Individual Producer Responsibility in the WEEE Directive - From Theory to Practice?

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2008

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From Theory to Practice?

Doctoral dissertation

the international institute for industrial environmental economics

Lund University, Sweden

IIIEE DISSERTATIONS 2008:3

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Chris
VAN ROSSEM

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December 2008

The International Institute for Industrial Environmental Economics
Internationella miljöinstitutet

Maria Scolieri created the 'pop art' painting on the front cover for the author of this research. It reflects the artist's interpretation of Extended Producer Responsibility for Electrical and Electronic Equipment after the WEEE Directive and the product categories included were briefly described to her.

Doctoral thesis in industrial environmental economics
at the International Institute for Industrial Environmental Economics
at Lund University
under the academic supervision of
Associate Professor Thomas Lindhqvist
Associate Professor Lars Hansson
and
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Published in 2008 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.
Printed by KFS AB, Lund.

ISSN 1402-3016
ISBN 978-91-88902-45-0

Acknowledgements

First and foremost I would like to recognise the support and guidance that my main supervisor Thomas Lindhqvist has provided me during this journey. Thomas, you have helped me in so many ways and I hope you know how much I appreciate all the support and kindness you have shown me. I've enjoyed having the opportunity to work with and learn from you over the last 6 years and I hope that we will continue to collaborate in some form or another.

Naoko Tojo has played an important role throughout this work and especially during the final stages of the write up. Without her sound and critical reasoning this process would have been a lot more difficult than it already was. I've been fortunate to have three supervisors looking out for me and I'd also like to say a word of appreciation to Lars Hansson for always taking the time out of his busy schedule to discuss my work.

Many thanks to my office mate and friend Carl, who has been a great support and colleague over the years. The amount of chocolate I 'borrowed' from you can probably not be measured. I always thought of it as pay-back for your role in the state of the office, which by the way, I never really minded because it made me look organised.

The IIIEE is truly an amazing organisation and I am grateful for the time I have spent here. The building is inspiring in itself, but it is the people, both present and former staff, that make it such a special place. Thank you all for the creative discussions and so many fantastic times, with special mention to my friends and colleagues Luis, Kes, Lotta, Bea, Fredrik, Åke, Philip, Håkan R, Murat, Andrius, Panate, Berni, Lars, Peter A, Oksana, Renato, Han, Zina, Dagmara, Tareq, Helen, Adriana, Hanna R, Kristina, Mihai, Lena, Mikael, Palle, Torvald, Torbjörn, Kate, Mårten, Tomas K, Don, Paola and TBJ. I'm appreciative of the administrative staff for support over the years. Thank you Gerd, Sinnika, Sengül, Gunilla, Karin, Elna, Agneta and Håkan E.

My gratitude extends to the Swedish EPA for financing the FLIPP programme within which my research project was situated and provided most of the financing for my PhD. It has been a pleasure to work with Emma, Johan, Anne-Marie and Henrikke from the Chalmers delegation. A word of thanks also to Stiftelsen Svenskt Kretslopp for supporting earlier projects.

I have learned a great deal about the business and political side of EPR implementation in my interaction with practitioners in the field and I am grateful for the exchange of ideas and information that you all have provided. A special thanks to Viktor Sundberg, Melissa Shinn, Mark Dempsey, Anders Sverkman, Kieren Mayers, Nathalie Cliquot, Frans Loen, Tomas Tengå, Gregor Margetson, Luk Van Wassenhove, Atalay Atasu, Reid Lifest, Mariana Herold, Karl Edsjö, Jean Cox-Kearns and Johan Näslund. And to all the people at Greenpeace International who have been interested in my work, thanks, and keep doing what you do best.

Thanks to my pals on the innebandy court Peter, Nico, Murat, Henrik, Frederik, Håkan, Calle, Lars, Cook and Parker for helping to keep me relatively fit. A bit of slashing and bashing was what I really needed now and then. Thank you also to my sister-in-law Maria for the fantastic painting that is adorning the cover of this book.

I'm grateful to my parents Pam and Joop, for always being interested in our lives here in Sweden. I want to thank you both for your continued support and for providing me with the right foundation to have built my life upon.

And finally, a few words to the most important people in my life, my beautiful wife Susanne and my children Oliver and Emily.

Susanne, without your enduring love, support and belief in me, this work would have never come to fruition. I am truly a lucky man to have found you and I look forward to the time when I can return to you all that you have done for me. To the two greatest kids in the world, Oliver and Emily, thanks for keeping my spirits up.

Chris van Rossem

Lund, December 2008

Executive summary

Background and Purpose

Traditional environmental policies have tended to focus on *process-related* environmental impacts from production activities, as these were often the most visible form of environmental pollution. More recently there has been a shift in policy focus from process-oriented considerations to what can be called a more product-focussed approach. Although policies focussing on production processes have been relatively effective in reducing pollution levels from point-sources, they have been less effective at addressing consumption-oriented problems, or dealing with diffuse emissions from products.

It is in the above context that the principle of Extended Producer Responsibility (EPR) has emerged and finds its value. EPR embodies the idea of *life cycle thinking*, has an inherent *product focus* and has the overall aim to reduce environmental impacts of products at *source*, by providing *incentives* through the extension of responsibility to the actor most capable of making the necessary change.

More explicitly, the EPR principle is considered to be built on two main environmentally-related goals. The first includes the goal to promote upstream design changes of new products primarily aiming to reduce the impacts from end-of-life management. The second goal centres on ensuring downstream improvements of collection and recycling infrastructure that facilitates high re-utilisation of products, components and materials.

Undoubtedly, there has been a wide uptake of EPR by governments around the world as a suitable policy approach to address the environmental impacts associated with the waste management of products This includes the desire to shift the costs away from taxpayers and on to producers and consumers. However, in the current discourse over what constitutes successful EPR policy implementation, there is an on-going debate over the ability of programme design to include an appropriate *incentive mechanism* to stimulate producers to improve the design of their products for reduced life cycle impacts, and especially the impacts and costs from the end-of-life management.

Electrical and Electronic Equipment (EEE) is one such wide ranging product group that has been at the centre of this debate. In the European

Union, the adoption of the Directive on Waste Electrical and Electronic Equipment (WEEE) at the end of 2002 was considered a landmark piece of EPR legislation. With respect to the EPR principle discussed above, the final text of the directive included an *explicit* goal of encouraging the design and production of EEE which take into full account and facilitate their repair, possible upgrading, reuse, disassembly and recycling. The main mechanism to achieve this goal is through use of *individual producer responsibility (IPR)*, where each producer is responsible for the waste from his/her own products as outlined in Article 8(2) of the Directive text.

It is in this context that the current research is placed, where on the one hand there is evidence to suggest that the theory behind EPR programme implementation with clear incentives can motivate producers to improve their product designs – against a rising tide of scepticism over the ability to implement such incentives in practice.

With this in mind, the overarching purpose of this thesis is to contribute to the understanding of how Extended Producer Responsibility (EPR) programmes can be structured to maximise incentives for improved environmental performance of products and product systems, especially from an end-of-life perspective. In this research the product area of electrical and electronic equipment (EEE) will be the focus of this investigation. To address the objective the following four research questions were chosen:

- What evidence is there that EPR legislation and practical implementation of EPR programmes with clear incentives will incite producers to design products for reduced end-of-life impacts and costs?

- What has been the European experience to date in embedding incentive-based EPR, firstly into applicable legislation and secondly into operational programmes for the management of household WEEE?

- Why is it so difficult to implement incentive-based EPR programmes for WEEE in the European context?

- How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?

Research Methodology

The starting point of this research is the assumption that EPR programmes based on IPR will provide the mechanism to incite producers to make self-interest design changes that are in line with cost reductions and environmental improvements at end-of-life.

Given the timing of the implementation of the WEEE Directive with respect to this research it was not possible to 'test' this hypothesis empirically. At the same time it was becoming increasingly apparent that the transposition process that would enable IPR was jeopardising its introduction. Therefore, the researcher explored the development and transposition of the WEEE Directive and its implications for IPR. In addition, supplementary cases where IPR had been embedded in the EPR programmes were reviewed. The current reality of implementation is compared with the principle of EPR, or rather the theory behind the principle, through both inductive and deductive analysis. From this process, factors deemed to be influencing the transposition and practical implementation are summarised and a characterisation of possible IPR implementation typologies is proposed.

As a means of organising this research, a *multiple, instrumental case study approach* was utilised. Cases on different levels, in terms of geographical boundaries and product scope are investigated and organised under the following three studies.

- Study 1: Product-Specific Environmental Information: Applicability of available data for determining individual product end-of-life cost/revenue structures for waste electrical and electronic equipment (WEEE).

- Study 2: The Producer Responsibility Principle of the WEEE Directive: DG ENV Study Contract N° 07010401/2006/449269/MAR/G4.

- Study 3: EPR programmes with elements of IPR: Japan SHARL, Maine's E-Waste Law, Bosch led Power-Tool Consortium, ICT Milieu and SWICO A-signatories.

The research is complimented by participation in a number of working groups focussing on practical implementation of IPR and literature review.

Main Findings

Regarding *EPR and its impact on inducing design change* there are a number of key conclusions that can be drawn from reviewing the pertinent literature. Clearly there are varying results regarding the effects of EPR legislation on product design found in the empirical research on EPR programme implementation for vehicles, EEE, and packaging.

Reviewed studies which have suggested that EPR programmes have had limited impact on product design, have pointed to a number of reasons why. One such reason includes the relatively low compliance cost associated with financing end-of-life products when they are placed on the market compared with other business costs. It has also been suggested that in many cases these fees are unavoidable and represent more of an output tax (when expressed as a fixed fee), thus providing no incentive for altering firm behaviour. Additionally, since consumers are often willing to absorb costs with little demand implications (price inelasticity), producers are even more reluctant to push for change in financing models. In some way these results are hardly surprising given that in the particular EPR programmes reviewed, there was never an intention to illicit change on behalf of producers, as the focus was rather on designing cost-covering measures.

On the other hand, while many of the studies documented explicit changes to both product design (upstream measures to improve end-of-life performance) as well as downstream improvements to collection and recycling infrastructure, they pointed to the role of anticipatory effects of the EPR legislation on firms decisions to innovate, rather than from the implementation of the programme and clear incentives themselves. In particular the WEEE, RoHS and ELV Directives have been cited as the key drivers in the literature.

An extensive review of the WEEE Directive, from its early stages of a working document to the transposition of the Directive into national laws, statutes and legal instruments of the 27 Member States (MS) of the European Union has been undertaken in this research. With respect to the provisions that relate to IPR, namely Article 8(2), the transposition outcome in the 27 MS is rather disappointing, but not all that surprising given the historical context. A closer look at the development of the Directive revealed that the Council and the Parliament were clearly not in agreement over the suitability of individual financing to drive innovation. The refinement of IPR continued through the co-decision process, starting from a simple concept that evolved into a detailed and complex mechanism requiring the need to distinguish between new and historical products, producer identification measures, as well as the need for financial guarantees.

While the final text of the WEEE Directive maintains the principle of IPR within Article 8(2), there are numerous ambiguities that allow a wide interpretation of its meaning. To recap the transposition outcome, 9 MS have been identified as correctly transposing Article 8(2) as intended in the spirit of IPR, while 11 MS have what can be described as an ambiguous interpretation and 8 MS clearly ignore IPR and even explicitly assign a collective responsibility.

The second part of Article 8(2) on the requirement for a financial guarantee shows similar results that are in line with above. Even though many MS simply list the options as they appear in the WEEE Directive, all MS – with the exception of Sweden and Germany – consider membership in a collective compliance scheme a suitable financial guarantee. As these systems are based on the idea of reciprocity, meaning that each member agrees to finance a share of orphans and free-riders, MS presumably are confident that the costs of these orphans and free-riders will not fall to them. This decision has lock-in effects, encouraging the continuation of collective financing for historic WEEE and new WEEE indefinitely.

MS have also transposed the definition of producer, to be the actor that brings products on to the national market. While this would first appear as a sound way of identifying a legal actor on the national market, it does have serious ramifications for IPR implementation. This is for 3 main reasons.

Firstly, due to common business procedures in line with the principle of the internal market, products frequently pass from MS to MS via distributors, wholesalers and national importers. However, when MS apply a national definition of producer, the product may inevitably end up having many producers on the European Market.

Secondly, in order to implement IPR in practice, identification of the producer is essential. Considering the above discussion, this implies that national producers would need to re-label products with their national producer identity so that when the costs arise at end-of-life an appropriate producer could be identified. Additionally, if the producer had become insolvent, then the guarantee would need to be called upon from the appropriate producer.

Thirdly, it is questionable whether a retailer or wholesaler (that inevitably becomes the producer on the national level because of the national definition of producer) is the appropriate actor to react to the incentive created by IPR in the first place. In summary, if not corrected the results of the transposition outcome regarding IPR relevant requirements do not allow practical IPR implementation to emerge. This only reinforces the continuation of collective systems employing PAYG financing models with little or no incentive for design improvements.

In addition to the technical barriers to implementing IPR as discussed above other impediments include identifying producer's individual product as well as employing methods to differentiate the costs to manage those products in the recycling stream. Other barriers include many uncertainty factors over whether the investment made in design will yield sufficient net present value given the potentially long pay back periods for durable electronics. While not openly discussed by producers, Article 8(2) my also have implications for accounting practices in which provisions need to be made in the balance sheet for future costs associated with a producer's own products when they are returned.

At the same time, while many arguments put forward that systems organised by individual producers do not enjoy economies of scale and are less effective, there are numerous producers and NGOs that are actively lobbying to ensure IPR as it is formulated in Article 8(2) remains. Part of the explanation why there is such a resistance to IPR is the belief that it implies all producers need to build their own collection and recycling infrastructure. However, specific cases within this research show that there are a number of real world examples of IPR implementation within collectively organised systems.

While it has been illustrated that IPR can be implemented in both collectively organised systems as well as independent own brand compliance systems, current implementation of the Directive in MS discriminates against independent systems. As producers complying collectively need not supply a financial guarantee, independent systems are at a financial disadvantage. Additionally, most MS have allocated physical responsibility to municipalities to collect WEEE from private households. Individually organised producer systems have been often been denied access to the waste stream. Since collection is often partially or fully financed by taxpayers and independent compliance schemes do not have access, this compliance option is less attractive to producers.

Concluding Remarks

As the review of the WEEE Directive moves closer to the Commission's release of the proposal for a revised Directive in December 2008, or early 2009, the debate concerning individual producer responsibility vs. collective producer responsibility is sure to be in the forefront once again. It is hoped by the author of this research that the conclusions found within this research may provide some value to policy-makers.

The potential solutions to the definition of producer in Section 11.1.1 would be especially relevant in the upcoming discussion. This solution has the potential to address many of the other implementation issues of the national approach to identifying producers, including the requirement to re-label products for producer identification, and potentially multiple producers for the same product on the European market. It is the view of this author that one of the major stumbling blocks for moving forward on IPR was many Member State's concern over having to assume financial responsibility for any orphan new WEEE that might arise in the event that guarantees were not available or where producers never registered. This calls on the European institutions to address this impasse through strong signals to the market over what constitutes a suitable guarantee. This in turn would incite financial institutions and insurance firms to develop innovative financial solutions for the market.

Alternatively, the issue of guarantees could be rethought altogether drawing on solutions in other jurisdictions where orphan WEEE is financed by producers on the market when those costs arise, either proportioned to market share or return share. This however, would be a step away from the strict principle of IPR as currently defined in the WEEE Directive.

As this research has illustrated, implementing IPR in Europe has not been a simple task whereby in this case 'the devil appears to be in details'. At the same time, evidence has suggested that strong signals sent to industry in the late 1990's regarding expected IPR implementation have stimulated a great deal of activity in product design and the development of downstream infrastructure for managing WEEE. While IPR implementation should not be seen as a 'silver bullet' its value in EPR policy design is clear. Failure to implement it sends an unfortunate message, not only to producers, but also to policy-makers in other jurisdictions.

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Abbreviations

BITKOM	German Association for Information Technology, Telecommunications and New Media
CECED	Association of European Manufacturers of Household Appliances
CPR	Collective Producer Responsibility
DfE	Design for Environment
DfR	Design for Recycling
EICTA	European Information & Communications Technology Industry Association
EC	European Commission
ELC	European Light Companies Federation
ELV	End-of-Life Vehicle
EoL	End-of-life
EP	European Parliament
EPR	Extended Producer Responsibility
FPD	Flat Panel Display
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
IPP	Integrated Product Policy
IPR	Individual Producer Responsibility
JBCE	Japan Business Council of Europe
LHA	Large Household Appliances
ODS	Ozone Depleting Substance
OECD	Organisation for Economic Cooperation
OEM	Original Equipment Manufacturer
ORGALIME	The European Engineering Industries Association (Organisme de Liaision des Industries Métallliques Européennes)
PAYG	Pay As You Go
PRO	Producer Responsibility Organisation
SDA	Small Domestic Appliances
SHA	Small Household Appliances
SR	Shredder Residue
MS	Member State (of the European Union)
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WSR	Waste Shipment Regulation

CHAPTER

ONE

1. Introduction

Chapter one aims to set the scene of the overall research presented in this thesis. It begins with a brief overview of the background to the research area. In Section 1.2 the main aim of the research is presented, followed by an explanation of how the research has evolved in Section 1.3. Section 1.4 provides a chapter by chapter outline of the research which is followed by definitions of key terms used in this thesis.

1.1 Background to the Research

It is becoming more and more evident that our current *patterns of consumption and production* are leading to significant environmental impacts. By the year 2030 the world economy is expected to double and global population to grow by one-third compared with today's levels. These trends will continue to assert pressure on natural resources and the assimilative capacity of the environment which may ultimately threaten the long term viability of the earth to sustain life.

Traditional environmental policies have tended to focus on the *process-related* environmental impacts from production activities, as these were often the most visible form of environmental pollution. Regulations that emerged in the 1980s required large investments by industry in 'end-of-pipe' technologies to treat emissions to air, water and land. Much of the attention of authorities was directed towards monitoring and enforcing pollution emission targets imposed on industry. However, policy-making over the last past decades has begun to change considerably. A move towards more preventative measures, including the notion of 'prevention at source', led to the emergence of such concepts as cleaner production and the waste management hierarchy (Tojo, N, 2004).

More recently there has been a shift in policy focus from merely process considerations to what can be called a more product-focussed approach. Although policies focussing on production processes have been relatively effective in reducing pollution levels from point-sources, they have been less effective at addressing consumption-oriented problems, or dealing with diffuse emissions from products. Today, we face constantly growing volumes of waste, increasing environmental impacts from transport and an increase both in the number and volume of chemicals on the market. The shortcomings of traditional policy approaches call for the development of new ones (Dalhammar, C, 2007).

By viewing environmental aspects through a product lens, the entire life cycle of the product is considered, from raw material extraction, production, distribution, use and end-of-life management. *Life cycle thinking* thus creates a more holistic view to environmental management and policy as it aims to avoid the risk of simply shifting environmental problems between life cycle phases or environmental media.

At the same time, it is being increasingly recognised that if moves towards a more sustainable economy are to be successful, then the concept of *stimulating innovation* needs to be more central to environmental policy design. This raises questions regarding the most appropriate policy instruments to help stimulate innovation, but also raises more fundamental questions regarding the process of how environmental policy can play a role in directing firms' innovative behaviour (DG Enterprise, 2002).

It is in the above context that the principle of Extended Producer Responsibility (EPR) has emerged and finds its value. As discussed in more detail in Chapter 2, EPR embodies the idea of *life cycle thinking*, has an inherent *product focus*, and has the overall aim to reduce environmental impacts of products at *source*, by providing *incentives* through the extension of responsibility to the actor most capable of making the necessary change.

To be more explicit, the EPR principle is considered to be built on two main environmentally-related goals. The first includes the goal to promote upstream design changes of new products primarily aiming at, but not limited to, reducing the impacts from end-of-life management. The second goal centres on ensuring downstream improvements of collection and recycling infrastructure that facilitates high re-utilisation of products, components and materials.

As EPR is as policy principle, it needs to be implemented through the use of administrative, economic and informative policy instruments[1]. Practical application to date has usually included the physical and/or financial obligation for producers to take-back their products at end-of-life, including collection and recycling targets and in the EC policy context, the restriction of hazardous substances in products that are known to cause environmental impacts during the waste management phase.

Undoubtedly, there has been a wide uptake[2] of EPR by government around the world as a suitable policy approach to address the environmental impacts associated with the waste management of products, including the desire to shift the costs away from taxpayers and on to producers and consumers. However, in the current discourse over what constitutes successful EPR policy implementation, there is an on-going debate over the ability of programme design to include an appropriate *incentive mechanism* to stimulate producers to improve the design of their products for reduced life cycle impacts, and especially the impacts and costs from the end-of-life management.

Electrical and Electronic Equipment (EEE) is one such wide ranging product group that has been at the centre of this debate. In the European Union, the adoption of the Directive on Waste Electrical and Electronic Equipment (WEEE) at the end of 2002 was considered to be a landmark piece of EPR legislation. With respect to the EPR principle discussed above, the final text of the directive included an *explicit* goal of encouraging the design and production of EEE which take into full account and facilitate their repair, possible upgrading, reuse disassembly and recycling. The main mechanism to achieve this goal is through use of *individual producer responsibility* (IPR), where each producer is responsible for the waste from his/her own products.

It is in this context that the current research is placed, where on the one hand there is evidence to suggest that the theory behind EPR programme implementation with clear incentives can motivate producers to improve

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1 Theoretically the principle of EPR can be taken up by producers voluntarily, and therefore its application is not limited to governmental policy application.

2 EPR programmes have been implemented in many OECD countries for product groups such as packaging, automotive tires, vehicles, batteries, electronics and pharmaceuticals.

their product designs – against a rising tide of scepticism over the ability to implement such incentives in practice.

1.2 Research Objective

The overarching purpose of this thesis is to contribute to the understanding of how Extended Producer Responsibility (EPR) programmes can be structured to maximise incentives for improved environmental performance of products and product systems, especially from an end-of-life perspective. In this research the product area of electrical and electronic equipment (EEE) will be the focus of this investigation.

1.3 Evolution of the Research

The idea to research 'how EPR programmes for EEE can be structured to maximise incentives for improved product design for end-of-life' first emerged in the year 2002. At that time the author was involved in a research project that was investigating how product-specific environmental information could be used to determine individual product end-of-life costs or revenues when treated in recycling facilities. The context for the study was the future implementation of the European WEEE Directive that was scheduled to take effect in August 2005. Given the clear preference of the legislators to implement individual producer financing as a means to incite eco-design, research into potential mechanisms that could be used to differentiate costs between individual producer's products was warranted.

This project was financed by Stiftelsen Svenskt Kretslopp, a research foundation set up by the Swedish insurance company, Länsforsäkringar AB, which had a specific interest in developing company knowledge in the area of product recycling. A particular focus of the foundation was to support projects that highlighted the economic effects of producer responsibility on products covered under the WEE Directive. Interestingly, Länsförsäkringar AB had lobbied extensively for the inclusion of recycling insurance to be included as an appropriate financial guarantee according to Article 8(2) of the WEEE Directive. Its intention was to develop such insurance solutions for the market. The outcome of the research project on differentiating fees in EPR systems is presented in Chapter 6 and forms an important part of this thesis (van Rossem, C, 2003).

In 2002-2003 when the IIIEE prepared an application for an IPP research programme, the author was invited to develop an individual research project. The 5-year research programme, 'Furthering Life Cycle Considerations through Integrated Product Policy (FLIPP)', was approved by the Swedish EPA. The specific project developed by the author was titled *"Corporate strategies for end-of-life management of WEEE: Implications for the product service system (PSS) concept"*. The purpose of the project was to add to the further understanding of what are the key environmental and business implications of individual producer responsibility systems for business-to-business and consumer product recovery.

At that time, the author was convinced that the WEEE Directive had the potential to support new proposed business models based on the product service system (PSS) concept. Again, it was the anticipation of incentives provided by the financial mechanism embedded in the WEEE Directive that encouraged the author to explore the connection between EPR and PSS. There was also considerable industry speculation at the time over how actual systems that were based on individual financial responsibility might develop and eventually be structured. The project was to be built on case studies where pioneering producers had developed individual take-back programmes for business to business (B2B) products. These would be investigated, and the feasibility of extending the programme to products sold to consumers was to be explored.

On the recommendation of the Swedish EPA the project was delayed until mid-July 2004 so that the project could align better with the outcome of the WEEE Directive transposition into the Member States of the European Union (MS) laws. During this period companies that were known to have individual take-back programmes for B2B products were approached to be included in the study. However, at this point in time most of the electronics company environmental employees were immersed in preparing for the upcoming Restriction of Hazardous Substances (RoHS) Directive, ensuring that their products were compliant with the law. At the same time it was also becoming apparent that the transposition was proving to be complicated, and that many MS were not interpreting the requirement for individual financing as was originally intended.

This forced the author to re-evaluate the focus of the research from that of how EPR influences corporate environmental strategy, to that of the policy implementation process and how incentives could be effectively included in the WEEE Directive and EPR policy in general. It was clear that an assessment needed to be made of how the transposition process would impact the original assumptions that the FLIPP project was based upon.

These developments would set the research agenda for second half of the research period, namely a focus on the transposition process in MS and the development of producer compliance schemes to meet producer's obligations. As the background research into transposition progressed, the author quickly began to realise that the original ideas behind individual financial responsibility were in jeopardy of being 'lost in transposition' (van Rossem, C et al., 2006).

During the first half of 2005 the author, with colleagues at the IIIEE, were invited by Environment Canada, to develop an assessment tool aimed at policy-makers and operators of producer responsibility organisations (PROs). The EPR Evaluation tool was designed to be used to determine how well practical EPR programmes had incorporated the EPR principle within their operational and financial models. This provided the opportunity to test the tool on a number of 'product stewardship' programmes in Canadian provinces for packaging, used oil and tires (Lindhqvist, T & van Rossem, C, 2005).

At the end of 2006, the author and colleagues at the IIIEE (as part of a larger research consortium) were successfully awarded a contract by the European Commission to review the producer responsibility principle of the WEEE Directive (Sander, K et al., 2007). This study was in support of the on-going review process of Directive which was launched earlier that year. This provided an opportunity to study in detail the outcome of the transposition process in all 27 MS, including 4 case studies on practical implementation in Germany, Sweden, Ireland and Lithuania.

Many opportunities to work with actors that were in support of the concept of individual producer responsibility (IPR) arose during the second half of the research period. The author actively participated in an IPR practical working group made up of industry and academics interesting in researching solutions to implementing IPR in the WEEE Directive.

It is the culmination of all of the various projects and experiences that have provided the empirical data subsequently analysed and used to make conclusions regarding the research questions. Details of the research design are further presented in Chapter 3 on the Research Methodology.

1.4 Thesis Outline

Chapter One presents the general background to the research area and formulates the main aim of the research. An overview of the various research projects that have contributed to the research is also provided.

Chapter Two provides the overarching framework that the research is built upon. It describes the origin and logic of Extended Producer Responsibility (EPR) as a policy principle, its goals and the rationale for its use in modern environmental policy making. At the end of chapter two, the Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE Directive) is introduced and its main provisions are described including a detailed description of its development by the European Institutions.

Chapter Three begins by revisiting the research objective and introducing the research questions. This is followed by an account of the research paradigm. In Section 3.3 an overview of the research design is presented including a description of the cases and research methods used in each study. The chapter ends with a discussion on validity and reliability of the research.

Chapter Four presents a detailed description of the end-of-life value chain, providing the reader with background on how typical EPR systems for EEE are operating in practice in Europe. This includes a description of the organisational and technical treatment processes that are involved in the management, recycling and recovery of a diverse range of end-of-life electrical and electronic equipment that fall under the scope of the WEEE Directive.

Chapter Five provides an overview of scholarly and practitioner views and opinions regarding EPR as a driver for product and process innovation. It summarises the empirical evidence found in the literature, and concludes that indeed the anticipatory impact of EPR programmes has been instrumental in motivating producers to review and alter their product design for improved end-of-life management, including supporting downstream innovations in recycling technologies.

Chapter Six explores how the characteristics of individual products influence end-of-life cost/revenue structures in managing WEEE. This case study explores the possibilities to differentiate compliance costs for individual producers' products in order to strengthen the incentives for improved product design in collective compliance schemes.

Chapter Seven presents the main findings regarding how Member States have transposed the WEEE Directive into their national laws. It summarises the main outcomes of transposition on key legal articles, including the definition of producer, allocation of responsibility for collection and recycling, and the financing mechanism which enables Individual Producer Responsibility (IPR).

In *Chapter eight* results of the implementation of the WEEE Directive are presented. This includes a general overview of implementation in the 27 Member States, including factors impacting possible IPR implementation.

Chapter Nine presents the results of the review of 5 EPR programmes for WEEE in which the system design has elements of Individual Producer Responsibility embedded in the operating structure.

In *Chapter Ten,* the main findings in previous chapters are summarised and analysed in the context of the research questions 1, 2 and 3 that are presented in *Chapter Four*.

Chapter Eleven specifically aims to answer research question 4 on *How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?*

In *Chapter Twelve* the overall conclusions of the research are presented in the context of the research questions which is followed by recommendations to policy-makers.

1.5 Definitions

Design for End-of-Life: In this context refers to an umbrella term encompassing similar concepts such as design for reuse, design for recycling and design for disassembly.

Dual use products: Electrical and electronic equipment that is used by both private consumers and by business users. Examples include laptop and desktop computers, mobile phones, desktop printers and refrigerators.

Economic Instrument: For the purposes of this dissertation, an economic instrument is defined as a mechanism to affect the relative cost of electrical and electronic products, or management of WEEE.

End-of-life: This term is used to describe the point in which a product is disposed of by its final owner.

Historical WEEE: Products that are placed on the market prior to the legislation coming into force are considered 'historical' WEEE. For Directive 2002/96/EC, this date was determined to be 13 August 2005.

Level Playing Field: The establishment of the same rules for all participants in an identified industry sector, geographical location or competitive sphere so as to remove barriers or increased costs that may exist for some participants and not for others.

Material Recycling: Means the reprocessing in a production process of the waste materials for the original purpose or for other purposes, but excluding energy recovery which means the use of combustible waste as a means of generating energy through direct incineration with or without other waste but with recovery of the heat.

New WEEE: In the context of the WEEE Directive refers to EEE that is placed on the market after 13 August 2005.

Orphan WEEE: WEEE that when returned has no identifiable producer that can be held financially responsible due to bankruptcy or other circumstances that lead to that producer exiting the market when the costs are incurred.

Pay-As-You-Go (PAYG): PAYG financial model is a mechanism to allocate costs of WEEE management to producers proportionate to their market share when those costs occur. The definition includes systems that charge producers a flat fee when placing a product on the market, which is usually based on an estimate of the number of products that are expected to be sold and the amount of all brands of WEEE expected to be returned in a given reporting period (usually annually). It also can apply to systems where current collection and recycling costs are based on market share calculations.

CHAPTER

TWO

2. Theoretical Framework: Extended Producer Responsibility (EPR)

Chapter two has the main purpose of introducing the origin and logic of Extended Producer Responsibility, which serves as the theoretical framework for this thesis. The chapter begins by providing a definition of EPR as a policy principle in Section 2.1. This is followed by a description of what the author considers the relevant goals of EPR that are particularly important to the research in this thesis. The rationale for implementing an EPR programme, a classification of the main types and allocation of responsibility, and EPR policy instruments are discussed in Sections 2.3, 2.4 and 2.5 respectively.

In Section 2.6, an important distinction is made between EPR programmes that are based on collective producer responsibility (CPR) versus individual producer responsibility (IPR), where it is hypothesised that systems based on IPR will provide more precise incentives for actors to innovate. This in turn should provide the right framework conditions for the goals of EPR to be realised. In order to familiarise the reader with how EPR programmes have to date been designed and implemented in practice, a generic description is provided in Section 2.7.

2.1 What is EPR?

Origins of the term Extended Producer Responsibility (EPR) can be traced to a report submitted to the Swedish Ministry of the Environment in 1990, titled "Modeller för förlängt producentansvar" [Models for Extended Producer Responsibility] (Lindhqvist & Lidgren, 1990). At this time EPR was elaborated as a *concept* and was developed based on the analysis of a number of Swedish and foreign recycling and waste management schemes, as well as experiences of policy-makers with the use of various policy instruments to promote Cleaner Production (CP) (Lindhqvist, 2001 p.29). A more formal definition of EPR was developed in 1991 that elaborated EPR as an environmental protection strategy (Lindhqvist, 1992).[3] Subsequently, in his doctoral dissertation published in 2000, Lindhqvist revised his definition to position EPR as a policy principle which he defined as:

> *Extended Producer Responsibility (EPR) is a policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling and final disposal of the product.*

The EPR concept was introduced at a time when several European countries, most notably Austria, Germany, the Netherlands, Switzerland and the Nordic countries began to develop or implement policy instruments, aimed at improving the management of end-of-life products (Lindhqvist, T, 2000). Tojo (2004) notes that development of the EPR concept can be viewed in the context of three main general trends in environmental policy-making at the time of its emergence. These include the prioritisation of preventative measures over end-of-pipe approaches, enhancement of life cycle thinking and a shift from the so-called command and control approach to a non-prescriptive, goal-oriented approach.

Although the term EPR was coined by Lindhqvist, the idea that less than optimal environmental outcomes had arisen from applying the common approach of dividing responsibilities for the environmental impacts of products between various actors was not new. In policy documents from Swedish, German and Dutch governments dating back to the mid-1970s, explicit mention of the need to involve the manufacturer and product designers in finding solutions to waste management and recycling issues was clearly articulated (Lindhqvist, T, 2000).

Extension of responsibility, explicitly implies a reallocation of responsibility to a part of the product chain which has the greatest ability to reduce the life cycle impacts of the product system through its actions, but at the current time has insignificant responsibility for those impacts to provide a strong enough incentive to do so (Davis, G, 2000).

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[3] "Extended Producer Responsibility is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product by making the manufacturer of the product responsible for the entire life cycle of the product and especially for the take back, recycling and final disposal of the product".

EPR should focus on results rather than prescriptive means to achieve the result. This goal-oriented approach to policy making provides more flexibility of implementation to producers allowing markets to provide the lowest-cost solution (Davis, G, 2000; Tojo, N, 2004).

Clearly, the implementation of the EPR principle in environmental policy-making falls in both product and waste policy arenas. While many EPR policy instruments when applied have the outcome of improving waste management practices and therefore impacts from waste, they specifically are targeted towards producers who particularly have control over the products causing harm. When viewed as a policy principle, EPR can provide the bridge between waste management policies and product-oriented environmental policies (Davis, G, 2000).

In addition to the early developments of EPR mentioned above, the OECD Secretariat has also been influential in the development of EPR and equally important in the promotion of its use in environmental policy-making today. Starting in 1994, OECD (financed by the Japanese government) initiated a 3-phase programme to examine the concept of EPR and over a 4-year period, several reports were published examining specific aspects of the concept.

In 2001, the OECD published the final report of Phase 3 in the form of a 'guidance manual for governments' that was intended to assist governments to design and implement effective EPR policies. In that manual the OECD defined EPR as:

> *An environmental policy approach in which a producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product's life cycle. There are two related features of EPR policy: (1) the shifting of responsibility (physical and/or economically; fully or partially) upstream to the producer and away from municipalities, and (2) to provide incentives to producers to incorporate environmental considerations in the design of their products (OECD, 2001).*

While the OECD's definition of EPR is considerably narrower than that of Lindhqvist's in terms of the life cycle stages addressed, both definitions stress that the main point of incidence as being at the post-consumer phase of the products' life cycle. Indeed EPR to date has been primarily incorporated in measures relating to the end-of-life management of products. However, this does not limit its influence on environmental impacts associated to other life cycle stages of the product. Products that are designed for reduced waste and increased recyclability decrease the amount of virgin materials that need to extracted, processed and manufactured, significantly reducing environmental impacts well beyond those associated with disposal (OECD, 2001).

2.2 What are the Goals?

What is clear in the debate over EPR and its effectiveness as an environmental policy approach is that there exists varying views regarding not only which policy instruments are included in its scope (see Section 2.5) but perhaps more importantly the overall *goals* of EPR (Lindhqvist, T & Lifset, R, 1998; Tojo, N, 2004).

Lindhqvist and Lifset (1998) identify four main views among scholars and practitioners of what constitutes the goal(s) that EPR attempts to achieve as an environmental policy approach. Generally speaking the first group simply view EPR as a strategy to divert waste from final disposal from landfill or incineration, otherwise known as 'downstream EPR'. The second view includes the same diversion goal as above but includes design for recyclability and other design activities that facilitate diversion from disposal within the goal of EPR.

A third group view the goal of EPR in terms of diversion from disposal and increased recyclability, but justify the intervention not only from mitigating environmental impacts from disposal, but also with respect to the environmental benefits that emerge in other life cycle stages as a result of recycling. These include reduced impacts from natural resource extraction as a result of the need for fewer virgin resources and less energy use when recovered materials are used in place of virgin materials. The final group believe that EPR should be aimed at optimising the environmental performance of a product throughout its entire life cycle.

This variation on the views of what constitutes the goals of EPR has implications when evaluating the effectiveness of such policy interventions. When analysing the utility of EPR in cost-benefit terms, a clear articulation of its goals is required, and specifically which costs and which benefits are included in the analysis (Lindhqvist, T & Lifset, R, 1998).

For example, whether the benefits of EPR coupled with recovery targets exceed the costs very much depends on what criteria are used to define cost and benefit. In a strict market efficiency view, recovery targets make sense if the targets would be achieved if all market failures and distortions were corrected (Lifset, R, 1993).

Typical market failures may include; resource depletion, government subsidies that favour primary resource extractions and use, environmental externalities that occur during resource extraction, environmental externalities that could be avoided through the substitution of virgin materials for recovered materials, and environmental externalities arising from disposal.

Within this context, as well as based on the definition of EPR provided in the OECD Guidance Manual and experiences from studies conducted at IIIEE, Lindhqvist and van Rossem (2005) developed an evaluation tool targeted towards policy-makers and EPR programme operators that is intended to be used to indicate to what extent the evaluated policy and programme design reflects the goals of EPR. Within the tool, the EPR principle is considered to be built on two main environmentally-related goals:

Goal 1. Design improvements of products – the EPR system should provide incentives for manufacturers to improve the environmental performance of products and the systems surrounding the life cycle of the products.

Goal 2. High re-utilisation of product and material through effective collection and re-use or recycling. This goal can be further divided into three sub-goals.

2a. Effective collection – A primary goal with an EPR policy is to ensure a high collection rate of the product in focus in order to avoid littering and abandoned products in nature. A related goal is to divert selected discarded products from the general waste stream in order to facilitate a more proper end-of-life treatment and utilisation of the product and its material.

2b. Environmentally sound treatment of collected products – Before being further processed many products need a pre-treatment in the form of dismantling and/or sorting. The aim of this can be to secure special treatment of hazardous components and materials, and to improve the possibilities for re-use and recycling.

2c. High re-utilisation of products and materials in the form of re-use and recycling – The EPR implementation should secure that products or their components, when appropriate, can be re-used, and that the materials are recovered and used for substituting the use of virgin materials, thus saving raw materials and avoiding the environmental impacts related to the extraction and processing of these materials (Lindhqvist, T & van Rossem, C, 2005).

2.3 Rationale for EPR

The imposition of EPR represents perhaps the most literal version of cost internalisation (Lifset, R, 1993). Assigning the financial and/or physical responsibility to producers for the end-of-life management of their products, in theory, should drive producers to re-consider issues around the end-of-life management of the products they produce. Rational producers will in all probability explore options to minimise the costs of end-of-life management through alterations in product design or choice of material.

The establishment of this feedback loop between downstream (end-of-life management) and upstream (product design) activities is a core feature within EPR, and is arguably the main differentiating factor between a system based on EPR and a mere take-back obligation (Lindhqvist, 2000). Therefore, designing EPR programmes that create or facilitate the establishment of feedback loops is essential to create the necessary incentives for producers to justify investments that positively influence the cost of end-of-life management.

Once strong feedback loops are established producers will strive to balance the costs associated with design change and increased material costs upstream with any savings that can be realised at end-of-life. Decisions made concerning product structural design and choice of materials will need to be balanced with expected increases or decreases in end-of-life costs downstream.

Product-oriented pollution prevention has lacked an underpinning principle to guide policy development. Some have suggested that the Polluter Pays Principle provides such an appropriate principle. The Polluter Pays Principle, as established by the OECD, has been the guiding principle for pollution control policies and production and process-oriented pollution prevention policies. However, according to Davis (2000), the Polluter Pays Principle is not well suited for product-oriented policy and EPR as a policy principle, supplements and more clearly defines the polluter pays principle (PPP):

> *EPR, on the other hand can provide the high-level consensus of a principle for pollution prevention policies that focus on product systems and design for environment instead of production facilities (Davis, 2000).*

2.4 Types & Allocation of Responsibility

Considering that EPR is the extension of responsibility to producers for activities traditionally not part of their legal obligations, a relevant question might be – responsibility for what? Although, extension of the responsibilities assigned to producers tends to vary between EPR programmes, in general there are three distinct types of responsibilities that can be found. These include financial responsibility, physical responsibility and informative responsibility (Lindhqvist, 1992).

Physical responsibility refers to the degree to which a manufacturer is involved in the physical management of his or her products and /or their effects.

Financial responsibility in EPR usually means that the producer will cover all or part of the costs for e.g. the collection, recycling or final disposal of the products he is manufacturing.

Informative responsibility signifies several different possibilities to extend responsibility for the products by requiring the producers to supply information on the environmental properties of the product he is manufacturing.

Other types of responsibility identified by Lindhqvist (1992) include, *ownership*, where a producer retains the ownership of the product and thus the responsibility through leasing or other business models such as selling services, and *liability,* where responsibility for environmental damages associated with products at various life cycle stages remains with the producer.

2.5 EPR Policy Instruments

As EPR is considered to be a policy principle, it is not in itself a legal mechanism or tool, but must be implemented through the use of administrative, economic and informative instruments. Although the choice of instruments that are included in any EPR programme may vary considerably from programme to programme, there is usually a mix of administrative, economic and informative policy instruments applied. Typical instruments (although not exhaustive) found in Figure 2-1 are described below.

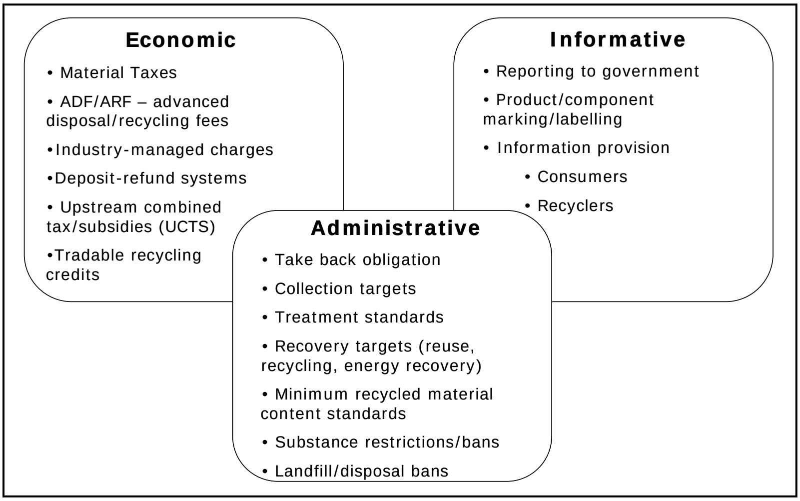

Figure 2-1: EPR Policy Instruments

2.5.1 Administrative Instruments

Command and control regulation or administrative instruments are labels that incorporate a wide range of regulatory practices that share the basic characteristic that government regulation dictates a particular end and requires industry to meet it (Lee, M, 2002). The most typical administrative instrument applied in EPR programmes is the mandate for producers to *take back* their products from customers when they reach their end-of-life. There may be *collection targets* imposed on producers or other actors to ensure that adequate systems are set up to collect end-of-life products at appropriate levels. In order to ensure that collected products are managed correctly there may be *treatment standards* which must be followed or achieved. This may be accompanied by *reuse, recycling and recovery targets* to ensure that a minimal level of reutilisation of materials in products and packaging takes place.

Minimum recycled material content standards have been used in EPR programmes to stimulate the demand for recycled materials generated through the collection and recycling system. Product manufacturers are required to have certain percentages of recycled materials in new products. This instrument has come under increasing pressure as it can be considered discriminatory and trade restrictive.

Substance restriction or bans of substances or materials that can cause negative environmental impacts when recovered, recycled or disposed have been common elements in EPR programmes, especially in the European Union. This is often to safeguard the environment from products that are not subsequently collected in the take-back system, as it is unlikely that all products will be recovered through the separate collection system.

Landfill/disposal bans of products covered under EPR legislation are used to encourage consumers and businesses to divert the end-of-life products to the separate collection infrastructure and not through mixed waste streams.

2.5.2 Economic Instruments

Economic instruments can be applied in end-of-life management of products or packaging in order to raise finance and/or stimulate prescribed behaviour via incentives (Turner, RK & Pearce, D, 1994). Economic instruments that have been used in respect of EPR programmes include the following:

A *materials tax* is an example of an input tax and would be imposed on the raw materials used to manufacture a product or packaging, with due account being taken of existing reuse and recycling rates. To meet the criterion of economic efficiency the size of the levy or charge needs to be directly connected to the environmental damage done by the production and consumption of the product, plus any scarcity premium if relevant (Turner, RK & Pearce, D, 1994). However it is noted that where existing legislation covers environmental impacts from earlier stages of the product life cycle, a levy may need to reflect only the end-of-life costs.

Advanced recycling fees (ARF) or advanced disposal fees (ADF) levied by governments can be considered product charges and are in contrast to a materials tax, considered to be output taxes. Financing charges have been used to facilitate collection, processing, recycling, and recovery and final disposal of waste. Incentive charges can be used to achieve multiple objectives such as waste minimisation, source reduction and increased recycling/reuse. Although the terms are usually part of government mandated charges some industry.

Tradable Permits: To date, the use of tradable material recovery certificates in the area of WEEE management is extremely limited.[4] While there has been explicit experience in the application of certificate markets with the UK implementation of the Packaging Directive, experiences in the WEEE area are limited to feasibility assessments (Bohr, P, 2007; ERM, 1999). Instead of promoting the push-through of material from collectors by supporting the costs of collection and sorting through producer compliance schemes, MRC systems aim to pull material through by re-processors (Europen, 2007). Instead of producers having to set up systems to collect end-of-life products, obligated producers would be responsible to obtain certificates that demonstrate that an appropriate amount of material or products have been recovered. Surplus certificates can be traded, and the premise is that the resale value of certificates will give re-processors an incentive to increase capacity and encourage collection.

Deposit-Refund Systems: Deposits have been traditionally used as a mechanism to ensure that reusable products or packaging is returned to the producer. *Voluntary deposit-refund systems* have been found in a number of industries, including refillable bottles, pallets and compressed gas bottles. The level of the deposit is set in relation to the value of the item, in the event that it is not returned.

Europen (2007) distinguishes a category of deposit-refund system that fit between voluntary and mandatory deposit systems, which they call *industry-managed quasi-voluntary deposits*. These systems are characterised by circumstances where 1) operating a deposit system is one of a range of permitted options, 2) where only deposit bearing non-refillable containers are taxed at a lower rate, or 3) where products were allowed on the market only when it was assured that a deposit systems would be put in place. *Mandatory deposit systems* are as the name applies deposit systems that are mandated to be set up according to the national legislation.

2.5.3 Informative Instruments

As an informative responsibility defined by Lindhqvist (2000), includes the extension of responsibility to a producer to supply information on the

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4 It could be argued that in the UK, WEEE evidence notes are in some cases 'tradable', however, the market is strictly controlled by the authorities and is limited to cases where one compliance scheme has over collected, while another has under collected.

environmental properties of the products he is manufacturing, a number of practical instruments are applicable.

Reporting requirements to authorities regarding the number of products put on the market as well as the amount of waste products treated, reused, recycled, recovered and sent to disposal are common components of EPR programmes.

Product and/or component labelling may be included in the programme to identify to consumers on the need to separately collect the product in question or specific components such as batteries within products from the general waste stream. Component labelling aimed at assisting treatment operators on the location of hazardous or valuable components.

In order to ensure that consumers are aware of the collection infrastructure as part of the ERP programme, *public information and promotional activities* may be a required component of EPR programmes.

2.6 Collective and Individual Producer Responsibility

As noted by Davis (2000), if EPR is to be a pollution prevention or waste minimisation policy it must stimulate the design of cleaner products. Direct take back, where the producer would have the physical responsibility for managing his own end-of-life products, would be the "purest incentive, as the producer would need to arrange these activities, deal directly with the technical feasibility, and finance the actual costs"(Davis, G, 2000).

The application of individual over collective financing reaches into the fundamentals of modern environmental thinking, as it determines the level of applicability of the polluter pays principle (Kalimo, H, 2006). In fact the implicit meaning of financial or economic responsibility as represented in the EPR model of Lindhqvist, was originally perceived to be an individual responsibility, although not explicitly stated at the time of its development (Lindhqvist, T, 2007).

To reflect this, and as discussed in the introduction, a more recent refinement of extended producer responsibility, referred to as Individual Producer Responsibility (IPR), has emerged which is expected to enhance the incentives provided to producers to implement design changes through strengthened economic feedback loops. Surprisingly, there is no generally accepted definition of IPR in use today and much confusion exists, despite the fact that some authors, (including the author of this thesis) have more recently begun work in this area. Using the typology of responsibility proposed by Lindhqvist (1992), Tojo (2004) developed definitions of individual physical and individual financial responsibility (based on actual examples in EPR programmes) and contrasted these to circumstances where physical and financial responsibilities are collective.

According to Tojo (2004), a producer bears an *individual financial responsibility* when he/she initially pays for the end-of-life management of his/her own products. Conversely, when a group of producers pay for the end-of-life management of their products regardless of brands, their financial responsibility is *collective.*

Similarly, *individual physical responsibility* is considered to be implemented when 1) the distinction of products are made at minimum by brand and 2) the producer has the control over the fate of their discarded products with some degree of involvement of the downstream operation. When products are handled together, the distinction of the properties of the products, including their features on end-of-life management, becomes necessary (Tojo, 2004).

Collective physical responsibility is taken when 1) products of similar kind are physically handled together regardless of the brand and 2) the handling is placed in the hands of a third party, such as a Producer Responsibility Organisation (PRO).

Given these definitions, it is possible to implement IPR in both collectively organised compliance schemes, such as PROs and systems that are set up by individual producers to collect and process their own branded products. This is *contrary* to the common misunderstanding that individual producer responsibility always implies that a single producer develops separate infrastructure for collection and treatment of his or her own products.

Surprisingly, many authors writing on EPR consider IPR to be possible only in the context of separate infrastructure where individual producers take back their own products. Below is a quote found in a recent study published by the OECD on EPR and product design, exemplifying this point.

> *Although the first generation of EPR programs involved collective take-back – i.e. PROs arranging with producers to collect and recycle their end-of-life products – there has been more interest of late in individual take-back programs. In such a situation, individual*

> *producers would be responsible for collecting and recycling their own products. Interest in this approach has arisen both because of the thinking that collective programs do not do enough to spur DfE and because some producers in some industries have advocated for it. (Walls, M, 2006).*

In Section 11.7 a characterisation of possible IPR implementation is presented in light of the empirical findings of this research. Within the above context, the model may prove useful for focussing the discussion regarding the merits or shortcomings of various types of IPR implementation.

2.7 General Overview of Design of EPR Programmes

This section aims to familiarise the reader with the most commonly found implementation models for EPR programmes established for packaging, electronics and end-of-life vehicles.

2.7.1 Producer Responsibility Organisations (PROs)

In responding to producer responsibility legislation, producers have typically collaborated to set up national or provincial collective compliance schemes often referred to as producer responsibility organisations (PROs) to fulfil their assigned individual legal responsibility. In many formulations of EPR legislation there may even be an explicit provision for producer's individual responsibility to be delegated to a body which collectively assumes individual responsibilities on behalf of its members (OECD, 2001).

Other terms used to describe collective industry collaboration include industry financing organisation (IFOs), stewardship organisations, designated bodies, compliance schemes, or similar. In this thesis, the term PRO is used to describe exclusively such organisations where producers collectively organise themselves to fulfil their individual responsibilities on a not-for-profit basis.

The term compliance scheme, as used in this thesis, refers to both not-for-profit PROs, waste management and logistics companies offering compliance solutions for producers, as well as when producers organise compliance systems for their own products.

Depending on the assigned responsibilities of producers, PROs and/or compliance schemes establish and operate collection points, pick up and transport end-of-life products collected by retailers and at collection points to treatment facilities, organise and undertake treatment and recycling, as well as report results to authorities.

The role of PROs has become pivotal in the implementation of EPR as they provide an important interface for organising financial transactions, collection, and communication between governments, producers, waste management firms, retailers and municipal authorities (Mayers, CK, 2007). PROs contract with collection sites (municipal sites, retailers, businesses for business to business (B2B) waste products, etc), recyclers, and logistic partners that carry out operations as required. PROs recover costs through levying fees, either fixed product charges or by allocating actual costs relative to the amount of products placed on the market over a defined reporting period – usually monthly, quarterly, biannually or yearly (see Section 2.7.3 for a more detailed discussion of funding mechanisms typically used).

Producers recover their costs associated with take back by charging their customers (retailers or consumers (B2C or B2B), either through visible or non-visible fees. Alternatively, producers can opt to absorb the costs through reduced profit margins. In certain PROs it may be mandatory, as part of the conditions of membership, to visibly display a fixed fee or cost per kilogram or tonne treated on all business transactions which is ultimately displayed to the final consumer of the product. In other PROs this decision is left entirely up to the individual members. Often proponents of the visible fee claim that its use serves to educate consumers on the importance of separate collection and treatment of the product at its end-of-life which is essential to avoid environmental impacts for improper disposal. For a discussion on the use and merits of visible vs. non-visible fees see van Rossem (2005) also presented in 11.2 of this thesis.

Early iterations of the PRO model typically resulted in a single provincial or national organisation representing all foreign and domestic producers of products under the EPR programme. In these cases no competition exists between PROs, however in most systems competitive tendering for collection, transportation and recycling is established within the PRO business model. While these compliance schemes can be considered monopolistic, from the point of view of compliance options for producers, more often than not there is ample opportunity for producers to establish competing schemes or develop individual compliance options.

More recently, through the implementation of the WEEE Directive the emergence of competing compliance schemes either set up by producer consortia or waste management firms can be found in the largest Member States (MS) of the European Union. The main premise behind this model is that greater competition in the marketplace will drive efficiencies and reduce costs for compliance through avoiding the formation of de facto national monopolies. This is discussed in more detail in Section 8.3.

2.7.2 Government Managed Programs

In contrast to PROs or compliance schemes described in Section 2.7.1, in some jurisdictions governments or quasi government/industry boards are mandated to manage the take back and processing of end-of-life products. Typical examples of this model include designated administrative organisations (DOA), or Management Boards. In the WEEE domain, examples of jurisdictions that have taken this approach include California in the US, Taiwan, and the province of Alberta in Canada. Typically, producers are not allocated significant responsibility under these programs. Physical and even financial involvement of producers in these schemes is in most cases minimal. This is especially true when retailers are responsible to collect the charge from consumers at the point of sale and remit it to the governmental department or third party managing the administration of the scheme.

2.7.3 Financing Models

Within PROs or other collective compliance schemes, generating funds to finance the collection, transportation, recycling and disposal of end-of-life products are essential and often contentious issues among the membership. The fee setting mechanism that a PRO, or in some cases governments decide upon, have for the most part focussed on ensuring sufficient funds are available to the organisation to run its day to day operations. Fee setting to steer design decisions of producers has not traditionally been a prominent feature in the financing structure, although in packaging compliance schemes with variable weight-based charging this is invariably apparent.

With respect to financing models within EPR programmes it is also important that a distinction be made between EPR programmes for *durable* vs. non *durable products*, especially when considering in what manner the fee setting structure may or may not influence design incentives. *Durables* are relatively long lasting products by their nature and include complex products such as automobiles, electrical and electronic equipment (EEE), clothing, carpeting, furniture, for example. *Non-durables* on the other hand are products that in general are short-lived and in certain cases consumed in their use phase. These are relatively simple products and include items such as food, beverage and product packaging as well as single use batteries.

There are *two main financing models* used by PROs operating today. These are (1) Market-Share Financing and (2) Return-Share Financing.

2.7.3.1 Market-Share Financing

In collectively organised compliance systems the most common design for the financing mechanism includes allocating the costs to manage waste products collected in a period of time in proportion to each producer's market share. There are several variations on this theme, however essentially the model resembles a Pay As You Go (PAYG) pension fund, where the products that are placed on the market today finance the waste from products currently arising as waste, a so-called inter-generational contract.

Type 1- PAYG financing with visible fee: A fee is levied on an obligated producer by the PRO on either a unit or per weight (kg) basis that will be used to finance current waste. The fee is shown at the point of purchase to the final consumer. The producer will most likely charge the fee as a separate line item on the invoice to the distributor or retailer, who in turn recovers this cost when he/she sells the product to the final consumer through the visible fee.

Type 2- PAYG Financing (Non-visible fee): Same as Type 1, but fee is not shown as a separate line item on the price of the product.

The market share financing mechanism is essentially a collective financing model as producers are financing the collected waste of all producers' products relative to their current market share.

2.7.3.2 Return-Share Financing in Collective Systems

In financing models based on return-share financing, producers are levied compliance fees based on the number of units or weight from their own branded products returned through the collection system. The type of calculation of return share determines variations of this approach.

Type 1: A representative sample of the collected waste stream is made to calculate a monthly (real time) or annual return-share rate (ex ante) for each participating producer.

Type 2: All products that are collected through the programme are weighed and allocated to the appropriate producer that represents the particular brand.

Obligated producers may or may not be required to make provisions in the balance sheet to account for the costs of managing these products when they become waste in the future.

The financing of orphan products[5] and free riders can be done in a number of discrete ways under the return-share model. One way would to be to divide total orphan and free rider costs, by current market share in a measurement period. Another could be to proportion the costs using the same return-share ratio.

2.8 EPR in the European Union

Four EU Directives addressing specific waste streams – Directive 2000/53/EC on End-of-life Vehicles,[6] Directive 2002/96/EC on the waste electrical and electronic equipment (WEEE)[7], Directive 2002/95/EC on the restrictions of hazardous substances in (RoHS)[8], and Directive 2006/66/EC on batteries and accumulators[9] – are based on the principle of producer responsibility. Although the Packaging Directive 94/62/EC as amended by

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5 Products that when returned have no identifiable producer that can be held financially responsible due to bankruptcy or other circumstances that lead to that producer exiting the market when the costs are incurred.

6 Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles. OJ L269 21/10/2000 p.0034 -0043.

7 Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE). OJ l37 13/02/2003 p. 24-39

8 Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restrictions of the use of certain hazardous substances in electrical and electronic equipment.

9 Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC. OJ L 266 26/09/2006 p.1 -14.

Directive 2004/12/EC is not formally based on the EPR principle, most Member States have implemented it in ways that at least partially include aspects of EPR.

Substance restrictions as in the RoHS Directive are mainly introduced because of the impacts in the end-of-life phase of the product, while the measures have to be taken during manufacturing. The EU Directive's for end-of-life vehicles and the waste batteries both include substance restrictions. This is a reflection of the supplementary nature of such substance bans to other EPR measures (for instance recycling requirements).

Looking at the recitals of the respective Directives listed above, it is clear that the application of producer responsibility in EU Environmental Policy has become more concrete. For instance, in the Packaging Directive, EPR is only a suggested measure in recital (10) while in the Directive on End-of-life Vehicles, recitals (7)[10] & (22)[11] refer primarily to the requirement that producers fund systems to manage discarded cars.

The WEEE Directive places even more concrete responsibilities on producers and addresses more clearly on the issues of upstream design change to be addressed in the Directive. Recitals (12) and (20) in the WEEE Directive, as cited below, indicates the link between the producer responsibility and upstream changes.

> *Recital (12) - The establishment, by this Directive, of producer responsibility is one of the means of encouraging the design and production of electrical and electronic equipment which take into full account and facilitate their repair, possible upgrading, reuse, disassembly and recycling.*
>
> *Recital (20) -….. In order to give maximum effect to the concept of producer responsibility, each producer should be responsible for financing the management of the waste from his own products. The producer should be able to choose to fulfil this obligation either individually or by joining a collective scheme. Each producer should, when placing a*

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10 Recital (7) reads "MS should ensure that producers meet all, or a significant part of, the costs of the implementation of these measures; ….".

11 Recital (22) reads "Producers should ensure that vehicles are designed and manufactured to allow the quantified targets for reuse, recycling and recovery to be achieved. To do this the Commission will promote the preparation of European standards and will take other necessary measures to amend the pertinent European vehicle type-approval legislation."

product on the market, provide a financial guarantee to prevent costs for the management of WEEE from orphan products from falling on society or the remaining producers. ….

The recitals in the WEEE Directive are translated into allocation of concrete responsibility on producers. A most notable example reflecting the rationales behind the producer responsibility principle is the allocation of individual financial responsibility for the management of new WEEE (those put on the market after 13 August 2005).

2.9 Directive 2002/96/EC: WEEE Directive

This section outlines the main requirements of the WEEE Directive as stated in the legal text of 2002/96/EC. It includes the objectives, scope, and allocation of physical responsibility for collection, treatment and recovery, as well as the provisions that lay down the mechanisms to allocate financial responsibility for the management of WEEE by producers – considered crucial for providing incentives for better product design (see Sections 2.9.2-2.9.6). Section 2.9.7 provides important context to the Directive as it outlines its development from the first working draft to final adoption of the Directive by the European Council and of the Parliament of the European Union. It is the author's belief that many of the issues discussed in latter parts of the thesis regarding transposition outcome are directly linked to the views of the main stakeholders expressed during the development period. Finally, Section 2.9 ends with a brief overview of the current review process that the WEEE Directive is currently under in Section 2.9.8.

2.9.1 Why a Directive on WEEE?

Electrical and electronic equipment (EEE) production is one of the fastest growing sectors of global manufacturing today. EEE are already ubiquitous in our daily lives, and this phenomenon is likely only to increase with new applications of electronic products continually emerging, including in completely new areas including, for example, e-textiles. At the same time the rate of technological improvement of products has led to a scenario where they are replaced much more rapidly than in the past, creating not only a greater demand for raw materials but subsequently a significant amount of waste.

Early estimations of WEEE arisings within the EU 15 Member States estimated the total at 6 million tonnes in 1998. Within the framework of the

EC priority waste stream project, it was determined that the average annual expected growth rate throughout the 15 Member States was between 3-5%. More recent estimations of WEEE generation in the EU 27 have predicted the total to be between 8.3 and 9.1 million tonnes in 2005 with an annual growth rate somewhere between 2.5% and 2.7% (Huisman, J et al., 2008). Given these growth rates and projecting forward, WEEE generation is expected to reach approximately 10.6 million tonnes or 12.3 million tonnes (including business to business (B2B) WEEE) by 2020.

While WEEE generation makes up only 3.5% of total municipal waste generation by weight in the EU 27, WEEE contains significant amounts of hazardous substances and materials that may cause negative environmental impacts if treated improperly, or sent to landfill/incineration. At the same time many of the materials contained in EEE are valuable from an economic and environmental perspective. While implementation of the RoHS Directive has led to significant reductions in heavy metal use such as cadmium, chromium VI, lead, mercury and certain brominated substances, there remain many exemptions, and their use remains. Despite the inevitable reduction of hazardous materials in EEE as a result of RoHS, the amount of rare and precious metals contained in WEEE, compared to their overall use in society, justifies the demand for collection and processing of WEEE to recover scarce and non-renewable resources.

2.9.2 Main Objectives

The main stated objectives are principally to prevent the generation of electrical and electronic waste and to promote re-use, recycling and other forms of recovery so as to reduce the quantity of such waste to be eliminated, while also improving the environmental performance of economic operators involved in its treatment. As shown in Section 2.8, recital (12) of the WEEE Directive clearly states that the directive aims to encourage design changes to reach these goals.[12]

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[12] Article 4 of the Directive requires MS to "encourage the design and production of electrical and electronic equipment which take into account and facilitate dismantling and recovery, in particular the re-use and recycling of WEEE, their components and materials …".

2.9.3 Scope

The WEEE Directive covers a diverse scope of electrical and electronic equipment (EEE). EEE is defined as any equipment which is dependent on electric currents or electromagnetic fields to work properly and includes equipment for the generation, transfer and measurement of such currents and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current. In total, there are 10 broad categories of EEE included in Figure 2-2 below. Compared with other EPR legislation for electronics around the world, the scope of the WEEE Directive is incredibly broad.

WEEE Directive 2002/96/EC - Product Categories

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools
7. Toys, leisure and sports equipment
8. Medical devices
9. Monitoring and control instruments
10. Automatic dispensers

Figure 2-2: Categories of EEE Equipment in the WEEE Directive

2.9.4 Collection

For WEEE from households, Article 5 obliges Member States (MS) to ensure that by 13 August 2005, systems are set up for consumers and retailers to return, at least free-of-charge, their end-of-life EEE. The Directive does not explicitly identify either producers or municipalities as the responsible party to set up this infrastructure and the legal text leaves MS the interpretation/discretion to make this decision. It also puts the onus on retailers to accept WEEE from consumers on a 1:1 basis when selling new products, although MS can deviate from this requirement if they can show that an alternative procedure is just as convenient for consumers.

For non-household WEEE, MS must ensure that producers or those acting on their behalf provide for the collection and finance of this waste stream.

For WEEE from households there is a collection target of 4 kg/ inhabitant/year, while for non-household WEEE (e.g. B2B (business to business) there is no such target.

2.9.5 Treatment & Recycling, Reuse and Recovery

Article 6 outlines the requirement for producers to develop systems to treat WEEE using the best available treatment, recovery and recycling techniques in accordance with Community legislation. More specifically, Annex II outlines certain requirements for selective treatment of WEEE. Many of these requirements have a potentially significant impact on the treatment paths employed by the national WEEE schemes operating before Directive 2002/96/EC was transposed and subsequently brought into force in MS.

Specifically, these include the selective treatment requirement to remove circuit boards greater than 10 cm^2, mercury-containing components such as switches or backlighting lamps, and plastic containing brominated flame retardants. If the 'have to be removed' wording in Annex II is interpreted as the requirement to remove these components *prior to shredding*, manual disassembly would be necessary, significantly increasing the cost of treating WEEE in certain categories.

In terms of recovery, Table 2-1 below outlines the *weight-based*[13] recovery, recycling and component re-use targets for the various categories of WEEE as found in the WEEE Directive. The difference between recovery required and component, material and substance re-use/recycling required is the amount that can be incinerated with energy recovery or treated through another recovery operation. This amount is, for instance, 5% for large household appliances.

13 Weight-based reuse, recycling and recovery targets are calculated by stipulating that an overall percentage of the product by weight is to be achieved, without stipulating which materials within the product are to be recovered. Weighted-based targets have been criticised by some actors for treating all material equally, despite that certain materials from a life cycle perspective are more relevant to recover than others. For a discussion on this see Section 4.8.

Table 2-1: Recovery, Recycling and Reuse Targets in the WEEE Directive

WEEE Category	Recovery by weight required	Component material and substance reuse and recycling by weight required
Large household appliances (1)	80%	75%
Automatic dispensers (10)		
Information & Communication Technology (3)	75%	65%
Consumer equipment: (4)		
Small household appliances (2)	70%	50%
Lighting equipment (5)		
Electrical and electronic tools (6)		
Toys, leisure and sports equipment (7)		
Monitoring and control instruments (9)		
Gas discharge lamps	80%	80%

2.9.6 Financial Responsibility

WEEE from households

Producers are required to finance at least the collection (collection from collection sites onwards), treatment, recovery and environmentally-sound disposal of WEEE from households deposited at collection sites. The significance of the term 'at least', is that it also allows MS to place the financial burden on producers to set up and operate the collection sites.

Recital (20) of the WEEE Directive (see Section 2.8) clearly shows that, in order to allow for the maximum effect of the producer responsibility principle, each producer of electrical and electronic equipment (EEE) should be financially responsible for managing waste from his/her own products. This is meant to provide the necessary financial feedback mechanism to producers to design their products for better end-of-life management that results in lower treatment costs and environmental improvements. In other words, it is not the intention to have a collectively-financed end-of-life management system where all costs are divided equally based on current market share. In this scenario, producers with better-designed products are not financially rewarded, as the cost savings attributed to their products are shared by all producers.

However, as it is not possible for producers to influence the design of their products that were already on the market before the Directive came into force (historical waste), in terms of allocation of financial responsibility for WEEE from households, Directive 2002/96/EC distinguishes between historical and new WEEE. This is found in Article 8:

For products placed on the market after 13 August 2005 (new WEEE), Article 8(2) states that

> *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.*

For products placed on the market before 13 August 2005 (historical WEEE) Article 8(3) stipulates the responsibility as follows.

> *The responsibility for financing of the costs of the management of WEEE from products put on the market before the date referred to in paragraph 1 [13 August 2005] (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.*

Article 8(2) clearly allocates individual financial responsibility to producers for their own products put on the market after 13 August 2005. Since this Article ensures that producers are only required to pay for the management of their *own* new WEEE *and not* of others that go out of business (orphan products) or producers that might try to avoid their obligations (free riders), a financial guarantee is necessary for individual financial responsibility to work in practice. Thus, producers must, when placing a product on the market (after 13 August 2005) show that the management of all future WEEE will be financed. The guarantee can take the form of one of three options (as specified in Article 8(2) second paragraph); (1) participation by the producer in appropriate schemes for financing the management of WEEE, (2) recycling insurance or (3) a blocked bank account.

Given that Article 8(3) requires that all players in the market pay a proportion of the costs to manage historical waste based on, for instance, their market share when those costs are incurred, systems must be developed to record all new products placed on the market by each producer today as well as all the historical WEEE collected by all compliance schemes. MS are required to set up *national registers* to provide the market share calculation that will determine the relative share of historical waste financed by each producer. Additionally, the register needs to confirm that for products placed on the market after August 13, 2005, there is a suitable financial guarantee covering the future costs of WEEE management.

Non-household WEEE

Directive 2003/108/EC amends 2003/96/EC with regards to financing WEEE from users other than households. The Commission acknowledged industry concern over the impact of retroactive financial responsibility for historical non–household WEEE, due to changing market share structure over time. For historical non–household WEEE, producers are only responsible when they supply new products on an old-for-new basis. The amendment does not change the obligations with respect to individual responsibility for new waste.

2.9.7 Essential Context: Development of the Directive

An EU Council resolution of 7 May 1990, asked for EU-wide actions on particular types of waste. As a result of this resolution the European Commission developed a 'Priority Waste Streams' programme, which concentrated on used tyres, end-of life vehicles (ELV), healthcare waste, construction and demolition waste (C&D) and waste from electrical and electronic equipment (WEEE)[14] (Commission of the European Communities, 1996). The programme established working groups involving a wide range of representatives from national governments, the Commission, economic operators and environmental and consumer protection associations. It had the aim of obtaining "a consensus of participants on quantified objectives for the different waste streams".

The European Parliament, in its Resolution of 14 November 1996(7), asked the Commission to present proposals for Directives on a number of priority waste streams, including electrical and electronic waste, and to base such proposals on the principle of producer responsibility.

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14 COM (96) 399 Final. Communication from the Commission on the review of the Community Strategy for Waste Management, Brussels, 30 07 1996.

By reviewing the developments of the WEEE Directive from its early Draft phases until its final adoption by the Council and the Parliament - a process which by the way took over 3.5 years to complete - considerable insight into the views and influence of various actors is achieved. This was considered essential context to have when examining the implementation phase of the WEEE Directive, namely transposition of the Directive into national statutes as well as actual EPR programme development. The author of this thesis was fortunate to be provided with all four draft versions of the proposal, which are not available in the Commission archives. Draft versions of EU Directives are usually circulated among the applicable DG and selectively shared with key stakeholders in industry and civil society.

Table 2-2 below compares the Draft 1 to Draft 2 from the period April- July 1998. For the purposes of this exercise, only key articles on allocation of responsibility for collection and financing of WEEE from households were reviewed. It is important to note that what would eventually become 2 separate Directives, the WEEE and the RoHS, were originally presented together in the original WEEE Draft.

It is particularly interesting to see how the proposal develops, especially after it is presented as a draft proposal and begins to pass between the Council and the Parliament in the co-decision process. These opposing views on key issues are presented in the paragraphs below.

As can be seen, in the first draft, responsibility for ensuring collection systems are set up was assigned to MS, however Article 5(3) pointed towards producers to develop take back schemes and retailers to have a collection responsibility for WEEE on an 'old for new' basis. When looking at the financial responsibility, however, it becomes clearer that producers should only be responsible for setting up take back systems to collect & process WEEE that has previously been collected by MS systems. Interestingly, collection targets were originally proposed to be calculated based on a percentage of total expected WEEE arising.

In the second draft, retailers continue to have an 'old for new' collection responsibility, but producers are now explicitly required to finance collection systems set up by MS. It allows and encourages producers to set up their own independent collection and treatment infrastructure. Worth mentioning is that an explicit requirement to include a 5% recycled plastic content in new products was proposed. A new recycling target based on 4 kg/inhabitant/yr as opposed to a % of WEEE arising was proposed.

Table 2-2: Comparison of WEEE Directive Development - Draft 1 - Draft 2

Financial and Physical Responsibility	Main Changes
Draft 1: April, 1998 WEEE & RoHS joined **Article 5: Collection** 5(1) MS shall take necessary measures to ensure schemes are set up 5(2) Distributors 1:1 5(3) MS to encourage producer take back schemes * *Collection targets in percent of waste generated between 40-90%* **Article 8: Financing** 8(1) Collection sites: MS (physical and financial, as producers finance from collection point onwards)) 8(1) Collection (from collection site onwards) Treatment, Recovery and Disposal: Producers (physical and financial)	
Draft II: July 27, 1998- WEEE & RoHS joined **Article 5: Collection** Article 5(1) MS to ensure *Producers* set up systems 5(2) Retailers 1:1 * *Collection target of 4kg/person/year*	Producers explicitly mentioned as responsible to set up take back systems Collection target changed from % WEEE arising to kg/inhabitant/yr
Article 8: Financing 8(1) Collection sites: MS to ensure producers finance costs of collection, treatment, recovery and final disposal	Producers now to finance both collection sites and treatment of WEEE
8(2) Collective systems allowed to meet 8(1) Guarantees needed also for new WEEE 8(3) Individual systems allowed: Producers obligated to finance a share of historical WEEE "in proportion to the individual producers market share at the time of payment"	Producers can set up their individual systems to collect own brands
**requirement to have 5% share of recycled plastic in total plastic content by 1 January 2004*	Recycled content in plastics required

Table 2-3 illustrates that in draft version 3, compared with version 2, producers can now finance WEEE either through collective systems or by setting up their own systems to manage their own brands and that there should be no discrimination of producers who chose either model. In draft version 4, the legislators now discuss differentiating the financing mechanism for new products put on the market after the directive comes into force and historical products that were already on the market before the directive comes into force. For new WEEE producers must finance the waste from their own products, but it is clear that they can do this either by joining a collective system or by developing their own system. Producers are no longer required to finance collection systems unless they set up themselves. There is also an explicit mention that historical WEEE should be financed by collective systems.[15]

Table 2-3: Comparison of WEEE Directive Development - Draft 3 - Draft 4

Financial and Physical Responsibility	Main Changes
Draft III: July 5, 1999 - WEEE & RoHS joined **Article 5: Collection** 5(1) MS ensure systems are set up (Producers financially responsible, see 8(2) 5(2) Retailers 1:1 *4 kg/person/year target **Article 8: Financing** 8(2) Costs for collection, treatment, recovery and final disposal for WEEE from private households borne by producers 8(3) choice between collective systems[16] or, Individual systems for their own brand only. * *should be no discrimination between producers who comply with Article 8 by means of collective or individual systems*	Producers can choose between collective systems or individual systems for their own branded products
Draft IV: May 10, 2000 – WEEE & RoHS joined **Article 5: Collection** 5(1) MS shall take the necessary measure to ensure systems are set up for private households to return WEEE * *No retailer requirement in Article 5* * *4 kg/person/yr* **Article 8: Financing** 8(2) For own brand products put on the market after entry into force (new WEEE), **each producer** provides for the financing of the collection of WEEE from private households made available at collection points. (implies collection from collection sites onwards) 8(2) collection (collection site onwards), treatment, recovery and final disposal. **Producers** may comply with this Article by means of collective or individual systems. 8(3) Financing for new and historic starts 5 years after entry into force And historic WEEE is financed by 'collective systems' and can use a visible fee for up to 10 years for historic WEEE	Explicit individual financial responsibility for new waste, which could be complied with through collective or individual systems. (In explanatory memorandum No retailer 1:1 requirement Producer only to finance WEEE from collection points onwards. Explicit mention that historical WEEE to be financed by collective systems.

Table 2-4 below shows the first official proposal of the WEEE Directive. Most notably is that RoHS and WEEE are now proposed as separate but sister Directives. Other changes from the fourth draft include the requirement that consumers must be able to dispose of their WEEE free of charge at the point of disposal. Retailer obligation to collect WEEE on an 'old for new' basis is reinstated. Further detail is provided about financing

[15] Note that the draft version mentions collective systems and not market share explicitly.

[16] The term 'collective systems' is used in the legal text.

historical WEEE and that this is to be done proportionally, with no mention that it should be done by collective systems. The version available after the Parliament's 1st reading strengthens the idea of individual financing of new WEEE by inserting an explicit definition in the text. MS could introduce collective financing for new WEEE only if they can show that individual financing is too expensive. Historical WEEE financing based on the concept of market-share is now introduced. Collection targets are increased to 6 kg/person/yr. and the concept of a visible fee to cover historical WEEE costs is added.

Table 2-4: Comparison of WEEE Directive Development: Official Proposal – Parliament 1st Reading

Financial and Physical Responsibility	Main Changes
Proposal: July 28, 2000 – WEEE separated from RoHS **Article 4: Collection** 4(1) MS take necessary measures to ensure that systems are set up so final holders and distributors can return WEEE from private households free of charge 4(2) Retailers 1:1 4(3) Collection shall be allowed on a voluntary and individual basis **Article 7: Financing** 7(2) Producers to finance collection of WEEE deposited at collection facilities, 5 years after entry into force of the Directive, plus treatment, recovery and final disposal 7(3) Financing in 7(2) can either by means of collective or individual systems and no discrimination regardless of choice. Historical WEEE to be 'shared by all existing producers' and producers that opt for an individual system must show that they are financing their fair share of historical WEEE.	Free of charge take back added for first time Retailers 1:1 reinstated Further definition of how historical financing would impact producers, i.e. shared by all existing producers. No discrimination between producer who chooses an individual system or collective system to meet financial obligation
1st Reading: May 15 2001 WEEE only **Article 3: Definitions** mc) 'individual financing' means the liability of each producer for the costs associated with its own products **Article 4: Collection** 4(1) Member States to ensure that systems are set up so that final holders and distributors can return WEEE 4(2) Distributors 1:1 , but MS may depart form this requirement if collection is not more difficult and 4(1)a distributors and producers may agree on centralised collection points to relieve financial burden on distributors 5(a) Systems to handle the waste may be set up by producers collectively and/or individually ** Collection rate: 6 kg/person/yr* **Article 7: Financing** 7(2) Producers to finance collection of WEEE deposited at collection	Explicit definition of individual financing Market share financing for historical WEEE explicitly introduced Increased collection target to 6kg/inhabitant/yr Introducers that producers may also be liable to finance or part finance MS collection systems Individual financing mandatory, MS may request that collective

Financial and Physical Responsibility	Main Changes
facilities, 30 months after entry into force of the Directive, plus treatment, recovery and final disposal Producers may also be responsible to finance or part-finance MS collection systems 7(3) Financing on a individual basis, provision of guarantees for the management of new WEEE (30 months after directive in force) MS may request to use collective financing schemes if individual financing would involve disproportionately high costs 7(3) Costs should be internalised, but other financing agreements in force prior to the entry into force of the Directive may continue for 10 years 7(3) Historical WEEE to be financed collectively in proportion to their respective share of the market by type of equipment 7(3)a Visible fee allowed for 10 years	financing schemes if IPR too costly

In Table 2-5 below there are some considerable changes to the proposal made by the Council after the Parliaments 1st reading. Most importantly is that the Council now sees it important that producers finance the new WEEE from any orphan and free riders, and removes the obligation for each producer to finance the WEEE from his/her own products. Again, targets are reduced back to 4 kg/person/yr, after being raised by the Parliament in the 1st reading. In the 2nd reading by the Parliament, all of its 1st reading amendments are reinstated. The concept of financial guarantees is introduced to quell the Council's concerns about orphans and free-riders. A disposal ban of WEEE generated by households is proposed as well as the concept of producer identification on products to practically enforce individual financing.

Table 2-5: Comparison of WEEE Directive Development: Common Position to 2nd Reading by Parliament

Financial and Physical Responsibility	Main Changes
Council Common Position: December 4, 2001 **Article 4: Collection** 4(1)a: MS take necessary measures to ensure that systems are set up so final holders and distributors can return WEEE from private households free of charge 4(1)b: Distributors 1:1 Producers can set up collective and or individual take back systems for their WEEE ** 4 kg/person/yr collection target* **Article 7: Financing** 7(1) 30 months after coming into force producers provide *at least* for the financing of the collection, treatment, recovery and disposal of WEEE deposited at collection facilities (collection points onwards)	MS to ensure that systems are set up for retailers and consumer to deliver WEEE free of charge. Collection target reduced to 4 kg/person/yr Producers at least financial responsible for WEEE collected at collection points onwards. Orphans and free riders now to be financed by producers

Financial and Physical Responsibility	**Main Changes**
7(2) Financing shall be provided in 7(1) by means of collective and/or individual systems. 7(3) Historical WEEE to be financed by one or more systems to which all producers existing on the market when the respective costs occur contribute proportionately. 7(4) Orphans and free riders to be financed by producers. MS may provide that it is financed in accordance with 7(3) 7(5) Distance sellers to finance WEEE in the purchasers MS	Added distance seller as producer
2nd Reading in Parliament: April 10, 2002 * **Article 4: Product design is inserted** **Article 5: Collection** 5(1) After 30 months into force, WEEE no longer allowed to be disposed with unsorted waste 5(2)a MS take necessary measures to ensure that systems are set up so final holders and distributors can return WEEE from private households free of charge 5(2)b Retailers 1:1, MS can depart if returning WEEE is not more difficult Producers can set up individual and/or collective take back systems * 6kg/person/yr collection target New rate based on sales in previous years for 2008 onwards to be determined in 2007. **Article 8: Financing** 8(1) 30 months after coming into force producers provide *at least* for the financing of the collection, treatment, recovery and disposal of WEEE deposited at collection facilities (collection points onwards) 8(2) Financing in 8(1) to be on an individual basis. Guarantees required 8(3) Historical WEEE to be shared collectively by all producers existing at the time the costs arise in proportion to their respective share of the market by type of equipment by volume. Visible fee allowed for a maximum time period of 10 years 8(4) To prevent costs for the management of WEEE coming from producers that are no longer present on the market or that can no longer be identified (orphan products and free-riders) from falling on society or the remaining producers, Member States shall ensure that producers provide a guarantee when placing a product on the market, as specified in paragraph 2, and that producers clearly mark products in accordance with Article 10(4) and the second paragraph of Article 11. The guarantee shall be used to finance the management of WEEE from producers that have disappeared. The guarantee may take the form of a recycling insurance, a blocked bank account, or participation by the producer in appropriate financial schemes for the financing of the management of WEEE. Where an importer cannot provide any of the above, customs authorities shall charge a guarantee provision (together with VAT and customs duties) when the product enters the EU. * *Definition of individual financing reinstated*	Disposal ban of WEEE introduced. 6kg/inhabitant/year collection target reinstated & new method of calculating to be developed and implemented from 2008 onwards. Individual financing definition is reinstated and 8(2) individual financing reinstated Concept of financial guarantees introduced Producer identification added to allow for IPR to function Market share to be the method of dividing historic WEEE costs reinstated
2002/96/EC: Described in Section 2.9	

As the Council did not accept the amendments made to its Common Position by the Parliament in its 2nd reading, the proposal was put on the conciliation track. This process took nearly 4 months of deliberations, mainly over the issues of individual financial responsibility, with the Council insisting that MS would retain the option of collective financing. Even though the final wording in Article 8(2) clearly defines an individual financial responsibility for new WEEE, some ambiguity is introduced in the last sentence of 8(2) where it is stated that "The producer can choose to fulfil this obligation either individually or by joining a collective scheme".

2.9.8 Current Review of Directive 2002/96/EC

The WEEE Directive requires the Commission to submit a report to the European Parliament based on the experience of the application of the Directive. The report, where appropriate, shall be accompanied by proposals for the revision of the relevant provisions of the Directive and in particular of the collection and recovery targets.

The Commission is using this opportunity to examine a number of defined issues, in particular with respect to separate collection, treatment, recovery and financing to inform decisions on whether improvements could be made to better achieve the Directive's goals.

The following activities and studies have been part of the review process to date.

- An information gathering exercise was launched in mid 2006 where stakeholders were invited to submit information on their experiences implementing the WEEE Directive. Stakeholders had until 11 August 2006 to submit their supporting information.

- Four research studies were launched to further analyse the impact and implementation of the WEEE Directive, including a background study published in 2005 on the overall implementation, a technical study on the implementation of the Directive, a study examining the producer responsibility principle of the Directive (both published in August 2007), and a study on the simplification of the WEEE and RoHS Directives (published in December 2007).[17]

[17] The studies can be found on the Commission's website located at: http://ec.europa.eu/environment/waste/weee/studies_weee_en.htm.

- An Impact Assessment and stakeholder consultation based on the results of the Commission's research was launched in April 2008 and will be used to gather information and opinions on the impacts of potential revisions. This closed on 5 June 2008.

Once the Commission has considered the opinions of stakeholders it will put forward its proposal for any revisions and the document will follow the co-decision procedure. The exact timing of this release is currently unknown, but it is possible that it could be sent before the end of 2008.

2.10 Chapter Summary

To summarise, coined by Lindhqvist (2000), Extended Producer Responsibility (EPR) is a policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling and final disposal of the product (Lindhqvist, T, 2000). Assigning the financial and/or physical responsibility to producers for the end-of-life management of their products, in theory, should drive producers to re-consider issues around the end-of-life management of the products they produce. Rational producers will, in all probability, explore options to minimise the costs of end-of-life management through alterations in product design or choice of material.

For the most part, producers have responded to EPR legislation by collaborating to set up national or provincial collective compliance schemes, often referred to as producer responsibility organisations (PROs) to fulfil their assigned individual legal responsibility. The financial mechanism employed in these schemes is usually a market share calculation which provides minimal incentives for producers to re-design their products as any investment made is essentially shared with all participating producers in the scheme.

However, a more recent refinement of EPR, referred to as Individual Producer Responsibility (IPR), has emerged in the policy and practical discussions and is expected to enhance the incentives provided to producers to implement design changes through strengthened economic feedback loops. The Directive on Waste Electrical and Electronic Equipment (WEEE) at the end of 2002 was considered to be a landmark piece of EPR legislation. With respect to the EPR principle discussed above, the final text of the directive included an *explicit* goal of encouraging the design and production of EEE which take into full account and facilitate their repair, possible upgrading, reuse, disassembly and recycling. The main mechanism to achieve this goal is through use of *individual producer responsibility* (IPR), where each producer is responsible for the waste from his/her own products.

It should be recognised that individual vs. collective responsibility in the WEEE Directive has always been a controversial issue, each position defended equally as hard by its respective supporters. It was the main reason that the Directive went through the conciliation process as the Council and the Parliament's views were too divergent. The debate continues today, the review process is ongoing. It certainly remains to be seen what the final outcome will be.

CHAPTER

THREE

3. Methodology

Chapter 3 begins by revisiting the research objective and introducing the research questions proposed. In Section 3.2 the research paradigm is presented followed by a description of the research design in Section 3.3. This is followed by an outline of the scope in Section 3.4 and ends with a concluding discussion on aspects related to the validity and reliability of the results of this research.

3.1 Revisiting the Research Objective & Research Questions

It is considered pertinent at this juncture in the dissertation to restate the main objective of this thesis presented in the first chapter.

> *The overarching purpose of this thesis is to contribute to the understanding of how Extended Producer Responsibility (EPR) programmes can be structured to maximise incentives for improved environmental performance of products and product systems, especially from an end-of-life perspective. In this research the product area of electrical and electronic equipment (EEE) will be the focus of this investigation.*

Reflecting upon the principle of EPR, as described in Chapter 2, incentives for design improvement are considered to be enhanced when EPR programmes are based on Individual Producer Responsibility (IPR). Although the WEEE Directive explicitly mandates IPR in Article 8(2), early in the research process it became apparent that practical implementation of IPR was proving more difficult than expected and that transposition into MS laws was a likely determining factor.

Considering this context as the starting point of this research, the following four main research questions (RQ) are proposed.

RQ 1: What evidence is there that EPR legislation and practical implementation of EPR programmes with clear incentives will incite producers to design products for reduced end-of-life impacts and costs?

RQ 2: What has been the European experience to date in embedding incentive-based EPR, firstly into applicable legislation and secondly into operational programmes for the management of household WEEE?

RQ 3: Why is it so difficult to implement incentive-based EPR programmes for WEEE in the European context?

RQ 4: How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?

3.2 Research Paradigm

As noted by Guba & Lincon (1998), the position of a research in relation to the major scientific paradigm influences the practical development and execution of the research project. This of course has implications for how research findings are analysed.

For any theory that we have about what knowledge is, we must have a presupposition about what the world is like. That is, we must assume that the world exists in such a way that it makes our theory of knowledge possible. Therefore, there is no way of avoiding having an ontological position, it is only a question of whether or not it is consciously acknowledged or whether it is left as an implicit presupposition of one's theory of epistemology. Considering this, the ontological position held by the author of this thesis is that, indeed there is real and tangible world that exists outside the mind of the researcher, which can never really be understood but nonetheless be 'approximated'. Meanwhile, the author does not hold the positivist's view that the researcher is seen as independent to the research subject and therefore does not influence the object of study.

3.3 Research Design

The starting point of this research is based on the assumption built upon the EPR principle and the expected outcomes from its application in EPR programmes. More precisely, it is hypothesised that EPR programmes that are based on IPR will provide the mechanism that will incite producers to make self-interest design changes that are in line with cost reductions at end-of-life as well as environmental improvements.

Given the timing of the implementation of the WEEE Directive it is not possible to 'test' this hypothesis empirically. However, it is possible to review the implementation of the Directive in terms of the transposition process to provide the current reality. As described earlier, as it became apparent that IPR may not be implemented as originally intended, the researcher looked for supplementary cases where IPR had been embedded in the EPR programme. This current reality of the implementation is compared with the principle of EPR, or rather the theory behind the principle, through both inductive and deductive analysis.

Finally, from this process, factors seen as important in influencing the outcomes in transposition and practical implementation are summarised and a characterisation of possible IPR implementation typologies is proposed.

Considering the evolution of the research as presented in Section 1.3, this thesis is built upon a compilation of case studies with varying units of analysis and is complimented by the author's participation in a number of practical working groups focusing on EPR programme implementation.

3.3.1 Case Studies

As a means of organising this research, a *multiple, instrumental case study approach* was utilised. As the phenomenon under investigation is complex and consists of variables that cannot be isolated, the case study approach was chosen (Yin, RK, 2003). The case study approach is thought to be particularly valuable when it aims to emphasise individual differences or unique variations from various programme settings of from one programme to another (Patton, MQ, 1987). With an *instrumental* case study, the objective is to use the findings of the cases for something other than the understanding of the case itself, including to obtain insights into the research questions or contribute to a general understanding (Stake, RE, 1995).

Multiple, instrumental case studies make it possible to rely, not on single, but on multiple sources of evidence and allows identification of both similarities and differences in various contexts (Stake, RE, 1995; Yin, R, K., 1994). As discussed further below, cases were selected based on purposeful sampling as they were chosen because of their potential to provide rich understandings of the studied phenomenon (Patton, MQ, 1987).

The three case studies are as follows:

Study 1: *Product-Specific Environmental Information: Applicability of available data for determining individual product end-of-life cost/revenue structures for waste electrical and electronic equipment (WEEE): 2002-2003*

Study 2: *The Producer Responsibility Principle of the WEEE Directive: DG ENV. Study Contract N° 07010401/2006/449269/MAR/G4: December 2006-July 2007*

Study 3: *EPR programmes with elements of IPR: Japan SHARL, Maine's E-Waste Law, Bosch-led Power-Tool Programme, ICT Milieu, SWICO A-signatories*: 2006-2007

3.3.1.1 Case Descriptions

This section outlines each of the 3 main studies in which the research cases are contained. For each study, the rationale for its inclusion in the overall research as well as the main methods employed is described.

Study 1: *Product-Specific Environmental Information: Applicability of available data for determining individual product end-of-life cost/revenue structures for waste electrical and electronic equipment (WEEE): 2002-2003*

This study had the explicit purpose of exploring how product design influences end-of-life costs. Since the notion of IPR rests on the premise that producers can be incited to design products with reduced end-of-life costs it was deemed necessary to understand what those differentiating product features might be. Findings from the study are expected to provide input when discussing the feasibility to differentiate end-of-life fees for individual producer's products in collective compliance schemes. The study was based on a literature review of design tools, eco-design guidelines, eco-label criteria and sources of data on product characteristics. As a means to triangulate the findings the literature review was supplemented with a site visit to an electronics recycler, Stena Technoworld in Bräkne-Hoby, Sweden. An in-depth interview was conducted to reconfirm earlier work on how product design influences end-of-life cost structures for processing electronics under the context of the WEEE Directive.

Study 2: *The Producer Responsibility Principle of the WEEE Directive: DG ENV. Study Contract N° 07010401/2006/449269/MAR/G4: December 2006-July 2007*

In order to appreciate the complexity of the implementation of the WEEE Directive in terms of the transposition into MS national legal texts, a comprehensive review of the process was necessary. This study provided the opportunity to explicitly review the legal instruments developed by MS and to provide information on practical implementation in 4 MS. In this study a combination of legal text analysis, interviews, and focus groups were employed as data collection methods.

Legal Text Analysis Since a considerable amount of empirical data presented in this thesis is a result of analysis of legal texts of primarily the WEEE Directive and Member State transpositions of it into national law, the compiling and review of these texts formed a concrete source of data. For the study component on MS transposition of the WEE Directive, an inventory was developed detailing how each MS has transposed producer responsibility provisions into national legal text. The inventory was based primarily on the *analysis of each Member State's legal text* whose English translation was available. The list of the EU national laws reviewed in this study is summarised in Annex B. Otherwise, when legal text was not available, secondary sources have been used to cover the gaps as much as possible.

In-depth interviews were conducted with a total of 33 people representing 12 producers, 3 National Registers, 6 government officials, 2 environmental consultants, 2 municipal organisations, 4 WEEE compliance schemes, 1 retailer, 1 wholesaler, 1 retailer organisation, 1 insurance company, 1 industry association, 1 municipal waste management company. The list of interviewees, their affiliation and the timing of the interviews are available in Appendix A.

For this study an *interview-guide* was developed for the relevant EEE Industry Associations (JBCE, EICTA, BIKTOM, ORGALIME, CECED) and can be found in Appendix C.[18] and subsequently distributed to their member companies. Except for the JBCE, the interview guide was presented at the member meetings of these associations. Industry associations also made available their position papers, guidance documents for their members and the like. In addition, a one-day meeting was held with the representatives of European Lamp Companies Federation (ELC).[19]

In addition to the meetings with the industry associations mentioned above, a one day *focus group* meeting was held with the European Recycling Platform (ERP). The purpose of the meeting was to get a better understanding of the European Recycling Platform's views on the way in which practical implementation of Individual Producer Responsibility in the WEEE Directive could be put into operation.

Study 3: *EPR programmes with elements of IPR: Japan SHARL, Maine's E-Waste Law, Bosch-led Power-Tool Programme, ICT Milieu, SWICO A-signatories*: 2006-2007

In order to better understand how IPR could be implemented in practice in the WEEE Directive, a number of EPR programmes that had elements of IPR embedded in their design were chosen as cases. These cases were identified by the author of this thesis in collaboration with colleagues in the *IPR Practical Working Group* described in Section 3.3.2 below. In three of the 5 sub-cases in this study the author of this thesis was the first author of the case. The primary research methods used in this study were in-depth interviews with system operators, internet homepages of the applicable organisations, as well as academic literature.

3.3.2 Participatory Research

Moreover, the participatory research method is an explicit component of the research design used in this research. Direct interaction with key stakeholders that influence the development and evolution of EPR programmes was considered invaluable for this research. Collaboration with industry and government practitioners, academics as well as NGO representatives has served at least 2 main purposes. Firstly, in the context of the WEEE Directive, implementation had not yet started at the onset of this

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18 The above abbreviations are found on p. VIII in this thesis.

19 For more information, see www.elcfed.org/index.php?mode=0.

research and there was much speculation over how practical implementation of IPR might occur. Therefore being in close contact with key informants was deemed necessary in order study the emerging phenomenon. Secondly, since the author aimed at encouraging the development of IPR implementation in the WEEE Directive, direct involvement with key actors having an influential role on its outcome was desirable. Main participatory activities are included in the following settings.

INSEAD WEEE Directive Series- Nov 2004-Nov 2006
Organised by INSEAD, in cooperation with a number of major producers affected by the WEEE Directive, the author of this thesis participated in the last three of the 5 workshops held in Fontainebleau, France. The series topics were particularly pertinent to the research and extensive information and insight into practical issues facing producers and authorities implementing the WEEE Directive was obtained. The series provided a unique opportunity to discuss the current research with relevant actors as well as to conduct informal interviews with producers and authorities.

WEEE Directive Series: Workshop titles and dates

- Return Logistics – November 22, 2004
- Financial and Accounting Requirements – July 5-6, 2005
- Harmonisation – February 23, 2006
- Infrastructure and Services – June 21-26, 2006
- Future Waste and Incentives for Eco-design – November 30-31, 2006

Political IPR Coalition
Established during the final INSEAD workshop, diverse actors including producers, NGOs and academics formed a group to further investigate the transposition outcome of the WEEE Directive, especially with respect to Article 8 of the WEEE Directive which stipulated the financial mechanism of IPR. The makeup of the group included a similar composition of actors that formed a similar IPR coalition during the WEEE Directive drafting phases. The group was formed in January 2007 and continues to have monthly meetings. The role of the author of this thesis in this group is essentially a passive observer.

INSEAD Practical Individual Producer Responsibility (IPR) Working Group
As an outcome of the political IPR coalition, a working group was formed in order to further explore the possibilities of implementing IPR in the European Union. The working group is currently ongoing and made up of representatives from producers of EEE and academia. The working group

provides a rich forum for stakeholders interested in exploring the merits of incentive-based producer responsibility, and has been instrumental for the author in receiving inspiration and idea-sharing on key issues related to this research. To date there have been three workshops held in Fontainebleau, which are listed below. The author of this thesis has been an active participant in all three workshops and has developed three of 5 case studies which are included in this thesis, which will appear in a forthcoming white paper on Individual Producer Responsibility.

INSEAD Practical Individual Producer Responsibility (IPR) Working Group

- IPR Workshop No. I – September 17-18, 2007
- IPR Workshop No. II - January 24-25, 2008
- IPR Workshop No. III – September 25-26, 2008

National Clearinghouse Development in Sweden:
The author of this thesis was invited to participate in preliminary meetings to discuss the development of a National Clearinghouse[20] in Sweden. In collaboration with IIIEE colleagues, background for a feasibility study was prepared that aimed to determine key future functions of a clearinghouse in Sweden. Considerable insight was gained through this process where preliminary functions of a clearinghouse in Sweden were proposed

National Clearinghouse Development in Sweden

- Meeting 1: August 23, 2007, Elektronikåtervinning AB, Stockholm
- Meeting 2: October 18, 2007, Elektronikåtervinning AB, Stockholm
- Meeting 3: May 9, 2008, Swedish EPA, Stockholm

3.4 Scope

Mandated EPR programmes for which producers have been assigned a legal responsibility to participate in the programme through either an individual take back obligation (which can be met collectively or through a third party organisation (TPO), producer responsibility organisation (PRO), or industry financing organisation (IFO) or the requirement to pay mandatory fees to a TPO if not developing an individual plan, is the main unit if analysis used in

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[20] National Clearinghouses are used in numerous Member States that have the main function of allocating WEEE collected at municipal sites to the competing collective producer responsibility schemes. The development of clearinghouses is discussed in several sections of the thesis, see for instance Section 8.3.

thesis. Voluntary EPR programmes are for the most part out of scope of this thesis and this is justified from the perspective that, while there does exist voluntary responses from industry, they are mostly placed in the context of the threat of backdrop legislation.

The type of EEE and subsequently WEEE that is included in the scope of this research is primarily limited to WEEE generated at households and excluding large business to business (B2B) products like computer servers, office photocopiers, automatic banking machines or large medical equipment. While there is overlap between EEE and subsequently WEEE that is used and disposed of both by business and private consumers – the so-called 'dual use products' – this thesis predominately addresses WEEE generated by households. However, the probable migration of dual use products used by business users to private consumers is included within the scope. Considerable attention is paid to this situation in this thesis and the possible impacts on programme design regarding any choice that is made on how to address 'dual use products'.

Of the two main goals of EPR presented in Section 2.2, it is the first goal that is the primary focus of this research, namely that of *Improved product design* where an EPR system should provide incentives for manufacturers to improve the environmental performance of products and the systems surrounding the life cycle of the products. The second goal of *high re-utilisation of product and material through effective collection and re-use or recycling*, although equally as important, is addressed only where relevant. The system costs and the achievement of targets associated with the second EPR goal are not the primary focus of this research.

3.5 Validity and Reliability

Regarding the validity of the results found within this research, the researcher undertook a number of methodological steps in order to judge whether the outcomes could be considered valid and reliable.

In terms of *internal validity* regarding whether there is a causal link between the introduction of an EPR programme and product design change the following points are made. It is explicitly recognised throughout this research that there are a numerous factors that are influencing the design of products for improved environmental performance, and therefore drawing inferences regarding the role of EPR programme is inherently problematic.

Given this, the research has focussed *not* on whether or not EPR programmes lead to design changes, but rather on *how can they be best designed* to reward producers that have made such investments in design.

On the topic of *external validity*, regarding whether the results can be generalised beyond the specific research topic, the following aspects are to be considered. Since the focus of a large portion of this research was on the implementation of the WEEE Directive in the European Union, including the associated peculiarities of Member State transposition and implementation, there are certain reservations regarding the appropriateness of extrapolating the context specific findings to other geopolitical regions.

On the other hand, the research design has been structured to include an assessment of experiences of implementing EPR programmes with inherent incentive mechanisms in other regions of the world. The author has attempted to draw on cases of EPR implementation where elements of IPR are included in the programme design which is reflective of the state of play on the global level, therefore the findings are relevant to other jurisdictions. At the same time caution should be drawn when generalising the findings to developing countries as the context in these areas may be very different indeed.

CHAPTER

FOUR

4. End-of-Life Value Chain for WEEE

Chapter four describes the structure and actors involved in a generic end-of-life collection and processing chain for WEEE. It is included here in order to provide context regarding how EPR programme goals are often put into practice and how the various actors involved may be influenced by the incentive structures intended in the EPR programme. Readers already familiar with the end-of-life value chain are recommended to proceed to Chapter 5.

The scope of activities described here include when EEE are discarded by their final owner as waste, although WEEE may in fact be in working order. Therefore, this section excludes a description of private second hand markets for EEE or established reuse centres and second hand stores. The main focus of the description is on traditional collective system type EPR programmes organised by PROs, however, a brief description of corporate take back activities, mainly limited to ICT manufacturers (B2C and B2B customers) and large commercial and office equipment manufacturers (refrigerators, photocopiers, x-ray equipment, etc) is referenced.

4.1 Collection Infrastructure

As collection is the first interface in the end-of-life system (not including product reuse through second hand markets) its impact on the effectiveness of the overall system is crucial. Downstream activities after collection could be highly efficient, but if collection rate of available WEEE arisings is low, the overall efficiency of the system will also be low.

The choice of design of collection infrastructure for EPR programmes for household WEEE encompasses a variety of different collection options. Common collection options include the following.

Municipal waste collection sites/amenity sites
Many municipalities operate recycling and waste management depots for bulky or hazardous and/or special wastes, and similarly are often involved in operating collection sites for WEEE from their residents and in some cases small business and commercial establishments. These sites may operate seasonally or open all year round as well as well as having diverse hours open to the public.

Curbside collection/mobile
Although not a common component in EPR programme design, some municipalities have traditionally offered limited pick up of large household appliances and cooling and freezing (C&F) appliances such as stoves and refrigerators, usually based on a fee for service or for no fee during limited periods within the year.

Retail collection sites
In many EPR programmes, retailers are often assigned an obligation to collect WEEE on an 'old-for-new' or a '1:1'basis, that is, customers are able to return their WEEE when purchasing a similar replacement product. In some programmes no purchase of a replacement product is required to return WEEE to a retail site.

Retail pickup when delivering a new product
This mode of collection has been used primarily as a service offer to customers as part of a product sale in the case of LHHA and C&F appliances which require delivery to the client's premises. Often the retailer or their service contractor will charge a fee for this service.

PRO-operated collection depots
In certain scenarios where municipalities and/or retailers have not been assigned a role in collecting WEEE, PROs or IFOs have needed to develop collection points where consumers can dispose of their WEEE. PRO-operated collection points may also operate in parallel to municipal and retail collection points, especially when participation of municipalities and retailers is not mandatory and there are gaps in a national collection infrastructure.

Direct return to producer or recycler via mail or courier service
Producers or their PRO or IFO may also use the national postal service to manage the take back of WEEE items. This may especially be suitable for smaller WEEE items with high relative intrinsic value such as mobile phones. However, in certain jurisdictions the national postal service has

been used for larger items such as desktop and laptop computers and monitors (Japan).

Special collection events
PROs, producers and municipalities may utilise special collection events either in parallel but more often in place of permanent collection depots to collect WEEE.

4.2 Collection Targets

As noted in Section 2.2, where the goals of EPR have been outlined, effective collection is an essential criterion to determine whether or not an EPR programme is successful. However, as will be discussed throughout this thesis, for durable products with long life cycles, calculating what an appropriate rate of collection should be is not a simple matter and is fraught with uncertainty.

However, in order to reduce this uncertainty as well as for programme operators to estimate expected volume of end-of-life products and hence budget for yearly system costs, three main methods have been developed to estimate the total amounts of durable of end-of-life (Lohse, J et al., 1998). These methods include; 1) Consumption and Use Method, 2) Market-Supply Method, and 3) Assumed Saturation Model.

The *Consumption and Use Method* determines the amount of EEE that an average household contains (could be divided into apartment dwelling and single dwelling households) as the basis to predict the total amount of WEEE potentially available. Assumptions are made about the average weight and life span of each EEE present in the average household. For each type of product, the assumed weight is multiplied by the number of households and the saturation rate of that EEE in the average household. This figure is then divided by the average life span of the product. This is repeated for all EEE product types. Data assumptions about product life spans are readily available from market actors and national demographics regarding the number of apartment dwellings and single-family households can be found at national statistics bureaus.

Market-Supply Method uses historical sales data and average product life span assumptions to calculate expected WEEE arisings for a given year. For example if the expected life span of a refrigerator/freezer is 16 years, then the total WEEE arising would be calculated in the current year based on the number of products placed on the market 16 years ago. For this model, sales data may be harder to obtain and must be corrected for imports and exports if not already done so in the reported sales statistics.

The *Saturation Model* simply assumes that ownership of EEE in private households is saturated and that for each new sale of EEE, the replaced product reaches its end-of-life. This model is rather simplistic and requires only new sales of products that are placed on the national market.

Waste Audits of municipal waste can also be conducted to determine total tonnages expected to be disposed of in this channel.

Setting Collection Targets
There are a number of ways of setting collection targets in EPR programmes for WEEE. On method is to base the target on the requirement for each producer to meet a certain percentage of what was placed on the market in the previous calendar year. For example, if producer A put on 100 tonnes of product on the market in 2007, and the target is set so that each producer must collect 70% of what he/she placed on the market, then in 2008 producer A is responsible to collect 70 tonnes of his type of equipment.

Alternatively, the collection target could simply be set on an aggregate level for all product categories that must be reached in a jurisdiction, for example as in the WEEE Directive, where 4 kg/inhabitant/yr is required to be met. Here, there is no distinction made on the relative contribution that each product category should make to reach the target.

Other variations include a hybrid method of setting collection targets whereby each producer's obligation to collect and treat WEEE is determined by taking the aggregate target of kg/inhabitant/yr and approximating what percentage of each producer's EEE placed on the market in the previous year would need to set in order to reach the aggregate target.

4.3 Collection Categories

While there are certainly variations between EPR programmes for WEEE with respect to how WEEE is grouped at collection facilities, in Europe in the context of the WEEE Directive, municipalities and compliance schemes tend to collect WEEE in the following 5 general categories: *1). Large Household Appliances, 2). Cooling and Freezing Appliances, 3). Small Domestic Appliances, 4). Televisions and Monitors, and 5). Gas Discharge Lamps.*

WEEE in each of the 5 collection categories have characteristics that make them suitable to be processed together in downstream facilities. In certain Member States these collection categories (or variations there of) are mandated in the legal national transposition of the WEEE Directive. Examples of products within each of the 5 collection categories are described below.

Table 4-1: Common WEEE Collection Categories

Collection Category	**Example Products**
Large Household Appliances (LHA)	Washing Machines, Clothes Dryers, Dishwashers, Stoves & other metal rich large appliances
Cooling and Freezing Appliances C&F)	Refrigerators and Freezers
CRT TV & Monitors (CRT)	TVs and computer monitors
Small Domestic Appliances (SDA)	Computers, printers, mobile phones, toasters, stereo equipment, small kitchen appliances
Gas Discharge Lamps (GDL)	Low energy mercury lamps

1. Large Household Appliances (LHA) (excluding C&F): Includes metal dominated white goods such as washing machines, dishwashers, stoves and clothes dryers.

2. Cooling and Freezing (C&F): Refrigerators and freezers containing refrigerants. To avoid mixing incompatible C&F appliances (ozone depleting substance containing vs. non ozone depleting substances) it is common practice not to sort C&F WEEE at collection points. In order to avoid damage of C&F appliances resulting in the release of "controlled substances" during collection, storage, transport and handling appropriate measures should be undertaken.

3. Small Domestic Appliances (SDA) This collection category includes Consumer Electronics (CE) such as home stereos and video recorders, DVD players, digital cameras, Information Technology and

Communication Equipment (ICT) such as computers and laptops mobile phones, printers, etc. Small household appliances (SHA) such as toasters and coffee makers, etc. The SDA category may often contain some of the smaller Large Household Appliances (LHA) such as microwaves and electric ceiling fans for example.

4. Televisions and Monitors: Includes CRT and flat panel displays (FPD) such as LCD TV and monitors and plasma TV.

5. Lighting Equipment (Lamps) This collection category includes most compact fluorescent bulbs (CFLs) and straight fluorescent tubes (SFTs).

Table 4-2 below provides a summary of how the *product categories* in the WEEE Directive: Annex IA and IB, the categories used by WEEE Forum, and the common collection categories described above match together. This provides a useful way to compare the categories to, for example, reuse, recycling and recovery targets as described in the WEEE Directive as well as to collection results where the breakout to WEEE Directive categories may or may not take place.

Table 4-2: Comparison of WEEE Directive & WEEE Forum Product Categories to Common Collection and Treatment Categories

WEEE Product Category	**WEEE Forum Product Categories**	**Collection/Treatment Category**
1. Large Household Appliances (LHA)	1A LHA (excl. cooling and freezing appliances)	1 LHA
	1B C&F	2 C&F
	1C LHA – smaller items (LHHA-small)	3. SDA (small domestic appliances)
2. Small Household Appliances (SHA)	2 SHA	
3. IT and Telecommunication Equipment (IT)	3A ICT (exclud. CRT & LCD) (IT ex CRT	
	3B CRT Monitors (IT CRT)	4. CRT Appliances
	3C LCD Monitors (IT FPD)	
4. Consumer Equipment (CE)	4A CE (excl. CRT)	3. SDA (small domestic appliances)
	4B CRT TVs (CE CRT)	4. CRT Appliances
	4C Flat Panel TV (CE FDP)	
5. Lighting Equipment (LE)	5A LE – luminaries (LUM)	3. SDA (small domestic appliances
	5B LE – gas discharge lamps (Lamps)	5. Gas Discharge Lamps
6. Electrical and Electronic Tools (Tools)	6 Tools (Tools)	3. SDA
7. Toys, Leisure and Sports Equipment (Toys)	7 Toys	
8. Medical Devices (Med)	8. Med	
9. Monitoring and control instruments (M&C)	9. M&C	
10. Automatic Dispensers (Auto Dispensers.)	10. Auto Dispensers.	1. LHA (treatment only)

4.4 Transportation & Consolidation

WEEE that is collected from collection points is in certain cases transported to consolidation centres where products are sorted and stored until sufficient quantities of WEEE are gathered to justify transport to primary treatment facilities. Sorting may be required in circumstances where limited space is available at collection points and therefore because of the need to reduce the number of containers, WEEE categories are co-mingled. In other scenarios, WEEE is often transported directly to primary treatment facilities for further processing.

4.5 Primary Treatment: Dismantling & De-pollution

Manual disassembly of certain WEEE types is integral to sound end-of-life management. Boks (2002) outlines two main reasons for incorporating a disassembly step in the treatment of WEEE. Firstly, manual disassembly to recover components that have a higher value when separated than if incorporated in the product when shredded. This typically includes part removal at the sub-assembly level for example a CDROM, video card or an electric motor. Alternatively, a part is removed because of its high scrap value, for example copper or aluminium parts. By removing the part from the main assembly, higher purity levels of that material are achieved. This value is higher than it would have been if left in the product and subsequently shredded, for example. This is because the purity of that substance would be compromised after shredding and co-mixing of materials. This is often why printed circuit boards are removed from electronic products, as the precious metals are highly concentrated there.

Secondly, a dismantling step is often desirable to remove hazardous substances that if otherwise left in the product would result in higher economic and environmental penalties/costs. For example, if whole products containing mercury switches or PCB capacitors are shredded, then the resulting material fraction may have to be disposed of as hazardous waste (if disposal site requires testing of the residue fraction). Whereas if the hazardous components were dismantled prior to shredding the costs associated would only be for the hazardous components themselves, and revenues would be obtained from the subsequent material streams after shredding.

At dismantling facilities, disassembly consists of manual, or semi-automated separation using common tools (pneumatic, or hand tools such as screw drivers, pliers, pry bars, tongs, etc.) as the most common ways to separate components from the main body of the product. Typically, depending on the type of WEEE, different levels of disassembly may occur. For example either selective (only a few important components are removed), partial, or full product disassembly will occur prior to further treatment options. Since disassembly is a non-destructive form of treatment, there exists a high potential for components to be reused or remanufactured for reuse if there is demand.

The above mentioned decision-making variables are especially relevant in an unregulated environment, or where imposed treatment standards are not enforced. In this scenario any rational recycler would only employ a depth of disassembly to remove hazardous components at a level to ensure no penalties would arise at downstream market outlets for separated materials. That is, if shredding of products with hazardous components and subsequent material separation would not lead to penalties from downstream outlets the recycler would be encouraged not to do so, as any hazardous components would need to be disposed of as hazardous waste. Therefore a double expenditure arises, that of manual labour to remove the component and then the hazardous waste disposal costs associated with that component or substance.

However, if there are treatment standards and they are adequately enforced, a recycler would have greater incentives to follow the minimum requirements. Since under EPR, producers are responsible to ensure treatment requirements and standards are met, they charge this responsibility onto recyclers through contractual arrangements.

4.5.1 Cooling and Freezing (C&F) Appliances

The majority (approximately 70-90%) of cooling and freezing appliances treated as WEEE today contain CFC, HCFC, HFC refrigerants, of which CFC and HCFC are ozone depleting substances (ODS). While HFC is not an ODS it does have a global warming potential (GWP) of approximately 1300 and therefore is required to be captured and treated. The remainder 10-30% of cooling and freezing appliances ending up in the waste stream contain hydrocarbons (HC). In the mid-1990s, manufacturers started to make use of hydrocarbons as refrigerants (isobutane) in the compressor cooling system and as blowing agents for the polyurethane foam insulation (cyclopentane). The hydrocarbons used in refrigerators, freezers and air conditioners do not deplete the ozone layer, and their GWP is typically 3 or 4, i.e. below the GWP threshold 15 of annex II(2)of the WEEE Directive. Since HC are VOCs, there is also concern that if gases in the cooling circuit or insulation foam are released into the open environment photochemical smog formation can occur. To a lesser extent some domestic absorbtion refrigerators also use ammonia in the cooling circuit.

While it is clear that CFC, HCFC and HCF in both insulation and cooling circuits needs to be recovered due to either its ODP or GWP factor or both, there is less agreement regarding how HC refrigerators & freezers need to be managed. There are differing views regarding whether HC refrigerators need to be treated together or separately from CFC, HCFC and HFC refrigerators. This revolves around the issue of whether HC containing appliances require their refrigerants in insulating foams to be captured and stored. Since the cyclopentane in insulation of HC appliances is highly flammable, suitable measures must be taken to ensure the risk of explosion is minimised. One method of ensuring this is through extensive ventilation in the shredding chamber. However HC capture is not possible when this is employed. If HC containing C&F appliances are treated together with CFC appliances new explosion prevention methods are required that otherwise are not needed if CFC appliances are treated separately as CFC, HCFC and HFC are non explosive. Proponents of treating all types of refrigerant appliances jointly, claim that inevitable sorting errors of identifying CFC appliances as HC causes considerable CFC emissions, especially if processed in auto shredders. Despite whether the C&F appliances are CFC or HC treatment of refrigerators containing appliances is predominantly a two-stage process whereby a first de-pollution step includes the following activities.

Step 1 – Manual de-pollution

- Removal of refrigerant in the cooling circuit and oils in the compressor
- Removal of compressor (manually), cooling circuit, glass and plastic trays, cables, capacitors, mercury containing components, etc. and appropriate recycling or destruction

Step 2: Mechanical Processing of Cabinets

- Shredding of refrigerator cabinet in an encapsulated plant operating under vacuum to collect refrigerants in the insulation foams.
- Removal and destruction of refrigerant released during the shredding process
- Subsequent separation of materials into relevant fractions including degassed PU foam (CFCs not exceeding 0.2% by weight), ferrous metals, non-ferrous metals and plastics with restricted quantities of PU foams in those fractions

Processing refrigerators in dedicated refrigerator shredders has higher associated costs compared with auto shredders. If HC are required to be captured (cooling agent only) the expected processing costs are approximately 4-5% greater than if it were able to be released into the environment (Strömberg, K & Ringström, E, 2003).[21] Similarly, CECED has estimated that any requirement stipulating that hydrocarbons are recovered and sent to recycling or reuse would unnecessarily add 10€ to the recycling cost of one refrigerator or freezer. However, in the study by Strömberg and Ringström (2003), the recycling and recovery targets of the WEEE Directive could not be achieved through processing C&F appliances in auto shredders as these facilities lacked downstream sorting technology to recover certain plastics and PU foam containing HCs.

4.5.2 ICT Equipment

Dismantling of ICT equipment has been taking place for over 15 years. Although more relevant for business to business sector products than for ICT from private consumers dismantling ICT has been set up prior to EPR legislation. Dismantlers generally decide when to disassemble certain parts for the reuse market or recycling when the value of that component either as a reusable component or the material recycling revenue is higher than the labour cost to remove it. There are however, examples where some manufacturers in the ICT sector that have either contracted with dismantlers or have vertically integrated into disassembly to recover valuable parts for reuse in refurbished products, as spare parts, or in new products. A classic example that is well documented in the literature is the case of Xerox remanufacturing activities (Guide, D & Van Wassenhove, LN, 2001; Kerr, W, 2000).

4.5.3 Televisions and Monitors (CRT containing devices)

CRT containing products require special treatment in order to ensure minimal environmental impacts as a result of processing and disposal. In the WEEE Directive specific treatment requirements are mandated and include that the CRT be separately removed from the television or monitor including the removal of the phosphorus (fluorescent) coating.

A cathode ray tube (CRT) is the video display component of computer monitors and televisions. Made predominately of glass (95%), lead (PbO) and other elements are added to the CRT to protect the user from x-rays generated from within the CRT. There are two major distinctions of the

[21] This study compared 4 treatment scenarios of HC and HFC refrigerators in dedicated refrigerator treatment plants and auto shredders in the Swedish context.

types of glass in CRTs. The panel glass or screen glass is at the front of the CRT and contains the metals barium and strontium mainly for image quality. Funnel or cone glass mostly contains the lead.

Due to the lead content in the funnel glass and luminescent materials, monitors and TVs containing cathode ray tube (CRT's) must be disposed of as hazardous waste, if not pre-treated. Therefore, CRT recycling is the most cost-effective method of handling these products today, not to mention that it is mandated to do so in the WEEE Directive. Environmentally sound pre-treatment must extract the contaminants of the luminescent coating as it usually contains cadmium, zinc sulphide, yttrium, europium and other rare earth compounds.

According to Huisman et al. (2007) there are two main approaches currently used to treat CRT containing devices. These include:

1. *Manual removal of the CRT* from the device and the subsequent separation of the front panel glass (lead-free barium strontium oxides) from the funnel glass (lead oxides) using one of the following commercial techniques including a). NiChrome hot wire cutting, b). laser cutting, c). diamond saw d). water jet, e). thermal shock, f). diamond wire. After separation of the CRT the removal of the phosphorus coating using predominately a vacuum suction tool is conducted. In terms of CRT management this general method is the most predominant approach to the management of CRT containing products.

2. *Manual removal of the CRT* from the device followed by *shredding of the intact CRT and subsequent mechanical recovery of the phosphorous coating*, dust and metal oxides and a final treatment/disposal of the residues.

Important to note is that in both processes listed above, there are a number of previous steps to remove the CRT from monitors and TV sets that was not discussed. This process is manually done through disassembly resulting in a number of other material fractions. These include printed circuit boards, most often flame retardant plastics, cables, and copper yoke.

4.5.4 Economic Considerations

Simply stated, like any business the economic outcome of a manual disassembly facility is dependent on how the revenue centres are balanced with the cost centres. Since disassembly operations today use human labour to dismantle WEEE components and materials, labour costs play a significant role in the total operating costs. Only if the value of the component (through part reuse, or material value) removed is higher than the labour cost associated with disassembly time is it economically justifiable. Alternatively, the removal of a certain part may not achieve an economic yield as such, but the savings associated with loss of material value expected if that part is not removed, can warrant the extra labour cost.

Although there does exist a market for used components, mainly for ICT products, there is a relatively low demand for used components and especially for reuse in new products. These markets are characteristically known as having relatively unstable prices. It is also very difficult to predict what this demand might be in the future. Dismantlers generally decide when to disassemble certain parts for the reuse market when the value of that part is greater than the cost to pull it. There are however, examples where some manufacturers, again mainly in the ICT sector, that have either contracted with dismantlers or have vertically integrated into disassembly to recover valuable parts for reuse in refurbished products as spare parts, or in new products.

Another point worth mentioning is concerning the source of the products, for example if they are coming from municipal collection facilities or from commercial business-to-business sources. This generally impacts revenues on the side of whole product reuse potential and component or part value. On the whole, products coming from municipal collection facilities usually have very little part or reuse potential (see (Scheidt, L-G, 2007) regarding results of study entitled "Analysis of the Reuse Potential of Used ICT Equipment").

Generally speaking, the capital equipment used at dismantling facilities is relatively inexpensive, especially compared with mechanical processing facilities discussed below. Although automated disassembly has been investigated through a number of pilot projects, this technology is not in operation commercially as of yet. Numerous researchers have devoted considerable time to develop such systems. If this were to change, the cost structure in terms of capital costs vs. labour costs could shift considerably.

4.5.5 Automated Disassembly

There has been some experimentation with automated disassembly in Europe as part of the CARE Project mentioned in other parts of this thesis.

Current concepts of automated disassembly are very inflexible and usually developed for a special task or product (for example a specific PC model) making this an un-economical approach (Knoth, R et al., 2001). Therefore, research into making this a more flexible option focuses on developing modular systems for flexible disassembly cells for dismantling 'families' of similar products.

Research into dismantling printed wire boards for component recovery, has been conducted by Knoth, Hoffmann et al. (2001). The method uses semi-automated disassembly of valuable integrated chips and hazardous components by targeted laser heating to melt the lead solder and with the use of "robotic grippers" the components can be removed. The uses of lasers decrease the heat stress on the components that are removed, extending the lifetime.

As mentioned above if successfully implemented automated disassembly could have positive effects on a number of factors associated with manual disassembly operations. Since, automated disassembly reduces the need for many tasks that previously relied on manual labour, reduced labour costs would be achieved if implemented.

Boks and Templeman (1998) performed a Delphi study with a panel of specialists in end-of-life management from around the world and from a number of different branches (i.e producers, recyclers, academia and consultancies) to assess the future of disassembly and recycling technologies. The results of this study are updated and summarised in Boks (2004). This dissertation included the following conclusions. It would appear that partial automated disassembly of consumer electronic goods, and presumably ICT products, is likely not to become economically attractive process before the current products on the market reach there end-of-life. For products designed today partially automated disassembly is a definite factor to take into account (Boks, C, 2002). Therefore, product design should consider this by designing housings and printed circuit boards so that they can be easily disassembled.

Boks (2002) makes the point that fully automated disassembly for consumer electronic and presumably ICT products that will reach their end-of life in 4-7 years, this technology will most likely not be implemented. However, they also point out that within the next 2-4 years, product designers should consider that automated disassembly could become an economic reality, by the time those products come to the end-of-life stage in 7-10 years (Boks, C, 2002).

4.6 Primary Processing: Shredding & Material Separation

In terms of processing WEEE through shredders, there are two main routes that are typically found. These are described below. Important to note is that mechanical recycling is considered as both an alternative and a complementary process to dismantling and de-pollution as shredders will often process separated material fractions from the dismantling stage for further separation and liberation. There are a range of separation technologies that are employed to separate the heterogeneous material resulting from the shredder which include but are not limited to overband magnets, eddy current separation, rotating trommel screens, air tables, optical screening, etc.

4.6.1 Large Household Appliances (LHA)

The primary route for LHA (white goods) has been traditionally through large shredders processing metal dominated products such as vehicles and white goods. A large hammer-mill rotating at high velocity reduces the products to pieces roughly between 3 and 25 cm (Furuhjelm, 2000). Subsequent steps are performed to sort materials into fractions that are further recovered at metal smelters. Steps include removal of non-metal light fractions materials such as plastics and other non-metal residues, known as shredder residue (SR), which is primarily landfilled or incinerated. Large magnetic devices separate ferrous metals such as iron and steel into relatively pure streams, which are subsequently processed at metal smelters. The non-ferrous fraction consisting of mainly copper, aluminium, magnesium and stainless steel is sorted using techniques including eddy currents, vibrating tables and sink-float installations that utilise the density and other physical properties of the metals to separate them.

However, at the same time certain LHA treated in auto shredders will not meet the WEEE Directive recycling targets unless the light shredder fraction, particularly plastics and glass, are further treated. Since the ELV Directive also has recycling targets investments have been or will be needed to meet the targets. Additionally, according to Annex II, PCB containing capacitors should also be removed as a whole and it is unlikely that auto shredders would be capable of this, unless removed prior to shredding. Considering this, new WEEE treatment facilities have been recently commissioned that manage LHA with other SDA with minimal or no pre-treatment or de-pollution prior to mechanical processing. These facilities are described at the end of the section below.

4.6.2 WEEE Treatment Facilities: Small Domestic Appliances (SDA)

Mechanical processing facilities that exclusively manage WEEE have been in operation since the mid 1980's. These facilities typically process WEEE categories 2,3 (excluding CRT displays) ,4 (excluding CRT Televisions), 6 and 7, either as whole products (directly into the shredder) or with selective dismantling prior to shredding to remove hazardous components for example cathode ray tubes (CRT's) in monitors and TVs. CRT recycling is described below. According to Stevels (2002), approximately half (on a weight basis) of all discarded EEE in Western Europe is shredded and subsequently separated into several material streams, without any prior disassembly steps. Similar to the shredding facilities above a number of separation steps are performed in order to separate the various metal and plastic streams.

From the perspective of actors involved in dismantling and mechanical processing of WEEE, the way in which actual processing takes place is highly dependent on the requirements of the secondary recyclers involved in scrap metal, plastics recycling, metal smelting facilities, incineration and landfill. However, important to note here, is that most of these factors are by no means constant, and the both the specification of these outlets for material streams and the cost and/or market value may vary over time.

Given this perspective, processors involved in the management of end-of-life electrical and electronic products tend to think of WEEE not as incoming individual products but rather as material streams based on their potential contribution to the output streams. Boks (2002) refers to this issue as the "ensemble issue", which he describes as the way WEEE streams are mixed. Although based on the actual situation of recycling processes in the Netherlands, it provides a useful categorisation of the way in which this is looked upon. From this viewpoint, WEEE products can be divided into at least four main categories (Boks, 2002). These include: CRT containing products, metals dominated products, precious metal dominated products and plastic dominated products.

As noted above, traditional WEEE dedicated shredding and sorting facilities did not handle LHA, as do the more modern WEEE recycling facilities being installed today. Despite this many of the earlier dedicated WEEE facilities are still in operation today and below is a description of one such plant run by SIMS Recycling.

The management of SDA WEEE in this facility is based on a two-stage shredding process followed by mechanical processing. In the primary shredding stage whole products are fed into the shredder which subsequently produces an output of a mixture of materials with a size of approximately 100 mm. In the second shredding stage, the material is then fed into a secondary shredder which further reduces the size of the material mixture to approximately 20 mm in size. Dust is extracted from the shredder and sent for further treatment (SIMS Group, 2007).

The size-reduced material is then transported on conveyor belts where an over-band magnet separates ferrous metals (iron and steel). The remaining material then continues on to an eddy current separator which separates non-ferrous metals (aluminium, copper, brass, stainless steel) from non-metallic fraction (wood, plastics, PCB pieces, glass, wire (coated with plastic covering)). The remaining non-metallic stream is treated on a separate line where it is fed into a water separator that produces two separate material streams. One stream is mainly copper wire pieces and printed circuit boards while the other contains mainly plastics and glass are further processed by SIMS recycling.

During the separation of the materials as described above from the complex material feed (WEEE) there is a likely probability that the unintended co-separation of precious metals will occur, which can add up to substantial overall losses. This primarily refers to mechanical separation of iron, aluminium and plastics form the copper rich stream which can lead to losses of precious metals into these side streams.

As noted by Hagelüken (2006), the liberation of different materials prior to mechanical sorting is extremely important as the complexity of the feed material has a considerable impact on the achievable results. The greater the number of interlinked materials and particles which are intensely interwoven with other materials, the poorer the results of mechanical processing. Therefore, circuit boards but also whole products like mobile phones, which are highly complex materials in this context *should be removed prior to mechanical pre-processing* (Hageluken, C, 2006).

4.6.3 Gas Discharge Lamps (GDL)

Described here are two main categories of GDL, including straight fluorescent tubes (SFT) and compact fluorescent bulbs.

Straight Fluorescent Tubes (SFT) End-cut Technology

This technology is best described as automated de-manufacturing of SFTs where the phosphor powder inside the tubes (mercury containing) can be reused in new SFTs when removed. Once a tube length is selected, tubes are fed into the machine either manually or automatically. There are a number of processing steps which include tube identification, hole making by row burners, end cutting, and discharge of the mercury containing phosphor from the tube. Cut off end caps are collected separately and can be further processed to separate the materials aluminium, ferrous metals and waste lead glass. Once the end caps have been cut off, the phosphorus coating inside the tube is blown out while the tube is still rotating and the phosphorus coating is collected in barrels with the aid of cyclones (MRT, 2007).

In the MRT system, a special unit can be added to the system to detect up to six different phosphor coating types. A colour detection camera is installed which can identify a particular coating type and signal the blowing nozzle to direct the coating to a specific container. The remaining empty soda lime glass tubes are then crushed and screened of any metal contaminants before being collected in containers and shipped to glass markets.

The collected mercury containing powders are either marketed to lamp manufacturers (in this case both the mercury and rare metals such as yttrium (Y) and europium (Eu) within the phosphor powder are reused) or sent for further distillation to recover mercury. The distilling process heats the mercury containing powder to at least 500°C. During heating process the mercury vapours are released from the waste material and continuously transferred to the cooling system where the mercury condenses into free floating liquid mercury. The reclaimed mercury has an average purity level of 99.99%, depending on mercury concentration before processing. Before being deposited in a super-sack or barrel, the non-hazardous by-products such as fluorescent powder will be cooled to facilitate handling (MRT, 2007).

Crush and Separation
An alternative technology for the treatment of both compact fluorescent bulbs and SFL involves processing of either previously crushed lamps or whole lamps through destructive crush and sieve technology (MRT, 2008).

Whole lamps or crushed lamps are feed into the system from separated points and are crushed by heavy duty auger screws which transport materials to intermediate silos accompanied with vibration feeders. A belt conveyor accompanied with dust evacuation technology transports the crushed lamps to the sieve. The sieve separates the crushed materials into a glass fraction, metal fraction and powder fraction. Glass fractions and metal fractions are further treated in a tumbler and vibrating conveyor, respectively, where any remaining dust or powder is shaken off to produce clean glass and metal fractions with very low residual levels making it suitable for further recycling. The fluorescent powder and dust is transported by dust evacuation equipment to the powder cyclone and dust filters. The final process air passes through mercury absorption filters before leaving the plant room. Removal of the mercury in the phosphor powder is done through distilling technology described in the above section on end cut technology (MRT, 2008).

4.7 Secondary Processing and Markets

4.7.1 Ferrous, Non-Ferrous and Precious Metal Recycling

Resulting metal fractions from the dismantling and mechanical processing of WEEE are ultimately processed by smelting facilities to recover the metals for reuse in the economy. Metals from WEEE are normally not significant inputs into these systems, however their significance to closing material loops is important for the sector.

Copper, aluminium and iron smelters usually have strict requirements on the purity level of the scrap metal that they receive from recyclers or scrap metal brokers. A typical testing protocol at a copper smelter, for example, includes the following screening process. Prior to the unloading of any shipments from recyclers, the containers are checked for radiation. A representative sample of the batch is taken to define the metal values and to check for unwanted impurities such as mercury, bismuth, antimony, and polybrominated flame retardants that have the potential to disturb the process. The sellers of the material are paid by the smelters according to the levels of precious metal and copper contained in the batch. Penalties may be applied for batches that have certain concentrations of bismuth and lead (Kindesjö, 2002).

Table 4-3: Elements in Electronic Scrap Influencing Copper Smelters

Metal	Elements which are detrimental to recycling	Elements which reduce the recycling value of the scrap
Copper	Mercury	Arsenic
	Beryllium	Antimony
	Polychlorobenzene	Nickel
		Bismuth
		Aluminium
Aluminium	Copper	
	Iron	Silicon
	Polymers	
		Tin
Iron	Copper	Zinc

Metallurgical processes to recover metals are also used to liberate, separate and purify materials. Depending on the type of metallurgical process there are, however, limitations to what can be achieved in terms of recycling the various materials in the input feed. These are described below.

With all *metallurgical processes* any organic constituent in the material feed is utilised to substitute coke as a reducing agent and fuel as an energy source but material recycling of plastics is not possible. *Integrated smelters based on complex lead/copper/nickel* metallurgy that use these base metals as collectors for precious metals cannot recover aluminium and steel/iron as metals, but rather they are transferred to the slag. *Aluminium smelters* cannot recover precious metals and all other metals are lost in the process. All non-ferrous metals are lost in fractions that that are landfilled, incinerated or processed in steel or plastic plants.

4.7.2 Hazardous Substances, Materials and Components

Once hazardous substances, materials and components are removed from separately collected WEEE, they are most likely to be deposited in hazardous waste landfill sites or thermally treated at hazardous incineration plants or in certain cases sent to recovery plants for material recovery (batteries for example). This chosen route will often depend on the applicable laws where the treatment facility is located, and may differ between MS in the European Union. These items include those PCB and other electrolyte capacitors, CFC gasses, asbestos, hazardous batteries, mercury containing backlights or whole LCD screens containing backlights, and phosphorus coating from CRTs.

4.7.3 Plastics

In general, recycling markets for plastic material in EEE are currently not functioning effectively, and it is unlikely that the WEEE Directive recycling targets are being met for many plastics dominated products. Although somewhat outdated, the latest available figures from Plastics Europe estimate that a total of 848 000 tonnes of plastic waste from WEEE was available for collection in 2002. Of this total, approximately 811 000 tonnes were either landfilled or incinerated (without energy recovery). 3 000 tonnes were recovered through energy-from-waste facilities, while 32 000 tonnes were mechanically recycled within Europe (Association of Plastics Manufacturers, 2004).

Besides landfill and incineration with or without energy recovery, there are two main approaches discussed for mechanically recovering plastics from WEEE, (not including valorisation, pyrolysis, gasification to produce syngas, production of cracker feed, or use as a reducing agent in blast furnaces (feedstock recycling)). These are directly connected to the way in which WEEE in plastics are either (1) manually dismantled prior to shredding or (2) mechanically processed through shredders and subsequently removed.

Manual sorting through disassembly is the most widely practiced approach for plastic recycling. Disassembly staff at dismantling facilities are required to make the correct sorting decisions when removing plastic components from WEEE products. This is done with the aid of ISO identification labels, or analytical tools that can distinguish polymers. This method is suited for product streams with few plastic types and grades, contain large parts, and do not need excessive labour. The advantages of manual sorting include; simplicity, low capital costs, and no specialised skills or equipment needed. The disadvantages include large shipping costs (bulky material, low weight), low throughputs with small parts (high sorting costs), operator dependent quality, and storage costs.

Large plastics housing removed from TVs and computer monitors as a result from the need to remove the CRT are typical examples of plastics that are manually disassembled. Other examples include ink cartridges or plastic drawers in refrigerators. Plastic housings from products such as computers or other precious metal containing products are also candidate cases when disassembly is required to remove the precious metal containing circuit boards or connectors.

Automated separation methods includes separation of mixed plastics after mechanical shredding and has proven to be a challenge, particularly for complicated streams as found in electrical and electronic products. This method includes automated plastic sorting and uses mechanical flake sorting to purify the target plastics in a commingled stream. The advantages of using this method include higher volumes, much lower plastic shipping costs, and enhanced sorting capabilities (Arola D.F. et al., 1999).

However, according to leading plastics recyclers in Europe, demand for high quality recyclate is increasing as more and more manufacturers recognise the financial, practical and environmental advantages of using recycled plastic, particularly in the light of rising raw material prices (Axion Polymers, 2008).

Similarly, greater efforts must be made to process WEEE in sorted streams of similar product types if the Directive is to demonstrate higher yields of polymer recyclate for top-quality re-application in new products (Axion Polymers, 2008). Streaming by product type, which has happened with fridges and CRTs, makes it possible to implement a more efficient de-pollution regime using processes designed for that particular application. As a result these processes typically produce recovered plastic streams that are more uniform which can then be upgraded for use in higher-grade applications (Axion Polymers, 2008). According to Axion Polymers (2008) the main types of polymers used across different brands of the same product stream are often very similar. Therefore, streaming of, for example vacuum cleaners, into a single product type "would lead to a higher recovery rate of the polymer ABS, with the associated benefit that de-pollution regimes could be tailored to suit the particular item being handled" (Axion Polymers, 2008).

4.7.4 CRT Glass

Since the manufacturing of new CRT TVs and monitors is drastically reducing with limited manufacturing taking place inside Europe, the market for CRT glass recyclate is also declining. Markets outside Europe have been identified in countries including Brazil and China where manufacturing of CRT TVs is an ongoing albeit declining (Huisman, J et al., 2008).

Other (potential) markets for CRT leaded and non leaded glass include limited application in lead smelters where the silica in the glass acts a reducing agent in the smelting process while the lead is recovered in the smelter. Since approximately 20% of the CRT contain lead, it is unlikely that the recycling targets could be met with this approach.

4.8 Efficiency of Mechanical Recycling

Opponents to weight-based recycling targets which are often part of EPR programmes, point to inefficiencies that can result from focussing on recycling materials with the greatest physical weight as opposed to the environmental weight (Hagelüken, C, 2006; Huisman, J, 2003). These proponents to the so-called 'environmental-weight recycling targets' point out that under weight-based targets, recovering 1 kg of iron is put on equal footing as recovering 1 kg of gold, even though the life cycle impacts associated with gold are considerably higher.

The recycling value chain has been described in the previous sections and would appear to be a straightforward process from collection of WEEE through to the final recovery of base metals and other materials such as glass and plastics, as well as, certain fractions ending up as final disposal in incinerators, landfill or hazardous waste facilities.

However, the recycling chain is more complex than it first appears. It is clear that these different and subsequent steps are interlinked and there exists numerous interdependencies between them. However, these single steps are mostly conducted in isolation and as a result there are many inefficiencies arising from a lack of a holistic view on the processes (Hagelüken, C, 2006).

Considering this, it is obviously important when considering that the 'bottom-line efficiency' of the entire recycling chain, depends on the efficiency at each of the steps. Thus, the least efficient step in the process has the largest impact on the efficiency of the entire chain. From this perspective, it is clear that in Europe, improving collection rates is crucial to improving efficiency of the entire system.

There are a variety of reasons why collection rates in certain MS are low, which will be explored in various sections of this thesis. However, generally speaking the three main explanations include: (1) the hoarding effect, where consumers hold onto their unwanted EEE and store it in their attics or garages, or the bottom of drawers; (2) disposal of WEEE in municipal waste; (3) WEEE is exported for reuse or recycling to mainly developing countries such as China, India and African countries.

Despite these 'leakage flows', even for WEEE that does end up in the European collection and recycling chain there are certain processing inefficiencies that need to be recognised and discussed. Mechanical processing (with or without prior dismantling to remove valuable or hazardous components) utilises an initial shredding step followed by a number of sorting technologies to sort the shredded materials into various fractions: ferrous (steel and iron), aluminium, copper, clean plastic and waste. Despite the relative success of these separation processes there are certain technical limits that arise. When separating these material fractions from complex material feed, the unintended co-separation of precious metals into these streams is inevitable (Hagelüken, C, 2006). These cumulative losses reduce the overall precious metal yield of pre-processing, which generally aims to concentrate them in the copper bearing fractions.

Precious metals and scarce elements which are unique to electronic products are concentrated primarily within certain electronic components. Gold is distributed mainly in edge connectors, connecting-plugs and sockets, contact pins and integrated circuit chips found primarily on PCBs, and other components connected to PCBs. Indium and tantalum are found primarily in the integrated circuit chips and tantalum capacitors respectively (Zhang, S, 1999).

Taking into consideration the technical limitations of mechanical processes it is estimated that approximately 20% of the precious metal content and scarce elements in circuit boards are lost to other processing fractions including the non-ferrous, ferrous and plastic fractions where they cannot be subsequently captured (Hagelüken, C, 2006).

This technical limitation of mechanical recycling to recover precious metals from electronic products was confirmed by Zhang (1999). The author extensively reviewed various density-based separation technologies as well as electrical conductivity-based separation and came to the conclusion that in both cases electronic components/products that contain a substantial amount of plated precious metals cannot be treated directly by physical separation technologies (Zhang, S, 1999). This is explicitly mentioned in the following passage below.

> *Therefore, we conclude that physical separations, in an attempt to upgrade metal contents, shall be used for EOL EEE in which precious metal-containing components like printed circuit boards are pre-dismantled or electronic products that contain very low grade precious metals such as brown goods. It can be expected that the separation efficiency will be enhanced significantly, if the components, in which the plated precious metal are present are removed. On the other hand, since the amount of precious metals used in EEE decreases steadily, physical separation directed towards upgrading the desired materials are considered to be strategically important (Zhang, S, 1999).*

Therefore in order to avoid this precious metal and scarce element loss, either the circuit boards need to be removed from the product prior to shredding as proposed by Zhang (1999) or by feeding them, after removal of batteries, directly into an integrated smelter (Hagelüken, C, 2006).

For low-grade products such as small consumer electronics and small domestic appliances with limited precious metal content, the direct smelter route is usually not applicable and mechanical pre-processing is required. However, Hagelüken (2006) notes that instead of intensely shredding the material a more optimal approach would be to employ a coarse shredding followed by the removal of circuit boards using manual or automated selective approaches.

Clearly, in the first option when products are fed directly into the shredder the recycling targets imposed in the WEEE Directive could not be met as plastics consumed in the process would not be counted towards recycling. Proponents of the environmental-weight based targets claim that this route is the most eco-efficient especially given current product design structures, and therefore imply that recycling targets should be reduced. However, the dynamic effects on product design as a result of strict targets are largely ignored and costs to remove circuit boards could be drastically reduced in response. This is discussed more in the sections below.

4.9 Cost Impacts of Article 6: Treatment and Annex II

Article 6 and Annex II of the WEEE Directive outline the general requirements of producers or third parties acting on their behalf to set up systems to provide for the treatment of WEEE. These systems should be in compliance with the Waste Framework Directive and as a minimum include the removal of all fluids and the selective treatment in accordance with Annex II. Thus, Annex II outlines the selective treatment requirements for materials and components stipulating substances, preparations and components that have to be removed from any separately collected WEEE. Table 4-4 list these substances, preparations and components that are required to be removed.

In terms of impacts on costs to manage WEEE compared with common methods used by recyclers prior to the WEEE Directive, Annex II was expected to have considerable cost implications, mainly concerning the increase in manual labour costs associated with dismantling to remove required components.

Surprisingly, neither the recycling industry nor producers paid much attention to Article 6 nor Annex II during the developmental stages of the WEEE Directive despite the potential impact on investments made in recycling technologies based on shredding and material separation. Table 4-4 below lists the Annex II list of substances, preparations and components that must be removed from any separately collected WEEE.

Table 4-4: Annex II of the WEEE Directive 2002/96/EC – List of Substances, Preparations, and Components to be Removed from WEEE

As a minimum the following substances, preparations and components have to be removed from any separately collected WEEE
- Polychlorinated biphenyls (PCB) containing capacitors in accordance with Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)
- Mercury containing components, such as switches or backlighting lamps
- Batteries
- Printed circuit boards of mobile phones generally, and of other devices if the surface of the printed circuit board is greater than 10 square centimetres
- Toner cartridges, liquid and pasty, as well as colour toner,
- Plastic containing brominated flame retardants
- Asbestos waste and components which contain asbestos
- Cathode ray tubes
- Chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC)
- Gas discharge lamps
- Liquid crystal displays (together with their casing where appropriate) of a surface greater than 100 square centimetres and all those back-lighted with gas discharge lamps
- External electric cables
- Components containing refractory ceramic fibres as described in Commission Directive 97/69/EC of 5 December 1997 adapting to technical progress Council Directive 67/548/EEC relating to the classification, packaging and labelling of dangerous substances (2)
- Components containing radioactive substances with the exception of components that are below the exemption thresholds set in Article 3 of and Annex I to Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (3)
- Electrolyte capacitors containing substances of concern (height > 25 mm, diameter > 25 mm or proportionately similar volume)

However, during the WEEE implementation period, increasing interest and concern over the cost impacts associated with Annex II certainly became apparent. The debate clearly centred on clarification over how *'have to be removed'* should be interpreted and whether this entailed manual removal only or included other removal process such as mechanical or chemical or metallurgical, for example.

In October 2004, the Technical Adaptation Committee (TAC) of the WEEE Directive met to discuss transposition of Article 6 and Annex II. At this meeting OVAM, Public Waste Agency of Flanders presented the results of an eco-efficiency study analysing certain entries in Annex II and their validity. Soon after a working group was established, led by the Dutch Ministry of Housing, Spatial Planning and Environment (VROM) to develop a guidance document to assist MS to interpret Annex II. Although it is not clear when the document was circulated to MS, it can be found on the VROM website and is dated 5 January, 2006. Below, the definition of 'have to be removed' as interpreted by TAC in its guidance document includes the following.

> *Substances, preparations and components may be removed manually, mechanically or chemically, metallurgically with the result that hazardous substances, preparations and components and those mentioned in Annex II are contained as an identifiable stream or identifiable part of a stream at the end of the treatment process. A substance, preparation or component is identifiable if it can be (is) monitored to prove environmentally safe treatment (VROM, 2006).*

Similar to the Dutch government, the UK also produced a Guidance Document on Best Available Treatment Recovery and Recycling Techniques (BATRRT) in November 2006. Under the UK DEFRA Guidance the issue of the definition of 'have to be removed' is dealt with in the following way:

> *The items listed in Annex two fall into two main groups; 1) those that should be removed as a whole, and 2) those that can be removed as materials i.e. in fragments or equivalent. Items should be safely removed as a whole where the material items concerned are hazardous and to do otherwise would lead to manifest pollution of the waste stream (DEFRA, 2006).*

Table 4-5 below compares the 2 guidance documents. The TAC Guidance document certainly has a wider interpretation of removal, and includes manual, chemical and metallurgical techniques as long as Annex II entries are contained as an identifiable stream or identifiable part of a stream at the end of the treatment process. Essentially, this definition allows for any treatment option that contains the substances, preparations and components at the end of treatment process as allowable. To take an extreme example, a whole product could be injected into an integrated metal smelter and as long as the fate of all the Annex II substances are known and not released to the environment, i.e. mercury captured by flue gas cleaning pollution control equipment, or other hazardous substances in the slag, then the treatment would be considered to meet Article 6 and Annex II requirements.

Table 4-5: Comparison of TAC Guidance Document and DEFRA BATRRT: Annex II Entries

TAC Guidance	**DEFRA**
Shall be removed as a first step	*Shall be safely removed as a whole*
a) PCB/PCT containing capacitors b) Mercury containing backlamps of LCDs. If backlights are not possible to remove manually, then the whole screen must be removed c) Other mercury containing components such as switches, contacts, thermometers, thermostats and relays d) External batteries (all batteries that can be removed prior to treatment without special tools), internal hazardous batteries, excluding printed circuit board mounted batteries e) Toner cartridges, liquid and pasty, as well as colour toner f) Asbestos waste and components containing asbestos g) Other gas discharge lamps than mentioned in b) h) Refractory ceramic fibres (RCFs) i) WEEE components containing radioactive substances such as smoke detectors	Capacitors containing PCBs Mercury containing components Toner cartridges Asbestos Components containing refractory fibres Components containing radioactive substances Gas discharge lamps Cathode ray tubes Electrolyte capacitors containing substances of concern Batteries that can be removed prior to treatment and internal hazardous batteries
Substances, preparations and components that shall be removed from WEEE as an identifiable fraction or as part of an identifiable fraction	*Can be removed as materials*
j) Batteries other than those mentioned in d) k) Printed circuit boards of mobile phones generally, and of other devices if the surface of the printed circuit board is greater than 10 square centimetres l) Plastics with brominated flame retardants m) Cathode ray tubes and fluorescent coating. When not treated metallurgically treated, then as a first step n) CFCs, HCFCs, HFC, and other gases that are ozone depleting or have a global warming potential above 15 o) LCD (together with their casing where appropriate) of a surface greater than 100 square centimetres p) External electric cables q) Electrolyte capacitors containing substances of concern (height > 25 mm or proportionately similar volume * entries o, p & q are considered to be deleted from Annex II	Plastic containing brominated flame retardants CFCs, HCFCs, HFCs and HCs External electric cables Liquid crystal displays Batteries other than those mentioned in the list above The fluorescent coating in cathode ray tubes

On the other hand, the BATRRT guideline restricts the definition of removal, especially with respect to specific components. That is, it stipulates the components that need to be removed as a whole and thus can not be simply shredded and then the fragments be recovered in various fractions in further downstream processes.

As previously mentioned, trends in WEEE recycling technologies are continually moving towards greater mechanical processing and subsequent material separation. Low speed shredding technologies utilising chains that liberate composite materials as a result of the input materials impinging against one another are increasingly being employed by recyclers in Europe. Considering the TAC and DEFRA interpretations above, it is questionable whether these plants would meet the DEFRA guidelines *unless* the settings on the equipment were so that the necessary components could be removed whole after the initial liberation and size reduction stages, either through manual picking lines or other separation technologies to capture these components.

> *However, even if the picture of treatment improves cost-wise, the total operational costs for scrupulous systems who comply with standards and legislative requirements, such as those spelled out in Annex II of Directive 2002/96/EC, are typically negative. Only one member managed to get total operational costs and even total costs, i.e. including administration, for large household appliances (excluding cooling appliances) below zero (WEEE Forum, 2008).*

What is clear however, is that from this lack of specific and detailed information, investment in recycling facilities has certainly been hampered primarily due to uncertainty over whether automated shredding and separation technologies would meet the 'to be removed' terminology (Dalrymple, I et al., 2007). Comparing the DEFRA and TAC Guidelines, the criteria presented by DEFRA would certainly have higher cost implications as increased sorting (hazardous components to be removed as a whole) will require higher labour costs (from hand picking after a coarse shred) or higher technological innovation, than those of the TAC.

4.9.1 Industry Studies on Impacts of WEEE Directive on Product Design

As part of the development of the grEEEn Cost Management System described in Section 6.1.2 studies on the cost implications of the WEEE Directive were conducted and the results presented in late 2002 (Boyce, J et al., 2002; Stutz, M et al., 2002). These included cost estimates associated with the design and recycling of mobile phones and PC monitors. These examples provide insightful information concerning how these requirements were *expected* (pre WEEE Directive implementation) to affect end-of-life treatment scenarios at the time.

4.9.1.1 Assessment: Mobile Phones

Recovery and recycling rates

According to Stutz, Burhard et al. (2002), the pre-treatment (Annex II) demands of the WEEE Directive require that the main battery, printed wire board (PWB), button cell battery and LCD screen must all be disassembled from the main unit. Since mobile phones fall within the category 3, a recovery rate of 75% must be achieved with 65% of the total weight through recycling. This leaves a total of 25% of the product by weight that can be disposed of in landfill or through incineration.

Given these requirements the Stutz, Burhard et al. (2002l) claim that a significant change to current recycling practices will be necessary to meet the demands of the WEEE Directive. Current treatment options for mobile phones require that only the battery be removed prior to shredding and subsequent precious metals from the PWB or alternatively processed whole (without battery) in copper smelters, again to recover the precious metal contents.

The 65% rate of recycling by weight applies to the main components of the mobile phone, and does not include the weight of the battery. The battery falls under separate legislation and therefore does not contribute to the overall rate of recycling (Stutz, M et al., 2002). The recycling processes that are available to handle each of the separately dismantled components (LCD, PWB, and housings, and rest fraction (rubber, small metal bits)) are not able to recover 100% of this material. The expected recycling rates possible from state of the art processing for the various components include 80-90% for plastic housings, 40-50% for the printed wire boards, 60 to 70% for LCDs, and 0% for the rest fraction. This combination achieves the 65% recycling rate.

Current model recycling rates

The study also investigated the possibility of current model phones to reach the 65% target. What was found was that current design of the product would not achieve the 65% target by processing the PWB, housings and LCDs. Parts of the rest fraction would need to be processed to reach the target.

Considering the related cost implications to mobile phone processing to conform to the WEEE, Stutz, Burhard et al. (2002) noted the following points. Although, revenues from plastics would be achieved, these would be significantly offset by the labour costs associated with the manual disassembly. Revenues from precious metals are not affected by the process change, but net costs are expected for the processing of LCDs.

General improvement rules

Since the labour cost associated with dismantling is the primary cost driver in the WEEE-conforming treatment option, general rules are suggested to decrease time. These include; ensuring that connections are easy to access, connections can release without destruction, reduce the number and varying types of connectors used, use similar materials to facilitate recycling, and if connections cannot be released then parts should be recyclable together.

Stutz, Burhard et al. (2002) continue to further suggest possible design solutions that from the producer's perspective are the most cost effective to reach the required target. In particular, the product characteristics that influence optimal recycling times that are discussed include the issue of painting housings and the attachment of adhesive stickers. Considering reducing disassembly time, the use of shape memory polymers is discussed.

Since painted housings interfere with the recyclability of plastics, 3 other design alternatives exist to address this issue: including using pigmented plastics, using paint that is compatible with polymers, or changing the housing material to metal. It was also found that adhesive stickers were interfering with recycling rates. Solutions suggested were to use a plastic sticker compatible with the polymer of the housing or alternatively attach the sticker to the PWB with a window in the housing so it could be read. With respect to batteries, it was suggested that batteries that are integrated in the housing have a negative effect on the recycling rate as opposed to batteries that have the housing separate. This is because the housing cover is not available to count towards the recycling rate when it is incorporated into the battery. And finally, Stutz, Burhard et al. (2002) suggest the possibility to use shape memory polymers (SMP) to decrease the disassembly time. SMP polymers are materials that remember different shapes when they experience certain temperatures, and will self-disassemble when triggered. Drastically reduced disassembly times (down to 1.5 seconds) have been experienced. However, these materials are not available commercially and no costs information is therefore available.

4.9.1.2 Assessment: Monitor Disassembly and CRT Recycling Case

Similar to the case above, the 'grEEEn' project assessed the estimated costs that would be associated with meeting the increased recycling targets in the WEEE Directive for monitors and TVs. Two main steps to determine this were investigated separately. First the steps taken to disassemble the monitor were timed, and the subsequent material yields and recycling potential was presented and secondly the process of CRT treatment was explained. This is summarised in the table below.

Table 4-6: Disassembly Times and Recycling Potential CRT

Task	Material	Weight (g)	Time (secs)	Recycling Potential (g)
Base and rubber feet removal	Unknown	500	3	0
Removal of rear cover	ABS – Flame retardant 6 metal screws	1500	50	48
Monitor cable removal	Copper – PVC coating	240	10	192
Circuit board removal	PWB – 20% metal	1500	45	352
Gun circuit board removal	PWB – 20% metal	260	5	
Picture tube removal	CRT	9500	30	9500 (0)
Copper yoke removal	Copper (highest revenue)	1000	15	1000
Cable removal in front case	Copper cables	460	60	460
Disassembly of circuit support arms	Aluminium	50	10	50
Wire and screws	Copper steel	250	5	5
CRT vacuum release	-		5	
	Total	15500	223 (3.7 min)	11600

What is important to discuss here are the challenges that this product category has in terms of meeting the recycling targets. Although from the table describing the dismantling stage it would appear that the overall recycling rate is approximately 74%, it is unclear how much of the CRT glass is actually recycled when sent on for further processing. Although there are limited markets for the panel glass to panel glass scenario this is not considered to be sustainable in the future (Boyce, J et al., 2002). However, this assumption is based on current costs of raw materials, and does not consider the impact of the WEEE on producers of new products. Although the lead bearing CRT glass (mostly in the funnel glass) can be treated in lead smelters, it is uncertain how much of the glass would be considered recycled in the process, as only the lead is recovered in the process. The silica in the glass is used up as a reducing agent in the process.

CHAPTER

FIVE

5. Evidence of EPR and Design Change

While a number of studies as well as commentary from influential stakeholders point to certain shortcomings of EPR implementation, including a lack of indisputable causality to design change, it is argued that these results are not at all surprising. This is because these studies have often been conducted on systems that never had the specific goal of influencing product design in the first place and as a result the incentive structures built into these systems reflect that ambition.

This chapter has the specific purpose to illustrate that there is considerable evidence to suggest that EPR has been, and will continue to be, an essential part of the environmental product policy portfolio. Chapter five begins by exploring the commentary regarding the connection between EPR and innovation from the perspective of both proponents and critics. This is followed by a review of empirical studies investigating the impact of EPR legislation on both product design as well as downstream innovations in collection and recycling activities. In Section 5.3, insights from the DfE literature on the role of EPR legislation as a driver for improved design are presented. Finally, this chapter ends by presenting the views of major producers with respect their positions on individual producer responsibility.

5.1 EPR and Innovation: Proponents & Critics

There is a considerable amount of commentary found in the trade and policy literature on the role, or potential role of EPR to motivate upstream design change and downstream improvements in the recycling and treatment infrastructure. Some of these views are presented below, and at the end of this section an attempt to put these positions into context is made.

Lifset (1993) is one of the earliest proponents of EPR and has been influential in promoting its value as an environmental public policy. Lifset (1993) posits that legislation based on EPR should be classified as a type of performance standard. He notes that, performance standards as environmental policy instruments differ from technology or design-based standards or other command and control style regulations in that they are not prescriptive, mandating specific technologies or product designs to achieve certain environmental outcomes. This provides producers the flexibility to innovate and to choose the least expensive approach to regulatory compliance (Lifset, R, 1993). And in the words of the author, "It is here that EPR can be seen as a form of incentive-based regulation." (Lifset, R, 1993).

Walls (2006) wrote on the role of EPR and product design from the perspective of economic theory. This is an influential piece of work as it was published under the OECD's Environment Directorate programme on EPR. The author notes that the goal of EPR is often not clear, and in many cases proponents of EPR often claim that it has multiple goals including: (1) reduction in waste volumes generated; (2) reduction in waste disposed (3) reduction in hazardous constituents in the waste stream; (4) decrease in virgin material use; (5) lowering of pollution in the production stage: and (6) increased DfE (Walls, M, 2006). It is argued by Walls (2006) that a long standing result in economics is that as many policy instruments are needed as policy goals and that one instrument cannot efficiently accomplish all objectives. The following example is provided to make this point. If the policy goal is to reduce hazardous substances in products as well as to reduce volumes of waste generated it is likely that at least two policy instruments are needed, and the author points to substance restrictions as in the RoHS Directive and an advanced recycling fee (ARF).

Walls (2006) posits that it is possible to compare the substance restriction with alternative approaches to phase out those substances, but it would not be possible to compare it with an ARF, if the objective of the ARF is to reduce volumes of waste. This, it is claimed, is like comparing apples to oranges. Walls (2006), however, appears not to acknowledge the case in which a fee, like an ARF or compliance fee charged by a PRO would be differentiated based on the hazardousness of the product. In this case a differentiated fee would incite producers to avoid those substances that cause the fee to be higher and at the same time it would generate funds to finance the collection of end-of-life products, which would lead to greater volumes of products being diverted from disposal. This then would mean that one policy instrument in fact could achieve multiple goals and it also would be possible to compare a differentiated ARF with a substance restriction.

Walls (2006) also notes the distinction between individual vs. collective take back and that interest in the individual take back approach has arisen because collective programs may not do enough to spur DfE. Walls (2006) notes that there are obvious trade-offs in a collective system versus an individual one, pointing out that in the individual system there are more direct incentives for DfE, but that it is more difficult for the government to monitor and enforce the activities of many individual companies in addition to the lost economies of scale associated with individual systems. It is clear from the above analysis that Walls (2006) views IPR implementation in the circumstances when an individual producer organises his own collection and recycling. The possibility to have individual financing within collective systems, however, seems to have been ignored.

Lifset and Lindhqvist have continued to map the course of EPR implementation and its refinement into IPR in a running editorial found in the Journal of Industrial Ecology. They have written on a number of key aspects embodying the original idea of EPR as a way to stimulate innovation in firms. The most recent of which, titled 'Producer Responsibility at a Turning Point' discusses the recent reports published by the European Commission aimed at supporting the review process of the WEEE Directive (Lifset, R & Lindhqvist, T, 2008). Presented below are their concluding remarks.

> *The revision of the WEEE Directive marks a turning point: Either the EU can abandon the intent that EPR policy instruments create product design incentives, making EPR simply a tool for shifting the cost of WEEE management away from government, or the EU can make a reinvigorated attempt to realize the incentive potential of EPR (Lifset, R & Lindhqvist, T, 2008).*

Sachs (2006) in an article published in the Harvard Law Review, examined how the US and the EU are diverging in their approaches to regulating hazardous products and packaging. He notes that while the EU is implementing product-oriented environmental regulation based on the principle of EPR, US policy making remains focussed on mitigating externalities from production (Sachs, N, 2006). In his critical review of EPR implementation in Europe, Sachs concludes that EPR legislation in the EU, in addition to the take back obligation, has involved extensive legal mandates regarding labelling, reporting, recycling, recovery, materials selection, and product design. These, he claims, are likely to be more effective in the long run than the more novel take-back requirement (Sachs, N, 2006).

European EPR programs have involved large logistical hurdles and transaction costs and, for many types of products, the legislation is not providing the expected ecological incentives that are the core of EPR theory. Indeed, the European Union has frequently coupled its take back programs with direct design mandates, such as materials standards or bans on certain chemicals in products, and it appears that these command and control mandates may be more important in the long run in improving the environmental profile of products than the "next generation" product take back legislation (Sachs, N, 2006).

Specifically relevant for the focus of this research, Sachs (2006) asserts that firms will have design incentives under an EPR programme only if there is true cost-internalisation where firms bear both the end-of-life costs of their product design decisions and can capture cost-savings under a take back mandate through redesigning products to be more ecologically friendly (Sachs, N, 2006). However he also notes that:

> *It is difficult to see how true cost-internalisation can be achieved for more complex products such as electronics, which contain a chemical stew of metals, plastics, liquids, glass and housings. Fees on manufacturers, to provide incentives for improved design, would have to reflect a wide array of product characteristics such as weight, bulk, chemical constituents of the product, and degree of recyclability (Sachs, N, 2006).*

He continues by asserting that this cost internalisation would need to be made by a PRO or some governmental authority of the present value of future waste management costs and environmental externalities (so called up front differentiated fees). This would need to be done for individual products within product groups (Sachs, N, 2006). If IPR were implemented through a physical take back systems rather than up front fees, products would have to be tracked and sorted out of the waste stream by individual producers.

In referring to the WEEE Directive, Sachs (2006) seems to interpret 8(2) as if producers have a choice to fulfil the financial responsibility obligation either individually or by joining a collective scheme. However, it is the understanding of the author of this thesis that in fact Article 8(2) provides producers a choice of how to fulfil the individual financial responsibility, either in a collective or individual system. In other words, even in a collective scheme, producers are still legally responsible for financing the WEEE from their own products for new WEEE.

Sachs also notes that all systems that were established in response to national legislation prior to the WEEE Directive, do not have any incentive mechanism built into their fee structures. While El-Kretsen – the Swedish PRO for EEE producers – has no cross financing between product categories, producers of, for example, TVs would each pay the same fee regardless of the properties of the product and the inherent value.

In 2003 the ICT Milieu collective compliance scheme, switched from a financing system based on return share financing to that of one based on a market-share obligation, and Sachs (2003) points out that this was "principally because of the logistics of implementing individual responsibility and associated problems of free riders (producers who never register with the system) and orphan products (products from defunct producers)". This may be part of the answer why the financial mechanism in the system changed, however there were other competition impacting effects that threatened the continuation of the scheme if not adjusted.[22]

In a 2004 OECD report on Economic Aspects of Extended Producer Responsibility, Veermen (2004), revises his former stance on producer responsibility in waste policy in the Netherlands (Veerman, K, 2004). The author concludes that the introduction of the producer responsibility instrument[23] has had a large impact on the increase in collection and recovery of the relevant waste streams (packaging and electronics). In this report, the Dutch civil servant notes that the producer responsibility provisions have not resulted in waste prevention (reduction). Veerman (2004) notes that when the principle of producer responsibility was introduced in the 1990s, it was thought it would lead to internalisation of the cost of waste management in the product price and hence to prevention efforts, as producers and importers would design products that would produce less waste resulting in lower end-of-life costs. Veerman (2004) claims that these expected outcomes did not materialise in practice due to two main reasons.

Firstly, he claims that producer responsibility is mostly funded by waste disposal levies that are either visible or non-visible to the consumer. Producers in the Netherlands have opted for a uniform charge per product category and not for differentiation by recyclability. Differentiation by recyclability, is in practice, very difficult as it requires brand-related collection or sorting and involves a relatively expensive registration system.

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22 For a detailed discussion on this issue refer to Section 9.3.

23 It is interesting to see that Veerman (2004) views EPR as a policy instrument and not as a principle that is implemented through a variety of policy instruments.

In addition the differences in recyclability of products within product groups are often marginal (Veerman, K, 2004).

Secondly, in the programs described, the cost of waste management generally makes up only a very small percentage of the price of a product. Reducing the cost to manage products through design for recycling does not impact the fee the producer pays, and from the view of cost, is therefore not an aspect of competition. However Veerman (2004) does conclude that while producer responsibility in its present form is not an instrument for prevention of waste, other instruments e.g. national or European product policy or immediately effective regulations as contained in the EU Directives on packaging, end-of-life vehicles and electrical appliances, are more suitable for this purpose.

5.2 Review of Empirical Studies on EPR Programmes

During all phases of this research, an extensive and continued review of the literature was undertaken to explore EPR programmes. However, the availability of empirical studies that evaluate how EPR legislation and implementation influence corporate strategy and product design is far from extensive.

Table 5-1 below contains the studies that have been reviewed in this thesis. In this table, the year that the study was published, the product groups covered under the legislation/programme and a summary of the main findings are listed.

Table 5-1: Empirical Studies Evaluating the Impacts of EPR Programmes on Corporate Strategy and Product Design

Author(s)	Product Group	Geographic Region	Main Findings
(Furuhjelm, J, 2000)	Electronics	Sweden	Anticipation of WEEE Directive led to new end-of-life consideration Customer requirements (Japanese B2B customers)
(Kim, N, 2002)	Vehicles	Sweden Germany Netherlands Germany UK	Different level of applications of EPR examined in selected ELV Systems illustrates that EPR can enhance the progress of ELV system in an environmentally effective and efficient manner.
(Orsato, RJ et al., 2002)	Vehicles	Germany France Italy	Car manufacturers developed pilot projects to assess recyclability, dismantling tests, downstream facilities
(Bailey, I, 2003)	Packaging	Germany UK	Some early source reduction activities in Germany at start of programme (anticipation), otherwise little evidence that producers are changing design
(Hosoda, K, 2004).	Packaging Vehicles Electronics	Japan	Examples of design change of packing attributed to the EPR system including; phase out of coloured PET, light-weighting, reduction of composites in PET bottles. Similarly, for the 4 household appliances under SHARL the following design changes were noted; design for ease of disassembly & uniformity of plastic resins
(Hafkesbrink , J, 2004)	Electronics	Germany	Anticipation of Draft WEEE Ordinance led to downstream development of recycling technologies.
(Quoden, J, 2004)	Packaging	Germany	Reductions in the total packing use of 18% from 1991-2000 as a result of DSD implementation.
(Tojo, N, 2004).	Electronics Vehicles	Sweden Japan	Design changes (hazardous material reduction, improved recyclability,) and downstream infrastructure development attributed to pending EPR legislation: Anticipation
(EEA, 2005)	Packaging	Austria Denmark Ireland Italy UK	Minimisation goals not realised with exception of Austria. Despite absolute increases in packaging waste, all countries achieved a relative decoupling of generation and economic growth Recycling targets generally met

Author(s)	Product Group	Geographic Region	Main Findings
(Røine, K & Lee, C-Y, 2006)	Electronics, Agricultural Film	Norway	No observed direct impact, but influences organisational innovation that indirectly influences technical change
(Gottberg, A et al., 2006).	Electronics (Lamps)	European Union	Take back obligation for lamps has not led to design improvements in the lamp sector.
(Yu, J et al., 2006)	Electronics	China	Investigated Chinese firm's response to the WEEE & RoHS Directives. Efforts more focussed on RoHS than WEEE, with little evidence to suggest that Chinese firms or their foreign customers (OEMs) are influenced by the WEEE Directive requirements.
(Mazzanti, M & Zoboli, R, 2006)	Vehicles		Evidence of both upstream (design and downstream (treatment) innovations in this sector
(Gerrard, J & Kandlikar, M, 2007)	Vehicles	European Union	Anticipation of ELV legislation led to downstream infrastructure and design for dismantling and recycling, hazardous substance reduction

Gerrard and Kandlikar (2007) found that improvements in ELV recovery have been influenced by national policies since the 1990s. Prior to the ELV Directive coming into force ELV regulations and/or voluntary agreements existed in 10 MS. They note that as a result of these early activities, a number of technological and organisational innovations occurred in the 1990s, including the creation of ELV treatment infrastructures and efforts to design for dismantling and recycling. Current advancements should be seen in the light of such innovations, which have been stimulated by pending ELV legislation for over a decade (Gerrard, J & Kandlikar, M, 2007).

Theses authors conclude that ELV legislation has contributed to greater consideration of recyclability in the design process. "This is already leading to rationalisation of plastic use" and may "hasten the trend towards a greater use of aluminium". At the same time the authors recognise that, end-of-life design considerations are not a priority for car manufacturers as "economic imperatives and a drive toward customisation remain the key motivation in automotive design" (Gerrard, J & Kandlikar, M, 2007). Furthermore eco-design efforts may be restricted by the delayed payback associated with long vehicle lifetimes and the fact that innovations in end-of-pipe recycling technologies will be required to process older cars regardless of design changes. This raises the possibility that car *manufacturers might get locked in to sub-optimal solutions* that favour recycling over remanufacture and reuse".

Gerrard and Kandlikar (2007) further note that policy instruments can influence the choice of innovation path and may work as selection devices by constraining some innovative options while providing incentives to pursue other innovations solutions. In the case of the automotive industry "the interplay of legislative and economic factors has led to an increased emphasis on recycling and hazardous substance removal" (Gerrard, J & Kandlikar, M, 2007). The innovations that result may be sufficient to meet the recovery and recycling targets and may also have spill-over effects to other industries. Other industries include EEE and especially large household appliances (LHA) which have traditionally and continue to be processed in automobile shredders.

In Haftkesbrink (2004) the impact of environmental policy, with a specific focus on the Draft German Electronic Ordinance in 1991, is described. In explaining the transition in the electronic industry innovation system (EIIS) towards more sustainable practices, it is noted that the crucial innovation driver was, what the author calls, the *policy style* at the time. The establishment of the Packaging Ordinance as well as the Draft Electronic Waste Ordinance, which embodies the Closed Substance Cycle Act, gave political weight to the rapid development of draft EPR regulation for WEEE. This gave a clear signal to industry to organise itself (Hafkesbrink, J, 2004).

Firms responded to these signals by "setting up initial actions", and this was important for awareness building rather than encouraging specific innovations (Hafkesbrink, J, 2004). The anticipation of possible regulation stimulated companies to inform themselves on issues which up until that point had only played a subordinate role in the traditional framework business conditions (Hafkesbrink, J, 2004). These initial actions led predominately to incremental innovations in end-of-pipe technologies within the area of material recovery from end-of-life electronics. Main activities included technical solutions concerning sorting, processing and recycling technologies to recover metals as well as process techniques for the recycling of plastic wastes (Hafkesbrink, J, 2004).

This led to the acquisition and processing of specific information and the realisation that expected changes in the business framework conditions were linked to the companies' competitive strategies. In establishing how the future regulations might impact producers business, companies began to increase actions, which even impacted product design (ease of dismantling). Importantly, Hafkesbrink (2004) stresses that such, politically desirable, reactions only prove to be sustainable when the initial motivated impetus is complemented by economic incentives, perhaps a critical lesson in the context of WEEE implementation.

Bailey (2003) evaluated the impact of EPR programmes on obligated producers in the packaging sector in Germany and the UK. The author makes it clear in his opening remarks that "establishing direct links between economics instruments and business behaviour is an imprecise science at the best of times (Ekins, P, 1999). Since economic instruments are not used in isolation, isolating the fiscal effects of those produced by other instruments can be extremely difficult (Bailey, I, 2003; Goddard, HC, 1995). Although such problems afflict all policy analysis, it is particularly evident for market-based instruments as they use subtle and indirect price stimuli to promote action.

Using a variety of arguments ranging from the previous comment and the fact that "many businesses claim that that increasing environmental costs rarely provides the chief impetus for change compared with standards based legislation or supply-chain pressures" the Bailey (2003) hypothesises that even though a strong correlation between environmental charges and changes in waste management was not expected in neither of the countries, if iterations in producer levies are to impact upon polluter behaviour, the relationship should be stronger in Germany than the UK because Green Dot fees are substantially higher than PRN fees. However, as results of the correlation were not significant, it is suggested that economic instruments "have not produced major changes in corporate waste management over and above those prescribed by national recovery and recycling targets" (Bailey, I, 2003).

Bailey (2003) offers a number of possible explanations to the above phenomenon where he notes that packaging charges are perhaps too low to have an impact on producer behaviour *beyond* activities to meet legal requirements. This, he says, is in line with economic theory on the marginal cost attributes of incentive charges. "Optimal abatement incentives are created with environmental taxes and charges where the marginal environmental-damage cost of further increases in pollution (in this instance, the production and consumption of packaging waste) is equal to the marginal benefit gained by the company from this activity" (Bailey, I, 2003).

However, Bailey (2003) notes that despite the price elasticity of packaging, it is still logical to argue that environmental charges should provide individual firms with an additional incentive for small-scale reductions in packaging consumption. In Germany many companies have reduced their fees to compliance schemes through light-weighting packaging or switching to alternative packaging materials with lower fees. Therefore, economic instruments can be "deployed progressively" to stimulate industry's adaptive capacity. The author provides a number of examples where the incentive structures vary between UK and Germany albeit for the same packaging material. For example, the UK incentive structure favours plastic over glass while the opposite is true in Germany. In Germany, packaging fees encourage producers to switch from aluminium to steel where the opposite is prevalent in the UK. What does this illustrate then? Bailey (2003) posits that economic instruments may actually increase the environmental damage if incentive structures are not based on sound ecological criteria.

Further explanation of the weak relationship between environmental charges and producer behaviour is the fact that corporate actions are influenced by many exogenous commercial factors that can negatively impact effective incentive taxes (Jones, E, 1999). An example that was cited was an electronics producer that had an annual compliance cost for packaging at 30 000 pounds, and any possible savings from re-evaluating the design and consumption of packaging were marginal to its overall business and did not justify major project expenditures.

Bailey (2003) notes that it is vital for governments to understand the main objectives of new environmental taxes and charges when deciding on their structure and level. Although any increase in business costs may prompt some reduction in polluting activities and therefore all environmental charges have some incentive potential, the range of market and internal cost factors affecting responses to economic instruments can eclipse the potential for a noticeable incentive effect. Equally, if other forms of strategic behaviour promise greater financial rewards for individual firms – in essence, failures in policy design rather than the underlying principle of environmental taxes and charges – major shifts in production and consumption patterns are unlikely.

The final factor is the redistribution of environmental costs within the market. One of the intentions of taxes and charges is that they spread the costs of pollution through the economy in order to re-internalise externalities and prompt adjustments on production and consumption patterns. If this is simply a dilution of financial impact of the charge, the instrument may become a negligible consideration to all parties and fail to raise stockholder's awareness of the environmental issue in question. This effect would be exaggerated if the environmental charge was only a minor component of the overall cost of the product in question (Bailey, I, 2003).

Overall broader lessons for the use of charges and taxes include: Charges needed to be raised to meet the Directives regulatory requirements were lower than those required to create a pollution reducing incentive. Charges were only developed to as cost-covering mechanism and changes in industry behaviour have been influenced by the overall regulatory regime in each country rather than the effects of economic instruments (Bailey, I, 2003).

Due to the price-inelasticity of packaging – only small reductions in demand have resulted. These conclusions are consistent with economic theory, which notes that there is no logical reason why the optimal rates for incentive taxes and cost-covering charges should naturally coincide because of the different functions they intend to fulfil (Bailey, I, 2003). While this is an accurate statement it should be recognised that cost-covering charges will transfer any incentive taxes to the ones who can more readily change. For instance, if taxes on landfill and incineration are made more substantial, then the incentives are through EPR transferred to the producer – and not left with municipalities and citizens.

Gottberg, Morris et al. (2006) comment on whether cost internalisation can provide an economic incentive for firms to undertake innovatory activities through eco-design, and explain that this very much depends on whether the marginal costs associated with EPR are sufficiently large to have a negative impact on the financial performance of the firm, and the degree to which producers vs. customers bear these costs. This is similar to the findings of Bailey (2003) as described above. With respect to price elasticity of the demand of goods, both authors note that if producers can transfer costs to customers via product price without significantly affecting demand, there is little incentive to innovate in order to reduce costs. Circumstances when this might apply include when a firm has market dominance or through branding and product differentiation, and when there is a perception among customers to be few close substitutes for particular products. Additionally, this is also relevant when the expenditure on the product is a very small proportion of total spending.

However, in the longer term substitutes are expected to emerge in response to this phenomenon such that there will be a tendency towards more elastic, price sensitive demands for particular products.

The response of firms to environmental charges is of course dependent on whether that firm can engage in activities that allow the producer to avoid them. As Gottberg et al. (2006) note, currently in schemes where there is a fixed fee per unit placed on the market, producers have no way of avoiding charges other than through reduced sales. This is not an option that could be entertained by any company on the market.

Given that the definition of producers is often made on the national level, in many cases the obligated actor under the law is the first importer, which is often the retailer or distributor. This has implications for the incentives directed at manufacturers regarding end-of-life considerations. If manufacturers and hence the designers of products are not obligated as producers, it could be argued that the incentives will be less direct (Gottberg, A et al., 2006).

Tojo (2004) conducted an empirical study in 2000-2001 which investigated the impact of EPR legislation for vehicles and electronics on manufacturers' product design and other environmental measures in Japan and Sweden. The influence of EU legislation namely, the WEEE, RoHS and ELV Directives on subject producers was also included in the scope of the study. Representatives from a total of 13 EEE manufacturers (9 in Japan and 4 in Sweden) and 8 automotive manufacturers (5 in Japan and 3 in Sweden) were part of the study (Tojo, N, 2004).

Interestingly, when interviewing the informants Tojo (2004) explicitly did not mention that the focus of the research was EPR legislation and its impacts on manufacturers, rather, the questions broadly covered factors surrounding the design and end-of-life management of products addressed in the study. The author found that in Japanese EEE companies, a number of initiatives had been undertaken including the reduction/elimination of hazardous substances (development of lead-free solders, halogen-free flame retardants, reduction of PVC use, substitution of Ozone depleting substances and the elimination/reduction of Chromium VI) (Tojo, N, 2004).

Similarly, measures taken to enhance resource efficiency and recyclability by EEE manufacturers in Japan were identified (reduction of material use, extension of product use phase, ease of disassembly/separation, recyclability of materials) in the research. A number of downstream measures to improve the management of end-of-life products were also mentioned by interviewed manufacturers. These measures included the development of collection and recycling infrastructure, the development of specific recycling technologies previously not on the market (technologies to separate mixed plastics as well as disassembly tools). In terms of organisational innovations, increased communication between recyclers and designers enabled a feedback mechanism to relay information on how product designs impact the recycling processes and vice versa.

A particularly important finding in this research was that the design for end-of-life measures reported by manufacturers have been integrated into other design strategies. When competing with other environmental priorities, careful consideration has been made so as not to increase the environmental impact from other phases of the life cycle at the expense of design for end-of-life (Tojo, N, 2004).

In terms of attributability of these noted changes to EPR legislation, Tojo (2004) notes that "literally all the manufacturers interviewed have considered the content of the EPR legislation in their undertaking of upstream measures and other measures mandated by/envisioned in EPR programmes" and that "the finding is a clear indication that the EPR legislation has had a tangible influence on the manufacturer's undertaking of such measures." (Tojo, N, 2004). Given that the study was conducted in 2000-2001, and that EPR legislation and operational programmes had not started or had only just recently begun, it was noted in the findings that anticipation of demands in the future legislation was a key driver of action.

Yu, Welford, et al. (2006) investigate the impact of European legislation on foreign, namely Chinese electronics producers. Given the dynamics of the electronics industry, with respect to patterns of manufacturing, contract manufacturers, original design manufacturers (ODMs), etc, valuable insight on the influence of EPR legislation on these actors can be drawn. (Yu, J et al., 2006) showed that although awareness of the WEEE and RoHS Directives is high (84% and 92% of surveyed firms are very well informed or well informed, respectively), only 44% of respondents thought that WEEE posed very significant or significant impacts on their businesses. Subsequent interviews with companies revealed that the most common approach by the interviewed companies in responding to RoHS was to require suppliers to supply material testing reports or material declarations certified by 3rd party authorities in order to ensure that the substances restricted under RoHS were not in products. "Proactive and voluntary approaches such as eco-design and life cycle analysis were less well recognised and introduced in China". Overall it was concluded that most effort focussed on RoHS, while for WEEE it was to a much smaller extent.

Very few companies passed the responsibility or requirement of WEEE on to their suppliers, mainly due to a lack of pressure from their own clients (large OEMs like HP and Dell for example).

Furuhjelm (2006) researched how Swedish and Finish EEE companies were incorporating the end-of-life aspect into their product development. strategies.

> *The case studies made clear that take-back legislation acts as one of the main drivers for dealing with issues related to the products' end-of-life phase. It was observed that the companies studied felt a need to learn more about how their products are treated, what environmental effects this has and what costs are associated with the activities (Furuhjelm, J, 2000).*

He asks a crucial question that is directly related to the current research. That is, "how can producers improve the design of their products and thus save costs associated with the treatment as stipulated by the legislation?"

Two main dilemmas need to be considered when determining how products should be designed. *Firstly*, the formulation of the legislation on an EU level, as well as in most countries that are in the process of implementing systems are under constant change. Furuhjelm (2000) notes that to align product design with legislative demands is like "shooting at a moving target". *Secondly*, neither the various national ordinances, nor the EU WEEE Directive, are formulated in a way that makes it possible for a designer to determine in a straightforward way what design principles the product should comply with.

> *An essential element of the legislation in this respect is what end-of-life treatment that will be allowed. Thee options for recycling WEEE in terms of mean of treatment could be classified into three alternatives*
>
> 1. *Manual disassembly with sorting of different fractions*
> 2. *Shredding followed by mechanical sorting*
> 3. *Recycling by metallurgical means, i.e. the product is fed straight into a smelter.*

Furuhjelm (2000) points out that for products with high metal content, which can be fed directly into shredders and/or smelters and subsequently meet the recovery and recycling targets, there is limited reason to apply Design for Disassembly principles, especially if technologies exist to separate the materials efficiently after shredding, or in the metallurgical process.

For plastics-dominated products and CRT products, shredding and smelting would most likely not be sufficient processes to reach the recovery and recycling targets and *would imply that that disassembly needs to take place to separate the different material fractions, as well as to enable component reuse.*

He also points out that with current financing systems based on market share (or a non-differentiated product fee) producers will not be driven to improve product design. However, if systems are implemented with a link between the charge for end-of-life and the actual cost for end-of-life treatment, the producer becomes motivated to incorporate applicable recycling-oriented design principles.

The selective treatment requirement(s) are mandatory for WEEE containing substances, preparations and components (see Section 4.9) listed in Annex II of the WEEE Directive. Selective treatment refers to the requirement to remove these components prior to any downstream processing such as shredding for example. Consequently, treatment will be more expensive as manual disassembly would be necessary to remove the substance, preparation or components to meet the legal requirement.

From a design perspective, Furuhjelm (2000) recommends that in order to avoid having to incur high costs associated with manual disassembly, the following design principles become essential to incorporate in the product development process:

- Avoid hazardous materials needing a selective treatment according to legislation
- Ensure that lead, mercury, cadmium, hexavalent chromium, PBB and PBDE are phased out by 2008.

Furuhjelm (2000) notes that Nokia satellite receivers were likely to be covered by the WEEE Directive, however at the time of the research the formulation of the WEEE Directive left room for interpretation of how it will impact this product type therefore assessing design implications were difficult. Despite this, the strategy taken by Nokia was conservative and reflects the impact of anticipation of the future WEEE Directive at the time.

> *Nokia also aims at designing products that are easy to disassemble as WEEE formulation are under constant change and the company has determined to safeguard itself for possible demands on disassembly when products reach their end of life phase (Furuhjelm, J, 2000).*

Harold (2007) found in her study on multi-national OEM corporate strategy on end-of-life management of EEE that the possibility for producers to benefit from higher levels of recovery increases manufacturer involvement. With respect to the WEEE Directive it was determined that national transposition by European member states do not leave companies with many realistic options and therefore do not foster innovation related to closed-loop supply chains (Herold, M, 2007).

Herold (2007) notes that the WEEE legislation (national transposition) does not take into account any refurbishment or remanufacturing programs operated by the manufacturer, as in most MS producers are not entitled to deduct the amounts of WEEE collected through their individual systems from their B2C collection obligations. This is partially the case, however, as producers are entitled to have individual compliance approaches in all MS for their own branded products, but are also responsible for a relative share of historical WEEE that is based on their current market share (van Rossem, C et al., 2006).

Producers that are complying individually also need to have financial guarantees and do not have access to WEEE collected at municipal collection sites. This double disadvantage, according to Herold (2007) is why manufacturers do not have incentives to invest in end-of-life management capabilities.

Results from the study by Herold (2007) support the findings from van Rossem, Tojo et al. (2006) where it is clear that in the MS transpositions of the WEEE Directive excessive administrative and financial requirements are only applicable to producers that are complying through individual systems, where as producers that comply through collective producer systems are often exempt. Herold (2007) draws on institutional theory to explain why firms in Europe are less engaged in development of their own end-of-life management infrastructure. She found that most case companies considered the WEEE Directive to be ambiguous in its wording and they spend most of their managerial efforts on making sure that they are compliant. According to institutional theory, in cases where legal structures are ambiguous and managers perceive there to be a risk, there is a tendency to copy each other's practices (Herold, M, 2007).

Herold (2007) found that all companies that had been involved in higher levels of recovery served either B2B or both B2B and B2C markets. Companies that had developed capabilities to manage B2B products use these capabilities to deal with their B2C end-of-life products. Drawing a parallel to resource-based theory which proclaims that company strategy depends on its possibility to leverage existing capabilities, firms are also likely to vertically integrate activities where they have capabilities that are considered superior to suppliers (Barney, JB & Zajac, EJ, 1994; Herold, M, 2007).

Glachant (2004) has the view that the goal of waste policies is clearly not to initiate product change. Instead the challenge is to modify the pattern of business as usual product change in order to position goods on less intensive innovation trajectories. When designing these policies it is essential to take into account these business-as-usual trajectories and the fact that they are industry-specific (Glachant, M, 2004).

In Quoden (2004) the impact of the introduction of EPR legislation for packaging in Germany enacted in 1991, is highlighted (one of the first and most often quoted pioneering implementation of EPR policy employing the take back instrument). According to Quoden (2004), one of the main objectives of the Packaging Ordinance was to reverse the positive correlation between gross domestic product and the consumption of packaging. This source reduction goal has been achieved, through the direct elimination of packaging material which was not needed for a specific function.

In summarising the effects of the German Packaging Ordinance, Schmid (2003) noted that in the 10 years since its inception in 1991, there have been notable positive effects in several areas. For example, in terms of absolute reduction of packaging use, in 2000 there were approximately 1.5 million tonnes less packaging used than in 1991 (Quoden, J, 2004; Schmid, T, 2003). Additionally, due to differentiated fees charged for varying packaging materials a number of changes in the packaging market were noted. Packaging had become lighter and smaller and substitution of higher fee materials for lower fee materials was evident. A trend towards reusable packaging for transport packaging for products such as furniture, food, pharmaceutical products and bicycles was also noted.

In an article summarising studies on EPR programmes for WEEE and agricultural film in Norway, Røine & Lee (2006) found little empirical evidence to suggest that the EPR programmes had any significant impact on technological change and innovation on regulated firms. In Norway, 2 PROs have been set up by industry associations of different product groups to manage WEEE on behalf of producers. These include Hvitevareretur AS for white goods, Elektronikretur AS for consumer electronics, ICT and other EEE product categories. The authors note that the "Norwegian EPR policies discussed here appear basically as collective financial mechanisms for establishing collection and recycling systems and for complying with recycling targets, and not for stimulating technological change and innovation" (Røine, K & Lee, C-Y, 2006).

According to Røine & Lee (2006) EPR policy-makers in Norway have not made technological change or innovation an explicit obligation or a measurable target that producers must comply with. Producers are responsible for complying only with collection and recycling targets, which according to the authors, enter as only one of several factors into their commercial decision-making processes (Røine, K & Lee, C-Y, 2006). However the authors do point out that EPR has, through institutional innovation, an indirect effect on technological change and innovation. It draws attention to relative issues and creates arenas for dynamic and stimulating discussions that may be brought into the actual decision-making processes within each company. "Although feedback mechanisms and design for environment might be overall conceptual objectives of EPR, it is how the EPR policies actually are designed and implemented in real politics that really counts" (Røine, K & Lee, C-Y, 2006).

Gottberg, Morris et al. (2006) conducted a number of case studies on producers within the lighting sector. Their research showed that EPR has had little effect on product development to date. The authors note that within the lighting sector, most producers have been able to pass on the incremental costs associated with EPR to customers with negligible effects on sales. Perceptions in the lighting sector are that because demand is relatively inelastic and the regulation effects all producers equally, EPR is unlikely to drive eco-design, at least in the short run (Gottberg, A et al., 2006).

On waste minimisation and product design, and therefore the influence of EPR on eco-design, the authors conclude that information was largely anecdotal coming primarily from published data by larger companies.

On the issue of how lighting companies had responded to the economic instruments of product charges, it was concluded that in the cases where producers were able to add the compliance cost to the price of the product with no negative impacts on sales or competitiveness, there was little incentive for producers to adopt eco-design to avoid the costs of producer responsibility. Since consumers were willing to absorb the extra cost, an indication of price inelasticity of demand, could be explained by the fact that costs did not exceed 1-2% of the total costs (Gottberg, A et al., 2006).

Given the context of the study the main findings are not all that surprising. Clearly, in all of the reported cases, producers are not members in take back programs where compliance fees are differentiated to reflect recyclability or hazardousness. This was recognised by the authors, as a further limit or reinforcement of the weak incentive provided by the economic instrument through low overall compliance cost per unit.

The authors do note that in the longer term, if any one producer had a large market share in a compliance scheme then it would theoretically be able to recover some of the costs as a large proportion of the products collected in the compliance scheme would be of that producer's brand. Large volumes of similar waste products with consistent properties that reduce end-of-life costs (under improved treatment standards and recovery targets) should reduce average costs.

The authors also ask the question of whether higher charges would be likely to provide an incentive for eco-design? It is concluded that higher charges on producers may not necessarily have a greater incentive on eco-design since competitors are felt to be equally impacted and demand in the lighting sector is relatively price inelastic.

Regarding the motivations for eco-design, almost all producers noted that design activities did focus on product size (volume and weight) reductions in order to reduce material input costs, packaging and transport. However, other design requirements including technical and fashion-oriented were perceived to overshadow potential cost savings.

Rather than rely completely on producer responsibility, it is likely that complementary incentives are required to progress eco-design (Gottberg, A et al., 2006), and that in most cases a mix of policy instruments is likely to be appropriate.

5.3 EPR and the Design Literature

In addition to the literature on EPR programme evaluations, in the area of generic eco-design and specifically design for recycling (DfR) in the EEE sector, there were numerous anecdotes found in the introductory chapters of articles and conference papers pointing to the importance of EPR programmes and take back legislation as a current and future driver for activity in this area.

In their electrical and electronic practical eco-design guide, Rodrigo and Castells (2002) list legislative instruments, with specific mention of the WEEE, RoHS and EEE (now EuP), as the first of 15 internal and external influences that motivate eco-design from a business perspective.

> *In accordance with future environmental legislation, the costs for collection, treatment, recovery and environmentally sound disposal of waste electrical and electronic equipment from private households will bear on producers, so any environmental design consideration that increases the amount of value that can be recovered from the equipment at its end-of-life will, obviously, result in an improvement of the equipment behaviour, but will also result in an important source of cost savings for manufacturers* (Rodrigo, J & Castells, F, 2002).

Similarly, in the introductory section of their book chapter in "Green Electronics/Green Bottom Line" Veerakamolmar and Gupta (2000) point to the emergence of legislation in Europe as an important driver for companies to invest in design for disassembly, reuse and recycling to gain a competitive advantage in the marketplace.

> *Environmental awareness and recycling regulations have put pressure on manufacturers and consumers, forcing them to produce and dispose of products in an environmentally friendly manner. In many parts of the world, and especially in Europe, the regulations are becoming more stringent and manufacturers are required to recycle their products at the end of their useful lives. If the trends continue, there is a great promise for environmentally friendly companies who quickly meet the impending regulations to gain a competitive advantage in the marketplace* (Veerakamolmar, P & Gupta, S, 2000).

In their introductory text, Masanet and Horvath (2007) note that design for recycling has become an increasingly important dimension of environmental management for computer manufacturers in the years leading up to 2002. The authors cite proposed take back policies in Europe, recycle-oriented eco-label requirements and increasingly environmental awareness as important factors that has prompted the computer industry to continuously improve the recyclability of its product designs (Masanet, E & Horvath, A, 2007).

5.4 Producer Views on Individual Producer Responsibility

As has been presented in several sections of this thesis, in the discussion around the design of EPR programmes for WEEE, most actors agree, that in theory, systems based on IPR provide more design incentives than systems where the financing is collective.

However, there are diverging opinions among producers of EEE regarding whether IPR is a suitable financial model for EPR programmes in practice. Companies appear to have different views regarding not only what exactly IPR is, but also how it could be implemented in practice and whether the practical implementation can provide strategic benefit to firms.

Herold (2007) examines producer's compliance strategies and positions on EPR in four product groups including (1) consumer electronics (CE), (2) Information technology (IT), (3) IT and Communication (ITC) and (4) White Goods. The position and current choice of compliance approach for 13 large OEMs operating on the European Market are summarised in Table 5-2. The terms CPR and IPR in the final column in the table, refer to collective producer responsibility and individual producer responsibility, respectively.

Table 5-2: Corporate Strategic Views on IPR

Producer	Sector	Current Compliance Strategy B2C	B2B	Position on EPR
Philips Consumer Electronics	CE -	Collective systems	Own system B2B medical	CPR/IPR[24]
Hitachi Limited	CE	Collective systems	Not indicated	Not indicated
Samsung	CE	Collective systems	Not indicated	IPR[25]
Anonymous	IT	Collective systems	Not applicable	Not indicated
Fujitsu Siemens	IT	Own system – mixed brands & parallel own brands (Germany) CPR systems in other MS	Own system	IPR
HP	IT	Collective systems EPR	Own system	IPR
NEC Corp	IT	Collective systems	Ad hoc	IPR
Motorola	ITC	Collective systems Parallel own collection	Own system: Ad hoc	IPR[26]
Nokia (handsets only)	ITC	Collective systems Parallel own collection	Not indicated	IPR
Huawei	ITC	Collective systems	Own systems (base stations)	Not indicated
Bosch-Siemens	White goods	Collective systems	Not indicated	CPR[27]
Electrolux	White goods	Collective systems Previous parallel in Sweden & UK	Own system for laundry equipment on lease (sold business unit in late 1990s)	IPR
Whirlpool	White goods	Collective systems	Not indicated	CPR

Source of information Herold (2007)

Although it is feasible that ICT company positions on IPR listed in Table 5-3 have been influenced by Greenpeace's Guide to Greener Electronics ranking, the following companies listed below openly support the concept and implementation of individual producer responsibility. In the Guide to

24 Philips' informant notes that it supports, if it was allowed, a hybrid system where mixed producer branded products were collected together, and subsequently a producer could opt to take out its own products for separate treatment (Herold, M, 2007) (p. 170).

25 Samsung's informant sees benefits to IPR, but recognises that considerable technological barriers exist. Seen as the mechanism to achieve financial benefits from its eco-design activities (Herold, M, 2007) (p. 178).

26 Motorola's informant sees that in the future the company could support a mixed system of collective collection and sorting with individual treatment (Herold, M, 2007) (p. 212).

27 The BSH interviewee strongly supported collective systems. BSH is not against 'individual systems' but sees loopholes in the concept (Herold, M, 2007) (p. 238).

Greener Electronics ranking, support for IPR is an explicit criteria on which the companies are ranked (Greenpeace International, 2008).

Table 5-3: Company Statements on IPR

Company	Statement on IPR
Sony Ericsson	Sony Ericsson recognises the importance of product 'take-back' and recycling. The idea of taking responsibility for our own products is a concept we believe in – for ourselves as well as in partnership with our industry.[28]
Nokia	Nokia supports the concept of individual producer responsibility. In order for us to carry out our own responsibilities we need others in the value chain, like consumers and retailers, to commit to bring back obsolete mobile devices for responsible recycling. Such co-operation eventually leads to a situation where significant drivers for environmentally optimized product design enabling easier recycling would become commonplace, bringing further benefits for consumers, producers and the environment.[29]
Samsung	SAMSUNG Electronics supports the concept of Individual Producer Responsibility (IPR), and understands that this is the critical mechanism that will incentivise manufacturers to make better products, and dramatically reduce the level of WEEE arising at traditional waste disposal options such as landfill and incineration.[30]
Dell	Individual producer responsibility has grown in importance as governments, manufacturers and other interested parties work to find effective means of ensuring that end-of-life products are responsibly retired. Dell has engaged directly with customers, investors and stakeholders on this important issue and this engagement has helped shape our position.[31]
Toshiba	Toshiba Group thinks the concept of IPR is one of the effective approaches to encourage design for recycling. Toshiba has already started its own take back solutions; for example, Toshiba's Trade-In and Recycling Program in the United States and Toshiba's Environmental Recovery and Recycling Effort (TERRE) in Canada.[32]
Acer	Acer's CSR agenda in 2008 focuses on the following five areas: energy and climate, green product, recycling, supply chain management, and reporting. We commit to: Taking the Individual Producer Responsibility (IPR) by implementing stepwise voluntary take back regime.[33]

[28] http://www.sonyericsson.com/cws/corporate/company/aboutus/sustainability/environment#product_recycling.

[29] http://www.nokia.com/A4243029.

[30] http://www.samsung.com/us/aboutsamsung/corpcitizenship/environmentsocialreport/environmentsocialreport_PolicyPrinciple.html.

[31] http://www.dell.com/downloads/global/corporate/environ/recovery_policy.pdf.

[32] http://www.toshiba.co.jp/env/en/industry/resource3.htm.

[33] http://global.acer.com/about/sustainability01.htm.

Company	Statement on IPR
Philips	We support and understand that the concept of "individual producer responsibility" can be a mechanism for products or business models, to create additional incentives for manufacturers in designing more environmentally friendly products and to reduce environmental impact. A lot has been achieved – for instance in design for disassembly – in Philips products on a voluntary basis, as a result of our Eco-Design efforts.[34]
Fujitsu-Siemens	Fujitsu Siemens Computers supports the principle of Individual Producer Responsibility (IPR) and recognises that increasing amounts of end-of-life products, if not properly disposed of, pose a significant threat to the environment. While Fujitsu Siemens Computers believes IPR can result in more environmentally compliant products and better accountability for equipment manufacturers, it also recognises that IPR poses significant challenges[35]
Apple	Apple promotes an individually responsible approach to recycling through our own take-back programs. We now operate or participate in recycling programs in regions where more than 95 percent of Macs are sold.[36]

5.5 Conclusions from the literature

An extensive review of empirical research on EPR programme implementation for vehicles, EEE, and packaging showed varying results regarding the effects of EPR legislation on product design. While many of the studies documented explicit changes to both product design (upstream measures to improve end-of-life performance) as well as downstream improvements to collection and recycling infrastructure, they pointed to the role of anticipatory effects of the EPR legislation on firm's decisions to innovate, rather than from the implementation of the programme and clear incentives in themselves

Still other studies claimed that the introduction of the EPR legislation and subsequent programme implementation had led to tangible change in product design in the such design areas as light-weighting and material selection (Bailey, I, 2003; Mazzanti, M & Zoboli, R, 2006; Quoden, J, 2004).

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[34] http://www.philips.com/about/sustainability/howwework/ourpoliciesandpractices/takebackandrecycling.page.

[35] http://www.fujitsusiemens.com/aboutus/company_information/business_excellence/environmental_care/recycling.html.

[36] http://www.apple.com/environment/recycling/.

In the studies that did not find any tangible impacts of EPR implementation on product design, study authors pointed to that fact the programme implementation did not include any incentives within the financing mechanism as compliance fees were based on a flat fee per unit sold (Gottberg, A et al., 2006; Røine, K & Lee, C-Y, 2006). Gottberg, Morris et al. (2006) also highlight that in the case of the lighting sector, most producers have been able to pass on the incremental costs associated with EPR to customers with negligible effects on sales. Perceptions are that because demand is relatively inelastic and the regulation effects all producers equally, EPR is unlikely to drive eco-design, at least in the short run (Gottberg, A et al., 2006).

In addition to the empirical findings on the connection of EPR and product design, Section 5.4 shows that there are a relatively large number of producers that publicly support IPR on company websites. This was confirmed by many interviewee companies as presented in Herold (2007). Further evidence of company support for IPR is found in Section 7.5.4.

CHAPTER

SIX

6. Role of Product Characteristics on End-of-life Costs/Revenue Structures

In order to understand how design of individual producer's products contributes to the end-of-life costs and/or revenues in treatment facilities, it is necessary to have an understanding of the technical and economic systems in which end-of-life products are managed. For this, Chapter 4 provided a description of the end-of-life processing chain relevant for Europe, including a discussion on how the *interpretation* of the treatment requirements laid down in Article 6 and Annex II of the WEEE Directive can widely impact the technical and economic system, ultimately impacting the costs to manage individual products.

This section has two main purposes. *Firstly*, it illustrates that there has been a considerable amount of interest from researchers as well as producers of EEE on this issue. Considerable resources have been invested by producers to develop tools to further understand how their product design impacts end-of-life costs, especially during the period when the WEEE Directive was first proposed.

Secondly, as shown in Section 5.4, although many producers support the principle of IPR, they note that practical implementation is proving to be challenging. Therefore, this section is intended to explore the feasibility of developing indicators that could be used by PROs or individual producers when attempting to *differentiate the relative end-of-life cost/revenue of their individual products* managed by collective schemes. Having an understanding of how individual products influence the overall costs to the compliance scheme would, in theory, make it possible to differentiate the compliance fees in order to create an economic incentive for better designed products.

For the purposes of identifying and classifying the ways in which product characteristics influence how WEEE is processed at end-of-life, and subsequently the associated costs, valuable insight can be obtained by looking at existing design tools that aim to assist in determining how to design products for end-of-life. Both producers and the research community have produced a great deal of research outcomes in this area.

Additionally, generic design for disassembly, recycling and environment checklists assist in similar ways. Since eco-label criteria are considered to be representative of industry best practice, particular criteria documents of the major eco-labels that cover EEE also provide insight to the task at hand.

Finally, existing formats of environmental product-related information found within the EEE sector are presented. Examples presented were obtained through corporate websites, and other internet sources as well as what was presented at industry conferences or other public venues. Here it is necessary to investigate as to whether environmental information found within the identified information interfaces could be used to estimate individual product costs at end-of-life.

6.1 Design Support Tools for End-of-life

The tools described below can be categorised as having the main purpose as support tools for product designers. Meant to be applied at the early stages of the design process, these tools guide designers regarding the choices they make and how those choices influence the end-of-life environmental and cost performance of products. Valuable insight can be drawn from what is identified as influencing environmental performance at end-of-life, especially from the perspective of manufacturers.

However, the tools listed below are by no means a complete inventory, and are only meant to illustrate what product characteristics are deemed influential on end-of-life performance of individual products.

6.1.1 Product Material Recycling Cost Model (PMRCM)

Developed as a result of a doctoral thesis starting in 1999, this work is an important contribution to the understanding of how uncertainty factors influence end-of life scenarios. Basically, what the model attempts to do is to calculate the costs or revenues of mechanically processing a product, based on the material composition of that product (Boks, C, 2002). This calculation is primarily based on the revenues and/or costs that are obtained/incurred via various market outlets. Given this, the model *does not* *consider the dismantling processes prior to mechanical shredding*, and thus the relevant costs associated with this activity are not included.

The PMRCM model produces both an economic and environmental score in order to assess end-of-life scenarios. The economic score is calculated as the total costs/revenues of processing a certain product, representing a state of the art material processing facility using product, process and market input parameters. Interestingly, the cost can be calculated on a per-product or per kilogram basis.

The environmental score is a weight based material recyclability score for a certain product, based on the material composition of the product and parameters representing the recovery characteristics of the recycling process.

Besides providing valuable information in terms of understanding the numerous uncertainties associated with future end-of-life scenarios, Boks' (2002) research provides a relevant classification of Consumer Electronics (CE) and electrical household equipment (brown goods) based on their material makeup. This not only provides a model of how existing mechanical processing facilities view input streams of WEEE, but can also be used as a *benchmark* to compare product information between different products of various producers in the same product category provided in material declaration formats.

Table 6-1: Default Scenarios Found in the PRMCM Model

Input parameter	Metals Dominated Weight%, material content	Plastics Dominated Weight%, material content	Precious metals Dominated Weight%, material content	CRT Dominated Weight%, material content	CRT Dominated Weight%, material content (with glass)
Ferrous	66	34	31	16	6
Copper	6	4	26	8	3
Aluminium	6	0	2	3	1
Recoverable plastics	4	35	6	39	15
Non-recoverable plastics	18	27	35	34	13
Glass	0	0	0	0	62
Gold	80 ppm	8 ppm	709 ppm	15 ppm	15 ppm
Silver	215 ppm	33 ppm	1938 ppm	590 ppm	590 ppm
Palladium	90 ppm	8 ppm	438 ppm	40 ppm	40 ppm

Source: (Boks, C, 2002)

6.1.2 grEEEn Method – Cost Management System for greening Electrical and Electronic Equipment

Funded by the European Commission's 5th framework programme, the goal of this project was to develop and make available a cost management system that can be used by manufacturers to develop green products and reduce the costs over the product life cycle. The project team is made up of 10 partners from the university institutes of ITU at the Technical University of Berlin, IKP at the University of Stuttgart, two research institutes - IVF in Sweden and Gaiker, 4 industrial partners (Motorola, Siemens, Fujitsu, and Lear, and 2 service providers – CIMA and PE (grEEEn Project, 2003). The project ran between the years 2001-2003 (Lichtenvort, K et al., 2003).

The grEEEn method aims to provide manufacturers with a tool to assess their products on three main aspects, (1) legal compliance with the WEEE and RoHS Directives and (2) economic and (3) environmental impacts of various design solutions chosen. The method uses two different models to develop the results needed – namely the process and product models. In terms of relevance with respect to providing insight into the current project, the 'product model' is worth describing in more detail. The origins for the product model are linked to a software program commercialised by Siemens called DEMROP, which is used for set-up guidance. Interestingly, this is also the origin of the PRMCM model of Boks (2002).

The product model focuses on the structure of a potential or existing product, containing the definition of materials, product hierarchy and the connections. It classifies a product into components, connection and materials. According to the authors, the product model is especially helpful for the end-of-life phase, where disassembly options have to be analysed. The product model assesses the product in question based on the characteristics listed above and creates a number of indicators. These include what they call simplified indicators, such as number of materials, mass, and toxicity index. Also relevant is a series of indicators called 'design for recycling which include, net rate of recovery, net rate of reuse and recycling, recycling efficiency rate and rate of energy recovery. These indicators provide insight into whether the product meets the recovery targets in the WEEE Directive.

An important result of the grEEEn method development so far, was presented at the CARE INNOVATION 2002 conference (Nissen, N et al., 2002). This relates to the development of a simplified procedure for modelling the interactions between product components or assemblies and the default disassembly scenario they consider. Four steps make up this procedure: *Step 1:* Decontamination Steps; *Step 2:* Additional Disassembly; *Step 3:* Calculate Metal Separation, and *Step 4:* Calculate Plastic Separation.

Within the first step assemblies to be dismantled are identified based on the components and materials listed in Annex II of the WEEE Directive (treatment requirements). Once the components are identified the grEEEn method then evaluates how far this removal of the targeted assembly should go. The decision is made by checking each connection to release the identified assembly according to connection type, assembly size, and subassemblies with different specific end-of-life processes (Nissen, N et al., 2002). Any components that are non-legislated for special treatment removed in step 1 are subsequently sent to step 2. In step 2 the method further decides assemblies that should be removed for 'optimal' recovery. In step 3 all metal components removed will enter metal shredder and further sorted using electrostatic separation for fines, magnetic separation, eddy current and sink float techniques. The products' listing of materials in the 'Material Content List' determines the material flow through these processes.

The remaining material then moves to the plastic separation step 4. A number of calculations are performed in order to model the results. These include: 1. List materials by density from lightest to heaviest; 2. Calculate the densities; 3. List the separable density differences, considering that only density differences over 0.05 g/cm^3 are separable; 4. Definition of existing Mixed Material Groups (MMG) between Separable Density Differences (SDD): All materials in the list between the separable density differences will form a mixed material group. These groups will be listed according to densities of materials; and 5. Check recyclability and compatibility of mixed material groups according to material properties. Mixed material groups are only considered recyclable when all materials within the groups are recyclable and a compatible recycling process for the mixture exists.

This method relies heavily on material data on components and assemblies in order to determine dismantling strategies. However, it is recognised by the authors that data gaps and data uncertainty, for example the content of hazardous substances in certain components, are some of the main problems for the implementation of the grEEEn method. To overcome this, a database which organises information on common components and prefabricated sub-assemblies is being developed. Parts lists in various stages of detail can be assigned to any product, for example a standard printed wire board (PWB).

6.1.3 Assessment Tool for Recycling Oriented Design (ATROiD) LG Electronics

ATROiD is a design support tool for end-of-life consideration. This OEM software tool is able to determine the optimal disassembly sequence for the product given the input variables. It groups several parts together into what they call a 'recycling segment' which leads to cost minimisation associated with end-of-life.

Composed of 4 main modules what they have called; *input, assessment, analysis,* and *improvement*. In the input module, product related information is further divided into 3 sub- modules listed in the table below (Kang, HY & Jung, JW, 2002).

Table 6-2: Input Module for ATROiD tool

Sub-Module	**Contents**
Parts information	Part name, shape, size, accessibility, material type, weight, serviceability of parts
Connection information	Types of joining techniques, quantity, joined parts
Disassembly priority information	Priority relations

Assessment, Analysis and Improvement Module

Disassembly Evaluation

ATROiD calculates the time necessary to disassemble the product and sub-assemblies based on a calculated optimal sequence. The optimal sequence is suggested based on the relationship of the product data inputted to pre-determined data on times necessary to carry out the procedure. In addition, ATROiD, generates a disassembly sequence for a group of related parts (or sub-assemblies) which they term 'recycling segments'.

In the analysis mode each part is classified into one of four levels based on its relative contribution to total disassembly time. From this result a designer gets an indication of whether the part should be redesigned or not. Finally, the software provides some guidance to the designer on how to solve the problem (i.e. improve its level).

End-of-life Cost

To estimate the end-of-life costs of the product in question, ATROiD relies on a database that stores cost data for material disposal (hazardous and non-hazardous), revenues from recyclable materials and parts as well as labour costs associated with disassembly. The end-of-life cost is estimated on a product, part and recycling segment. Similar to the disassembly time criteria, the model classifies the parts or segments into one of four levels depending on their total contribution to the end-of-life cost and suggests improvement options.

Recycling Potential

According to Kang and Jung (2002), both the disassembly time and end-of-life factors produce quantitative results that are useful to identify the environmental status of the product. They can be used to estimate how a product can be improved by manipulating design as well as to benchmark the improved products. However, they also state that these factors are insufficient to identify detailed end-of-life problems.

This is where the recycling potential factor comes in to support a designer with detailed information. Composed of 29 criteria, classified into 4 groups (1) Material, (2) Product structure, (3) Joining techniques and (4) Printed Circuit Boards – the assessment comes up with rather qualitative results to produce a weak point analysis and again guides the designer on how to improve the recycling potential.

ATROiD provides further support to designers in terms of polymer compatibility in general and as well specific to a product under review. Tables are also presented on the preferred materials and joining techniques most suitable. Unfortunately, details and specifics of how these factors are determined are not transparently presented in available literature.

6.1.4 CAD File Data – DFD-Compact

The DfD-Compact can be described as a design tool that evaluates disassembly complexity and material recyclability. Input data required for this design for disassembly tool can be extracted from CAD (computer aided design) programs. The necessary data required include a part relationship tree, part weight, and part material composition. Other data required are stored in standard libraries developed by the authors (Mani V. et al., 2001).

DfD-Compact employs a number of procedures that use CAD data to estimate other product data in combination with their developed "standard libraries" to produce what they call a DfD ratio. This ratio provides information about the products' end-of-life characteristics in three main ways. These include; (a) material separation and recyclability, (b) unfastening difficulty, and (c) disassembly accessibility. Results are displayed as a ratio representing the difference between the potential reclaim value and the disassembly cost. Therefore, a product that receives a score of greater than 1 indicates profitable disassembly.

The process is divided into 5 executable steps requiring no manual intervention by designers. There are three data inputs, the CAD file for a product, part reuse value, and a design for disassembly library data. Included in the library are 8 common material output streams from the disassembly process (1. ferrous metals (steel), 2. non-ferrous (aluminium and copper) 3.

sources of precious metals (gold, silver and palladium), 4. glass and ceramics, 5. plastics, 6. hazardous parts, 7. paper, and 8. packaging materials), the approximate market value of these streams, and the impurity thresholds.

Given this, *Step 1* of the process extracts required data from the CAD file using XML (extensible markup language) creating a bill of materials consisting of all product parts and their material composition and weight.

Step 2: Initial Assignment of Parts to Material Streams: Parts that are identified in Step 1 are assigned to either a) one of the 13 material recycling streams identified, b) components for reuse, or c) waste fractions. The developers have built in a functional equation that dictates the assignment and includes variables such as weight of the part, material type of the part, reuse value of the part, the recycling yield of a part material in material streams, and value of recyclate in material streams.

Step 3: Estimating the disassembly effort. In this step a model is developed, based on previous studies, that provides a reliable approximation of the required effort. This model derives the cost to disassemble all the fastening links that are identified in step 1 from the CAD file data and is a function of the number of links unfastened, the packing density, access level of each sub-assembly and labour costs. Similar to Step 2 the developers have built in a series of functional equations to automatically arrive at a total disassembly cost, assuming a complete disassembly of the product.

Step 4: Identifying parts with low disassembly value: Since it can be expected that many parts in a typical product will have no disassembly value, there is no motivation to remove them. This step aims to isolate these low value parts and remove them from the recommended disassembly level. Two rules are included in the model, which attempts to achieve this. First, low weight parts (below a defined threshold) are expected to have high disassembly costs relative to their material value. Obviously, the threshold weight for materials varies depending on the market price of the recyclate. Second, the model assumes that subassembly breakdown is uneconomical, and therefore does not recommend further disassembly. Parts or subassemblies that are not disassembled are automatically assigned to the material stream in which the heaviest part of that assembly is part of.

Step 5: Recompute the DfD ratio. From the results of step 4, as the assignment of parts to material streams (Step 2) is modified, the DfD ratio can be recalculated taking into account the associated changes in cost and revenues.

6.1.5 Kroll's Disassembly Evaluation Method

Kroll's experimental work in understanding disassembly efficiency of products indicates that there are four sources of difficulty in performing dismantling tasks. These are accessibility, positioning, force and base time. Briefly described, accessibility is a measure of the ease with which a part can be reached by a tool or by hand. Positioning measures the required precision necessary to place the tool or hand. Force is a measure of the effort to carry out the task, and base time is time required to do the basic movements without difficulty.

Within the method there are 16 standard tasks and 24 tools listed that are common to the disassembly process. In order to quantify the ease of disassembly for each of the 16 dismantling tasks, all sources of difficulty are rated on the same scale, in this case time was the chosen metric. Instead of presenting the results in time (seconds) the method converts time information on a scale of 1 (easiest) to 10 (most difficult). Since all the scores are defined on the same scale, it is possible to compare the difficulty ratings for different tasks.

The chosen method used to calculate the time spent on actions in each of the tasks was the Maynard Operation Sequence Technique (MOST). Task difficulty scores for all the pre-defined disassembly tasks were derived from an estimation of task performance time using this method. Standard models for each disassembly task were identified and defined as a starting point to develop the difficulty ratings. By applying the MOST system to the defined operations to calculate the expected time for each of the tasks, taking into account effects of various disassembly factors such as obstructions, handling difficulties and assigned these times to the appropriate aspect of task performance (accessibility, positioning, force and base time). Finally, these times were converted into difficulty scores on a scale of 1 to 10 and repeated for each of the 16 standard task classifications.

The method was originally developed for designers to help designers identify weaknesses in the design from a disassembly perspective. The applicability of using this method warrants further investigation to understand how the 16 standard tasks could be applied to estimating total dismantling time for example (Kroll E. & Carver B.S., 1999).

6.1.6 Optimal Part Disposal Model (OPD)

Das and Yedlarajiah (2002) have presented what they call an OPD model, which sets out to solve some of the problems that disassembly facilities face when ascertaining how and at what level to dismantle WEEE and then sort the dismantled fractions according to pre-determined material or part streams. The model is formulated as a mixed integer program that attempts to maximise the net profit from the disposal action by considering expected revenues from the sale of reusable parts and the material streams (Das, S & Yedlarajiah, D, 2002). It also considers the constraints due to acceptable impurity levels of the material streams, as well as the projected effort to release each part or subassembly. This release effort is a function of the number and type of fastening links that have to be detached in order to release the part.

The authors make an interesting point with respect to why WEEE is not often evaluated for product disassembly. They note that there is a general lack of information about the valuable content in discarded products as well as the lack of an effective tool for predicting associated profits from disassembly (Das, S & Yedlarajiah, D, 2002).

Since Das is both the developer of OPD and the DfD-Compact (see Section 6.1.4) much of the same logic applies to this model, but comes at the problem from the perspective of the end-of-life dismantler rather than from designers. However it does assume that certain key data about the part and material content of the product along with relevant design data will be available to the user. The OPD model is based on the same parameters as listed in the DFD-compact and is not further described here.

6.1.7 End-of-Life Design Advisor (ELDA)

Developed as part of a PhD dissertation, ELDA uses technical product characteristics to determine end-of-life strategies (Rose, C, 2000). ELDA objectively investigates the technical characteristics that control the product's possible end-of-life treatment. By using available data in the early stages of product design, ELDA is claimed by its author to bring in the environmental perspective without the usual subjectivity (Rose, C, 2000).

Technical Product Characteristics that are integral to end-of-life strategy prediction are:

Wear-out life is described as the point at which consumers perceive the product to no longer attain the level of function they want. This is influenced by product design, materials used, quality of manufacturing, consumer use and service. Technical wear-out life, according to Rose (2000), can be measured by three definitions: time until the critical part providing function wears out, time until the complete product fails loosing all functions, and mean time to failure. One aspect of product wear-out life not addressed in the model is 'emotional wear-out' described as when consumers discard products for reasons other than functionality.

Technology cycle is defined as *"the length of time that the product will be on the leading edge of technology before new technology makes the original product obsolete or less desirable"*. Typically, the technology cycle is 10-20 years for automobiles. On the other hand the technology cycle of computers is approximately 6 months to a year (Rose, C, 2000). The technology cycle of a product depends on market pressures, scientific advances and company focus and is propelled by a number of actors, including consumer preferences, governments (stimulating growth), scientists and engineers (trying to increase performance while reducing costs) and competition.

Level of Integration tries to assess the interrelation between modules and functions. For example, if there are many unique functions for each module, the level of integration would be considered high. The level of integration is considered low if each module only performs one or two functions.

Number of Parts is the number of assemblies in the product that are only relevant for end-of-life treatment. For example, printed circuit boards are considered one part because in most scenarios these will be disassembled as one part.

Reason for Redesign is similar to technology cycle in that the reasons companies design or redesign products depends on customer demand, competitor behaviour and scientific progress. Customer demand and competitor behaviour push the firm to release products with improved aesthetics through external design. Functional changes require improvements in technical performance. Important to end-of-life treatment, this product characteristic determines if the product will experience an end-of-life of remanufacturing, recycle with disassembly or recycle without disassembly. Original design and functional changes distinguish a product to have an end-of-life strategy of remanufacture or recycling without disassembly.

Design cycle is the frequency in which producers design new products or redesign existing ones. It relates to the competition's release of new products, marketing plans, and actual research and development success (Rose, C, 2000).

Of these characteristics, Rose (2000) asserts that *wear-out life* and *technology cycle* are the most important.

6.1.8 QWERTY

According to Huisman (2003) the QWERTY[37] concept focuses on the determination of environmentally relevant recycling scores rather than a weight-based recycling score. It describes the environmental performance of treatment of discarded products and can be used to assess the effectiveness of end-of-life processing and the consequences for design of products in relation to recyclability (Huisman, J, 2003).

Based on a streamlined QWERTY analysis, Huisman (2003) asserts that there are three main design strategies can be employed to improve efficiency in mechanical processing, mainly from the perspective of ensuring that liberated materials end up in the correct fractions to avoid cross-contamination as well as to reduce emissions of environmentally relevant substances (Huisman, J, 2003).

The 3 main design strategies proposed are:

Reduce the amount of critical or undesired materials such as specific metals and other substances that are known to impact the smelting process where smelters penalty apply a penalty charge if they are present and other hazardous substances such as heavy metals and alloys containing toxic or disturbing elements for further processing;

Reallocate materials so that cleaner fractions can be obtained. Based on an analysis of problem areas of the product under investigation reconfiguring components

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[37] QWERTY (Quotes for environemntaly WEighted RecyclabiliTY)

or assemblies might be an option. For example, any cross contamination of Aluminium or Steel in the Copper/Precious Metal fractions will be lost in the smelting process in copper smelters. Similarly, Copper and Precious Metals are lost when processed in Aluminium or Steel smelters; and

Improving the unlocking properties of parts and components will improve both disassembly times and shredding efficiencies.

Huisman (2003) conducted an evaluation of detailed redesign options for 2 WEEE archetypes, a glass dominated product (17-inch CRT monitor) and a metal dominated DVD player. The QWERTY evaluation claimed that while from an overall environmental perspective, there was only marginal environmental improvement[38] with the end-of-life performance of the redesigned product, the economic costs were significantly reduced in the case of the 17-inch monitor (see Table 6-3).

Table 6-3: End-of-life Costs of 17-inch Monitor

Product	End-of-life scenario	End-of-life costs
Original design	State-of-the art recycling	5.95
Original design	As above, include. Max/glass plastic recycling	6.47
Redesign	State-of-the art recycling	4.86
Redesign	As above, include. Max/glass plastic recycling	5.37

Source: Huisman (2003)

6.1.9 Other Tools

There are numerous other tools that have been identified from the literature that could provide useful insight into this process. However, the tools were not reviewed as they were considered to be outdated or insufficient information was publicly available. However, they are listed in order to provide an indication of the past level of activity in this area.

- ReStar – Carnegie-Mellon University – 1993-94
- LASeR (1994-96) –Stanford University
- EOL –Cost Model at Philips (1994-96)
- Reloop 1998 – European Union Funded project

[38] The environmental improvement was reported as 4.5% and 8.6% for the 17-inch monitor and DVD player respectively.

6.2 Design for Recycling (DfR) Guidelines

This section reviews three generic design for recycling guidelines that have been developed either by the electronics industry associations, or by specific electronics industry firms in collaboration with academia. This aims to describe which product characteristics are deemed important to influence the environmental and economic performance of EEE products at their end-of-life.

International Electrotechnical Commission Guide 109: Environmental aspects – Inclusion in electro-technical product standards: The International Electrotechnical Commission (IEC) created Guide 109 to assist persons involved in the development of international standards for EEE products on incorporating environmental issues into regular standard development (IEC, 2003). In Annex C – Guidance on Design for Environment (DFE) principles for the electrotechnical industry under the heading Design for Disassembly and Recyclability, the guidelines provide some useful information to consider. Interestingly, guidance is provided on the most suitable choices for fastening techniques, plastics recyclability, marking/ labelling, and design for maintainability

Guidelines Facilitating Disassembly Furuhjelm (2000) proposed a universal approach for incorporating the end-of-life aspect into product development. The guidelines that are put forward are proposed as generic factors to facilitate improved design for end-of-life.

On-line Designers Guide for Electronics: Released by the Institute for Product Development (IPU) the Danish Toxicology Centre (DTC), GN-Teknik and financed by the Danish Environmental Protection Agency, the Designer's guide has been designed for actors that are involved in the design and development of EEE. The target group, according to the developers is marketing and management, engineers, and quality/environmental specialists. It contains a number of interesting modules, but in terms of the scope of this research the 'Eco-Design' Guidelines are the most relevant. Under this heading are guidelines for end-of-life and materials (Danish Ministry of Environment, 2002).

EE Practical Eco-design Guide: This guide developed by Rodrigo & Castells (2002) intends to assist the EEE industry to introduce and apply eco-design methodology during the production of equipment. It is written for designers and product developers and those responsible for environmental compliance issues in EEE companies. Chapter 4 presents practical eco-design guidelines of which end-of-life are specifically addressed (Rodrigo, J & Castells, F, 2002).

The four sources of design guideless are compared in Table 6-4 below. They are grouped by the author of this thesis in 3 product characteristics; product structure, materials and connectors (the mechanism to join components).

Table 6-4: Comparison of Eco-design Guidelines

	IEC Guide 109	**IPU Design Guide**	**EE Practical Ecodesign Guide**	**Furuhjelm**
Product Structure	None	- Components/parts to be removed at disposal shall be identifiable and removal should be easy (batteries, LCDs, other Annex II entries) -Screws should be accessible from one side in order to avoid turning the equipment - Parts with high recycling potential must be easy to remove (e.g. cooling plates, coils and transformers). This can be done by placing them along the edge of the board to ease breakage. - Ensure easy access to parts, which can be re-used and removed without damage.	- Use surface-mounted components - Facilitate the removal of valuable/hazardous parts/components Mark hazardous and toxic components	- Integrate structure & modular design - Minimise number of parts - Allow a linear and unified disassembly direction - Make valuable & hazardous parts easily accessible - Cluster parts that need to be removed - Avoid metal inserts and reinforcements moulded into plastic parts
Materials	- Reduce material diversity in the product - Avoid hazardous materials listed as hazardous - Variation of material types should be eliminated or minimised - Plastic parts should be clearly marked with ASTM , ISO or other identifiers (no labels) - Plastics: Use of plastic surfaces with paint or sprayed metallic coating should be minimised	- Avoid mixing of different types of materials e.g. Press fits of non-compatible metals in iron or aluminium - Chemical surface plating of metals (galvanizing, nickel plating or chromium plating) - Painting or coating of plastics (because of EMC) Metal inserts in plastics - Joining of non-compatible plastics -Plastics weighing >25 grams should be identified with ISO 11469 plastic code to ease recycling identification	- Use as few different materials as possible - Plastic parts weighing more than 50 g should be identified by type of plastic - Select plastic types with well established recovery and recycling system (thermoplastics PET, PS etc, and polyolefines: HDPE, LDPE, PP, etc) - Avoid using labels on plastic parts - Avoid painted plastics	- Minimise the number of different types - Avoid hazardous materials - Make inseparably connected parts of the same or compatible materials - Mark all plastic parts with identification marking - Eliminate incompatible labels on plastic parts - Mark hazardous parts
Connectors	- Priority to the use of snap fits - All screws should be of similar head configuration -Threaded inserts as embedment should be avoided	- Use the same kind of screws to avoid tool change. - Use as few screws as possible. Join by "clicking" whenever possible. - Avoid joining that needs special tools - Avoid joining of non-compatible plastics	- Avoid metal fasteners in plastic parts	- Minimise # used - Minimise # of tools needed to remove fasteners - Ensure fasteners are accessible - Use fasteners that are compatible with material of the parts that are connected - Eliminate adhesives unless compatible with both parts joined

6.3 Eco-label Criteria

As eco-label criteria are usually set to allow only the best performing products within a product group to achieve the standard, applicable end-of-life criteria were reviewed to further distil which product characteristics influence end-of-life performance. There are a number eco-labelling programmes (ISO Type I) in Europe that have established product criteria for EEE, including Germany's Blue Angel programme, the European Commission's EU Flower, the Nordic Swan to name the most prominent.

In addition to ISO Type I labels, there are a number ISO Type II programmes including the ECMA TR/70 and IT Företagen Eco Declaration now ECMA 370 as well as the EPEAT programme in the US.

Table 6-5: ISO Type 1 and Type II Eco-label Programmes EEE Product Groups

Program	Issuing Country(s)	EEE Product Groups covered
Nordic Swan	Norway, Finland, Denmark, Iceland, Sweden	Dishwashers, Refrigerators and Freezers, Washing machines, Heat pumps, PCs, Copiers, Printers, Fax machines
EU Flower	EU Member States	Dishwashers, Refrigerators and Freezers, Washing machines Heat pumps, Vacuum cleaners, PCs, laptops, Televisions, CFLs
TCO	Sweden	PCs, VDU (CRT's & LCDs), Mobile telephones
ECMA TR/70 ECMA 370	ECMA	Applicable for ICT products in general
IT Företagen	Nordic Information Technology Organisations IT Företagen, IKT Norge, IT-Branceforeningen, Denmark	PCs, Printers, Faxes, Copiers
EPEAT	USA	B2B Desktop PCs, laptops, monitors

EPEAT Criteria

Table 6-6 lists the mandatory and optional criteria that must be met for producer's to obtain either, Bronze, Silver or Gold, EPEAT certification listed in the Table 6-5 above.

Table 6-6: EPEAT Criteria Relevant for Design for End-of-life

	EPEAT (Criteria: Design for end-of-life)	
	Design for recycling through recycling systems that utilise shredding	*Design for Recovery through disassembly*
Product Structure	- Identification of materials with special handling needs: **Required** - Identification and removal of components containing hazardous materials: (consistent with Annex II requirements): **Required** - Easy disassembly of external enclosure: **Required** - Minimum 65% reusable/recyclable: **Required** - Minimum 90% reusable/recyclable: **Optional**	- Manual separation of plastics parts shall be easily separable: All covered products shall have the plastic parts, except very small ones easily separable. **Optional**
Materials	- Elimination of paints or coatings not compatible with recycling or reuse: **Required** - Marking of plastic components according to ISO 11469: **Required** - Reduced number of plastic material types: **Optional**	- Marking of plastic components according to ISO 11469: **Optional**
Fasteners and connectors	- Moulded/glued in metal inserts in plastic enclosures eliminated or removable: **Optional**	

6.4 Summary of Product Characteristics Influencing End-of-life Costs

From the design for end-of-life support tools and guidelines presented above, Figure 6-1 summaries three main product characteristics that are identified that influence end-of-life costs/revenues associated with recycling. Variations of these three main product characteristics are found consistently in the design for end-of-life guideline, product development tools, as well as eco-label criteria reviewed in the sections above.

It must be stressed that this is a generic classification and very much depends on the actual treatment scenario that the product undergoes, the level of manual disassembly or mechanised treatment utilised in the process, the value and potential reuse possibilities for components and output materials, and the treatment requirements placed on recyclers concerning the removal of certain hazardous components. The relative degree of uncertainty over each of these factors makes it particularly difficult to evaluate design choices, especially considering the delay in terms of when the product is put on the market to when it is managed at a treatment facility. However, by considering which product characteristics of products treated in the current recycling stream influence the costs and revenues valuable insight can be realised.

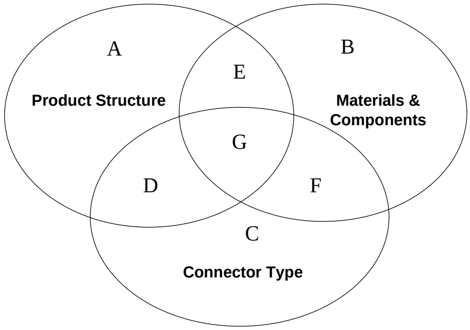

Figure 6-1: Product Characteristics Influencing End-of-life Costs

As can be seen in Figure 6-1 the three characteristics are overlapping and therefore create 4 additional sub-categories. Each of these is detailed in Table 6-7 below.

Table 6-7: Product Characteristics Influencing End-of-life Costs

	Summary of Main Suggestion to Improve Design for Recycling: DFR Guidelines & Tools
A	a). Cluster Parts that must be removed
	b). Modular Design
B	a). Reduce material diversity
	Plastics
	b). Select plastics with well established recovery and recycling systems
	c). Avoid painted plastics
	d). Avoid labels on plastics
	Hazardous Substances & Components
	e). Avoid hazardous substances &components Annex II
	f). Label hazardous components
	g). Avoid chemical surface plating of metals Ni CrVI
C	a). Minimise the number of fasteners
	b). Priority to using snap fits
	c). Minimise the number of tools needed ,i.e. use same screw types
	d). Avoid metal fasteners in plastic parts
	e). Avoid threaded inserts
D	a). Ensure fasteners are accessible
	b). Ensure screws are accessible from one side to avoid turning of product
E	None identified
F	a) Use fasteners that are compatible with the part material that it is connecting
	b). Do not join incompatible materials
	c). Eliminate adhesive bonding unless compatible with both parts joined
G	a). Easy access to valuable or hazardous parts

6.4.1 Connectors and Hazardous Components

Product structure in terms of type of connectors or joining mechanism as well as accessibility of these fasteners is especially important for products that are likely to be partly manually disassembled to remove hazardous or valuable components. Even by taking a conservative view on the required removal of certain components and materials prior to any mechanical processing as outlined in the TAC Annex II Guidance document discussed in Section 4.9, the relative influence of connectors on end-of-life costs is clear.

For products managed currently at end-of-life treatment centres that are contracted by PROs or compliance systems, the importance of type of connectors used are applicable to *CRT containing products* that at minimum require the CRT to be removed. Clearly the type, number and accessibility of fasteners, in this case, used to connect the housing of the equipment, could be a differentiating factor as this will directly impact time to dismantle (assuming non-destructive tools are used). Similar conclusions can be made for products containing the following components or materials where disassembly is most often required as a first step in the treatment process.

- Products containing hazardous batteries (including internal batteries)
- Mercury containing backlights in LCD TV and LCD monitors/screens
- Products containing mercury components, switches
- Products containing external batteries (mobile phones, portable power tools)
- Circuit board containing products (see Section 6.4.2, below)
- Large household appliance containing PCB capacitors (no longer produced)

6.4.2 Metal Content in Products

As it is known that the economics of recycling of WEEE has historically been driven by the precious metal content in electronics, the relative amount of Gold, Silver and Palladium that each product contains will influence the end-of-life costs. In terms of cost incentives for end-of-life design, from a life cycle perspective the use of this criterion should be carefully considered, as it would be counter-productive from an environmental perspective to add precious metals in an attempt to reduce end-of-life costs in the future. In reality, it is unlikely that any manufacturer would intentionally add such materials as the up front costs would also be prohibitive.

Similarly, Steel, Aluminium and Copper metal concentration contribute to the revenue stream of the recycling operations and therefore relative contribution of these metals in products are a potential differentiating criteria.

Given the estimated 20% loss of precious metals when circuit board containing products are treated in mechanical processing facilities that rely on shredding and subsequent separation, the importance of their removal prior to fine shredding in important to avoid this scenario (see Section 4.6.2 and Section 4.8).

6.4.3 Plastic Content in Products

Masaner, Auer et al. (2002) visited and conducted interviews with over 20 computer disassemblers and plastics recyclers to determine which DfR guidelines were most effective at improving the recyclability of computer plastics (Masanet, E et al., 2002). Of the 18 disassemblers that were interviewed, 16 employed manual disassembly methods while the remaining two treated computers mechanically in WEEE shredders along with subsequent materials sorting and recovery. One of these facilities had automated sorting technology to sort the plastic fraction while the other sent plastic fraction to a smelter for remaining metal recovery. Of the six plastics recyclers interviewed, 4 were utilising automated sorting technologies. Three of the four facilities employed density separation technology while the remaining recycler was using a floatation technique.

The study confirmed that the majority of design for recycling guidelines that have been mentioned above are valid in the context of improving recycling rates of plastics in computers managed by facilities included in their study. Two guidelines however, did not prove to be influential in improving recycling rates of plastics. These included the heuristics 1) to use one polymer type for all large components and 2) to use one colour per type of polymer used. The major reason why these recommendations do not hold up is that at all facilities included in this study the variety and diversity of computers managed was high with no known situations when large volumes of same model or brand are treated simultaneously.

Since there are established markets for the plastic resins containing PS, ABS, PP and PE, the relative contribution of these compared to other less recyclable materials could be a differentiating factor in addition to the above criteria.

6.5 Product-Specific Data & Availability

An important step in understanding *whether it is possible to differentiate compliance fees* that producers pay to *collective compliance systems* for the management of their products is to assess the current availability of product-specific data on key characteristics that are known to influence these costs.

6.5.1 Material and Substances of Concern Data

Since the mid 1990's EEE producers based in Europe, Japan and North America have been increasingly interested in gaining a better understanding of the materials and substances contained in both the components purchased from suppliers as well as their complete products when finally assembled and marketed. This demand emerged from a variety of factors, including both future regulatory requirements as well as customer requirements and general corporate strategy (van Rossem, C, 2001, 2003). This led to a situation where OEMs had begun to issue material declaration questionnaires to suppliers in increasing diversity. This created considerable resource demand on behalf of both suppliers and producers needing to develop and answer numerous formats from various suppliers and customers. As a result industry associations in Japan, Europe and the USA initiated projects to standardise material declaration questionnaires.

The Electronics Industry Alliance (EIA) Material Declaration Guide, the Japanese Green Procurement Survey Standardisation Initiative (JGPSSI) and EICTA were all either in the process of developing or had already developed material declaration formats for their respective member companies and their suppliers. Considering the developments that took place in Europe, Japan and the US to develop standards for gathering material and substance data in the supply chain as well as the international nature of the electronics industry, it is not surprising that these organisations decided to collaborate to develop an international standard to further implement harmonisation on a global level. After approximately three years of deliberations and negotiations, a Joint Industry Guide was published by the EIA in April 2005 (EIA, 2005). Since then more organisations have developed standards for data transfer to assist in the management of data between companies.

While it is clear that increasingly more and more producers have detailed information regarding the substances of concern and valuable materials in their products, this information is highly proprietary and it is not common to find this publicly available in formats such as the ECMA 370. Even more importantly, these declarations are applicable only for the ICT sector.

6.6 Conclusions on Current Differentiation Potential

If differentiation of end-of-life costs between various producer's products handled jointly within the same collection category or even product category is to be made at the point of recycling, there are a number of conditions that must be met. Any differentiation efforts will need to consider whether this is made at the product group level (WEEE category Annex IA), product type (WEEE Annex IB) or at the collection group level (i.e. large household appliances, Cooling & Freezing, etc.).

In order to differentiate costs to more accurately represent the relative contribution of each producer's product there would need to be a mechanism to identify each product collected/treated (return share) and cross reference this to a product database where information on material composition, product structure, and connector type is stored for each product. From this information, the recycler or PRO could determine which parameters most influence the net cost or revenue of treatment and adjust each producer's contribution to the total compliance costs of that category accordingly.

Given that the current availability of the type of data necessary to differentiate individual products when they will be returned in the future is limited, and does not even exist for many product groups placed on the market today, the feasibility of this approach is further complicated.

Even if the data were readily available, the administrative complexity to achieve the desired differentiation would be considerable, especially given the volumes of products handled at recycling facilities and the effort that would be required to cross reference the returned product to the appropriate producer and the correct model and year in order retrieve the correct data sheets on relevant product information.

There could of course be ways to simplify the complexity, including the use of automatic identification technologies including RFID among other technologies (Butz, C, 2007). However, to date this technology has not been applied universally and even if it were to be implemented today across all product groups, depending on the product group in question the products would not be returning in the WEEE stream for minimum 2-3 years from now. For some very durable products such as large household appliances, this period would be much longer (10-15 years from today).

From this, it is concluded that in the current situation any differentiation of compliance fees when mixed products are treated together based on return share and product characteristics would need to be based on sampling proxies and average product characteristics of a producer's fleet of a particular product category (Annex IA) or collection category at least until automated product identification technologies are in place.

CHAPTER

SEVEN

7. WEEE Directive: Transposition in the Member States

Although Directive 2002/96/EC has been described in previous chapters of this thesis, including a detailed description of its development through various Commission drafts and the co-decision procedure, the transposition of the Directive into each MS national legislation is required to implement the WEEE Directive. Therefore, in order to answer RQ 2, an analysis of the transposition outcome in MS needed to be undertaken. This is especially relevant since it became apparent to the researcher that transposition outcomes will largely determine how systems are set up in practice in MS. Where relevant to IPR, results of practical implementation outcomes associated with the key parameters reviewed will be included in this section.

The content included in this Chapter has for the most part originated from Study 2: *The Producer Responsibility Principle of the WEEE Directive: DG ENV. Study Contract N° 07010401/2006/449269/MAR/G4* of which the assessment and write-up were developed by the author of this thesis.

7.1 Overall Status

Article 17(5) of Directive 2002/96/EC requires that Member States bring into force regulations, laws or administrative provisions that comply with the WEEE Directive by 13 August 2004. Although, most MS missed this deadline, by April 2007 all but one MS had transposed the Directive and had officially notified the Commission. Since the WEEE Directive is based on Article 175 of the EC Treaty, MS must transpose the minimum requirements outlined in the Directive, but are not prevented from setting more stringent requirements than those outlined in the legal text.

Recital 8 of the WEEE Directive, as it reads below, indicates the overall importance of a standardised application of the producer responsibility principle in the European Union's 27 MS.

Recital (8) The objective of improving the management of WEEE cannot be achieved by Member States acting individually. In particular, different national applications of the producer responsibility principle may lead to substantial disparities in the financial burden on economic operators. Having different national policies on the management of WEEE hampers the effectiveness of recycling policies. For that reason criteria should be laid down at Community level.

Given the diverse outcome of the transposition of the WEEE Directive in MS national laws as presented below, Recital 8 is somewhat ironic, although not surprising given the ambiguity of the wording of key elements of the WEEE Directive as was described in Section 2.9.

7.2 Producer Definition

Producer definition is a critical component of any EPR legislation as most legal obligations for fulfilling the objectives of the directive fall onto the producer. Article 3(i) of the WEEE Directive defines producer, the primary actor subject to the principle of producer responsibility, as follows:

Article 3: Definitions

(i) 'producer' means any person who, irrespective of the selling technique used, including by means of distance communication in accordance with Directive 97/7/EC of the European Parliament and of the Council of 20 May 1997 on the protection of consumers in respect of distance contracts:

(i) manufactures and sells electrical and electronic equipment under his own brand,

(ii) resells under his own brand equipment produced by other suppliers, a reseller not being regarded as the 'producer' if the brand of the producer appears on the equipment, as provided for in subpoint (i), or

(iii) imports or exports electrical and electronic equipment on a professional basis into a Member State.

Whoever exclusively provides financing under or pursuant to any finance agreement shall not be deemed a 'producer' unless he also acts as a producer within the meaning of subpoints (i) to (iii).

7.2.1 Transposition Outcome

What has emerged as a significant issue in the transposition process is how MS have interpreted importers and exporters under Article 3(i) sub-point (iii). That is, whether import and export is defined on the national level (intra-community trade), or whether it refers only to the trade with countries outside of EU (extra-community trade).

In the first case, being dubbed the '*National Approach*' to producer identification, in the absence of a manufacturer any legal actor that brings products onto the national market, either from countries within or outside of the EU, would be deemed the producer (CECED, 2004). Meanwhile, the Commission has argued that Article 3(i) sub-point (iii) refers to imports from outside EU and not intra-community trade. Under this so-called *'European Approach'*, once inside the internal market the terms importing and exporting are no longer applicable, and instead it is more appropriate to speak about intra-community trade.

Table 7-1 summarises the approaches taken in the EU 27 Member States, as found in the legal text available in English. As found in the table, most MS have defined import/export on the national level. In most cases MS have merely replaced the text "Member State" with their own country name, effectively obligating the first importer of EEE products into the national state as the producer in the absence of a manufacturer. Commission Services, on the other hand, has communicated their interpretation – European Approach – to Member States on a number of occasions.[39]

Table 7-1: Interpretation of Importers and Exporters - Definition of Producers in the Legal Text of Member States[40]

Member State	Legal clause defining Producer	Approach
Austria	13(1) of Waste Management Act	National
Belgium (Brussels)	1(3)	National
Belgium (Flanders)	Part 1 Def.	National
Bulgaria	No definition found in legal text	-
Cyprus	2(1)	National
Czech R.	37g (e)	National
Denmark	9i(2) Act no. 385 of 25 May 2005	National
Estonia	1(5), Government Regulation 376-2004	National
Finland	3(9), Government Decree 852/2004	European
France	3(1)	National
Germany	3(11)	National
Greece	3(15)	Ambiguous[41]

39 PRODI(2004)A/4700. Letter to Mr. Lugi Meli, Director General CECED from Mr. Romano Prodi, President of the European Commission. 26 07 2004.

40 The articles, sections and numbers referred to in this table are from the national legislation listed in Appendix B. When more than two legal texts are analysed, the relevant law is specified.

41 With respect to importers and exporters in the definition of producer, The Greek legal text simply states "imports or exports electrical and electronic equipment on a

Member State	Legal clause defining Producer	Approach
Hungary	2(d-f)	Ambiguous[42]
Ireland	3(3)	National
Italy	3(1)m	National
Latvia	20^2 (1), Waste Management Act	National
Lithuania	2(18), (19), (32) Law on Waste Management	National
Luxembourg	3(i)	National
Malta	3(1)	National
Netherlands	1 Section 1(j)	National
Poland	3(13)	National
Portugal	3(d)	National
Romania	3(i)	National
Slovakia	54a (10)	National
Slovenia	3(20)	National
Spain	2(c)	European
Sweden	3	National
UK	2(1)	European

Although in Finland, Spain and the UK, the producer definition with respect to importers and exporters is in line with the European Approach, firms registered in other EU countries are not able to register directly to the national register in Finland, effectively putting onus on Finnish importers to register as the obligated producer, in the absence of a local manufacturer or brand owner.

7.2.2 Stakeholder Views

Industry Associations EICTA, AEA and JBCE note that there is considerable uncertainty caused by the implementation of the WEEE

professional basis" without stating whether this is on to the national or European market.

42 Definition of import and export used in Hungary seems to support European approach, however all provisions on producer responsibility refer to manufacturers (definition of manufacturer includes distributors and does not refer to importers and exporters). Import & export is defined as follows. Import: electric equipment is transported on the area of Republic of Hungary for commercial purpose through the customs border of the European Community; Export: electric equipment is transported out for commercial or other purpose through the customs border of the European Community.

Directive in national legislation and the obligations on a producer to register. Most concerns expressed in the paper centre around the impact of Member States not allowing a company willing to take on the producer obligations to register without having a legal presence. They point out that this creates problems for larger companies and more importantly for SMEs that wish to fulfil the legal obligations for their distributors in countries where they have no legal presence. For SMEs it may be particularly costly to set up legal entities in the Member States where they sell their products. In addition, if the local producer (the SME's customer) would register, the costs can be largely disproportional to the turnover or profit.

The group calls for any producer legally established within the EU to be able to register at all national producer registers. They call on the Commission to investigate on which legal basis certain Member States allow companies from abroad to fulfil the producer obligations in their national territory. They do not necessarily call for a change to the producer definition.

CECED, in its 'red flag' initiative, mentioned that there are two key problems with the definition:

> *The word producer is not specific enough to designate the responsibilities and obligations given by the directive to the concerned economic operators and;*
>
> *The definition does not exclude multiple producers for one and the same product.*

CECED pointed out quite early, before MS had transposed the Directive, the potential problems that might arise when the national definition of producer is applied in Member States and called on the Commission to provide clarification on the issue. In its 2004 Q&A on why CECED is raising a red flag, the Association's vision on who the legally responsible party should be, is clarified as follows: "Whoever, after 13 August 2005, puts a product on the European single market, as manufacturer, importer into the European Community territory or reseller under own brand, is the legally responsible party." They claimed the national approach should apply for historical WEEE (CECED, 2004).

ELC (European Lamp Companies Federation) has proposed an alternative definition of producer which they believe would ensure that European producers have legal designation of producer in each Member State, as found below:

> *'Producer' means any person, established in the EU who, irrespective of the selling technique used, including by means of distance communication in accordance with Directive*

97/7/EC of the European Parliament and of the Council of 20 May 1997 on the protection of consumers in respect of distance contracts (1):

(i) Sells for the first time electrical and electronic equipment in the EU,

(ii) Resells under his own brand electrical and electronic equipment supplied by other manufacturers, a reseller not being regarded as the 'producer' if the brand of the producer appears on the equipment, as provided for in sub point (i), or

iii) Resells in the Member State, where it has an establishment, electrical and electronic equipment, upon acquisition from a producer, which has not fulfilled its legal obligations in the Member State where the reselling takes place.

iv) Buys for own use as a professional end user, electrical and electronic equipment, from a producer, which has not fulfilled its legal obligations, in the Member State where the electrical and electronic equipment is used, or from a supplier outside the EU.

ELC argues that the alternative definition would make it legally possible for European lamp producers to register and take responsibility for their products placed on the market in each MS. They claim that the definition also ensures that if a European producer does not exercise its responsibility in a MS, a national retailer or direct importer from another MS or outside of the EU would become legally responsible in his absence. This, in their view would encourage producers to fulfil their responsibility in each MS in order to avoid putting burden on their customers – i.e. retailers and direct importers.

7.3 Allocation of Responsibility for Collection of WEEE from Households

Separate collection of WEEE from the rest of the waste stream is a prerequisite for the improvement of WEEE management. The WEEE Directive distinguishes separate collection of WEEE from private households and those from non-households. Article 5 and Article 8(1) address the allocation of responsibility of collection of WEEE from households. These are presented below:

Article 5 Separate Collection

5(2). For WEEE from private households, Member States shall ensure that by the 13 August 2005:

(a) systems are set up allowing final holders and distributors to return such waste at least free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities, taking into account in particular the population density;

> *(b) when supplying a new product, distributors shall be responsible for ensuring that such waste can be returned to the distributor at least free of charge on a one-to-one basis as long as the equipment is of equivalent type and has fulfilled the same functions as the supplied equipment. Member States may depart from this provision provided they ensure that returning the WEEE is not thereby made more difficult for the final holder and provided that these systems remain free of charge for the final holder. Member States making use of this provision shall inform the Commission thereof;*
>
> *(c) without prejudice to the provisions of (a) and (b), producers are allowed to set up and operate individual and/or collective take-back systems for WEEE from private households provided that these are in line with the objectives of this Directive;*
>
> *(d) having regard to national and Community health and safety standards, WEEE that presents a health and safety risk to personnel because of contamination may be refused for return under (a) and (b). Member States shall make specific arrangements for such WEEE.*
>
> *Member States may provide for specific arrangements for the return of WEEE as under (a) and (b) if the equipment does not contain the essential components or if the equipment contains waste other than WEEE.*

5(5). Without prejudice to paragraph 1, Member States shall ensure that by 31 December 2006 at the latest a rate of separate collection of at least four kilograms on average per inhabitant per year of WEEE from private households is achieved.

Article 8(1) Financing in respect of WEEE from private households

8(1). Member States shall ensure that, by 13 August 2005, producers provide at least for the financing of the collection, treatment, recovery and environmentally sound disposal of WEEE from WEEE from private households deposited at collection facilities, set up under Article 5(2).

The provisions of the WEEE Directive quoted above provide some room for Member States to decide to organise collection from households in several ways.

Regarding *physical responsibility*, the Directive does not explicitly identify who should be responsible for setting up the infrastructure as stipulated in Article 5(2)(a). It puts the onus on distributors to accept WEEE from consumers on a one-to-one basis when selling new products, although a Member State can deviate from this requirement if it can show that an alternative procedure is just as convenient for consumers (Article 5(2) (b) (c)).

Concerning *financial responsibility*, Article 8(1) indicates that producers are financially responsible for "at least" the collection from collection points onwards, leaving room for extending the responsibility to producers to finance collection from households.

7.3.1 Transposition Outcome

Due to the ambiguity in the legal text over collection responsibilities, Member States take a variety of ways to allocate responsibility for collection from households. The diverse legal solutions taken by Member States are summarised in Table 7-2 below. If alternatives are given to actors that would relieve them from their responsibility, the actors concerned are not listed as obligated party. When *physical responsibility* is given to an actor and no other actor is explicitly mentioned as having *financial responsibility*, the party having physical responsibility is listed as having *financial responsibility*.

As found, the solutions taken in MS vary significantly. The ambiguity of the Directive text with respect to Article 8(1) wording of "at least", as well as the wording of Article 5, creates considerable leeway for MS to assign responsibility to actors already involved in the collection of WEEE from private households. Furthermore, the directive does not provide clear indication as to whether the *'distributors'* obligation to receive WEEE 1:1 is merely a physical responsibility, or whether they need to cover the cost associated with it. This also provides room for various solutions to emerge.

It should be noted that what respective national laws say do not necessarily correspond to what is happening in practice.

Table 7-2: Allocation of Collection Responsibilities (Physical and Financial) in EU 27

Member State	Physical Responsibility	Legal clause	Financial Responsibility	Legal clause
Austria	D/M/P	3(13), 5, 6	D/P	19
Belgium	D/M	3 (1)	D	3 (2)
Bulgaria	P	11	P	11
Cyprus	P	5.(2)a.	P	5.(2)a.
Czech R.	D/P	37k (1) (3)	D/P	37k (1) (3)
Denmark	M	6(1), 6(2), 6(3), 6(8), Statutory Order No. 664	M	
Estonia	D/P	26^2, 6(1), Government Regulation 376-2004	D/P	
Finland	D[43]/P	6(2), 18h(2) of Waste Act	P	6(2)
France	D/M/P	8.II. & 8.III	D/P	8.II. & 8.III
Germany	M	9(4)	M	9(4)
Greece	P	9(B)	P	9(B)
Hungary	P	3	P	3
Ireland	D/M	14, 15, 19	D//P	3(3), 14, 16
Italy	D/M	6	D/M	6
Latvia	P	20^4, Waste Management Act	P	
Lithuania	D/M/P	$34^{(2)}$, $34^{(4)}$, Law on Waste Management	P	$34^{(6)}$, Law on Waste Managemen t
Luxembour g	D/M	6	D/M	6
Malta	D/P	6(2)	D/P	6(2)
Netherlands	D/M	2, Section 3 & Section 4	D/M	2, Section 3 & Section 4
Poland	D	42(2)	D	Article 42(2)
Portugal	D/M/P	9(4)	D/P	9(5), 9(6), 23
Romania	M	5(1)	M	5(1)
Slovakia	D/P	54c (2), 54 b (1)(e)	D/P	54c(2). 54 b (1) (e)
Slovenia	D/M	7, 8	D/M	7, 8
Spain	D/M	4(2) & 4(3)	P	7(2)
Sweden	P	12 , 13, 16	P	15
UK	D/P	31	D/P	31

Abbreviations in table: D – distributor; M – municipality; P – Producer

43 In the Waste Act Section 18h(2) in Finland it is stated that sellers of EEE shall accept WEEE from private households if replaced by purchasing a similar product, or shall direct the purchaser to another reception point.

Municipalities have been concerned over the increased financial obligations placed on them as a result of the WEEE Directive. Reviewing implementation through a variety of sources mostly including industry contacts, presented in Table 7-3 below are cases found in which municipalities are requiring producers to pay for infrastructure or labour costs.[44]

Table 7-3: MS Where Producers Finance Collection Sites

MS	Municipal Site	Compensation	Financial Responsibility in Legal Text
Austria	Yes	€ 57/tonne	Distributor/Producer
Belgium (Flanders)	Model Proposed	€ 45/tonne 0.22 € per inhabitant	Not Reviewed
Finland	Yes	€50/tonne	Producer
France	Yes	*Standard* Fixed €1560 and variable €20-65/tonne Communication support €0.20/capita	Distributor/Producer
Portugal	Yes	€26/tonne	Distributor /Producer
Spain	Yes	€80/tonne	Producer

7.3.2 Stakeholder Views

Association of Cities and Regions for Recycling and sustainable Resource management (ACR+): "WEEE-PIN (Waste Electric and Electronic Equipment Public Interest Network) was created within ACR+ (Association of Cities and Regions for Recycling and sustainable Resource management) and

[44] To date, there is no comprehensive picture of how the allocation of costs to actors for the costs associated with operating municipal collection sites. There is however a planned study coordinated by the Association of Cities and Regions (ACR+) that is scheduled for mid-April to mid-May 2007, that will be investigating this topic through a questionnaire to municipalities in Europe. To date, 13 October 2008, the study results have not been published.

represents local and regional public authorities on WEEE issues at the European level" (ACR+, 2007).

"WEEE-PIN aims to involve local authorities in the revision process of the" WEEE Directive "and make their voices heard in the debates." The group claims "the local and regional authorities have lots of expertise in the collection and recycling of waste, but they are suffering today from an insufficient application of producer responsibility and from the confusing and inconsistent way the European WEEE Directive has been implemented throughout Europe" (ACR+, 2007).

Council of European Municipalities and Regions (CEMR): CEMR notes in its input into the information gathering exercise for the WEEE Directive review that in many Member States government and industry have relied on the knowledge and experience of local authorities when implementing the national WEEE laws (CEMR, 2006). This on the one hand has resulted in legislation and collection systems that in certain MS are quite favourable to municipalities. However, in other cases industry heavily relies on local authorities when they realise that setting up systems is expensive. When producers contract municipalities for their services this relationship can function quite well, they say. However, when responsibilities are not clearly defined in the legal text, the costs that according to the Directive should be borne by producers, end up with the local authorities. This, they say, is not acceptable as in accordance with Article 8(1) of the Directive, the producer financial responsibility encompasses the whole recycling chain of the concerned waste products, i.e. when the product is discarded by the consumer, which generally happens at the household (CEMR, 2006).

CECED: In its January 2004 FAQ on "Frequently asked questions about the household appliance industry's appraisal of Directive 2002/96/EC on WEEE", CECED clearly articulates its position on the allocation of responsibility for the collection of WEEE. CECED recognised that the likelihood of certain Member States assigning responsibility solely to producers remained high. CECED pointed out that if producers have to pay household collection, the impact on prices would be considerable.

According to CECED, to make producers finance the collection of waste equipment directly from private households would be objectionable on legal, environmental and economic grounds.

From a legal perspective, it is claimed that producers should not be required to pay for an activity that someone else is performing (public authorities) especially if they would have no control over the costs incurred by municipalities, who will in the majority of cases continue physically to collect WEEE.

Secondly, CECED notes that the main objective of introducing producer responsibility is to create an incentive for producers to reduce environmental impact of their products through better design. Making producers fund the collection of WEEE, they say, cannot yield any environmental benefit, since eco-design cannot impact the costs of collection.

Thirdly, they say that making producers responsible for collection risks penalising established market players, as municipalities will seek them out for financing rather than identifying all producers and demanding payment.

DG Environment: Although the final wording in the WEEE Directive text is ambiguous in terms of allocation of physical and financial responsibility for setting up and operating collection sites, the Commission has communicated that this responsibility rests with MS and the obligation for producers starts from collection points onwards. This explicit interpretation is found in the opening lines of Recital 20;

> *Whereas, producers should therefore finance collection from collection facilities onwards*

It is also found in the explanatory memorandum of the Commission's proposal for an amendment of the WEEE Directive regarding the financing of non household WEEE. Here, the Commission notes that:

> *The financing of collection, treatment, re-use, recovery and environmentally sound disposal of WEEE is to be provided by producers of electrical and electronic equipment.*

A footnote placed on collection further defines collection as:

> *The financing obligation of producers for the collection of equipment from private households only applies from the collection point onwards (Commission of the European Communities, 2003).*

7.4 Allocation of Responsibilities for Recycling of WEEE from Households

Allocation of responsibility for the management of WEEE from households in terms of collection and recycling reuse and recovery from collection points onwards has clearly been assigned to producers under the WEEE Directive.

Article 5(4), Article 6(1) and Article 8(1) combined, allocate responsibility for the collection, treatment, recovery, recycling and disposal of WEEE deposited at collection sites.

Article 5(4)

> *Member States shall ensure that all WEEE collected under paragraphs 1, 2 and 3 above is transported to treatment facilities authorised under Article 6 unless the appliances are reused as a whole. Member States shall ensure that the envisaged reuse does not lead to a circumvention of this Directive, in particular as regards Articles 6 and 7. The collection and transport of separately collected WEEE shall be carried out in a way which optimises reuse and recycling of those components or whole appliances capable of being reused or recycled.*

Article 6(1)

> *Member States shall ensure that producers or third parties acting on their behalf, in accordance with Community legislation, set up systems to provide for the treatment of WEEE using best available treatment, recovery and recycling techniques…*

Article 8 (1)

> *Member States shall ensure that, by 13 August 2005, producer provide at least for the financing of the collection, treatment, recovery and environmentally sound disposal of WEEE from private households deposited at collection facilities, set up under Article 5 (2).*

7.4.1 Transposition Outcome

With respect to financing treatment, recycling & recovery operations, not surprisingly, all MS have assigned *producers* the responsibility of setting up systems to provide for the treatment of WEEE using best available techniques.

Table 7-4: Allocation of Responsibility for Collection from Collection Points Onwards & Treatment, Reuse, Recycling and Recovery in the EU 27

Member State	Collection onwards (private households) Physical & Financial Responsibility	Legal clause
Austria	Producers	7
Belgium	Producers	3
Bulgaria	Producers	15
Cyprus	Producers	6.(1), 8
Czech R.	Producers/Operators	37l (1) (3)
Denmark	Producers	16, Statutory Order No. 664
Estonia	Producers	26(4), Waste Act 6(2), Regulation No. 376
Finland	Producers	7(1), Government Decree 852/2004
France	Producers	13
Germany	Producers	10(1)
Greece	Producers	
Hungary	Producers	3
Ireland	Producers	16, 19, 21, 22
Italy	Producers	7
Latvia	Producers	20[4], Waste Management Act
Lithuania	Producers	
Luxembourg	Producers	9
Malta	Producers	8
Netherlands	Producers	3, Section 8
Poland	Producers	27
Portugal	Producers	9(7), 12
Romania	Producers	5(12)
Slovakia	Producers	54e
Slovenia	Producers	10
Spain	Producers	6(2)
Sweden	Producers	12, 13, 15, 16
UK	Producers	8(1)

7.5 Financial Mechanism: Principle of IPR

7.5.1 WEEE from Households

In terms of allocation of financial responsibility for WEEE from households, Article 8(2) and 8(3) of the WEEE Directive distinguishes between historical and new WEEE, as follows.

Article 8(2): New WEEE

> *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.*

Article 8(3)

> *(3) The responsibility for financing of the costs of the management of WEEE from products put on the market before the date referred to in paragraph 1 [13 August 2005] (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.*

7.5.2 Transposition Outcome

In this section an analysis is presented of how Member States have, within their national legal texts, set forth the financial mechanisms to be applied for historical and new WEEE respectively. The results of this legal text analysis are found in Table 7-5 below. Specific articles that address the financing of WEEE from private households in each MS legal text are denoted. If specific reference is made to financing of WEEE from products placed on the market after 13 August 2005 (new WEEE), this is noted and followed by a more detailed description. Likewise for historical WEEE we note the specific article addressing financing obligations followed by a more detailed description.

Table 7-5: Transposition of Financing Mechanism for WEEE from Private Households in the EU 27

Member State	Financing of WEEE from private households Legal clause	Financing of WEEE put on the market after 13 August 2005 (New WEEE) Legal clause	Content	Financing of WEEE put on the market before 13 August 2005 (Historic WEEE) Legal clause	Content
Austria	7	7(3)	Choice of financing individual or collective	7(2)	Proportion based on current market share
Belgium (Brussels)	35	35(1)	Finance waste from own products	35(1)	Proportion based on current market share
Belgium (Flanders)		3.5.1A.(1)	Finance waste from own products	3.5.1A.(2)	Proportion based on current market share
Bulgaria	11	11 (4), 11 (5)1.	Proportion based on current market share	11(4),11(5)2.	Proportion based on current market share
Cyprus	8	8(2)	Finance waste from own products	8(5)	Proportion based on current market share
Czech R.	37n	37n(1)	Finance waste from own products	37n(3)	Proportion based on current market share
Denmark	16 (1), Statutory Order No. 664	/	Proportion based on current market share	/	Proportion based on current market share
Estonia	26 ,Waste Act	26 (1), (4)	Finance waste from own products	26 (5)	Finance waste from own products
Finland	18a(1) & 18c(2), Waste Act, 6, Gov. Decree 852/2004	/	His own as well as proportion to the market share	/	His own as well as proportion to the market share
France	13	/	Proportion based on current market share	/	Proportion based on current market share
Germany	14	14(5) 1. or 2.	Choice of financing individually or collectively	14(5)	Proportion based on current market share
Greece	10A, Decree 15 amending Presidential Degree No. 117.	/	Producer responsible, but no specific financing mechanisms	/	Producers responsible, but no specific financing mechanisms
Hungary	15	15(1)a	Defines new WEEE but no financial mechanism	definition 2.c) & 3(1)15	Responsibility defined but not financial mechanism
Ireland	16	16(1)(a), 30 (a)	Finance waste from own products, but exemption from responsibility if members of approved bodies	16(1)(b) 30 (a)	Proportion based on current market share, but exemption from responsibility if members of approved bodies

Member State	Financing of WEEE from private households Legal clause	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)	
		Legal clause	Content	Legal clause	Content
Italy	10. & 11.	11(1)	Producers responsible but no mention of "own"	definition 3(q) & 10.(1)	Proportion based on current market share
Latvia	21, Waste Management Act	/	Producers of waste are responsible	/	Producers of waste are responsible
Lithuania	34^6, Law of Waste Management	34^6 1(2)	Producers responsible but no mention of "own"	$34^6$1(1)	Proportion based on current market share
Luxembourg	9	9(2)	Finance waste from own products	9(3)	Proportion based on current market share
Malta	9	9.(1)(b)	Finance waste from own products	9.(1)(f)	Proportionate, market share as example
Netherlands	5 Sec. 11	5. Sec 11(1)	Finance waste from own products	5. Sec. 11(2)	Proportion based on current market share
Poland	27, 28, 57	27, 28(1)(1), 57	Collection of own products mandated. No specific financing mechanisms. Responsibility could be delegated to collective systems.	27, 28(1)(2), 57	Collection mandated based on market share. No specific financing mechanisms. Responsibility could be delegated to collective systems.
Portugal		/	Not mentioned	9(8)	Proportion based on current market share
Romania	8	8(2)	Finance waste from own products	8(5)	Proportionate, market share as example
Slovakia	54e	54e(1)	Finance waste from own products	54e(2)	Proportion based on current market share
Slovenia	13	/	Proportion based on market share.	/	Proportion based on market share
Spain	7	/	Producers responsible but no mention of own products	second additional provision 1.(a)	Proportional based in market share
Sweden	12, 13	12	Defines new WEEE , but no explicit individual financial responsibility	13	Proportion based on market share
UK	3. 8.	/	Proportion based on current market share	/	Proportion based on current market share

7.5.3 IPR Interpretation in Member States

Given the way MS have chosen to formulate Article 8(2) of the WEEE Directive, according the author, there are three main patterns of interpretation that have emerged with respect to the allocation of financial responsibility in the EU 27.

Pattern 1: IPR Transposed in Accordance to Article 8

In the countries listed below the legal text clearly distinguishes that producers are required to finance the waste from their *own* products placed on the market after 13 August 2005.

Table 7-6: Member States Transposing IPR for New WEEE

Member State	Transposition Outcome Regarding IPR
Belgium (Brussels and Flanders) Cyprus Czech Republic Estonia Luxembourg Malta Netherlands Romania Slovakia	These Member States transpose an explicit individual financial responsibility for new WEEE and allocate collective financial responsibility for historical WEEE[45]

Pattern 2: Ambiguous or inexplicit interpretation of IPR

The following countries, in the opinion of the author, have not formulated their legal text in such a way that an explicit individual financial responsibility is assigned. That is, in many cases each producer's responsibility for products placed on the market after 13 August 2005 are mentioned in the plural form which makes for an ambiguous interpretation that producers in general are responsible for financing waste from their products.

Other variations are found of Article 8(2), such as in the case of Germany and Austria, where producers are given the choice to decide whether or not they are individually or collectively financially responsible for products placed on the market after 13 August 2006. Additionally, in the case of

45 In the Estonian Waste Act, producers are responsible for the management of WEEE from their own products even if it is historical WEEE.

Ireland, producers that are members of an "approved body" are exempt from Article 16 on financing WEEE from private households which clearly assigns an individual financial responsibility for new WEEE.

Table 7-7: Member States with an Ambiguous Interpretation of IPR for New WEEE

Member State	Transposition Outcome Regarding IPR
Austria	Producers may choose individual or collective financing for future WEEE
	7(3)1. if individual, must sort out their own products at all collection sites
	7(3)2. if collective, allocation by market-share mandated
Belgium (Walloon)	Article 18 only mentions that "The financing of the costs originating from products put on the market after 13 August 2005 is provided by the manufacturers."
Germany	Producers may choose individual or collective historic financing for new WEEE
	(Article 14 [5])
Hungary	Mentions manufacturers bear responsibility for products manufactured "by him" but only defines responsibilities for historic waste (Article 15 [1] [a]).
Ireland	New WEEE producers are responsible for their own products, however explicit exemption from this requirement if a member of an approved body (Article 30(a)).
Italy	Article 11(1) Producers are responsible to manage new WEEE, but no explicit mention of their own WEEE
Lithuania	Article 34[6] 1(2) Producers are responsible but no explicit mention of own
Poland	Makes collective schemes responsible for future waste rather than producers
	(once producers are members of a collective scheme) (Article 62).
Portugal	Individual for new WEEE only mentioned in preamble and not in main body of the legal text
Spain	Individual for new WEEE only mentioned in preamble and not in main body of the legal text
Sweden	Producers are responsible to manage new WEEE, but no explicit mention of their own WEEE

Pattern 3: IPR ignored

In Table 7-8 MS are listed that have simply ignored Article 8(2). In many of the MS listed, allocation of financial responsibility for new WEEE is to be calculated by market-share when costs are incurred, as in the historical WEEE financing mechanism definition found in Article 8(3).

Table 7-8: MS Where IPR for New WEEE is Ignored

Member State	Transposition Outcome Regarding IPR
Bulgaria	Art. 11(4) mandates producers to collect a relative share of the required kg/ inhabitant/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
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

7.5.4 Stakeholder Views

On March 2, 2007 a group of 34 companies, associations and environmental NGOs released a Joint Industry/NGO Statement on Producer Responsibility for WEEE (Joint Statement, 2007). In essence, the group stressed its concern that the present transposition of the WEEE Directive in MS will not achieve the Directive's primary goal to reduce waste.

The group specifically acknowledges and supports the main objective of introducing producer responsibility in the WEEE Directive, namely to create incentives for producers to proactively improve the design of their products. The statement is quite clear in pointing out that the WEEE Directive obliges producers to bear financial responsibility for the end-of-life management of their own products put on the market after 13 August 2005. It further points out that Article 8(2) is the instrument chosen by the

EU institutions to achieve the objectives of the WEEE Directive and the signatories are in full support of its formulation.

Compared to the findings in Table 7-5, the signatories come to a similar conclusion on the outcome of transposition by Member States with respect to the interpretation of financing obligations for WEEE from private households. The group claims that 12 Member States have transposed Article 8(2) as intended in the WEEE Directive, while 11 seem to have ignored the provision for Individual Producer Responsibility for new WEEE.

In the 2007 statement the group claims that "individual producer responsibility encourages competition between companies on how to manage the end-of-life phase of their products" and that "this in turn drives innovation, such as in business models, take-back logistics and design changes, to reduce the environmental impact of products at the end of their life" (Joint Statement, 2007).

The group stresses that the "EC Treaty obliges each Member State to implement the WEEE Directive in such a way as to give full effect, in legislation and in practice, to the wording, object and purpose of the WEEE Directive and not to put in place any measure that would jeopardise the attainment of the Directive's objectives" (Joint Statement, 2007). Finally, the group urges the EU institutions and the Member States to ensure that individual producer responsibility of article 8(2) is correctly transposed and implemented in national legislation.

European Information and Communication Technologies Association (EICTA) , American Electronics Alliance (AeA), and the Japan Business Council in Europe (JBCE) have made specific reference to the issue of IPR in their joint submission to the Information Gathering Exercise for review of the WEEE Directive, dated 11 August 2006 (EICTA et al., 2006). In terms of Article 8, the three organisations are of the opinion that producers are responsible to meet the costs of recycling their own products.

The group called for the European Commission and the Member States to ensure that the freedom of choice between individual compliance and collective compliance is properly implemented in National WEEE legislation. They claimed that there is an opportunity to strengthen the freedom of choice for IPR (individual producer responsibility), during the review process. The three organisations stress it should be mandatory for

Member States to give producers the option to choose between IPR and collective solutions based on their product portfolio and business models used. Meanwhile, they point to the fact that producers can choose to fulfil this obligation either individually (which they call IPR) or by joining a collective scheme.

The group point out that a first step towards IPR would be to allow the possibility for producers to collect products of an equivalent type as sold by the producer, directly from end-users. They claim it should be possible to deduct these volumes from the obligations that the companies have towards the collective compliance system. In fact, Austria has included such a measure in its WEEE transposition (Article 17) and in Sweden, within the collective compliance scheme El-Kretsen, ICT producers can deduct any WEEE collected by themselves from their obligations in that scheme.

During the development of the WEEE Directive, the same group of industry associations made a clearer statement on its support for individual producer responsibility, in line with the Article 8(2) of the WEEE Directive. It was in reference to the Parliament amendment to the Common Position of the Council with respect to the Council's view that any future orphans be paid by remaining producers on the market. The group clearly articulated the principle behind Article 8(2), as follows:

> *We support Parliament's Amendment 93 to Article 7 on the understanding that the reference to "financing" being provided "on an individual basis" refers to the producer's financial or legal responsibility, and not to how he discharges that responsibility. In other words, we support the principle of ALL producers being legally liable for financing the end-of-life treatment and disposal costs of their own products (and ONLY their own products). They must, however, remain free to set up whatever types of recycling systems they so choose. The distinction between financial responsibility (individual) and the execution of that practical responsibility (which can be done either via individual or collective recycling schemes) must be clear to all parties…(EICTA et al., 2001).*

On the issue of implementing individual financial responsibility, the *WEEE Forum*[46] concludes that IPR is a feasible strategy for the future of collective organisations.

> *As amounts of historic waste steadily decline, and when all consumer waste put on the market has financial guarantees, it will be reasonable for producers to make calculations on the actual return share of their branded products. As the actual return share may be less than present market share, due to longevity or market saturation of the products, it would be more equitable to divide costs via return share. This may be done reasonably first through statistical sampling, then through the use of Radio Frequency Identification technologies to recognize specific, manufacturer product models.*[47]

Electrolux, probably one of the most active companies that have been promoting the importance of IPR has provided input into the information gathering exercise for the revision of the WEEE Directive. The company notes that IPR, as stated in the WEEE Directive: "needs to be consistently transposed into national legislation" and that "less than half of the countries have properly transposed this provision" (Electrolux, 2006).

Electrolux points out that the principle that the producer should be responsible for the recycling of his own products (sold after 13 August 2005) is one of the main objectives of the WEEE Directive and is essential to provide the producer with an incentive to design and produce product that are easier to recycle.

While many opponents to IPR (IPR in the legal sense of the meaning) in the WEEE Directive have maintained that IPR as worded in the Directive provides an obligated producer the choice of whether his/her responsibilities are individual or collective, there is increasing evidence to suggest that this view is not legally accurate. This has become clear in the discourse between the *EU Parliament and DG Environment.*

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46 WEEE Forum is a not-for-profit association of more than 40 open collection and recovery systems in Europe. It was founded in April 2002 preceding the entry into force of Directive 2002/96/EC on WEEE in February 2003. The aim of the WEEE Forum is to provide a platform for these producer responsibility organisations, or take-back systems, to foster ideas and share best practices while optimising environmental performance through a proper management of electrical and electronic waste. http://www.weee-forum.org.

47 WEEE Forum. (2008). *About collective take-back systems.* [On-line]. Available: http://www.weee-forum.org/index.php?section=collective&page=collective_about. [23 January 2008].

Parliamentary Question to the Commission regarding 8(2): Member States failure [to]correctly transpose the WEEE Directive

On 5 October 2007 Chris Davies, MEP submitted a written question to the Commission regarding clarification of how MS had transposed the WEEE Directive on the particular issue of Article 8(2).[48] This was a follow-up question to an earlier question submitted to the Commission which was answered by Commissioner Dimas. The question was as follows:

> *Further to my Question E 3049/07 of 19 June 2007, and to the answer given by Commissioner Dimas on 24 August 2007, will the Commission confirm that, as Article 8(2) of the WEEE Directive 2002/96/EC(1) states, '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' — it is essential that in transposing the legislation Member States accept the importance of the words 'each' and 'his own'?*
>
> *Does the Commission accept that a formulation that does not include these words, or specifically embrace the concept to which they refer, would not represent a correct application of the concept of individual producer responsibility as addressed in Article 8(2)?*
>
> *Will the Commission confirm that a number of Member States (including Bulgaria, Denmark, Finland, France, Greece, Latvia, Portugal, Slovenia, Spain and the UK) have not included these key words in their national law?*
>
> *What action does the Commission intend to take to ensure that the principle of individual producer responsibility is properly addressed by every Member State?*

On 9 November 2007 Commissioner Dimas provided the following answer on behalf of the European Commission.[49]

> *Article 8(2) of Directive 2002/96/EC of the Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) provides that: '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*

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48 Parliamentary questions 5 October 2007. P-4971/07 WRITTEN QUESTION by Chris Davies (ALDE) to the Commission: Available: [online] http://www.europarl.europa.eu/sides/getDoc.do?type=WQ&reference=P-2007-4971&language=EN

49 Parliamentary questions 9 November 2007. P-4971/2007 Answer given by Mr Dimas on behalf of the Commission. Available: [online] http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=P-2007-4971&language=EN

> *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.'*
>
> *When transposing these provisions, Member States are not requested to implement each word of Article 8(2) but are requested to give full effect of the objective of financial responsibility of each producer for its own products. Transposition has to ensure the optional possibility of setting-up collective schemes. The provision of a financial guarantee is also covered by the second paragraph of Article 8(2).*
>
> *The Commission is currently investigating the conformity of transposition of the directive and can confirm that, for some Member States, the provisions of this article have not been implemented in a way ensuring that a direct link is maintained between production of products generating WEEE and financial contribution of producers. In particular, some Member States seem to calculate the financing of WEEE of products put on the market after 13 August 2005 exclusively on the basis of market shares, a system which would, a priori, not be in compliance with the directive. However, the Commission cannot give at this stage a list of Member States which, in its view, would have incorrectly transposed Article 8(2) of the WEEE Directive since additional investigations are needed.*
>
> *After these complementary verifications, the Commission will, if necessary, start infringement proceedings covering this point in the coming months.*

From the above answer it is clear that an explicit allocation of financial responsibility based on market share for products put on the market after 13 August 2005 is not in compliance with the intent of the Directive. However, in the above response from Commissioner Dimas there is no indication provided that the Commission is of the opinion that MS which have an ambiguous interpretation of Article 8(2) as defined in Section 7.5.3 above, have transposed the financing mechanism incorrectly.

Despite this uncertainty, in an infringement letter sent to Sweden regarding its transposition of the Directive, more evidence is provided regarding the Commission's interpretation of Article 8(2). In the assessment made in Section 7.5.3, Sweden was determined to have an ambiguous transposition of Article 8(2). This interpretation was corroborated by Commission Services, when it pointed out to the government of Sweden that its transposition of Article 8(2) was not sufficient to meet the legal intent.

> *Finally it is not clear if the obligation is applicable to producers own products (von Kempis, K, 2008).*

7.6 Financial Guarantee: WEEE from Households

As the WEEE Directive stipulates individual financial responsibility for new WEEE, producers are required to finance the costs of waste management of their own products. As discussed in the previous section, although producers can choose to fulfil their obligations collectively, they can never be mandated to finance the cost of other producer's WEEE. Since it cannot be assumed that all producers that are on the market today will remain active on the market when their products are collected as WEEE, a financial guarantee is required so that these costs will not fall on society or other producers.

Article 8(2) lays down the requirement for a financial guarantee

> *Article 8 (2) Second paragraph: 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.*

Three alternatives for financial guarantees are mentioned in the text; (1) participation of the producer in appropriate schemes for the financing of the management of WEEE, (2) a recycling insurance, and (3) blocked bank account.

7.6.1 Transposition Outcome

In this section the transposition outcome for the requirement of financial guarantees is presented in two ways. Presented first, Table 7-9 summarises the manner in which the Member States have transposed the requirements related to the financial guarantee in their national legislation. When the text 'as WEEE Directive' is denoted, the transposition is the same as what is found in WEEE Directive as verbatim. Where there are variances to the WEEE Directive text these are noted in the table. This is followed is by an assessment of what MS are applying in practice in Table 7-10.

Table 7-9: Transposition Outcome of Requirement for a Financial Guarantee in 8(2)

Member State	Legal Clause	Requirement for a Financial Guarantee
Austria	8	Producers in collective schemes are legally exempt from guarantee requirements 8(1)1. Producers with individual guarantees must sort products by brand during collection.
Belgium (Brussels)	10(1)	Guarantee required for both individual scheme and collective scheme but only needed for 6 months contingency (must be paid to Region)
Belgium (Flanders)	3.5.1A. (1)	As WEEE Directive
Belgium (Walloon)	Not reviewed	Not reviewed
Bulgaria	Not mentioned	-
Cyprus	8(3)	As WEEE Directive
Czech R.	37n(2)	Producers in collective financing schemes are legally exempt from guarantee requirements
Denmark[50]	12(6)	Producers are legally exempted from guarantee requirements if collective scheme has more than 10 producer members, or 30% share of WEEE market or any WEEE category.
Estonia	26 of Waste Act	As WEEE Directive
Finland[51]	18m(2)	As WEEE Directive
France	16	Guarantees needed for both individual and collective compliance but only for current year of obligation
Germany	6(3) &14(5)	As WEEE Directive, Guarantee in collective systems can be based on reciprocity 14 (5)
Greece	7. C. (1). a1. 7. C.(2). a1.	Guarantee: Annex VI, A & B - Mentions only the need to describe guarantee as mentioned in 7 C (1) a1: Individual alternative management systems – approval requires proof of necessary economic infrastructure and 7. C. (2) a1.: same as above for collective alternative management systems
Hungary	16	16 (7): Producers in collective financing schemes are legally exempt from guarantee requirements
Ireland	16(2)	Individual guarantees must secure future financing whereas collective guarantees must only assure sufficient 'contingency reserve' against current costs.
Italy	11(2)	As WEEE Directive
Latvia		20.6 of Waste Management Act requires producers that place EEE on the market after 13 August 2005 that have not fulfilled the obligations to collect and manage WEEE provide a guarantee with a bank guarantee or civil liability insurance.
Lithuania	3, Rule 2006, Nr.61	Five options are provided, including the membership in a licensed organisation.
Luxembourg	9(2)	As WEEE Directive
Malta	9.(1) (c)	As WEEE Directive
Netherlands	5. Section 11. (4.)	II. Notes on individual sections: Guidelines say producers may choose collective historic financing for future waste when selecting guarantees. (section 11)

50 Statutory Order No. 664 of 27 June 2005 on the management of waste electrical and electronic equipment (the WEEE Order).

51 Waste Act (1072/1993) amendments up to 1063/2004 included.

Member State	Legal Clause	Requirement for a Financial Guarantee
Poland	3, 18	Guarantee is limited to costs of current year and not future waste costs 18(1). (1).
Portugal	25 (3)	Producers with individual system must provide guarantees for each product sold, whereas collective systems must agree fee structures with the relevant ministry.
Romania	8(3)	As WEEE Directive
Slovakia	54h(1)	Producers with individual system must provide guarantees for each product sold, whereas no requirements are set of guarantees from collective systems.
Slovenia	17	17(8): Producers in approved scheme do not need to provide guarantee. Individual guarantee is limited to 1 year operational costs, refundable at the end of each year.
Spain	7(5)	Producers with individual system must provide guarantees for each product sold, whereas producers in collective system must not.
Sweden	18	Interpretation of what is a suitable financial guarantee in (NFS 2007:6)..
UK	None	Schedule 3: regulation 6. new 28A (2)
	but see,	Mandates each scheme to submit a report by 31 Dec 2007
	Schedule 3: reg. 6 , new 28A (2) b(ii)	b(i) how members will finance their own future WEEE b(ii) how scheme provide a guarantee for future WEEE

Table 7-10: Member States Requirements for Financial Guarantee in Practice

Member State	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
Austria	•		
Belgium	•[52]		
Bulgaria			•
Cyprus			•[53]
Czech R.	•		
Denmark	•[54]		
Estonia	•		
Finland	•		
France	•		
Germany		•[55]	

52 Belgium: Collective scheme guarantee needs governmental approval.

53 Cyprus: Although required, little evidence to suggest proof of guarantee is being offered.

54 Denmark: Collective scheme guarantee not needed if it has at least 10 members, or 30% of market share in the relevant WEEE categories, or if they satisfy more detailed Environment Agency requirements.

55 Germany: For producers who choose PAYG for new WEEE, there are available on the market collective guarantee solutions based on reciprocity.

Member State	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
Greece	•		
Hungary	•		•
Ireland	•[56]		
Italy	•		
Latvia			•
Lithuania	•		
Luxembourg	•		
Malta	•		
Netherlands	•		
Poland	•		
Portugal	•		
Romania			•
Slovakia			•[57]
Slovenia	•		
Spain	•		
Sweden		•	
UK	•		

As seen, most Member States have interpreted membership in a collective compliance scheme to be an appropriate guarantee for new WEEE obligations. At the same time, producers that wish to comply individually must either have a blocked bank account or recycling insurance to satisfy the guarantee requirement. It is only in Germany and Sweden where a financial guarantee is required by all compliers. However in Germany the guarantee can be based on a collective guarantee, meaning that producers will be responsible for other producers' products in the event that one member exits the market.

56 Ireland's legislation does require a contingency reserve for compliance schemes.

57 Producers are required to pay into the Recycling Fund, if not complying through individual or collective systems.

7.6.2 Financial Guarantee in Sweden

As Sweden is only one of two MS in the EU 27 requiring a financial guarantee from all producers regardless if they are a member in a collective compliance scheme or not, a review of the structure of the requirement provides an interesting example.

Section 18 of Ordinance 2005:209 lays down the general requirement for a financial guarantee for products placed on the market after 13 August 2005 without specifying in detail what each option should consist of.

> *Section 18*
>
> *A producer who sells electrical and electronic products in Sweden or at a distance to another Member State of the European Union shall ensure through a financing system, insurance arrangements, blocked accounts or in some other appropriate means that financing is available for the fulfilment of the producer's obligation to deal with products under Section 12 read together with Section 16 even if the producer terminates his operations or fails to carry through on fulfilment for some other reason. Action to ensure fulfilment shall be regarded as appropriate if it is likely, in view of the expected use and service life of the product sold and other circumstances, that the obligations will be fulfilled or that the person who fulfils the producer's obligation can obtain compensation for the costs that fulfilment will entail.*

In order to further elaborate what the Swedish Environmental Protection Agency considers to be a suitable financial guarantee, the Agency had commissioned an independent study which explored possible options that would meet the criteria laid out in Section 18.

The outcome of the study was used to develop a proposal for general guidelines that were circulated for comments until 20 June 2007. The Swedish EPA published a final version of the guidance document on October 15th, 2007, titled "The Swedish Environmental Protection Agency's regulations concerning financial guarantees as required by Section 18 of the Ordinance (2005:209) on Producer Responsibility for Electrical and Electronic Products, NFS 2007:6".

NFS 2007:6 Guidance Document

Within the guidance document, the EPA points out that the level of the guarantee should include a total amount that corresponds to the total cost for managing a product at its end-of-life. This cost can be partially reduced by the material value of the product. The calculation of the end-of-life costs and the product's expected life length should be accessible to authorities on demand. If a producer is responsible for more than one type of product, information should be provided for each WEEE category that it places on the market. In the calculation of the guarantee it should be evident if products within a category have different life lengths and different end-of-life costs. The guarantee should be valid for the entire expected life length of the product (Naturvårdverket, 2007).

Type of Guarantee

The proposal suggests that the following types of guarantees from banks or insurance companies conducting business according to Swedish law should be acceptable if all of the requirements mentioned above as well as those in Section 18 are fulfilled. These are:

- A *recycling insurance* that guarantees that the party conducting the end-of-life management of the insured products, or corresponding similar products, will have enough compensation for the dismantling activities;
- A *bank guarantee* in Swedish currency that is adjustable yearly to correspond to the total amount of products that needs to be guaranteed. The guarantee should be accessible to the authorities in the event that the producer is insolvent, has exited the Swedish market, or for some other reason the producer does not meet his obligations;
- A *blocked bank account* in Swedish currency which is held in reserve for the benefit of supervisory body which can only be used with the permission of the authorities.
- Further to the forms of guarantee listed above, *a collective financing system* should be considered appropriate if producers can demonstrate that the guarantee meets the monetary and time requirements mentioned in the general guideline. These monetary and time risks should be considered guaranteed if:
    - The financing system ensures that sufficiently available funds exist and that the system's members have no control over how the funds can be used. The system, in relation to its members, accepts not to use the funds for purposes other than what is stated in the ordinance or the guidelines (Option A);

  Or

    - The system's members explicitly agree to take care of each others waste from household products if the need should arise and that the system is suitably stable to guarantee that members WEEE will be managed (Option B).

If a collective financing system with an explicit recycling agreement where members secure each others obligations contractually (Option B), the total reciprocal guarantee should be greater than the members total cost for managing WEEE calculated according to these guidelines. Up to 150% of the calculated costs should be suitable to fulfil this reciprocal agreement.

The proposal for a guidance document notes that a collective financing system (Option B) should be considered suitably stable if:

- The system's members are suitably creditworthy in relation to members total guarantee;
- The system has a suitable number of members and is not financially dependent on a few members;
- The system has funded means to such an extent that it covers the management of such waste as is referred to in Section 18 until the producers shall next report on how the guarantee requirement is observed, i.e. during a period of one year.

According to the Swedish EPA, regardless of how the collective financing system guarantees its members' undertakings, the nature of the guarantee should be reflected in the contract between the financing system and the members. A copy of the agreement should be shown at the authority's request.

7.6.2.1 Market Solutions for Financial Guarantees in Sweden

In Sweden, as of July 2008, there are 4 major guarantee solutions proposed by producers or available on the market. Elektronikåtervinningföreningen (EÅF), Länsförsäkringar Insurance Solution (LF), El-Kretsen's Bank Guarantee through Nordic Guarantee and the Vitvaror Återvinning i Sverige AB (White Goods Recycling in Sweden Limited). Although the Swedish EPA does not intend to formally approve these solutions, it has reserved the right to continue inquiries in order to ensure that these solutions meet the demands of the regulation.

A notable distinction between the types of guarantees listed above, can be made between whether or not there are actual funds accrued within the guarantee solution itself. For example, in both the insurance and the blocked bank account options, producers are providing upfront premiums or providing funds at the time products are placed on the market to cover the future costs at end-of-life.

With a bank guarantee option, there are usually no funds put up front by the producer to cover the future costs of managing products. However, producers may use funds as collateral against the risk of insolvency to lower annual fees of the guarantee. In this case the bank or sometimes insurance company guarantees that the funds will be available in the event that a producer or group of producers become insolvent, but funds are usually not accrued in this model.

Therefore, according to accounting rules the choice of guarantee could have an impact on whether or not producers need to include provisions in their balance sheets for future costs of new WEEE. A recycling insurance (based on the model where funds are accrued within the system) as well as a blocked bank account would imply that there is no further need to accrue, since provisions to manage products placed on the market after August 13, 2005 when they become waste have been made upfront when these products are placed on the market. While with a bank guarantee, covering only the risk of insolvency, the producer would need to accrue for these future costs and reflect these future costs in its balance sheet.

Each of these guarantee solutions are described below based on preliminary information provided by the respective representatives of these guarantee solutions. A further confirmation of the author's interpretation of this information is required to ensure that the description accurately reflects how each guarantee is structured.

Elektronikåtervinningsföreningen (Swedish Association of Recycling Electronic Products)

Since April 2007 a newly established system for WEEE recycling insurance has appeared on the Swedish market, called Elektronikåtervinningsföreningen (Swedish Association of Recycling Electronic Products). The Association is owned by its members (currently Siba, Netlogic, Order, ON/OFF, and now El Giganten, which are retailers having producer status in Sweden as first importers). It is open for all companies, designated as producers according to the ordinance implementing the WEEE Directive in Sweden.

The system builds on the fact that several EEE retailers are today offering various insurance solutions for the products they sell. Such insurance offers have been a way to prolong the manufacturer warranties. These retailers have established their own insurance companies in order to efficiently deal with a high number of low-value, and thus low-premium, insurances. They manage to operate such insurance solutions by benefiting from computerised systems and minimising the number of people involved. The Association makes use of these insurance systems to minimise administrative costs. *Additionally, the member companies will, because of the ownership structure, be able to regain future savings, emanating for instance from improved design solutions or lower treatment costs.* The financial guarantee will ensure the coverage of future recycling cost for 15 years (universally to all the products). The association uses an insurance company to guarantee that the funds will be available for the entire life cycle of the product.

What is offered by the Association is not only limited to the financial guarantee requirement, but also to the management and financing of take back and recycling. The Association charges its members a separate fee for the management of historic WEEE and for the future end-of-life management costs for new WEEE. Table 7-11 below suggests the indicative price for four products that the system manages (prices have since been lowered to reflect developments in metal prices). With low administrative costs and good capital management, the Association promises to supply financial guarantees at attractive prices to its members. They claim that the level of combined cost for historical WEEE and financial guarantee for future fee, which they offer today, is on average ca 80% of what El-Kretsen charges its members for historical WEEE (Tengå, T, 2007).

Regarding the organisation of physical collection infrastructure, the Swedish Ordinance requires a nation-wide collection system. The Association has utilised members' retail outlets for collection points. However, there are a few municipalities where members of the Association do not have stores. Moreover, most likely waste from EEE sold by its members would end up in the existing El-Kretsen system, and visa versa. These, among others, indicate the need to collaborate with existing systems on a number of issues.

Table 7-11: Fee Charged for Management of Historical Products as well as Financial Guarantee and Future End-of-life Management of New WEEE under Elektronikåtervinningsföreningen and El-Kretsen in 2007 (in SEK)

	Elektronikåtervinningsföreningen		**El- Kretsen**	
	Management of historical WEEE	Financial guarantee and future management of new WEEE	Management of historical WEEE	
			February 1, 2007- July 1, 2007	From July 1, 2007
Washing machine	3.50	3.04	5	0
Vacuum Cleaner	6.25	4.53	15*	15*
Laptop computer	6.12 (per unit)	4.44 (per unit)	2.2 (per kg)	2.2 (per kg)
TV 32 inch	75.60	71.13	100	120

* Includes financial guarantee for new WEEE.

Currently, the system is collecting WEEE from all producers regardless of the brand (not only from its member's products) in order to ensure that its members' historical WEEE obligations are met. It is uncertain whether in the future, only new WEEE from its members will be collected at retail sites or whether mixed brands will be continued to be accepted. Since insured products are currently not individually identifiable as the insured product (no distinct labelling with RFID tags, for example, existed on future WEEE placed on the market for the period August 2005 to December 2007), it is likely that the insurance solution covers a volume of products to be recycled in the future, with an agreed upon payout according to a predetermined disposal curve. Systems to allow individual ID are planned, pending ongoing technology procurement and pilot testing. If in the event that an individual member of the scheme exits the market, the other actors remaining within the scheme would receive the payout from the insurance scheme, effectively covering the cost of the `orphaned´ products. It would appear that the producer could theoretically leave the EÅF system and go to another PRO and the EÅF insurance structures would still pay out to another system. *In other words, it seems the guarantee insurance provides full mobility for the producer (i.e. the producer is not locked in to a particular compliance scheme to manage its obligations).*

Länsförsäkringar LF Recycling Insurance

A new model for recycling insurance available to individual producers or a group of producers (in a collective system for example) has been developed to satisfy the demands in the legislation is now being implemented for WEEE. Instead of insuring each product, a specified generic volume of products are insured. The premium is based on the volume of products sold.

Länsförsäkringar and the producer agree on the expected life cycle (length to disposal) of the product, and the expected future costs associated with the type of products insured. The recycling costs will be paid to the producer as a claims settlement according to predetermined agreements. *The amount paid by the insurer is based on the actual cost for recycling per product each year.* If the producer has left the market the insurer will still pay for the recycling (to an actor that takes on the role of recycling the WEEE of the insolvent party), thus eliminating the risk of this producer to become a free rider in the system.

To illustrate how this would work in practice the following example is provided below in Figure 7-1 below.

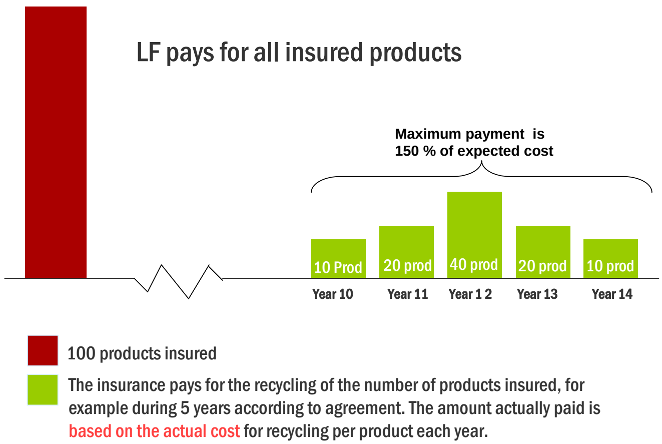

Figure 7-1: Länsförsäkringar Recycling Insurance Solution

Source: Anders Sverkman, Länsförsäkringar AB

If a producer were to use this recycling insurance as a guarantee for new WEEE, it would still need to finance its current historical WEEE obligations separately (i.e. paying fees to a collective system) or developing its own nation-wide network of collection sites and financing its current share of historical WEEE (based on market share calculations). As the recycling insurance will pay out claims based on a pre-agreed waste pattern, the producer will receive payment from the insurance company which it can use towards financing its compliance costs. Thus if the producer is a member of a compliance scheme that continues to use the 'pay as you go' (PAYG) financing model for both historical and new WEEE obligations to finance current WEEE arisings (rather than individual identification or a return share), the insured producer can use the payout from the insurance company to finance the system costs that it is charged by a compliance scheme.

This market share obligation assigned by the compliance scheme may not necessarily match the payment that it receives from the recycling insurance company which will be calculated based on a expected scrapping curve. However, the legislative demand for the financial guarantee is met, while at the same time the premium paid when the product was put on the market is returned to the producer, albeit at a later date. *As with EÅF it seems the LF guarantee insurance provides full mobility for the producer.*

El-Kretsen (Nordic Guarantee)
The current financing models used in El-Kretsen includes a per unit fee to manage the current costs to manage WEEE arisings as well as a ICT Model where each producer finances a proportion of the total monthly costs to collect and manage various IT products based on that producer's calculated market-share. These PAYG financing models operate on the basis that the current costs to manage WEEE are divided proportionately to each producer's market share (with excess funds potentially contributing to a reserve fund of El-Kretsen)**,** *and therefore new WEEE will be financed in a collective manner if this model is continued in the future.*

According to El-Kretsen, the collective compliance system has now developed a financial guarantee solution on behalf of its members that can be classified as a solution that lies somewhere between a bank guarantee and a recycling insurance, although the Swedish EPA classifies it as a collective bank guarantee.

The solution is offered by Nordic Guarantee, an insurance company that specialises in surety bonds. According to Nordic Guarantee, the solution offered can be considered as secure as a traditional bank guarantee, without the demands for collateral, capital binding and unnecessary administration (Rundstöm, S, 2008).

According to El-Kretsen the cost per annum to each producer for the bank guarantee would be approximately 1000 SEK (approximately 100 Euro) *if all members signed up to the solution.* El-Kretsen would use its reserve fund (150 MSEK) as part of the collateral for the bank guarantee solution. It claims that the total guarantee is adjusted yearly to reflect the cost of recycling, of all products placed on the market since 13 August 2005, with an average expected life cycle length of 8 years. The total amount of the bank guarantee for El-Kretsen's membership is unknown at this time.

The agreement between El-Kretsen and Nordic Guarantee regarding the bank guarantee appears to be one whereby members (producers) agree to pay for the costs to manage both new and historical WEEE that is collected using the current financing methods of PAYG. In other words, members explicitly agree to finance the waste of other members new WEEE (if one producer exits the market due to insolvency or ceases to operate while the scheme is in operation (reciprocal responsibility for orphaned WEEE). However if El-Kretsen scheme should collapse Nordic Guarantee would then cover any subsequently orphaned products, but the guarantee would no longer be valid to remaining solvent producers. In the event of the schemes collapse remaining solvent producers would need to form new guarantees, including retroactively for those products put on the market since August 13, 2005 (Rundstöm, S, 2008).

Similarly if a producer chooses to leave El-Kretsen, whilst still solvent, the bank guarantee will no longer be valid for the products it placed on the market since August 13, 2005 and therefore that producer must make new arrangements for the guarantee. It is not clear what happens concerning the El Kretsen reserve fund, whether a producer leaving the scheme could take their part of the funds with them and its not clear what impacts this would have on the El-Kretsen fund. *In other words the El-Kretsen guarantee solution does not allow the producer mobility***.** As the original proposal was based on the assumption that all members of El-Kretsen would choose the solution, it is uncertain at the moment how the choice of certain sectors (such as the white goods – see below) to develop their own guarantee has impacted the viability of the solution.

According to the Swedish EPA, more information is required that reflects these changing conditions in order for an assessment to be made on whether the solutions meets the requirements laid down in Article 18 and the Guidance document on financial guarantees.

In addition to the EL-Kretsen bank guarantee solution, Nordic Guarantee also offers individual producer bank guarantees for producers that want to have individual bank guarantee solutions. To date approximately 20 producers have taken this offer.

White Goods Recycling in Sweden AB

Vitvaror Återvinning i Sverige (White Goods Recycling in Sweden AB) shareholders represent nearly 95% of all large household appliance sales and 60% of small household appliances sales on the Swedish Market.

Approximately 20 shareholders from major white goods producers have established a company that holds/manages funds to be used as a guarantee to ensure that the future costs of products placed on the market after 13 August 2005 will be financed (Category 1 & 2 only). This solution serves as financial guarantee only, meaning that the fund is not used directly to finance the current costs of recycling products in a compliance scheme (but it could be used to cover such costs if the producer so chose). Each of the company shareholders retains its own account within the company where it is required to have sufficient funds to cover expected future costs of recycling all its products placed on the market since August 13, 2005. Since the costs to manage white goods will not arise for an expected time of 15-20 years (life cycle used for large household appliances) or 8-10 years (life cycle used for small household appliances) the company has determined that 40 MSEK growing to 60 MSEK by the end of 2008 will be sufficient to cover the future costs of managing these products given the cost structures of managing these products today and reasonable expectations for future costs. In fact, for certain large household appliances, white goods producers are currently paying no fees to manage their historical products (Spånberg, M, 2008).

Currently, all shareholders of White Goods Recycling in Sweden AB are also members of El-Kretsen, the collective compliance scheme managing producer responsibility requirements of its member's historical and new WEEE obligations. The current financing models used in El-Kretsen for Category 1&2 (large and small household appliances) include a per unit fee to finance the current costs to manage WEEE arisings, although for large household products (non-refrigeration) the cost is currently zero.

Therefore, if one of the 20 producers in Vitvaror Återvinning i Sverige AB were to exit the market, the funds earmarked to manage the future costs could be designated to a collective recycling scheme to manage the insolvent producer's waste products in the coming years. The details of how and when these funds would be available to the collective recycling system (El-Kretsen in this case) is currently unknown.

7.6.3 Financial Guarantee in Germany

Section 6(3) of the ElectroG lays down the general requirement for a financial guarantee for products placed on the market after 13 August 2005.

Section 6 Clearing House, Registration and Financing Guarantee

> *(3) Each producer shall provide to the Competent Authority an annual guarantee for the event of insolvency to guarantee financing of the return and disposal of the electrical and electronic equipment which is placed on the market after 13 August 2005 and which is suited to use in private households. This does not apply to electrical and electronic equipment for which the producer plausibly documents that it is used solely in establishments other than private households or that such equipment is not usually used in private households. The guarantee may be provided in the form of an insurance policy, a frozen bank account or the producer's participation in an appropriate system to fund WEEE disposal, for example a system based on the calculations contained in Section 14 (5) sentence 3 No. 2.*

The legislation clarifies that the requirement is *only for B2C products*. The examples of the financial guarantee provided include an insurance policy, a frozen bank account or the producer's participation in an appropriate system to fund WEEE disposal. With regard to the third option, they provide the system with market-share based calculation as an example of the appropriate system.

7.6.3.1 Market Solutions for Financial Guarantees in Germany

In the EAR rulebook, there is a distinction made between collective guarantee systems and compliance based on individual 'pre-financing' WEEE, which relates to the option provided to producers with respect to financing new WEEE. A further explanatory note issued on 5 January 2005 intended to provide clarification on a number of issues, such as the following:

Collective groups of producers (consortia) are not exempt from the obligation to provide a financial guarantee:

- The relevant actors that are to be included in the guarantee. These included (a) the producer, (b) German-based security provider, (c) German Trustee, the Beneficiary (other producers paying for the bankrupt producer's WEEE)
- EAR has the authority to decide if a guarantee is to be activated. If a decision is made to activate a guarantee, EAR instructs the

security provider to provide funds to the trustee, who passes these funds on to the beneficiary or beneficiaries.

- Depending on the chosen financing option for EEE placed on the market after 13 August 2005, producers are required to provide either a collective financial guarantee (based on reciprocity) or an individual pre-financing guarantee.

Table 7-12: Individual and Collective Guarantee Requirements in Germany

Type	EAR reference	Calculation Methodology for Amount if Guarantee	Guarantee activated
Collective Guarantee	EAR rulebook 25/07/2005	Guarantee (EUR) = EEE placed on the market in the × Expected return rate in percentage % × Expected WEEE costs (EUR/tonne)	When last producer of a pay as you go system leaves the market
Individual Guarantee	EAR FAQ 23/07/24	Same as above, plus proof of sorting costs of WEEE. Guarantee is required over maximum product life cycle	When individual producer exits the market

Source: Adapted from (Perchards, 2007)

Collective Guarantees

Only when producers opting for their share of the total quantity of new EEE per type of equipment placed on the market in the previous calendar year can they choose the collective guarantee option. Collective guarantees are based on the principle of reciprocity. Under this system, if any producer were to become insolvent, the remaining producers in the product category would assume the market share obligation of the insolvent producer. The criteria concerning when a collective guarantee can be released for the use of financing WEEE, is determined at the point when the last guaranteed producer in the respective category of EEE leaves the market. Therefore, as long as there is one actor left in the market (producer would have 100% market share) there would be funds available to finance collected WEEE. Obviously, the risks of this extreme situation to happen are very low, and the premiums applied by the 2 main collective guarantee solutions reflect this, as found below.

GSA: Guarantiesystem Altgeräte[58]

GSA is founded by Bitkom Service Gesellschaft (BSG) and 12 producers including Brother, Cherry, DeTeWe, Deutsche Telekom, Fujistsu Siemens, Ingram Micro, Kyocera, Motorola, Siemens, Sony, Toshiba and Vodofone. It was approved by EAR on 21 September 2005, and work based on the following charging mechanisms.

- Registration Fee : € 52 (exclusive of VAT) one-off
- A premium to cover external risk protection: € 1.25 for € 1,000 guarantee amount (or 0.125%) of required total guarantee
- Yearly Administration Fee

Table 7-13: Yearly Administrative Fee Charged by GSA in Germany

	Single type of equipment	**Several types of equipment**
Up to € 1000 guarantee amount	€ 290 plus VAT	€ 680 plus VAT
Up to € 5000 guarantee amount	€ 450 plus VAT	€ 910 plus VAT
Above € 5000 guarantee amount	€ 910 plus VAT	

Source: GSA - http://www.garantiesystem-altgeraete.de/en/content/c_systemgebuehr.php

The solution is open to all Manufacturers/Producers in all 10 WEEE Categories. As of 2007, GSA has 800 subscribers with a cumulative guarantee capital of nearly € 150 million.

A premium is paid annually for the life-expectancy of the product. GSA initiates a credit check on the manufacturer/producer during the application process. Table 7-13 compares the premiums set by two collective financial guarantee schemes in currently available in Germany.

Annual Bank Guarantee

Bosch-Siemens is using an Annual Bank Guarantee to meet its obligation for a financial guarantee.[59] The company representative noted that the annual

58 Information provided in this section was mostly gathered from the homepage of GSA found at: http://www.garantiesystem-altgeraete.de/en/content/c_systemgebuehr.php.

bank guarantee is less expensive than collective insurance options above. No costs/prices given were provided at the time of inquiry. No information was provided with respect to the details on how the guarantee would be released if company became insolvent. Other producers have used this solution in Germany. One anonymous source has indicated that similar to the collective guarantee the bank guarantee only can be triggered in the event that there are no more producers that have market share in a particular category.

7.7 Product Labelling & Producer Identification

There are two references in the WEEE Directive, requiring producers to mark their products in order to identify the responsible producer. The first reference is in Article 8(2), where financial obligations for new WEEE are laid down.

Article 8(2) second paragraph

> *…and that producers clearly mark their products in accordance with Article 11(2)*

From this reference to Article 8(2) it is clear that producer identification is deemed crucial by the legislators in order to facilitate the requirement that producers are responsible to finance the management of WEEE from their own products.

The second and primary requirement is found in Article 11: Information for treatment facilities.

> *Article 11(2) Member States shall ensure that any producer of an electrical or electronic appliance put on the market after 13 August 2005 is clearly identifiable by a mark on the appliance. Furthermore, in order to enable the date upon which the appliance was put on the market to be determined unequivocally, a mark on the appliance shall specify that the latter was put on the market after 13 August 2005 The Commission shall promote the preparation of European standards for this purpose.*

In accordance with Article 11(2) on 12 June 2004 the Commission issued mandate M/336 EN to CEN/CENELEC/ETSI to develop a European standard to facilitate a harmonised approach to the labelling of EEE products. Obviously, a European standard was considered important in this context, as producer identification and distinction between new and

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[59] Graziani, Claudia. (2007, March 29). Personal interview.

historical WEEE would subsequently be used to allocate costs among producers. If an ad hoc approach would have been applied, ambiguities over identification and whether a product is new or historical WEEE leads to legal uncertainty over producer responsibilities.

In January 2005 CENELEC published EN 50419:2005 which has subsequently been replaced by EN 50419:2006, after an initial review by the European Commission required minor changes to be made from the original standard. Accordingly, EN 50419:2006 denotes the following requirements for identification of the producer. The standard notes that in order to identify the producer a number of options for marking exist for producers. Marking can take the form of a brand name, trademark, company registration number or other suitable means to identify the producer.

The document further states that whichever option is chosen, this shall be recorded in the Member States' register of producers in accordance with Article 12(1) of the WEEE Directive. Producers have the option of identifying that their products have been placed on the market by either: (1) The date of manufacture/put on the market, in uncoded text in accordance with EN 28601 or other coded text, for which the code shall be made available for treatment facilities, or (2) Marking as shown in Figure 1 being an additional mark used in conjunction with the crossed-out wheeled bin in accordance with Annex IV of Directive 2002/96/EC already required under Article 10(3) of this Directive. The additional marking to the crossed-out wheeled bin referred to above should consist of a solid bar, with specific height requirements. The bar shall only be used in conjunction with the crossed out wheeled bin. The bar shall not contain any text or any kind of additional information.

7.7.1 Transposition Outcome

Table 7-14 indicates the requirements related to producer identification stipulated in the Member States. The assessment includes (1) whether the producer identification is required or not, (2) if B2B and/or B2C products are covered by the producer identification requirements, and (3) whether any additional remarks/requirements have been made.

Furthermore, if the definition of producer in the national legal text is defined to include intra-community imports (i.e. the so-called national approach discussed in Section 6.1), and the requirement to mark products for producer identification only mentions that "producers" must do so, we classify this as a "national" requirement. In this case, any obligated producer would need to ensure that his/her name can be identified on the product.

Conversely, if the legal text explicitly requires that the name of the producer who places his products on the European Market for the first time to be on the products, it indicates that the manufacturer or first importer to Europe have the obligation to mark products. The same applies if a Member State takes a so-called European approach when defining producer. These cases are classified as a "European" requirement.

Table 7-14: Requirement for Producer Identification in the EU 27

Member State	Producer Identification Required	B2B & B2C	Additional
Austria	Yes, if choosing individual responsibility(national) No, if collective (EC)	Both	No
Belgium	yes (national)	Both	No
Bulgaria	yes (national)	Both	Name and statistical register number BULSAT to be used
Cyprus	Yes (national)	Both	No
Czech R.	Yes (national): Producer identification either by producer name or registration number or by the brand under which the product is imported;	Both	Brand name requirement exempts importers from having to re-label
Denmark	Yes	Both	Refers to EN Standard
Estonia	Yes (National): producer name, tel. number, address and registry code	Both	Tel. number, address, registry code
Finland	Yes (EC) name of producer introduced on the EC market	Both	No
France	Yes (National)	B2C only	No
Germany	Yes (EC)	Both	No
Greece	Yes	Both	Refers to EN Standard
Hungary	Yes (National)	Both	No
Ireland	No	-	-
Italy	To be defined	-	Refers to EN Standard
Latvia	Yes (National)	Both	Refers to EN Standard
Lithuania	Yes (National)	Both	Refers to EN Standard
Luxembourg	Yes (National)	Both	No
Malta	Yes (National)	Both	No
Netherlands	Yes (National)	Both	No
Poland	No	-	(weight published in manual)
Portugal	Yes (National)	Both	Refers to EN Standard
Romania	No	-	-
Slovakia	Yes (National)	Both	No (not needed for lighting)
Slovenia	No	-	-
Spain	Yes (EC)	Both	Refers to EN Standard
Sweden	Yes (National)	Both	No
UK	Yes (EC)	Both	No

In the fall of 2007 the Swedish EPA undertook a study to determine the extent to which products sold in stores were labelled correctly with the crossed out wheeled bin as well as unique producer identification. Of 111 electronic products checked 94 out of 11 had the correct symbol of the crossed out wheeled bin. However only 8 of the 111 were properly labelled to identify the legally obligated producer in Sweden.[60]

[60] http://eeregistret.naturvardsverket.se/net/ee/Producent+logga+in.

CHAPTER

EIGHT

8. Practical Implementation of WEEE Directive in Member States

Chapter eight aims to answer the second part of research question 2 listed below.

Research Question 2: What has been the European experience to date in embedding incentive-based EPR, firstly into applicable legislation and secondly into operational programmes for the management of household WEEE?

8.1 Compliance System Overview in EU 27

The practical implementation of the WEEE Directive varies considerably between Member States, mainly on the roles and responsibilities for collection of WEEE from private households, the financial mechanism applied and the level of competition between compliance systems set up by producers to fulfil their producer responsibility obligations.

The compliance schemes for WEEE from private households in Member States can be categorised into two main approaches – the 'single national compliance system' and 'competing collective systems'. As the names imply, the categorisation is based on whether two or more compliance schemes handle WEEE in the same category in competition (competing collective system), or not (single national compliance system). The characteristics of these approaches, as well as their variations, are described further in sections below.

Table 8-1: Compliance Schemes for WEEE in the EU 27

Countries with Single National Compliance System	Countries with Competing Collectives or National and Pan-European Consortia		
NL: Netherlands NVMP (All except cat. 3) ICT Milieu (cat. 3) **SE: Sweden** EL Kretsen EÅF – competing scheme **BE: Belgium** Recupel **LU: Luxembourg** Ecotrel **EL: Greece** Appliances Recycling S.A. **MT: Malta** RofA SA **CY : Cyprus** EDHHA **CZ: (4) Czech Republic** Asekol (cat 3,4, 7, 8,10) Electrowin (cat. 1,2,6) Rema (cat. 2,3,4,6,7,8) Retela(cat.1,2,3,4,5,6,7,8,9,10) Ekolamp (5) Bold: *Approval for Historical WEEE exclusively* **Switzerland:** SWICO SENS **Norway: EL Retur**	**DK: Denmark**[61] NERA (all) El-Retur (all) LWF (cat 5) **IR: Ireland: (2)** WEEE Ireland (all) ERP (all but cat. 5) **IT: Italy** Ecodom (cat. 1) Ecolamp (cat. 5) Ecolight (cat. 5) EcoR'It (cat. 3) ANIE (cat 1, aircon) AINE (cat 2) ERP **FR: France** Eco-Logic EcoPlanet's Eco-Systèmes ERP Recyclum (cat 5) ELEN (B2B) Recy'stem-Pro (B2B) **DE: Germany** Clearinghouse assigns individual producer allocation **EE: Estonia** EES-Ringlus AS Cleanaway **SK: * Slovakia** SEWA (All cat.) Ekolamp (cat. 5) ZEO (cat. 6) Etalux (cat 5)	**AT: Austria** UFH Lamps (cat. 5) UFH (all but 5, B2C & B2B) ERA (all cat., B2C & B2B) EVA (all cat., B2C only) ERP (all but 5, B2C & B2B) **FI: Finland** FLIP Ry (Elker Oy) (cat. 5) ICT (Elker Oy) (cat. 3) SELT Ry (Elker Oy) Serty Oy NERA **PT: Portugal** AMB3E (all cat.) ERP (all but cat 5.) **ES: SPAIN** Assoc. Ambilamp ECOASIMELEC Ecofimatica ECOLEC Foundation ECOTIC ERP Tragamovil **SI: * Slovenia (3)** ZEOS (All cat.) Interseroh (All cat., mostly B2B) Slopak (All cat. B2C&B2B) **UK : United Kingdom** 42 open schemes	**CZ: (4) Czech Republic** Asekol (cat 3,4, 7, 8,10) Electrowin (cat. 1,2,6) Rema (cat. 2,3,4,6,7,8) Retela (cat.1,2,3,4,5,6,7,8,9,10) Ekolamp (5) Bold: Approval for Historical WEEE exclusively **HU: * Hungary (6)** Electro-Coord (All cat.) Comp-Cord (2,3,4,5) E-Hulladeck (All cat.) Elektro-Waste Kht (3) Ökomat Kht. (All categories) Re-Elektro Kht. (All cat.) **LV: * Latvia (3)** LZE (All cat.) Green Dot (LZP) LEtA (All cat.) Ecolight **LT: * Lithuania** (1 producer association, 20 recyclers) Infobalt EPA (1, 2,3,4,5) EMP (recyclers, All cat.) Kuusakoski (recyclers, All cat.) Zalvaris … **PL: Poland** Auraeko Biosystem Elektrorecykling EL-Centrum ElectroEko ERP

[61] Divided geographically by clearinghouse.

8.2 Single National Compliance System

Single National Compliance systems have been the standard approach for countries with legislation prior to the implementation of the WEEE Directive. These countries include Belgium, the Netherlands and Sweden[62], as well as Norway and Switzerland, which are not Member States. They have developed and continue to have in place national compliance systems, initiated by producers or their trade associations collectively, to practically arrange the take back and recycling operations on behalf of members. Although there may be competitive tendering for services such as transportation, pre-treatment and recycling, in terms of options for producer compliance, these systems are the only collective compliance option available.

Even when there is more than one scheme in operation in the country (i.e. ICT Milieu and NVMP in the Netherlands) there is usually no competition between product categories for the management of WEEE. With the national approach to the organisation of producer responsibilities, there is neither a need for a clearinghouse function to allocate collection sites nor market share for historical WEEE. This is because the national scheme is responsible for setting up a national-wide collection system, in collaboration with municipal collection sites and retailers and there is no need to divide this obligation with other collective compliance schemes.

8.3 Competing Collective Systems

Both driven by certain national government's opposition to monopolistic arrangements of national compliance schemes, and producer's concern over the price impact of lack of competition, there is an emerging trend towards the establishment of multiple collective systems in competition. From industry side, this process has been spearheaded by the European Recycling Platform (ERP) founding members, Braun/Gillette, Sony, Electrolux and HP. These producers were generally unsatisfied with the functioning of monopolistic compliance schemes for WEEE management in Member States where there is a single national compliance scheme and the tendency to accrue large sums of operating reserve to treat future WEEE.

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62 A competing scheme has emerged in Sweden since August 2007 known as Elektronikåtervinningsföreningen.

Proponents of the competitive approach to compliance systems have identified supply chain management as the basis to this model and indicate that single national approaches run contrary to this management strategy (European Commission Joint Research Centre, 2006). This is because in large organisations supply chains are managed on the basis of competitive tender and WEEE in their view is simply regarded as part of the supply chain activities that could benefit from identical management skills as those used in other areas of product life cycle management.

8.3.1 Development of the National Clearing House Model

Required Coordination

In order to facilitate competition between schemes certain involvement of the authorities or a central coordinator is required to ensure that the competitive playing field is level for all market actors on key issues such as access to WEEE and market share allocation of responsibilities for historic WEEE. A clearing house, as it is often referred to, is the most common body responsible for allocating, in essence, producers responsibilities in a fair and accurate way.

Given this, one way of further classifying competing collective schemes is by the mechanism used for the allocation of waste to individual producers or their competing collective organisations managing their responsibilities. It also relates to the level of intervention to ensure access to WEEE is fairly distributed among the producers on the market.

Variations of the Approach

On one end of the spectrum, there is the use of an algorithm to determine when and where a producer is required to pick up and process WEEE from collection sites. Since producers are responsible for the costs to manage historical WEEE collectively based on, for example, his/her weight-based market share, the total amount of collected WEEE needs to be known so it can be divided among obligated parties. In addition, the location of collection sites in relation to urban centres and recycling facilities is an obvious factor that influences costs to manage WEEE. In remote locations and sparsely populated areas cost can be significantly higher.

The algorithm attempts to distribute these cost differences among producers for a more equitable outcome. This ensures that all locations are serviced by producers and that all collected WEEE by municipalities is financed by producers. In theory, this could be considered the most equitable way of assigning responsibility for the management of WEEE collected at collection points. For this allocation mechanism to function there is a need for a strong coordinating body that has the trust both of the producers and municipalities. This approach is used in, for instance, Germany.

On the other end of the spectrum is the situation where government authorities or coordinating bodies have a more or less hands off approach to organising the allocation of responsibility for access to WEEE. Instead of having the starting point of dividing responsibilities based on what is actually collected at municipal sites, the coordinating body assigns a required amount of WEEE to be collected, and leaves it up to producers or their compliance scheme to achieve the results. This provides a so called 'bounty on WEEE' that encourages compliance schemes to meet their collection quotas in the least expensive way. There is usually very little municipal collection infrastructure already in place, and compliance schemes will contract directly with retailers for collection of WEEE or may organise special WEEE collection days or even curb side collection.

Under this approach, there is a need for authorities to set the required collection amount to adequately reflect the availability of WEEE in the Member State as well as the desired level of collection rate ambition. Countries employing this approach most often mandate that if producers to not meet their collection targets, any shortages would need to be made up through payment of product fees or payment into a recycling fund. Variations of this scenario are found in Hungary, Lithuania, Latvia, Bulgaria, Poland, Slovenia and Slovakia.

In between these ends of the spectrum there are approaches used where varying degrees of coordination exist to allocate access to WEEE. For example, in Ireland, the national authorities and the 2 competing compliance schemes came to an agreement on how to divide the obligations to collect WEEE from municipal collection sites. In an original agreement the collection sites were divided up based on a geographical allocation of existing sites. This allocation of collection sites represented an equal population served with a representative selection of urban and rural population densities as well as similar average distances to recycling centres.

In Austria the four competing collective schemes are free to contract directly with municipalities to collect WEEE from their municipal collection sites. However, any WEEE collected by un-serviced municipalities not under contract with a compliance scheme, is allocated to the scheme with the highest outstanding obligation of its market share calculation.

In the UK there will be a similar set-up where compliance schemes or waste collection companies operating on their behalf will negotiate directly with municipalities that have agreed to become designated collection facilities (DCF). Approved compliance schemes are also free to establish their own private DCFs.

In Italy a coordination body run by industry has been established to ensure the rationalisation and equity of allocation of collection of WEEE from municipal collection sites by the competing collective systems.

In Portugal and Spain, two competing systems are establishing their own collection networks based on both distributors and municipal collection points. In the absence of a coordinating body overseeing the allocation of collection points, each collective scheme in Finland contracts with municipalities directly and allocation of collection occurs on a rotating basis, where municipal collection sites inform collective systems of their obligation on an ad hoc basis.

8.4 Current Financing Models

The findings from Section 7.5 regarding how MS have transposed the financial mechanism for WEEE from private households illustrates that only 9 MS provide for a clear definition that for products placed on the market after 13 August 2005 each producer is responsible for financing the WEEE from his own product.

However, despite the fact that even in MS where the transposition is in line with Articles 8(2) and 8(3), the majority of compliance schemes have introduced collective financing models based on market share calculations. Given that membership in these compliance schemes is considered to be the financial guarantee, (that is the explicit or implicit agreement between producers to finance each other's new WEEE in the event that a member becomes insolvent) necessitates that the PAYG financing model will remain indefinitely.

As discussed in Section 2.7.3.1, in collectively organised compliance systems the most common design for the financing mechanism includes allocating the costs to manage waste products collected in a period of time in proportion to each producer's market share. There are several variations on this theme, however essentially the model resembles a Pay As You Go (PAYG) pension fund, where the products that are placed on the market today finance the waste from products currently arising as waste, a so-called inter-generational contract.

Models found in compliance schemes are all variations of the above PAYG financing structure. Variations include 1) Fee/Unit placed on the market: visible or non-visible 2) Fee/kg placed on the market: visible or non-visible 3) Fee/kg returned (apportioned to market share): non visible.

CHAPTER

NINE

9. Variants of IPR Implementation for WEEE

This chapter is intended to provide working examples (both in operation in the past and present) of EPR programmes where elements of IPR are embedded in system design. The cases included in this section have emerged out of previous research by Tojo (2004) updated in this thesis, and participation in an ongoing research project on "Practical Implementation of IPR" coordinated by INSEAD Business School in France, in which the author of this thesis led the development of the Japanese SHARL & Bosch-led Power Tool Consortium cases below.

These systems are used as case studies to explore the experiences when setting up programmes where incentives are embedded into system design. This part of the research was deemed essential in order to place the outcomes of the WEEE Directive transposition into a relative context as well as draw on experiences in which elements of IPR are operating in practice.

This section explicitly does not attempt to make cost comparisons between systems as this exercise is, in the author's opinion, wrought with uncertainty with regard over transparent system costs, different requirements in the system regarding collection rates, recycling and treatment standards and the like.

9.1 Maine's E-waste Legislation

In 2004 the State of Maine enacted its E-waste Law (38 MRSA[63] § 1610 Electronic Waste). It was the first US State to adopt such legislation mandating the end-of-life management of monitors and TVs where financial

[63] "M.R.S.A." is the acronym for the Maine Revised Statutes Annotated.

and physical responsibilities are shared among manufacturers, municipalities, consolidators, retailers and consumers.

There are multiple objectives which are clearly articulated in the law. Article 1 explicitly notes that its purpose

> *is to establish a comprehensive electronics recycling system that ensures the safe and environmentally sound handling, recycling and disposal of electronic products and components and encourages the design of electronic products and components that are less toxic and more recyclable.*

Additionally the law aims

> *to establish an electronics recycling system that is convenient and minimizes cost to the consumer of electronic products and components. It is the intent of the Legislature that manufacturers of electronic products and components will be responsible for ensuring proper handling, recycling and disposal of discarded products and that costs associated with consolidation, handling and recycling be internalized by the manufacturers of electronic products and components before the point of purchase.*

To implement the program, Maine's Department of Environmental Protection (DEP) adopted new rules in October 2005 – *Chapter 415, Reasonable Costs for the Handling and Recycling of Electronic Wastes*. The rules set the standards for consolidator approval processes and provide criteria for determining reasonable costs that consolidators are able to charge manufacturers for handling and recycling of waste televisions and monitors collected by municipalities. Based on the effective date of the rule, manufacturers became responsible for the management of their own products collected at municipalities beginning January 18, 2006. Following the adoption of the new rules, a prior law banning the disposal of CRTs went into effect on July 20, 2006.

9.1.1 Covered Products

Currently, the programme scope includes *computer monitors* (including laptops) and *televisions* (both CRT and flat screens TVs and portable DVD players) with diagonal screen sizes greater than 4 inches generated from households only.

Desktop computers are not covered by the recycling elements of the statute, but these manufacturers as well as TV and monitor manufacturers are required to affix brand identification to their products in order to be eligible for sale in the state. Labelling was required to assist consolidators in identifying manufacturers and was extended to desktop computer manufacturers in the event that the State decides to add computers to the list of WEEE to be collected.

As a means to discourage free riding, after January 1, 2006, manufacturers and retailers are not eligible to sell a covered electronic device in Maine unless the manufacturer is in compliance with the law.

Based on recent evaluation of the programme conducted by the Maine Department of Environmental Protection, the department has proposed that desktop printers and digital picture frames be added to the scope of the programme (Cifrino, C, 2008).

9.1.2 Collection

Municipalities are responsible for developing a system for delivery of residential waste televisions and computer monitors to a consolidation facility in Maine. Each municipality decides whether it wants to operate an on-going collection centre, offer one-day collections, or direct their residents to a near-by consolidator. Municipalities are responsible for the costs associated with transporting waste household computer monitors and televisions from the local collection point to the in-state point of consolidation (4 of 6 consolidators are located in neighbouring states).

However, the definition of consolidation facility in the statute includes transport vehicles owned or leased by a consolidator used to collect covered electronic devices at municipal collection sites. Under the Maine Solid Waste Management Rules, Chapter 415: Reasonable costs for handling and recycling electronic wastes, allowable costs for which consolidators are able to bill manufacturers include the provision of geographically convenient consolidation facilities services, including the cost of mobilising a transport vehicle to collect at least a 40 foot trailer full of covered electronic devices at a single municipal site and the cost of transporting a 40 foot trailer of covered electronic devices collected from multiple municipal collection sites from the point at which the trailer is full. Therefore in practice, manufacturers are financing the cost of transportation of TVs and monitors from the point of collection to the consolidation centres and recyclers.

Under the law there is nothing restricting municipalities from charging residents a fee for accepting monitors and televisions. Table 9-1 and Table 9-2 below summarise the results from a recent survey of fees charged by municipalities in Maine representing 83% of municipalities or 85.8% of the population (Cifrino, C, 2008).

Table 9-1: End-of-life Fees Charged by Maine Municipalities for Monitors

Fee	$ 0	$1-5	$6-10	$11-15	$16-20	>$20	Un-known
# of municipalities	126	112	53	17	8	3	14
% of population	29.8%	36.7%	9.7%	2.6%	1.4%	1.8%	1.5%

Source: Maine Department of Environmental Protection (2008)

Table 9-2: End-of-life Fees Charged by Maine Municipalities for Televisions

Fee	$ 0	$1-5	$6-10	$11-15	$16-20	>$20	Un-known
# of municipalities	126	81	35	10	33	28	15
% of population	29.8%	22.4%	9.8%	1.9%	1.4%	1.8%	1.5%

Source: Maine Department of Environmental Protection (2008)

To ensure that manufacturers are charged only the cost of recycling household computer monitors, municipalities need to clearly identify which televisions and computer monitors were generated by households. This may be done either by marking the outside of each unit generated by a household with a permanent marker and, when applicable, by providing documentation that the facility only accepts televisions and computer monitors from households.

There are approximately 130 permanent municipal collection sites. Many municipalities that do not have permanent sites offer special event collection or partner with other municipalities and direct their residents to neighbouring municipal sites (Cifrino, C, 2008).

Consolidators: Consolidation facilities are responsible for counting and weighing waste household televisions and computer monitors by manufacturer, and for reporting the results to Maine DEP on an annual basis (consolidators may contract with recyclers to provide the count by manufacturer). Consolidation facilities are also responsible for shipping only to recyclers that provide certification of meeting Maine's ESM Guidelines, and for billing manufacturers for allowable costs. In 2008, 6 consolidators have been approved by the MDEP. Four of the six approved consolidators are located outside of the State of Maine in the neighbouring States of Connecticut, New Hampshire and New Hampshire.

Allocation of waste collected at municipalities to consolidators: Maine DEP is responsible for approving up to 10 consolidators that are eligible to manage covered electronic devices and bill manufacturers for reasonable allowable costs. There is no formal allocation mechanism in place to determine which consolidators receive municipally collected covered electronic devices. This is left up to the market actors to solve contractually. Prior to the commencement of the programme, one participating consolidator had contracts with 60-70% of municipalities for the management of collected televisions and monitors, as well as other hazardous and special wastes.

Collection Results

According to the Maine Department of Environmental Protection, in the first 18 months of the programme, a total of 5 985 901 pounds or 2 715 156 kilograms of TVs and monitors, which is the equivalent of 3.29 pounds per capita or 1.5 kilogram per capita (Cifrino, C, 2008).

9.1.3 Treatment, Recovery, Reuse, Recycling

Consolidation facilities in Maine are required to provide evidence that they contract only with dismantlers and recycling facilities that provide sworn certification that the handling, processing, refurbishment, and recycling meet environmentally sound management guidelines published by the Maine DEP. A dismantling/recycling business that contract to pick up waste household televisions and computer monitors from local collection sites in Maine, (thus acting as an in-state consolidator as defined in the law) must certify that its handling, processing, refurbishment, and recycling meet the environmentally sound management guidelines published by the Maine DEP, and must provide that certification to the Maine DEP upon request.

In accordance with 38 MRSA §1610.5(C), the Maine Department of Environmental Protection has developed guidelines for recycling and dismantling facilities engaged in the handling, processing, refurbishment and recycling of televisions and computer monitors generated as waste by Maine households. These guidelines provide a framework for environmentally sound management of these wastes. Consolidators operating in Maine may not transport these electronic wastes to a recycling or dismantling facility unless the facility has provided a sworn certification to the consolidator that the facility substantially meets these guidelines.

Product reuse of candidate waste televisions and monitors is encouraged by municipalities, if feasible, prior to pickup/delivery to consolidators. It is common practice that working order products delivered to municipal collection points by residents are separated and offered to the public. Any waste products that shipped to consolidators/recyclers that are subsequently reused as whole appliances are not eligible for manufacturer financing and are not included in the reported quantities of covered electronic devices processed through the programme.

9.1.4 Financial Mechanism

Manufacturers are individually responsible for the costs of handling and recycling their own household-generated waste computer monitors and televisions once they are received at a consolidation facility in Maine. This includes products manufactured by any business for which the manufacturer has assumed legal responsibility. Computer monitor and television manufacturers with more than 1% of the waste stream are also responsible for a pro rata share (based on return-share) of orphan waste computer monitors and televisions respectively. Orphans: 2.4% television waste stream 13% of computer monitor (January 2008).

Manufacturers are required to work cooperatively with consolidation facilities to ensure implementation of a practical and feasible financing system. Each manufacturer has a choice of one of three following methods for handling their share of computer monitors and/or televisions:

Option 1: The consolidator separates a manufacturer's product and informs the manufacturer annually or when a 40-foot truckload of the manufacturer's product is available, whichever occurs first, for manufacturer shipment to a qualified recycling and dismantling facility as contracted by the manufacturer. Under this option the consolidator bills the manufacturer for the management of its share of orphan products and handling costs associated with the manufacturer's product; OR

Option 2: The consolidator informs a manufacturer when it has handled 16,000 pounds of the manufacturer's product and makes a full truckload of mixed brand product available to the manufacturer for shipment to a qualified recycling and dismantling facility as contracted by the manufacturer. Additionally, the consolidator bills the manufacturer for handling of the manufacturer's share and the handling, transportation and recycling costs of the manufacturer's orphan share; OR

Option 3: The consolidator performs a brand count and contracts with a qualified recycling and dismantling facility, and bills the manufacturer for the costs associated with handling, transportation and recycling based on weight of the products received for which that manufacturer is responsible plus its share of orphan products.

Consolidators are required to manage the handling, transportation, recycling and billing in accordance with each manufacturer's selected annual preference for one of these 3 options (or such other contracted arrangements negotiated that are consistent with these rules but vary from the 3 listed above).

Each manufacturer must notify consolidators by January 1 of each year or consolidators automatically use option (3) for the handling, transportation, recycling and billing of the brands and orphan.

Calculating share of Orphan waste

The share of orphan waste in a particular billing period that each mandated manufacturer is responsible for financing is based on a calculated pro-rata basis using data from the previous year collection results.

The DEP issued the first list of each manufacturer's pro-rata share for the year 2006 as of January 1, 2006. Each subsequent year an annual schedule of pro rata shares is issued by November 15th, which is effective for the following calendar year. Under the Maine law, any producer that has under 1% of a calculated return share is exempt from financing orphan waste.

9.1.5 Variant of IPR

The variant of IPR found in the Maine programme depends on the choice of financing model that each manufacturer makes. Since in the default scenario and option 2, at minimum, manufacturers finance a share of the collective costs of managing televisions and monitors apportioned by the actual weight contribution of their own products returned, the programme employs financial IPR based on return-share through brand counting.

Since for options 2 and 3, brands are mixed and no distinction is made concerning the actual costs to manage individual brands, in terms of the type or physical responsibility, the recycling is considered to be collective, although product weight is used as a cost differentiator.

However, if manufacturers chose option 1, then both a physical and financial IPR is established as producers are only financing the actual costs to manage their own branded products.

Regardless of which of the 3 options that a manufacturer chooses, any individual effort made to collect end-of-life monitors or TVs from consumers will be financially rewarded in a number of different ways. First any own branded products that are diverted from municipal collection sites will ultimately not end up being counted towards a manufacturer's obligation in the general programme. Additionally, the calculation of the pro rata share of orphan WEEE that each manufacturer is required to finance favours manufacturers that develop their own collection systems. This is because any competitors brands that are collected in the manufacturer's collection will be deducted off his recorded total tonnes collected in the general program which is the figure used in the numerator of the pro rata share calculation. Any own branded waste is not subsequently added to the denominator of the total WEEE collected of all manufacturers.

9.1.6 Analysis

The stated motivation for return-share financing model includes both a desire to provide an incentive for manufacturers to improve the environmental end-of-life performance of their products as well as out of administrative simplification. Since producers are financing the cost of managing their own products when they become waste, they have an incentive to design products with longer life cycles (thus delaying the financing obligation), compared with financing systems based on market share allocation of total waste management costs. Similarly, since producers have a choice whether they would like to manage the waste from their own products through physical sorting of the waste stream, producers are able to benefit directly from any cost advantages over competitors in terms of costs associated with managing individual brands.

Another argument used by staff at the MDEP to justify the use of return-share financing was that it would have been difficult for the state to collect market data necessary to calculate market shares of each participating manufacturers (Cifrino, 2008b). The department felt that it would be more open to legal challenges from manufacturers disputing the reported sales figures and allocated market shares.

"The sales ban has proven to be a very effective tool to encourage manufacturer compliance" (Cifrino, C, 2008). Manufacturers once notified by retailers that their products will no longer be marketed at retail are quick to respond and comply with the law. Although the ban is important in terms of limiting future orphans, there is no guarantee that even though a producer is currently participating in the programme that in the event of insolvency those products will become orphans unless another manufacturer legally takes over the brand. While in the Maine programme orphan waste is allocated to each participating manufacturer based on its relative return share, other states (namely Connecticut) use a market share calculation to allocate orphan WEEE. This could be considered a more equitable way of allocating orphan WEEE as producers with existing market share and hence sales revenue can offset the burden to new product sales. If a return-share allocation of orphan waste is used, then producers with declining market shares but historically high return-shares will finance a higher relative proportion of orphans to current sales.

Surprisingly, no manufacturers have opted to report the collection of WEEE through their own voluntary programs. While many manufacturers do offer voluntary programs in the US market, it appears that none offer this service in Maine (exception is Dell, Apple), even though there is a direct incentive to do so.

9.2 Bosch led Power Tool Take back Consortium: Germany

This case describes a manufacturer consortium take back and recycling program for power tools and power tool portable batteries in Germany. It covers 2 distinct periods of the programme development, first as a *voluntary initiative* and secondly adaptation of the programme to conform to legal requirements of the ElektroG, the German transposition of the WEEE Directive.

In the first period (Phase 1, from 1993-2005, 22 brand owners[64] led by Bosch Power Tools developed and operated the program in response to a draft German WEEE Ordinance in 1991. These producers (representing approximately 80% of power tool market) wanted to fulfil their potential legal obligations through their own system, independent of any national compliance scheme that may have formed (Cerowski, U, 2008a).

After the introduction of the ElektroG in 2005, the Phase 1 programme was expanded to include collection of power tools at municipal collection facilities (collection category 5). Although the Phase 1 system continued to operate, the tool producers decided to form a new consortium of 105 producers, made up of 73 members of the associations ZVEI power tools, ZVEI welding machines, ZVEI Automation and IVG (Industrievereinigung Garten) including 32 non-members of ZVEI.[65]

The ElektroG requires that for historical WEEE, producers finance a proportion of the total WEEE collected in the country relative to their market share in a particular compliance period (historical WEEE and new WEEE (Optional). In Germany, municipalities are required to collect WEEE in 5 categories of which tools fall into the 5th, commingled with other small household appliances, toys and sports, monitoring and medical equipment. In order to calculate tool producers share of WEEE collection in a given compliance period, Stiftung Elektro-Altgeräte Register (EAR), the German national producer register and clearinghouse determines the total EEE weights placed on the market for all EEE producer's products falling under collection category 5. Each producer is given an assigned percentage of the total EEE placed on the market in a given compliance period. Correspondingly, each producer is responsible for the same percentage of total WEEE collected.

9.2.1 Covered Products

In *Phase 1* the system product scope included all *handheld power tools* from private households and businesses Welding equipment, sewing machines,

[64] Including Bosch Power Tools, Metablo, Festoo, Atlas Copco, Hitachi, AEG, Fein, Protool, Kress, ELU, Milwakee, Dewalt, Wagner, Mafell, Berner, Dremel, Flex, Baier among others.

[65] Cerowski, Udo (2007, November 14). Email correspondence.

spraying equipment, that fall under EEE category 6 of the WEEE Directive and ElektroG were not included in the program.

In *Phase 2* all products that are listed in EEE Category 6 of the ElektroG (see Table 9-3below) are eligible to be members of the consortium. However, for reference, under the ElektroG all 10 WEEE Directive EEE categories make up the total mandated product scope in Germany (Cerowski, U, 2008a).

Table 9-3: Products Included in Category 6 of ElektroG

Category 6 of ElektroG : Electrical and Electronic Tools (with the exception of large-scale stationary industrial tools)
1. Drills
2. Saws
3. Sewing machines
4. Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials
5. Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses
6. Tools for welding, soldering or similar use
7. Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means
8. Tools for mowing or other gardening activities

9.2.2 Backdrop Legislation *(Phase 2)*

As previously mentioned, for WEEE collected at municipalities, *Category 6 products* are to be collected in *Collection Category 5* as outlined in the German ElekroG (see Table 9-4 below), which are commingled with small household appliances (EEE Category 2) lighting equipment, excluding bulbs (EEE Category 5), toys, sports and leisure equipment, medical products (EEE Categories 7,8,9).

Table 9-4: WEEE Collection Categories in ElektroG

WEEE Collection Categories under ElektroG
1. Large household appliances, Automatic dispensers
2. Refrigerators and freezers
3. IT and telecommunications equipment, consumer equipment
4. Gas Discharge Lamps
5. Small household appliances, lighting equipment, *electric and electronic tools*, toys, sports and leisure equipment, medical products, monitoring and control instruments.

Under the ElektroG, Section 9(8) producers and importers of EEE in Germany have the option to set up and operate individual or collective take back systems for WEEE from private households. This provides the legal basis that allows for the consortium's individual collection efforts of WEEE collected from retailers, service centres and business customers to be recognised in the national system. Producers that operate independent (own) systems can reduce their obligation to collect WEEE from municipal collection points stipulated under Section 10(1). Therefore, as described in the introduction, the Power tool consortium needs to report its collected volumes from retailers, business clients, and repair centres and report this to EAR to be included in the total volume of WEEE collected in collection category 5.

WEEE collected from business clients and repair centres (both consumer and business products) is reported to EAR as collected WEEE from private households as all power tool producers in the consortium declare tool sales as EEE sold to private households (considered dual use products). Therefore, both tools sold to business clients as well as collected from business clients are included in the total household tons reported (put on the market and collected (Cerowski, U, 2008b).

Within these framework conditions, the consortium continues to operate the *Phase 1* system design (same product scope), but has opened up the consortium to other producers of all other products under the *EEE Category 6*. Although, these added products are not collected at retail collection points, the consortium has bundled compliance volumes to obtain a favourable price from recyclers for the recycling of mixed collection category WEEE collected at municipal collection sites.

9.2.3 Collection

In *Phase 1:1993-2005* the consortium utilised 3 main collection site types including; 1. Retail Partners, 2. OEM service centres, and 3. Large commercial clients. In total there were 7600 collection points.

Table 9-5: Types of Collection Sites Utilised in Phase 1 of Bosch-led Power Tool Recycling Consortium

Type of collection site	Number of sites	Approximate % of total weight collected
Retailers	~7570	17%
Service/Repair centres	~15	71%
Large B2B clients	~15	12%
	7600	100%

At each collection site power tools and their batteries (cordless tools) are collected separately in cage containers (power tools) and cardboard shipping boxes (batteries). Once containers are full, collection points fax the logistics provider directly and the containers or boxes are picked up within 48 hours of notice (Cerowski, U, 2008a).

Table 9-6: Allocation of Responsibility for Collection site Operation and Transportation to recycling Centre – Bosch-led Power Tool Case

Type of collection site	Collection Site Operation		Transportation
	Physical Responsibility	Financial Responsibility	
Retailers	Retailers*	Retailers*	Producers
Service/Repair centres	Producers	Producers	Producers
Large B2B clients	B2B clients*	B2B clients*	Producers

* Containers are provided by the producer consortium

Collection Results Phase 1

Figure 9-1 below shows the total tons of power tools collected in phase 1 from 1993-2005.

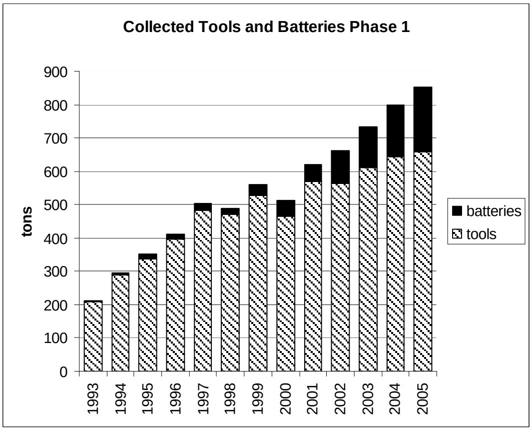

Figure 9-1: Collection Quantities of Power Tools from Retailers, Service Centres and Industrial Customers (Phase 1)

Figure 9-2 below, shows the proportion of tons collected from the three main sources of power tools collected in *Phase 1* of the program. Interestingly, despite the fact that there are over 7500 retail collection sites, over 70% of the weight of collected power tools originate from service centres of the member companies (Cerowski, U, 2008a).

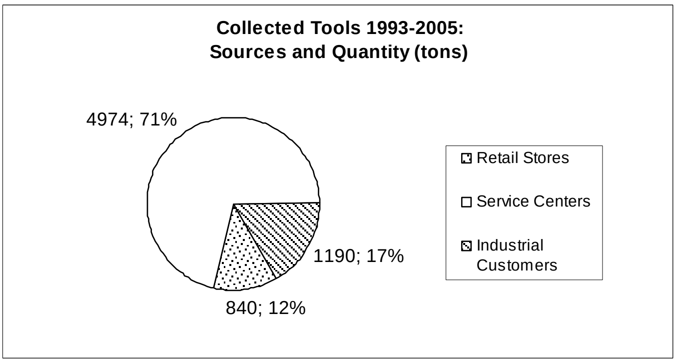

Figure 9-2: Relative Breakdown of Sources of Waste Power Tools in Phase 1 (1993-2005)

In *Phase 2* which started in 2005 and is currently on-going, collection consists of two main systems including 1. Own System (*Phase 1* infrastructure) & Municipal Collection Obligations (allocated by EAR).

Since the 'own system' component of *Phase 2* system is described above in the *Phase 1* description it is not repeated here. The allocation of responsibility to the various actors in *Phase 2* remains the same as *Phase 1*.

Table 9-7: Allocation of Physical and Financial Responsibility: Bosch Power Tool Case

Type of collection site	**Collection Site Operation**		**Transportation**
	Physical Responsibility	**Financial Responsibility**	
Retailers	Retailers*	Retailers*	Producers
Service/Repair centres	Producers	Producers	Producers
Large B2B clients	B2B clients*	B2B clients*	Producers
Municipal collection	Municipalities*	Municipalities*	Producers

* Containers are provided by the producer consortium

Collection Results Phase 2

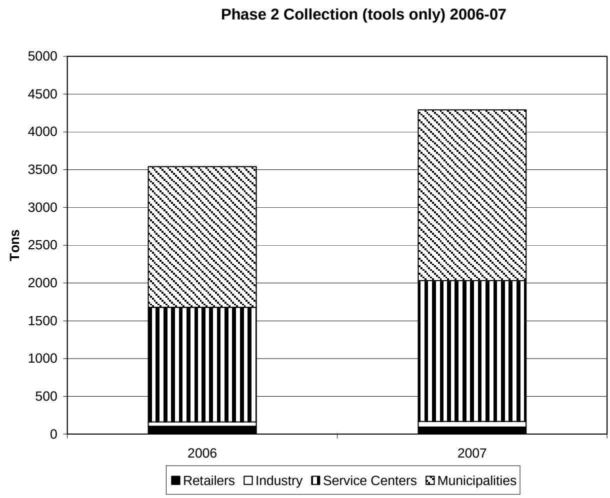

Figure 9-3: Collection Results: Phase 2: Bosch-led Power Tool Consortium

Neither EAR nor the Federal Environment Ministry has released data on the amount of WEEE collected in Category 5 at municipalities or through producers own systems.

9.2.4 Treatment, Recovery, Reuse and Recycling

In *Phase 1* waste tools and batteries collected at above collection points were transported to a central recycling centre in Willershausen, central Germany, by a contracted logistics firm (Hellmann).

Primary treatment of WEEE is conducted on-site at Willershausen with subsequent output fractions being processed by secondary processors. During *Phase 1* product dismantling and processing consisted of primarily manual disassembly of power tools resulting in 8 main output fractions depicted in Figure 9-4 below.

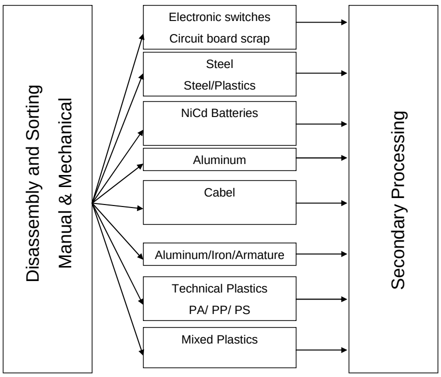

Figure 9-4: Output Fractions from Primary Treatment of Power Tools Processed at Willershausen

For *Phase 2,* WEEE collected at retailers, businesses and service centres is no longer sent to Willershausen for brand counting and processing. The logistics provider organises pickup from these sites and transports directly to the recycling contractor for the management of end-of-life tools through mechanical processing and subsequent material sorting.

9.2.5 Financial Mechanism

In *Phase 1,* producers financed all costs of collection from retailers *(provision of containers and transportation only, i.e. no financial payment to retailers for administration costs).* All costs for dismantling, sorting, and transportation to further material recycling is financed by producers in the consortium. No costs are publicly available.

What was unique about the financial model is that each producer financed the management of WEEE tools associated with their *own* products. All waste products and batteries were sorted by brand and each producer was responsible to finance the costs to manage the tonnage from his *own* products.

In *Phase 2*, WEEE tools collected through the retailers, commercial clients (B2B customers) and service centres, the consortium finances all costs of collection and recycling, as described above. For WEEE assigned to members through pickup orders at municipalities, consortia members finance transportation and recycling costs, (plus the provision of containers), while municipalities incur operating costs of collection site. All consortium members are *required* to use the contracted transport carrier and recycler when assigned a pickup order from a municipality by the EAR. Similarly, for all WEEE generated at customer sites and own service centres consortia members are bound to use the contracted parties. While costs for transportation and cost (revenues) received for processing WEEE are not available, there is a € 160/ton difference in the revenues received for collection category 5 WEEE (lower end) and dedicated tool streams from retailers, service centres and businesses (higher end) (Cerowski, U, 2008b).

9.2.6 Variant of IPR

In *Phase 1*, the form of IPR displayed can be classified as *return-share by brand*, where return share is based on *full brand identification*. Important to note is that the variant of IPR displayed here was established as an entirely voluntary initiative, in the absence of backdrop legislation. Producers finance only the total weight of all own brands collected or delivered to Willershausen from own service centres or business clients at a yearly agreed upon cost per kg. Although producers finance only the total tons collected of their own brands, there is no further cost differentiation based on product properties such as inherent recycling value or cost associated with the products returned. Tools collected from non-member companies were financed by all producers *proportionate to the return-share of their own brand.*

In *Phase 2*, the form of IPR displayed for the consortium's own system *(continuation of Phase 1 system where tool WEEE is collected from retailers and service centres)* is return-share by brand where return-share is calculated based on a sampling proxy and used against a market share obligation calculated by EAR.[66] WEEE collected from municipal collection sites is strictly based on a market share allocation assigned to consortium members by EAR and therefore there is no IPR.

All 22 brands that were part of the *Phase 1* Bosch Consortium continue to finance tonnage collected from service centres (own brand), retailers as well as commercial customers.[67] For tools collected at retailers, there is no longer a complete brand sort done. Instead a sampling proxy is used to estimate relative brand return-share attributed to each producer. Tonnages processed for each brand are reported to EAR and counted towards total WEEE collected from B2C sources (municipalities and other sources) and checked by EAR against each producer's market share obligations. If tonnages are less that those calculated by EAR, then a brand owner is obligated to reach this tonnage through assigned pickups of collection category 5 containers from municipal sites.

Therefore individual producers obligations are based on the market share calculation in a compliance period, and checked against individual tonnages managed through their own system. Given that producers are financing collective WEEE based on current market share, IPR is not directly possible, even though much of the WEEE processed to meet the obligations are from the management of participating producers own products. In this sense, it is positive that producers are able to develop programs to collect WEEE outside the government operated collection system. Total collection of WEEE is increased and producers are rewarded by obtaining more valuable streams than expected at municipal recycling sites (Collection category 5 in this case).

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66 In this sense, the total WEEE that is collected through the retailers and service centres (described here as 'own system') is allocated to each producer in the consortium based on the sampling proxy. The producer then uses this tonnage to offset its calculated market share allocation of required WEEE to be collected at municipal collection sites.

67 This is included in B2C tonnages as producers declare it as B2C when placed on the market.

It is currently unclear whether or not it is possible to bank over compliance due to over collection in Germany, given that EAR has not made a clear decision on this point. Bosch believes this is currently happening because it has not received a pickup order from EAR for 2008, even though they have only reported 11 tons of own collection in this period. Considering from January-November 2007, 600 tons were reported by Bosch, it expected to have received an order in January 2008. This did not happen.

9.2.7 Analysis

This case provides some interesting points of discussion regarding the impact of new legislation on an existing voluntary EPR programme. In this case, the system moved from a return share based financing system to a market share one, although the 22 brands in the original voluntary system do get credited for their return-share WEEE[68] to use towards their overall market share allocation from EAR.

In Germany, it is likely that all power tools are declared as B2C when placed on the market (even tools sold to automotive manufacturers), given that this is the case for Bosch Power Tools. In the *Phase 2* program design these products (automotive manufacturing tools) are subsequently collected by the consortium and counted towards B2C collected WEEE. Since WEEE collected at municipal collection sites in Category 5, is a mixed batch of product types with varying recycling cost structures, the cost to manage this WEEE is more costly than purer streams of primarily tools when collected at retailers, businesses and service centres. This provides a business case for producers to become engaged in individual collection efforts in order to avoid or having to collect less WEEE from municipalities. This may lead to increased total tonnages of WEEE collected in a country.

It remains to be seen how new WEEE will be financed in the future, however since the consortium has chosen the *collective financial guarantee option*, presumably they have opted to have all *new WEEE* financed collectively (based on market share calculations). Even though many producers in the consortium (original members) are collecting and financing WEEE from their own products, the total legal obligation of producers is calculated based on market share.

68 Calculated based on a sampling proxy.

9.3 ICT Milieu 1999-2002

ICT Milieu is one of two collective compliance schemes in the Netherlands set up in response to national legislation. ICT Milieu was established in January 1999 and continues to be the main compliance scheme for ICT producers post transposition of the WEEE Directive in the Netherlands. From its formation on 1 January 1999 to 1 January 2003 ICT Milieu members financed the system based on the return share of their products in the waste stream. It is this period of operation that this case study analyses.

9.3.1 Covered Products

ICT Milieu handles all products listed under Category 3 of the WEEE Directive, IT & Telecommunication Equipment. Only B2C products are included in the ICT Milieu system. All products less than 35 kg are classified as B2C, while all above 35 kg are B2B. This distinction is not determined by the backdrop regulation, but rather by ICT Milieu itself as a means of organising financing of ICT products. This is discussed further in Section 9.3.4 below. Certain products that are classified as Category 7: Toys, in the WEEE Directive, including video game consoles and accessories are included in the scope of ICT Milieu membership (ICT Milieu, 2007).

9.3.2 Collection

There are 2 main collection options that consumers of WEEE from households can use in the programme, including municipal depots and participating retailers.

There are over 500 municipal collection sites available to private citizens to hand in their ICT WEEE. Retailers are required to accept WEEE on and old for new basis and it is estimated that there are approximately 18 000 retailers participating. Retailers can deposit collected WEEE at municipal collection sites, although only seven items at a time are permitted. A total of 17 regional aggregation centres are contracted by ICT Milieu where municipalities and retailers can deliver WEEE that they have collected from private consumers. ICT Milieu also arranges transportation of collected WEEE from private consumers collected by approximately 125 retailers and repair centres, and ships them directly to the consolidation centre or contracted recycler (ICT Milieu, 2007).

ICT Milieu informs businesses consumers, that producers have the physical responsibility to organise WEEE collection infrastructure however for historical WEEE, the financial responsibility remains with the final business consumer. For new WEEE the financial responsibility remains with the producer. Business consumers cannot hand in ICT WEEE to municipalities or retailers.

9.3.3 Treatment, Recovery, Reuse and Recycling

WEEE that was consolidated at regional aggregation centres was transported to contracted recyclers for end-of-life management. Each container which was delivered to ICT Milieu's recycler, MIREC, was subjected to a full brand count. Each product was weighed on a scale and using a touch screen each unit was assigned to a manufacturer. If a brand name was recorded which was not related to a registered member of ICT Milieu, it was recorded as a "free rider" (Insead IPR Practical Group, 2008).

9.3.4 Financial Mechanism

Until 1 January 2003, ICT Milieu based their financing system on the return share of the products of each member. Producers were charged a fixed annual fee plus a charge per kilo of equipment taken back and processed according to brand. Individual producers received a monthly invoice directly from the recycler based on the weight of their products that had been recycled. Each container which was delivered to ICT Milieu's recycler, MIREC, was subjected to a full brand count. Each product was weighed on a scale and using touch screen PCs each unit was assigned to a manufacturer. If a brand name was recorded which was not related to a registered member of ICT Milieu, it was recorded as a "free rider".

In addition to their own products, producers also covered the cost of orphaned products and products of free-riders. These were allocated to the respective producers pro rata in proportion to their return share. Because producers only paid for products coming back in the waste stream at the moment product recycling took place, membership of ICT Milieu provided sufficient financial guarantee, and so in this case a separate financial guarantee was not required.

9.3.5 Variant of IPR

During the period from 1999 to the end of 2002, ICT Milieu's financial model was based on *return-share* calculated by *full brand counting and subsequent weight*. The financial mechanism was not mandated in the backdrop ordinance and developed as a voluntary approach.

However, from the beginning of 2003, the financing system changed to the allocation of cost based on the current market share, and as a result individual financial responsibility ended. With this change sorting products by brand also disappeared. Although the free rider issue was a determining factor in the discontinuation of the individual financing mechanism in ICT Milieu, a more pressing issue was the role of changing proportion of market shares of members from a historical perspective. For example, a large PC manufacturer with a considerable market share in the past had seen a reduction in sales at the end of the 1990s. Given its historical presence in the market a large proportion of the total product returns at this time were from its own brand. Coupled with more recent reduced sales, this meant that this particular PC manufacturer had – in comparison with its competitors – much higher costs when proportioned to per unit placed on the market. Given these circumstances the manufacturer threatened to leave the system unless the financing model was changed. Here it should be noted that, under the WEEE Directive, approaches to IPR should only apply to new WEEE that is products placed on the market after 13 August 2005.

There were other mitigating factors that contributed to the decision of ICT Milieu to change its financing structure, including the existence of parallel importers which created a situation where more than one producer existed for a single brand. Other producer concerns included the difficulties in predicting their brand-specific returns and recovery costs which ultimately created issues for financial accounting purposes. This series of events actually emphasises the importance of financial guarantees in building a fair and efficient system based on IPR.

9.3.6 Analysis

The ICT Milieu case is interesting from several points of view. First of all it is interesting that in the Netherlands, ICT producers were not in favour of joining the NVMP scheme and established their own system for ICT products. Although, it has not been determined why this occurred, the author of this thesis has speculated that this was because ICT producers did not support the visible fee used in NVMP as well as the view that ICT products have more end-of-life value than 'brown goods' and hence did not want to cross subsidise another product group resulting in higher fees.

The fact that the system incorporated a return share model to allocate costs during 1999-2002 illustrates that influential members saw initial value in this financing mechanism. Although administrative costs and high orphan levels have often been cited in the literature as the main reason for the change towards market share, it was confirmed during interviews with representatives of ICT companies, that the main reason for switching to a market share allocation had more to do with a certain firm experiencing changing market shares over time connected to a retroactive individual financial responsibility. This lead to a higher current obligation to new sales ratio that ultimately disadvantaged a certain large player with a high historical market share.

9.4 Japan: SHARL Implementation

The Specified Home Appliances Recycling Law (SHARL) was enacted in 1998 and came into force in April 2001. The scarcity of final disposal sites, the increased volumes of EEE in the waste stream, and inadequate treatment facilities, were the main driving forces for the enactment of the law (MOE, 2003b; Tojo, N, 2004). Treatment standards for printed circuit boards and cathode ray tubes (CRT) in TV sets are mandated separately through a revision of the Waste Management Law. Under SHARL, producers of household appliances are required to take back their discarded products, dismantle them and meet reuse, recycling and recovery targets between 50-60%.

9.4.1 Covered Products

Four types of household appliances (B2B appliances not included) fall under the scope of the legislation. Products in scope include:

- Air conditioners (heat pumps)
- Televisions (CRT based only)
- Fridges/freezers
- Washing machines

SHARL is currently (2007-2008) under review by the national authorities and there is strong indication that two additional product groups will be added to the scope in the revised law. These include clothes dryers and LCD-display and Plasma-display TV Sets.

9.4.2 Collection

Under the law, *retailers* are mandated to accept end-of-life products from consumers when they sell products similar to the replacement product (1:1) as well as products they sold themselves in the past.

Retailers are required to deliver collected products to regional aggregation facilities set up by producers and are permitted to charge consumers a collection fee to cover these costs. Approximately 90% of the volume of collected WEEE treated by producers is from retailers, while roughly 10% is collected by local governments (in remote areas) or designated legal entities in the case of orphan products.

Producers are also permitted to *charge* an end-of-life management fee to the end user when the product is discarded. This fee is collected by the retailers or from post offices (consumers purchase a recycling ticket or manifest, and is forwarded to the appropriate producer account within the recycling ticket management organisation, known as RKC, once the final manifest copy is returned to the retailer from the recycling plant).

The recycling ticket is used to track the product from the point of collection through to the regional aggregation centre and recycling plant. The recycling ticket has five copies in which the consumer retails the original. The retailer keeps one copy and the remaining 3 copies follow the product to the regional aggregation points. A copy is filed at the regional aggregation centre and the remaining 2 are transported with the product to the recycling plant. The recycling plant retains the 4th copy and sends the final copy to the retailer to complete the cycle. On each copy of the ticket, product details (model number and manufacturer name) and the name of the retailer that collected the waste product are recorded. This allows for a consumer to be able to track the status of their waste appliance, through various processing phases. It also allows producers to trace how many waste products it has collected fees on and when and where these products have been managed.

In fiscal 2006, METI reported that 22.87 million home appliance units were discarded by consumers and other parties (. Of that total, retailers collected 17.2 million units for a fee and subsequently shipped 11.62 million to manufacturer consortia for recycling. Figure 9-5 below illustrates a breakdown of the products shipped to manufacturers from retailers that are handled through the producer recycling systems. Since the start of the program in 2001 volumes collected have continued to rise until 2005, when volumes have begun to level off.

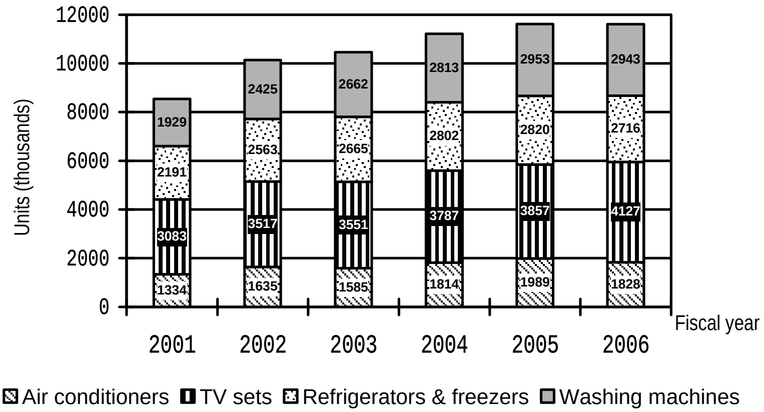

Figure 9-5: Total Units Collected by Retailers and Managed by Producers 2001 2006 (source (AEHA, 2008))

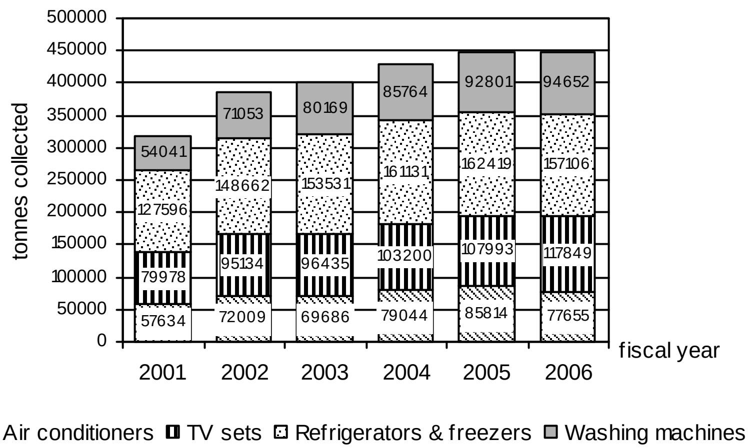

Figure 9-6: Total Tonnes Collected by Retailers and Managed by Producers 2001-2006 (source: (AEHA, 2008)

In Figure 9-7, the total collection tonnages are expressed as kilogram per capita ratio to give an indication of the relative success of the programme. Although the scope is considerably narrower than that of the EU WEEE Directive, the collection the system is close to meeting the WEEE target of 4 kg/capita/year. It should also be noted that computers and their peripherals are managed under another system, and that home appliances are generally lighter than those of their European counterparts. Important to note is that the total units handled through the producer schemes is estimated to be just over 50% of the total waste units arising.

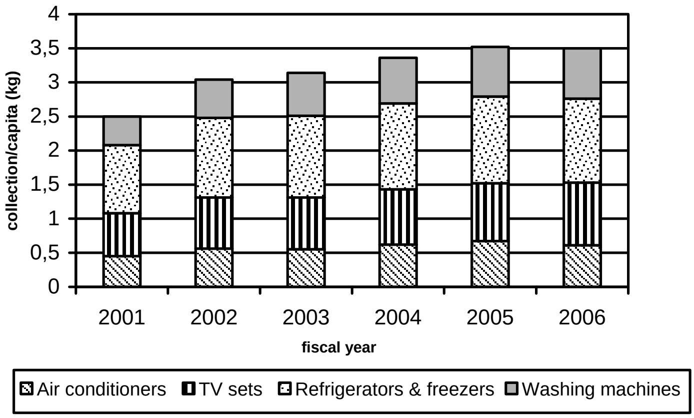

Figure 9-7: Per Capita Collection Rates in Japan in 2001-2006 (source (AEHA, 2008)

9.4.3 Treatment, Recovery, Reuse and Recycling

Under SHARL, producers have the operational responsibility for treatment and recycling. However, in order to fulfil their legal obligations, producers have formed two main groups imaginatively named *Group A* (21 manufacturers) and *Group B* (22 manufacturers). Waste products collected by retailers are separated into two streams according to the brands of either *Group A* or *Group B* and are then delivered (retailers responsibility) to consolidation or regional aggregation centres corresponding to the applicable producer group (DTI, 2005; Tojo, N, 2004).

Group A manufacturers have chosen to contract with existing recycling operators as much as possible, but certain producers in this group have also invested in their own recycling plants. Alternatively, producers in *Group B* decided to establish their own recycling plants through joint ventures where ownership of each recycling plant appears to be dominated by one key shareholder with financial contributions from other members in the group (DTI, 2005).

9.4.4 Financial Mechanism

Final consumers finance both the cost for collection and recycling through an end-of-life fee that is charged at the time of disposal. Separate fees are collected by retailers and producers for the collection and recycling respectively. For the costs of recycling, which includes the costs associated with operation of aggregation centres, transportation to recycling centres, administration costs, costs of the manifest system, recycling costs, etc, all producers have chosen to set the fee at the same level. Depending on the size of the retailer, prices charged for collection vary considerably.

9.4.5 Variant of IPR

Since all waste appliances are tracked through the manifest system by *brand and model*, each producer receives the recycling fee paid by the consumer into their own account. Subsequently, producers are responsible for financing the number of units handled by the recycling consortium respective of their own brand. However, there is no further differentiation of costs between brands, and a standard recycling fee/unit processed applies for all members in their respective consortia based on volume processed (Bohnhoff, 2008). Therefore the variant of IPR displayed is *Return-share by Brand.*

Although the last owner or final consumer finances the end-of-life costs at the time of disposal, the way in which the finances are allocated to the specific producer of the disposed product which is subsequently used to finance the treatment of that particular product, we consider this an IPR implementation. IPR applies to both new and historical WEEE, since there is no distinction made between historical and new products in the Japanese system.

Producers in Group B own and operate recycling plants as joint ventures, where typically one producer is the primary shareholder operating the plant. Therefore, for any efficiency that is achieved either through improved product design or improved treatment technologies that result in reduced end-of-life costs the benefits are realised by the producers themselves.

Similarly, the predominant producers in Group A have also invested in and operate at least one of their own recycling plants. Therefore there is *also individual physical responsibility* in the practical implementation of SHARL.

9.4.6 Analysis

The advantage of the producer's implementation of the SHARL is the creation of a strong link between the downstream management of waste products and the producer. This system allows the manufacturer to get feedback about the end-of-life issues related to the product. The recycling plants provide the manufacturer with product design related feedback from the recycling of their own product. Feedback reports from the recyclers encourage proposals for design improvements on issues such as material composition, ease of disassembly, and labelling. Companies operating the recycling plants see them as very much part of their R&D structure, and a number of manufacturers test their equipment through the plants before it is released on the market (DTI, 2005). The striking feature of this system is that it creates incentives for greener designs. Incentives to improve the efficiency of recycling operations, and hence lower operating costs, create positive feedback on greener designs, sometimes even beyond the legal requirements.

Although it is recognised that determinants of product innovation are likely to come from a variety of push and pull factors including law, consumer preferences, customer requirements, etc, Tojo (2004) provides empirical evidence that SHARL, as well as anticipation of the WEEE and RoHS Directives does provide tangible incentives for environmentally-conscious design in the case of electrical and electronic equipment (EEE) in Japan. The analysis of her interviews in 2001 revealed that all manufacturers that were interviewed considered anticipated regulatory requirements posed by SHARL in their product development strategies. Upstream measures in design, both in terms of reduction of hazardous substances and enhancement of source reduction of material use, re-use and recycling, have been undertaken by many Japanese manufacturers.

Vertical integration of OEM into recycling activities allows for ready available markets for plastics recovered at recycling plants. For example, a large proportion of plastics recovered at Kansai Recycling Systems Corp (KRSC) (Group B recycling plant) is incorporated into new products by Sharp. This includes approximately 150 tonnes/yr. from SHARL appliances, 15 tonnes/yr. from photocopiers and 10 tonnes/yr. from personal computers (DTI, 2005). Similarly, the Sony example provided below provides an interesting sub-case on the merits of this EPR system design for closing material loops.

On 4 December 2007 Sony Corporation announced that it had established an industry-first in-house recycling system for polystyrene (PS) cabinets from previously sold Sony CRT TVs and PS packaging materials used to ship product parts. The in-house system incorporates post consumer and post industrial materials into high quality, flame-retardant polystyrene that will be used in the production of parts in "BRAVIA" LCD TVs, scheduled to be released on the Japanese market in the Spring of 2008 (Bohnhoff, A, 2008).

Currently, the source of Sony-branded PS TV housings are exclusively from Green Cycle Corp, one of 15 recycling plants of Group B handling TVs for its members and in which Sony is the primary shareholder. To date no figures on the total number of expected TVs processed to recover PS are available, but to give an indication of expected quantities, in fiscal year 2006 (April 1, 2006, and ended on March 31, 2007), approximately 760,000 Sony-manufactured televisions were recycled in all Group B facilities. It is currently not known whether Sony expects to expand the recovery of PS housings from its TVs processed by the other 14 Group B recyclers.

In addition to the recovered PS from TVs, Sony sources polystyrene from used packaging from product parts shipped to Sony. Previously this material was reused and reformed as polystyrene foam products only, however Sony has now implemented a new proprietary additive that enhances heat and impact resistance of the recovered PS foam to a sufficient level to be used in TV parts.

According to Sony, the activities in this area deliver two significant advantages to the firm by reducing Sony's use of virgin materials while simultaneously lowering production costs, estimated to be approximately 10% (Bohnhoff, A, 2008).

Sony claims that the development of this closed loop recycling system has been facilitated by many product design initiatives it has undertaken since the early 1990's including, replacing and reducing the range of flame-retardants it uses, labelling plastics with the type of plastics and flame-retardants used, unification of the types of materials used and improving designs that improve disassembly efficiencies.

Other Issues

Since consumers or end-users of home appliances finance the end-of-life costs when they discard products, there has been some concern over the emergence of illegal disposal due to the relatively high fees (approx. 17 Euro to 32 Euro) incurred. However, this fear has largely been overestimated. According to the MOE, other than the first initial months of the system, the percentage of illegal disposal as compared to the total number of discarded products is less than 2% (MOE, 2003a). More recent estimates of product disposal pathways, suggest that this percentage has been further reduced to 160 000 units out of a total of approximately 22.8 million units disposed of annually (METI & MOE, 2007).

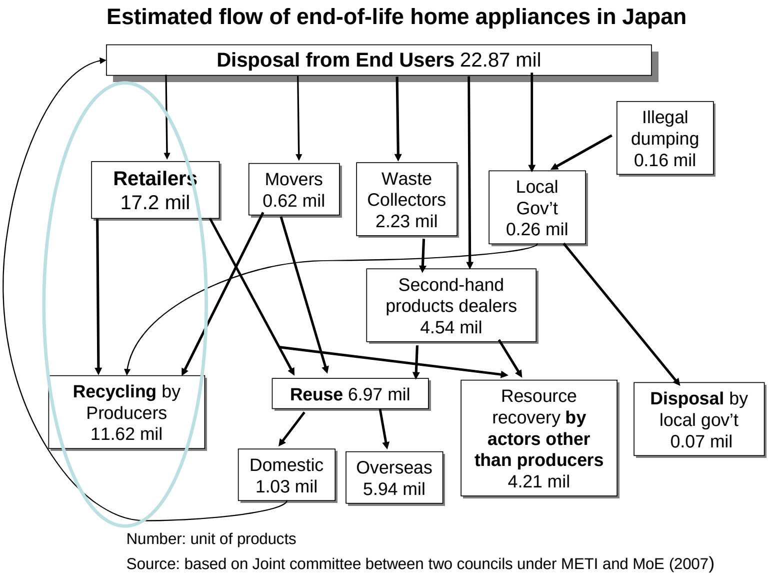

Figure 9-8: Flows of End-of-life Home Appliances in Japan (SHARL)

Given that it is final end users of appliances that finance the collection and recycling costs, there is no risk of costs falling on society or the remaining producers for orphan products. SHARL had a specific requirement that a 'designated legal entity' be formed to manage the physical responsibility of recycling products from producers that exit the market. This system was also available for small importers of products as well.

9.5 SWICO: A-signatories

9.5.1 Background

The Swiss Association for Information, Communication and Organisation Technology developed the 'Recycling Guarantee Programme' [hereinafter called SWICO] as early as 1994, with the backdrop legislation (Ordinance on the return, the taking back and the disposal of electrical and electronic appliances (ORDEA) only coming into force in July 1998.

In SWICO there are 5 product groups or sectors that make up its membership including; (1) Office electronics/information technology, (2) Consumer electronics, (3) Communication, (4) Dental equipment, (5) Photographic equipment (SWICO Recycling, 2008).

SWICO's membership is divided into what it classifies as 'A' and 'B' signatories. A-signatories finance the WEEE from their own returned products[69], and B signatories on a market share basis.[70]

9.5.2 Covered Products – A-signatories

Twenty-three (23) A-signatories are currently financing their own WEEE based on a quasi-return share. Products potentially covered under this financing model include those that fall under the SWICO product groups (1) Office Electronics/IT and (3) Communication.

9.5.3 Collection

There are four main collection routes for WEEE in the SWICO system. These include WEEE from (1) Producers' own take back efforts & service/repair centres – 'A-signatories', (2) Retailer collection sites, (3) Collection points (municipal collection sites, SWICO sites) and (4) SWICO organised pick up from large businesses, schools, hospitals, etc that are not

[69] Since A-signatory producers are financing the cost to manage the WEEE collected by their own activities (mostly their own branded WEEE), plus a portion of the costs to handle the SWICO WEEE stream this financing mechanism is similar to a return-share calculation.

[70] Since B-signatories simply forward the collected ARF to SWICO, the funds are used to finance the scheme on a PAYG model. This is essential a market share calculation.

organised by producers themselves. It should be noted that 2, 3 and 4 collection sources are considered to be the SWICO stream, while category 1 is the collection source of A-signatory managed WEEE streams.

Table 9-8: SWICO Collection Results 1997-2007(tonnes)

Year	(1) Producers *(A Signatories)*	(2) Retail	(3) Municipal & Other	(4) B2B collection	Total
1997	5 472	1 832	310		7 614
1998	5 838	2 439	967		9 244
1999	6 631	4 192	871		11 694
2000	5 920	5 443	1 418		12 781
2001	4 772	6 565	1 879		13 216
2002	4 284	13 839	5 570		23 693
2003	2 270	11 895	11 758	3 700	29 623
2004	4 900	8 309	15 100	8 100	36 409
2005	5 054	10 108	17 268	9 687	42 117
2006	3 687	9 677	21 198	11 521	46 083
2007	5 887	9 812	22 567	10 793	49 059

Source: (SWICO Recycling, 2008)

Table 9-9: SWICO Collection Results by Product Group – 2006-2007 (tonnes)

Product Group	2006	2007
Consumer Electronics	17835	21180
IT, Measurement, Security and Medical Equipment,	26831	26071
Communications	1201	1600
Mobile phones	74	69
Photographic Equipment	77	82
Dental Equipment	64	57
Total	46082	49059

(SWICO Recycling, 2008)

In terms of an indicator of effectiveness, the SWICO system compares past sales of products (average product life of 8.5 years in tonnes) to current collection amounts (tonnes) to get an overall collection rate expressed as a ratio. In 2007 the collection rate was 80%, however, in reality this percentage is higher as the tonnages collected by A-signatories that are reused as whole appliances are not included in the collection tonnages (Brändli, P, 2008).

Similarly, collected products from retailers that are subsequently selected for whole appliance reuse are not included in the total collected tonnages. Given this, it is clear that collection rates reported in SWICO refer only to collected WEEE that is further recycled. Given the reporting structures, it is not possible to know exactly what portion of the 20% of WEEE that is theoretically available for collection, is reused, exported, stored by consumers, or disposed of as municipal waste. In terms of kilogram/capita/year, SWICO has achieved a collection rate of 6.5 kg in 2007.[71]

9.5.4 Treatment, Recovery, Reuse and Recycling

All WEEE that is deposited at SWICO system collection sites (does not include A-signatories collection) must be treated by authorised SWICO recyclers. No reuse of components or parts by processors is permitted under the contract terms with SWICO, however A-signatories managing their own returns have no restrictions with this respect.

9.5.5 Financial Mechanism

The financial mechanism for both A & B producers is based on the ARF charged to customers on the sale of each product. However, while ARFs collected by B producers are deposited in SWICO's joint account and subsequently used by SWICO to finance the SWICO stream of returned products, A-signatories retain the collected ARFs in their internal accounts. The way in which A-signatories organise and finance the collection of their own WEEE plus a portion of their expected contribution to the SWICO stream is what distinguishes the A-signatory model as a return share allocation. This is described below.

Firstly, all WEEE that is collected by A-signatory producers through their *own* collection efforts is financed directly by A-signatories which is deducted from their internal ARF income accruals. A-signatories report on a bi-annual basis the amount of ARF collected and deduct permissible expenses associated with managing the take back and processing of end-of-life

[71] Based on 49 059 total tonnes collected and a population of 7 591 400 as reported at Swiss Statistics http://www.bfs.admin.ch/bfs/portal/en/index/themen/01/02/blank/key/bevoelkerungsstand.html

products. This may include own branded WEEE as well as WEEE from competitors products.

For the SWICO managed collection and recycling stream[72], each A-signatory finances a proportion of the total costs to manage the WEEE from office electronics/information technology (1) and communication (3), relative to its calculated return share in the SWICO stream. This proportion of costs is determined by the Environment Commission of SWICO, and includes an evaluation of the amount of expected WEEE for each A-signatory that is treated in the SWICO stream as well as an assessment of the amount of net revenue in A-signatories balance sheet from collected ARFs. The amount that each A-producer contributes to SWICO to manage its expected return share of WEEE and subsequent costs are invoiced as a percentage of ARFs collected. This percentage level is evaluated on a yearly basis, by re-examining the level of accrued revenue and relative return share in the SWICO stream and is adjusted accordingly (Brändli, P, 2008).

It should be noted that the ARF does not cover the future costs of managing the product which it has actually been charged to. Therefore the term 'advanced' is misleading to some extent. Essentially, the ARF is a variation of the PAYG system, where consumers of goods that are purchased in the current year finance the products that have gone on the market in the past and which have now become waste.[73]

9.5.6 Variant of IPR

For WEEE managed by A-signatory producers through their own collection i.e. collected from businesses directly and service/repair centres, producers have both a physical and financial individual responsibility for their own branded products. Individual financial responsibility is established as producers are financing the cost to manage their own WEEE through direct take back from customers. Since A-signatories are predominately treating their own branded products separately from other brands, a physical individual responsibility is also present.

[72] This does not include WEEE collected by A-signatories own efforts.

[73] An analogy can be drawn to the traditional pension system where retirees' pensions are paid from the contributions of current workers.

Each 'A' signatory producer finances the cost to manage their own products that the end up in the SWICO channels, based on return-share which is based on a combination of statistical sampling of the WEEE collection stream at selected treatment facilities and the level of accruals in each A-signatory account. However, there is no further cost differentiation between individual brands within product categories, to reflect further cost variances to manage products. Additionally, A-signatories have no control over how these products will be managed, and therefore no physical individual responsibility is established.

9.5.7 Analysis

While it is noted in SWICO's 2007 annual report that the reason for the declining number of A-signatories over the last number of years is related to the increasingly shorter product life cycles and reduced added value in the reuse of spare parts, there are other factors that also need to be considered that might explain this shift in chosen financial model.

One explanation could be that the A-signatories that have switched over to B-signatories have been experiencing declining market shares in comparison to competitors resulting in declining sales year on year. With decreasing sales comes less revenues generated from ARFs to finance the producers WEEE emerging from past sales. Once a decline in sales from year to year occurs, any rational producer would likely switch over to the jointly managed account (B-signatory) to avoid any potential shortages in funds which would require further outlay than the already levied ARFs.

Likewise any surplus of ARF generated revenues remaining in A-signatory individual accounts would by definition mean that the ARF is set at too high a level, or producers are not collecting significant volumes of their own products that are available for collection. This is especially true since the ADF is used (at least for B-signatories) as a PAYG financing mechanism, which by definition should be set at the actual level of costs to manage WEEE from past consumption to reflect intergenerational equity.

The financial mechanism for A-signatories is quite unique in terms of comparison to other financial mechanisms implemented for WEEE, not in that fees are levied on new sales of products to finance the waste of past products placed on the market, but that A-participants are using those fees to finance the WEEE that arises from their own products only. Most typically in collective PAYG models where for each product type (e.g.

laptop) the product fees are the same regardless of brand, the PRO uses those generated funds to finance all laptops collected. Where fees are charged based on a per unit price the PRO needs to estimate what the total WEEE costs are expected for each product group compared with the number of products within that product group expected to go on the market. With the total expected costs to manage a product as the numerator and the total number of new sales as the denominator the per unit fee to charge can be simply calculated. There are several ways of addressing the accounting issues associated with either a shortfall or surplus of funds depending on the actual number of products returned and sold in a given year. If there is a shortfall of funds in one year then fees can simply be increased to reflect the difference in the following year. Similarly, if a surplus is established, then producers could be returned a portion of the fees charged during the year.

However, in practice most PRO have been accruing large reserve funds which indicates that unit fees are often higher than the actual costs to manage collected WEEE. Examples include, Recupel in Belgium, NVMP in the Netherlands.

9.6 Other Developments

9.6.1 Washington State

Washington State passed EPR legislation on July 6, 2006 Chapter 70.95N RCW and Chapter 173-900 WAC that establishes the Electronic Products Recycling Program enabling individual producer responsibility based on return share. The programme is scheduled to begin operation in January 2009, and includes TVs, desktop computers, computer monitors and laptop computers. Individual producer responsibility in Washington is based on brand sampling rather than a full brand count of returned covered equipment. 'Return share' is the percentage of electronics products, by weight, that consumers have returned for recycling. The State determines the return share for each individual manufacturer and each plan. The total return share of the manufacturers participating in the plan determines the weight of electronic products that a recycling plan must collect in a given year (Washington State Department of Ecology, 2008).

Producers register with the State and must either participate in the standard plan developed by the State's Materials Management and Finance Authority

(WMMFA), or they can choose to operate their own independent plan if their return share is over 5% of the total.

Financial Mechanism

Within each independent plan or standard plan financial responsibility can be apportioned between members according to return share, or it may be apportioned according to other financial models such as market share.

The operators of the Standard Plan, WMMFA, recently approved a finance plan known as the "50-50" policy that incorporates market share. During the Plans first year of operation (2009), half of the costs will be financed based on market share and half will be financed based on return share. Over the course of seven years, all of the costs for manufacturers participating in the Standard Plan will be based on market share (Washington State Department of Ecology, 2008). What is interesting here is that although the market share model will be phased in over time, the denominator of the equation is the total return share of the members in the standard plan.

Table 9-10: Financial Mechanism in the Standard Plan: Washington State

Year	Allocation of total costs by weight put on market	Allocation of total costs collected by weight (return share)
2009	50%	50%
2010	55%	45%
2011	60%	40%
2012	65%	35%
2013	70%	30%
2014	80%	20%
2015	90%	10%
2016 and beyond	100%	0%

Source: (Washington Materials Management & Financing Authority, 2008)

WMMFA has also created an Independent Umbrella Plan (IUP) option to accommodate manufacturers who may have their own collection and processing activities. Under the IUP, members with at least a 1% return share in Washington will have the opportunity to get credit from the Authority for electronics products that they collect and process under the umbrella of the Standard Plan. IUP members will be responsible for the costs they incur to collect, transport and process their electronics, and will be responsible for their portion of the administrative costs of the Authority, consistent with the 50-50 policy. At this time, it is expected that all manufacturers will participate in the standard plan for the first programme year. In addition there is an annual administrative fee to be paid to the Department of Ecology, which is based on the market share of the manufacturer.

Western Electronic Product Stewardship Plan (WEPSI) & National Electronic Product Stewardship Plan (NEPSI) United States

WEPSI and NEPSI in 2002 organised multi-stakeholder dialogues throughout the Western States, which engage manufacturers, suppliers, distributors, recyclers, non-profit organisations, government and consumers.

One of the tasks in both initiatives was "to examine the feasibility of creating a mechanism to objectively evaluate electronic products according to their design-for-environment characteristics, specifically their design for end-of-life management" (Rifer, W & Stitzhal, D, 2002). The primary mechanism that was to be explored was the structuring of front-end fee according to product DfE characteristics. Specifically, the purpose was summarised in the following quote "If a front-end fee on the sale of electronic products is established to pay for the costs of end-of-life management, is it feasible to structure that fee such that a lesser fee would be paid for products that cost less to manage, and a greater fee for those that cost more?" (Rifer, W & Stitzhal, D, 2002).

CHAPTER

TEN

10. Analysis of Findings

Findings from 4 key components of the research; (1) the multiple cases on the transposition of the WEEE Directive into MS national legal instruments, (2) Chapter 6 on the role of product design on end-of-life cost/revenues, (3) Chapter 8, regarding practical implementation of the WEEE Directive and (4) Chapter 9 on variants of IPR implementation are analysed to provide insight into the determining factors causing difficulty when implementing the IPR principle. Chapter 10 aims to answer the third research question as outlined below:

Research Question 3: Why is it so difficult to implement incentive-based EPR programmes for WEEE in the European context?

10.1 Implication of MS Transposition in the WEEE Directive: Barriers to IPR

The following section provides an analysis of how the MS transposition outcomes presented in Chapter 7 have impacted the practical implementation of IPR as intended in the WEEE Directive.

10.1.1 Producer Definition

Section 7.2, summarises the outcome of each MS interpretation of whether a producer is defined as the actor who brings the product on the national market or on the European market. Clearly most MS interpret import/export as on the national market as only 3 MS apply the European definition of producer. Since MS have legal jurisdiction within their own borders, establishing a national approach has the advantage of facilitating authorities to identify a legal actor within their national territory that can be held liable for WEEE financing obligations. In fact, the Commission, in contradiction to its position described in Section 7.2, did officially acknowledge that it should be possible for Member States to impose national obligations on natural or legal persons who are placing products on their national market for the first time, irrespective of whether these products are from third countries or other Member States.[74]

However, with the national approach taken by the majority of MS, there are some unfavourable consequences with respect to the application of producer responsibility which can be summed up in the following 2 ways:

Potential multiple producers for the same product when traded on intra-community level and increase in administrative burden

Since MS define 'import' on the national level, the first importer is considered the producer if no manufacturer of that brand is present on the national market. Therefore, when products are subsequently shipped from MS to MS for distribution through intra-Community trading, there exists a potential that the same products will have one producer in one MS and one producer in the other MS. This is illustrated in the Figure 10-1 below, given a hypothetical example of intra-community trading between companies in Sweden and Germany. For this particular shipment of EEE products, a producer would be identified in Germany – i.e. the brand manufacturer who sold them on the German Market – as well as the Swedish wholesaler or reseller placing the products on the Swedish market, who would be identified as a producer according to the Swedish law.

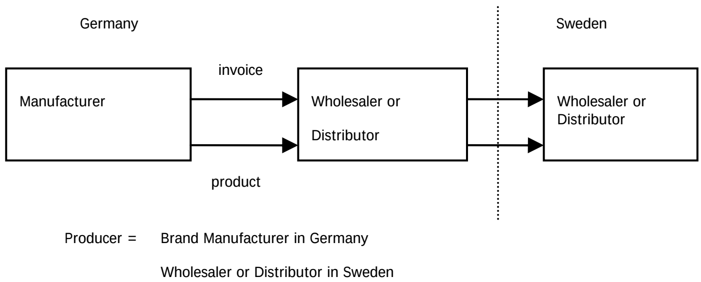

Figure 10-1: Potential Impact of National Definition of Producer

Since obligated producers are required to register and report products placed on the market, provide financial guarantees, label products to identify the

[74] Barroso (2005) A/5856. Letter to Mr. Xavier Durieu Secretary General EuroCommerce. From Mr. José Manuel Barroso, President of the European Commission, 28 11 2005.

producer and finance WEEE, duplication of these activities and costs occurs when the national definition of producer is applied.

Potential Conflicts with incentives for Product and Product System Improvements and the implementation of Individual Producer Responsibility

The second major implication from the national definition of producer arises in following scenario similar to what was described above. When a 'manufacturer' or brand-owner does not have a legal presence in a MS that uses the national approach to the definition of producer, the legally obligated party designated as the producer becomes the actor who brings EEE onto the national market for the first time. Given that this would likely be a wholesaler or 'distributor', it is questionable whether this actor is best suited to meet the requirements of the producer responsibility in the Directive.

Producers are obligated under Article 4 of the WEEE Directive to ensure certain design characteristics are met for the products they place on the market. In addition to encouraging the design and production of EEE that facilitates dismantling and recovery, and in particular reuse and recycling, producers must also ensure that the deliberate design of products that inhibits reuse is avoided. It could be questioned to what extent a wholesaler has influence over the design of products and thus the effectiveness of applying responsibility for such activities to these actors.

Given that IPR in the WEEE Directive is intended to provide the maximum effect of producer responsibility, it could also be questioned whether these incentives are best aligned when wholesalers or retailers become the legal producer on a national market rather than the manufacturer or brand owner of the product who presumably has a greater level of control over product design.

10.1.2 Allocation of Responsibility for Collection

As found in Section 7.3, the solutions taken in MS vary significantly. The ambiguity of the Directive text with respect to Article 8 wording of "at least", as well as the wording of Article 5, creates considerable leeway for MS to assign responsibility to actors already involved in the collection of WEEE from private households. Furthermore, the Directive does not provide clear indication as to whether the distributors' obligation to receive WEEE 1:1 is merely a physical responsibility, or whether they need to cover the cost associated with it. This also provides rooms for various solutions to emerge.

From a national perspective, the ways in which Member States allocate responsibility for the collection of WEEE from private households appear to impact all producers equally. This means that prices of products will not be disproportionate to one another within a MS. However, the same may not be said when comparing prices of products in MS where the financial responsibility for collection has been placed on producers to prices of products in MS where collection is financed by general taxpayers or other actors.

Another implication of the involvement of municipalities in the collection of WEEE from households is that it may create a *disturbance to a level playing field* for producers that choose to set up their own independent compliance schemes. This is because they may not have access to collection sites that is potentially subsidised by municipalities.

Industry has argued that collection costs have little or no connection to eco-design incentive and therefore producers should never be given the obligation to finance such activities. Their aspiration is reflected in the WEEE Directive text within the opening lines of Recital 20, where financial responsibility of producers is suggested to begin from collection point onwards and not the collection from households. However, when considering the polluter pays principle, it may not be appropriate that general taxpayers, rather than consumers of EEE, finance the collection of WEEE from private households.

10.1.3 Financial Mechanism: Principle of IPR

In terms of the producer responsibility principle, Article 8 of the WEEE Directive has been considered to have significant importance with respect to establishing incentives for producers to design products for improved end-of-life management. As described in detail in previous sections, this is made possible by assigning an individual legal and financial responsibility to each producer to finance the management of waste from 'his own' products.

The distinction between the financial mechanism to be applied for new WEEE (placed on the market after 13 August 2005) and historic WEEE (placed on the market before 13 August 2005) is clearly laid down in the WEEE Directive. Producers have an individual financial responsibility for new WEEE while at the same time since they could not influence the design of products placed on the market before the directive came into force, the WEEE Directive assigns collective responsibility for this historic WEEE and the costs to deal with those products are apportioned to all producers on the market when the costs arise.

However, the second sentence of Article 8(2), which states that producers are able to fulfil the obligation for individual financing for new WEEE either individually or by joining a collective scheme, and it is this wording that is causing a great degree of confusion on the issue.

Interpretation of the financing principle for New WEEE: IPR

The implications of Article 8(2) mandating individual financing of new WEEE can be discussed from two aspects. The first is the limitation of responsibility given to the producers by specifying that they are responsible for financing their own WEEE, and secondly, the operational side of developing systems to manage WEEE in practice.

Article 8(2) allows a producer to be able to fulfil the obligation to finance new WEEE management relating to the waste from his own products either individually or by joining a collective scheme. Given that producers have the flexibility on how to fulfil their obligation in practice, it has been argued that producers who choose to join collective operational schemes using the *'Pay As You Go'* financial mechanism would be able to meet their obligations for new WEEE as well, even though compliance scheme does not allocate costs based on what is actually returned. At the same time proponents of IPR claim that Article 8(2) does not allow the producers to chose between collective and financial responsibility for new WEEE, rather how they physically meet the legal obligation to finance their own WEEE.

Despite this ambiguity, regarding the limitation of financial responsibility for new WEEE, the wording of Article 8(2) makes it clear that whether producers are members in collective compliance systems or individual systems, they should never be forced to pay for the costs of managing WEEE from other producers. This raises an important question. If producers are not required to finance the WEEE from other producers that have become insolvent, which actor would be responsible for financing the WEEE where no financial guarantees are available because the waste products to be financed are those of free-riders that never registered or made financial guarantees in the first place? If the obligation is not on the remaining producers then who should pay the costs, MS, municipalities or general taxpayers?[75]

This means that market surveillance is critical to ensure that all actors placing EEE on the market are identified and provide a suitable financial guarantee for the future end-of-life management of these products. *This is perhaps one of the most likely arguments why certain MS have not explicitly allocated individual financial responsibility to producers or have explicitly chosen to take the market share based approach for the financial mechanism for new WEEE.* From the market surveillance perspective, less pressure is placed on national governments to identify all actors on the market when a collective responsibility based on market share is defined The remaining producers on the market would inevitably pay for the management of free-riders and there would be no risk that these costs would fall on actors other than producers.[76]

It should be clarified that a producer is legally responsible to finance the waste from his own products, regardless of the choice to physically develop an individual system or to join together with other producers in a collective infrastructure.

There is a difference between the legal obligation to finance a producers own WEEE, and how systems are set up in practice to meet this obligation. Individual financial responsibility does not necessitate the development of individual systems to manage producers own brands. If producers choose to

75 The range of new WEEE whose end-of-life management is not secured may become even wider considering how the requirement for financial guarantee is currently understood in many MS (see Section 7.6 for details on MS interpretation).

76 This argument is supported by the fact that in the Council's Common Position of 4 December 2001, Article 7(4) (added by the Council) clearly placed the legal responsibility on remaining producers in the market to finance any future orphans that may arise if producers are not identified and provide for a guarantee when they place products on the market. Article 7 (4) reads: "The management of WEEE coming from producers that are no longer present on the market or which can no longer be identified at the time when the costs occur shall also be financed by producers, and Member States may provide that it is financed in accordance with paragraph 3."

As a counter proposal to the Council's view that any future orphans be financed by producers on the market when the costs arise, the Parliament inserted the requirement for a guarantee to be made when producers place products on the market, which ultimately remained in the final legal text of the WEEE Directive after the conciliation process. This clear difference of opinion between the European institutions provides insight into the current outcome of the transposition process.

join a collective scheme that uses the PAYG[77] financing mechanism, in essence they may agree to finance the WEEE of others, as this is there choice. However, as noted above, this approach entails a risk of missing actors that are responsible for handling of orphaned products.

IPR in practice

As was discussed above, elements of IPR can be realised in practice both in collectively organised and individually organised compliance systems. Given that there are both environmental and economic benefits from collectively organising the collection and transportation and processing of WEEE, especially from private households, it is not surprising that there has been collaboration between producers on this front. However, in terms of the financial mechanism applied for allocating the costs of the system to individual producers, there are collectively managed EPR programmes that attempt to base this on actual costs associated with managing individual producers WEEE.

As presented in Chapter 9, there are several EPR programmes in operation today or in the past that have or had elements of IPR embedded within their operational structure. For example, within ICT Milieu (the collective system for ICT equipment in the Netherlands) until the end of 2002, an individual producer's monthly financial contribution was based on the actual weight of their own brands recycled plus a proportion of the WEEE from orphaned and free-rider products.[78] In Japan, under the Specified Household Appliance Law (SHARL), for the two main compliance schemes that have emerged, financial responsibility for treatment and recycling is determined on the basis of each manufacturer's own share of returned equipment.[79] Similarly, Maine (in operation), Washington State, Oregon and Connecticut

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[77] PAYG is a financial model used as a mechanism to allocate costs of WEEE management to producers proportionate to their market share when those costs occur. The definition includes systems that charge producers a flat fee when placing a product on the market, which is usually based on an estimate of the number of products that are expected to be sold and the amount of all brands of WEEE expected to be returned in a given reporting period (usually annually). It also can apply to systems where current collection and recycling costs are based on market share calculations.

[78] Section 9.3 includes a detailed description and analysis of the ICT Milieu compliance system during the period from 1999-2002 when it employed return-share financing.

[79] Section 9.4 provides a detailed description and analysis of the implementation of SHARL in Japan.

(planned) in the United States have or will have EPR systems that are based on the return-share financing model.[80]

In these models, although no distinction has been made between the properties of products when treated, producers financed a share of the total costs to manage WEEE based on their own products that were returned. This financing model based on *return-share* provides incentives for producers to both lightweight products and encourage durability, since the costs producers pay individually are dependent on these variables. Meanwhile, none differentiate the fees based on the inherent costs to handle an individual producer's products. This means that other variables that influence cost, such as the presence of hazardous components that need to be dismantled and separately treated – and hence increase costs – do not influence individual producer's fees under the existing return-share model. Although return-share could be considered a proxy for Individual Producer Responsibility, further differentiation of the fees that producers pay to manage their individual costs is needed in order to provide further incentives for improved design.[81]

The most common argument brought forth against the financing model based on return-share, is that added costs associated with sorting or sampling WEEE by brand and that these additional costs do not yield enough environmental gain to justify them. While there is no doubt that costs would increase as a result of either a full WEEE sorting by brand, or a representative sample and subsequent sorting by brand to identify return-share, in many collective systems operating today there is already sampling or full sorting taking place. This is required for a number of reasons, such as the request of members in collective systems to ensure that no cross subsidisation takes place within collection categories and to meet the reporting requirements of national authorities for WEEE collected and managed by producers. Some sorting of representative samples or full

[80] Section 9.1 provides a description and analysis of Maine's EPR programme based on return-share through full brand counting.

[81] Depending on the product category in question, there may be very little variance between the costs to manage individual producers brands. This of course should be considered when deciding on the suitability of individual financing mechanisms within collective schemes. At the same time, one should not under estimate how such incentives might drive firms to consider product alterations in order to reduce the cost of end-of-life management.

stream takes place on a product category level, although not to the brand level. The added costs to identify individual brands may not be significant.

While added costs to administer a return-share based financial mechanism may be overstated, there are other factors that may hinder the introduction in the European context. Firstly, since historical WEEE in many countries are financed collectively based on market share of each producers, it might be difficult to introduce the return-share model while historical WEEE dominates what is being collected. On the other hand, the market-share allocation is only suggested in Article 8(3) of the WEEE Directive as an example for how to allocate the costs to manage historical WEEE proportionately.

Another problem may arise when there are parallel imports of the same brand. This may pose difficulties in subsequently identifying who the appropriate producer for return-share purposes. If parallel importers are identified as producers in the national context and they subsequently do not label their products to distinguish themselves as the producer, it would not be possible to determine which producer to credit for the return (either the brand owner or the parallel importer). The implications of this are discussed further in Section 10.1.6.

Changes in the market share of producers over time may bring resistance to the return-share model. This is especially the case where certain producers who had a historically large share of the market in the past and currently have a smaller share are required to finance a proportionately larger share of the current costs. Similarly, variation in market share over time might make it difficult for producers to predict the recovery costs when based on return-share financial models. These points were all raised by ICT Milieu as being influential in the decision to move to away from the return-share model.

Despite these difficulties, renewed interest in the return-share model for financing has emerged in Europe. The European Recycling Platform (ERP) has as recently as June 2007 conducted return-share pilots in Ireland and Portugal in order to investigate and demonstrate the feasibility of a return-share based system for IPR and to explore the return share data that is generated in comparison to existing data from the Netherlands and the USA. Results are complete for Ireland, where WEEE collected during one week period from 9 retailer and 10 civic amenity sites was collected and sorted by WEEE product categories 1-10, the product type and brand. Results are currently being analysed by ERP Ireland (Dempsey, M, 2007).

The issue of Provisions

As the WEEE Directive places financial responsibility on producers for the management of historical and future WEEE from private households differently, the question of how to treat this financial liability through accounting practices became an issue for corporate auditors. Namely, the WEEE directive had given rise to questions about when the liability for the management of WEEE for historical and new WEEE should be recognised. This was brought to the attention of the International Accounting Standards Board (IASB).

Through the work of the International Financial Reporting Interpretations Committee (IFRIC), a draft interpretation D-10 "Liabilities arising from Participating in a Specific Market—Waste Electrical and Electronic Equipment" was issued in November 2004. This was later released as IFRIC Interpretation 6: Liabilities arising from Participating in a Specific Market - Waste Electrical and Electronic Equipment in 2005 (IFRIC, 2005).

IFRIC 6 clarifies the timing upon which certain producers of electrical goods will need to recognise a liability for the cost of waste management relating to the end-of-life management of historical WEEE supplied to private households. IFRIC 6 states that the event giving rise to the liability for costs of such historical waste, and so its recognition, is participation in the market in a measurement period. In other words, this can be understood as a period in which market shares are determined for the purposes of allocating waste management costs for historical WEEE.

The Interpretation addresses neither new waste nor historical waste from sources other than private households. The liability for such waste management is adequately covered in IAS 37.

IAS 37, is a specific standard under the International Accounting Standards Board (IASB) that creates generic rules for the accounting treatment of all legal obligations with inherent financial liabilities. Specifically, IAS 37 provides rules under which provision can or can not be made in internal accounts of organisations (IASB, 1998).

Since under Article 8(2) of the WEEE Directive producers are responsible for financing the waste from their own products placed on the market after 13 August 2005, a legal obligation is present satisfying one of the 3 essential criteria of IAS 37 that should be satisfied before making a provision.

The amount recognised as a provision should be the best estimate of the expenditure required to settle the present obligation at the balance sheet date, that is, the amount that an enterprise would rationally pay to settle the obligation at the balance sheet date or to transfer it to a third party. Provisions for large populations of events (warranties, customer refunds) are measured at a probability-weighted expected value. Measurement are at discounted present value using a pre-tax discount rate that reflects the current market assessments of the time value of money and the risks specific to the liability (IASB, 1998).

In reaching its best estimate, the enterprise should take into account the risks and uncertainties that surround the underlying events. Expected cash outflows should be discounted to their present values, where the effect of the time value of money is material (IASB, 1998).

Even though IFRIC 6 may imply that if in national legislation new waste from private households is treated in a similar manner to historical waste the principles of the interpretation could apply, it is not explicitly stated.

Given the outcome of transposition with respect to Article 8 and the fact that many compliance schemes are not making a distinction between historical and new financing obligations, it can be expected that producers in different Member States will be subject to varying requirements when it comes to making accruals for WEEE management. This may result in an inconsistent application of accounting practices between Member States.[82]

In fact, discussions with producers on this issue revealed that producers are uncertain if long-term provisions are needed for new WEEE, given that in certain Member States the WEEE transpositions do not make a distinction between new and historical WEEE liabilities. Even in the Member States where it is clear that for new WEEE, producers are responsible for the financing of the waste management of their own products, accountants seem to have varying views on whether long term provisions should be made for new WEEE. This is primarily due to fact that membership in a compliance schemes is considered the financial guarantee. Since the financing mechanisms of these collective schemes are based on market share calculations, it is believed that IFRIC 6 should apply.

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82 http://ec.europa.eu/internal_market/accounting/docs/ias/roundtable/060920issues-paper.pdf.

This issue of whether long-term provisions should be made or not by producers for new WEEE is not resolved, especially with respect to producers who are members in collective compliance schemes where membership in the scheme is considered the financial guarantee. On the other hand, the requirement is more certain if producers chose to organise their compliance individually, especially when the national legal text mandates individual financial responsibility for new WEEE, as in Article 8(2). This does not provide for a level playing field between collective compliance approaches and producers who wish to organise the management of WEEE take back individually. The issue will be further discussed in the following section 10.1.4.

A similar parallel can be drawn to the issue of provisions made for product returns under manufacturer warranties. Under IAS 37, provisions should be made at the time of sale, which is the past event.

Financial Mechanism for Historical WEEE

Although retroactive effect or retroactive responsibility is prohibited in European Law, exceptions are possible, as reflected in the *Moscov* case (Vedder, H, 2002). In this case the Court observed that in general the principle of legal certainty precludes a Community measure from taking effect from a point in time prior to publication, although "it may exceptionally be otherwise when the purpose to be achieved so demands and where the legitimate expectations of those concerned are duly respected".[83] What this means, is that any measure applying retroactive effect will firstly be assessed in terms of proportionality. "Then it will have to be established whether the complainant's expectations qualify for protection, in the sense that he was entitled to rely on them".

10.1.4 Financial Guarantees

The results from Section 7.6 show that most MS exempt producers who are members in a collective compliance scheme from their obligation to set aside financial guarantees for new WEEE. This transposition outcome has various implications for implementation of IPR in the European Union.

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83 Case C-244/95 Moskov[ECRI-6441, para 77.

Lack of a level playing field and inflexibility

The current transposition in most MS requires a producer that chooses to set up an own brand or limited brand compliance system to take out recycling insurance or create a blocked bank account as a financial guarantee. Meanwhile, producers joining a collective scheme are exempt from the requirement of providing a financial guarantee.

This implies a higher financial burden for producers choosing to set up an individual system or limited brand compliance scheme. Many producers have cited the fact that the added costs of providing a financial guarantee is one of many limiting factors hindering the development of individual or limited brand compliance schemes.

Moreover, for economic efficiency it is essential that a producer can leave one system and join another or establish his own. This will force the various actors to continuously improve their systems. This is equally important when it comes to the system for financial guarantees. A producer must be able to shift the way he/she organises the financial guarantee without jeopardising the guarantee for the products which are already on the market and without jeopardising the guarantees of an organisation to which he/she previously belonged (van Rossem, C et al., 2006).

Findings from interviews with producers that have producer responsibility obligations on a Pan-European basis suggest that for the most part there has been little demand on the market for financial guarantee solutions. In their view, this is primarily a result of the fact that in most Member States membership in a compliance scheme is considered as the financial guarantee. Two notable exceptions are in Germany and Sweden, where there is a legal requirement to provide a financial guarantee regardless of the compliance approach taken. A number of insurance type solutions have emerged that have been developed by industry associations to meet this demand. The adequacy of the type of guarantee in Germany can be questioned, as discussed in detail in Section 7.6.3. Solutions developed in response to the demand for financial guarantees are presented in Section7.6.2.

In order to ensure a level playing-field for producers whether they choose to join a collectively-organised compliance system or establish an own-brand or limited brand compliance system, the requirements for a financial guarantee should be the same for both. This would also help allows a dynamic and flexible development of various efficient solutions.

Provision of adequate funds for WEEE Management

Recital 20 of the WEEE Directive provides an overall goal of the guarantee, namely that costs do not fall on society or the remaining producers on the market. Membership in a collective scheme based on the PAYG model that includes agreements on reciprocity, as considered by most Member States as an appropriate guarantee, can be questioned from this aspect.

There are a number of uncertainties regarding whether there will be adequate funds available to finance all new WEEE placed on the market. The risk is found primarily in countries where the national transposition addresses individual financial responsibility as written in the WEEE Directive, and at the same time the financial guarantee is waived for producers that are members of collective compliance schemes. In such a case, according to the law the producer could never be forced to finance the WEEE of other producers. If a major actor was to leave the compliance scheme either to develop its own individual systems, join another collective system, or exits the market due to insolvency, which negatively impacted the costs of all remaining producers in the scheme, there is no legal argument that would force the remaining producers to finance the WEEE of the actor leaving the scheme. Unless there were long-term agreements of producers that stipulate that producers could not leave the scheme, the chances that this might occur are real. Moreover, if any player with significant market share were to leave the market or the collective scheme, potential system collapse cannot be ruled out.

Member State concern over IPR: If market surveillance is not successful.

With IPR the market surveillance is essential in order to ensure that all actors on the market are identified and place a financial guarantee to ensure the availability of adequate funds for the end-of-life management of WEEE in the event of insolvency or bankruptcy. Therefore, increased onus is placed on Member States not only to survey the market, but also to ensure that financial guarantees will hold up to the test when they are called upon.

Conversely, this onus is placed on producer compliance schemes and producers when the collective approach to financing WEEE is chosen. This is because orphan products will be financed by actors on the market at the time when the cost to manage orphans occur. As discussed in Section 6.4, the MS concern over the market surveillance prompted them to argue for collective responsibility.

Lack of consultation with the financial sector and guidance to Member States

During the legislative process of the WEEE Directive, it was realised quite late that in order to ensure that IPR could be operationalised, there was a need for a financial guarantee to ensure that costs do not fall on actors other than the producer who placed the product on the market.

The requirement for a guarantee calls on Member States to build certain mechanisms to ensure that the financial guarantee would be available in the event that a producer is no longer present on the market when the costs to manage the new WEEE is incurred. There must be assurance that neither the producer nor the guarantee provider would be able to cancel the guarantee before it can be triggered. A guarantee should be secure from creditors in the case of bankruptcy or insolvency.

However, no guidance was provided in the WEEE Directive on what these mechanisms could be. Moreover, little consultation with the financial sector was undertaken to understand how the guarantee would impact a company's financial accounting and more importantly how these options would actually be put in practice. In order to facilitate further development of financial guarantee, existing knowledge in the field should be better cultivated. The role the producer register may play in the confirmation and suitability of producer guarantees, although not explicitly mentioned in the WEEE Directive, is an important consideration for Member States.

10.1.5 Distinction between B2C & B2B

Due to the different legal requirements to collect, finance and provide guarantees for WEEE between that from private households and that from business several issues have arisen that may impact the implementation practice. This is referred to the B2C/B2B split dilemma, where part of the legal differences refer to when the products are placed on the market (financial guarantees only required for B2C products) and part when WEEE is collected. Problems specifically arise in the special case of the so-called *dual use products* – products used by both private households and institutional users. Dual-use products include products such as mobile phones, laptop computers, desktop PC, but may also include refrigerators and stoves that are often found both in work offices and homes.

Migration of products from business users to private households

It is important to ensure that the management of WEEE of dual use products sold to businesses that subsequently migrate to private households and eventually discarded will be financed at end-of-life. To address this migration issue, many MS have mandated that unless otherwise proven, all dual use products should be declared as B2C EEE. Although this may help to ensure that all WEEE that migrates to household users is financed, it may also have certain negative impacts as well.

In the case when dual use products sold to businesses are classified as B2C (laptops, mobile phones, etc.) and must be reported to the national register as B2C, several issues arise. Since in many cases the clearing house uses this reported figure to calculate market share obligation of a producer, if producers have contracts with their commercial clients to manage end-of-life products (for the same products that are classified as B2C), there is a concern that producers are in essence paying twice for the management of these products. Once when they are put on the market, and second when WEEE from the business is treated.

Certain countries such as in Austria and Germany have attempted to address this by allowing producers to deduct any dual use products classified as B2C that they have collected from businesses by their own efforts from their B2C obligations calculated by the clearing house.

Provision of collection sites for business users

If producers declare dual use products sold to businesses as B2C, whether or not these businesses have access to collection points for disposal becomes a potential issue that needs to be considered. If businesses are not allowed access to municipal collection sites to dispose of their WEEE, producer's compliance scheme should make alternative arrangement to collect this WEEE from businesses. This is true especially when fees have been levied based on the number of products placed on the market. It also applies to systems where costs to manage WEEE collected from private households is based on market share.

Take back of other producers' WEEE as common business practice

Depending on the product category it is fairly common that producers agree to take back products that the new sale is replacing at the time of delivery or soon thereafter. These replacement products may not be the same brand as the products being replaced. One question that emerges is how could this impact responsibilities for own new B2B WEEE. If it is expected that producers will continue to offer collection of B2B WEEE on a 1:1 basis would producers also need to have dedicated systems for new WEEE? This has not been determined in any detail.

Added responsibility and selection of compliance approaches

In certain MS the national legislation has laid down additional responsibilities above and beyond what is required in the WEEE Directive. B2B producers are in certain countries required to develop waste management plans and financial guarantees. Administrative burden associated with developing a waste management plan may limit the development or continuation of individual compliance systems for B2B products and clients. Producers may simply decide to contract the same compliance scheme that handles its WEEE from private households obligation, instead of developing or operating its own system for B2B WEEE.

Similarly, although the requirement for a financial guarantee in Article 8(2) of the WEEE Directive applies to WEEE from private households, some Member States have extended the obligation for a financial guarantee for WEEE from users other than private households. If membership in a collective scheme is considered to be the financial guarantee, as is the case for WEEE from private households, then producers may be inclined to join such compliance schemes to avoid more costly guarantee options associated with individual compliance.

This may have a negative effect on the development of producers' national Europe-wide individual take back systems which have been developed either before the onset of the WEEE Directive or in response to new obligations.

EICTA's proposed criteria list to distinguish B2B from B2C

EICTA has proposed the following list of criteria that could be applied when deciding how to classify an EEE when it is placed on the market (EICTA et al., 2006).

1. Evidence in the form of signed contract between the business user and the Producer (or party representing the Producer e.g. reseller under contract), that clearly assigns responsibilities for end-of-life collection and treatment costs, ensuring that the EEE will not be disposed of through municipal waste streams, or

2. EEE that due to its features is not used in private households and that will therefore not be disposed of through municipal waste streams. This criterion should be supported by either one or a combination of the following criteria:

a) EEE that is operated by specialised software as for example an operating system or system environment requiring a special configuration for professional use.
b) EEE operating at a voltage or having a power consumption outside of the range available in private households
c) EEE requiring professional licenses to operate, e.g. Base Stations requiring the license of the telecommunication regulator
d) EEE of large size or weight requiring to be installed and de-installed or transported by specialists
e) EEE which requires a professional environment and / or professional education (e.g. medical X-ray equipment)
f) EEE in category 10 of Annex 1A
g) EEE outside of the scope of the General Product Safety Directive for consumer products.

Sub-points a-g in point 2 seem to provide a clear indication that these types of products would never end up as WEEE from private households. The first criterion could be more difficult to ensure compliance with as these products may end up being re-sold to users from private households. This would be difficult to monitor in practice. However, by not allowing this option many initiatives by individual producers to take back WEEE would be discouraged.

10.1.6 Producer Identification

Producer identification is crucial to enable individual producer responsibility for new WEEE as outlined in Article 8(2). That is, if the costs are to be allocated to producers for the management of their own WEEE, some form of identification is necessary to achieve this. Moreover, producer identification is also necessary for authorities to be able to trigger a financial guarantee of a producer that is no longer on the market when the costs to manage its new WEEE arise.

This does not necessarily require all WEEE to be sorted by each individual producer, but at minimum identification of the responsible producer through sampling of WEEE must be possible. Similarly, being able to distinguish between new and historical WEEE is equally important as individual financing is only applicable for new WEEE, according to Article 8.

Producer definition and product identification

From the government perspective, there does not seem to be any identified issues with respect to producer identification, when the legally obligated producer is the brand owner or manufacturer of the EEE placed on the national market. This is due to the fact that labelling for producers is made during the manufacturing stages of the product. Even when production is outsourced to third-party manufacturers, these requirements are easily communicated in contractual agreements determining product specifications.

However, problems arise when considering how Member States have interpreted the definition of producer as discussed in previous sections. When the national definition of producer is applied, the identified producer in many circumstances will be the local actor that brings EEE on to the national market. In countries where a manufacturer has no legal operations this is either the wholesaler, distributor or in some circumstances retailers. Accordingly, these actors identified as the producer on the national level are required to mark these products to distinguish themselves as the producers. This would ultimately require a re-labelling of the product if the national producers' identity was not printed on the product during the manufacturing process.

In reality, however, this is not common practice within the EEE industry as products are manufactured for the entire European if not international markets. As mentioned in Section 7.2.1, Commission services have responded to industry concern over the requirement to re-label products. When speaking with manufacturers and wholesalers during interviews, we have not been made aware of any actors that are re-labelling products to meet the requirement to identify the producer in Member States, especially where the obligated producer is different from the producer identification marked on the product. Similarly the brand manufacturers interviewed had not mentioned that they had received any requests from customers (distributors, wholesalers or retailers) to re-label their products.

Additional requirements

Certain Member States have mandated additional marking requirements on products that go beyond requirements of the WEEE Directive and EN 50419:2006. For example, Bulgaria requires that the registration number appear on the product, while Estonia requires that the producers' telephone number, address and registration number are marked on the product. Additionally, Poland requires that producers report the weight of the product in the user manual. Interviewees from industry have indicated frustration on additional administrative burdens these requirements create.

10.2 IPR Implementation & Applicability to the European Context

In this section the findings from the cases on implementation of systems with elements of IPR are compared with the results of European transposition and implementation in the MS in order to analyse the applicability of those implementations to the European context.

10.2.1 Distinction between Historical vs. New WEEE

One of the key differences with respect to IPR in the WEEE Directive compared with the variants of IPR found in the Japanese SHARL, Maine and ICT Milieu programme implementation is that only in the WEEE Directive is there a distinction made between the financing mechanisms for historical vs. new WEEE.[84]

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[84] The author of this thesis is aware that the EPR programme for ICT in Japan does distinguish the financing mechanism between new and historical WEEE. For historic WEEE the end-user finances the disposal and recycling costs through end-of-life fee

In fact, in the Maine and former ICT Milieu systems, producers have a *retroactive individual responsibility* for their products put on the market before the law came into effect. From a practical implementation standpoint, this mechanism is far simpler than making a distinction between historic and new WEEE, as there is no need to identify their relative proportions in the waste stream. Since making a distinction also requires a unique identifier on a product to account for new and historic WEEE ratios, no identification is necessary in these retroactive IPR systems, other than to identify the producer.

However, at the same time since producers were not aware of future legislation when they designed products in the past, the incentive mechanism is non-existent for these historical products. Since only new products can be redesigned the argument for IPR for new products exclusively, and not for historic products is logical.

The above argument is also supported when looking at the plausible explanation of why the ICT Milieu model shifted from that of return share to market share. Shifting market share over time, especially from a high market share in prior years to a declining current market share, negatively impacts these producers compared to new entrants and producers with growing market shares as the costs to finance their return share are levied on new product sales. If a producer has a higher return share (because of historically higher market share) than his/her competitors, coupled with a declining market share, then the proportionate levy that it must put on each current product sale is higher than its competitors. This translates to a higher levy per unit sale (if included as a separate item) or lower profit margins compared with competitors.

Similar sentiment is found in Maine and other US States implementing return share financing, where TV producers have been particularly vocal with respect to retroactive financing for their own branded products. As reported by the Maine DEP, several major television manufacturers contend that the return share system creates an unfair market advantage for new market entrants (Cifrino, C, 2008).

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charged at disposal, while for new WEEE the individual producer is responsible for financing own products. The cost of future recycling is included in the price of the product.

> *Historically, manufacturers that sold televisions which are now appearing in the waste stream did not price their products to include the cost of recycling 15 years in the future. This means that those television manufacturers have to increase their current market prices to recoup their recycling obligations, including orphan share obligations, under state e-waste laws. New Asian manufacturers are introducing low-cost televisions into the market place at an accelerating rate. Because these new market entrants do not have units currently in the household waste stream, this is one less cost they need to recoup through pricing…… Additionally, new market entrants are much more likely to go out of business, leaving their branded units as orphans in the waste stream, increasing the cost of orphan share liability to the long-standing manufacturers (Cifrino, C, 2008).*

Therefore, while the logic for making a distinction between historic and new WEEE financing is sound, especially in the context of the negative competition effects due to retroactive financing, there is clearly an added level of complexity in terms of practical implementation of financing systems that include this split. There are a number of potential solutions to this issue which are further proposed and presented in Section 11.1.8.

10.2.2 Managing Orphan WEEE

According to the WEEE Directive text, historical WEEE is to be financed collectively, so that any orphan products that were put on the market prior to 13 August 2005 would essentially be financed by all actors on the market when the costs arise proportionately. For new WEEE, producers are required to provide a financial guarantee so that in the event of insolvency, funds will be available. However, as has been illustrated, MS have not transposed this requirement into their national legislation as intended in Article 8(2) of the WEEE Directive. With the exception of Sweden and to a limited extent Germany, any producer that is a member of a collective compliance scheme is exempt from providing a financial guarantee. In other words only producers that are complying through their own independent compliance system need to provide a financial guarantee for new products placed on the market (B2C only).

As touched upon above, in the systems where financing is based on return share, such as in Maine, ICT Milieu, orphans are financed by the existing producers on the market which is based on their return-share, meaning that if a producer has a 10% return share then he is obligated to finance 10% of the costs to manage orphans in the system. Similarly, in the Japan SHARL implementation, final consumers are responsible to pay for recycling costs at the time of disposal. Given this, there are no orphan products. Orphan products are physically managed by a third system that uses the fees collected from the final consumer to finance their management.

For the management of PCs, historical orphans are financed by the consumer and are therefore not an issue. For new PCs and peripherals individual producers are responsible to finance the costs when the consumer disposes of the equipment. However, as noted in the system description, it is the responsibility of the consumer to finance the costs of disposal if the producer of the product is no longer on the market (PC3R Promotion Centre, 2008). This means that in these circumstances the consumer will have paid twice for waste management fees, once when the product was put on the market, and subsequently when sent in for recycling.

10.2.3 Provisions & Financial Guarantee

Provisions for future liabilities

Provisions are not necessary in Japan under SHARL as the end-user is responsible for financing take back and recycling at end-of-life. Therefore although there is a future liability, the final holder of the WEEE has the financial obligation and not the producer.

While it would appear that producers in Maine, Washington State, and other states that employ the return share financing system are required to making provisions for the future recycling costs at the time products are sold, to date there has not been any discussion in the US accounting community on this issue (King, L, 2008). However, since an explicit responsibility for orphan and free-riders is placed on obligated producers, it is uncertain how this obligation to finance future recycling costs should be treated within internal accounting practices.

Financial Guarantee

In Japan, at least for products that are regulated under the SHARL there is no financial guarantee needed in the system, as it is the final user of products that are required to finance the end-of-life costs of products when disposed. Whether a producer became insolvent in the period between when a consumer purchased a product and when it was disposed, does not matter.

As described briefly above, the system for PCs and peripherals in Japan addresses the guarantee issue, by placing the obligation to finance new

WEEE from producers that become insolvent on consumers of WEEE. This, according to the WEEE Directive, was the primary argument for having the guarantee, that is, to avoid having the cost of WEEE fall on society or the other producers in the market.

10.2.4 Scope of the Programme

A notable distinction can be drawn between the product scope in the programmes with elements of IPR described in Chapter 9 compared to that of the WEEE Directive and actual implementation in MS. For example, in the Maine statute the scope is limited to TV and Monitors, while the Japanese SHARL includes only 4 large household equipment product groups. The ICT Milieu & SWICO compliance schemes have a scope that is limited to ICT equipment (Category 3 of the WEEE Directive) although in both countries there is a parallel compliance scheme managing the other product categories in the WEEE Directive.

While there is no specific evidence to suggest that the wide and far reaching scope found in the WEEE is a deterrent to IPR implementation, it is speculated that where there is a narrower scope, such as in the Maine and Washington, the complexity of brand counting and sampling is considerably reduced. Similarly, in the SHARL implementation, where there are only 2 groups of competing compliance schemes and four product groups, retailers are only required to sort the products into 2 streams, that of A-group brands and B-group brands. Given that the implementation in Europe in many of the largest MS consist of multiple competing compliance schemes, sorting products into the various producer groupings (up to 30 in the UK) would be a daunting exercise, likely to be resisted by retailers and municipalities due to space restrictions as well as high transaction costs.

10.2.5 Government Intervention

Interestingly, the level of government intervention in determining the practical implementation varies considerably in the studied cases. In Maine, the level of state intervention is high, and the DEP exclusively approves consolidators that participate in the program, including the mandate to count WEEE returns by brand and weight. Producers do however, have some flexibility to decide the fate of their products. At the same time producers are able to set up their own systems to recover their own brands and are credited for their activities, by 1) less returns in the State program and 2) through reduced obligations to finance orphan products.

On the other hand, the financing model applied in ICT Milieu programme was decided upon by the management of ICT Milieu, reflecting the will of its membership at the time. Likewise, A-signatories in the SWICO system managing their own individual recycling programmes is the decision of the individual companies who see added value in managing their own products.

The situation in Washington State provides an interesting middle ground between mandating IPR and providing the framework for it to occur. Return-share calculations are made in advance for all obligated producers in the programme. With some exceptions, producers are able to either join the 'standard plan' or develop their own independent plan to meet their calculated return share obligations.

10.3 Additional Barriers to IPR Implementation

10.3.1 Capital Tie-up – Provisions & Accruals

A growing concern by industry stakeholders concerning the impacts from the legal requirement 'to finance the waste from each producer's own products', is that according to accounting principles, namely International Accounting Standards (IAS) 37, a producer may be required to make provisions for all future end-of-life costs associated with his/her own products at the balance sheet date.

Although the IFRIC 6 interpretation only applies to historic WEEE, there has been effort by industry stakeholders to lobby to get accounting professionals to accept the IFRIC 6 interpretation in MS where the transposition outcome assigns a collective financial responsibility for new WEEE (EICTA, 2005) or where individual producers are members in collective schemes based on PAYG financing principles.[85] According to all current international accounting rules accruals/provisions are currently being made for potential warranty claims. A parallel can be drawn to making provisions for end-of-life management under an IPR regime. It could be

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85 For example in all MS where Article 8(2) was not transposed to clearly indicate that each producer is responsible for financing the waste from their own products (see Section 7.5).

argued that the same degree of uncertainty exists for predicting the amount of product returns that will occur under the warranty period as for the how many products will be disposed of by consumers in the future.

While it is understandable why producers would like to avoid making provisions in the balance sheet, including its impact on company solvency and therefore credit rating, these are potential taxable deductions which could benefit the financial position of the company. These issues are not commonly understood and in the opinion of the author of this study they need to be further explored and discussed more openly in the debate about the financial impact of Article 8(2).

In interviews with company managers responsible for ensuring compliance with the WEEE Directive, there was a lot of hesitancy to discuss the impact of Article 8(2) on the balance sheet of companies. This suggests one of two things; either the representatives did not have the expertise to answer these questions, or the answer is considered too strategic to share.

10.3.2 Minimal Cost Variances between Products

IPR critics point to the fact that for many products, the end-of-life cost differences between competing brands within the same product category are minimal, i.e. 10-15% between the best cost performers and the worst. While this cost variance may seem marginal, considering the volume of products sold and subsequently returning as waste in the EU 27, this can add up to significant compliance cost ranges between competitors on the market.

Considering that many of the same producers not in favour of individual financing are in product groups known to have low profit margins and stiff price competition, for instance consumer electronics (TVs), it is surprising that new ways of increasing profit margin, relative to competitors are not be further explored (Boks C.B. et al., 1996; Herold, M, 2007; Huisman, J, 2003).

However, what is rarely discussed, with respect to current cost differences, is what the effect on product design of future product offers would be if a producer was explicitly aware that any potential cost savings through design change would become tangible. This may be partially connected to Section 10.3.1 where any provisions that must be made as a result of Article 8(2) might be calculated lower than competitors' due to expected lower end-of-life costs.

10.3.3 Administrative Costs: Product Identification and Sorting

While increased administration costs associated with product identification have been expressed as "expensive" and potentially outweigh any benefits achieved through better incentives for design, very little empirical evidence has been presented in the literature regarding the actual costs associated with this activity.

This is especially true given that in many collective compliance schemes reviewed in this study a certain degree of auditing through sampling or sorting at recycling facilities has, or is already, taking place. For example El-Kretsen in Sweden, required contracted recyclers that were processing the collection category 'diverse electronics' to record the weight of each product category managed within this stream in order to avoid cross subsidisation between product groups. For example, the weight of all CRT TV products managed compared with laptops is recorded, so that laptop producers do not finance the cost associated with TV recycling (cross financing). Given this scenario, an additional step to identify the producer of each product may only be of marginal cost.

Revealed through this research, recyclers in Sweden (Stena Technoworld) and the Netherlands (Sims-Mirec) have developed data management systems to facilitate the recording of individual producer's own WEEE, represented as both weight and the number of units processed. Unfortunately, neither of these actors was willing to provide any details of the cost of this service to compliance schemes, and therefore it is difficult to determine whether the cost to identify individual producer's products are high or low relative to other costs in the system.

The National Centre for Electronic Recycling in the US has developed a statistical model to ensure a representative sample of the collected WEEE accurately represents return share of all producers in the waste stream. The sample size required is dependent on the brand share percentage of the largest producer in the system. If the largest brand share is 7 per cent, the number of samples required is 10,000 at a confidence level of 95 per cent and with a 0.5 per cent margin of error. The sample sizes decline if the brand share of the largest producer is lower than 7 per cent. NCER have determined that the cost of sampling 10,000 items is €28,627 per annum ($44,048 USD)(Insead IPR Practical Group, 2008).

10.3.4 New Entrant Advantage

IPR opponents point out that any financial mechanism that is based on return-share will favour new entrants on the market. The argument is that since new entrants have no products returning in the waste stream they have no financial obligation regarding end-of-life fees to a compliance organisation. However, this is not necessarily the case considering that return share financing by definition should create a known future liability (the products placed on the market now will require financing in the future when they are discarded by their final owners) and thus producers should make provisions for this future expense and recognise it in the balance sheet. This requirement will not be necessary in the case a producer uses a recycling insurance or a blocked bank account or another suitable financing instrument. Therefore, the argument doesn't necessarily hold, since any new market entrant would need to account for this future liability in its balance sheet and therefore presumably need to adjust prices accordingly.

In addition, and in the context Article 8(3), new entrants are required to finance a proportional share of historical, based on, for example, market share, so they will need to pay compliance fees when entering the market in any event.

10.3.5 Agency Problems

Internal agency problems can arise in organisations where the individual or department responsible for equipment purchase or maintenance differs from the individual or department whose budget covers utility costs. DeCanio (1998) explored the significance of organisational factors in explaining firms' perceived returns to installation of energy-efficient lighting. Similarly, studying external agency problems can be useful in understanding the WEEE outcomes. Take the classic tenant/landlord relationship for example, where the tenant pays the utility bill, while the landlord makes decisions on which equipment to purchase, or vice versa. Clearly the landlord will favour purchase of products that are least costly, which are often the less efficient ones, as the operating costs are financed by another agent, in this case the tenant (DeCanio, SJ, 1998).

Agency problems have been expressed in interviews with producers subject to the WEEE Directive. Given the way in which producers have been defined on a national level, it is not surprising that manufacturers may be hesitant to strive towards optimising material choices and product design if they know they will not be the obligated producer on the national market. This is because the first importer will be the obligated steward in many cases with the current interpretation applied. Similarly, even when manufacturers do have national branches in MS and are therefore the obligated producer, internal agency problems may arise. For example, often it has been the case that there is little interaction with managers responsible for WEEE Directive compliance and those for product development and design. WEEE managers are simply responsible for ensuring that overall compliance costs are minimised, and given the current implementation of the WEEE Directive, this translates into ensuring that in a MS where there are multiple compliance schemes in force – choosing the scheme with the best value for money i.e. the lowest Euro/kilogram or unit price. In MS where there is a lack of competition between compliance schemes due to monopolistic national systems, efforts by WEEE managers has been focused on creating competition in the marketplace with respect to options for compliance (Herold, 2007).

10.3.6 Uncertainty Factors

Uncertainty is another factor that may limit the uptake of new technology, which is unrelated to imperfect information. There may be uncertainties with new technologies, so that firms act in ways to avoid risks regarding performance attributes that are not fully tested. Especially for resource saving technologies, uncertainties over the price of resources in the future, may limit their uptake.

In the context of design for end-of-life and the structure of EPR programmes, a number of points above have a clear resonance. Producers may not be in favour of incentive based legislation, such as physical and financial IPR, as the uncertainties over future benefits with respect to the price of materials are not known. Alternatively, an arbitrary choice of the future costs could be made by authorities or compliance schemes where differentiation of compliance fees when products are placed on the market are made to reflect these choices.

Similar to above, a lack of certainty and control over when and if products will be returned may encourage producers to support a PAYG financing models. Since PAYG models are based on financing the total costs of WEEE management relative to a producer's current market share, there is certainty over a producers cost within a specified compliance period. The same can not be said about a system that is based on return shares which are less certain. Although it is possible to estimate return shares based on previous sales and attrition rates, the relative uncertainty is higher than PAYG models.

The choice of discount rate applied to investments in eco-design is a challenge to the encouragement of financing systems based on IPR. Applying a modest discount rate to current investments to improve the design of products that lead to reductions in costs when products are disposed in 8-15 years may negate any benefit perceived by the producer. In other words, any current investments would not lead to significant net present value benefits for firms.

However, these arguments must be considered in light of the need for producers to make financial guarantees and/or accruals depending on the type of guarantee chosen, especially under a system based on IPR. If the principle idea of IPR is for producers to finance the WEEE from their own products and not those from producers that subsequently go out of business, a financial guarantee is required that ensures provisions have been made to finance future WEEE so that the costs to manage those products do not end up being paid by the producers remaining on the market or society (general taxpayers).

With the requirement of producer to finance only their own future WEEE when it arises, and not that of others, a financial guarantee is needed for this concept to apply. Even with the requirement of financial guarantees, there remains a risk that any products placed on the market of a producer not registering and therefore not providing financial guarantees (free riders) will end up being financed by national governments or general taxpayers. This may be the primary reason why MS have transposed the WEEE Directive in the manner that they have, namely collective financing.

Given that approximately *3 years* of products going on the market since 13 August 2005 have not been accompanied with financial guarantees one of two options is needed to resolve the pending financial crisis. *Either a new date will need to be selected from which new/historical WEEE split is made* (i.e. 13 August 2009), with producers providing financial guarantees, or *a compromise is needed to address any future orphan products that may arise in the absence of financial guarantees.* More specifically this would mean that the principle idea of IPR (producers only finance the WEEE from their own products) would need to be relaxed.

Although producers would pay for the management of their own products based on their return share, any orphan products would also be the responsibility of the producers on the market. There are a number of ways to address this, similar to the ICT Milieu model (from 1999 2002) and the application of IPR in the US States of Maine and Washington State (starting in 2009), where any future WEEE being returned where no producer is on the market at the time the waste arises is proportioned to all the producers based on their respective *return share*. Alternatively, this share of orphan products could be allocated based on *market share* of all producers participating on the market when those costs arise.

10.4 Product Characteristics and End-of-life Cost: Beyond Heuristics?

In Chapter 6, the role of product characteristics on the influence of end-of-life costs was investigated. The beginning sections in that chapter presented a considerable number of corporate tools that had been developed for the specific purpose of understanding what the end-of-life costs for an individual product design would be and how, through design change, could those costs could be reduced.

In the context of this thesis, the presence of these tools illustrates that design for recycling was clearly a focal point for producers, especially during the period prior to and during the WEEE Directive proposal and implementation. Considerable R&D effort into design for end-of-life provides strong evidence that future legislation was having an effect on company strategy and design.

At the same time there has not been much discussion within collective compliance schemes on the feasibility of using such tools to differentiate compliance charges. This may not be all that surprising given that the very nature of collective systems is that competitors join together to take environmental issues of take back and end-of-life management out of the competition equation.

CHAPTER

ELEVEN

11. Discussion

Chapter eleven discusses the findings from previous chapters with the specific goal to answer the fourth research question which is stated as follows.

RQ 4: How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?

At the end of the chapter a characterisation model of possible ways of implementing the 'spirit' of IPR in the WEEE Directive is presented and discussed.

11.1 Level Playing Field Criteria for IPR Implementation

As has been pointed out in previous sections there are numerous technical, legal and organisational challenges that seem to tip the playing field in favour of collective producer responsibility which in turn creates limited incentives for producers to improve the end-of-life performance of their products.

This section discusses possible solutions to level the playing field for IPR in the WEEE Directive. Importantly, it also discusses where appropriate, conditions for success that apply to both collective and individual financial responsibility including a discussion on potential negative effects of IPR that could possibly arise when and if implemented.

11.1.1 Producer Definition

As noted in Sections 7.2 and 10.1.1, the current wording of the producer definition in the WEEE Directive has led to a situation where MS have transposed the definition of producer on a national level as opposed to a European level. Essentially this has had a number of impacts on both the functioning of the internal market as well as diluting the producer responsibility principle.

As a result of the national definition of producer, and in the absence of a local branch of a product manufacturer, the obligated producer in a MS is the first importer bringing product onto the national market, regardless if products have already be put on the European market or have come from a third country outside the EU. In the first scenario where the first importer may be a distributor or retailer that has purchased inventory from a manufacturer or distributor in another MS, potential problems arise such as duplication of producer registration fees, potential compliance fees and product guarantees, including the need to remark products to identify the applicable producer on the national market. In the second scenario, the distributor or first importer clearly is the responsible party since the product is first being introduced to the European market via this MS. However, under the national definition of producer employed by most MS, when the products move between MS, the subsequent first importer in the importing MS would become the obligated producer. This again would lead to a situation where for one product there may be many producers in different MS.

One of the primary arguments against the application of the national definition of producer, beyond the preservation of the internal market, is its impact on the producer responsibility principle. Since it has been argued that it is the producer who has the most control over product design, it is questionable to what extent importers or retailers can influence this. Similarly, other obligations such as information provision to recyclers on the location of hazardous or valuable materials and components are unlikely to be well understood by these actors and in practice may be difficult to receive from OEMs.

Given the above circumstances, it has been argued that it should be possible for any producer registered in Europe to be able to register in all 27 MS registers so that it can fulfil the producer responsibility obligations on behalf of its customers (distributors and retailers) in all European MS. This "solution" does not address the concern over the administrative burden associated with registering and reporting in 27 national registers, but does tackle the issue of ensuring that the actor most appropriately influenced by EPR legislation is given legal responsibility as a producer.

There are issues associated with this solution that need to be considered and perhaps resolved in order to ensure that the functioning of the producer responsibility principle is optimised. For example, MS have argued that it is essential that a legal entity reside within their national legal jurisdiction in order to enforce the producer responsibility provisions. In principle, the Commission has agreed with national governments on this point, while at the same time has defended the internal market provisions of the EU Treaty, and maintained that the definition of producer within the WEEE Directive, as it related to importers, refers strictly to imports from third countries outside the EU. This contradiction in the application of the definition of producer has complicated implementation *and cannot be resolved without further clarifications from the European institutions.*

By allowing EU registered manufacturers to register and hence assume the legal responsibility for all producer responsibility provisions, it is clear that manufacturers would relieve a retailer or distributor from these obligations. However, there are particular issues with this approach that need to be addressed which would require additional measures to be laid down in the WEEE Directive.

The first issue revolves around the monitoring of the quantity of products that are placed on each national market by each European producer. It may be particularly difficult for any EU producer to know the exact final destination of its products when originally sold for the first time, as products originally sold to a large distributor may be subsequently resold to distributors and retailers in other MS. EU producers (manufacturers) have acknowledged that this is a particular concern. The problems that arise include national authorities not having an accurate account of the number of products placed on their national markets. This causes problems in terms of implementing WEEE Directive financing provisions. Recall that according to Article 8(3) the cost to manage historical WEEE is the responsibility of all producers on the market proportionately, i.e. to their market share, when those costs arise. Therefore, the number of products placed on the "national" market for each producer must be known to determine the relative share that each producer must finance.

Similarly, for new WEEE, according to Article 8(2) each producer needs to provide a financial guarantee to ensure that the costs to manage each producer's products do not fall on society or other producers. Therefore, in the event that a producer is insolvent, there needs to be a mechanism in place for each MS to know which producers are placing products on their national markets, so in the event that no producer exists when a product is managed in a particular MS, that MS will have access to those funds.

Large EU-wide distributors have called for a "vendor managed system" where each distributor would agree with manufacturers (their customers) to disclose the final market destination of purchased products. However, this might prove more difficult in practice since this information may not be disclosed when products are resold to distributors in other MS in subsequent sales. The uncertainty provided in this model is unlikely to satisfy national governments and they would therefore be less likely to support it. Additionally, application of the financing provisions would also prove to be troublesome in practice. This is because EU producers would need to charge customers (for this example, let this be distributors) the expected costs to manage both historical WEEE and the future costs associated with disposal of products in question when they become waste in the future. This will prove difficult when the EU producer is uncertain to where these products will end up, with subsequent different costs depending on MS particularities.

These above circumstances point to another solution that reverts back to the application of the European definition of producer. Like all product-based Directives in the EC, the responsible party is defined as the actor that either manufactures the product and/or places the product on the internal market for the first time. Similarly, the European Commission[86] argues that this is how the definition of the producer in the WEEE Directive is formulated, however, at the same time recognising that it should be possible for MS to impose national obligations on natural or legal persons who are placing products on the market for the first time, irrespective of whether these products are from third countries or other MS.

Despite this ambiguity in interpretation, the European definition of producer could be strengthened with only minor adjustments necessary. One particular argument against the European definition of producer however, is that its application would lead to a situation where MS have no suitable mechanism to be able to find responsible actors to fulfil the producer responsibility provisions of their national legislation. This would lead to a scenario where a producer would only need to register to a national register where it first places products on the European market. MS registers

[86] See Section 7.2.1 for a discussion on this issue.

would presumably communicate with each other to determine subsequent flows of products between national borders. However, it is difficult to see how a MS would determine this information, given the scenario described above. Therefore, the outcome of this would be disproportionate producer registrations in MS where the large ports exist (point of entry to Europe and possibly where they are placed on the EU market for the first time), as well as where manufacturers are located, while a limited number in MS who import products from other MS. These circumstances would make it extremely difficult to practically run and finance compliance systems.

Potential Solution

A solution around this rests in the idea that EU producer registration can exist as suggested in the above paragraph, however with an added requirement that in each MS retailers or any party selling products to final users be required to register the sales on the national market. These retailers or other actors selling products to final consumers would only be allowed to sell products from EU producers with the appropriate EU registration. By applying this model, each MS would be able to maintain its national register, but instead of producers registering sales on to the national market, this would be the retailers' obligation. Since the EU producers' unique identification would need to be accompanied with the registration, each MS would be able to calculate both the historical obligation of each EU producer on its national market, plus the new WEEE costs when they arise. This is due to the fact that the producer identification on the product (in compliance with the standard) would be that of the EU producer, the actor that first places the products on the European market, and the actor that in most cases manufactures the products and if importing into the European Union for the first time is also required to identify itself according to other CE marking directives. In other words, the producer identification on the product would be that of the EU producer or first importer. With the national definition of producer, remarking of products to identify the national producer would need to occur, and given the Commission's signals to date, would go against the freedom of movement of goods in the internal market.

The total number and/or weight of products that producers report to the EU register could be compared with that of the national registers to ensure consistency for monitoring purposes.

11.1.2 Financial Mechanism: Principle of IPR

The transposition outcome of Article 8(2) shows that only 9 of the 27 MS have transposed individual financial responsibility as outlined in the WEEE Directive, while a further 11 have a transposition that is ambiguous in assigning IPR. 8 MS explicitly assign a collective responsibility for WEEE placed on the market after 13 August, 2005. It remains to be seen if the Commission will enforce the provisions of 8(2), although an infringement letter sent to Sweden indicating an imprecise assignment of individual financial responsibility may provide some indication of the Commission's view on the matter.

Without a clear legal interpretation of IPR, the likelihood of seeing further practical implementation is highly doubtful. At the MS level, from the meetings the author has taken part in regarding the development of a clearing house in Sweden, it is clear that the main stakeholders are not interested in discussing how the issue of new WEEE would be considered in any clearing function developed. The focus has been limited to how access to waste and market share calculations could be facilitated, with little interest in moving the discussion further. Similar experiences have been identified when discussing with producers involved in other national clearinghouses in Germany and Italy, for example.

Correct transposition of Article 8(2) is an essential requirement for IPR to emerge in the European Union, especially in MS where an explicit collective responsibility for new WEEE has been assigned in the legal transposition. It would not only deter movement towards a return share financing system in collective programs, but it could deter any own WEEE collection efforts, by individual producers.

11.1.3 Financial Guarantee

It is clear that nearly all MS have discouraged the development of individual systems for producers that want to recover their own WEEE put on the market after 13 August 2005 (or the national equivalent date), by requiring a true financial guarantee when placing these products on the market, while not placing the same demand on producers that join collective schemes.

The financial guarantee is considered essential for IPR to work in practice both in collectively-organised compliance schemes and own-brand or limited brand compliance systems. With financial guarantees, one option allowed according to the WEEE Directive mentions the producer's participation in 'appropriate schemes' for the financing of the management of WEEE. A crucial issue in this context is whether this option is defined to ensure that funds will actually be available for the future costs of producers' new WEEE in the event of bankruptcy. To comply with the spirit of the WEEE Directive as outlined in Recital (20) and the requirements of Article 8(2) it is clear that any such guarantee must be based on financial means being allocated for the future costs at the time of the product's introduction to the market. The guarantee of funds for future costs is essential to ensure that if a company leaves the market the future costs of managing that producer's WEEE do not fall on the remaining producers in the market or society in general. Simply being a member in a collectively-organised compliance scheme with limited operating reserves will not ensure that all of a bankrupt producer's WEEE will be financed in the future.

Moreover, for economic efficiency it is essential that a producer can leave one system and join another or establish his own. This will force the various actors to continuously improve their systems. This is equally important when it comes to the system for financial guarantees. A producer must be able to shift the way he/she organises the financial guarantee without jeopardising the guarantee for the products which are already on the market and without jeopardising the guarantees of an organisation to which he/she previously belonged.

By relieving collective systems (that are using a PAYG model) of the responsibility of a true financial guarantee, for example by a proper guarantee system embedded within the collective scheme, the MS is not only in breach of the intention of the EU WEEE Directive. It may also be committing itself to a financing model based on paying for historical waste by current market share forever, unless there is a clear requirement and date for transition in the transposed legal text.

Clearly, in order to ensure a level playing-field for producers whether they choose to join a collectively-organised compliance system or establish an own-brand or limited brand compliance system, the requirements for a financial guarantee should be the same for both. If simply being a member of an appropriate scheme for financing the management of WEEE is considered a financial guarantee, then for a producer that chooses to set up an own brand or limited brand compliance system will, by default, need to take out recycling insurance or create a blocked bank account as a financial guarantee. Both of these options are presumed to be significantly more costly than joining a collectively-organised compliance scheme with a guarantee based on reciprocity. The requirement for a financial guarantee to be the equal for all compliance options is a prerequisite if the fundamental ambitions of the WEEE Directive are to be met.

The fact that the text about financial guarantees in the Directive allows such counter- productive interpretations at Member State level, suggests the need to clarify that the term "appropriate" does indeed mean that all compliance systems must guarantee funds for handling all future WEEE.

However, the position of many MS, regarding concern over being left with the financial responsibility for any orphan WEEE that arises due to free-riders, needs to be duly recognised. This relates to the fact that the strict legal definition of the responsibility to finance one's own WEEE in Article 8 implies that an individual producer is not responsible to finance the waste of others. Although this is sound legal logic, in practice there will always be some level of free-riding in the system and there is a risk that the national government and hence taxpayers would end up financing orphan WEEE.

It is the opinion of the author that one way to get over this impasse would be to find a solution to assure MS that a mechanism would be in place to finance any new WEEE, if in the event that no responsible producer or guarantee were available. Perhaps there needs to be a compromise solution, where a special fund that all producers contribute to handle such circumstances if they emerged. Other options include assigning each producer a share of the orphan products based on either a market share or return share calculation.

Since most MS consider the financial guarantee to be covered by a membership in a collective compliance scheme, in reality there are no individual guarantees for products placed on the market from 13 August 2005. Inevitably, this must be addressed in one of either two ways. Either producers would need to retroactively find guarantee solutions for those products or the 13 August 2005 date would need to be changed to some future point in time.

11.1.4 Allocation of Responsibility for Collection

Many of the conflicts leading up to the implementation of the WEEE Directive have centred over issues where a clear allocation of responsibility has not been made. Classic examples include the obligation for setting up systems for collection of WEEE. Forced negotiations between municipalities and producers and compliance schemes negotiating on their behalf over unclear rules where one actor is physically responsible, while the other is financially responsible, lead to numerous delays in reaching agreements between actors.

The idea of sharing responsibilities along the end-of-life chain, although an appealing idea from a fairness perspective, experience in policymaking has taught us an important lesson: *making everyone responsible usually means that no one takes responsibility* (Lindhqvist, T & Lifset, R, 2003; Tufet-Opi, E, 2002).

It appears that in most MS municipalities will be physically involved in the collection of WEEE from households. But the degree to which producers compensate them varies significantly. This highlights the issue of shifting the financial burden from municipalities to consumers and producers and the important signals such an internalisation of costs will give. It also poses 'level playing-field' issues between the MS where collection is state-subsidised and where it is not. Importantly, it also deters individual producer systems from developing because such systems are often not given access to subsidised collection facilities.

Generally speaking, the shared approach of allocation of physical and financial responsibility between municipalities and retailers (for collection) and producers (for treatment, recovery, reuse and recycling) complicates the implementation of IPR in the WEEE Directive. This complication can be described on a number of levels, both practical and theoretical.

On the theoretical side, one could question to what extent the polluter pays principle applies when taxpayers rather than the consumers of EEE pay for the cost of managing waste. If the cost to manage collection sites at municipalities is financed by municipal taxes, this is precisely what happens. If producers were assigned the physical and financial responsibility for obligation to finance collection than the full costs would be included in the sales price of the product. This statement is based on the assumption that it is ultimately the consumers in the end that pay for the cost of waste management of WEEE and not general taxpayers.

On the practical side, two distinct problems arise in this respect. Firstly, if municipalities are given the physical and financial responsibility to collect WEEE from private households (could also include WEEE from companies and institutions, depending on how the split between B2B and

B2C is made), then implementation evidence to date suggests that access to this WEEE will generally be provided to collective compliance schemes that are collecting mixed producer brands. This is so because municipalities are unlikely to sort out WEEE by the brands of producers in each of their respective compliance schemes, since they are already sorting by product type. Depending on the MS this could mean between 3 and 10 separate collection categories and hence containers. The counting or sampling of brands could however be addressed by other mechanisms such as waste sampling to determine a national return share rate, as discussed in Section 11.1.5, for all producers conducted by national authorities or clearing houses. Other solutions could include product sorting at consolidation centres where all WEEE is transported after collection at municipal collection sites.

While difficult to generalise for the entire spectrum of 27 MS in the EU, in many circumstances municipalities have traditionally been charged with the responsibility for municipal solid waste, and continue to control this function, even in the countries where no formal responsibility has been allocated. While it is true that in many cases the necessary infrastructure is already in place in the form of civic amenity sites where households can drop off bulky and special/hazardous, leaf and yard waste, construction and demolition wastes, etc, many MS are only now developing this infrastructure. This means that considerable investments will need to be made to create the necessary infrastructure.

Clearly, there are logistic and financial benefits to be found for producers when leveraging this existing infrastructure, however extra costs to municipalities are inevitable. Depending on which party is supplying containers for WEEE, the costs might even be significant for municipalities and retailers in this respect.

11.1.5 Access to WEEE

When municipalities are allocated the physical responsibility to collect WEEE from private households implications arise for how compliance schemes or individual producers have access to collected WEEE. This has been a contentious issue in the design of EPR programmes, especially in Europe. In some MS and jurisdictions outside Europe, considerable intervention on the part of national government authorities to control the process of allocation of WEEE has occurred.

For example, Germany has gone to extensive lengths to control the flow of WEEE from municipal collection points to responsible producers. However, it was the industry itself that was the strongest *proponent* and initiator of the clearing house mechanism, which was developed to avoid *'cherry picking'* by strong market actors of the most accessible and largest volume generating municipal sites, which in turn would be the least costly way of compliance with market share allocations.

The algorithm used to randomly allocate pickups of WEEE at municipal sites is intended to ensure a fair allocation of WEEE. However, with this model it is difficult for actors such as compliance schemes, transport companies and municipalities to establish long term business arrangements. There is a lack of a client/customer relationship with this model that can lead to a neglect of services. Clearing house systems in other jurisdictions have consisted of competing compliance schemes developing the clearing house either with or without the involvement of national governments and municipalities.

In order to facilitate IPR implementation, there is need for a clearing mechanism. Considering that the competing collective model is now the dominant compliance model in terms of representative population in Europe, it is expected that this model will continue for some time. Given this, if for example, the European Commission decided in the review process to mandate return share calculations for new WEEE, a national clearing house which is already handling producer registration and reporting and hence market share calculations, would be the most appropriate actor to make this calculation and report each producers return share.

In addition, in order to level the playing field between producers that want to set up their own collection system and those that prefer the collective approach to meeting their individual financing obligations, access to WEEE should be possible for all producers through whatever allocation method chosen by the national clearing house as described in Section 8.3.1.

11.1.6 Effective Collection Targets & Incentives

Effective collection targets that are reached are crucial for the success of any EPR programme. As discussed in Section 4.8 the efficiency of recycling of WEEE depends very much on the first step of the process, i.e. collection. This is important for any EPR system whether it is based on collective financial responsibility or individual financial responsibility.

Current financing models of either return share or market share usually take the denominator of the equation as 'whatever is collected' and this gets divided by products returned or products placed on the market. Given that the 4kg/inhabitant/year current collection target is easily achieved in most MS, this target is simply too low to be considered effective.

Critics of IPR, in the context when producers or a limited number of producers set up their own system, claim that there is potential for abuse in that these systems may deliberately discourage high collection rates to avoid financial responsibility (ELC, 2006, 2008). In other words, there is a concern that no incentive exists to strive for higher collection rates. In the current formulation of the WEEE Directive, this is true for both collectively and individually organised systems as producers finance 'whatever is collected' as described above.

In the event that return share financing for new WEEE replaces the current entrenched model of market share financing, as long as consumers can hand in their WEEE to an adequate collection sites (if run by municipalities) it would be difficult to see how a producer could deliberately limit its own return share. This is especially true if there is proper information sharing through a national clearing system that ensures producers are responsible for their share and/or their products in all the channels of WEEE returning. As described in Section 8.3.1, a clearing system is necessary for the efficient and fair functioning of the overall recycling system, to prevent free-riding competing or independent schemes.

Incentives mechanism for higher collection

In the absence of high collection targets in the WEEE Directive (currently set at 4 kg/inhabitant/year) it is unlikely that compliance schemes both independent and collective will strive to go beyond targets that are already being achieved. This calls for more realistic targets set in the WEEE Directive to reflect the actual WEEE arisings in the MS in question. This can be calculated based on what has been placed on the market in past years and can be assigned to individual producers in respect to their relative contributions. Information on the number or weight of products placed on the market by individual producers is available from national producer registers from 13 August 2005, or equivalent date set in the national legal text. Therefore this calculation could be made relatively easily and communicated to individual producers who then could meet this obligation to collect either through a collective and/or individual system. For collective schemes the total of all individual members would represent the total WEEE needed to be collected by the scheme.

The European Lamp Companies Federation have proposed an interesting model that could promote increased overall collection when there are competing collective systems on a national market (ELC, 2008). Although obligations are based on a market share allocation rather than a return share allocation, it has the necessary elements to incite higher collection in compliance systems and is applicable for historical WEEE. The model describes an allocation of obligations in a scenario when two schemes are on a national market. The following example in provided for illustrative processes.

Table 11-1: Allocation of Costs between Schemes (ELC Proposal)

	Compliance Scheme		
	A	B	**Calculation**
Put on the market	120	80	(1)
Market share	60%	40%	(2) = (1)/sum(1)
Collection % of total WEEE collected (A+B)	80%	20%	(3)
Coverage of put on the market	133%	50%	(4) = (3)/(2)
Compliance fee charged	0,25	0,10	(5)
Under collected units		40	(6) = (100%(4) x (1)
Settlement Amount		10	(7) = (5) of scheme that over-collected x (6)

Source: (ELC, 2008)

ELC claim that application of this model would avoid abuse by other schemes which search for low costs through limiting collection and recycling activities as well as to avoid speculation by compliance schemes having collected and recycled in excess of their obligations.

11.1.7 Reuse, Recovery and Recycling Targets

Much criticism has been put forward by academics and industry alike regarding the weight-based targets for reuse, recovery and recycling under the WEEE Directive (Hageluken, C, 2007; Huisman, J, 2003; Huisman, J & Stevels, A, 2003, 2004, 2005; Mayers, CK, 2007). The main arguments against weight-based targets are that they equalise the importance of the recovery of all materials, although different materials in WEEE have very different environmental profiles.

For a detailed discussion on this issue see Huisman (2003). While there is certain merit in this approach which highlights the importance of "environmental weight" of materials and hence the relative importance of recovering such materials, there is the potential that by using this approach, materials with currently low recovery rates such as plastics will be less prioritised. It is the opinion of the author of this thesis that any fundamental changes to weight-based targets will simply entrench the status quo. This is especially true since recycling practices are already driven by the high value precious metals in printed circuit board-based products and are subsequently captured from the products that are treated, unless exported or disposed of as municipal waste.

In Section 4.8, a discussion on mechanical recycling efficiency revealed that there is an estimated 20% loss of precious metals in circuit boards when whole products containing them are shredded and then subsequently processed. Given the importance of environmental weight as stressed by the above authors, the importance of the Annex II requirement to remove circuit boards from separately collected becomes apparent.

Moreover, the purpose of setting recycling targets above business as usual is to challenge the market to improve the design of products as well as the recycling industry to facilitate increased material recycling. This discussion relates to the requirement of MS to monitor not only treatment facilities but also the final destination of materials so that high re-application rates are achieved.

11.1.8 Controlling Administrative Cost

Producer identification is crucial in order to be able to practically implement IPR, and technologies that can assist in this process without the interaction of human activity will drastically reduce the overall costs of sorting products and facilitating individual financing within either a single or competing collective compliance schemes within MS.

In order to operationalise Article 8(2) of the WEEE Directive within collective systems, either a brand count or brand sample to identify each obligated producer's new and historic WEEE would be required. If there are numerous competing collective compliance schemes on the market in a MS, it would become burdensome and costly if all schemes individually sampled their return streams to determine their member's return share plus the share of competing compliance scheme's members. The amount of data exchange would simply be unmanageable unless this was an automated process.

A *possible solution* to reducing this need to separate new and historical WEEE, would be to decide upon a date in the future where all WEEE within a particular category would be considered new WEEE. There would not be a need then to sort new and historical WEEE when sorting/sampling by brand. However, this would have other consequences, including that it is likely that some producers would finance their own historical WEEE retroactively, as a certain percentage of historical products would still be in the waste stream.

Another potential solution would also revert back to what was discussed in Section 11.1.5 where a national clearing house would be mandated to calculate the return share of producers. If this was applied in conjunction with the possible solution to the producer definition issue presented in Section 11.1.1 then the number of producers would be greatly reduced and the parallel import issue would also be remedied to some extent.

11.2 Parallel, Hidden and Illegal Flows

Hidden flows in this context refer to unaccounted for flows of WEEE that are not reported through formal EPR programme channels. Hidden flows of WEEE can be both legal and illegal flows and can include local processing of WEEE as well as export to countries outside of the jurisdiction under the EPR legislation.

Recent data for the European Union as a whole suggests that these hidden flows are quite substantial and can represent up to 75% of all expected WEEE arisings (Huisman et al 2007). However, it is recognised that caution must be drawn regarding generalisation of the situation to all MS. Many of the largest populated European MS had not fully implemented the WEEE Directive when the data were collected (UK, Italy, Spain, and Poland representing over 210 million inhabitants). Estimations of WEEE treated as a percentage of WEEE arisings reported by Huisman et al. (2007) (2.1 million tonnes treated out of an estimated 8.3-9.1 million tonnes arising which is approximately 23-25%) was based on multiple sources of data. Data sources included average collection rates in Europe based on reported collection rates (kg/inhabitant) for 11 MS as well as data from recyclers (EERA) on the amount treated across the EU. Despite these uncertainties it is clear that in many countries, especially those with newly established compliance systems, there is considerably less WEEE being channelled into the 'official producer schemes' and reporting mechanisms.

For example, while collection rate as expressed in kg/inhabitant in Hungary has been 1.27, Sweden has reported over 17.5 kg/inhabitant of collected WEEE in 2007, primarily through the municipal collection infrastructure (of this approximately 3400 tons or 0.37 kg/ inhabitant collected from businesses) by El-Kretsen alone. There are other producers complying individually for both WEEE from households and B2B that also collect WEEE which is not reported in El-Kretsen's total. Although official figures have not been reported by the Swedish EPA, it is estimated that total tonnages from this stream could be up 20 000-30 000 tons or equivalent to 2.1-3.2 kg/ inhabitant for 2007. WEEE disposed of in the household waste stream has been calculated as 12 000 tons per annum or 1.3 kg/ inhabitant (Schultz, J, 2008). The sum of these flows account for roughly 22 kg/ inhabitant per annum, in line with what is expected as WEEE arisings (Naturvårdsverket, 2008).

In the Netherlands a recent study financed by the collective compliance schemes NVMP and ICT Milieu, found that although only 5.7 kg/ inhabitant of WEEE was collected and managed by these PROs, an estimated 18.5 kg/ inhabitant of WEEE is expected to be collected. The estimation is based on field research at municipal collection centres, household waste reuse centres, second hand stores and regional sorting centres. Additionally, structured interviews with retail employees and additional data from treatment facilities and distribution centres complemented the research (ICT Milieu, 2008).

The above text highlights that caution should be made when drawing conclusions regarding how well or poorly a particular EPR system diverts WEEE from disposal, especially when there are parallel flows that are processed in licensed facilities within the country where WEEE is generated. Perhaps more importantly however, this draws attention to the issue of enforcement of the requirements within EPR legislation and the need to ensure that all actors involved in the end-of-life management of WEEE are included within the scope. This is discussed further in Section 11.6 especially in light of when there is positive revenue associated with end-of-life products. Understanding the extent of illegal flows of WEEE either to unlicensed treatment facilities or exported under the auspices of product reuse is however a critical matter that needs to be closely monitored and enforced.

EC Revised Correspondents' Guidelines No 1 on Shipment of Waste Electrical and Electronic Equipment (WEEE)

With respect to the shipment of WEEE and the shipment of EEE destined for reuse, the EC on 12 July, 2007 published 'Correspondence Guidelines' on Shipments of Waste Electrical and Electronic Equipment (WEEE) that represents the common understanding of all MS on how Regulation (EC) No 1013/2006 (Waste Shipment Regulation – (WSR)) should be interpreted. Although not legally binding, the guidelines are intended to provide information for actors whom are arranging shipments of WEEE, holders of EEE arranging transboundary transports who wish to avoid non-compliance with the WSR, as well as authorities responsible for the enforcement of the WSR. Despite its non-binding status, these guidelines are sure to be used by the European Court of Justice (ECJ) when ruling on specific cases regarding the shipment of WEEE, and therefore do have considerable legal weight.

Considering this, regarding the issue of drawing a distinction between when a shipment is EEE rather than WEEE the guideline lists a number of criteria that should be applied. When a holder of EEE intends to ship product and not WEEE, the following information should be provided to corroborate any claim to an authority on its request: a) A copy of the invoice and contract relating to the sale and or transfer of ownership of the EEE which states that the equipment is functional, b) evidence of evaluating/testing in the form of records on every item within the consignment, c) a declaration made by the holder who arranges the transport of the EEE that none of the material or equipment within the consignment is waste as defined by Article 1(a) WFD, d) That there is sufficient packaging to protect it from damage during transportation, loading and unloading.

The guideline provides further criteria to be used when ruling out if a shipment declared as EEE is in fact not WEEE. It clearly states that EEE should not be considered WEEE if the criteria listed above are met and the EEE is not destined to any treatment facility as described in Annex II of the WFD and will be directly reused as it was originally intended for or will be put on the market or exported for the purpose of being put back to direct reuse or sold to end consumers for reuse. A shipment of EEE should not be considered WEEE, if it is composed of defective products that are returned to producers or repair facilities and if criteria c) and d) above are met and the repaired products are intended for reuse.

To further clarify whether a shipment is WEEE or EEE the guideline provides additional criteria that help to identify when EEE is in fact really WEEE. EEE would normally be considered WEEE if the product is not complete, has physical damage that impairs functionality or safety as well as if the packaging for protecting it from damage during transport is insufficient. Further, if the appearance is generally worn or damaged thus reducing the marketability of the item or if the item has parts that are required to be discarded or are prohibited in the European Community, including PCBs, asbestos and CFCs, then the shipment in question is WEEE. If the EEE is destined for disposal or recycling instead of reuse or if there are not established markets or it is old or outdated and destined for cannibalisation for spare parts then again the shipment would normally be considered as WEEE.

Shipments of WEEE destined for recovery *within the EU* and *OECD Decision countries* may be subject to either the procedure of prior written notification and consent (wastes listed in Annex IV 'amber listed' of WSR) or to general information requirements (Annex III of WSR 'green listed'). The applicable controls are determined by the classification of the WEEE in question according to the relevant lists of waste annexed to the WSR. Under Annex IV the following categories listed in the table below are applicable to WEEE.

Table 11-2: Categories Relevant to Untreated WEEE in the WSR Annex IV 'Amber listed'

Code	Description
A1030	Waste having as constituents or contaminants any of the following: - Arsenic; arsenic compounds - Mercury, mercury compounds - Thallium; thallium compounds
A1160	Waste lead acid batteries, whole or crushed
A1170	Unsorted waste batteries excluding mixtures of only list B batteries. Waste batteries not specified on list B containing Annex 1 constituents to an extent to render them hazardous
A1180	Waste electrical or electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury switches, glass from cathode ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex 1 constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III
A2010	Glass waste from cathode-ray tubes and other activated glass
A2050	Waste asbestos (dust and fibres)
AC150	Chlorofluorocarbons
A3180	Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphenyl (PCT), polychlorinated naphthalene (PCN), polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50mg/kg or more

Table 11-3: Categories Relevant to Untreated WEEE in the WSR Annex III 'Green listed'

Code	Description
GC010	Electrical assemblies consisting only of metals or alloys
GC020	Electronic scrap (e.g. printed circuit boards, electronic components, wire, etc) and reclaimed electronic components suitable for base and precious metal recovery

However, it is not entirely clear how untreated WEEE (depending on the category) should be classified. While the guidance document lists the possible categories (in Annex III and IV of the WSR) that untreated WEEE prior to shipment could fall under, there still exists a certain level of ambiguity, as Article 3(1)b (iii) states that waste not classified under one single entry in either Annex III, IIIB, IV, or IVA, is subject to the requirements of prior written notification and consent.

With respect to the *shipment of WEEE to non-OECD countries*, where a general export prohibition of hazardous waste applies, Annex V Part 1, of the WSR lists wastes that are both included (Part 1, List A) and not included (Part 1 List B) in the export ban. Concerning WEEE, the categories listed here under List A are the same as Annex IV categories, (presented in Table 11-2) where prior notification and consent are required for shipments in the EU or to OECD countries. List B includes categories of waste that can be permitted for export, unless any MS in accordance with Article 36(4) and (5) of the WSR classifies an entry as hazardous. Part 2 and 3 of Annex V are applicable only if a waste does not appear in List A or B of Part 1. If a waste is listed as hazardous in Part 2 of Annex V (hazardous wastes are marked with an asterisk) or is listed in Part 3 then the export of such waste is prohibited. If the waste does not appear in Part 2 or 3 of Annex V then its export is potentially allowable and subject to the procedure of prior notification and consent.

For wastes that are not subject to export prohibition and as determined through the above procedure to be potentially permitted, its export is also subject to the procedure of prior notification and consent as referred to in the WSR.

Green listed wastes to non-OECD countries are potentially allowable as determined by Commission Regulations (EC) No 1418/2007 and No 740/2007 for which non-OECD countries have responded to their specific requirements for entry of green listed wastes. Each country listed in the above regulations has indicated which green listed wastes are prohibited, which wastes where prior written notification and consent applies, and which wastes where no control is mandated.

Importantly, in the WSR, Article 49(2) states that

> *in the case of exports from the Community, the competent authority of dispatch in the Community shall (a) require and endeavour to secure that any waste exported is managed in an environmentally sound manner throughout the period of shipment, including recovery as referred to in Articles 36 and 38 or disposal as referred to in Article 34, in the third country of destination; (b) prohibit an export of waste to third countries if it has reason to believe that the waste will not be managed in accordance with the requirements of point (a).*

Enforcement of the WSR

Infringement of the WSR as regards to WEEE has been highlighted as a major issue in Europe. It is estimated that considerable quantities of the expected WEEE arisings in Europe are either being exported to countries in Asia or Africa under the auspices of product reuse, or sent for recovery and recycling as green-listed waste. Considering what was discussed above regarding the WSR it is estimated that there are serious breeches to the WSR with respect to WEEE. The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) is an international non-profit association of the environmental authorities of the Member States, acceding and candidate countries of the European Union and EEA countries. IMPEL was set up in 1992 as an informal Network of European regulators and authorities concerned with the implementation and enforcement of environmental law. The IMPEL-TFS (Trans-frontier shipment of waste) cluster has investigated the implementation of the WSR in a number of key projects including the Seaport projects I&II (Dec 2004 & May 2006), Threat Assessment project (June 2006), and Enforcement I (July 2008). With respect to WEEE the following key findings from these projects are presented.

In the final report of *Enforcement I*, seventeen countries carried out a total amount of 168 inspections, most of which (65%) were transport inspections. During these 168 inspections a total number of almost 14 000 transports were inspected, of which more than 2 000 (16%) concerned transfrontier shipments of waste. Of these 2 000 waste shipments, more than 300 (15%) turned out to be in violation of the requirements of European Waste Shipment Regulation. 40% of these violations concerned illegal shipments and the other 60% were administrative violations.

The most common cases of illegal shipments are either exports of hazardous waste destined for non-OECD countries or loads containing waste which were shipped under the procedure for *green listed waste*, where this is not allowed. After analysis of 74 cases of illegal shipments for which some details were documented, WEEE comes out as the most important waste stream (21 cases), followed by end-of-life vehicles and vehicle parts (eleven cases), plastic waste (eight cases) and metal waste (seven cases) (IMPEL, 2008).

11.3 Debate over Visible vs. Non-visible fees

This section discusses the debate over the use of visible fees at the point of purchase to finance the management of end-of-life electronics. A specific focus is on the potential impacts of the use of visible fees on incentives for improved environmental performance of products. Most of the content of this section was developed in conjunction with the author of this thesis's participation on a panel discussion on "Visible vs. Hidden Fees" at the Recycling Council of Ontario's 2005 annual conference. The panel provided rich debate over the arguments presented by both proponents and opponents for the use of visible fees in product stewardship or EPR programmes (van Rossem, C, 2005).

The polarity of the debate around whether it is appropriate or not to show the consumer the cost of end-of-life management of a product at the point of sale is a manifestation of the fact that both are perfectly justifiable at opposite ends of the spectrum.

At one end of the spectrum (scenario 1) are circumstances where a government mandates that each producer/retailer must collect a pre-defined sum of money on each product sold that must be remit to the revenue authority. Funds collected are not channelled directly for the purpose of end-of-life management and end up in government coffers. This clearly represents a government tax, similar to any value-added or sales tax and subsequently should be displayed on the sales receipt.

At the other end of the scale (scenario 2), consider the fact that a producer sells a product on the market, and as part of the offer agrees to collect and processes it when it reaches end-of-life. This service is clearly an inherent part of the resource and labour inputs that are embodied in the product offer. It would be inappropriate for the producer to separate the cost of this service from any other cost associated with delivering the product to the market (i.e., labour costs associated with production, raw material cost, transportation costs, etc.) The consumer can and should be made aware that financing for the end-of-life is included in the price of the product, without displaying the actual cost of this service.

However, the reality today (scenario 3) is that most EPR programmes employ a model of responsibility in which a producer responsibility organisation (PRO) or industry funding organisation (IFO) is established to meet the set goals of the legislation collectively. This is where the debate tends to surface, as the clear lines of the examples above can become somewhat blurred. In most cases, set fees are established that are applicable to all products or materials in an appropriate category either on a per weight or per unit basis. These collective costs of end-of-life management of products sold in the past are most often divided among producers based on current market shares of existing product sales as opposed to paying based on actual processing of producers' individual brands. These systems offer very little incentive for producers to invest in the design of products that will reduce total end-of-life costs because such benefits will be shared among all producers participating in the scheme. Given that fees are the same for each producer's product in the system, there is a tendency for producers to want to externalise this cost from other competitive pricing factors.

An important consideration when discussing the appropriateness of visible and non-visible fees, in this case, centres on the degree to which a producer is bound to joining the collective organisation. If for example, this requirement is mandated in the legal text or some other circumstance prevents an individual producer from access to subsidised collection facilities, then a similar comparison could be made to scenario 1 in which visible fees would be reasonable. On the other hand, if the legal text allows any producer to be able to meet the legal obligations individually (such as scenario 2), then clearly a producer is not bound to joining a collective system. It is this element of choice that reduces the validity of using a visible fee. Another consideration is on how representative the fee levied on producers' products compared to the actual cost of managing his/her individual products. This implies to the level of cross-subsidisation between different producers' products in the system, for example if a uniform fee is levied but costs to manage individual producers brands varies considerably In cases where this is minimal or non-existent, the use of visible fees is questionable.

Importantly, the preceding examples point to a parallel issue closely tied to the visibility of end-of-life fees and concerns the level of involvement of producers in the end-of-life system. Clearly, in scenario 1 the producer has no involvement in the system at all, as it is the consumer who simply pays the tax at the point of purchase, assuming it is the retailer that is responsible for levying the fee and remitting it to the authorities. This is the opposite situation in the second scenario, in which the producer has either vertically integrated into the product chain acquiring end-of-life processing capabilities or has outsourced these services to third-party contractors. Since all costs/benefits of system or product changes can be directly realised, the producer will make the most rational choices within the conditions set by the backdrop legislation.

The degree to which a system as described in scenario 3 involves producers can vary considerably between programs. However, what is crucial from an incentive perspective is the degree to which an individual producer in the scheme can benefit from investing in product or system design improvements that reduce costs and subsequently improve the end-of-life management of his/her products. Very often as producers pay the same fee per product type, regardless of the inherent recycling properties (ease of disassembly, level of hazardous substances, precious metal content, etc) there is no such incentive to make the necessary investment, as such benefits will be shared among all producers participating in the program.

As previously discussed, having non-differentiated fees, especially on a per unit basis, as part of the collective scheme encourages producers to separate this fee from other similar business costs (through visible fees). These factors are important to consider when designing systems that will encourage incentives for not just better management of end-of-life products but less impacting systems in general.

Below are additional points that have been identified throughout the research which may provide useful to program operators or legislators when considering the appropriateness of either having visible or hidden fees in the management of end-of-life products.

Depending on the product in question (i.e. for durable complex product rather than non-durable packaging, for example) visible fees may be a fair way of addressing the financial burden of historic waste (products put on the market before the legislation was enacted), especially if the costs are assigned on current market share of existing producers and when there has been significant changes in markets shares over time. However, it is critical to ensure that there will be some way of clearly identifying "future or new waste" or in other words - products put on the market after the introduction of the program/legislation. If this is not done then it will be difficult to move away from a model in which current products put on the market pay for the products currently managed as waste to a model financed by producers based on return share by brand, once historic waste has been managed. This has impacts on incentives for product durability and reuse.

At the same time, mandatory advanced disposal fees (visible or hidden) placed on products when put on the market to finance the current WEEE arisings will avoid problems associated with financing the end-of-life management of orphan products, but again no incentives for better designed products are apparent. Alternatively, producers can be required to have a financial guarantee when placing a product on the market, earmarking funds for end-of-life management in case of insolvency.

Although a visible fee to cover product recovery and recycling or final disposal is really an environmental charge, consumers often perceive it as a government initiated tax. This may have serious implications for the public acceptability of an EPR programme.

Systems designed to collectively fund current end-of-life costs based on current product sales through visible fees (pension system) can lead to either a surplus or deficit of the stewardship fund depending on the ratio of new sales to current recycling costs unless the fee is adjusted to account for this dynamic. In order to avoid deficits in the fund the fees are often higher than the actual costs to manage the end-of-life products. Alternatively, these fees are adjusted periodically and if visible could lead to consumer confusion and mistrust unless communicated effectively. If these fees are hidden the problem is avoided.

If visible fees are tied to actual costs of managing a particular product, then it should be expected that the fees should be higher in areas where end-of-life management costs are higher. By internalising the cost to manage waste in the price of the product any geographical variations can be better addressed.

Backdrop regulation that allows for individual programs or multiple producers programs to co-exist with PRO/IFOs, may create variances in the visible fee between systems. This may lead to confusion for consumers, but could also stimulate the market through price signals.

According to the Retail Council of Canada (RCC) there are certain negative implications pertinent to retailers if end-of-life fees are not displayed as a separate cost at the point of purchase. One argument is that for retailers that lease premises, their rent will increase due to the fact that rent is often based on gross sales which increase as prices are increased to cover stewardship program costs. In the Canadian perspective, higher advertising costs are incurred for national or regional retailers who must produce separate production runs due to province-specific pricing. Additionally, product prices may become inflated due to mark-ups that occur along the supply chain (Horsman, A, 2005).

Many retailers have information systems that are not easily configured for higher product prices in a given jurisdiction for the same product and this will lead to expensive modifications or even the need for new information systems. Retailers also fear losing business to neighbouring jurisdictions when advertised prices are lower due to the absence of an embedded environmental charge. The RCC also supports the argument that the use of a visible fee provides an important opportunity to educate consumers about a stewardship program thus encouraging their participation. An alternative however, would be to include a note outlining that the price of the product includes the cost of disposal (even though the funds generated are used to finance the cost of current WEEE recycled and not the future disposal costs of the particular product the fee is being levied upon).

While it has been argued that by not having a separate visible fee displayed at the point of sale, producers are more likely to consider the costs associated with end-of-life management in business planning, similar to other cost of delivering a product or service to market, this view is not shared by all actors. Representing the Canadian Paint and Coatings Association (CPCA) on the panel discussion, Susan Peterson, Chair of the Post Consumer Waste group noted that "eco-fees at the point of sale keep the monies required to run these programs separate and apart from other business concerns. Internalising the fees allows the express eco-fee purpose to be overshadowed by other market considerations like margin increases, sales quotas, sales to rent charges" (Peterson, S, 2005). With regards to the mark-up issue, CPCA estimate that a 50 cent eco-fee that is included at point of manufacture can become $ 1.35 after distributors and retailers margins have been added.

Additionally CPCA notes that visible eco-fees also allow the added advantage of ensuring a level playing field amongst brand owners. When for example, a retailer does not include the fee, authorities and program managers are often alerted to non compliance. If however, retailers are charging an end-of-life fee at the point of sale on products that they themselves have not been charged by distributors or brand owners then the retailer is pocketing the added fee (in programs where the legal responsible actor is the brand owner of manufacturer who must remit fees to the PRO or IFO). Similarly, if brand owners include the compliance cost that it must remit to the IFO or PRO in the sales price as a separate visible fee to distributors and retailers, but do not in turn pay fees to the IFO or PRO and will benefit directly by pocketing the revenues generated from the visible fee.

11.4 Improving Design for End-of-Life: EuP, RoHS and WEEE

The opportunity to regulate the design of products to minimise the environmental impacts of EEE in various life cycle stages exits in a number of other legislative directives besides WEEE in the European Union. Primarily these include Directive 2005/32/EC of the European Parliament and of the Council establishing a framework for the setting of eco-design requirements for energy-using products (EuP) and the RoHS Directive.

Numerous stakeholders are proposing that all reference to the WEEE Directive's influence on product design be removed from the legal text and instead be addressed through the EuP and RoHS Directives. The main argument put forth, is that the WEEE Directive should primarily focus on addressing the impacts associated with the end-of-life phase of the products life cycle (Huisman, J et al., 2008). In essence this would limit the Directive's influence to waste management practices only. Given that the main argument for introducing the RoHS Directive was to reduce impacts in the end-of-life stage and that according to the definition of EPR used in this thesis, which includes substance restrictions as falling under the umbrella of EPR instruments, the extended use of this instrument is encouraged, especially given the success it has achieved to date.

Despite the positive impacts of the RoHS Directive, given the sheer number of exemptions to date (33), it is clear that restricting additional substances of concern in electrical and electronic products is complicated, time consuming, and expensive, albeit potentially impacting and effective. Therefore, the relative importance of alternative incentives to encourage the disuse of hazardous substances seems warranted from this perspective. Additionally, any future decisions to restrict further substances is influenced by pioneering companies that have already phased out substances proving that it is technically possible.

While not restricting the use of substances of concern in products when they are put on the market through legal standards, better monitored *treatment standards* concerning the maximum concentration of hazardous substances in material output flows or in emissions to air, water and soil from treatment and recycling facilities allows for greater flexibility in reaching the same goal.

Additionally, internalising the social costs associated with hazardous waste treatment requirements in downstream processing would drive the cost to manage products containing these substances and encourage their substitution by less hazardous substances.

An initial review conducted by the author of this thesis on the draft implementing measures (IM) developed to date, shows that none of the 10 draft documents include either generic eco-design or specific eco-design requirements addressing design for end-of-life aspects. This suggests that in its current form, it is unlikely that the EuP Directive could replace the incentives created through the IPR mechanism in the WEEE Directive.

11.5 Alternatives to Take-Back Mandates

Bohr (2007) argues that the current view of EPR (where producers are responsible for the waste from their own products) has caused tremendous difficulties in the EU implementation process. He notes that environmental objectives such as product design feedback have not been achieved and recycling quality has even deteriorated in some MS. In his view, the incentives created by this EPR interpretation shifts the attention to aspects of minor environmental importance such as identification and tracking of products and claims that this has no environmental value if all products are recycled in the same way in a recycling facility (Bohr, P, 2007).

Bohr (2007) posits that a direct relation of EPR obligations to the consumption of resources in a producer's current production and an adjustment of obligations according to current product design, connects these obligations with environmental impacts. In essence, this is a sort of ex ante assessment of the products future potential end-of-life costs. One way of formalising this, Bohr argues, would be to require a producer to ensure that an amount of secondary materials from WEEE is fed back into the economy which is equal or proportionate to his current virgin material use through the production of new equipment. Additionally producers must divert hazardous materials from disposal to their current use of hazardous materials in products.

According to Bohr (2007) the mechanism described above could be achieved by requiring producers to purchase Material Recycling Credits (MRC) from recyclers. The MRCs are issued by recyclers on quality-defined output fractions and can be bought and sold by producers to meet their issued obligations.

The author points out that the application of EPR in this context is not only a fairer implementation of responsibility but also has several other benefits with respect to the achievement of environmental and economic goals in WEEE recycling systems. Bohr (2007) posits that the tradable MRC model moves towards a system which incites recyclers to collect and process WEEE since they finance their activities through selling material recovery certificates to producers. This system design leads to competition among recyclers, which is likely to bring the price to recover a material down (Bohr, P, 2007). It is also claimed that this model is compatible when producers set up their own individual collection and treatment systems. OEMs can exploit the full potential of a product line in order to issue MRCs (Bohr, P, 2007).

At the same time Bohr (2007) does not address the difficulties associated with calculating each producer's use of materials in products. This would be a major point of contention between producers (establishing the relative contribution of each producer in relation to competitors) and an especially difficult task for regulators to administer and enforce compliance with. Information requirements/flow concerning material compositions of complex durable electronic products would be enormous. Experience to date regarding setting up and administering national producer registers in Europe for producers to report sales on the national market as well as quantities collected and treated has proven to be troublesome for national authorities, so any additional burdens regarding administering MRCs could be controversial.

Despite the above shortcomings, this approach is nonetheless quite novel and warrants further evaluation. Comparing this approach to the characterisation of possible ways to implement IPR in Section 11.7 below, from the view of the author of this thesis, the MRC model in a way fits into the *front end* financial model of implementing IPR.

11.6 EPR in the Context of Positive Intrinsic End-of-life Value

Given the positive trends in material prices, including precious and rare metals, ferrous and non-ferrous metal, as well as plastics, many product categories of EEE products are increasingly yielding positive or near positive revenues, after including the cost of collection, transportation, dismantling, mechanically processing and final secondary treatment.

Given these trends it is not surprising to see other private actors involved in collecting these products at their end-of-life as a business opportunity. This trend is evident in many MS of the EU, and it is expected to increase if material prices remain at their current levels or increase in value.

In the opinion of the author of this thesis, this should not be seen as a negative implication for EPR programmes. These parallel streams to producer organised systems will increase total WEEE diversion. What is important and crucial is that all actors that are involved in collection, transportation and processing of WEEE adhere to the standards set in the backdrop legislation to ensure a level playing field between producer organised systems and other market actor systems. In the case of the WEEE Directive, this will require clarification. For authorities to be able to monitor nation-wide collection rates and recycling targets, all actors involved in these activities need to report to national registers. CECED has indeed pointed this out as a weakness in the current formulation of the WEEE Directive, and have suggested that the responsibilities that are assigned to producers (relevant to collection, and recycling), be also applicable to other actors involved in the end-of-life management of WEEE (CECED, 2008). This is a logical position and should be valid for all EPR legislation current and future, especially given trends in the prices of raw materials and hence secondary materials.

Some stakeholders have called on the Commission to make it mandatory for retailers and municipalities to hand over collected quantities of WEEE to producer compliance schemes. This, they say, is required to ensure that WEEE is treated in approved facilities and that WEEE is not simply sold to the highest bidder in which the ultimate fate of the collected WEEE is unknown or uncertain. In light of the circumstance when end-of-life products have positive value, it hardly appears equitable that retailers or municipalities would be required to finance the collection activities while producers retain all the positive value. This highlights one of the main problems associated with allocation of responsibility for collection of WEEE where such allocation is not precise enough to ensure legal certainty regarding cost assignment.

11.6.1 Producer Liability

To date, the formulation of producer responsibility legislation for EEE has been rather vague in terms of setting collection targets for products and the responsibility assigned to individual producers in meeting these targets. EPR programmes in many jurisdictions do not even include collection or even recycling targets. WEEE Directive collection targets are currently set as an aggregate 4 kg/inhabitant/yr for all product categories combined and it is therefore not possible to allocate specific responsibilities in the current iteration. WEEE Directive text simply requires MS to ensure that the 4 kg/inhabitant/yr is achieved.

Clearly, it is recognised that collection targets are difficult to set considering that there are a number of important uncertainties.[87] Given these uncertainties it is even more difficult to assign explicit individual responsibility to producers for the collection of their own WEEE in the waste stream. This is not to say that it cannot be done, as seen in the case of certain MS where each producer's obligation to collect WEEE has been assigned as a percentage of its total weight put on the market in the compliance period. This is similar to the approach taken in the State of Minnesota in the USA. However, setting legal minimum targets at the appropriate level, so that they can actually be achieved, will be difficult for the authorities, given the uncertainties listed above. Both collective PAYG and return-share financing models commonly take whatever is collected through the system as the denominator, and use either market share or each individual producer's number of products returned as the numerator for PAYG and return-share financing systems respectively.

Whether a producer can be held liable for reaching collection targets corresponding to their own products in the situation when those products are recovered by other actors is a difficult question and remains unanswered. Clearly, as mentioned above, all actors involved in collection and processing of WEEE must be required to report to the national register, so that accurate and complete data for the MS and European Union can be used to assess all WEEE flows and not those just managed by producers. The uncertainty over a producer liability of meeting targets however, is a pressing issue which has numerous implications for future EPR legislation, especially as the demand for raw materials increases. At the same time any decision on

[87] See Section 4.2 for a detailed description of these uncertainties.

this issue must also be considered in light of the points made in the following section.

11.6.2 Balancing Costs of Materials in Production vs. End-of-life Costs

There is an interesting dynamic between the price of primary materials and the cost to manage end-of-life products. As the cost for primary materials such as precious metals and plastics increase, prices obtained for recycled materials also increase, reducing the overall cost to manage end-of-life electronics and in some cases even providing positive revenues. As can be seen in many EU countries when this occurs, other market actors outside the official producer operated schemes become interested in diverting these products to their own processing channels. Evidence suggests that this already happens to positive revenue WEEE streams such as LHA and mobile phones.

Once a product has positive end-of-life value, it is likely that producers have realised that others are netting the benefits of the structural surplus in their products, and may as a result try to find substitute materials to reduce production costs. If however, producers are individually responsible to manage the costs arising from their own WEEE, they will have the inherent incentive structure to balance the extra costs associated with selecting expensive materials with the expected end-of-life costs associated with financing their own WEEE. Producers whose products are entering alternative streams will not bear end-of-life costs, but they cannot recover the added material costs associated with production. However, it is likely that manufacturers would have already been searching for less expensive materials for their products as the cost of raw materials would have already been felt on the manufacturing side, before the end-of-life side of the business costs.

On the other hand, if the end-of-life value is negative, more of the producer's products will end up in the producer compliance scheme, meaning greater end-of life costs. Thus EPR programmes should be able to adapt to these dynamics.

11.7 Characterisation of IPR Implementation

This section begins by reviewing the definition of Individual Producer Responsibility (IPR) first proposed by Tojo (2004). To recap, Tojo (2004) developed definitions of *individual physical* and *individual financial responsibility* (based on actual examples in EPR programmes) and contrasted these to circumstances where physical and financial responsibilities are collective.

According to Tojo (2004), a producer bears an *individual financial responsibility* when he/she pays for the end-of-life management of his/her own products. Conversely, when a group of producers pay for the end-of-life management of their products regardless of brands, their financial responsibility is *collective* (Tojo, N, 2004).

To enable individual financial responsibility, *individual physical responsibility* is considered to be implemented when (1) the distinction of products are made at minimum by brand and (2) the producer has the control over the fate of their discarded products with some degree of involvement of the downstream operation. When products are handled together, the distinction of the properties of the products, including their features on end-of-life management, becomes necessary (Tojo, 2004).

Collective physical responsibility is taken when (1) products of similar kind are physically handled together regardless of the brand and (2) the handling is placed in the hands of a third party, such as a Producer Responsibility Organisation (PRO).

From the above definitions of *individual physical* and *individual financial responsibility* it is clear that IPR can be realised in both collectively organised and individually organised systems. That is, it is possible to implement individual financing in PROs when, for example, a producer pays for his own WEEE by return-share. In the eyes of practitioners, this has become analogous with individual financial responsibility. While Tojo (2004) might disagree that return share, without the distinction of properties would not allow an individual financial responsibility to be established, in practice this concept has not been disputed by any of the major actors involved in EPR programmes to date.

While the definitions proposed by Tojo (2004) have been instrumental in helping to define what IPR is and is not, among practitioners and academics there is still a considerable degree of confusion regarding the use of the term *individual physical responsibility*. This is thought to arise because of the association of physical responsibility with 'who' is conducting the activity rather than how *products* are physically handled in the collective or individual system.

For this reason, it is proposed to no longer use the term individual physical responsibility when describing IPR. In addition, considering that physical identification of individual producer's products is the pre-requisite to implement individual financial responsibility, the added value of defining individual physical responsibility is lessened, especially considering the confusion it creates among practitioners.

With this background, and in the context of the WEEE Directive and more specifically the interpretation of Article 8(2), the following characterisation of possible IPR implementation is proposed in Figure 11-1, and further described below.

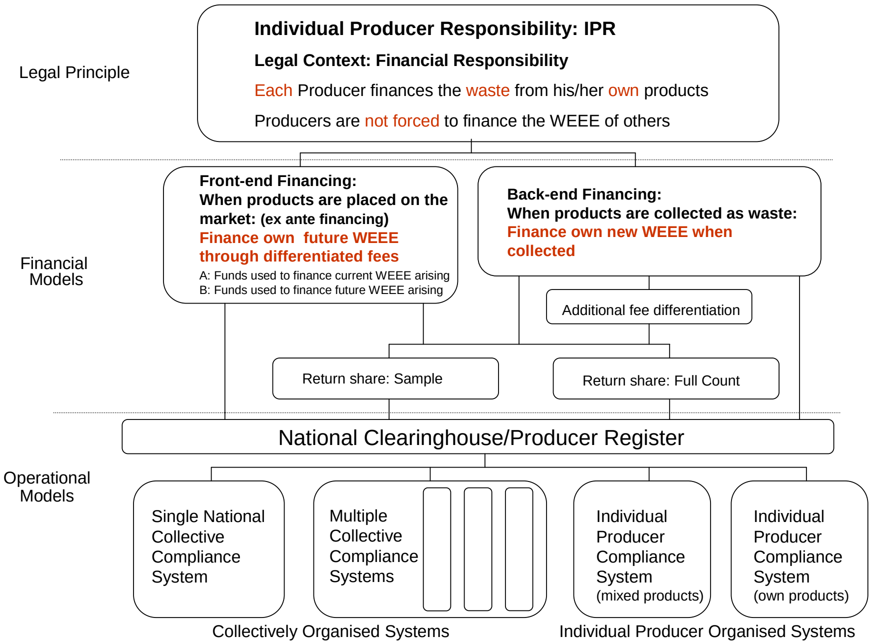

Figure 11-1: IPR Characterisation in the Context of the WEEE Directive

Legal principle

As the financing mechanism described in Article 8(2) assigns an explicit individual financial responsibility for products placed on the market after 13 August 2005, a legal obligation exists for each producer to finance the WEEE from his own products. More importantly, the obligation ensures that producers are not legally required to finance the WEEE from others put on the market after 13 August 2005. Under these assumptions a financial guarantee is required to avoid the cost of any producer that exits the market between the time the product is put on the market and when it reaches its end-of-life. Under this model, all guarantees are to be solid and there are no free riders (those producers not registering and therefore not providing guarantees).

Financial Models

Given the need to satisfy the legal principle above, it is proposed that two main categories of financial model could be applied. The first model, the front-end financing model, can be considered an ex ante financing and refers to the scenario that for new WEEE each producer is financing the future costs to manage his/her own products when those products are placed on the market. Since the fee is differentiated, in theory the producer is paying for his/her own products. Two variations are considered; A) refers to the situation where the funds generated would be used to finance current WEEE arising and B) where funds are used to finance future WEEE arisings. Variation A) implies that the funds would be used to finance both historical and new WEEE as well as orphan products which would not satisfy the legal principle.

Back-end financing model can be considered the most literal understanding of Article 8(2) as each producer finances the WEEE from his/her own products when those cost actually arise (when products are returned). For the purposes of determining the relative return share of each producer's own products in the waste stream, one of at least two methods could be used. These include return share calculated by a statistically significant sample of the return stream or alternatively by identifying each product that is returned in the waste stream. In addition to the return share calculation, a further differentiation of the fees paid to a compliance scheme or recycler could be made based on the characteristics of the individual producer's products returned. To illustrate this, consider the circumstance when laptops returned by producer A contain mercury backlights and products returned by producer B do not. Producer B's fees could be lower than A's as the actual costs will be lower to treat products without mercury backlights.

The various strengths and weaknesses of these financing models are summarised below in Figure 11-2. Many of these points are self-explanatory, however some details are provided here. Since the front-end financing model is in essentially a differentiation made ex ante and is used to finance the current WEEE arisings (Option A only) no financial guarantees are needed as all producers that are on the market when the fees are levied will contribute to the financing of WEEE arising, with the assumption that this model will continue indefinitely. Since producers fees are differentiated based on properties deemed to influence the future costs of managing products, this provides an immediate signal to designers, however, albeit arbitrary. In terms of weaknesses with this model, it could be difficult to get producers to agree on what the differentiating criteria of current design should be, given the strategic issues and the uncertainty regarding future recycling infrastructure, material prices, etc.

Also, with *front-end-financing*, new entrants would be required to pay fees for new WEEE as soon as they enter the market, even though none of their products are arising as WEEE. Some actors however, may see this as a strength of the model. And finally, there is an inherent problem with option B related to the ability to accurately forecast future costs of managing WEEE. This can lead to a situation where either under funding or over funding occurs. While over funding is less of an issue, under funding can lead to serious financing shortages and equitable solutions need to be determined in advance.

	Front-end Financing: **When products are placed on the market** **Finance own future new WEEE through differentiated fees** A: Fees to finance current WEEE arising B: Fees to finance future own WEEE arising	**Back-end Financing:** **When products are collected as waste** **Finance own new WEEE as it arises**
Strengths	• No Financial Guarantee Needed (Option A only) • No delay in financial incentive/disincentive to producers (designers) • No sorting/sampling required (Option A only) • Costs are spread over all products placed on the market regardless if collected or not	• Based on actual end-of-life costs • Financing is connected to actual producer's WEEE when arises – direct connection to costs • Can be differentiated based on product weight returned and other cost/environmental criteria • New entrants do not finance until WEEE returned
Weaknesses	• Difficult for stakeholders to agree on differentiating cost criteria • Only indirectly connected to producers own WEEE (as based on placed on the market) • Financial risk/equity with major technological changes (LCD display finances CRT) (Option A only) • New entrants finance at market entry (Option A only) • Risk of over/under funding when fees calculated ex ante (Option B only))	• Financial Guarantee and possibly accruals needed • Delay in financial incentive to producers (designers) • Sorting/sampling required and associated administration costs • Potential disincentive for high collection rate

Figure 11-2: Strengths and Weaknesses of Financing Models

With respect to *back-end financing models*, strengths include the fact that fees producer pay for their own WEEE are the actual costs incurred, as opposed to arbitrary cost assignment with front-end financing. This incentive may albeit stronger if fees based on return share are further differentiated based on the individual properties of product and how they impact the costs to manage a mixed brand WEEE stream. However, this model does entail sorting or sampling costs when mixed branded WEEE is collected together. This however, can be avoided with automated identification technologies. Clearly, financial guarantees are required in this model, as described in Article 8(2) and there is an obvious delay in the time from when the product is designed and when the product is collected as WEEE which may discount any future benefits from investment in design today.

Operational models

Finally, there are four operational models proposed in Figure 11-1. These are not considered to be a full representation of all possible models but are used for illustrative purposes. These operational models do represent implementation in reality to a certain degree, especially with respect to the collectively organised systems, where there may be either a single national collective compliance scheme or many competing collective compliance schemes on the national market. Also included are individual producer organised systems which producers may either be collecting their own branded products only, or possible mixed brands of the same product type as their own. Again, these individual producer organised systems refer to who is physically conducting the activity. Clearly, for a producer that is collecting mixed brands, in order for the individual financial responsibility to apply, the producer must be using the collected WEEE as a minimum against its return share obligations.

Clearly in all cases above, perhaps with the exception of a single national compliance scheme a clearing house function is required in order to facilitate several activities. This will depend on how responsibility for collection is assigned i.e.) whether municipal collection sites will need to be allocated among the collective compliance schemes or individual producer schemes.

Considerations when organisational models and financial models are combined

Given that sorting or sampling of WEEE is required to determine the relative share of new and historic WEEE as well as return-share is needed, it would be less complex to implement in a single national compliance scheme. Since there is only one PRO that is in operation in these models, WEEE collection is handled by one system. Therefore all sorting or sampling at collection sites to determine brand-share of new WEEE is less complex to manage.

In the other models, WEEE sorting and/or sampling must be done for each PRO and individual producer system (mixed brands) since mixed brands are collected. Information sharing between the systems would be necessary to determine the return-share of each producer's new WEEE. This is more administratively complex. Alternatively a national clearing house could take a representative sample of the entire country and assign return-share proxies to each producer. Each system would be responsible for managing the return share WEEE of its total membership.

Assumption on Clearing House Role

In Figure 11-1, it is assumed that a National Clearing House is in place that functions as a coordinating body that manages key activities that underpin the functioning of a level playing field including;

- National producer registers and data reporting (products placed on the market)

- Oversee development of national collection infrastructure or compliance schemes: Can include allocation of collection sites, geographical responsibilities, etc.
- Development of rules on how to solve disputes between compliance schemes with respect to over reporting WEEE collected and managed
- Development of rules for classifying dual-use WEEE as either WEEE from private households (B2C) or WEEE other than from private households (B2C) when:
- Placed on the market: for calculating historical WEEE obligations for B2C
- Determining how historical WEEE from businesses should be managed: either as B2C or B2B WEEE which will determine financial mechanism to apply, collection options etc.
- How new dual-use EEE sold to businesses will be managed when arising as new WEEE.

In terms of the designation of dual use products, the following is proposed. Dual use products (sold to businesses) can be managed by producers themselves, by compliance schemes (collecting from businesses) or a combination of both. All sources of collected dual use products collected from businesses should be reported to the National Register or Clearing House as either B2C or B2B. Any dual use WEEE collected by a producer himself should be credited towards his obligations calculated under the national compliance scheme. This WEEE can also be from special collection events, own take back programs and the like. Dual use products (sold to businesses) are included in the calculation of market-share for historical WEEE (B2C) unless the producer demonstrates that these products will never end-up in the calculation described above.

CHAPTER

TWELVE

12. Conclusions

12.1 Revisiting the Research Questions

Undoubtedly, there has been considerable uptake of EPR by governments around the world as a suitable policy approach to address the environmental impacts associated with the waste management of products, including the desire to shift the costs away from taxpayers and on to producers and consumers. However, in the current discourse over what constitutes successful EPR policy implementation in the context of WEEE, there is an on-going debate over the ability of programme design to include an appropriate *incentive mechanism* to stimulate producers to improve the design of their products for reduced life cycle impacts, and especially the impacts and costs from the end-of-life management.

The aim of this research is to contribute to the understanding of how Extended Producer Responsibility (EPR) programmes can be structured to maximise incentives for improved environmental performance of products and product systems, especially from an end-of-life perspective. As this research focuses on the product area of electrical and electronic equipment (EEE) the following research questions guided the research.

RQ 1: What evidence is there that EPR legislation and practical implementation of EPR programmes with clear incentives will incite producers to design products for reduced end-of-life impacts and costs?

RQ 2: What has been the European experience to date in embedding incentive-based EPR, firstly into applicable legislation and secondly into operational programmes for the management of household WEEE?

RQ 3: Why is it so difficult to implement incentive-based EPR programmes for WEEE in the European context?

RQ 4: How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?

12.1.1 Main Findings

RQ 1: What evidence is there that EPR legislation and practical implementation of EPR programmes with clear incentives will incite producers to design products for reduced end-of-life impacts and costs?

Regarding the first research question, the results presented in Chapter 5, Chapter 6 and Section 9.4, shed light on the issue. There are a number of key conclusions that can be drawn from reviewing the pertinent literature on the impacts of EPR legislation on producer and other relevant actor decisions regarding product design and the choice of compliance approach. Clearly there are varying results regarding the effects of EPR legislation on product design found in the empirical research on EPR programme implementation for vehicles, EEE, and packaging.

Reviewed studies which have suggested that EPR programmes have had limited impact on product design, have pointed to a number of reasons why. One such reason includes the relatively low compliance cost associated with financing end-of-life products when they are placed on the market compared with other business costs. It has also been suggested that in many cases these fees are unavoidable and represent more of an output tax (when expressed as a fixed fee), thus providing no incentive for altering firm behaviour. Additionally, since consumers are often willing to absorb costs with little demand implications (price inelasticity), producers are even more reluctant to push for change in financing models. In some way these results are hardly surprising given that in the particular EPR programmes reviewed, there was never an intention to illicit change on behalf of producers, as the focus was rather on designing cost-covering measures.

On the other hand, while many of the studies documented explicit changes to both product design (upstream measures to improve end-of-life performance) as well as downstream improvements to collection and recycling infrastructure, they pointed to the role of anticipatory effects of the EPR legislation on firms decisions to innovate, rather than from the implementation of the programme and clear incentives themselves. In particular the WEEE, RoHS and ELV Directives have been cited as the key drivers in the literature.

Other evidence to show that EPR policies with clear incentives can lead to product improvements was found in the way in which producers developed tools to assess their products for end-of-life environmental and cost management, especially in anticipation of the WEEE Directive. These tools were developed to assess products against recycling targets and treatment methods laid out in the Directive to determine implications for their current designs.

RQ 2: What has been the European experience to date in embedding incentive-based EPR, firstly into applicable legislation and secondly into operational programmes for the management of household WEEE?

For this research question, an extensive review of the developmental process of the WEEE Directive, from its early stages of a working document to the transposition of the Directive into the national laws, statutes and legal instruments of the 27 Member State (MS) of the European Union has been undertaken.

Undoubtedly, the development and adoption of the WEEE Directive has put the spotlight on the role of EPR programmes to stimulate improved product design. For example, Recital 20 of the WEEE Directive explicitly mentions that in order to allow for the maximum effect of the producer responsibility principle, each producer of electrical and electronic equipment (EEE) should be financially responsible for managing waste from his/her own products. This is meant to provide the necessary financial feedback mechanism to producers to design their products for better end-of-life management that results in lower treatment costs and environmental improvements.

However, a closer look at the development of the Directive, especially through the co-decision process in the Council and the Parliament, revealed that these two groups were clearly not in agreement over the suitability of the key mechanism to achieve the desired incentive, namely the financing mechanism based on IPR. It is interesting to see the refinement of the idea of IPR throughout the development process, starting from a simple concept that evolved into a detailed and complex mechanism requiring the need to distinguish between new and historical products (producer identification and date stamp) along with the need for financial guarantees to avoid the costs of orphan products falling onto taxpayers or other producers.

While the end result of the WEEE Directive maintains the principle of individual financial responsibility within Article 8(2), there are numerous ambiguities in the wording of the text to allow for proponents of either collective financial responsibility or individual financial responsibility to find their own arguments for adopting one or the other. In the conciliation process, it was the Parliament that won the debate to keep IPR in the WEEE Directive, however the clear definition of what individual financing entailed was dropped from the list of definitions in Article 3. Similarly, the allocation of physical and financial responsibility for collection sites was left up to MS to decide depending on their local context. A lack of other key definitions including what is a suitable financial guarantee and the defining criteria to distinguish WEEE from private households from that of WEEE from businesses has resulted in various interpretations by MS.

Turning to the actual results of the transposition process in MS, specifically concerning the provisions related to IPR, the outcome is disappointing, but not all that surprising. Most MS transposition reflects the above context with respect to the position of the Council (which represents National Governments) during the conciliation period of the WEEE Directive development and the ambiguity of the wording of key Articles, namely Article 8(2). To recap, 9 MS have been identified as correctly transposing Article 8(2) as the intended in the spirit of IPR, 11 MS have what can be described as an ambiguous interpretation and 8 MS clearly ignore IPR and even explicitly assign a collective responsibility for new WEEE.

The second part of Article 8(2) with respect to the requirement for a financial guarantee shows similar results in line with the above. Even though many MS simply list the options as they appear in the WEEE Directive, all MS – with the exception of Sweden and Germany – consider membership in a collective compliance scheme as a suitable financial guarantee. As these systems are based on the principle of reciprocity, meaning that each member agrees to finance a share of orphans and free-riders, MS presumably are confident that the costs of these orphans and free-riders will not fall to them. This decision has lock-in effects, encouraging the continuation of collective financing currently used for historical waste, indefinitely for new WEEE. If the Commission were today to enforce Article 8(2), considering the absence of financial guarantees for products placed on the market since 13 August 2005, over 3 years of potentially new WEEE could remain unfunded when it is returned as WEEE.

MS have also transposed the definition of producer to be the actor that brings products on to the national market. While this would first appear as a sound way of identifying a legal actor on the national market, it does have serious ramifications for IPR implementation in three main ways.

Firstly, due to common business procedures in line with the principle of the internal market, products frequently pass from MS to MS via distributors, wholesalers and national importers. However, when MS apply a national definition of producer, the product may inevitably end up having many producers on the European Market, requiring duplicated producer registration, compliance fees and financial guarantees.

Secondly, in order to implement IPR in practice, identification of the producer is essential. This implies that national producers would need to re-label products to identify themselves as the producer so that when the costs arise at end-of-life the appropriate producer can be identified. Additionally, if the producer had become insolvent, then the guarantee would need to be called upon from the appropriate producer.

Thirdly, it is questionable whether a retailer or wholesaler (that inevitably becomes the producer on the national level because of the national definition of producer) is the appropriate actor to react to the incentive created by IPR in the first place.

To summarise, if not corrected the results of the transposition outcome regarding IPR relevant requirements do not allow practical IPR implementation to emerge. The transposition outcome of Article 8(2) only reinforces the continuation of collective systems employing PAYG financing models with little or no incentive for design improvements.

RQ 3: Why is it so difficult to implement incentive-based EPR programmes for WEEE in the European context?

The absence of legal certainty is a major barrier to the implementation of IPR in the WEEE Directive given the transposition outcome. Despite this, there are a number of technical barriers to implementing EPR programmes for WEEE in the European context which have been addressed in the above paragraphs. Other technical impediments to realising IPR are connected to identifying producer's individual products in the waste stream as well as differentiating the costs to manage those products in the recycling stream. The expected costs to individually count and weigh products returned or the costs associated with automatic identification for all WEEE categories is currently not known. Although often claimed as a major barrier to IPR, very few financial figures are presented to support such arguments.

Other barriers include many uncertainty factors over whether the investment made in design will yield sufficient net present value given the potentially long pay back periods involved for large household appliances and other long lasting products. For products with shorter life cycles, including ICT equipment, this may be less of a concern for manufacturers. As Article 8(2) in the WEEE Directive creates a legal future liability for producers to finance the waste from their own products, implications for financial accounting have also emerged. While not openly discussed by producers or the accounting community, the need to make provisions in the balance sheet for these future costs is in line with international accounting standards (IAS 37). Although the full financial impact of such a requirement has not been determined in this research, it is likely to impact each producer's financial position in different ways.

However, while there are many arguments put forward that systems organised by individual producers do not enjoy economies of scale and are therefore less efficient, there are numerous producers that are lobbying intensively to maintain IPR as it stands in Article 8(2) today. Part of the explanation why there is such a resistance to IPR is the belief that it implies that all producers need to develop their own infrastructure and recycling activities. This is simply not the case as has been highlighted throughout this research and a number of real world examples in Japan, the US and in Europe where the principle of IPR has been successfully implemented in collectively organised systems.

While it has been illustrated that IPR can be implemented in both collectively organised systems as well as independent own brand or limited producer compliance systems, independent systems are currently discriminated against in the implementation of the WEEE Directive in MS. This is primarily as a result of the explicit requirement for producers who wish to comply through their own independent compliance schemes to have financial guarantees, while at the same time producers that are members of collective compliance schemes are exempt. Similarly, most MS have allocated physical responsibility to municipalities to collect WEEE from private households. Individually organised producer compliance schemes are in most cases not allowed access to the waste stream. Since municipal collection is often partially or fully financed by taxpayers and independent compliance schemes are not eligible for these subsidies, independent compliance options are less attractive alternatives.

RQ 4: How can the difficulties experienced in implementing incentive-based EPR programmes for WEEE be overcome?

For many of the IPR implementation barriers (as IPR is defined in the WEEE Directive) this research has suggested a number of potential solutions. In terms of addressing the definition of producer at the 'national level' (as it is today through the transposition outcome) vs. the 'European level' as originally outlined in the WEEE Directive text, a potential solution to the problem is proposed. Interestingly, the 'definition solution' as presented in Section 11.1.1 has the potential to solve many of the other problems including the producer identification and labelling requirements. It provides the means to focus the financial obligations on the actor most likely to be influenced by it, namely the manufacturer or first importer into the EU.

Regarding the financial guarantee, in the view of the author, this needs to be further researched. The financial impact on firms as a result of the guarantee requirement is not well understood. If the requirement for a true financial guarantee were upheld by authorities, market solutions that emerge may offer alternatives to fund building drastically reducing the roughly estimated capital outlay figures. However, even less well understood is how the legal requirement of 8(2) for producers to finance their own products put on the market after 13 August 2005 would impact accounting requirements. This issue has been in some ways hidden from the debate, but ultimately needs to be addressed.

At the end of Chapter 11 a characterisation of IPR is presented which describes a number of potential ways of implementing IPR in the WEEE Directive. This can be useful in the discussion regarding ways to move forward or even perhaps to re-think the way IPR is constructed today. The model illustrates that it is possible to implement IPR through both front end financing and back end financing scheme models. In light of the practical developments of multiple competing schemes on national markets, the back end financing model would seem to be the best route forward. Given the inertia of collectively organised systems based on the PAYG financing model, it is doubtful that a mandatory return share model could be enforced at the national or European level. However, having said this and in the context of how Washington State has attempted to address this issue, a potential solution can perhaps be found. If it were mandated at the national or European level that each producer's return share be calculated (based on sampling), and at the same time producer's were left to decide how they financed their return share, this might strike a balance where it is much needed. That is, collective responsibility proponents could maintain their financial model of market share allocation based on the combined return share of its members.

As each producer would only be liable for a relative share of the returned waste based on his own products arising, any producer's efforts to develop their own collection systems would not be disadvantaged as would be if the financing mechanism was based on market share. While highly speculative, this could have an impact on manufacturers strategic views regarding their own closed loop reverse supply chains or even new business models such as product leasing or Product Service Systems (PSS).

At the same time it must be recognised that certain product groups, or more likely collection groups are more suitable than others for return share financing models. For example, products that require a first step manual disassembly, including CRT based products or Cooling and Freezing (C&F) could be good candidates for this model. At the same time new CRT manufacturing is in rapid decline and the long term incentive possibilities are minimal in this product category. ICT equipment is a highly eligible candidate as many of the proponents of IPR are manufacturers in this sector.

12.2 Recommendations to Policy-Makers

As the review of the WEEE Directive moves closer to the Commission's release of a proposal for a revised Directive in December 2008 or early 2009, the debate concerning individual producer responsibility vs. collective producer responsibility is sure to be in the forefront again. It is hoped by the author of this research that the conclusions found within this research may provide some value to policy-makers during this process.

A potential solution to the producer definition in Section 11.1.1 would be especially relevant in the upcoming discussion. This solution has the potential to address other issues that arise when the national approach of identifying producers is employed, including the re-labelling issue for producer identification and potentially multiple producers for the same product on the European Market.

It is the view of the author that one of the major stumbling blocks for moving forward on IPR is the concern of many MS over having to assume financial responsibility for any orphan 'new WEEE' that might arise in the event that guarantees are not available or where producers never register. This calls on the European institutions to address this impasse through strong signals to the market over what constitutes a suitable guarantee. This in turn would incite financial institutions and insurance firms to develop innovative financial solutions for the market. Alternatively, the issue of guarantees could be rethought altogether drawing on solutions in other jurisdictions where orphan WEEE is financed by producers on the market when those costs arise, either proportioned to market share or return share. This however, would be a step away from the strict principle of IPR as currently defined in the WEEE Directive.

As this research has illustrated, on the one hand the anticipation of IPR implementation has shown to have motivated producers to initiate change in product design for improved end-of-life performance. However, on the other hand, the practical implementation in the European WEEE Directive context has failed to emerge reminding us of the popular idiom 'the devil is in the details'. While IPR implementation in EPR programmes should not been seen as a 'silver bullet', its value in EPR policy design is clear. Failure to implement it would send an unfortunate message, not only to producers, but also to policy-makers in other jurisdictions.

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Appendix A – List of Interviews

Timing	Interviewee	Affiliation
22 January 20 Februrary 16 March 2007	Viktor Sundberg	Electrolux Home Products Corporation N.V.
14 February 5 and 13 March 2007	Raphael Veit	Perchards
24 February 2007	Kieren Myers	Sony Computer Entertainment Europe
27 February 2007	Bernhard Brackhahn	Danish Environmental Protection Agency/Danish TAC member
27 February 2007	Tomas Tengå	Elektronikåtervinning Ekonomisk Förening (Electronics recycling economic association)
1 & 5 March 2007	Frans Loen	Sony Deutschland GmbH
5 March 28 June 2007	Lars Eklund	Swedish Register
6 March, 10 April , 2007	Cristof Delater	Flemish Association of Municipalities
8 March 2007	Ulf Gilberg	WEEE System Denmark
9, 16 March 2007	Christianna Papazahariou	Euro commerce
12 March 2007	Dominic Henry	WEEE Registers Society Ireland
20-22 March 2 April	Wolfgang Hahn	SANYO-Fisher Sales (Europe) GmbH
22 March 2007	Rasa Usléte	Ekokonsultacijos
22 March 2007	Jolanta Dvinelyte	Lithuanian Environmental Protection Agency
22 March 2007	Emilie Prouzet	Carrefour
22 March 2007	Pascal Leroy	CECED
26 March, 2007	Eelco Smit	Epson Europe B.V.
28 March 2007	Per Dorfnäs	Telefonaktiebolaget LM Ericsson
29 March 2007	Claudia Graziani	Bosch-Siemens
30 March 2007	Matthias Aigner	Ingram-Micro
30 March 2007	Rob Koppejan	Philips Lighting
4 April, 11 July 2007	Kirstie McIntyre Mark Dempsey*	HP
10 April 2007	DI. Christian Ehrengruber	LAVU AG, Wels
11 April 2007	Sylvain Chevassus	European Council of European Municipalities and Regions
24 April 2007	Hans Kormacher	Procter & Gamble, ERP
7 May 2007	Thomas Marinelli	Royal Philips Consumer Electronics
9 May 2007	Margarita Gómez Moreno	IBM
25 June 2007	Teemu Virtanen	Finnish Environmental Administration
26 June 2007	John Hayes	ERP Ireland

Timing	Interviewee	Affiliation
27 June 2007	Sean O'Suilleabhaln	Department of Environment, Heritage and Local Government, Ireland
3 July 2007	Conrad Leonard	WEEE Ireland
10 July 2007	Christiane Schnepel	UmbweltBundesAmt German Federal Environmental Agency
15 January 2008	Udo Cerowski	Bosch Power Tools
26 March 2008	Matts Spångberg,	Branschkansliet
1 April 2008	Stefan Runström	Nordic Guarantee
12 May 2008	Johan Näslund	Stena Technoworld
	Sverker Sjölin	
7 May, 2008	Paul Brändli	SWICO
6 July 2008		
2 October 2008		
21 August 2008	Carole Cifrino	Maine Department of Environmental Protection
26 August 2008	Lawrence King	HP Product Recycling
29 September 2008	Jean Cox-Kearns	Dell Computers Corporation

Appendix B – MS national WEEE transposition legal Instruments Reviewed

Member State	Implementing Measures Reviewed
Austria	Ordinance of the Federal Minister of Agriculture and Forestry, Environment and Water Management on Waste Prevention, Collection and Treatment of Waste Electrical and Electronic Equipment (WEEE Ordinance), BGBl. (Federal Law Gazette) II No. 121/2005 [non-authorised translation]
Belgium	Belgium (Brussels): 18 JULY 2002.- Order of the Brussels Regional Government introducing a take-back obligation for some waste materials for the purpose of the useful application or elimination thereof [non-authorised translation] Belgium (Flanders): VLAREA – Consolidated Version (updated to 14 July 2004) Belgium (Walloon): 10 MARCH 2005. - Order of the Walloon government modifying the Order of the Walloon government of 25 April 2002 instigating an obligation of recovery of certain waste items with a view to their enhancement of value or management.
Bulgaria	DECREE No. 82 dated 10 April 2006, on the adoption of Regulation on the requirements to putting on the market of electrical and electronic equipment and treatment and transport of waste from electrical and electronic equipment
Czech Republic	106 THE PRIME MINISTER promulgates full wording of Act No. 185/2001 Coll., on waste and amending some other laws, as follows from amendments introduced by Act No. 477/2001 Coll., Act No. 76/2002 Coll., Act No. 275/2002 Coll., Act No. 320/2002 Coll., Act No. 167/2004 Coll., Act No. 188/2002 Coll., Act No. 317/2004 Coll. and Act No. 7/2005 Coll. ACT on waste
Cyprus	EU Par III(I)O. 3888 30.7.2004, KDP 668/2004, Number 668: The Hazardous Waste (Solid Waste from Electrical and Electronic Equipment) Regulations 2004, issued by the Council of Ministers under the provisions of article 5 of the Hazardous Waste (Solids) Act 2002, after submission to and approval by the House of Representatives, have been published in the Cyprus Government Gazette in accordance with article 3 (3) of the Approval of Parliament (Regulations) Act, statute 99 / 1989 as varied by statute 227 / 1990. [unofficial translation]
Denmark	Statutory order on management of waste electrical and electronic equipment (the WEEE Order) No. 664 of 27 June 2005 Act no. 385 of 25 May 2005, Act amending the Environmental Protection Act (Producer liability for electronic waste, etc.)
Estonia	Waste Act Passed 28 January 2004 (RT1 I 2004, 9, 52), entered into force 1 May 2004. Amended by the following Acts: 08.02.2007 entered into force 12.02.2007 – RT I 2007, 19, 94 (NB! Missing in that translation); 31.05.2006 entered into force 30.06.2006 – RT I 2006, 28, 209; 16.06.2005 entered into force 10.07.2005 – RT I 2005, 37, 288; 22.02.2005 entered into force 03.04.2005 - RT I 2005, 15, 87; 14.04.2004 entered into force 01.05.2004 - RT I 2004, 30, 208.

Member State	Implementing Measures Reviewed
	Requirements and Procedure for Marking Electrical and Electronic Equipment, Requirements, Procedure and Targets for Collection, Return to Producers and Recovery or Disposal of Waste Electrical and Electronic Equipment, and Time Limits for Reaching Targets1: Regulation No. 376 of the Government of the Republic of 24 December 2004 (RT2 I 2004, 91, 628), entered into force 1 January 2005
Finland	Waste Act (1072/1993; amendments up to 1063/2004 included) [unofficial translation Ministry of the Environment] Government Decree on Waste Electrical and Electronic Equipment (852/2004) [unofficial translation Ministry of the Environment]
France	Decree n° 2005-829 of 20 July 2005 relating to the composition of electrical and electronic equipment and to the elimination of waste from this equipment (Official journal of the French republic - 22 July 2005) NOR: DEVX0400269D [Ministry for Ecology and Sustainable Development translation]
Germany	Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment (Electrical and Electronic Equipment Act, or ElektroG) 1 of 16. March 2005
Greece	5 March 2004, PRESIDENTIAL DECREE No 117, Measures, terms and programme for the alternative management of waste electrical and electronic equipment in compliance with the provisions of the Council Directive 2002/95 “on the restriction of the use of certain hazardous substances in electrical and electronic equipment” and Council Directive 2002/96 “on waste electrical and electronic equipment” of 27 January 2003”. Decree 15 amending Presidential Degree No. 117 (available only in Greek).
Hungary	264./2004 (IX.23.) governmental decree on taking back wastes of electric and electronic equipment [unofficial translation]
Ireland	S.I. No. 340 of 2005 WASTE MANAGEMENT (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT) REGULATIONS 2005
Italy	Legislative Decree 25th July, 2005 – no. 151, Implementation of the Directives 2002/95/CE, 2002/96/CE and 2003/108/CE concerning the reduction of the use of hazardous substances in the electrical and electronic equipments as well as the disposal of wastes. [EcoR’it unofficial translation]
Latvia	Waste Management Act: [unofficial translation] The Cabinet of Ministers of the Republic of Latvia, Regulation No.736, Riga, 24 August 2004 (prot. No.50 29.§) Requirements for Labelling Electric and Electronic Equipment. formation Issued in accordance with Article 207 , Section two, Paragraph 1 and 4 of the Waste Management Law [unofficial translation: source unidentified]
Lithuania	Law on Waste Management. 1998 Nr. 61 and its amendments 2002, Nr. 72-3016; 2005, Nr. 84-3111

Member State	Implementing Measures Reviewed
	Rules for creating bank guarantees, collateral agreements and other agreements proving, that management of waste electric and electronic equipment will be financed, as well as rules for the accumulation, use and return of funds. approved by the Government of the Republic of Lithuania, Jan 19, 2006, Nr. 61 Licensing rules for the organization of product and/or packaging waste management. approved by the Government of the Republic of Lithuania Jan 11, 2006, decision Nr. 18 Rules of the management of waste electric and electronic equipment. new edition by the minister of environment, August 16, 2005, Nr. D1-395 Rules of registration of producers and importers. approved by the order of the Minister of environment, Nov 17, 2005, Nr. D1-555 amended 2006, Nr. D1-619 (the five pieces of legislation above are available only in Lithuanian) Extract from the Law on Waste Management of the Republic of Lithuania CHAPTER VIII(1) RIGHTS AND OBLIGATIONS OF PRODUCERS, IMPORTERS AND DISTRIBUTORS [unofficial translation: source unidentified]
Luxembourg	A – No. 13, 31 January 2005, WASTE FROM ELECTRICAL AND ELECTRONIC EQUIPMENT, Grand Duchy regulation of 18th January 2005 on waste from items of electrical and electronic equipment and the restrictions on the use of certain of their hazardous components. Page 214. [unofficial translation]
Malta	ENVIRONMENT PROTECTION ACT(CAP. 435) Waste Management (Waste Electrical and Electronic Equipment) Regulations, 2004 [
Netherlands	WEEE Management Regulations Directorate General for Environmental Management Chemicals, Waste and Radiation Protection Directorate Non-Hazardous Waste Department Regulations laid down by the State Secretary for Housing, Spatial Planning and the Environment, on 19 July 2004, under reference no. SAS\2004072357, relating to waste electrical and electronic equipment (WEEE Management Regulations)
Poland	Text of the Act concluded following the Amendments of the Senate Act of 29 July 2005 on Waste Electrical and Electronic Equipment
Portugal	Decree Law no. 230/2004, December 10
Romania	GOVERNMENT DECISION no. 448/19.05.2005 (OJ no 491/10.06.2005) on waste electrical and electronic equipment (WEEE)
Slovakia	733 ACT from December 2, 2004, by which the Act No. 223/2001 of Coll. On Waste and On Amendment of Certain Acts as amended by subsequent provisions and On Amendment of Certain Acts is amended
Slovenia	Decree of 04/11/2004 (Official Journal RS, No. 118/04, 56/05), transposing the WEEE Directive into Slovenian law.
Spain	ROYAL DECREE 208/2005, of 25 February, on electrical and electronic equipment and the management of the waste thereof.[unofficial translation]
Sweden	Swedish Code of Statutes 2005:09, Ordinance on producer responsibility for electrical and electronic products issued on 14 April 2005.
UK	2006 No. 3289 ENVIRONMENTAL PROTECTION, The Waste Electrical and Electronic Equipment Regulations 2006: 12 December 2006

Appendix C – Interview Guide: DG Env. Study

The Producer Responsibility Principle of the WEEE Directive: DG ENV. Study Contract N° 07010401/2006/449269/MAR/G4

The following list of question items has been developed as a part of the study, entitled the Producer Responsibility Principle of Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE), that research teams from Ökopol, IIIEE and RPA are awarded to conduct by the DG Environment of the European Commission. This is one of a number of studies being carried out by the Commission as part of the review of the Directive.

The objective of the study is to provide a thorough evaluation of the operation of the Directive's provisions relating to producer responsibility obligations for WEEE and to consider options to improve the operation of those obligations in the EU. Among the issues to be examined, of special relevance to the questions below are:

- the interactions between the systems set up by Member States (MS), the achievement of the Directive's objectives and the impacts on business; an
- the functioning of the register of producers that MS shall draw up and options for its further improvement, development and simplification.

We would be grateful if you could contribute to our studies by providing insights to the issues ad-dressed below. Many of the questions are of qualitative nature; however, we are very interested to obtain any quantitative data that you may hold on the costs or benefits of the Directive for your business. We would like to learn from you your experiences in the any of these issues. Except for the first point, whose answer we need to know to obtain the general picture of your company, it is not necessary to provide us with answers to all the questions but please provide as much information as you can, as this will help to ensure that the revision of the Directive takes account of your experiences..

The insights provided will be utilised anonymously in the study report and if requested will be treated as confidential.

Please send your answers, by 30 March, to:

Naoko Tojo (naoko.tojo@iiiee.lu.se, +46 46 222 0260) and/or Chris van Rossem (Chris.van.rossem@iiiee.lu.se +46 46 222 0231). We would be also happy to contact you via phone.

a) General information about the company

1. Name of your company
2. Size of your company (# of employees, turnover)
3. MS in which your company or affiliate are registered as the producer

4. The WEEE categories 1-10 that your products fall under
5. Which of your products put on the EC market, and the percentage this comprises of the total products you produce (in sales value)
6. Contact information (your name, e-mail and telephone number)

b) Registering and Reporting

1. What are the administrative costs related to registering yourselves as a producer (per product), ideally in terms of person-days time required per year and costs per hour? (We would appreciate it if you could indicate data related to 1) initial set up cost and 2) operational cost once the system is set up.)
2. What are the administrative costs related to reporting products put on the market (per product) , ideally in terms of person-days time required per year and costs per hour? (We would appreciate it if you could indicate data related to 1) initial set up cost and 2) operational cost once the system is set up.)
3. What are the value and nature of any new investment made to develop/revise software/other tools to facilitate registering and reporting?
4. Do you have any examples of difficulties/drawbacks your company experienced with registering and reporting sales data (if related to specific MS, please specify which MS)?
5. Do you have any examples of how the ways in which sales data are reported leads to potentially disproportionate financial obligations for your company (please specify which MS, how this happened and the level of costs involved)?
6. Actions that your company has to take to deal with products move across the national boarder, estimated costs and other impacts experienced.
7. Could you provide examples of how the registers make distinction between B2B and B2C products? If you are part of a collective scheme, is the distinction made by the register corresponding to the distinction made by the collective scheme? If it is not, how are they different? (please specify which MS, how this happened and the level of costs involved)
8. Could you provide examples of how the products are regarded as they are "put on the market" in the MS you are operating? (please specify which MS, how this happened and the level of costs involved)

c) Definition of producers

1. Could you provide examples of any impacts your company has experienced in relation to the differences in the definition of producers among MS? Please quantify any costs incurred, if possible

d) Product labeling

1. Do you have any experience of re-labeling of your products by distributors: if yes, please pro-vide examples and estimated cost per product re-labeled?
2. What might be the (potential) benefits of re-labeling from the company perspective?

3. What might be the (potential) disadvantages of re-labeling from the company perspective?

e) Cross subsidisation between product categories

1. Are you aware of any examples of cross-subsidisation between different product groups for the financing WEEE (please specify which MS, how it happened and the cost impacts for your company)

f) Paid incentives for retailers to participate

1. Do you have any examples of where retailers receive financial incentives to participate in collection activities (Please specify which MS, the scale of the payment, e.g. percentage of the fee, concrete arrangements by which the retailers are paid)?

g) Level of financial reserves to cover contingencies

1 .Do you have any examples of the level of financial reserves available to collection schemes to cover contingencies (please specify the MS and the magnitude)?

h) Financial guarantees

1. How does your company provide financial guarantees for future WEEE?
   - Participation in collective compliance scheme exempts my company from paying the financial guarantee
   - Members of a collective compliance scheme insure the payment of the others
   - Fees for the management of future WEEE are kept in a blocked bank account
   - Fees for the management of future WEEE are paid to an insurance company
   - others (please specify)
2. How are the financial guarantees calculated and what is the size of the guarantees paid?
3. Do you have any examples of how the current forms of financial guarantee that you and your competitors use might affect your business?

i) Research and development regarding alternative solutions

1. Could you provide us with examples of any alternative solutions your company, or the systems your company participates to handle WEEE, have investigated to improve the existing system? What does the new system aim to improve (cost efficiency, provision of design incentives, etc)? What is the esti-mated amount and value of resources spent on the R&D?

j) Information related expenditure

1. Could you provide us with examples of information related activities your company/ the systems your company participates in to handle WEEE. (Frequency of the activities, estimated amount and value of resources)?
   - information on the web/commercials on TV (xx times in total, cost per time)
   - commercials in movie theaters (xx times in total, cost per time)
   - newspaper advertisement (xx times in total, cost per time)
   - posters in the city hall (xx pieces in total, costs per piece)
   - posters in public places (xx pieces in total, cost per piece)

- ◦ leaflet to households (xx pieces in total, costs per piece)
- ◦ Others (please specify)

k) Location of recycling activities

1. Where are WEEE of your company recycled (within the MS where WEEE is generated, outside of MS or outside European Union), and what are the cost implications of this?

l) Treatment requirements

1. What are your views on the specifications in Annex II of the WEEE Directive, including the implications for environmental impacts and costs of the specifications?

m) Individual producer responsibility

1. What are your views on individual producer responsibility and the manner in which it can be operationalised?

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Chris
van Rossem

Individual Producer Responsibility in the WEEE Directive

From Theory to Practice

In the current discourse over what constitutes successful Extended Producer Responsibility (EPR) policy implementation, there is an on-going debate over the ability of programme design to include an appropriate *incentive mechanism* to stimulate producers to improve the design of their products for reduced life cycle impacts, and especially the impacts and costs from the end-of-life management. At the centre of the debate is the Directive on Waste Electrical and Electronic Equipment (WEEE) which has the explicit goal to encourage the design and production of electrical and electronic products which facilitate dismantling, recovery and in particular the reuse and recycling of WEEE. *Individual Producer Responsibility (IPR)* is the main mechanism to achieve this goal, whereby each producer is responsible for financing the waste from his own products.

This thesis presents an account of the transposition outcome of the WEEE Directive into EU Member State legal text and the practical implementation that has emerged as a result. It explores the factors that have led to the current impasse regarding IPR implementation in Europe, and together with the investigation of more successful IPR implementation and industry practice, suggests a characterisation of possible ways of implementing IPR given today's reality.

IIIEE Dissertation 2008:3
The International Institute for
Industrial Environmental Economics
Lund University, Sweden
ISSN 1402-3016
ISBN 978-91-88902-45-0

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ISBN 978-91-88902-45-0