overseas producers and may also require some non-EU firms having to set up a legal entity in the country where they wish to sell their products instead of dealing with a distributor. Where a Non EU firm already has a subsidiary in Europe, they are likely to have access to greater information on the regulations in force in that country and consequently be at an advantage over the companies that sell via distributors and agents.

Standards

The IPTS study also noted concerns that within the EU, certain countries might seek to gain competitive advantage by applying only minimum targets and deploying minimal oversight of recycling and treatment standards. Harmonisation and application of best practice across the EU would avoid the distortion of competition in the EU internal market and a level playing field should be ensured, before setting a more ambitious collection, recovery and recycling regime. In addition to these potential areas for concern above, Perchard, D. et al. Reiterates the fact that there are significant differences in national registration and reporting requirements for the WEEE Directive across Member States, and these give rise to serious administrative costs and thus to barriers to trade for imports. The Okopol et al study provides a comprehensive analysis of the reporting systems in place for a selection of countries and a summary of the overall provisions in the table repeated below.

Table 11.19: WEEE Reporting Requirements

Member State	Reporting Frequency		Categories/ Type of Equipment	Product Data
	B2C	B2B		
Austria	Quarterly	Quarterly	5 collection categories	weight
Belgium – Collective System	Monthly or Quarterly	Monthly or Quarterly	7 categories, plus subcategories	Units – (B2C) Units & Weight (B2B)
Bulgaria	Quarterly	Quarterly	WEEE Annex 1A & 1B	weight & units
Cyprus				
Czech R.	Annually	Annually	WEEE Annex 1A & 1B	Weight, units & brand name
Denmark[1]	Annually	Annually	WEEE Annex 1A	weight
Estonia	Quarterly 2006, Annually 2007	Quarter 2006, Annually 2007	WEEE Annex 1A	weight & units
Finland	Annually	Annually	WEEE Annex 1A	weight & units (if possible)
France	Bi-Annually	Bi-Annually	WEEE Annex 1A, 1st four number of customs code	weight & units
Germany	Monthly	Annually	WEEE Annex 1A & Type of Equipment List	weight & units
Greece (national collective system as register)	Monthly	Monthly	WEEE Annex 1A	weight & units
Hungary	Annually	Annually	WEEE Annex 1A Categories	weight
Ireland	Monthly	Monthly	WEEE Annex 1A plus 21 sub-categories	weight & units
Italy	Annually	Annually	WEEE Annex 1A, 1B	weight & units
Latvia	Quarterly	Quarterly	Both 99 custom code categories and	weight & units

Member State	**Reporting Frequency**		**Categories/ Type of Equipment**	**Product Data**
	B2C	**B2B**		
			15 Natural Resources Tax categories	
Lithuania	Annually	Annually	WEEE Annex 1A	weight
Luxembourg (Individual compliers register with Administration de l'Environnement)	Annually	Annually	Variation of WEEE Annex 1A with 43 sub-categories	weight & units
Luxembourg (national collective scheme as register)	Quarterly: if annual cost exceeds € 500 Annually: if annual costs are less than € 500	Not applicable	Variation of WEEE Annex 1A with 43 sub-categories	units
Malta				
Netherlands (Individual compliers)	Annually	Annually	WEEE Annex 1A	weight & units
Netherlands (NVMP as register for Members)				units
Netherlands (ICT Milieu as register for Members)	Quarterly	Quarterly Annually	Category 3 only	weight & units
Poland	Quarterly	Quarterly	WEEE Annex 1A, 1B & national customs code	weight & units
Portugal	Bi-annually	Bi-annually	List of 250 product types	weight & units
Romania	Annually	Annually	WEEE Annex 1A & 1B	weight & units
Slovakia	Annually	Annually	National customs code	weight & units
Slovenia	Quarterly	Quarterly	470 custom tariff codes identifying 1500 EEE items	weight & units
Spain	Quarterly	Quarterly	National Register list of products – 103 sub-categories	weight & units
Sweden	Annually	Annually	WEEE Annex 1A	weight
UK (based on legislation)	Quarterly	Quarterly	WEEE Annex 1A, plus additional sub-categories for display equipment, cooling appliances containing refrigerants and gas discharge lamps	weight, & units

[1:] It has been noted that collective schemes in Denmark asks for monthly reports on a higher number of categories than the 10 in the Directive.

Okopol et al state

> *"By far the largest concern raised by industry stakeholders is the lack of harmonisation between the administrative functions of the national producer registers. Actors claim that the lack of clear guidance by the Commission with respect to key definitions has created a situation where producers must adhere to up to 27 varying requirements for reporting. Member States have developed their systems independently with little communication and exchange of information between and among them. "*

A number of concerns have been raised relating to the varied approaches to registration and reporting in Member States:

- Reporting Periods (frequency of reporting);
- Reporting Formats;
- Associated administrative costs;
- Lack of a common definition of weight;
- Criteria to distinguish B2C vs. B2B EEE which will end up as WEEE;
- Definition of “put on the market” ; and
- Who can register/report as the producer.

The first three categories of issues all have implications for producers in respect of the burden associated with reporting. The many different reporting periods and formats across Member States mean it is very difficult to integrate reporting activities for companies operating in a number of Member States, requiring them to duplicate efforts and spend a lot of time and money (in IT systems for example) to accommodate the collection and collation of all relevant information. This then has implications for the third category, namely the costs involved in fulfilling the reporting requirements. As mentioned earlier in this report, the relative position of SMEs to cover these costs and their relative importance in SME producers’ overall costs means that their burden is relatively higher.

The second set of four categories have implications in terms of who bears the cost of WEEE compliance and how much that cost will be, which is more significant from a competition point of view.

Brief summaries of registration and reporting requirements existing in the 5 focal countries are set out below to illustrate the range of approaches adopted.

Ireland

Registration.

Producers are required to register (annually) and pay fees and display a registration number on all documentation issued to distributors. Those producers that do not register are not permitted to place products on the market and distributors are not permitted to sell products from producers that cannot prove they are registered.

Producers have to report monthly the number of units placed on the market and are then invoiced, also on a monthly basis, by the scheme they are a member of for the approved Visible Environmental Management cost

Registration carries a registration fee determined by (in 2007) a producer’s turnover as follows:

Table 11.20: Registration Fees in Ireland

Company Turnover	Fees
< € 250,000	€ 250
< € 500,000	€ 500
< € 1,000,000	€ 1,000
> € 1,000,000	€ 2,000

Reporting

Reports must be submitted on a monthly basis by producers and include information on the categories of WEEE (including sub-categories and in some cases product types) put on the market, the number of products sold, total weight of the products sold and to which group (B2C, B2B or unknown) the products were sold. Okopol et al has pointed out that there appears to be some difference in interpretation even within Ireland on the definition of B2B. WEEE Ireland (one of the compliance schemes) apparently takes the view that if a product can be "sold to or used by a consumer", it counts as B2C, whereas the competent authority, the Department of Environment, Heritage and Local Government considers dual use products can be classed as B2B if a producer takes back WEEE on a 1:1 basis. Also, if the buyer agrees to transport the WEEE and producer agrees to finance the recycling, it can also be classed as B2B

Germany

Registration

Registration fees are approved by the Ministry of the Environment and were reviewed in 2006 with smaller producers being exempt if they met criteria relating to the weight of products being put on the market. A rather complicated schedule of registration fees has been approved and the table below has been extracted from Okopol et al.

Table 11.21: Registration Fees in Germany

Measures Subject to Fees	**Fee (Euro) July 2005**	**Fee (Euro) Jan. 2007**
Registration		
Basic Registration Per producers, fist brand and first type of equipment	155	150
Supplementation of the basic registration according to No. 1.01 For every additional brand including one type of equipment and every additional type of equipment belonging to a brand	85	80
Update of quantitative data on existing registrations according to Nos. 1.01 and 1.02	100	95
Detailed review of an individual producer guarantee per producer, first brand and first type of equipment	455	300
Detailed review of a guarantee based on a Clearing House certified producer guarantee system Per producer, first brand and first type of equipment	545	270
Extension of a proven guarantee according to Nos. 1.04.a and 1.04.b. to another type of equipment per producer for every additional brand including one type of equipment and every additional type of equipment belonging to a brand	90	85
Change or annual update of a proven guarantee according to Nos. 1.04.a, 1.04.b or 1.04.c concerning the quantity and evaluation for an unchanged type of equipment per change or per update	215	193
Change of other guarantee data per change made	90	85

Reporting

Producers are required to report on sales of products to consumers on a monthly basis whereas reporting on B2B products is annually. Reporting on treatment and recovery is also required on the basis of annual reports for both B2C and B2B.

Reporting is based on Annex 1A of the WEEE Directive and a predetermined list of Type of Equipment (TOE) categories.

A product will be classed as B2B if evidence is produced to demonstrate that it will not appear in the municipal waste stream and this evidence will be required by the registration authority.

Lithuania

Registration

In Lithuania, producers are required to register annually and prior to placing any products on the market. A certificate of registration is included in the registration process and producers are required to be registered in the on-line list of producers and importers published by the Environmental Protection Agency.

There is, however, no charge for registration in Lithuania.

Reporting

Producers are required to report annually by the 31st of January for the previous year and must report the actual quantity of products placed on the market during the year. These reports can be submitted on-line and details required include the weight of each category of Annex 1A of the WEEE Directive, with weight not including non-electrical and electronic accessories, batteries and packaging.

B2B and B2C classification is done on the basis of self-declaration by producers.

Belgium

Registration

Administrative procedures related to the environment are dealt by the three regional authorities i.e. OVAM (Flanders), DGRNE (Wallonia), IBGE (Brussels). All three have their own regulations on WEEE which have been amended to complete transposition of the WEEE Directive.

Currently, there is no national registration for WEEE compliance at the federal government level. Registration is done through the regional authorities or an Entry Agreement with Recupel (compliance scheme). Registration with environment agencies of the three regions is free of charge and is required by individual compliers that do not sign up to Recupel.

Reporting

In Flanders, producers and importers must provide OVAM, yearly, with the following information for each WEEE category (by 1 July):

- the amount of EEE (by weight) placed on the Flemish market;
- the amount of WEEE taken back in the context of the take-back obligation;
- treatment facilities contracted and treatment methods used; and
- quantities of WEEE recycled, recovered, incinerated or disposed of.

In Wallonia, producers must report waste management data to the Walloon Waste Agency. Retailers have to be prepared to provide information at the Agency's request. Reporting requirements have been aligned with the Directive: quantities of equipment, their components or materials/substances placed on the market (in kg), quantities collected, quantities entering and leaving pre-treatment facilities, and the treatment facilities used.

United Kingdom

Registration

In the UK producers have the following obligations:

- registration shall be with the appropriate environment agency1 either directly or through an approved producer compliance scheme. Joining a Producer Compliance Scheme (PCS) has the benefit that it discharges the obligations as a producer of EEE, for example, registering as a producer, reporting data on EEE put on the UK market, and financing any costs of collection, treatment, recovery and disposal of WEEE in line with the notified obligation;
- the marking of EEE put onto the UK market to assist with its separate collection at the end of its life; and
- making information available to treatment facilities in respect of new types of EEE put on the UK market.

Registration in the UK can be via a collective scheme[2] or individually. A producer can set a private WEEE compliance scheme to register directly with the EA. This has the same administration requirements of all WEEE compliance schemes and would cost £12,174 to register for a 3 year period as well as the producer registration fee. Producer annual registration fees are:

- £30 for Non VAT registered companies;
- £220 for VAT registered companies with a turnover below £1 Million; and
- £445 for companies with a turnover above £1 Million.

A Producer Compliance Scheme would register and report on behalf of its members with the £12,174 spread across the membership of that WEEE compliance scheme. The WEEE compliance scheme would then charge individual producers a joining fee, normally based on company turnover, and subsequently they would charge for all the collection/recycling undertaken on behalf of that producer. The registration fees are the same as those mentioned above.

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[1] SEPA or EHS as it applies.

[2] Producers will not be able to join more than one scheme to meet their obligations under the Directive and will not be permitted to change scheme membership part way though a compliance period.

Reporting

When a producer joins a Compliance Scheme they will be asked for data on the types and quantity of EEE placed on the UK market during 2006. The environment agencies will then be able to calculate that producer's market share and, in turn, the market share of their Producer Compliance Scheme. The environment agencies will also receive quarterly reports from the Schemes to confirm how much WEEE has been collected from Designated Collection Facilities and how much new EEE has been placed on the market. This data will be used to calculate each Scheme's financial responsibility for treating and recycling household WEEE.

Producers or their Schemes will also need to provide evidence to the environment agencies at the end of each compliance period to monitor their ability and capacity to meet their treatment and recycling obligations. The evidence will come from approved Authorised Treatment Facilities (ATFs) and approved exporters of WEEE.

12 LEGISLATION COVERING WASTE ELECTRONIC AND ELECTRICAL EQUIPMENT IN THIRD COUNTRIES

12.1 CHINA

China is the destination for a substantial proportion of WEEE from developed countries, ostensibly exported to developing countries for re-utilisation. The majority of WEEE in China is processed in small workshops using basic methods such as manual disassembly and open incineration where the appliances are stripped of their most valuable and easily extracted components and materials, while the remainder is dumped. The most prominent areas for the small-scale, unlicensed processing of WEEE are in southern and eastern China.

The international and domestic attention given to the processing of WEEE in southern and eastern China has drawn responses from the central and local authorities in China. In Taizhou, for instance, the city government has attempted to regulate and control its WEEE processing enterprises and the processing of imported waste and domestically produced WEEE is moving towards a system of fixed-point processing parks. These are government-established industrial parks, where processing enterprises can set up regulated recycling and disposal businesses. The Taizhou Environmental Protection Bureau (EPB) states that Taizhou now has 42 fixed-point waste processing enterprises capable of processing waste including WEEE.

As for the central government, three major, national-level pieces of legislation have also been drafted. These build upon and strengthen earlier regulations on the prevention of pollution from solid waste and the import of waste, which have proven insufficient for the management of WEEE. Prepared by different government agencies, the three new legislations focus on different stages of WEEE management, with two draft laws in a similar format to the two EU directives on WEEE and RoHS, and a third technical policy providing guidance for the State Environmental Protection Administration's (SEPA) management of WEEE. These are described below.

The draft ordinance on the management of waste household electrical and electronic products recycling and disposal

The National Development and Reform Commission (NDRC) began preparation of this law in 2001, including research, workshops, and the initiation of a pilot programme to trial WEEE management measures. The major content of the draft includes:

- the establishment of a special fund to assist in the financing of WEEE recycling and disposal;
- the use of positive measures to encourage the establishment of WEEE recycling and disposal enterprises, as well as support the development of relevant technology, methods and education;
- the implementation of extended producer responsibility (EPR), obliging producers to cover the costs of collection, recycling and disposal. Their responsibilities will include using designs beneficial to recycling, choosing non-toxic, non-hazardous substances and recyclable materials, and providing information to aid recycling. Appliance retailers and service providers will also be obliged to collect WEEE from consumers; and
- the establishment of standards and a certification system for second hand appliances, and recycling and disposal enterprises, to ensure safety and the environmentally-sound processing of WEEE.

A draft for comments was released in September 2004, and has now been submitted to the State Council (The People's Daily, February 7, 2005). However, the actual date for the official issuance of the legislation remains a matter of speculation.

The draft management measure for the prevention of pollution from electronic products

The National Ministry of Information Industry (MII) began drafting this law in 2002. It aims to reduce the hazardous and toxic substances and materials present in electronic appliances, and to reduce pollution caused by the production, recycling and disposal of these products. This draft legislation is a counterpart to the EU RoHS directive, including:

- restrictions on the use of six hazardous substances in electrical and electronic products: lead, mercury, chromium IV, cadmium, PBBs1 and PBDE2;
- requirements for green product design; and
- requirements for producers to provide information on the components and hazardous substances present in their products, as well as on safe use and recycling.

The legislation was finally adopted in December 2005 and came into force on the 1st March 2007. The first products to be covered have been published in a catalogue that will be revised annually. It covers not only products but most electronic components and sub-assemblies. It applies to products sold in China, and not those exported. All products coming under the legislation must be tested for compliance before they can be sold to authorized testing laboratories.

The technical policy for the prevention of pollution from waste electrical and electronic products

Drafted by SEPA, this technical policy was approved at an expert meeting in September 2004. The goal of this policy is to reduce the overall volume of WEEE, to increase the re-utilisation rate and standard of WEEE recycling, and to reduce negative environmental impacts. It includes content on:

- green product design and green product labels;
- the management of WEEE collection, storage, recycling and disposal;
- the encouragement of research and development of technology and equipment; and
- the formulation of associated national policies and standards.

China's draft WEEE and hazardous substances legislation has drawn cautious responses from stakeholders, such as the electrical and electronic equipment manufacturing industry. Although the improvement of environmental standards is recognised as an opportunity to promote the technological advancement and competitiveness of Chinese industries, there are major concerns about how the future WEEE management system will be financed and enforced. The manufacturing sector claims to have too small a profit margin to bear the increasing costs of green design, testing and recycling. Recyclers are also worried about the high costs of purchasing WEEE in China, and the lack of preferential policies for recycling and disposal companies. In addition, enforcement of legislation is already a contentious issue in China, where government departments have limited resources for monitoring and control.

The main pieces of legislation in China are summarised in the following Table.

Table 12.1: Overview of China's national WEEE management-related legislation

Law on the prevention of environmental pollution from solid waste (SEPA)	Disposal of municipal and industrial solid waste; use of solid wastes as raw materials	Effective from April 1, 1996.
Notification on the import of the seventh category of wastes (SEPA)	Ban on the import of the seventh category of waste	Effective from February 1, 2000.
Notice on strengthening the environmental management of WEEE (SEPA)	WEEE processing to meet the requirements of the Law on the prevention of environmental pollution from solid waste; generation of WEEE to be reported to local Environmental Protection Bureaus (EPBs).	Issued August 26, 2003.
Ordinance on the management of waste household electrical and electronic products recycling and disposal (Draft, NDRC)	Mandatory recycling of WEEE, based on extended producer responsibility; certification for 2nd hand appliances, and recycling enterprises.	Submitted for approval to the State Council in early 2005.
Management measure for the prevention of pollution from electronic products (Draft, MII)	Restrictions on the use of hazardous substances; green product design; provision of information on the components, hazardous substances, and recycling.	If approved, effective from July 1, 2005; restrictions to be enforced after July 1, 2006.
Source: different sources in Hicks et al (2005)		

The NDRC is currently implementing a national pilot programme, with the goal of addressing the problems in the draft legislation and the difficulties in establishing a WEEE recycling system.

In 2003, the city of Qingdao and the Province of Zhejiang were selected to implement pilot WEEE management systems and explore different models for WEEE recycling and treatment. In addition, the NDRC (2003) asked that the pilots make use of technology and processes suited to China's circumstances, carry out analysis of recycling costs, and develop relevant technical standards.

Qingdao is host to China's largest appliance manufacturers, such as Hai'er, Aucma and Haixin. The Qingdao Economic and Trade Commission directs the pilot, and will trial a producer-owned recycling plant model, aiming to establish a plant with the capacity to process 600,000 items of WEEE per year. According to the China Business Herald (January 4, 2005), the Hai'er Group is implementing the project, and a total of RMB 80 million (approx. US$10 million) will be invested in establishing the WEEE treatment plant. Of this investment, approximately 15% will be contributed by the government. At this stage, the project has reportedly been put on hold, as it is not clear how the investment will be recouped, and no local WEEE management regulations have been prepared.

The WEEE management pilot in Zhejiang will follow a specialized disposal plant model, with the establishment of a WEEE treatment facility by a specialised company. The agency responsible for the management of the pilot is the Zhejiang Provincial Economic and Trade Commission (ZETC). According to the ZETC (2004), the Hangzhou-based company, DADI Environmental Protection Co. Ltd, has been commissioned to construct a centralised disposal centre, which will make use of a network of collection and recycling points across the province. After its establishment, Zhejiang Province aims to recycle 800,000 units of WEEE each year. At this stage, DADI's recycling and disposal facility will process major appliances, including air conditioners, washers, refrigerators, televisions, and computers, as well as printed wiring boards. Together with the China Home Appliance Research Institute and the China Home Appliance Association, DADI has invested RMB 2 million (US$250 000) in the establishment of an R & D centre. Approximately RMB 100 million (US$12.5 million) will be invested in the centralised treatment facility, which has already obtained approval and begun collecting WEEE. The ZETC has also formulated standards for the certification of second-hand appliances for resale, and a provisional WEEE Management Measure, which came into effect on January 1, 2005. The Measure is broad and temporary, to allow changes once national regulations are in place.

China's changing WEEE processing industry and growing equipment manufacturing sector offers both opportunities and risks for companies. The demand for recycled materials and the potential new regulatory framework are contributing to industrial scaling-up and increased interest among companies in investing in WEEE processing. More formal recycling enterprises are also developing an interest in WEEE recycling and processing in China. Cheap labour and a favourable investment environment have already seen the relocation of recycling business in general from industrialised countries to China. New WEEE recycling and treatment facilities are planned and financed by both governments and private companies for Hangzhou, Wuxi, Nanjing and Beijing, despite the current lack of a regulatory framework for such enterprises. Private sector WEEE take-back schemes are still limited in China, although mobile phone producers have begun to collect waste phones and accessories. Nokia launched its 'Future is in Your Hands' campaign in the Asia-Pacific in 2001, and in China in 2002, with more than 200 recycling bins placed in around 100 major cities at Nokia service centres. At this stage, Nokia China has only collected approximately 0.5 t of batteries and chargers, as consumers prefer to sell old mobile phones on the second-hand market, a common practice in China. Philips has stated it will soon choose a company to recycle its products in China and sponsored the Sino-Netherlands Electronic Waste Recycling Conference in November 2004 (Central TV Economic News Broadcast, November 20, 2004). In addition, Fortune Plastic and Metal Inc. won a contract from Motorola to collect and recycle mobile phones in more than 100 Chinese cities, to be processed at the Jinze WEEE plant in Nanjing.

China's WEEE recycling and disposal market is at an early stage; the need to comply with environmental and technical standards has created a market opportunity for the provision of consultancy to Chinese companies on green design, design for disassembly and testing for hazardous substances. However, the difficulties of operating in an uncertain regulatory environment and competing with China's large and effective informal sector also demonstrate the risks of investing in this field (Hicks et al, 2005).

12.2 JAPAN

The Japanese developments are due to the Japanese Home Appliance Recycling Law which was formulated in the late 90's and enacted in 2001. The law is the basis of EPR programme for four large home appliances (large TV sets, washing machines, air conditioners and refrigerators) and was a response to an increasing scarcity of disposal sites, the increase of EEE in the waste stream, and the inadequate capacity of existing treatment plants (mainly local governments), together with the growing use of EPR programmes abroad. The Law specifies that manufacturers have individual responsibility for their own products.

From October 2003 and as a result of the Revised Law for Promotion of Effective Utilisation of Resources, producers of PCs are required to take-back PCs from households and establish a take-back and recycling system for PCs. The allocation of responsibility in the case of PC producers is different, reflecting the difference between the four large appliances and the PCs (type of customers, distribution channels, existing infrastructure, etc.).

Retailers are the primary actors responsible for collecting the end-of-life products from household to regional aggregation stations. Upon the request of consumers, the retailers are responsible for accepting a) an old appliance when selling a similar new product (old-for-new), and b) an old appliance that they themselves have sold (Tojo, 2003).

Municipalities and designated legal entities collect the products not collected by the retailers. The government appointed the Association for Electric Home Appliances (AEHA) as a designated legal entity. With regard to collection, designated legal entities collect products from remote areas in response to the request of municipalities governing the area or of local residents themselves.

Producers have the obligation to establish the regional aggregations stations and transfer the discarded products to recycling plants. Prominent Japanese manufacturers established two groups, referred to as Group A and Group B, and companies within the two groups cooperate with each other in fulfilling their tasks. As of May 2003, Group A consists of 16 companies, while Group B consists of 14 companies (AEHA, 2003c). Producers that put limited number of products on the Japanese market may delegate their tasks to designated legal entities. Currently, 29 producers belong to the last category (Tojo, 2003).

Producers also have the responsibility to recycle their products either themselves or delegate their responsibility to the third party. In the initial phase, they need to achieve differentiated recycling rate targets on weight basis, which are 60% for air conditioners, 55% for TV sets, and 50% for refrigerators and washing machines. The recycling rate must be achieved by reuse of components or material recycling. Only the recycled materials that have positive or zero monetary value can be included when calculating the recycling rate. Recycling of products whose producers cease to operate in the market (orphan products) is done by the designated legal entity. Producers also have to recycle the ozone depleting substances used as freezing agents in refrigerators.

It is the end users (consumers) who pay for the collection at the time of disposal (end-user-pays). The fee is announced by those who are physically responsible for collection. The majority of the fees per item set by the retailers have been between 500 and 2500 JPY (3.5-17.4 Euro), while in some cases, the set fee is more than 3100 JPY (21.6 Euro). This fee also covers the management of the regional aggregation stations (Takahashi, 2003, in Tojo, 2003). The cost associated with the physical responsibility of the producers (establishment of regional aggregation stations and transport of discarded products from the regional aggregation stations to recycling plants) is covered within the recycling fee (Tojo, 2003).

The total number of products collected in the first year of implementation was 8,538,000 (April 2001-March 2002) while the figure for the second year (April 2002-March 2003) was 10,147,000. The legislation does not set any collection target (Tojo, 2003).

Tojo (2003) provides empirical evidence that EPR law provides tangible incentives for environmentally-conscious design in the case of electrical and electronic equipment (EEE) and cars in Japan. For example, several Japanese EEE manufacturers have made material substitutions to increase the recyclability of their products. Specifically, Hitachi, NEC, Fujitsu, Matsushita and Sony have replaced plastic housings with magnesium alloy for TV cabinets and personal computers, owing to the low plastic recycling results. Similarly, efforts have been made to improve the recyclability of products through material unification and standardisation of types and grades of plastics used in products.

In Japan, there is evidence of advances of eco-design, e.g. 'design for disassembly' and use of 'automated disassembly using smart materials' (ADSM). At least one manufacturer is systematically passing new products through a test recycling system (DTI 2005, in Bio Intelligence Service, 2006).

Another reference mentions that there is intense competition among electronics producers in Japan to eliminate toxic substances and initiate design changes that facilitate reuse and recycling. These initiatives are seen as providing marketing advantages (Fishbein 2002, in Bio Intelligence Service, 2006).

The Japanese system is viewed generally as providing more incentives for design changes as the EEE manufacturers are closely linked to recycling installations (Bio Intelligence Service, 2006).

12.3 UNITED STATES

To date, there is no federal law in the United States that addresses the growing issue of end-of-life electronic equipment management and disposal.

The study conducted by the Basel Action Network (BAN) in 2002 noted that the electronics industry in the United States has, for the most part, moved at a snail's pace in preventing the problem at the source through green, toxic-free, recyclable design. Instead, thanks to the convenient pipeline of export, industry, aided by government, has taken a head-in-the-sand, business-as-usual, for-as-long-as-possible approach, with most of the e-waste being exported to Asia (around 50% to 80% of that collected) (BAN and Silicon Valley Toxics Coalition (SVTC), 2002[1])

However, in 2003, e-waste legislation was proposed as HR 1165, also known as the National Computer Recycling Act, which would require the US EPA to administer a grant programme to aid the establishment of computer recycling programmes in the United States. The legislation called for a fee of no more than $10 on the sale of new computers with exemptions. The bill allowed the administrator of the US EPA to designate additional electronic devices to charge a fee if these devices contained a significant amount of hazardous materials and included a liquid crystal display(s), cathode ray tube(s) or circuit board. Additionally, the legislation called for a study detailing the e-waste problem and current management practices. The EPA administrator would have required to report on the status of computer recycling to Congress every four years. No further information is available on the status of the bill (WRPPN, 2005).

The most current e-waste legislation was proposed in January 2005, HR 425, the National Computer Recycling Act and HR 320, the Tax Incentives to Encourage Recycling Act (TIER). (WRPPN, 2005).

However, some states have implemented measures to deal with electronic waste since 2001. California became the first state to impose an advance recovery fee (ARF) on the sale of electronic products (TVs, monitors (4'' or greater), CRTds, and laptops). Fees are collected by retailers, managed by the state, and used to fund the recycling programme. Products are collected by participating recyclers, through collection events, or city programmes. All computer owners in California can participate.

In Maine, legislation requires computer manufacturers to be responsible for the handling and recycling of computer monitors (CRT and flat panels), TVs, laptops, and central processing units (CPUs) is attached to the monitor. Producers are primarily responsible for the cost of the programme; local governments provide collection. The programme is for households only.

[1] Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC) (2002): Exporting Harm – High-Tech Trashing of Asia, Seattle, WA.

Maryland collects monitors, CPUs and laptops. Counties pay the cost; they can apply for grants from the state. The programme is a five-year pilot. Producers pay a registration fee to state's recycling fund, which is reduced after the first year if they institute a take-back programme. It is not specified as to who can participate in recycling.

Washington requires electronics manufacturers to pay for the collection, transportation, and recycling of computers, monitors and TVs from consumers, small businesses, schools, small governments and charities in the state. It provides recycling options in every county in the state and prohibits use of prison labour for e-waste disassembly.

Landfill bans have also been passed in Arkansas, Hawaii, Maine, Massachusetts, Minnesota, and North Carolina. Several other states are considering bans. Voluntary initiatives are also on-going. These include, for instance:

- Federal Electronics Challenge (FEC): is a voluntary partnership programme that encourages federal agencies and facilities to purchase greener electronics products, reduce impacts of electronic products during use, and manage electronics in an environmental safe way;
- EPEAT (the electronic products environmental assessment tool) is a multi-stakeholder process to design, implement and disseminate a tool that measures the environmental performance of electronic products for use in government and institutional purchasing. EPEAT provides a Product Register for manufacturers with environmentally preferable products. There are three levels of qualification, based on meeting a set of minimum criteria and going beyond the minimum;
- The National Electronics Product Stewardship Initiative (NEPSI) is a multi-stakeholder dialogue aimed at developing a national financing system to help maximise the reuse and recycling of used TVs and personal computers. The NEPSI dialogue includes representatives from electronics manufacturers, retailers, state and local governments, recyclers, environmental groups and others.

Some examples of Product Stewardship programs are as follows:

- Engineers at Apple design their products to be upgradeable to extend their life and contain components and parts that are recyclable at their end-of-life;
- In November 2000, IBM announced that, for a fee of $29.99 including shipping, consumers and small businesses can recycle any manufacturer's PC, including system units monitors, printers and peripherals;
- In October 2000 Sony Electronics and the state of Minnesota began a five-year program to take back all Sony electronics and personal-computing products, from Walkmen to Vaios, sold in the state. SEL initiated the "We Make It, We Take It" recycling program;
- HP's computer hardware recycling service allows businesses and consumers to dispose of any piece of computer equipment in a way that not only won't harm the environment but will reclaim virtually every bit of the material. Part of HP's Planet Partners Product Take-Back, the new service grew out of an existing effort to responsibly dispose of HP's own obsolete computer equipment;
- In December 2001, Dell set up its Dell Exchange program, which offers consumers three options--trade-in, sale or donation for disposing of older PCs and related products, regardless of the brand.

13 PROPOSALS TO REVISE THE WEEE DIRECTIVE

This study forms part of the overall review of the WEEE Directive and as such is required to formulate options for revising the Directive as part of the Commission's plans for simplifying legislation. A wide range of interest groups, industry associations and individual companies have been formulating positions on the potential review of the Directive and have issued their own position papers and participated in a number of consultation exercises run by the Commission and individual Member States.

The Task Specification for the study requires the following:

> "Formulation of proposals to revise the WEEE Directive with a view to improving its cost effectiveness, while maintaining the same level of environmental protection, in relation to the categories of impact analysed."

This study has drawn on documents and position papers issued by these groups as well as responses which have been made during our own consultations and these have been consolidated and analysed to develop a number of potential options which are discussed below. The options are presented in the following sections and an assessment made of the potential effectiveness of each one with respect to a range of economic, environmental and social criteria.

The analysis of the impacts on innovation and competition of the Directive to date identified in the earlier sections of this report have been drawn upon to inform the development of these options. In addition, this section sets out various concerns that have been raised by the different stakeholders in these areas, identifies what their consequences are for competition and innovation and then presents a list of options for consideration.

13.1 ISSUES ON SCOPE

Annexes IA and IB of the WEEE Directive set out the categories of electrical and electronic equipment and list of products to which the Directive applies. Since the Directive's entry into force, however, a number of companies, trade associations and interest groups have highlighted difficulties in the interpretation of these Annexes and point to the fact that Member States have been interpreting these annexes differently, leading to the situation where a product might fall within the scope of national regulations in one country but not in another. Different interpretations on definitions provided in the Directive for 'producers', 'distributors, the distinction between WEEE from private households (B2C) and from businesses (B2B) and 'weight' have also been highlighted as being interpreted differently in different Member States resulting in different treatment and obligations being attributed to stakeholders according to where they are placing their products on the market.

Consultation with stakeholders has confirmed this and a joint industry position paper on the review of the WEEE Directive by EICTA, AeA and the Japan Business Council for Europe notes:

> "During the implementation of the WEEE Directive into national law there have been many problems with differing implementations in the Member States. These differences are partly caused by ambiguous definitions in the Directive but also partly by the freedom in implementation of the Member States. We would like to propose a dual legal basis for the Directive where article 95 of the Treaty should form the basis for those articles which affect internal market aspects."

Article 95 concerns aspects of the internal market whilst currently the Directive has Article 175 of the Treaty relating to environmental aspects as its legal basis and a number of stakeholders are promoting the use of Article 95 in order to enable the Directive to facilitate harmonization of the interpretation of scope across Member States.

The consultation exercise undertaken for this study confirmed that a range of stakeholders including industry associations and individual companies were in favour of pursuing options which addressed the various issues associated with the scope and definitions included within the Directive.

A number of options for revising the scope of the Directive and clarifying definitions are proposed in the joint paper produced by EICTA et al and have been further confirmed during the consultation with industry stakeholders for this study. Those concerning aspects of competition and innovation are summarised in Table 13.1:

Table 13.1: Issues on Scope

Issues of Scope	*Current issue*	*How it affects competition and/or innovation?*	*Solution required*
Article 2. Scope	Some Member States have chosen to adopt the widest scope possible and not to limit themselves to the categories listed in Annex I A, or to those that are reasonably close to the products listed in Annex I B. A particular issue of concern is the treatment of components as WEEE which differs between Member States	Could affect intra-community trade directly as companies are unclear as to what comes under the Directive in different countries; this would particularly affect SMEs with the greater resources that would be required to investigate compliance obligations	Clarify scope vis-à-vis products to be included and issues relating to finished products, use of goods in products not covered by the Directive etc.
Article 3. Definitions	Problems with different interpretations of some terms such as finished products, weight, producers and B2B/B2C WEEE Lack of clear definitions such as fixed installations	Could affect intra-community trade directly; and innovation indirectly	Clarify definitions and agree on process for declaring EEE as B2C and B2E
Article 4. Product design	Freedom for Member States to introduce national design requirements	Could affect intra-community trade and innovation directly as different Member States introduce different standards and regulations related to product design	Delete article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy using products. Handle all product design issues at EU level.

13.2 ISSUES ON HARMONISATION

The issues relating to scope arise largely due to the different interpretation of the Directive's provisions between Member States. In addition to those issues noted above, the analysis of the producer responsibility systems in different countries and the conclusion that there are significant differences between Member States has identified a number of other areas where there are significant issues regarding harmonization.

Table 13.2: Harmonisation Issues

Issues of Harmonisation	*Current issue*	*How it affects competition and/or innovation?*	*Solution required*
Article 12 requiring Member States to establish a register	Differences in the process for registration e.g. whether or not a registration fee is charged and the level of the charge if required, the period a registration remains valid	Potential barriers to trade, particularly for SMEs as need to gather lot of information, adapt to different processes and costs vary	Harmonisation of registration processes across Member States. Move towards centralized European registration system.
Article 2 Scope, Annex IA on categories covered and IB on products falling under categories	Different Segmentation by Type of Equipment (ToE); this item relates to the issue of scope outlined above as different countries define product categories in different ways thereby making it confusing and sometimes difficult for producers to assess their obligations	Could affect intra-community trade directly as companies are unclear as to what comes under the Directive in different countries. This would particularly affect SMEs with the greater resources that would be required to investigate compliance obligations	Utilisation of standards
Article 5.5 sets out weight targets for collection (and many Member States use EEE weight to identify obligations)	Different definitions of weight and how these are handled; how a product's weight is defined will clearly have and end result in terms of a producer's obligation	Different producers producing the same product may have different levels of obligations in different countries	Adopt agreed standard definition for weight
Article 12	Differences in content, detail and frequency of reporting; this requires significant administrative resources when companies are required to report in a number of different countries utilizing a number of different systems and reporting formats etc.	Places significant administrative burden on companies, particularly SMEs	Harmonisation of reporting procedures with respect to content, timing
Article 10	Some countries impose different labelling requirements	Extra administrative burden, particularly affecting SMEs	Ensure standardization of labelling requirements across Member States
Article 12 requiring Member States to establish a register	Registration of foreign companies (within the EU): in some countries, companies are required to be legally established in the country before it can become registered as a producer and place EEE on the market.	Significant issue from a competition perspective, particularly for SMEs with costs associated with establishing in multiple countries	All registers should be opened to non-national companies. Move towards centralized European registration system.

13.3 ISSUES ON PRODUCER RESPONSIBILITY

Consultees have highlighted repeatedly that take-back schemes based on collective responsibility are hampering innovation. Responses to the questionnaire have highlighted that one of the main incentives to innovate would be the recognition and implementation of individual producer responsibility, i.e. Article 8.2, in all Member States. In other words, allowing the producer to meet the requirements for their own products. Table 13.3 below highlights this and other issues identified in this area.

Table 13.3: Issues on Producer Responsibility

Issues of Competition	*Current issue*	*How it affects competition and/or innovation?*	*Solution required*
Article 8.2 Financing in respect of WEEE from private households	Article 8.2 of the WEEE Directive has not been properly transposed by Member States as regards individual producer responsibility	Limited incentive for individual companies to innovate	Ensure that producers have the opportunity to opt for individual producer responsibility
Article 8.2 Financing in respect of WEEE from private households	Member States appear to vary in interpretation of the requirement to include a financial guarantee when placing products on the market	Potential barrier to trade, particularly for SMEs	Common approach across Member States to the nature of guarantees required
Articles 5, 6 and 7	There are a limited number of compliance schemes operating in some countries, restricting the choice for producers	Higher prices are paid in some product categories for WEEE to be processed in countries which have a limited number of producer compliance schemes	Ensure that all transposition of the Directive does not impose any restrictions on the numbers of compliance schemes that can operate within a country

It is uncertain at this point however whether changes to the Directive alone can trigger innovation. As noted earlier in the report, frequently it will be a combination of aspects, such as economic instruments that will encourage changes in design. Walls (2006) reviews the effectiveness of different instruments in spurring innovation and design. Her results are shown in the following Table. As can be seen, the most effective appear to be:

- A combined output tax;
- Pay-as-you-throw;
- A recycling subsidy (€/lb);
- Take-back mandate and recycling rate target, with PRO setting fees based on sales: if PRO fee is weight based (€/lb);
- Take-back mandate and recycling rate target with PRO and tradable credit scheme with credits assigned to producers;
- Take-back mandate and recycling rate target, with PRO and tradable credit scheme with credits assigned to recyclers: if PRO fee is weight based (€/lb)

Table 13.4: Alternative instruments

Policy Instrument	*Impacts on product design?*	*Impacts on recycling?*	*Comments/other considerations*
Advance recycling fee (ARF), €/unit: e.g., $10/computer*	Yes, indirect, only	Unlikely No (recycling may even fall as output falls)	
ARF, €/kg*	Some downsizing and light weighting of products	No (recycling may even fall as output falls)	
Recycling subsidy (or tax credit for recycling), €/unit	Indirect; subsidy's impact sends price signal upstream to producers to make products more recyclable	Yes, direct	Funding necessary Recycling subsidy
Recycling subsidy (or tax credit for recycling), €/kg	Indirect; subsidy's impact sends price signal upstream to producers to make products more recyclable (more direct than $/unit subsidy)	Yes, direct (more direct than $/unit subsidy)	Funding necessary
Recycling lump-sum grants: e.g., grants for establishing programs, centres	Possible, but very indirect	Yes, but only indirect, since no marginal effect	Funding necessary

Policy Instrument	*Impacts on product design?*	*Impacts on recycling?*	*Comments/other considerations*
Recycled content standard	Indirect	Yes	Inflexible if all producers must meet same requirement
Virgin material tax, €/lb	Some: downsizing and light weighting of products	Yes, substitution effect causes shift from virgin to recycled inputs, so more recycling	
Combined output tax (ARF)/recycling subsidy, €/lb	Direct effect on downsizing and light weighting of products; indirect impact on recyclability: subsidy sends price signal upstream to producers	Yes, direct	
Pay-as-you-throw	Indirect impact on recyclability: price signal encourages downsizing and light weighting of products and improved recyclability	Yes	Could lead to illegal dumping
Landfill ban	No, unless ban is specific to a particular product component or material	Yes	Could lead to illegal dumping
Product labelling	Possible, depending on type of label	Possible small effect, depending on type of label	May be more appropriate for hazardous products
Take-back mandate and recycling rate target, with PRO setting fees based on sales	If PRO fee is weight based (€/lb), downsizing and light weighting of products; no impact on recyclability	Yes	Cost effectiveness depends on how PRO operates
Take-back mandate and recycling rate target with PRO and tradable credit scheme (credits assigned to producers)	Yes, direct; more recyclable a firm's product, more credit it earns	Yes	Sorting requirements and administration could be costly, but credits add flexibility
Take-back mandate and recycling rate target, with PRO and tradable credit scheme (credits assigned to recyclers)	If PRO fee is weight based (€/lb), downsizing and light weighting of products; no impact on recyclability because no brand sorting	Yes	No sorting by brand so lower cost but less impact on recyclability
Source: Walls M (2006)			

13.4 OTHER ISSUES ON COMPETITION

In addition to the harmonisation and scope issues identified above, the problem of free riders (detailed in Table 13.5 below) was also identified as a significant problem by stakeholders. Whilst it is difficult to quantify the problem, free-riding does appear to be a concern and places an unfair burden on compliant companies where it exists. It is likely that with significant differences in the market surveillance systems and capacities in different Member States, the problem of free-riders may be more of an issue in some countries than in others.

In addition we would like to highlight here the issues on competition arising from exclusive agreements that are occurring in some MS such as Estonia as a result of exclusive agreements between waste management companies and WEEE collective schemes. It is uncertain however the extent to which this problem can be dealt by changes to the Directive alone or just action at MS level through court procedures,

Table 13.5: Other Competition Issues

Issues on Competition	*Current issue*	*How it affects competition and/or innovation?*	*Solution required*
Article 12.1 Registration	Whilst it is difficult to quantify the problem, the issue of free riders is of concern to a number of stakeholders	The burden of the un-met free rider obligations is met by the compliant firms	Strengthened market surveillance systems within Member States

13.5 ISSUES ON COLLECTION, TREATMENT AND RECOVERY

The WEEE Directive in Articles 5, 6 and 7 sets out certain requirements relating to the treatment of waste, re-use of appliances or components and the recovery of materials from WEEE. Concerns have been raised that in order to achieve the targets set for recovery (or any future higher targets that might be set) it may be the case that, for certain products, the level of energy and other materials that might be required to achieve these targets may have significant negative environmental effects in excess of any benefits that might ensue from their recovery.

Similarly, some stakeholders have questioned the target of 4kg per person per year set for the collection of WEEE, arguing that in many Member States an amount in excess of this is already being collected and setting a low target may actually reduce collection rates. However, in other Member States which have only recently started implementing the WEEE Directive, rates are lower than this and caution is urged before increasing collection targets with careful monitoring of the situation over time under the current target regime being advocated. Producers have also highlighted the fact that they are unable to control consumer behaviour and their co-operation in returning WEEE.

Environmental organisations have highlighted a problem with illegal shipments of waste in contradiction to the Directive through a series of reports and studies.

These issues and their potential solutions are set out in Table 13.6.

Table 13.6: Issues on Collection, Treatment and Recovery

Issues on Collection, Treatment and Recovery	*Current issue*	*How it affects competition and/or innovation?*	*Solution required*
Article 5.4 Collection targets	Current target of 4kg per person per year is considered too low by some and too high by others as producers have no control over what is returned by consumers	Too low a target may discourage collection and too high a target might not be achievable	Careful monitoring of the ability of schemes to collect specified amounts is required
Article 6 Treatment	Article 6 establishes standards for shipments of waste but illegal shipment of WEEE may still be widespread	Shipments of waste outside of the community to sites not meeting the requirements represent a negative effect on competition as producers are not meeting their obligations	Stronger enforcement of legislation on shipments of waste through increased monitoring
Article 7 Recovery	Adherence to high recovery targets may have significant negative environmental effects	If targets produce more negative benefits than positive ones, innovation does not provide any environmental benefits. May penalise some products and companies over others	Establish standards for disassembly and recycling based on stringent scientific research e.g. through life-cycle analysis

14 DEFINITION OF OPTIONS

In the above sub-sections a range of potential solutions to the various issues identified have been suggested and these are translated into potential options for revising the WEEE Directive below which have been provisionally assessed against the following criteria:

- Feasibility of implementation;
- Potential effects on competition and innovation; and
- Overall cost effectiveness.

A qualitative assessment is carried out below in the section on Impact Assessment. Each of the options is examined against the criteria above in greater detail and utilizing a simple scoring system to rate each of the options.

Table 14.1: Options

Solution required	*Option*	*Feasibility*	*Potential effect on competition and/or innovation*	*Overall effectiveness*
Handle all product design issues at EU level.	Delete article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy using Products.	Yes. Straightforward to remove from WEEE directive. Would need careful wording and revision of EuP?	Will ensure any requirements are EU-wide so will support internal market Ability of SMEs to contribute as effectively at EU level might be an issue. Strong potential effect on innovation but de-links cost incentive (from producer obligations from design aspects)	Potential strong effect on environmental outcomes as well as integrated life-cycle approach for products is advocated under EuP
Clarify scope and issues relating to definitions, finished products, use of goods in products not covered by the Directive etc.	Amend Article 2 and Article 3 and provide unequivocal guidance through amended annex and FAQ	Yes. No identifiable issues other than agreement on definitions but will require clear and focused guidance to be issued	Potential strong effects on competition through harmonization but would need to involve stakeholders and provide quality information.	Depends on clarity and acceptability of guidance
Harmonisation of registration processes across Member States. Move towards centralized European registration system.	Introduce new article in Directive on National Registers or European Centralised Register	Uncertain if agreement would be forthcoming from Member States. As regards a centralized register, Member States would need to be confident of registration procedures/standards in other countries. Who would manage the register?	Strong potential effect on the internal market and would especially benefit SMEs through improved confidence and decreased burden	Likely strong effect but centralized register may incur significant extra costs?
Utilisation of standards	Define product categories for WEEE collection according to standards in Annex IA/IB	Given the variability in product specifications, unlikely to be feasible to develop agreed standards	Limited if any effects on competition or innovation	Low
Adopt agreed standard definition for weight	Amend Article Definitions with agreed definition	Straightforward if can get agreement of key stakeholders	Harmonisation of obligations for similar products in Member States promotes internal trade	Medium
Harmonisation of reporting procedures with respect to content, timing etc.	Amend Article 12.1 with mandatory instructions re. content, timing etc. of reporting	Straightforward	Significantly reduced burden for companies operating in more than one member state. Particularly beneficial to SMEs	Strong positive effect with limited costs. Should also improve reporting by Member States and aid sharing of information

Solution required	*Option*	*Feasibility*	*Potential effect on competition and/or innovation*	*Overall effectiveness*
Ensure standardization of labelling and information requirements across Member States	Amend Article 10 to define labelling requirements mandatory	Will require agreement from those Member States utilising differing labelling and information instructions. Linking this Article to Art 95 of the Treaty would enforce the legal basis for harmonisation	Some affect on competition but problem does not appear great. Some benefits to all, especially SMEs. Can have effect on public demand for innovation if include Information requirements for the public on e.g. the predicted life span of the equipment, reparability, % of recycled materials	Medium
All registers should be opened to non-national companies without representation in-country Move towards centralized European registration system.	Amend Article 12 or introduce new Article specifying standard and open registration practice	Need to check legal requirements in different Member States	Strong positive effect in terms of ability to compete for SMEs, in particular if move towards centralized registration	Likely strong effect but centralized register may incur significant extra costs?
Strengthened market surveillance systems within Member States to minimize free-riders	Amend Article 16 Inspection and monitoring to specify inspection and monitoring obligations of Member States in greater detail and possibly introduce targets?	Difficult to get agreement on % levels for free riders but possible in terms of having active detection, monitoring and management plans?	Uncertain as to the extent of the free rider problem so effect on competition is also unclear	Market surveillance can be costly and unclear the extent to which the level of free riders might be reduced. Capacities in different Member States may be an issue
Producers should have the opportunity to opt for individual producer responsibility	Ensure that producers have the opportunity to opt for individual producer responsibility	Currently this choice does not exist in a number of states and will require significant changes to some Member States established systems	Consultation appears to demonstrate an appetite for this, promoting its potential effects on innovation and equity. But mechanisms still need to be worked out.	May be beneficial in terms of costs or some companies able to innovate quickly but may have negative effect on SMEs?
Common approach across Member States to the nature of guarantees required	Amend Article 8.2 with description of types of guarantees that are permitted	Guarantee schemes of this nature are not particularly prevalent so information on what works and what does not is limited	Will create level playing field for companies and so benefit competition. If linked to recyclability and levels of waste in products, will also provide incentive for innovation	Potentially significant effects but could tie up company funds leading to less available for eco-design
Ensure that all transposition of the Directive does not impose any restrictions on the numbers of compliance schemes that can operate within a country	Amend Articles 5, 6 and 7 or introduce new article on Producer Compliance Schemes which obliges Member States to avoid any restrictions (direct or indirect) on the numbers of schemes	Straightforward in terms of amending or adding Articles. Will need careful wording.	Potentially significant effects on competition for some product groups	Unlikely to involve significant costs and can use existing competition law to monitor

Solution required	*Option*	*Feasibility*	*Potential effect on competition and/or innovation*	*Overall effectiveness*
Careful monitoring of the ability of schemes to collect specified amounts is required prior to changing targets	Amend Article 5 to require Member States to monitor and report regularly to the Commission. Include provision to set higher targets according to portfolio of products in-country	Possibly complicated and would result in different targets for different countries	Unclear which way effect on innovation might move – does a high weight collection encourage eco-design or the opposite? May encourage innovation in recycling industry as a result of economies of scale if targets are raised. Unlikely to be any effects on competition	Uncertain
Stronger enforcement of legislation on shipments of waste through increased monitoring	Amend Article 6.6 to include strong monitoring requirements to be enforced by Member States	Straightforward, but capacity to enforce may be an issue in some Member States	Competition effect depends on the amount of WEEE being legally exported and the effectiveness of monitoring/policing systems established. Indirect effect on innovation	Monitoring and policing can be expensive and depends on amounts involved. Maybe limited benefits.
Establish standards for disassembly and recycling based on stringent scientific research	Amend Article 7 to clearly establish process for developing standards	Yes.	Unlikely to affect competition. Potential strong effect on innovation.	Cost of developing and agreeing standards to be considered.

15 ASSESSMENT OF OPTIONS

15.1 BACKGROUND TO THE ASSESSMENT OF IMPACTS

As noted earlier, this study forms part of the overall review of the WEEE Directive and as such is required to formulate and assess options for revising the Directive as part of the Commission's plans for simplifying legislation.

A number of options have been set out above for revision to the Directive. These were based on the specific problems with the current Directive and based on the responses from the consultation and other position papers issued by a wide range of interest groups, industry associations and individual companies on the potential review of the Directive.

This Report now assesses the impacts from the different options on the following:

- Individual Producer Responsibility (IPR);
- Competitiveness, trade and investment flows;
- Competition in the internal market;
- Operating costs and conduct of business;
- Administrative costs on authorities;
- Administrative costs on businesses;
- Innovation and research;
- Waste production / generation /recycling; and
- Employment and labour markets.

The EU Guidelines of impact assessment have been used as the guidance to the assessment and also for impact selection with a particular focus on innovation and competition. IPR has its own impact category it has been highlighted in the literature and by stakeholders as having a significant impact on innovation.

The measures have also been categorised according to the issues/problems they are trying to address. These relate to:

- Scope (incl. objectives for collection targets);
- Individual Producer Responsibility (IPR);
- Harmonisation; and
- Competition.

Due to the overall paucity of quantitative data, impacts are described in qualitative terms and are assigned a rating according to the expected magnitude of the effect. A seven point rating scale has been applied for these purposes:

--- may have a major negative impact

-- may have significant negative impact

- may have slight negative impact

0 may have no/negligible impact

+ may have a slight positive impact

++ may have a significant positive impact

+++ may have a major positive impact

Parenthesis are used to indicate uncertainty e.g. potential slight positive/slight negative impact due to uncertainty

15.2 IMPACT ASSESSMENT OF MEASURES RELATED TO SCOPE & OBJECTIVES

Since the Directive's entry into force a number of companies, trade associations and interest groups have highlighted difficulties in the interpretation of Annexes IA and IB setting out the categories of electrical and electronic equipment and list of products to which the Directive applies. They have also pointed to the fact that Member States have been interpreting these annexes differently, leading to the situation where a product might fall within the scope of national regulations in one country but not in another.

Other stakeholders have identified problems associated with the different interpretations of key definitions in the Directive with respect to 'producers' and 'distributors', the distinction between WEEE from private households (B2C) and from businesses B2C), and the definition of weight.

Table 16.2 summarises the impact assessment of the measures related to Scope. As can be seen from the Table, there will be benefits in clarifying the scope of the directive in terms of competition through harmonisation but some of the impacts are highly uncertain, as the current scope varies across Member States significantly therefore imposing additional costs to businesses and authorities in some while compared to the other countries. Collection targets are included in the assessment, since although they are unlikely to have any significant effect on levels of competition, they have been identified as a potential measure for providing greater incentives for innovation.

15.2.1 Clarification of scope and definitions

The first measure proposed is a clarification of scope and issues relating to categories of goods and products, finished products, use of goods in products not covered by the Directive as well as key definitions included in the Directive. This will require amending Article 2 and providing unequivocal guidance through amended Annexes and FAQ. It will also require amending Article 3 definitions relating to producer, distributor, and the distinction between WEEE from private households and businesses.

Differing applications of Annex 1 of the directive across Member States has led to the situation where certain products are being treated as being covered by the Directive in some countries but not in others. This implies an unequal treatment of producers and therefore has implications for the competitive position of those companies which are placing products on the market in Member States where they are included within scope as compared to those companies placing the same products on the market in Member States where they are not included. Standardising the application of Annex 1 would lead to a common interpretation and equal treatment of producers.

The impact of applying this measure would be to strengthen individual producer responsibility through ensuring that all producers placing products on the market within the scope of a revised Annex 1 would be subject to the financing obligations of the WEEE Directive in all Member States. However, agreement on the applications of standards for defining products to be included in a revised Annex 1 might be a difficult process, involving EEE producers, Member States' competent authorities, the Commission and other interested stakeholders.

There are unlikely to be significant impacts with respect to international competitiveness and trade and investment flows since products placed on the EU market from outside of the EU will be treated in the same way as those produced within the EU. However, there will be stronger impacts on competition within the internal market as a level playing field will be established for producers as all products coming within the scope of the Directive will be treated the same in each Member State. A major determinant of the extent of the impact will be the degree to which a new standardised Annex 1 is implemented in Member States and this will require clear guidelines on its applicability as well as robust monitoring and feedback mechanisms to ensure equal treatment for products across the internal market.

With respect to the impact on the operating costs of businesses, the extent of the divergence in the current interpretation and the numbers of products (and associated costs to producers) affected is not clear. Individual producers have raised this issue in respect of their own products, but lack of information in terms of consolidated interpretations across Member States is currently not available. The effect on producer costs could be quite significantly negative in the event that revisions to the scope of the Directive through products listed in the Annex results in an increase in all products being treated as subject to the Directive in all Member States. However, if the revision results in fewer products overall than at present being subject to the Directive's provisions, the overall costs to businesses will decrease.

The development of standards for revising the Directive's Annex and developing comprehensive guidance will result in costs to the national authorities and the Commission, as will increased monitoring and surveillance in order to ensure that the standards are being interpreted consistently. As regards administrative costs to businesses, the consistent interpretation of the Directive across Member States will clarify which products are within the scope of the directive and which are not and businesses will benefit positively from this as they will no longer be required to investigate the scope of products being covered in each Member State. Administrative cost increases or decreases with respect to registration and reporting requirements are indeterminate for similar reasons as outlined under operating costs as at this stage it is not clear whether or not any revision of the Directive's Annex will result in an overall increase or decrease in the number of products subject to the Directive's obligations.

Impacts on innovation and research from clarification of scope are not considered likely to be significant. The fact that this issue has been identified as significant by some producers implies that their products are already being considered as subject to the Directive in some countries and cost incentives for improving recyclability and waste reduction are already in place to some extent. This is linked to the expected impact on levels of waste production/recycling since there is not likely to be much improvement in incentives to innovate. Any changes in waste production/recycling are more likely to be influenced by the extent of changes to the range of products being included in the Annex and as stated above, this is indeterminate at this stage.

Changes to definitions of the terms 'producer' and 'distributor' are deemed necessary to clarify who precisely is responsible for meeting the producer obligations defined in the WEEE Directive. Various stakeholders have argued that the term 'producer' (as currently defined in the Directive) is not specific enough to allocate the responsibilities and obligations set out in the Directive to the economic operators concerned. The issues associated with the imprecise definition included in the Directive are compounded by the fact that Member States interpret placing on the market in different ways, with some Member States adopting what has been termed the 'national' approach (where the first importer to a particular Member State is classed as the producer) and others adopting a 'European' approach (where the producer is defined as the first actor placing the product on the EU market).

Under this option, clarification would be made in favour of adopting the EU approach with placing on the market being defined as being the first introduction to the EU market. Key areas of impact include a re-distribution of costs away from importers who purchase goods from another Member state and back onto those who have either imported the goods from third countries or who have produced goods within a Member State. The net effect would therefore most likely be 0 and so would not impact on the assessment categories for operating or administrative costs to businesses. Competent authorities may end up with less producers to register but they will still have to register in all Member States, making any net effect negligible.

In terms of impacts on competition in the internal market, revising definitions will have the impact of ensuring that those intended to bear the obligations for financing the management WEEE as set out in the Directive actually do so.

Increased collection targets is included here as an option under scope as it has been promoted by environmental NGOs as an important measure to ensure that the environmental objectives of the WEEE Directive are achieved in the long run. As can be seen from the assessment in Table 15.1, there are no significant impacts anticipated in areas related to innovation or competition.

Table 15.1: Impacts of Measures related to Scope and Standards

	Scope & Standards	**Increased collection targets**
Brief Description	Clarify scope and issues relating to categories of goods and products, finished products, use of goods in products not covered by the Directive etc. Amend Article 2 and provide unequivocal guidance through amended annex and FAQ. Amend Article 3 definitions relating to producer, distributor, WEEE from private households	Careful monitoring of the ability of schemes to collect specified amounts is required prior to changing targets. Amend Article 5 to require Member States to monitor and report regularly to the Commission. Include provision to set higher targets according to portfolio of products in-country. Possibly complicated and would result in different targets for different countries
Strengthens IPR	Positive impact likely but will require clear and focused guidance to be issued. May be difficult to get agreement on standards (+)	No impact likely (0)
Competitiveness, trade and investment flows	No clear impact (0)	Unlikely to have any effects on competitiveness (0)
Competition in the internal market	Potential strong effects on competition through harmonization but would need to involve stakeholders and provide quality information. Depends on clarity and acceptability guidance. Clarification of placing on the market will help ensure equity (++)	Unlikely to be any effects on competition (0)
Operating costs and conduct of business	Will increase clarity but direction of change will depend on degree to which clarification increases/decreases scope over and above what is already being implemented in some Member States (+++/---)	Will probably increase the operating costs of companies, i.e. reporting and increased collection (-)
Administrative costs on authorities	Costs associated with producing the guidance and potential changes in monitoring requirements. Costs associated with producing and disseminating standards (-)	Monitoring costs will increase slightly (-)
Administrative costs on businesses	Will increase clarity but direction of change will depend on degree to which clarification increases/decreases scope over and above what is already being implemented in some Member States (+++/---)	No likely impacts (0)

	Scope & Standards	Increased collection targets
Innovation and research	No clear impact (0)	Unclear which way effect on innovation might move – does a high weight collection encourage eco-design or the opposite? May encourage innovation in recycling industry as a result of economies of scale if targets are raised. (+/-)
Waste production / generation /recycling	Effects on waste production depend on new scope and standards; uncertain impacts (+/-)	Will depend on new targets; although this is likely to increase as more stricter collection targets could be expected; this however could have an effect on the number of free-riders (+/-)
Employment and labour markets	No clear impact (0)	Effects highly uncertain (0)

15.3 IMPACT ASSESSMENT OF MEASURES RELATED TO IPR

Consultees have highlighted repeatedly that take-back schemes based on collective responsibility are hampering innovation. Responses to the questionnaire have highlighted that one of the main incentives to innovate would be the recognition and implementation of individual producer responsibility, i.e. Article 8.2, in all Member States. The following Table summarises the impacts from the options related to IPR.

Harmonising the approach across Member States to individual producer responsibility will allow producers to develop schemes that are most appropriate for their requirements. As such, the competitive position of European producers may be enhanced vis-à-vis their competitors from outside of the EU. On the internal market, a fair playing field would enable individual producers to establish their own schemes for take-back and/or financing of their own WEEE. By ensuring that producers pay for the actual costs associated with their own WEEE, greater competition in the internal market should ensue as price competition with respect to waste management costs becomes more of a factor in a companies overall competitiveness.

Benefits from introducing a greater degree of IPR would also arise with respect to innovation via the strengthening of the link between design and recycling/waste management costs and this in turn could lead to overall reductions in the amount of waste generated and the recyclability of products. This will inevitably come at the expense of some companies who are currently members of collective financing schemes and are effectively having their recycling and waste management costs subsidised by those producing more innovative, recyclable and low-waste products. This might be a particular issue for SMEs which are not able to invest the resources necessary to increase research and development expenditure levels to develop more eco-friendly products.

An increase in the number of individual compliance schemes will have an impact on the levels of monitoring required from competent authorities. This might be reduced however from the registration fees charged to those establishing such schemes.

A common approach across Member States to the treatment of financial guarantees requiring an amendment of Article 8.2 is set out in more detail below. The following tables 1.7.2 and 1.7.3 sets out the advantages and disadvantages of the different types of financial guarantees but the impact assessment in Table 1.7.4 only considers the impact of making an independent financial guarantee mandatory for all producers, without specifying the type of guarantee to be adopted.

Table 15.2: Financial Guarantees (1)

	Recycling Insurance	Blocked Bank Account	Entries in Balance Books	Individual Bank Guarantee
Brief Description	Producers are required to take out an insurance policy against future recycling costs of products placed on the market.	Producers required to put sufficient funds to cover future recycling costs aside in a separate bank account	Producers are required to reserve an amount of money sufficient for the future recycling costs (liabilities) in their balance sheets	Producers would be required to take out a bank guarantee with a recognised banking institution which would then be responsible for funding recycling costs in the event of default by the producer
Strengthens IPR	Yes, strong effect if product design is taken into account for determining the level of the guarantee	Yes, strong effect if product design is taken into account for determining the level of the guarantee	Yes, small effect if product design is taken into account for determining the level of the guarantee	Yes, small effect if product design is taken into account for determining the level of the guarantee
Competitiveness, trade and investment flows	Effect limited as guarantee would be required by all producers placing products on EU market. Potential to be applied across EU assuming consistent legislation.			
Competition in the internal market	Equitable across producers as would require ALL to have some form of independent guarantee. Would have significant impact on SMEs which are mostly members of collective schemes and currently are not required to make separate provision. All have potential to be applied across EU assuming consistent legislation.			
	Number of companies offering such insurance is limited. Differences in 'insurance premium taxes' across Member States could create inequities if these are not harmonised.	Difficult to ensure that account is 'inaccessible' to creditors in event of insolvency and therefore available to fund recycling.	Entry in balance books requires common accounting procedures, methods for estimating liabilities etc. (need for Local Guidelines?).	Unlikely to be available in all Member States for all products for the same period. SMEs likely to have more problems in securing guarantees.
Operating costs and conduct of business	May require that producer is identifiable at time of recycling, necessitating some form of technology or sampling of waste streams with associated costs. Although development costs for technology likely to be borne by larger firms, new equipment costs (if needed) are likely to be proportionally higher for SMEs.			
	Increase in operating costs due to premiums but insurance companies are set up to deal with long-term planning, risk assessment and financial management.	Ties up companies' working capital and payments to bank not likely to be tax-deductible(?).	No immediate costs but put into future obligations	Even if banks are willing to provide the guarantees, these are likely to be very expensive if required for the long-term. Likely to limit companies' ability to access further credit.
Administrative costs on authorities	Additional monitoring costs for competent authorities to ensure that guarantee responsibilities of producers are being met and that guarantees are sufficient to meet future waste management and recycling costs.			

Administrative costs on businesses	Limited to dealing with payment of premiums and notification to authorities. May need to provide regular updates/confirmation policy is appropriate	Comparative ease of administration for producer.	Ease of administration for producers, not requiring physical deposit of cash.	Additional time required by producers to locate, negotiate and update appropriate guarantees.
Innovation and research	Direct link between guarantee and recycling costs could provide an incentive to produce products which are lower in waste or more recyclable. However, the extent of incentive cannot be proven at the present stage of implementation of the Directive.			
	Provides certainty to producer and a potentially stronger incentive for eco-design. Premiums can be tailored to reflect 'design for recycling'.	Funds available for innovation and research may be reduced due to funds being tied up in separate bank account, but may provide incentive to ensure ease of recycling is considered in product design.	Less immediate incentive for eco-design as funds do not have to be set aside, but future obligations may have limited influence over design for recycling.	Less incentive for eco-design.
Waste production / generation / recycling	May require that producer is identifiable at time of recycling, necessitating some form of technology or sampling of waste streams. Caters for producers going out of business			
	Existing regulatory framework for insurers will help ensure adequate future funds for recycling are available.	There is a risk that funds set aside will not cover future recycling costs.	Requires careful monitoring of funds on company books to ensure that they are sufficient to cover future recycling costs.	Difficulty in accessing long-term bank guarantees may have significant impact on ensuring that sufficient funds are available to cover recycling costs.
Employment and labour markets	Potential to boost employment in the specialist insurance sector if sufficient companies take out policies	Little or no effect.	Little or no effect.	Little or no effect.

Table 15.3: Financial Guarantees (2)

	Group Guarantee	Securities	Trust/Group Fund	Collective Scheme Based on Reciprocity
Brief Description	A parent company would provide the required guarantee for any/all of its subsidiarities	Producers provide purchased securities as guarantee against future obligations instead of cash	A legally separate trust financed through contributions of member producers would provide the guarantee	Members of the compliance scheme agree to pay the obligations of other members if they go out of business
Strengthens IPR	Limited as guarantee taken on by parent company without necessarily being linked to recyclability of the product	Yes as individual producer is required to purchase securities against the recycling obligations of its own products. Stronger if the level of securities required is linked to product design and ease of recycling	Yes if the value contributions to group fund required is linked to product design and ease of recycling	Obligations of producers going out of business will be taken on by remaining members of the scheme irrespective of product design.
Competitiveness, trade and investment flows	Effect limited as guarantee would be required by all producers placing products on EU market. Potential to be applied across EU assuming consistent legislation.			
Competition in the internal market	Equitable across producers. Would have significant impact on SMEs which are mostly members of collective schemes and currently are not required to make separate provision. Potential to be applied across EU assuming consistent legislation.			Members of collective schemes not required to provide independent guarantee whereas those setting up individual schemes are.
	Favours companies which are part of a larger group with parent company providing guarantee for subsidiaries in different countries. Requires pan-European application and acceptability of guarantee issued in one member state as applicable in another.		Could be used on EU wide basis with Trust set up in one country but able to cover obligations in whole EU market. Would require pan-European agreements.	Requires minimum standards to avoid free riding and must be binding and non-limited. Collective means that a company will absorb and share someone else's risk. Tendency for collective schemes to head towards 'monopoly' status, with producers having no control over recycling costs.
Operating costs and conduct of business	May require that producer is identifiable at time of recycling, necessitating some form of technology or sampling of waste streams with associated costs. Although development costs for technology likely to be borne by larger firms, new equipment costs (if needed) are likely to be proportionally higher for SMEs.			Result would be that other companies take on liability of those that default or go out of business, implying higher costs

	Group Guarantee	Securities	Trust/Group Fund	Collective Scheme Based on Reciprocity
			Companies joining together in a fund are likely to be able to negotiate more preferable terms. SMEs likely to benefit from higher purchasing power as member of a group rather than individually. Could allow for reimbursement of monies advanced in the event recycling costs are lower and thereby provides incentive for eco-design.	to remaining companies. No need to associate products with producers so no associated costs. Tendency for collective schemes to head towards 'monopoly' status, with producers having no control over recycling costs.
Administrative costs on authorities	Additional monitoring costs for competent authorities to ensure that guarantee responsibilities of producers are being met and that guarantees are sufficient to meet future waste management and recycling costs			Perceived ease of administration by authorities and producers.
Administrative costs on businesses	Costs only incurred by parent company.	Limited to administering buying and selling of securities	Limited to operation of trust/fund	
Innovation and research	Direct link between guarantee and recycling costs can provide incentive to produce products which are lower in waste or more recyclable. However, the extent of incentive cannot be proven at the present stage of implementation of the Directive.			
			Could allow for reimbursement of monies advanced in the event recycling costs are lower and thereby provides incentive for eco-design.	Costs not linked to recyclability of product so no incentive for eco-design.
Waste production/ generation/recycling				Without incentive for eco-design, no positive effect on reducing waste or making products easier to recycle.

	Group Guarantee	Securities	Trust/Group Fund	Collective Scheme Based on Reciprocity
		Value of securities fluctuates with no guarantee that value will be sufficient to cover recycling costs. Access to these funds by creditors in event of bankruptcy is an issue.	Guarantees against bankruptcies and ensures funds available for waste management/recycling. Access to these funds by creditors in event of bankruptcy is an issue.	Difficulties if a whole scheme disappears.
Employment and labour markets	No effect	Limited to employment of those handling companies' securities	Limited to those managing funds	No effect

Table 15.4: Impacts of Measures related to IPR

	IPR	Financial guarantees
Brief Description	Ensure that producers have the opportunity to opt for individual producer responsibility.	Common approach across Member States to the nature of guarantees required. Amend Article 8.2 with description of types of guarantees that are permitted and obliging all companies to provide
Strengthens IPR	Likely positive effects as it will give producers scope to set up their own responsibility schemes (+++)	Guarantee schemes of this nature are not particularly prevalent so information on what works and what does not is limited. Impact is therefore uncertain. (+/-)
Competitiveness, trade and investment flows	It will allow producers to set schemes that fit best; this could also give them a competitive advantage (+)	No clear impact (0)
Competition in the internal market	No negative impacts are foreseen; as it will allow producers to set schemes that fit best (++)	Will create level playing field as all companies will be required to provide guarantee (++)
Operating costs and conduct of business	May be beneficial in terms of costs or some companies able to innovate quickly but may have negative effect on SMEs (+)	A number of producers currently not providing guarantees will be required to do so. May also require introduction of technology to identify own waste (-)
Administrative costs on authorities	May increase costs for authorities in terms of administering the registers and other monitoring arrangements (-)	Possible increase in costs of monitoring financial guarantees (-)
Administrative costs on businesses	No significant impacts are foreseen (0)	Administration costs associated with declaration and updating of guarantees (-)
Innovation and research	Consultation appears to demonstrate an appetite for this, promoting its potential effects on innovation and equity via direct link between design and recycling/waste management costs (+++)	If linked to recyclability and levels of waste in products, will also provide incentive for innovation. Potentially significant positive effects but could tie up company funds leading to less available for eco-design (+)
Waste production / generation /recycling	May increase waste recycling; waste generation may be less as a direct effect from innovation and research (++)	Depends on design of the guarantees; but could have positive impacts if linked with recyclability and levels of waste in products (+)
Employment and labour markets	Indeterminate effects (0)	Limited impacts expected (0)

15.3.1 Impact Assessment of Measures Related to Harmonisation

The issues relating to scope arise largely due from differing interpretations of the Directive's provisions across Member States. The analysis of the producer responsibility systems in different countries has led to the conclusion that there are significant differences between Member States and other significant issues regarding harmonization. Table 15.5 summarises the assessment of the options related to harmonisation.

15.3.2 Incorporating design objectives into Directive 2005/32/EC

Removing the objective of promoting eco-design from the WEEE Directive and placing it into Directive 2005/32/EC on the eco-design of Energy-using Products (EuP) would not have any impact on IPR directly in terms of the requirement for producers to finance WEEE arising from their own products. Producers would still have the same incentives to reduce costs from dealing with WEEE under this option and as the current Directive does not include any targets for eco-design, transferring the objective to the EuP Directive would ensure that design elements for dealing with waste and recycling are placed alongside all other aspects of eco-design relating to energy use. This would address the issue raised by a number of stakeholders who argued that targets for recycling and materials extraction from WEEE can compromise other aspects of eco-design, for example by using excessive amounts of energy during the recycling and/or materials extraction processes.

There would be little overall impact on trade and investment flows but a likely small impact on trade in the internal market resulting from the fact that standards for EEE with respect to waste content and recyclability would be developed at the EU level. This would mean that individual standards would not then be developed on a country-by-country basis, thereby contributing to a reduction in potential barriers to trade. This would particularly benefit SMEs who often have more restricted access to information on different standards in different countries and limited financial capacity to develop products to differing standards for different markets.

There are unlikely to be any impacts on the operating and administrative costs of businesses and national authorities associated with this option. Design objectives would still be pursued under the EuP and compatibility with other elements of the products' lifecycle would be ensured, thereby increasing the benefits to the environment from innovation.

15.3.3 Registration Processes

Two options for making revisions to the registration process for obligated producers have been identified, one focussing on harmonisation of the registration systems existing in the different Member States and the other seeking to establish a centralised EU system for registration. At this point, it is difficult to assess the benefits in any great detail as the precise nature of a system which harmonises the registration systems between Member States or a centralised EU system would be a complicated process involving the agreement of a number of issues by Member States. Consequently, only a broad assessment of the potential costs and benefits associated with the two options is provided here.

Both options are likely to have an indirect effect on individual producer responsibility by ensuring that producers from all Member States and from outside of the EU are able to register (and thereby meet their obligations in all Member States).

Both options will therefore have a positive impact through reductions to trade barriers. Currently, SMEs in particular face significant problems in finding their way through the many different registration procedures. In countries where foreign traders are not permitted to register, they are forced to establish a legal entity in that country if they wish to directly meet their obligations. Whilst this will benefit SMEs who do wish to register in different countries, overall the options might benefit larger companies disproportionately since they are already operating in more countries and will benefit from the streamlined registration process to a greater extent.

The added advantage of a single EU wide system would mean that producers are only required to register once, with lower associated administrative burdens. The potential does exist for increased costs for competent authorities due to the increased monitoring tasks that might be involved with monitoring products placed on the market by a greater number of producers not represented within the Member State and the co-ordination activities with other Member States that would be necessary to ensure strict adherence to a harmonised registration system. The establishment of an EU wide registration mechanism would itself involve fairly significant costs to competent authorities, but the increased fees from registration that might arise from making the whole registration process easier and therefore lead to more companies registering would serve as a trade off against the negative impact of these costs.

No innovation impacts are anticipated from this option, other than those that might be associated with the indirect improvement in IPR that would stem from manufacturers registering their products in all countries where they are being placed on the market and their having direct control over the design process rather than an importer or distributor whose influence, if any, is at best indirect through their purchasing decisions.

Limited positive effects on waste and recycling may arise from these two options if the number of free-riders is reduced through increased recycling. This will only be the case if the greater amount of funds available from the increased registration were channelled into recycling higher volumes of waste or in investment in better waste recycling technology rather than to reduce the overall costs of compliant companies.

Opening up, consolidating and making registration systems easier may have slight impacts on employment within Member States if more producers register as a result and more trade takes place. However, these impacts are highly uncertain.

15.3.4 Reporting, labelling and information requirements

Standardisation of reporting, labelling and information requirements is unlikely to have any effect on levels of producer responsibility, nor on innovation or waste generation and recycling, as they will have no effect on the degree to which producers are held responsible for meeting their obligations for financing WEEE as set out under the Directive. Positive impacts however should be seen in competition in the internal market as the option would create a more even playing field, particularly from the perspective of SMEs who currently bear a proportionally higher burden for the multitude of reporting requirements across Member States related to their lower volumes of products placed on the market.

The reduction in costs to businesses that would result would benefit small and large producers alike, with the larger producers benefiting to a greater extent due to the larger number of reports in different formats that they are currently required to produce. The same would be true in respect of labelling and information requirements.

National authorities would likely benefit from reduced administrative costs from these options due to increased ease of consolidation of reports and onward reporting to the European Commission. The fact that producers will be subject to the same reporting and labelling requirements in each Member State would possibly improve the quality of reporting, labelling and information provision as they would be able to concentrate on developing a single quality system for each to cover their obligations in all Member States.

15.3.5 Establishing standards for disassembly and recycling

Establishing standards for disassembly and recycling based on stringent scientific research would not in itself serve to make producers more responsible for meeting obligations under the Directive for financing WEEE from their own products. However, there would likely be a significant effect on innovation as products would need to be designed in order to meet the standards. In the same way, the effects on waste would also be positive as the standards would require improvements in waste generation and recycling levels. The main difficulty with this approach will be the development of appropriate standards that do not hamper product innovation in other areas or that might have significant impacts on the other environmental properties of products at different stages in their life cycle. Securing agreements across Member States and with industry as to the precise nature of the standards is also likely to be extremely challenging.

The option may affect the opportunities of EU companies that export WEEE to do so if recycling systems in non-EU companies are not able to process the WEEE in its revised form. In the internal market, all companies will be subject to the same standards which should improve competition.

There is a potential negative effect for those currently producing products which are below any standards agreed upon and these companies will incur extra operating costs in order to bring their products into compliance. Businesses would also be faced with increased reporting costs to demonstrate compliance with the standards. With a system for standards in place, national authorities would be required to monitor and enforce compliance, which would be likely to result in increased costs over existing monitoring and surveillance mechanisms.

15.4 IMPACT ASSESSMENT OF MEASURES RELATED TO COMPETITION

A number of the options identified above under scope and harmonisation are also designed to have positive impacts on competition in the internal market. Three further options addressing market surveillance systems, increasing the number of compliance schemes and strengthening the enforcement of the trade in WEEE have also been identified for their impacts on competition in the internal market.

15.4.1 Market Surveillance Systems

The strengthening of market surveillance systems attempts to address the issue of free-riders among others and if successful, would have a positive impact on the principle of producer responsibility by ensuring that all obligated producers placing EEE on the market are registered and fulfil their obligations.

In so far as a higher proportion of obligated producers would be registered, the option would have a positive impact on competitiveness of EU companies with respect to their non-compliant competitors from both outside and within the EU. The extent of the impact is hard to quantify given the imprecise nature of current figures on the quantity of free-riders. The fact that most stakeholders believe it to be an issue would suggest there is a sizeable positive impact to this option.

Again, assuming that more companies are brought into compliance, the number of companies contributing to the overall amount of funds available for financing WEEE management will be increased, with potential reductions in contributions then being required from compliant companies to finance the equivalent amount of overall WEEE. This would represent a positive benefit for compliant companies with respect to their operating costs. As regards administrative costs to companies, these are less likely to be affected by strengthening of surveillance systems unless strengthening involves increased reporting burdens on compliant companies, or if additional administrative costs to competent authorities (which would be a negative outcome in terms of costs of the option) are passed on to producers through increased fees.

There is unlikely to be any direct effect on the levels of innovation and research into eco-design for waste reduction or ease of recycling, unless free-riders brought into compliance engage in re-designing products to reduce their costs of compliance. However, any such benefit might be off-set by reduced costs to existing compliant companies which result in lower levels of innovation since the incentive for those companies to re-design their products is likely to be reduced in proportion to the amount that their costs decrease.

Only small effects are likely on the amounts of waste generated and recycled from the increased participation of former free-riders as a results of improved surveillance systems.

Table 15.6 presents the impacts expected in relation to these other competition issues.

15.4.2 Remove restrictions to the number of compliance schemes in operation in Member States

The number of compliance schemes operating in any one Member State has been shown to have an effect on the costs incurred by producers for dealing with their WEEE. Amending the Directive to oblige Member States to ensure that there are no restrictions to the number of schemes that can be established will have an important effect on the overall costs faced by companies.

This will be a positive effect for producers and may also increase competition in the recycling market as more buyers become available. Whilst there are no envisaged increases in administrative costs for companies, their operating costs will most likely be reduced as competition between compliance schemes in those Member States where only limited options are available increases.

Overall effects on innovation are uncertain. With more schemes and reduced costs, producers may have more funds available for research and development, but without individual producer responsibility and a direct link between the cost of financing WEEE and the design of a producer's own products, the incentive to innovate is reduced.

An increased number of compliance schemes might lead to increased volumes of waste being processed through greater capacity and, as a result, there is potential for some increase in employment in the recycling sector. However, the effects are likely to be small since the increase in the number of schemes will have its effects mostly on the reduction of costs to producers.

15.4.3 Strengthening the enforcement of the trade in WEEE

Amending Article 6.6 of the WEEE Directive to include strong monitoring requirements for competent authorities for the enforcement of legislation relating to the trade in WEEE will have a beneficial effect on producer responsibility by ensuring that producers are not able to illegally export waste to countries where it will not be treated to the same standards (health and safety, environmental standards) as it would be subject to in the EU. The extent of this and other impacts is to a degree uncertain as the extent of illegal shipping of waste is also uncertain.

The effect of this option on competitiveness within and outside of the EU is expected to be positive as more of those defaulting on their obligations will be brought into compliance, with the net effect depending on the numbers of non-compliant producers brought into compliance and the strength on the monitoring systems established. Where more producers are brought into compliance, this will have a negative effect on the operating costs of those companies but the extent of this is highly uncertain due to the lack of information on not only numbers, but also on the savings they are making by exporting waste illegally.

The cost of monitoring and surveillance activities is generally expensive and strengthening these systems across Member States will involve a significant addition to the administrative costs of competent authorities, particularly for those that have weaker systems currently.

Table 15.5: Impacts of Measures related to Harmonisation

	EuP –Eco-design	Opening registers	EU centralised registration system	Reporting	Labelling and Information requirements	Disassembly and recycling
Brief Description	Delete article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy using Products.	All registers should be opened to non-national companies without representation in-country Amend Article 12 or introduce new Article specifying standard and open registration practice	Harmonisation of registration processes across Member States. Move towards centralized European registration system to replace individual MS systems. Introduce new article in Directive on European Centralised Register	Amend Article 12.1 with mandatory instructions re. content, timing etc. of reporting	Amend Article 10 to define standardised labelling requirements across MSs as mandatory	Establish standards for disassembly and recycling based on stringent scientific research. Amend Article 7 to clearly establish process for developing standards
Strengthens IPR	No clear impact on IPR as producers should still be responsible for own WEEE. (0)	Will ease registration process and enhance IPR indirectly (+)	Will ease registration process and enhance IPR indirectly (+)	No clear impact (0)	No clear impact (0)	No clear impact (0)
Compe-titiveness, trade and investment flows	No clear impact (0)	Potential positive impact on investment flows; may increase competitiveness among EU and its non-EU rivals (++)	Will have a positive impact on trade, as barriers to registration are removed. Equally, competitiveness will be enhanced. Impacts on investment are less certain (++)	No clear impact (0)	No clear impact (0)	May reduce opportunities for EU companies exporting WEEE to non-EU countries but increase competitiveness for both EU and non-EU companies within the internal market (+/-)
Competition in the internal market	Positive effects (+) from developing standards on a EU wide basis for products thus reducing barriers to trade;	Will ensure harmonised procedures and enhance functioning of the internal market, enabling equal access to all markets for all companies (++)	Ensures all producers have equal ability to register products for all markets so positive impact (++)	Standardised reporting requirements across MSs will ensure companies are facing similar responsibilities and reporting burdens in each MS (+)	Slightly positive as all companies would be subject to the same labelling requirements in each MS (+)	All companies will be subject to the same disassembly/recycling standards, thereby increasing competition in the internal market (++)
Operating costs and conduct of business	No significant impacts (0)	Companies no longer have to establish subsidiaries in MS previously requiring it. (+)	Likely to reduce costs for some companies operating in more than one MS but impacts on SMEs likely to be less significant as operate in fewer MSs (+)	Companies likely to experience economies of scale with standardised reporting requirements (+)	Positive (but maybe less so for SMEs) as no longer subject to different labelling requirements in different MSs. (+)	Potential negative (particularly for SMEs) impact where standards are raised above current levels (-)

	EuP –Eco-design	Opening registers	EU centralised registration system	Reporting	Labelling and Information requirements	Disassembly and recycling
Administrative costs on authorities	No direct impacts (0)	Opening up national register will have its advantages (increased income from fees) and disadvantages (increased resource requirement). Net effect uncertain (+/-)	Costs of setting a centralised system; impacts at EU level likely to be significant (depend on final arrangements) (--)	Positive impacts from increased clarity and ease of consolidation (+)	No clear impact (0)	Authorities will be required to establish monitoring/surveillance systems to ensure standards are observed (-)
Administrative costs on businesses	No significant impact (0)	Unlikely to have significant effects.(0)	Depends on level of fees but overall positive effect for companies operating in more than one MS as only have to register once (+)	Lower costs in producing standard reports for companies results in positive impact (+)	Positive (but maybe less so for SMEs) as no longer subject to different labelling requirements in different MSs. (+)	Likely increased in admin costs via reporting (-)
Innovation and research	EuP Directive will have a positive effect on innovation, linking all stages of product life-cycle (+++)	No significant impacts (0)	Registration alone unlikely to affect innovation significantly (0)	No significant impacts (0)	No clear impacts (0)	Significant positive impacts expected (ease of disassembly) and innovation in the recycling industry (++)
Waste production / generation /recycling	Balance of effects unclear for individual products as EuP considers all phases of product life-cycle, not just waste production (+/-)	May reduce the number of free-riders therefore positive impacts on unaccounted waste (+)	May reduce the number of free-riders therefore some positive impacts on unaccounted waste (+)	No significant impacts (0)	No clear impacts (0)	Will ensure that waste /recycling is managed in the most environmentally appropriate manner (++)
Employment and labour markets	No direct impacts	May spur cross-border investment flows and, indirectly, employment. But highly uncertain (+/-)	May spur cross-border investment flows and, indirectly, employment. But highly uncertain (+/-)	No significant impacts (0)	No clear impacts (0)	May encourage employment in the recycling sector (+)

Table 15.6: Impacts of Measures related to Competition

	Increased market surveillance	Collective Compliance Schemes	Waste Trade
Brief Description	Strengthened market surveillance systems within Member States to minimize free-riders. Amend Article 16 Inspection and monitoring to specify inspection and monitoring obligations of Member States in greater detail and possibly introduce targets?	Ensure that all transposition of the Directive does not impose any restrictions on the numbers of compliance schemes that can operate within a country Amend Articles 5, 6 and 7 or introduce new article on Producer Compliance Schemes which obliges Member States to avoid any restrictions (direct or indirect) on the numbers of schemes that can operate Straightforward in terms of amending or adding Articles. Will need careful wording. Potentially significant effects on competition for some product groups	Stronger enforcement of legislation on shipments of waste through increased monitoring Amend Article 6.6 to include strong monitoring requirements to be enforced by Member States
Strengthens IPR	Will strengthen the principle of producer responsibility (especially for free riders). (+)	Will strengthen the principle of producer responsibility as more compliance schemes will become available (++)	Will strengthen the principle of producer responsibility (+)
Competitiveness, trade and investment flows	This will affect EU compliant companies as it will restrict competition from non compliant companies producing abroad whose goods are distributed in the EU market (++)	Uncertain whether companies will relocate just because of availability of collective compliance schemes; limited impact expected in terms of competitiveness (if any, these are likely to be positive but highly uncertain) (0)	Will increase competitiveness; impacts on trade and investment flow more uncertain (+)
Competition in the internal market	Uncertain as to the extent of the free rider problem so effect on competition is also unclear; but likely to be positive nevertheless with respect to companies complying (most of the respondents showed concern about free-riders) (++)	Increase in the number of schemes likely to increase competition in the recycling sector. (+)	Competition effect depends on the amount of WEEE being legally exported and the effectiveness of monitoring/policing systems established. Overall expected to be positive (+)
Operating costs and conduct of business	Depending on the extent of bringing free-riders into compliance, will be a positive effect for compliant companies as costs for recycling/waste management will be shared among more companies (+)	Likely to have positive impacts as there will be more competition between compliance schemes. (++)	Unclear, depending on the current levels of enforcement (+/-)

	Increased market surveillance	**Collective Compliance Schemes**	**Waste Trade**
Administrative costs on authorities	Market surveillance can be costly and unclear the extent to which the level of free riders might be reduced. Capacities in different Member States may be an issue (--)	There could be some costs associated with the administering of permit and other set-up costs; although these are not expected to be significant (0)	Monitoring and policing can be expensive and depends on amounts involved. Maybe limited benefits. Capacity to enforce may be an issue in some Member States (--)
Administrative costs on businesses	Unlikely to affect directly; unless costs are passed down by surveillance bodies through registration system (0)	No likely impact (0)	Direct impact unlikely (0)
Innovation and research	No direct effect (0)	No direct effect; indirect effect uncertain. More compliance schemes and competition may deter companies from innovating; as there will be more means to deal with waste. Depends on how producer responsibility schemes are set up. (+/-)	No direct effect (0)
Waste production / generation /recycling	May increase recycling as greater amount of WEEE may be collected (reduced number of free-riders) (+)	No clear impact on waste production but possibly on recycling volumes (+)	No clear impact (0)
Employment and labour markets	Changes in surveillance systems may affect number of staff required but unlikely to be significant (+/-)	Positive impact in the recycling sector (+)	Changes in surveillance systems may affect number of staff required but unlikely to be significant (+/-)

16 EVALUATION OF OPTIONS ACCORDING TO IMPACTS

It is clear from the preceding analysis that there is no 'one option fits all' and that different issues require different types of measures. For instance, issues related to scope may help harmonisation but may not be as affective in spurring innovation. Alternatively, aspects related to IPR may encourage innovation but there may be issues relating to free-riding if other additional measures are not implemented, such as increased surveillance with the additional costs implications on public expenditure.

The final decision will depend on the weight assigned to the different problems, with the decision-maker having to assess the different trade offs between the impacts; but this is likely to require more than one measure and indeed a combination of measures.

In addition, there will be uncertainty surrounding the impacts. This is because although some impacts may be easy to predict there will also be compounding and unexpected factors affecting them that are not easy to foresee from the outset. When uncertainty is so great, impacts have been graded accordingly (e.g. +/-) with the number of pluses and minuses reflecting the scale of potential impacts

The following table summarises the impacts with the greatest positive impacts as assessed above according to the different impact categories. Some of the potential disadvantages or trade-offs are also highlighted.

Table 16.1: Impacts of Measures – Overall assessment and trade-offs

	'Best Measure'	**Trade-offs associated with measure**
Strengthens IPR	Ensure that producers have the opportunity to opt for individual producer responsibility.	No significant trade-offs although it may increase the costs of authorities in terms of administering the registers and other monitoring arrangements.
Competitiveness, trade and investment flows	No clear best. The most positive impacts are expected from the options regarding the opening of registers and centralised European registration system. Also strengthening market surveillance systems within MS to minimise free-riders may have a significant positive impact on competitiveness.	These measures are likely to impose significant costs on public authorities. The impacts on innovation and research are unlikely to be significant.
Competition in the internal market	As above. In addition, other measures that are expected to have a significant positive impact include: • Clarification of scope and standards; • Standards for disassembly and recycling; • Opportunity to opt for IPR.	As above. The trade offs associated with the additional measures are; • Uncertain impacts, and potentially significant, on operating and administrative costs of businesses; • Costs to authorities of monitoring; In addition, the impacts on innovation are not expected to be significant with the exception of the standards for disassembly and recycling and opting for IPR.
Operating costs and conduct of business	Overall, impacts from the measures are difficult to predict. The measures with a more likely positive impact are those related to harmonisation and competition. This is because it will remove barriers to trade and increase flexibility.	The downside of any measure related to harmonisation and competition is the administrative costs on authorities. Impacts on innovation and research are not always clear.
Administrative costs on	Amend Article 12.1 with mandatory instructions regarding content, timing, etc. of reporting	No significant trade-offs. Indeed, other positive impacts could also be expected from harmonisation of

	'Best Measure'	Trade-offs associated with measure
authorities		reporting requirements (economies of scale)
Administrative costs on businesses	As above	No significant trade-offs.
Innovation and research	Delete Article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy Using Products. Also, ensure that producers have the opportunity to opt for IPR.	No significant trade-offs with the first measure. There may be cost implications for public authorities associated with the second measure in terms of administering the registers and other monitoring arrangements.
Waste production / generation / recycling	Establish standards for disassembly and recycling based on stringent scientific research, Amend Article 7 to clearly establish process for developing standards.	There may be some costs implications for businesses and authorities. It also likely to increase administrative costs of business from increased reporting.
Employment and labour markets	As above, as it may encourage employment in the recycling sector. Although impact is unlikely to be significant.	As above.

The following Tables show the total score by type of measure. Note that positives and negatives have been aggregated without any weighting. The following conclusions can be drawn by type of measure:

- There will be positive impacts from clarifying the scope and issues related to the categories of goods and products covered by the directive although the scale of impacts will finally depend on how the new scope is formulated and the clarity and acceptability of the guidance to be provided. The impacts on businesses are highly uncertain and will vary across Member States as current legislative frameworks are more stringent in some Member States than others;
- Ensuring that producers have the opportunity to opt for individual producer responsibility will have the greatest benefits on competition and innovation and research. This view has been voiced by some of the stakeholders consulted for this study and re-stated in some industry position papers;
- Opening registers seems to be the measure with regard to harmonisation with the largest positive impacts: as noted above, the largest positive impacts would be expected in terms of increased competitiveness and competition and will guarantee a level playing field for companies in the EU and outside the EU. The trade-offs were those related with the costs of administering the registers.
- Allowing collective compliance schemes with limited restrictions will be the measure with the greatest impacts on competition. No negative impacts can be foreseen with this measure; although the impacts on innovation and research are uncertain. Although more compliance schemes may help companies dealing with any type of waste minimising their cost, there is also scope for setting up exclusive agreements that may spur innovation;

Table 16.2: Impacts of Measures related to Scope and Standards

	Scope & Standards	**Increased collection targets**
Brief Description	Clarify scope and issues relating to categories of goods and products, finished products, use of goods in products not covered by the Directive etc. Amend Article 2 and provide unequivocal guidance through amended annex and FAQ	Careful monitoring of the ability of schemes to collect specified amounts is required prior to changing targets. Amend Article 5 to require Member States to monitor and report regularly to the Commission. Include provision to set higher targets according to portfolio of products in-country. Possibly complicated and would result in different targets for different countries
Total Score	**+2**	**-2**

Table 16.3: Impacts of Measures related to IPR

	IPR	**Financial guarantees**
Brief Description	Ensure that producers have the opportunity to opt for individual producer responsibility. Currently this choice does not exist in a number of states and will require significant changes to some Member States established systems. But mechanisms still need to be worked out	Common approach across Member States to the nature of guarantees required
Total Score	**+11**	**+2**

Table 16.4: Impacts of Measures related to Harmonisation

	EuP –Eco-design	**Opening registers**	**EU centralised registration system**	**Reporting**	**Labelling and Information requirements**	**Disassembly and recycling**
Brief Description	Delete article 4 from the Directive and focus efforts on eco-design for recycling under Directive 2005/32/EC on design of Energy using Products	All registers should be opened to non-national companies without representation in-country Amend Article 12 or introduce new Article specifying standard and open registration practice	Harmonisation of registration processes across Member States. Move towards centralized European registration system Introduce new article in Directive on European Centralised Register	Amend Article 12.1 with mandatory instructions re. content, timing etc. of reporting	Amend Article 10 to define standardised labelling requirements across MSs as mandatory	Establish standards for disassembly and recycling based on stringent scientific research. Amend Article 7 to clearly establish process for developing standards
Total Score	**+3**	**+7**	**+6**	**+4**	**+3**	**+4**

Table 16.5: Impacts of Measures related to Competition

	Increased market surveillance	**Collective Compliance Schemes**	**Waste Trade**
Brief Description	Strengthened market surveillance systems within Member States to minimize free-riders. Amend Article 16 Inspection and monitoring to specify inspection and monitoring obligations of Member States in greater detail and possibly introduce targets?	Ensure that all transposition of the Directive does not impose any restrictions on the numbers of compliance schemes that can operate within a country Amend Articles 5, 6 and 7 or introduce new article on Producer Compliance Schemes which obliges Member States to avoid any restrictions (direct or indirect) on the numbers of schemes that can operate Straightforward in terms of amending or adding Articles. Will need careful wording. Potentially significant effects on competition for some product groups	Stronger enforcement of legislation on shipments of waste through increased monitoring Amend Article 6.6 to include strong monitoring requirements to be enforced by Member States
Total score	**+5**	**+7**	**+1**

In the following table are listed Member States that have transposed Article 8(2) in such a way that for new WEEE the provision that producers should be individually responsible for the waste from their own products appears to be ignored. In many of the countries listed, allocation of financial responsibility for new WEEE is to be determined by a current market-share when costs are incurred, as in the historical WEEE financing mechanism.

Table 16.6: Implementation of Article 8.2 in different Member States

Member State	Rationale
UK	No distinction made in Regulation 8, market-share allocation of both new and historical mandated. However, Schedule 3: regulation 6. new 28A (2) Mandates each scheme to submit a report by 31 Dec 2007 b(i) how members will finance their own future WEEE b(ii) how scheme provide a guarantee for future WEEE
Bulgaria	Art. 11(4) mandates producers to collect a relative share of the required kg/capita/yr of WEEE, calculated based on the market-share of that producer in the obligating year Article 11(5) although distinguishes between historic and future WEEE, simply states that … each manufacturer or importer shall for performing their obligation under 11(4), collect both historic and future WEEE
Denmark	No distinction made between financing historical and future WEEE in Section 16 of Statutory Order No. 664 Market-share allocation mandated in 16(1)
Finland	No distinction made between financing historical and future WEEE in Section 6 of Government Decree 852/2004 and Chapter 3a, Section 18a(1) and Section 18c(2) of Waste Act
France	Article 13 mandates markets-share calculation for both historical and future WEEE
Greece	Article 7: No distinction between historical or new WEEE, only financing obligation
Latvia	Section 20^4 no distinction between historical and future WEEE financing requirements
Slovenia	13(1,2,3) mandates financial responsibility of all WEEE collected , allocated by market-share
Source: OKOPOL, iiiee, RPA (2007): The Producer Responsibility Principle of the WEEE Directive, Draft Final Report, July 2007	

Thus even for the most promising option with respect to innovation, the impacts are likely to vary regionally. For those countries where Article 8.2 does not take account of own waste the impacts are likely to be greater.

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ANNEXES

Annex 1: Stakeholder workshop of 3 July 2007

Annex 2: Analysis of other legislation for the assessment of potential synergies and conflicts