

Practical steps for a transition from “historical” to “future” waste systems

Individual producer responsibility for the Waste Electrical and
Electronic Equipment Directive

Lloyd Hicks

Supervisors

Dr. Märten Karlsson

Chris van Rossem

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, October 2004

© You may use the contents of the IIIIEE publications for informational purposes only. You may not copy, lend, hire, transmit or redistribute these materials for commercial purposes or for compensation of any kind without written permission from IIIIEE. When using IIIIEE material you must include the following copyright notice: 'Copyright © IIIIEE, Lund University. All rights reserved' in any copy that you make in a clearly visible position. You may not modify the materials without the permission of IIIIEE.

Published in 2004 by IIIIEE, 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: iiiiee@iiiiee.lu.se.

ISSN 1401-9191

Acknowledgements

First and foremost I thank those at SONY for providing the opportunity to perform my research there. Andreas Schneider, without your guidance in the early stages, and constant encouragement throughout, this thesis would not have been possible. I am grateful for the patience of Frans Loen, as he slowly led me through so many new developments in such a relaxed, refreshing way. Karl Bodenhofer, your thoughts were always rational, clear and always appreciated. And Markus, thanks for the bike for the summer!

To my advisors Chris Van Rossem and Mårten Karlsson at IIIIEE, I owe you the utmost gratitude for your always challenging discussions. Chris, your enthusiasm was really appreciated for my research, and this was indeed unmatched and unending. Mårten, I thank you for your straightforward suggestions and the confidence you gave me along the way. Some initial conversations with Thomas Lindhqvist, Naoko Tojo, and Don Huisingh were more helpful than you perhaps think, and I thank each of you.

To the IIIIEE Batch 9, each of you made the last year of my life truly exceptional! Without your always loving support through the struggles, I think I would not be able to thank you now. There are too many of you to list, but thank you to those who helped me in some little though not insignificant way! Lastly, I thank my family who provided me weekly support - I love you all.

Abstract

The Waste Electrical and Electronic Equipment Directive of the European Commission places the responsibility on producers to finance collection and treatment of waste deposited at collection facilities after 13 August 2005, on a collective or individual basis. For “historic” waste, put on the market before this date, producers are responsible for a proportion of their respective share of the market by type of equipment. For products put on the market after 13 August 2005, termed “future” waste, producers should finance operations related to waste from *his own products*.

Given the shortage of discussion in literature around practical implementation of individual responsibility, the research identifies practical steps that are needed for producers to address WEEE from private households on an individual, rather than a collective basis. Producers would like to control end-of-life costs; therefore, present emphasis is on setting up a competitive system in Member States. An issue that should be addressed is the fact that national schemes prevent individual producers free access to waste, due to established national networks.

To address this, developments in some Member States show a national clearinghouse or register is to be formed, allowing producers to set-up multiple competing consortia. Part of the task of the clearinghouse is to apply a scheduled allocation method for pick-ups on a geographical basis, and/or reconcile recycling activities performed by individual producers. Establishing this competitive system with a fair means of dividing up obligations is the aim of producers. It is also more equitable for obligations to eventually be determined by a producer’s actual return share rather than present market share, due to product longevity or market saturation of the products.

Stimulating environmentally conscious design remains challenging in unsorted waste, as all producers share any financial benefits. Direct customer arrangements are acknowledged to provide opportunities to gain financial feedback, however, must be balanced by the cost-effectiveness of the activity.

Executive Summary

In December 2002, the European Commission put forth a Directive on Waste Electrical and Electronic Equipment (WEEE), acknowledging this waste should be distinguished from the typical Municipal Solid Waste (MSW) stream, and placing the responsibility on producers to finance End-Of-Life (EOL) operations. Due to the environmental burden from resource extraction for products and possible hazardous content of WEEE, it is believed that producers have the best opportunity to consider system and product level changes. Therefore, a form of Extended Producer Responsibility (EPR) requires producers, rather than municipalities, to become responsible for the entire product life cycle, including the product’s EOL.

The WEEE Directive aims to reduce the disposal of waste by prevention, followed by reuse, recycling, and recovery. Further, improving the environmental performance of those involved in EOL treatment operations. Given the typical routes of disposal, (e.g. landfilling, incineration, and recycling), human and environmental health problems can be related to the management of WEEE. Also, the Directive is based on Article 175 of the EC Treaty, where Member States may adopt more stringent measures in respect to the environment.

After 13 August 2005, it will be prohibited to dispose of WEEE in the MSW, and Member States and producers have shared responsibilities in meeting the obligations of the Directive. The financing of collection and treatment of waste deposited at collection facilities will be the producer’s responsibility, and from this date producers shall fulfill this obligation collectively or on an individual basis. The focus of the research is on the division made between what is termed “historic” and “future” waste. For waste put on the market before this date, “historic,” producers are responsible for a proportion of the respective share of the market by type of equipment. For products put on the market after 13 August 2005, “future” waste, producers should finance operations related to waste from *his own products*.

Articles 5, 6, 7, and 8 of the WEEE Directive all mention that producers may fulfill their obligations on an individual basis, however, practical implementation of individual responsibility has not been discussed widely in literature. Therefore, the thesis identifies what practical steps are needed for producers to address WEEE from private households on an individual basis. Collective schemes now operating across Europe already collect and treat WEEE, and act as a Producer Responsibility Organization (PRO), as they fulfill the obligations of the producers. The schemes deal with “historic” waste in a variety of ways, all applying some form of calculation of market share of the scheme participants, to fund the take-back operations. These national schemes will likely carry on as present for the coverage of “future” waste, without major changes.

What has appeared to producers is that EOL costs are not directly controlled in such a collective arrangement. Some systems apply visible fees where customers directly cover the take-back costs, while others have non-visible fees per unit that are also indirectly passed on to customers through the product price. Other models that bill producers in arrears on the actual costs will also affect the sales price. What is claimed, at least for some national PROs, is improvements could be made on the cost effectiveness of their operations. A group of companies forming what is called the European Recycling Platform (ERP) is pushing for a decentralized system, one with multiple producer consortia and multiple EOL service providers. Each producer consortia will seek transparency, cost effectiveness in treating waste, and select recyclers that extract more value from the WEEE.

By design, a decentralized system inherently stimulates competitiveness among EOL operations, and relies on a few features. First, there is a need to establish a national

clearinghouse (NCH) or register, so producers can register new sales. Then calculation of obligations for producers can take place. Second, a financial guarantee should be calculated that would cover future liabilities. The form of this guarantee is still under discussion, however, it is believed that producers will retain the funds themselves, and treat this like any other liability. Financial auditors assure assets that are earmarked for EOL WEEE remain protected from insolvent conditions or remain available when producers leave the market. Third, a scheduled allocation mechanism is needed to equitably distribute the pick-ups across the country. Otherwise, the situation would invite corruption, and waste hunting would take place, where producers would simply be “cherry picking” WEEE for the most cost-effective way to meet obligations. Finally, the NCH would report collected and recycling amounts to the authorities.

Common misperceptions with the competitive system are that the number of containers and collections sites would increase; on the contrary, these would stay the same as producers are only allocated pick-ups from these sites on a fair, rotating basis. One can imagine the country divided into a patchwork of areas representing, mainly, differing geographical and population densities. Moreover, integration is possible with other individual producer initiated recycling activities, e.g. direct customer arrangements through retailers or otherwise, and this will be reconciled with their obligations.

As the Directive allows obligations to be fulfilled on an individual basis, the multiple consortia system seeks to come closer to realizing Individual Producer Responsibility (IPR). Economies of scale are still achieved, just as under national collective schemes, because producers form a consortium with other producers. In actuality, the producers are individually *financially* responsible for a share of WEEE that remains unsorted by brand, i.e. part of a mixed stream of waste.

The research focuses on what systems look like that could realize the full potential of IPR, under a competitive system, and dealing with “future” waste. As amounts of historic waste steadily decline, and when all waste 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. The research concludes how this may be done reasonably, and how this approach may encourage reuse or remanufacturing, slowing the product’s eventual EOL.

After selecting and comparing systems using key performance criteria, the result shows both the NCH model and national schemes remain viable, especially since no cost comparisons can be made yet. Operational results are needed from the NCH model, and other factors will be relevant such as the geographical size of the country. A NCH is still needed in each country, even if the majority of WEEE is collectively handled. *In practice, national PRO systems will not provide a fair means for implementation because individual producers will not have fair access to waste.* The inequity is due to the fact that national consortia already have networks of collection sites, economies of scale exist in urban areas, and it is costly to collect in rural and remote areas. There are some exceptions, such as El Kretsen for ICT products, which allows producers to apply for repayment of fees for self-initiated recycling activities related to the sale of new products.

Finally, stimulating environmentally conscious design is challenging in waste unsorted by brand. Benefits from design changes are shared in systems with no sorting, so no direct financial feedback exists. Differentiated fees from producer to producer have the potential to send signals to designers. However, if no reasonable difference exists regarding EOL costs

from producer to producer by product type, there is no reason to sort WEEE, or use differentiated fees for that matter. Setting aside collection costs, direct customer arrangements offer the best possibility for financial feedback from environmentally conscious design. Further research is needed into these possible differences between producers.

Table of Contents

List of Figures

List of Tables

1	INTRODUCTION	1
1.1	BACKGROUND	2
1.2	RESEARCH OBJECTIVES.....	6
1.3	SCOPE AND LIMITATIONS.....	8
1.4	METHODOLOGY.....	9
2	CRITERIA FOR ASSESSING EPR PROGRAMS	11
3	“FUTURE” WASTE SYSTEMS BASED ON IPR	17
4	EVALUATION OF EPR PROGRAMS	29
4.1	EFFECTIVENESS IN COLLECTION AND TREATMENT OF WEEE.....	32
4.2	COST EFFECTIVENESS IN COLLECTION AND TREATMENT OF WEEE	34
4.3	IMPACT UPON BUSINESS COMPETITIVENESS.....	38
4.4	LEVEL OF ADMINISTRATIVE COMPLEXITY.....	42
4.5	EQUITY OF SCHEME FOR STAKEHOLDERS	44
4.6	COMPLIANCE WITH WEEE DIRECTIVE	46
4.7	EFFECTIVENESS IN IMPROVING ENVIRONMENTAL PERFORMANCE	47
4.8	SUMMARY OF EVALUATION.....	50
5	CONCLUSIONS	61
6	ROADMAP FOR TRANSITION TO “FUTURE WASTE” SYSTEMS	64
	BIBLIOGRAPHY	69

List of Figures

Figure 1-1 The product end-of-life chain.....	1
Figure 1-2 Relevance for collection and treatment from a life cycle perspective.....	2
Figure 3-1 European Recycling Platform and other producer(s).....	19
Figure 3-2 Market share with NCH in (D, F, UK)	20
Figure 3-3 IPR 1 - Return share statistical sampling.....	22
Figure 3-4 IPR 2 - Return share of RFID tagged only - read at recyclers	23
Figure 3-5 IPR 2 - Return share of RFID tagged only - read at collection sites	24
Figure 3-6 IPR 3 - Returns only - sort by consortia at sites.....	24
Figure 3-7 Direct customer arrangement or collection events	25
Figure 3-8 PRO – Return share with producer liability.....	26
Figure 3-9 System options with a National Clearinghouse	27
Figure 3-10 System options with a PRO compliance scheme.....	28
Figure 4-1 Present compliance schemes in Europe	51
Figure 4-2 Options for market and return share under NCH.....	53
Figure 4-3 Returns only under NCH, sorting by consortia at sites	55
Figure 4-4 Direct customer arrangement and collection events under NCH and PRO	56
Figure 4-5 Return share with producer liability under PRO.....	57

List of Tables

Table 1-1 Financial responsibility for "historic" and "future" waste.....	3
Table 1-2 Substances of Concern in a Personal Computer.....	5
Table 1-3 ANNEX II - Selective treatment for materials and components of WEEE.....	6
Table 2-1 Comparison of criteria for EPR assessment.....	11
Table 2-2 Criteria for assessing WEEE systems.....	12
Table 4-1 Effectiveness in collection and treatment of WEEE.....	34
Table 4-2 Cost effectiveness in collection and treatment of WEEE.....	37
Table 4-3 Scheme funding structures.....	39
Table 4-4 Number of outsourced service providers.....	40
Table 4-5 Impact upon business competitiveness.....	41
Table 4-6 Level of administrative complexity.....	43
Table 4-7 Equity of scheme for stakeholders.....	46
Table 4-8 Compliance with WEEE Directive.....	47
Table 4-9 Effectiveness in improving environmental performance.....	50
Table 4-10 Summary of systems with key criteria.....	59
Table 4-11 Risks to address with decentralized system.....	59
Table 6-1 What not to do for "future" waste.....	65
Table 6-2 Roadmap from "historical" to "future" waste.....	65

1 Introduction

As described in a 2000 European Commission Explanatory Memorandum¹, technological innovation and expanding markets are generating a growth in the electrical and electronic sector, subsequently leading to an increase in Waste Electrical and Electronic Equipment (WEEE). Products that fall in this sector include: large and small household appliances (refrigerators, washing machines, stoves, vacuums, toasters), IT and telecommunications equipment (computers, printers, mobile phones), consumer equipment (TVs, radios), lighting equipment, tools (drills, saws), sport equipment, toys (video game consoles), and other categories. The Commission states that WEEE should be distinguished from the typical Municipal Solid Waste (MSW) stream, namely, because of this rapid growth, the possible hazardous content, and the environmental burden from resource extraction. Human and environmental health problems can be related to the management of WEEE, given the typical routes of disposal, e.g. landfilling and incineration, as well as recycling. Huisman provides an overview in Figure 1-1 illustrating disposal options and how materials may re-enter the system at previous stages.

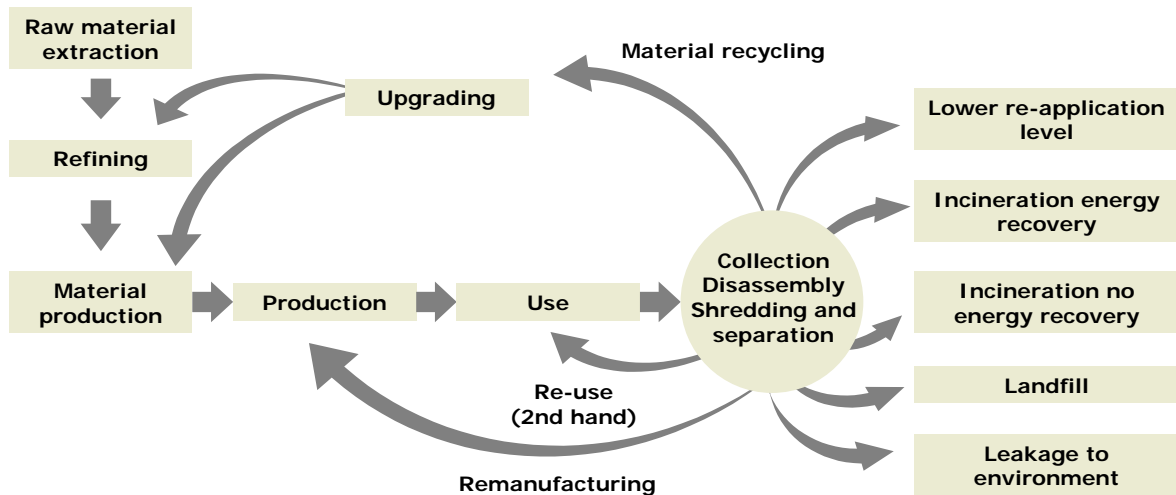


Figure 1-1 The product end-of-life chain²

Extended Producer Responsibility (EPR) is defined by OECD³ as “an environmental policy approach in which a producer’s responsibility for a product is extended to the post-consumer stage of a product’s life cycle.” For WEEE, this means a shift in responsibility from municipalities to producers, with the aim to encourage producers to address environmental characteristics throughout the product chain. Traditionally, producer responsibility was limited to production; however, EPR includes the disposal after use. According to Huisman⁴, End-Of-Life disposal of WEEE in MSW accounts for around 3% of the environmental burden of the total product life cycle for an average consumer electronic product. The Eco-

¹ Commission Proposal COM(2000)347 final. p. 4.

² Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 42.

³ OECD. (2001). *Extended producer responsibility: A guidance manual for governments*. <http://www.oecd.org> [2004, July 13]. p. 9-10.

⁴ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 50.

Indicator '99 approach is applied. Interestingly, in Figure 1-2, one can see that under state-of-the-art recycling processes there is a minus 13% realized. The relevance for collection and treatment is quite clear, as it reduces the level of raw material extraction needed for production. However, one should also acknowledge the energy required for material recycling.

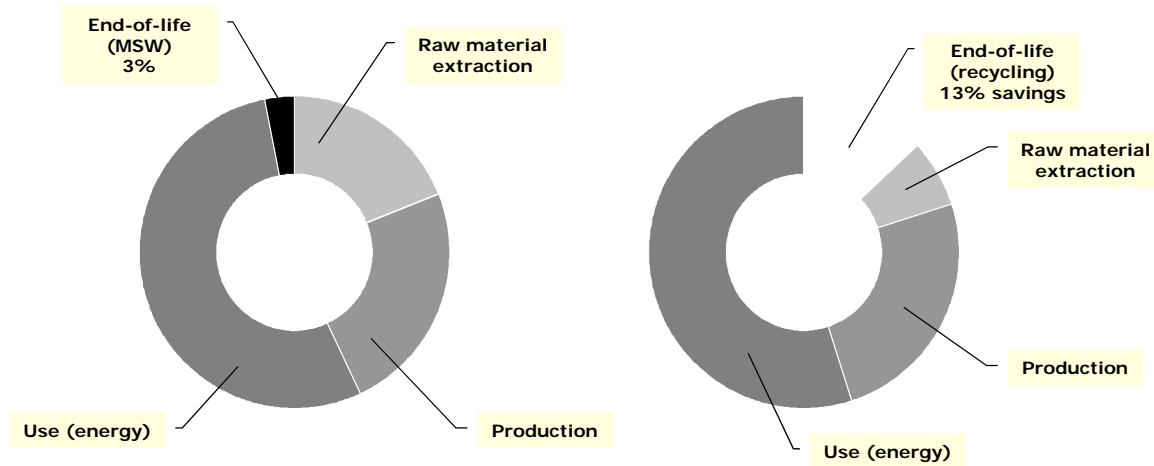


Figure 1-2 Relevance for collection and treatment from a life cycle perspective⁵

1.1 Background

By 13 August 2005, producers will have established the means to separately collect and treat WEEE in each Member State of the European Union. The WEEE Directive 2002/96/EC⁶ aims to fulfill objectives of the European Community ensuring preservation of the quality of the environment, protection of human health, and sustainable natural resource use. The “precautionary principle”, where preventative actions are taken when necessary, and the “polluter pays principle”, when polluters bear the burden of the associated environmental impacts, are both integral to the Directive. The first objective of the WEEE Directive is reducing the disposal of waste by prevention, and secondly, reuse, recycling, and recovery. The third objective is improving the environmental performance of those involved in the life cycle of the products, particularly those involved in End-Of-Life (EOL) treatment operations.

The requirements under the WEEE Directive can be summarized as follows by physical, financial, and informative responsibilities:

Physical

Art. 5 – Separate collection – From private households should be free of charge, Member States ensure convenient location, One-to-one at “distributor” when equivalent type, Producers can set up and operate individual or collective take-back, Transported to facilities unless reused as whole, By 31 Dec 2006 4kg per capita per year, New target by 31 Dec 2008;

⁵ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 50.

⁶ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 2-6.

Art. 6 – Treatment – Producers can set up individually and/or collectively, Minimum quality standards, Facilities obtain permits, Once a year inspections ensuring compliance, May take place outside of Member State with restrictions;

Art. 7 – Recovery – Producers can set up individually or collectively, Meet recovery targets, Record mass of input and output to treatment facility and/or input to recovery/recycling facility, New targets by 31 Dec 2008;

Financial

Art. 8 – Financing WEEE from private households – Producers finance collection, treatment, recovery, and environmentally sound disposal of WEEE deposited at collection facilities, From 13 Aug 2005 “his own products” individually or collectively, Financial guarantee when placing on market (marked with symbol), “Historical waste” paid by all producers existing in market when “respective costs occur” by market share, Costs of treatment not shown after 13 August 2013, Internet sales should comply in Member State where purchaser resides;

Art. 9 – Financing from others – Producers finance collection, treatment, recovery, and environmentally sound disposal of WEEE, From 13 Aug 2005 “historical” old-for-new financed by that producer, Other than old-for-new the “others” finance;

Informative

Art. 10 – Information to users – Producers mark products put on the market after 13 August 2005, Member States inform users not to dispose in MSW and take measures for users to participate in WEEE collection;

Art. 11 – Information for treatment facilities – Producers provide reuse and treatment information after one year (components, materials, location of hazardous substances) to treatment facilities;

Art. 12 – Information and reporting – Register collects amount: put on market, collected, reused, recycled, recovered, and exported (by weight, not possible then numbers), Also participating producers, Internet sales must provide information on compliance.⁷

Table 1-1 Financial responsibility for "historic" and "future" waste

	<i>Article 8 – Financing of WEEE from private households</i>	<i>Article 9 – Financing of WEEE from users other than private households</i>
“Historic” waste – products put on market <u>until 13 August 2005</u>	Producers responsible for proportion of respective share of the market by type of equipment;	Producers responsible when replaced by new equivalent product; For other waste users are responsible;
“Future” waste – products put on market <u>later than 13 August 2005</u>	Producers responsible for waste from own products individually or collectively; guarantee when placing product on market.	Producers and users may make other agreements.

⁷ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003, p. 7-13.

In Table 1-1 the distinction is illustrated between what is commonly termed “historic” and “future” waste as it relates to financing of WEEE from private households. A topic presently under discussion in the Member States is on the set-up of the systems addressing both divisions. One can also see from the above physical and financial requirements listed, wording recognizes producers that act on more of an individual basis, as mentioned in Articles 5, 6, 7, and 8 of the WEEE Directive. However, practical implementation of individual responsibility has not been discussed widely in literature, and is the main topic of this research. Financing of WEEE from users other than private households, e.g. Business-to-Business (B2B), is not the focus of this research. One can conclude that these obligations are not included in the specific collection targets as noted in Article 5.

By 1 July 2006, new products placed on the market will have to comply with the Restriction Of the use of certain Hazardous Substances (ROHS) Directive 2002/95/EC⁸. The Commission states that available evidence indicates measures are necessary to address the problems associated with heavy metals and flame-retardants found in WEEE. ROHS bans the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE), citing risks to human and environmental health. Substitution by safe or safer materials when technically and economically feasible is the objective of the Directive, by restricting these substances, there is an increased likelihood for improved recycling and avoidance of negative health impacts from EOL treatment facilities.

A distinction should be made between the WEEE and ROHS Directives, due to the fact that the Directives are based on Article 175 and Article 95 of the EC treaty, respectively. When the Directives were proposed, the European Environment Bureau (EEB) made a call to have them combined under Article 175, where Member States may adopt more stringent measures in respect to the environment. Article 95 considers harmonization in the EU and seeks to ensure functioning of the internal market; therefore, Member States are restricted from going beyond the law.⁹ What this means for the WEEE Directive is producers are closely watching national transposition in Member States due to the degree of freedom under Article 175.

An OECD technical guidance document for Environmentally Sound Management (ESM) of personal computers¹⁰, can serve as an introduction to the common risks involved with EOL treatment operations for a personal computer. Importantly, the substances described as risks, are not released to the environment or exposed to humans through ordinary use of the products. Also, some substances are in products for lowering the risk to humans, e.g. lead shielding from x-rays in CRTs, flame-retardants in plastics for potential fires. The risks present in disposal and recycling operations are shown in the Table 1-2. In addition to the contents in the table, some Member States may also consider liquid crystals (LCD displays), arsenic (gallium arsenide in LEDs), liquid electrolytes (electrolyte capacitors), and powder toner (printers) as Substances of Concern (SoC).

⁸ Council Directive 2002/95/EC of 27 January 2003. p. 1-3.

⁹ European Environment Bureau. (2001). *Towards waste-free electrical and electronic equipment*. <http://www.eeb.org/publication/general.htm> [2004, September 11]. p. 53.

¹⁰ OECD. (2003). *Technical guidance for the environmentally sound management of specific waste streams: Used and scrap personal computers*. <http://www.oecd.org> [2004, July 12]. p. 5-7.

Table 1-2 *Substances of Concern in a Personal Computer*¹¹

Substance	Location of substance	Human and environmental health concerns
Antimony (Sb)	Component in Pb solder; CRTs may contain Sb in screen and/or cone glass	Leaching under certain land disposal conditions
Barium oxide	Getter plate of the electron gun of CRTs, deposited on interior surface of screen and cone glass	BaO dust can be released during dismantling and handling of CRTs
Beryllium	Cu-Be alloy in motherboard; slots used to connect daughterboards	BeO dust or fumes may be released during high temperature metal processing
Cadmium	Plated contacts and switches, stabilizer in PVC wire insulation; laptops often contain rechargeable Ni-Cd battery	CdO dust released if plastic is burned in metal reclamation; Cd in plated metal contacts and switches may be released as CdO dust or fumes during high temperature metal processing; and incineration
Chlorine and/or Bromine: Organic halogenated (brominated) flame retardants and inorganic flame retardants (e.g. antimony chloride)	Plastic in printed circuit boards and cases; Chlorine is in any PVC insulation of wires and cables	Br in plastics as brominated fire retardants or chlorine in PVC insulation may recombine with C and H in disposal or recovery processes with heat, (e.g. combustion, plastics extrusion), to form other halogenated organic compounds of environmental concern, (e.g. chlorinated or brominated dibenzodioxins and -furans)
Lead	Encapsulated in leaded glass in CRTs (2-3 kg in older models, 1 kg in new); solder on printed circuit boards in CPUs; some laptops contain a sealed lead acid battery	Leaching under certain land disposal conditions; incineration can result in release to air and deposition in ash - then landfilled; circuit boards may release fumes if heated for harvesting of components; through fine particulates if board burned or shredded prior to metal reclamation; smelting may release PbO dust or fumes from circuit board
Lithium	Possibly in small battery on motherboard	Released if battery is shredded with circuit board it is attached to, potentially causing fire
Mercury	Lighting device used to illuminate the screen in large flat panel displays	Displays release upon shredding and subsequent handling; landfilling and incineration can release Hg to environment
Phosphors	On interior of a CRT screen zinc sulfide and rare earth metals, and cadmium sulfide	Cd phosphor coating of some older CRTs could present an inhalation hazard to workers in glass breaking operations; also leached in landfill environment

As shown in Table 1-2, the human and environmental health concerns occur when disposed of in landfills or incinerated, and certain EOL treatment operations that are for reclamation of components, metals, or plastics involving melting of solder, shredding, or burning. All of which can be controlled through emission control systems to mitigate effects on human and

¹¹ OECD. (2003). *Technical guidance for the environmentally sound management of specific waste streams: Used and scrap personal computers*. <http://www.oecd.org> [2004, July 12]. p. 5-7.

environmental health¹². In Table 1-3, ANNEX II of the WEEE Directive details what products should be selectively treated due to some of the aforementioned SoC.

Table 1-3 ANNEX II - Selective treatment for materials and components of WEEE¹³

Substances, preparations, and components of WEEE separately collected that have to be removed:	Components of WEEE separately collected have to be treated as indicated:
<ul style="list-style-type: none"> • PCB containing capacitors • Mercury containing components, e.g. switches or backlighting lamps • Batteries • Printed circuit boards of mobile phones, and of other devices if 10 cm² or more • Toner cartridges, liquid and pasty, colour toner • BFR plastics • Asbestos waste and components which contain asbestos • CRTs • CFC, HCFC, HFC, and HC • Gas discharge lamps • LCDs with casing, greater than 100 cm², all with back-lighted with gas discharge lamps • External electric cables • Components containing refractory ceramic fibers • Radioactive substances, with some exceptions • Electrolyte capacitors containing substances of concern (ht. > 25 mm, dia. > 25 mm or proportionately similar volume) 	<ul style="list-style-type: none"> • CRTs: fluorescent coating has to be removed • Equipment containing ozone depleting or GWP above 15: e.g. those contained in foams and refrigeration circuits, gases must be properly extracted and properly treated. • Gas discharge lamps: Mercury shall be removed

1.2 Research objectives

From the literature review, the author recognized decidedly lacking discussion around *how* to actually realize Individual Producer Responsibility (IPR) in Europe. Therefore, the main objective of the research is to identify the practical steps from “historical” waste, market share based, collective schemes towards individual producer based recycling systems for WEEE from private households. The research explores what level of IPR, as opposed to collective responsibility through national consortia, can be realized in the Member States.

IPR, defined by Tojo, is when “manufacturers are responsible for the end-of-life management of their *own* products.” Collective responsibility is described as “where producers of the same product group fulfill their responsibility for the end-of-life management of their products together regardless of brand.” Tojo also makes a distinction between individual *financial* responsibility, when the producer pays for EOL management for its own products; and

¹² OECD. (2003). *Technical guidance for the environmentally sound management of specific waste streams: Used and scrap personal computers*. <http://www.oecd.org> [2004, July 12]. p. 5-7.

¹³ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 21.

individual *physical* responsibility, when brand distinctions are made and when to some extent producers control EOL aspects.¹⁴

However, in this thesis, the term IPR as used by the author is closer to Tojo’s definition for both collective responsibility and individual financial responsibility, for reasons that will be discussed in the paper. “Collective” will be used in the sense of *physical* collection that is shared by a group of producers. Therefore, IPR is defined as producer responsibility for EOL management for its own *return share* of WEEE collected in a waste stream remaining unsorted by brand, with producer retention of the financial guarantee. However, some exceptions will be noted in Chapter 3. Reasons for using return share rather than present market to calculate obligations will also be discussed. Moreover, it is addressed whether in practice a producer can only be responsible for its own waste, and furthermore, if distinctions within product types are reasonable.

In countries where no producer funded take-back exists, e.g. Germany, France, and UK, producers are now forming or have formed the basis for all future IPR systems through a National Clearinghouse, described in Chapter 3. Those countries that have operating compliance schemes, e.g. Belgium, Sweden, and the Netherlands, are of great interest because they are generally meeting the targets of the Directive. However, criticism exists of these systems that is addressed in this thesis, and changes will have to take place in each respective country to meet the requirements of the WEEE Directive. Bringing competitiveness to EOL operations, lowering costs to customers, and stimulating design changes are some of the points that IPR attempts to address. The research questions are as follows:

1. What are the key criteria for an evaluation of WEEE systems?

First, in Chapter 2, criteria are chosen that reflect the operational and financial performance of WEEE systems. Particular emphasis is on impacts to businesses, e.g. maintaining a competitive environment and preventing cartels. The criteria are identified for an analysis of current “historical” waste and “future” waste systems. From the governmental standpoint, achieving such goals as economic efficiency and continuous environmental improvements remain the most important. Furthermore, the operational performance reflects if targets for collection and treatment are being met. The first research question provides the structure for the following comparison, with criteria that can provide a good measure between systems. To form a methodological basis, selection of criteria will come from sources such as OECD documents and other EPR assessments, e.g. “Level of Administrative Complexity” and “Cost Effectiveness in Collection and Treatment of WEEE”. Additional criteria are to be added, such as “Effectiveness in improving environmental performance”.

2. What are options for fulfilling obligations on an individual producer basis for “future” waste from private households?

Second, in Article 8(2) of the Directive, it is stated that each producer is responsible for financing the waste “from his own products.” And that this obligation can be fulfilled “either individually or by joining a collective scheme.”¹⁵ In Chapter 3, the second research question will then address what these options are. “Future” waste systems are identified by the author based on IPR, with specific attention given to return share based systems, and system approaches that stimulate competitiveness among producers and EOL operators. General

¹⁴ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. viii.

¹⁵ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 10-11.

operational and technical requirements of each system are developed, and projections are made on what producers will be responsible for in systems.

3. By comparing present collective schemes, planned systems (Germany, France and UK), and individual producer systems, which systems can be effective at addressing the key criteria?

Third, in Chapter 4, the above criteria are used to evaluate and compare the following: 1) present, collective EPR systems in Europe, 2) three WEEE compliant “historical waste” systems under development (e.g. Germany, UK, France) and 3) identified “future” waste IPR systems. Systems set-up as monopolistic national consortia are compared to systems with competitive EOL operations, then attributing the pros and cons of each system.

4. What are the practical steps from “historical” waste, market share based, collective schemes towards individual producer based recycling systems for “future” waste from private households?

Finally, in Chapter 6, the author creates a roadmap with practical steps for the transition to a “future” waste IPR system. Key requirements that are necessary to be implemented or avoided now are described in order to realize IPR in the future. An understanding of the technical possibilities/limitations are linked to legal requirements placed on producers. As the IPR systems have technical requirements that will have to be met, producers will need to act together on the transitional steps to IPR for “future” waste.

1.3 Scope and limitations

The scope of the research covers, 1) a review of present producer funded take-back systems in Europe, 2) the ongoing developments in the national transposition of the WEEE Directive, and 3) WEEE system scenarios that can be realized in the next 10 years. WEEE from private households was only addressed, not B2B. No assessment of different types of Extended Producer Responsibility (EPR) was performed since legislation already exists.

The WEEE Directive and transpositions into national legislation, then acting as framework for possibilities, provide the overall scope. And given that many Member States have existing legislation and systems already meeting the requirements of the Directive, valuable information is gathered from an assessment of these systems in operation, e.g. Belgium, Sweden, and the Netherlands. A look at the present systems will be of a descriptive nature that serves the purpose of the evaluation, as more detailed descriptions can already be found in literature. As the research also looks at possible WEEE system scenarios, comparisons alongside present systems are not possible, however, value is gained from realizing the gaps in data and determining business risks.

The main limitation is that national transposition of the Directive is still in progress, as Member States did not meet the 13 August 2004 date. Furthermore, present business models may change relating to product take-back. Another challenging point is comparing operations in various countries. With data on the varying collection and treatment amounts and costs, one is at risk of comparing them side-by-side due to different geographical distances, labor costs, etc. In depth research and interviews with present compliance schemes on operational characteristics are not performed since comprehensive government commissioned studies presently exist. However, very few studies of this nature were found that provide such comparisons of operating systems in Europe.

1.4 Methodology

A review of secondary literature including comparative studies of WEEE take-back schemes in Europe is performed, followed up by personal communications. Interviews at SONY also provide knowledge on the various schemes, as they are part of the compliance schemes in the Member States. Having close collaboration with individuals from SONY was beneficial, namely, those with positions in either technical or business strategy areas. From this research, initial ideas are formed on how to assess the different systems on its operational and financial performance. Criteria are identified for an evaluation of the systems. The sources of the criteria come from OECD documents on general EPR evaluation methods, and government commissioned studies covering both operating systems and the status of WEEE implementation.

To achieve practical results from the thesis, observations are made of national compliance schemes detailed in the commissioned studies, supported by interviews at SONY, and system approaches are developed by the author that address the interests of producers to move toward IPR for “future” waste. Upon review of selected literature, there also exists other proposed system approaches. System diagrams are created to describe the different options producers have, and a decision tree approach is used to illustrate the systems that are possible under the WEEE Directive. Here it is noted which directions should not be pursued from a business point of view. The new system approaches are the result of a creative process, and are intended to present all plausible directions for WEEE take-back schemes under the Directive.

In an analysis of the present, planned, and “future” waste systems, the author draws comparisons between the systems. The benefits and/or drawbacks of the systems are described using the criteria as points of discussion. To simplify the comparison, a plus and minus is used to represent if the system generally meets or fails to meet the goals of stakeholders for that respective criterion. The criteria cover both quantitative and qualitative differences in the systems, and, when within reason, comparisons are drawn between them. A final summary of the systems is put forth, and conclusions by the author are made, as well as recognized risks to address. Lastly, the author creates a roadmap with practical steps for the transition to “future” waste. A benefit of the methodology applied in the research is that it aids both legislators and producers that are presently determining how the systems will be set-up and run in Member States. This *ex ante* approach is needed to help recognize the interests of stakeholders now during the legislative process, so that the system is designed having the best opportunity to meet goals of the WEEE Directive, businesses, and customers. Also, further discourse shall be encouraged from new findings of the research by the author.

2 Criteria for assessing EPR programs

In Table 2-1, criteria are introduced representing, from left to right, preliminary environmental policy considerations, key performance indicators of a system, practical comparisons of national legislation, or operational characteristics.

Table 2-1 Comparison of criteria for EPR assessment

OECD ¹⁶	Future Energy Solutions ¹⁷	Perchards ¹⁸	Ernst & Young ¹⁹
Decision criteria typically used by governments for environmental policy evaluations	Uses criteria for a comparative study of existing European WEEE schemes	Uses requirements of WEEE Directive to compare existing WEEE related measures and transposition plans developing in member states	Uses criteria to describe and compare main features of functioning, organization, control and funding of PROs in Europe
A guidance manual for governments based on EPR implementation results from countries	Report commissioned by DTI (Department of Trade and Industry) in the UK	Report commissioned by DTI (Department of Trade and Industry) in the UK	Report commissioned by ADEME (French Environment and Energy Management Agency)
<ul style="list-style-type: none"> • Environmental effectiveness • Economic efficiency • Equity and distributional effects • Administrative feasibility and costs • Concordance with institutional frameworks • Political and social acceptability • Adjustment costs associated with transactions • Incentives for innovation of environmentally compatible products 	<ul style="list-style-type: none"> • Effectiveness in collection and treatment of WEEE • Cost effectiveness in collection and treatment of WEEE • Impact upon business competitiveness • Level of administrative complexity • Equity of scheme for stakeholders • Consumer awareness • Compliance with WEEE Directive 	<ul style="list-style-type: none"> Art. 4 – Product design Art. 5 – Collection and take-back requirements Art. 6 – Treatment, monitoring/inspect Art. 7 – Recovery targets Art. 8 - Financing WEEE from private households Art. 9 - Financing WEEE from users other than private households Art. 10 – Information for users Art. 11 – Information for treatment facilities Art. 12 – Information and reporting 	<ul style="list-style-type: none"> • Legal and decision-making status • How responsibilities are shared • Relations with the State • State control of the PRO • Calculating financial contributions • Competition • Obligations to provide the general public with information

¹⁶ OECD. (2001). *Extended producer responsibility: A guidance manual for governments*. <http://www.oecd.org> [2004, July 13]. p. 23.

¹⁷ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 9-10.

¹⁸ Perchards. (2004). *Transposition of the WEEE Directive in other EU Member States*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 14-16.

¹⁹ Ernst & Young. (2003). *European overview of producer responsibility organisations and bodies assuming producer responsibility in managing end-of-life products*. <http://www.ademe.fr/anglais/publication/vaoverview.htm> [2004, July 13]. p. 78.

In this chapter, the following research question is addressed:

What are the key criteria for an evaluation of WEEE systems?

The approach by Future Energy Solutions (FES) in a report²⁰ commissioned by the UK Government, Department of Technology and Industry (DTI), is judged by the author to be the most practical set of criteria for an assessment of WEEE systems in Europe. More on an operational level, FES also looks at: legislation, structure of management organization, product scope, operational characteristics, financing structure, and audit and enforcement.

The OECD EPR guidance manual for governments provides good criteria for initial environmental policy deliberations; however, most of points are captured in the FES criteria. Also noted is the fact that “Political and social acceptability” is especially important for initial policy discussions. OECD makes one contribution through the criteria, “Environmental effectiveness” and “Incentives for innovation of environmentally compatible products”. These are then communicated through “Effectiveness in improving environmental performance”, and can be interpreted on both the product design level as well as the EOL level. Perchards simply uses the requirements of the WEEE Directive in its comparative analysis, what is already captured by “Compliance with the WEEE Directive” in FES. Ernst & Young are providing more of a descriptive study of the operational characteristics of all types of EPR programs in Europe, however, places competition as one of the main criterion.

As mentioned in the research objectives, criteria are chosen that reflect the operational and financial performance of WEEE systems, with particular emphasis on impacts to businesses. Governments also want to achieve such goals as economic efficiency and continuous environmental improvements. Accordingly then, the criteria chosen by the author are:

Table 2-2 Criteria for assessing WEEE systems

1. Effectiveness in collection and treatment of WEEE
2. Cost effectiveness in collection and treatment of WEEE
3. Impact upon business competitiveness
4. Level of administrative complexity
5. Equity of scheme for stakeholders
6. Compliance with WEEE Directive
7. Effectiveness in improving environmental performance

²⁰ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13].

Effectiveness in collection and treatment of WEEE

Important for meeting goals of the WEEE Directive, “Effectiveness in collection and treatment of WEEE” shows to what extent a system subscribes to legislative requirements. The goals of the Directive are diverting electrical and electronic equipment away from municipal landfills, first through prevention of waste, and then otherwise, environmentally sound treatment and recycling that are financed by producers. One can conclude that when collection and recycling targets are met, the burden of raw material extraction is lessened due to application of the recycled materials in production processes. Some factors that make up the criterion are:

- Amount of WEEE per capita collected and treated
- Extent WEEE is recycled or recovered
- Treatment standards
- Consumer awareness
- Accessibility of drop-off facilities

Measuring the amount of WEEE per capita collected and treated provides a good measure for this criterion. Then the extent to which the WEEE is either recycled or recovered through energy reclamation, and to what treatment standards these processes are held is the next progression. Then, beginning with the level of consumer awareness, based on the ability to communicate the importance of WEEE collection, one should ascertain how accessible the drop-off facilities are for customers. The first two points mentioned above will be addressed by Articles 5 and 7 of the WEEE Directive, respectively, and will be a good quantitative measure for assessing systems. Consumer awareness can also be measured, though only through surveys, and this may reflect the varying collection rates. Municipalities may address the accessibility of sites by looking at population densities and locating sites in highly visited locations, that is if not already in place.

Cost effectiveness in collection and treatment of WEEE

Primarily an interest for producers, “Cost effectiveness in collection and treatment of WEEE”, is of importance due to the fact that producers want to meet obligations at the lowest overall cost to their business. Furthermore, one can conclude legislators should also acknowledge the economic impacts on the region or state. EOL service provision, especially the recycling industry, now offers or has the potential to offer job growth. Some factors that make up the criterion are:

- Cost per kilogram of WEEE collected and treated
- Allocation of revenues for system operator

Measuring the cost effectiveness can be done by determining the cost per kilogram of WEEE collected and treated, however, direct comparisons of these costs with other systems should be done with acknowledgment of the risks in doing so, as outlined in Section 4.2. When the data is provided one should also determine the allocation of the revenues for a system operator, e.g. management overheads, provisions (reserves) made for historic waste, monitoring costs, etc. Special consideration should be made towards reserve forming schemes that maintain control of large operating reserves.

Impact upon business competitiveness

Also largely an interest for producers, the “Impact upon business competitiveness” is important to assess to what extent the design of the system will affect business operations. For example, are producers given choices on how to fulfill individual obligations, or does one national compliance scheme exist. Recyclers also would like to ensure free market access to treatment contracts in whatever system that develops. Governments are also keen to encourage market-based systems, avoiding the formation of cartels that may affect the economic health of its local businesses. Some factors that make up the criterion are:

- National or multiple consortia
- System plurality through competitive tendering and multiple service providers
- Funding structures

Several potential impacts on business competitiveness make up this criterion. Whether one national consortium or multiple consortia exist is the first point, though comparability within WEEE systems at present is not possible since competition between schemes does not exist. Some countries have two or more schemes, however for different product sectors. Given the drawbacks, the only measure would then be comparing costs of collection and treatment from B2B contracts. Second, PROs describe themselves as having “system plurality” through both competitive tendering processes and the number of service providers. A further look into the detail of the tendering process is not likely to provide a quantitative measure, however, will be useful. Third, also in Section 4.3, a look at funding structures reveals impacts on competitiveness. Namely, whether accruals are being made for historic waste or is all waste considered current waste, and are the reserves operational contingencies or do they remain managed by PROs.

Level of administrative complexity

Governments, producers, and EOL service providers are all concerned with the “Level of administrative complexity” systems require for operation. Governments are monitoring bodies that may or may not monitor producer participation, depending now on legislative outcomes, and they grant permits as well as make inspections of treatment facilities. Producers are interested in the overhead spend on administration for compliance schemes because this is directly related to their costs. Some factors that make up the criterion are:

- Spending on employees, e.g. number and salaries of staff
- Any operations, e.g. logistics provision
- Monitoring of participation
- Auditing
- Compensation to retailers/municipalities

The proportion of overall revenues spent on administration, though not always easily attainable, provides data on different administrative levels. A breakdown within these costs allows one to look at the above-mentioned points.

Equity of scheme for stakeholders

Legislators should be concerned with scheme set-up, as it should generate conditions that do not prevent small producers from participating, or give large producers unreasonable

advantages. On a basic level, “Equity of scheme for stakeholders” means financial obligations by producers should be distributed in a fair, proportional method, this being an interest for both producers and legislators. While producers are the main stakeholders, and remain the focus of the thesis, others are recyclers, customers, municipalities, and authorities. Some factors that make up the criterion are:

- Scheme participation fees
- How revenues are raised
- Determination of product category fees
- Compliance costs in working hours
- Level of free-riders

The level of producer equity is determined in this criterion by analyzing various aspects that either looks at the respective size of the producer or just the basic differences between the national schemes. The first is participation fees required by schemes and determination if large producers or SMEs are affected unequally. Second, product fees or system cost allocations by market share describes how schemes choose systematically to raise revenues, and which is more efficient. In Section 4.5, a general comparison is made between the brown/white goods sector (product fees) and the IT sector (system cost allocation). Third, what the basis for setting product category fees is determined by will affect the level of cross-subsidies between different product types. Related to this is the amount of compliance costs a producer has for each scheme, in terms of working hours. Lastly, the level of free riders in the system should be identified to determine the level of subsidies participating producers make for those not taking part.

Compliance with WEEE Directive

As briefly outlined in Section 1.1, the requirements by producers involve the financing of separate collection, treatment, and recovery of WEEE. Information requirements for users, treatment facilities, and for reporting purposes are also needed on the part of producers. This criterion will serve as a basis for the acceptability of any system dealing with “future” waste. For this research, the criterion deals with compliance requirements by producers, with less emphasis on requirements from others, e.g. Member States. The factors that make up the criterion are:

- Physical – separate collection, treatment, and recovery
- Financial – financing WEEE from private households; financing from others
- Informative – Information to users and treatment facilities; information and reporting

Effectiveness in improving environmental performance

“Effectiveness in improving environmental performance” is viewed from either improvement made towards Environmentally Sound Management (ESM) of WEEE, or through environmentally conscious design by producers. From the first perspective, one should determine to what level a system is promoting improvements in collection and mainly treatment operations, i.e. eco-efficiency of the EOL processes. For the latter, is the system able to stimulate design changes that improve the eco-efficiency of the EOL operations? The factors that make up the criterion are:

- Environmentally sound management of WEEE

- Environmentally conscious design

From a policy perspective, continual improvements should be integral to an operating WEEE system. The criterion is intended to reflect the nature to which these improvements are possible in each system. And legislators should determine if mechanisms exist that could be applied to encourage these improvements.

3 “Future” waste systems based on IPR

In this chapter, the following research question is addressed:

What are options for fulfilling obligations on an individual producer basis for “future” waste from private households?

Giving emphasis to its importance, the United Nations Development Program describes the process of scenario creation as envisioning plausible options for the future. As opposed to forecasting, which extrapolates from the past, scenarios imagine the future, serving to “build the capacity to assess change.” And integral to a scenario are the assumptions behind it. The purpose of the activity is to enrich debate, identify threats and opportunities, identify inconsistencies and/or gaps in existing situations, and to encourage a strategic planning process.²¹

Before an evaluation in the next chapter, that uses the criteria from Chapter 2, this chapter presents scenarios that are the result of a process by the author, imagining all possible options under the WEEE Directive for producers to fulfill obligations. Some systems are under consideration at present by Member States, while most are the result of the research. Figures 3-9 and 3-10 illustrate all options considered by the author, additionally, those that should be avoided. As noted above, the benefit of this approach is to identify threats and opportunities, thereby, aiding the planning for businesses as well as contributing to the legislative process. Following a description of the market share based system with a National Clearinghouse (NCH), acting as a basis to realize further steps towards IPR, the rest of the systems portrayed in this chapter are for exploring scenarios for the coming years.

FES states that the majority of pick-ups generally come from collection points at municipal sites, followed by retailers, other special collection points, and curbside collections. There exists a wide range of difference between the present systems. For example, in Denmark and with ICT Milieu (the Netherlands) all collection is from municipal sites, however, SWICO (Switzerland) actually collects more from retailers (58%).²² Understanding the present routes for collection helps, as one begins to look at the optimal system for product take-back.

As of early September 2004, the direction for Germany, France, and the United Kingdom appears to be set. For **“Market share with NCH in (D, F, UK)”**, it is likely that a national clearinghouse will be set up, and various producer consortia OR producers alone, will fulfill obligations through a scheduled allocation method for pickup and treatment operations. The obligations are to be divided on present market share by weight. Not only will collections be possible from municipal collection sites, where the majority of pick-ups now take place, but any other individually initiated collections are recognized, e.g. retail shops. No national based scheme is expected at this time, as present in other Member States.

The second two systems, **“IPR 1 - Return share statistical sampling”** and **“IPR 2 - Return share of RFID tagged only”** are methods for calculating a producer *return* share rather than market share. The system operates on the same principal as the systems planned in Germany, France, and UK, using a NCH to allocate producer responsibility, however the obligations are

²¹ OECD and UNDP. (2002). *Sustainable Development Strategies: A Resource Book*. p.171-6.

²² Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/wcee/> [2004, July 13]. p. 16-18.

for the amount of products actually returned. A key point is there is no sorting by brand in these systems.

The third system, **“IPR 3 - Returns only - sort by consortia at sites”**, represents an option that assumes producer consortia have sorting performed at collection sites on a national basis. Each producer or consortia will then contract all EOL operations for their returns only. No scheduled allocation from a NCH of pickup and treatment is then needed.

The fourth system, **“Direct customer arrangement or collection events”**, describes other options that producers have for fulfilling obligations as prescribed by the NCH. One way through arrangement of pickup directly from private customers, or another through collection events most likely coordinated with retailers. Importantly, these arrangements can exist in parallel to other systems.

Last, a look is given to a national scheme, **“PRO - Return share with producer liability”**, and how it may fulfill some of the same principles as other IPR based systems.

As first suggested by Hieronymi, the need for a national consortium is limited by applying a model where each producer is individually responsible for an amount of WEEE both financially and logistically. Under this model producers report to the NCH, by weight, the products put on the market. The NCH uses this market share, by weight to calculate what a producer is responsible for, and then producers contract and collect this amount of WEEE. This method helps achieve the goal of lowest possible overall costs, by bringing competition for recycling services and establishing low administrative costs.²³

²³ Hieronymi, K. (2001). Implementing the WEEE Directive. In *IEEE International Symposium on Electronics and the Environment*, May 2001, Denver, CO, USA, p. 218-21.

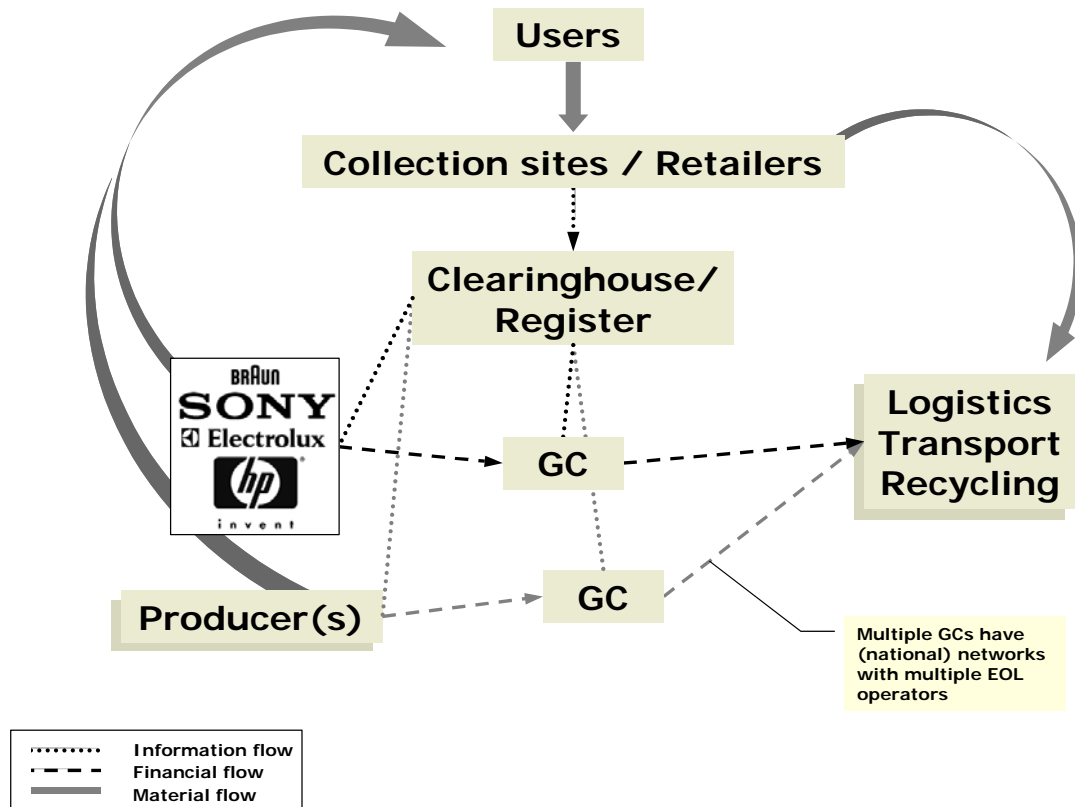


Figure 3-1 European Recycling Platform and other producer(s)

The European Recycling Platform (ERP)²⁴, as illustrated in Figure 3-1, is merely one of producer consortia and/or producers that will each fulfill the obligations allocated by the NCH. Each consortium will likely have a General Contractor (GC) to make contractual arrangements with EOL service providers. The key point here is that competitiveness among EOL operations is facilitated in the system due to multiple GCs seeking to obtain contracts with multiple service providers. Each producer consortia would make these contractual arrangements in this system, as opposed to a national scheme where the national PRO has a competitive tendering process for contracts. Figure 3-2 more comprehensively considers the linkages, and all stakeholders; whereas, the above is to merely illustrate the multiplicity integral to the NCH system.

The Strategic Waste Policy Forum (SEWPF), formed by a group of producers in October 2003, is seeking a solution for the WEEE Directive in the UK. In a June 2004 discussion paper, the NCH model is described as a means for producers to meet obligations while facilitating competitiveness for collection and treatment. SEWPF lists the key functions the NCH would have:

- Registration of producers, sales data is reported by equipment type;
- Allocation of collections to producers or a consortium of producers;
- Reporting amounts of WEEE collected and recycled to authorities.²⁵

²⁴ European Recycling Platform. (2004). <http://www.erp-recycling.org> [2004, August 30].

²⁵ Strategic Electronic Waste Policy Forum. (2004). *National Clearinghouse Discussion Paper*. <http://www.pswg.org.uk/sewfp/nch.htm> [2004, August 29]. p. 1-3.

SEWPF states that the NCH is not for enforcement, with this task being attributed to environment agencies that should monitor and enforce compliance. Furthermore, the NCH should not be involved with any other service provision; otherwise, collusion may possibly take place. The financing of the NCH comes from registration fees, and should take into account the position of Small-to-Medium size Enterprises (SMEs). The registration of sales is proposed to be by weight, rather than sales value or units.²⁶ In Germany, the EAR project is also addressing a national clearinghouse²⁷.

According to Loen, as of October 2004, the number of compliance schemes is multiplying in the UK, as it appears there will not only be one national consortium. Furthermore, these companies that are willing to make contractual arrangements for EOL operations are already contacting producers.²⁸ The author acknowledges concerns about large producers and/or large consortia having an advantage in this type of set-up, however, on the contrary, there is no reason why smaller producers should be disadvantaged, or will have any increased administrative or financial burden, especially if given a choice for EOL service provision. The logic should flow that producers with smaller obligations will join together to gain access to larger quantities of waste, hence, approaching greater economies of scale.

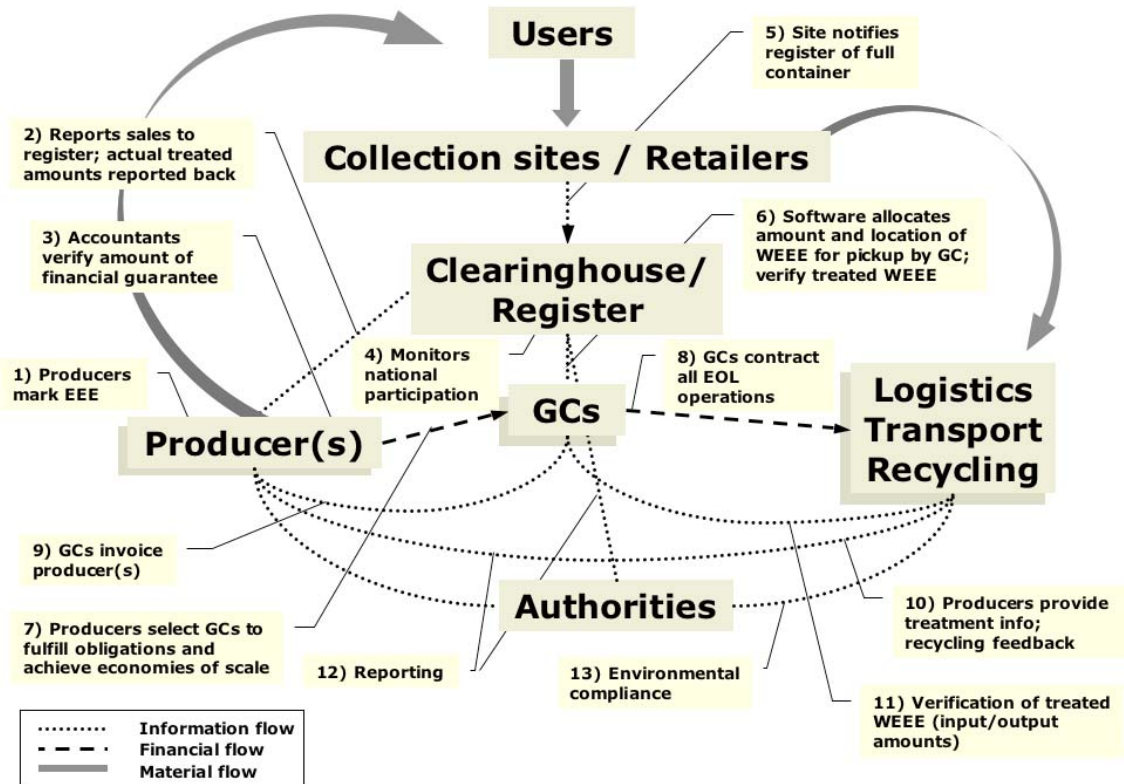


Figure 3-2 Market share with NCH in (D, F, UK)²⁹

²⁶ Strategic Electronic Waste Policy Forum. (2004). *National Clearinghouse Discussion Paper*. <http://www.pswg.org.uk/sewpf/nch.htm> [2004, August 29]. p. 3-5.

²⁷ Elektro-Altgeräte Register. (2004). <http://www.ear-projekt.de/> [2004, September 1].

²⁸ Loen, Frans. (2004, October 15). Sony International Europe. Personal interview.

²⁹ Loen, Frans. (2004, July 14). Sony International Europe. Personal interview.

The system in Figure 3-2 represents how a market share based system may be set up in Germany, France, and the UK. As other scenarios are based on a good understanding of this system, it is helpful to go through step-by-step. 1) As producers place products on the market, 2) the amount of sales by weight is reported by category to the NCH. And naturally, producers will report back to the NCH how much waste has been collected and treated. 3) Accountants will verify producers set aside a financial guarantee for the corresponding amount of products placed on the market. The form of guarantee is yet to be decided by governments and producers as of September 2004. 4) The NCH will in effect be monitoring national participation since they obtain the information, however, Member States are expected to actively enforce participation. 5) After the collection site notifies the NCH of a full container, there is, 6) an allocation mechanism applied to factor in differences between sites. On an ongoing basis, treated amounts are verified, to ensure accuracy. As further described later, this is the key aspect of a decentralized system.

As already noted consortia have formed, or are forming, and are, 7) selecting a general contractor to fulfill their obligations for them. 8) GCs will then sub-contract EOL operations for given quantities of waste, and 9) invoice producers, thereby achieving direct transparency of costs. 10) Producers remain responsible for providing treatment information to facilities, and should be encouraged to obtain feedback on recycling, e.g. how might design for recycling improve disassembly processes? 11) Treatment facilities report input/outputs of waste from the given consortia to the NCH, and subsequently, 12) reports are made to authorities and producers. Lastly, authorities, 13) continually monitor environmental compliance of EOL facilities.

The general requirements can be determined from the previous description; however, a key point for the success of this system is the scheduled allocation mechanism that will ensure equity for producers. It is proposed that the NCH can fairly allocate the collections using software to manage and optimize the pick-up. The quantity of the allocation is calculated by market share, with different types of collection sites being shared equally (e.g. remote, rural, suburban, and urban sites). The mechanism ensures that no "cherry-picking" of collection sites will occur.³⁰

Another feature of the software will be to correct for actual amounts collected for treatment, by resolving any differences in the next allocation. The process will happen for practically every pick-up since containers of WEEE will vary in weight. This is not expected to have any administrative burden, and can actually be applied easily to individual producer activities outside of the allocation mechanism.³¹

Fischer, a software developer at webix in Germany, has designed software that will address three different conditions when determining allocations: geography, filling quality, and filling quantity. As Fischer states, there are three ways for the software to allocate sites: 1) real-time, 2) batch, and 3) site. "Real time" allocation of waste would be the simplest of the methods for optimization, however, a problem arises when multiple producers have pick-ups at the same sites, and a container pool is therefore needed. One can logically see how a truck would like to bring empty containers when picking up. Producers may organize a pool for themselves, and if containers were standardized this may be less of a problem. Fischer says "batch" is most likely at present, at least in the UK, with a consortium spending time at one site for 4

³⁰ Strategic Electronic Waste Policy Forum. (2004). *National Clearinghouse Discussion Paper*. <http://www.pswg.org.uk/sewfp/nch.htm> [2004, August 29]. p. 4-5.

³¹ Loen, Frans. (2004, September 10). Sony International Europe. Personal interview.

weeks at a time. After this period the software will control for over or under-collection and address this difference. Overtime, the aim is to have to change sites less in the future. "Site" allocation for longer periods, such as a year are difficult because producers may over-collect or under-collect, and any self-initiated pickups are hard to reconcile when a consortia is locked into one site.³²

As of September 2004, in the UK, the government's goal is pick-ups with the same service provider for longer periods, and they accept "batch" and "site" but not "real-time" allocations at this point. In this system, not only will collections be possible from municipal collection sites, where the majority of pick-ups are, but other self-initiated collections are recognized, e.g. retail shops. Fischer described how the Commission presently wants 1 ton of self-initiated pickups to equal 1 ton collected at sites. Reasoning that the intention is to avoid waste collecting at sites all together.³³

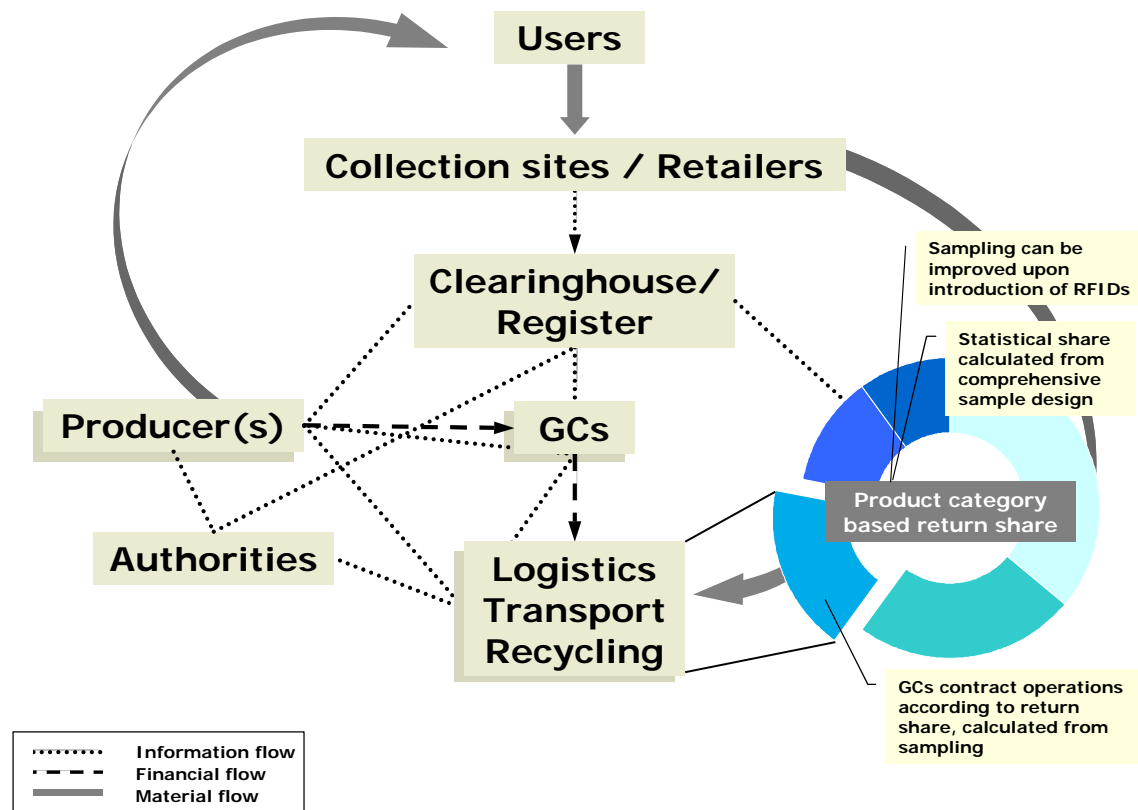


Figure 3-3 IPR 1 - Return share statistical sampling

Figure 3-3, developed with Schneider³⁴, shows the first method for calculating a producer *return* share rather than market share. The same scheduled allocation method will be applied for collection of mixed, unsorted waste. The system does not suggest any sorting by brand at treatment facilities, only that a statistical share is calculated of the WEEE returned to facilities. As the "historical" waste burden will be significant for some time, this system may be viable at some future point. And then it would only be reasonable if this return share were less than the producer's current market share. A calculation of obligations on return share would not

³² Fischer, Frank. (2004, September 23). webix. Personal interview.

³³ Ibid.

³⁴ Schneider, Andreas. (2004, July 5 – August 25). Sony International Europe. Personal interviews.

give new entrants competitive advantage, as proposed by Hieronymi³⁵, because producers will have to place a financial guarantee when the product is placed on the market.

Scientific American describes Radio Frequency Identification (RFID) and addresses the technological challenges ahead in detail, however, to summarize, it consists of an electronic circuit located in an unpowered, or “passive,” tag that can be powered intermittently from a distance by radio-frequency signals sent by a reader. When powered, the tag exchanges information with the reader. The tags require no batteries or power supply and are considered maintenance free.³⁶ In Figures 3-4 and 3-5, developed with Schneider³⁷, RFID tags on products are proposed to help calculate a producer *return share*. In both scenarios, readers will recognize the specific product type and its producer. In Chapter 4, an evaluation communicates the benefits and drawbacks of each system.

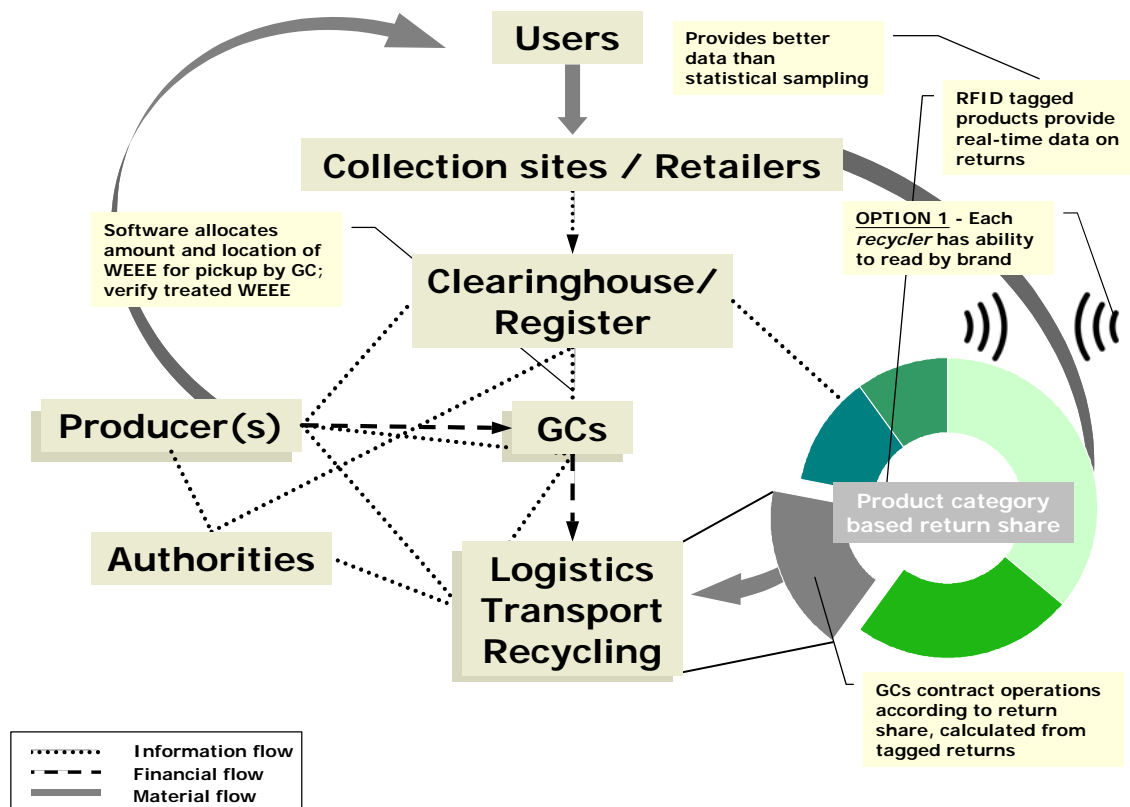


Figure 3-4 IPR 2 - Return share of RFID tagged only - read at recyclers

³⁵ Hieronymi, K. (2001). Implementing the WEEE Directive. In *IEEE International Symposium on Electronics and the Environment*, May 2001, Denver, CO, USA, p. 220.

³⁶ Scientific American. (2004, January). RFID: A key to automating everything.

³⁷ Schneider, Andreas. (2004, July 5 – August 25). Sony International Europe. Personal interviews.

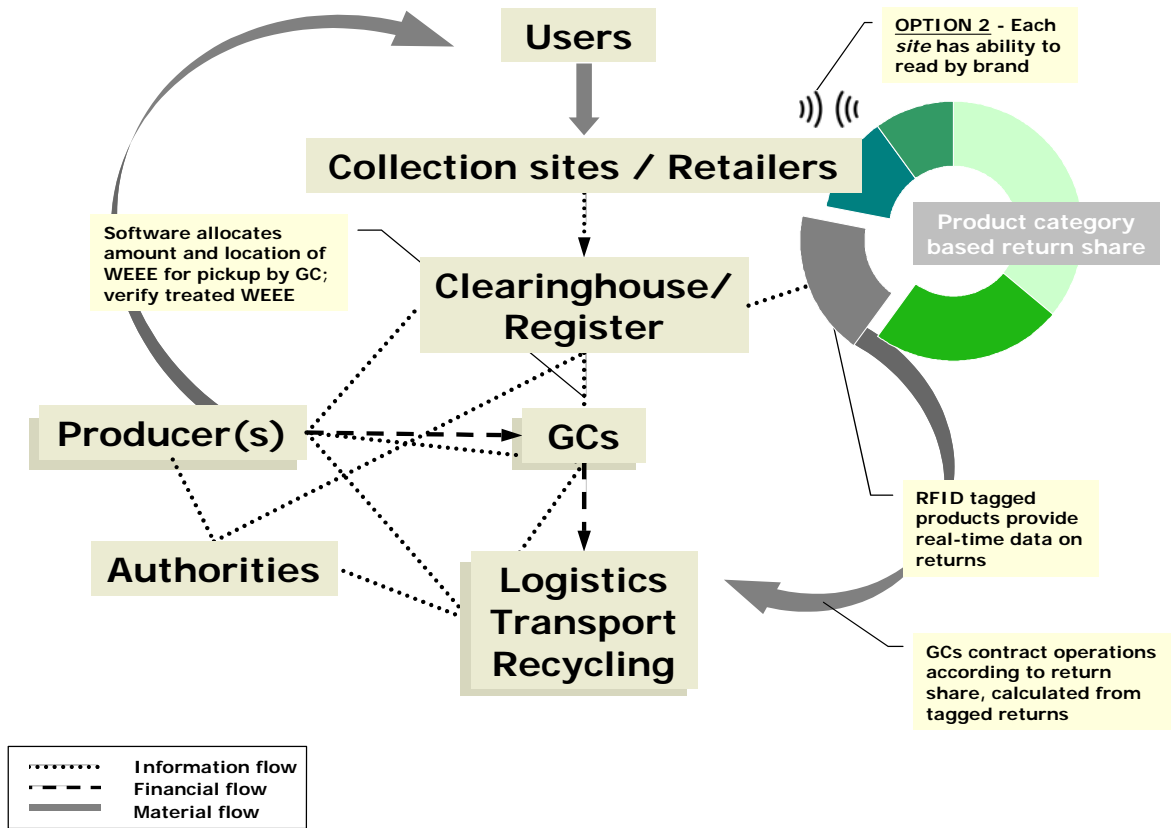


Figure 3-5 IPR 2 - Return share of RFID tagged only - read at collection sites

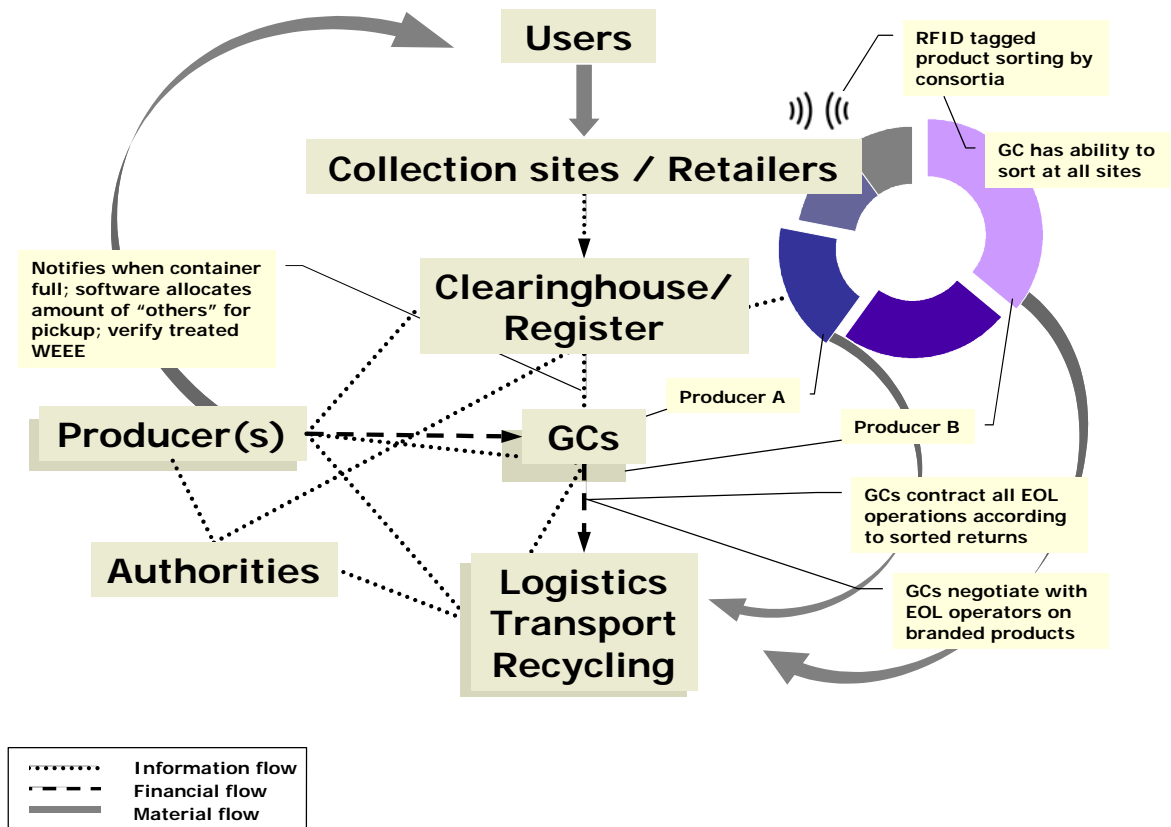


Figure 3-6 IPR 3 - Returns only - sort by consortia at sites

A departure from the other systems, Figure 3-6, developed with Schneider³⁸, illustrates a scenario that calls for sorting at least by consortia at all collection sites. In practice, this implies that if a site has six different containers, e.g. brown goods, IT equipment, etc., then there would have to be 18 different containers if three producer consortia exist. Furthermore, there is a requirement for either a customer to sort and/or staffed sites that perform sorting for them. The key point is GCs contract all EOL operations according to their sorted returns, with the possibility of negotiating with service providers according to known product characteristics, e.g. design for disassembly / recyclability, high precious metal value, etc.

The main requirement for the system is that producers and/or consortia have containers covering all possible collection sites in the country. Concerning waste from others, as amounts of historical waste decline and all waste have a financial guarantee, it is expected there will not be a need for scheduled allocation for a share of “others”. In Section 4.8, an evaluation of this system can be found.

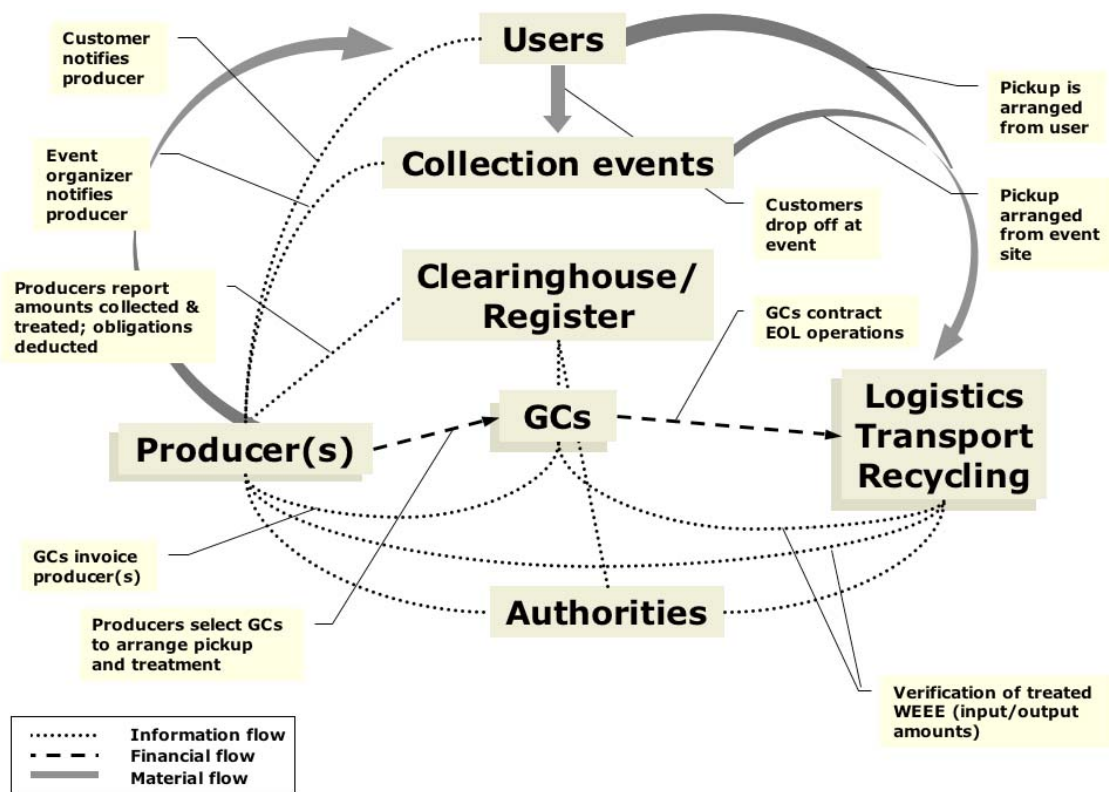


Figure 3-7 Direct customer arrangement or collection events

Figure 3-7, developed with Schneider³⁹, represents the last option for IPR to present. Direct arrangements for pick-up of personal computers, including CRTs and keyboards, is presently common in the US. Apple⁴⁰, Dell⁴¹, IBM⁴², and HP⁴³ have programs, as of September 2004,

³⁸ Schneider, Andreas. (2004, July 5 – August 25). Sony International Europe. Personal interviews.

³⁹ Schneider, Andreas. (2004, July 5 – August 25). Sony International Europe. Personal interviews.

⁴⁰ Apple. (2004). <http://www.apple.com/environment/recycling/nationalservices/us.html> [2004, September 1].

⁴¹ Dell. (2004). http://www.dell.com/us/en/dhs/topics/segtopic_dell_recycling.htm [2004, September 1].

⁴² HP. (2004). <http://www.hp.com/recycle> [2004, September 1].

⁴³ IBM. (2004). http://www.ibm.com/ibm/environment/products/ptb_us.shtml [2004, September 1].

which either charge per unit or box shipped back to them, or provide free return shipping (Dell) with the purchase of a new PC. To some extent, there are similar arrangements in Europe, however; in general the typical routes were described previously.

Organized collection events may take place at retailers; for example, Office Depot formed a partnership in the US for a promotional waste electronics take-back with HP⁴⁴. Office Depot is accepting all types of electronics; with a strategy that this will bring in new sales to offset the costs of treatment. HP has agreed to cover costs of transport and processing of their *own* products, with Office Depot covering the rest. However, the status of the program is uncertain, and not likely to be sustainable, since customers are just dropping off old electronics and leaving the store.⁴⁵

What is illustrated with direct customer arrangements and collection events, is the necessity for free access to waste. Whatever the arrangement may be, the amount producers remain obligated for should be reconciled with the NCH.

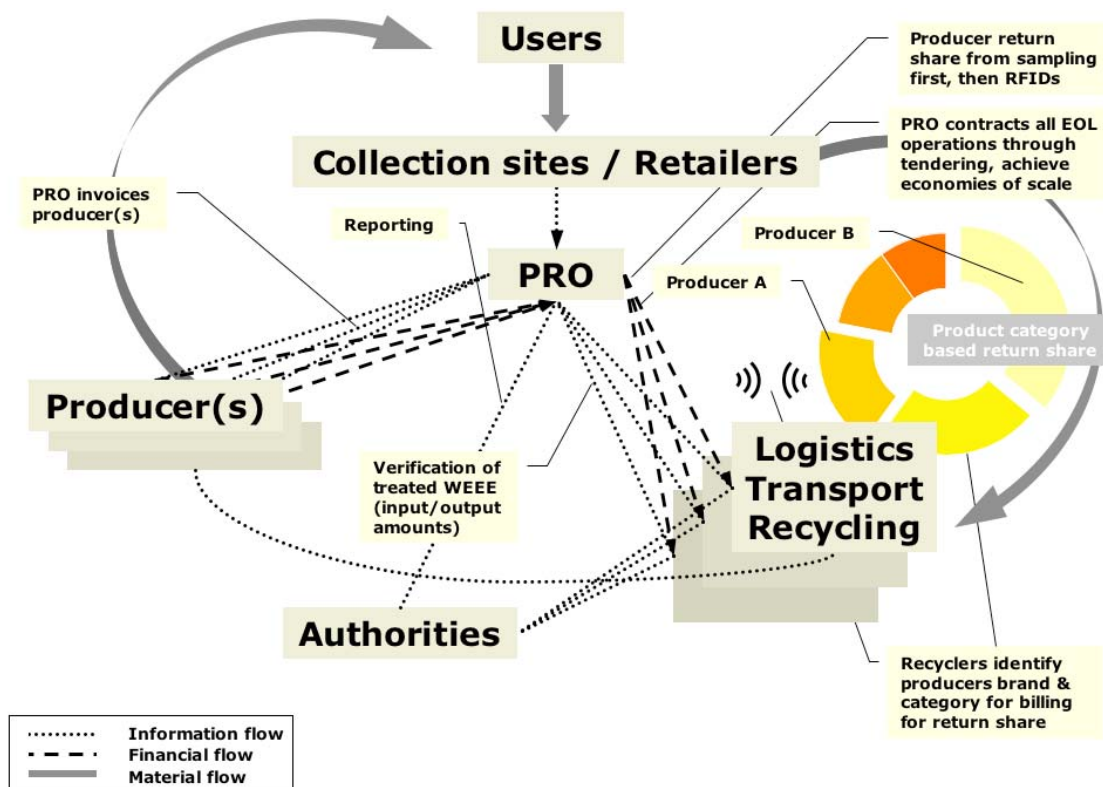


Figure 3-8 PRO – Return share with producer liability

In Figure 3-8, developed by the author, some of the principles of IPR are applied to a national scheme by calculating the return share, rather than using market share to divide costs. Similarities exist to ICT Milieu, where real costs are presently billed in arrears according to *market* share of the producers, though the above system uses the same methods mentioned in IPR 1 and 2 to calculate the actual return share. Again, no sorting is done, and all waste will be processed together according to necessary categories and product type.

⁴⁴ Office Depot (2004). <http://www.officedepot.com/recycle> [2004, September 1]

⁴⁵ Moreau, Ray (2004, August 4). FW: Office Depot Electronics Recycling. Email to Sean Skaling.

Therefore, the main distinctions from a NCH system are, 1) Only the national PRO does tendering processes for service provision, and 2) All costs are split for national collections, i.e. no scheduled allocation is needed. As with the NCH system, obligations will have to be reconciled with any direct customer arrangements or collection events. A more in-depth look into differences is in Section 4.8.

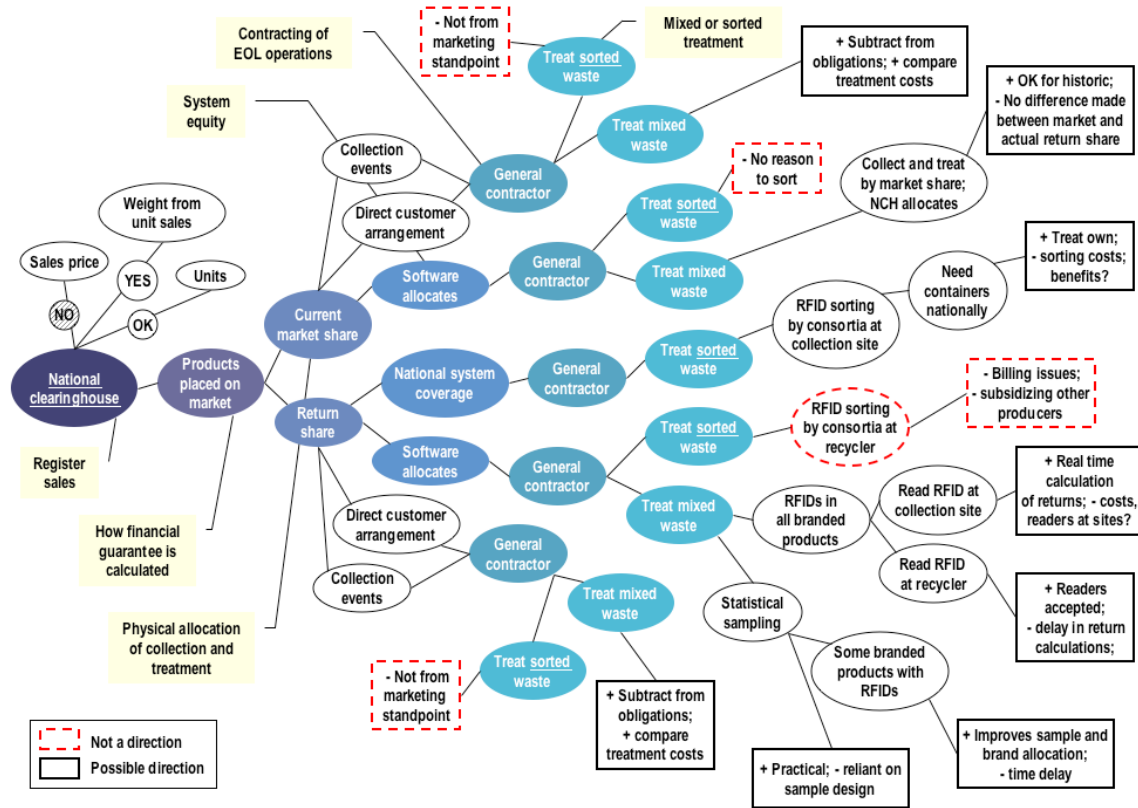


Figure 3-9 System options with a National Clearinghouse

Summarizing all the options recognized in this research by the author, in Figure 3-9, the possible directions are shown that address WEEE collection under a NCH. The following Figure 3-10 shows the possible directions with a national PRO. Distinguished by colors, described from left to right, both diagrams show:

- How the products are to be registered;
- What financial guarantees are based on;
- How the costs of the system are allocated;
- How equity for producers is achieved;
- Who does the physical contracting;
- Is the WEEE to be treated mixed or sorted by brand or consortia.

Pre-screening of the directions that are not chosen to take to the evaluation stage help reduce the level of complexity. For practical reasons, they are excluded. The first direction involves the treatment of sorted waste from direct customer arrangements or collection events. In reality, a business cannot only accept back their own waste; otherwise they would never acquire new customers. Therefore, the waste stream from these points will always be mixed to

some extent, so producers will be responsible for these products. The second direction that serves no purpose is sorting when costs are allocated by market share.

The last direction to avoid is based on the practical difficulties in billing and cross subsidies from transport. What is proposed is trying to separate costs of a mixed stream of waste coming into a recycler, where RFIDs could be read and producers recognized. Difficulties arise when a container is allocated to a consortium and very few of its own products are there once collected.

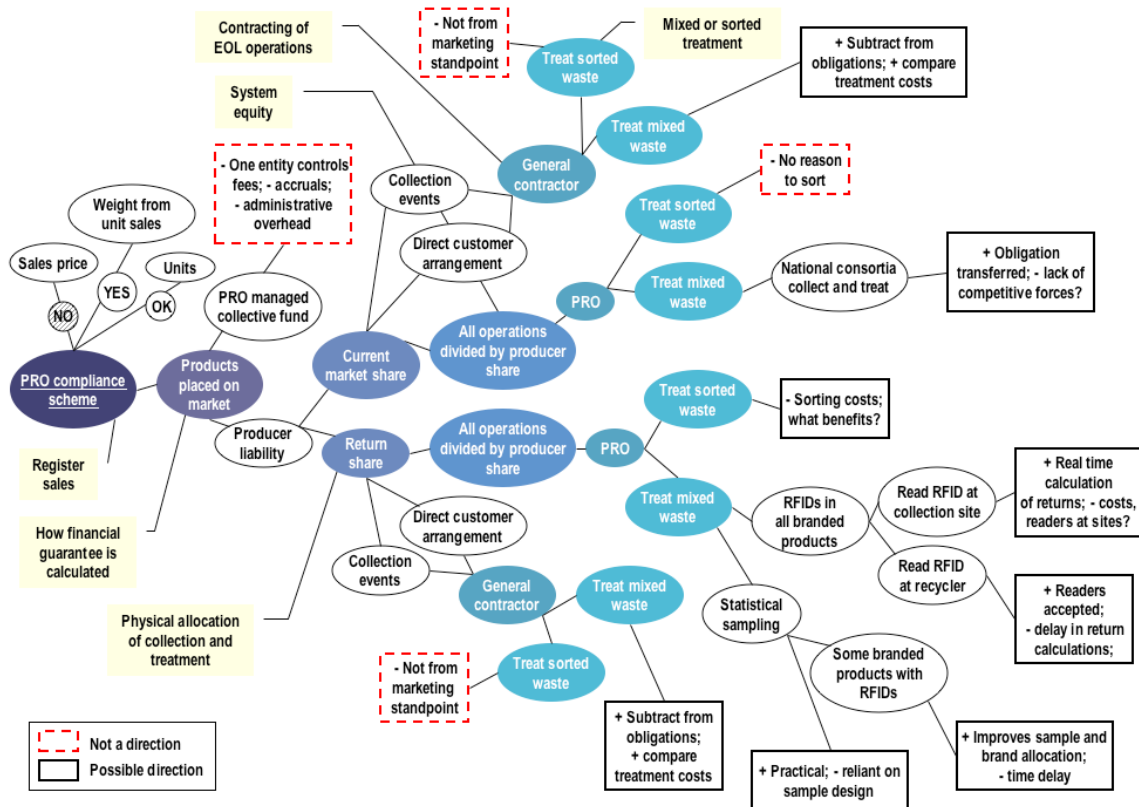


Figure 3-10 System options with a PRO compliance scheme



Similar to the previous diagram, in Figure 3-10, developed by the author. the same structure (registry, guarantees, etc.) helps describe the possibilities under one national system. The main division comes when deciding whether the national scheme has reserve forming (accruals) or allows producers to retain funds for EOL operations. In Section 4.3, these differences are described in detail, and supporting arguments are made since fund-forming schemes exist presently.

4 Evaluation of EPR programs

In the previous chapter, system proposals are made for fulfilling WEEE obligations on an individual basis. In this chapter, the following research question is addressed:

By comparing present collective schemes, planned systems (Germany, France and UK), and individual producer systems, which systems can be effective at addressing the key criteria?

For practical purposes, the evaluation builds off a November 2003 study commissioned by the UK government that compares present systems in Europe. The study consisted of a literature review, and more importantly, interviews with scheme operators and industry representatives. For a comparison of schemes, it is necessary to introduce three systems in Europe that generally represent the operational systems that now exist. The representative systems are Recupel (Belgium), El Kretsen (Sweden), and ICT Milieu (the Netherlands). Following these introductions, Section 4.1 begins to compare planned systems (Germany, France and UK) alongside systems generated through the research. Knowledge of the developments in Germany, France, and the UK is gained from interviews at SONY, since they are active in discussions on the system set-up in the respective countries. As of early September 2004 no English version of the transposition is available from these Member States.

The evaluation beginning in Section 4.1 makes use of a plus and minus when discussing whether a respective system meets the goals of stakeholders. In general, a  represents a belief by the author that the system generally meets the goals of stakeholders for that respective criterion, while a  represents a failure to meet the goals. If there is no mark, then the assessment is uncertain. While the main stakeholders are different in some cases, generally, it first encompasses producers and EOL service providers, followed by government and customers. As producers and EOL service providers are believed to be the most affected by the legislation, the evaluation is aimed towards practical use by these businesses.

At the end of Section 4.8, conclusions are drawn by the author, reflecting on these plus and minuses, in an attempt to communicate systems that are more positive towards both meeting the goals of stakeholders and the aim of the Directive. The final summary of the systems alongside the criteria serves to recognize opportunities and risks, and not to provide a quantifiable, scientific assessment.

Recupel

Recupel is a national, not for profit collective scheme for the collection, transport, and treatment of WEEE. Beginning on 1 July 2001, Recupel was set up with no government funding and relies on visible fees at the time of purchase, according to product type. It is free of charge for customers to take WEEE to retailers or collection sites. Recupel collects 80% of its WEEE volume from c. 2000 collection sites and the other 20% from c.16000 retailers. Before being sent to treatment facilities, it is sorted into 1) TV and computer screens, 2) Cooling and freezing equipment (CFC), 3) Large white goods (exc. CFC), and 4) Small white/brown goods and ICT equipment. It is assumed there is also a facility for electrical

tools and gardening equipment. One transport provider picks up at both retailers and collection sites for all of Belgium.⁴⁶

Recupel allocates part of its budget towards customer awareness campaigns for WEEE recycling. The customer is shown the amount on her receipt that is attributed to the costs of recycling when new purchases are made, and helps reinforce awareness. The fees for producers vary by product type, and Recupel bases the amount on an estimate of items coming back into the system, including provisions for both historic waste and future sales. In Section 4.2, these future liabilities are further discussed. Because of the financial division between sectors, there is no cross subsidies among them, only to some extent within the sector itself. Producers are responsible for reporting the number of units sold within the respective sector. Recupel employs several persons for monitoring reporting in order to address the free riders in each sector. Summarizing, in Recupel's visible fee system, producers only have the burden of reporting, since the customer at the point of sale covers all costs.⁴⁷

El Kretsen

El Kretsen is a national, not for profit collective scheme created on 1 July 2001. El Kretsen maintains an operating contingency (reserve) to make up for short-term variations in collection levels. The legislation requires preliminary treatment for WEEE that will be dismantled, incinerated, or landfilled. Here producers have set up a one-for-one system, which is free when purchasing like equipment. The former applies to retailer sites, whereas WEEE collected from households is free for customers, with no requirement for old-for-new. Originally, Local Regional Authorities (LRAs) collected and treated WEEE from sites; however, El Kretsen has made arrangements to treat this waste now. Producers shall also inform customers about the possibilities they have for collection of WEEE. The law also allows producers to fulfill their responsibility individually, but most producers have contracts with El Kretsen.⁴⁸

There are 350 collection points at retailers, with at least one in each of the 290 municipalities, and 700 household collection sites that are run by local municipalities. The WEEE is sorted into three fractions: electronics, large white goods, and light sources. Some logistics is done in-house, and transport and treatment is subcontracted. In 2003, 33 treatment and recycling operators existed that are decided by technical abilities, location, and price. Visible fees are not allowed, and fees are paid to the respective sector based on the number of units sold by category. Collectors are then paid per kg of waste collected (for electronics) and per unit (white goods and lighting). The treatment facilities then disassemble and sort, and are paid per ton of waste received. The sorted waste goes to other processing facilities, e.g. incineration (plastics). Two main models exist for funding:

- **Debiting Model Preliminary Cost:** A preliminary cost based on (SEK/unit, SEK/kg or % of sales value) is fixed for the year. The surplus that may accrue is returned to producers according to product type at the years end;

⁴⁶ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 46-48.

⁴⁷ Ibid. p. 49-58.

⁴⁸ Ibid. p. 98-99.

- **Debiting Model ICT Products:** Real costs for collection and treatment of ICT products are divided between producers according to market share. Billing is done on a monthly basis, and will be based on the market share in the preceding year.

El Kretsen has established around 50 different unit based fees, and determine them from return rates, weight, cost of treatment, material content, possibility of reuse, and other factors. FES provides a simple example, fees are higher for products with little material value when transport and treatment costs are high, and fees are lower for products with higher material value when other costs are low. No collection or treatment targets are set, though all material must be treated, and it must all remain in Sweden. Legally LRAs are responsible for WEEE from collection sites, i.e. WEEE not returned to retail shops. However, El Kretsen has agreements with all municipalities to treat this waste in exchange for providing and maintaining collection sites. Retailers are also said to benefit by not having to take back WEEE at their stores.⁴⁹

An interesting fact for the ICT producer’s part of El Kretsen is that they can apply for repayment of fees for products recycled at the company’s expense. This applies only to products related to the sale of new products, and not through any other means.⁵⁰

ICT Milieu

The Netherlands has two parallel schemes for WEEE, one for white and brown goods (e.g. refrigerators, TVs) known as NVMP, and one for ICT equipment (e.g. computers, printers, photocopiers, and telephones) known as ICT Milieu. For purposes of the evaluation the focus will remain on ICT Milieu since NVMP has similar operational characteristics as Recupel, e.g. visible fees and accruals for future liabilities. Tojo has a more in depth analysis of the two parallel schemes in the Netherlands⁵¹. Formed in 8 April 1999, ICT Milieu collects both from 540 municipal collection sites and 65 regional sites; these regional sites are funded and make up 25% of the budget. Customers can hand in WEEE for free on an old for new basis at retailers, or drop it off at collection sites, where sometimes fees are charged. Up until January 2003, weight based charges on returned products, sorted by brand and processed, plus a fixed annual fee funded the system. These actual return share charges were designed to cover collection, sorting, and treatment of products by specific producers. According to FES, reasons for changing the system were:

- High levels of orphans and free-riders where no producer could be charged – level was initially as high as 44%;
- Retrospective taxing - system was unfair to manufacturers with significant levels of historic waste and reduced current market share;
- Brand sorting too expensive, not transparent.

Presently, producers declare the total weight of products placed on the market, and the respective categories they are in. Each month producers pay for their share, including all categories, based on this determination of current market share by weight. Payments are made in arrears after the WEEE has been processed; accordingly, producers absorb the costs since

⁴⁹ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 100-108.

⁵⁰ El Kretsen. (2004). *Self declaration for calculating the ratio*. <http://www.el-kretsen.se/Index-e.htm> [2004, September 11].

⁵¹ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 192-210.

there is no visible fee. The system then covers all orphans and free riders that exist. No targets exist for collection and treatment. FES states that ICT Milieu has the approval of the ICT sector due to its low cost, limited staff and overhead costs; it is maintained that this is the “most simple and fairest way to manage WEEE operations and apportion costs.”⁵²

From interviews by Tojo, views were expressed favoring a collective system in the Netherlands. Criticism exists there of another system that would separate by brand and individual producers, and cites the difficulties in getting the branded products back.⁵³ However, as scenarios in Chapter 3 show, IPR does not involve sorting by brand as put forth by the interviewee. There is one exception in the scenarios presented by the author, but the feasibility of this option is questioned further in this evaluation.

4.1 Effectiveness in collection and treatment of WEEE

As discussed in Chapter 2, the following factors make up the criterion:

- Amount of WEEE per capita collected and treated
- Extent WEEE is recycled or recovered
- Treatment standards
- Consumer awareness
- Accessibility of drop-off facilities

FES states that there are two primary factors that describe the level of effectiveness in collection and treatment. First, is the amount of WEEE per capita. The countries within the scope of the FES report already meet the 4 kg target of the WEEE Directive, and the systems are now expanding collection of other product categories. The second factor is the level of treatment waste undergoes and under what standards is this taking place. There are issues with comparisons of treatment operations, since treatment standards differ, data is collected from different categories, and recycling has different definitions among the countries.⁵⁴ The final point is addressed in the WEEE Directive in Article 3(e) through the definition of recycling, “the reprocessing in a production process of the waste materials for the original purpose or for other purposes, but excluding energy recovery [...]” Data collection should be easier under WEEE due to reporting requirements within the categories. Pertaining to treatment standards, in Article 6 of the Directive, it is detailed that as a minimum, selective treatment should be carried out according to Annex II. Additionally, Member States may put in place minimum quality standards for environmental protection, facilities need to obtain operational permits, and require inspections at least once a year.⁵⁵

Among the systems in the evaluation, it is difficult to speculate what the outcomes concerning effectiveness of collection and treatment will be. Risks for a decentralized system are summarized in Section 4.8, and uncertainty on effectiveness will remain for the author until systems are up and running in some countries. General areas producers should address,

⁵² Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 65-74.

⁵³ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 202.

⁵⁴ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 22-24.

⁵⁵ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 6, 8-9.

acknowledged by the author, include: reporting procedures, treatment standards, cross-border movements, and treatment contract lengths.

Another point related to effectiveness in collection is consumer awareness and participation. Under the WEEE Directive, Article 10, this obligation resides with the Member States, aside from the marking requirements by producers. The requirement not to dispose in municipal waste, what collection systems are available to them, what their role is in recycling, and the meaning of the symbol is to be communicated by the Member States. However, depending on the interpretation of Article 10(4), Member States or producers may be made responsible for consumer awareness and encouraging participation.⁵⁶ According to FES, in 2002 spending on consumer awareness campaigns ranged from .28% (ICT Milieu) to 4% (Recupel, NVMP) of a schemes budget. With the estimation by the author of the FES report, this amounts to 1 million Euro for Recupel, therefore, this remains significant.⁵⁷ One note related to awareness is regarding the confusion in the Netherlands around visible fees. Since NVMP (white and brown goods) has visible fees for the products covered, and ICT Milieu (ICT products) has none, customers regular contact the Ministry asking why no scheme exists for those products; a point that should be addressed by requirements of WEEE Directive.⁵⁸

Lastly, effectiveness in collection is not only amounts per capita, but also the accessibility of convenient drop-off facilities. The Directive states that Member States are to address the accessibility of collection facilities, taking into account population density⁵⁹. This is also a reason why transport costs can vary significantly from country to country due to varying geographical distances. Taking into account the relative environmental impacts of transportation, the logistic operations that are contracted for the collection of waste are also important. Systems should be designed to optimize collection at the lowest cost, and environmental effectiveness.

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-1:

1. Decentralized systems ask producers to address reporting procedures, treatment standards, cross-border movements, and treatment contract lengths, more so than national compliance schemes;
2. Article 10(4) allows Member States to make producers responsible for consumer awareness and encouraging participation, however, the effectiveness is then questioned by the author, unless a cohesive message is somehow communicated. How could each producer actually run awareness campaigns?;
3. Under a national clearinghouse system, producers must meet recovery targets and remain liable for any contractors to follow treatment standards; For PROs, they only carry out responsibilities producers still have;
4. Systems such as El Kretsen have all dismantlers with ISO certification, leading to more transparency of operations – ISO 9001 and 14001 (or equivalent certification) should be

⁵⁶ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 10.

⁵⁷ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 30, 57.

⁵⁸ *Ibid.* p. 74.

⁵⁹ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 7-8.

sought for EOL operators under the NCH system with general contractors, e.g. dismantling, smelting, material recycling, energy recovery.

Table 4-1 Effectiveness in collection and treatment of WEEE

System	Effectiveness in collection and treatment of WEEE
Market share with NCH in (D, F, UK)	Producers MAY have to encourage participation of customers rather than Member States and will be responsible if targets are not met; Producers must meet recovery targets and remain liable for sub-contractors to follow treatment standards.
IPR 1 - Return share statistical sampling	Same as above.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	Same as above.
IPR 3 - Returns only - sort by consortia at sites	Same as above;
	⊖ In order to remain effective in collection and compliant with WEEE Directive, producers must have national coverage with containers at all collection sites / retailers.
Direct customer arrangement or collection events	Producers must meet recovery targets and remain liable for sub-contractors to follow treatment standards for under NCH; Both collection events and/or direct customer arrangements are seen as supplemental to a scheme with a NCH or PRO;
	⊕ Both NCHs and PROs should recognize amounts of WEEE collected and treated, and reconcile this with the producer obligations, either according to market (or) return share; Some SME's may be able to fulfill obligations entirely through this means.
PRO - Return share with producer liability	NOTE: Regarding targets and standards, PROs only <i>carry out</i> responsibilities producers still have.

4.2 Cost effectiveness in collection and treatment of WEEE

As discussed in Chapter 2, the following factors make up the criterion:

- Cost per kilogram of WEEE collected and treated
- Allocation of revenues for system operator

FES suggests two parameters to assess the cost effectiveness of the systems. First, is the cost per kilogram of WEEE collected and recycled. And the second is how revenues are budgeted, allocated, and spent outside of collection and treatment costs. The data published by schemes may not specify the following: management overheads, auditing and monitoring costs, provisions for historic waste, publicity expenditure, and financial compensation for retailers, municipalities or other bodies. PROs are described as being less forthcoming with data, due to the likelihood of cost comparisons being made without an understanding of all the factors involved.⁶⁰ FES gives examples of why cost differences can exist from scheme to scheme:

⁶⁰ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 25-26.

- Distance and geography – Shorter distances reduce transport and logistics costs, e.g. SWICO (PRO in Switzerland) compared with El Retur (PRO in Norway) and El Kretsen (Sweden);
- Costs of labor – Higher labor costs in the Nordic countries and Switzerland are reflected in total costs due to the labor intensiveness of recycling;
- Type of product – Recycling and recovery of different products has varying costs, and schemes focus on only some categories, excluding others that could have more or less costs;
- Volume of products – Economies of scale achieved from having greater volumes can be reflected in better rates;
- Time in operation – System improvements can be realized in schemes having been established for a longer time, plus capital investments that show up in overall costs.
- Recycling standards and treatment – Doubts remain over standards because of a lack of a common definition for recycling, low costs could represent different standards;
- Quality and standardization of reporting data – Schemes can report in units collected or kilograms with different categories, currency fluctuations for non-Euro countries.⁶¹

Concerning revenues, Loen makes a point regarding schemes that are reserve forming, described as, “accumulating the difference between the level of advanced recycling fees and the actual costs of recycling. This reserve forming can hamper the development of competition between systems as producers are kept from leaving those collective schemes since a part of the non-transferable funds is linked to their products.” Furthermore, Loen believes,

“If multiple compliance schemes act on a given market, producers should be made responsible for a physical quantity of waste and should not be required to pay a share of the total WEEE recycling costs on that market. Producers responsible for a physical quantity of waste will naturally look for the best available contract to manage the waste, whereas responsibility for a part of the costs would suppose first adding up the cost of all systems on that market (regardless of the different financial performance of the systems) thus forcing producers to pay an average cost of recycling and hindering them to encourage competition.”⁶²

The FES report acknowledges the same concern with some compliance schemes. Though there was no consensus among producers, there is a belief that schemes that make provisions, e.g. NVMP and Recupel, are billing excessively compared to those schemes that operate based on current costs, e.g. ICT Milieu, El Kretsen. In the fund forming schemes, visible fees paid by customers cover all costs, however, this remains to be seen as positive by many producers. According to FES, the provision for future liabilities, as part of the total costs, can only be speculated from the annual reports because of the lack of transparency, but the provisions are

⁶¹ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 15, 25-26.

⁶² Loen, Frans. (2004, September 14). Sony International Europe. Personal interview.

believed by industry respondents to be very significant.⁶³ Tojo also has found evidence of large reserves in the Netherlands with NVMP, however comparably ICT Milieu has none⁶⁴.

The WEEE Executing Forum collects data on amounts of WEEE collected, transported, and treated. However, only a range of minimum to maximum *amounts* collected is available on the website. All cost figures are not published officially, however, FES uses data from the Executing Forum that compares each scheme side by side. FES also speculates on the amount of reserves certain schemes have.⁶⁵ The author seeks to withdraw from making any conclusions from this data due to the above-mentioned points, e.g. distance and geography, costs of labor, etc.

Reserves controlled by a PRO are argued to be addressing both future and historic waste, waste that no fee was paid for. However, producers still believe the fees are set too high and the reserves are excessive. Forecasting is done to decide on the fee structure. Acknowledging the projections to collect more amounts of historic waste per capita, this growth outpacing new sales, the argument that remains is current reserves are indeed justifiable. The authors maintain that over time the amount of fee paid should reduce with the decrease in historic waste, especially when reserves are creating investment income that can cover ongoing costs of historic waste. FES states that producers are less concerned with schemes that operate on 3-6 month operational contingencies, e.g. SWICO, El Kretsen. SWICO even allows its larger members to keep these operational reserves in a segregated account.⁶⁶

Tojo also finds a reason why visible fees are applied to cover waste in the Netherlands. According to interviews, major producers there influenced the decision. The share for Philips, who had a large market share 15 years ago, is now cut in half. And Sony has had an increase from zero to a now significant share. The noticeable shift in market share made it difficult for Philips to agree on individual responsibility.⁶⁷ One can logically see that Philips would carry a larger share of costs for its own “historic” waste, disproportionate to its present market share.

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-2:

1. Compliance schemes, namely visible fee / reserve forming systems (Recupel, NVMP), do not give producers control over costs, compared to a NCH system where costs are more directly controlled;
2. Cost comparisons do not yet exist for comparing a national PRO to a market share based competitive scheme, so the benefit is less clear over schemes having competitive tendering and multiple service providers (“system plurality”), then billing for actual costs in arrears allocated by producer market share;
3. For all return share systems, the benefit is also less clear, however, as amounts of historical waste decline, benefits may appear if return share is less than market share;

⁶³ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 8, 53.

⁶⁴ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 204.

⁶⁵ WEEE Executing Forum. (2004). <http://www.weee-forum.org> [2004, September 11].

⁶⁶ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 28-30.

⁶⁷ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 203.

4. Greater transparency is achieved by direct invoicing from general contractors;
5. Significant costs expected for sorting by brand or consortia, with no clear advantages from an EOL eco-efficiency perspective⁶⁸. A rationale needed for separating, i.e. cost savings for treating own waste.

Table 4-2 Cost effectiveness in collection and treatment of WEEE

System	Cost effectiveness in collection and treatment of WEEE
Market share with NCH in (D, F, UK)	⊕ Transparency achieved by direct invoicing from GC;
	⊖ Less clear benefit over schemes billing for actual costs in arrears allocated by producer market share.
IPR 1 - Return share statistical sampling	⊕ Same as above; As amounts of historical waste decline, benefits may appear if return share is less than market share;
	⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share; Added costs for determining return share covered by producers.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	⊕ Same as above; OPTION 1: Added costs of readers to recyclers easily absorbed; OPTION 2: Direct calculation of return share, compared to RFID readers at recyclers;
	⊖ Same as IPR 1; OPTION 1: Delay in calculation of return share, compared to readers at collection sites capturing real-time data; OPTION 2: Added costs for collection sites could be significant for administration and technical requirements.
IPR 3 - Returns only - sort by consortia at sites	⊕ GCs negotiate and <u>contract for sorted waste only</u> ; As amounts of historical waste decline, benefits may appear if return share is less than market share; Transparency achieved by direct invoicing from GC; May realize returns from environmentally conscious design changes;
	⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share; Significant costs for administration and technical requirements at sites, plus space concerns for both sites and retailers; Allocated share of “others” if exist.
Direct customer arrangement or collection events	⊕ Both are arranged by producers, cost effectiveness may be assumed; GCs negotiate and contract for collected waste; Transparency achieved by direct invoicing from GC; May realize returns from environmentally conscious design changes;
	⊖ Unless other value added benefits, e.g. marketing events bringing new sales, OR customer acquisition / retention via pickups, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share.
PRO - Return share with producer liability	⊕ In case of sampling, RFID tag reading, or sorting by producer to determine return share at recyclers, producers will share costs; Avoid possible differences in producer costs from software allocations under NCH by sharing costs on national basis; As amounts of historical waste decline, benefits may appear if return share is less than market share;
	⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share; Sorting option: Significant costs expected to sort by brand.

⁶⁸ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 215, 241-3.

4.3 Impact upon business competitiveness

As discussed in Chapter 2, the following factors make up the criterion:

- National or multiple consortia
- System plurality through competitive tendering and multiple service providers
- Funding structures

For SONY, and its European Recycling Platform (ERP) partners, competitiveness among multiple consortia and subsequently EOL operations is the key goal for national implementation of the WEEE Directive⁶⁹. In the FES report⁷⁰ it is made clear that most schemes presently in Europe are effectively monopolies, though legislation may allow individual producer schemes. Most are said to have had some disputes with competition authorities in their country. In those countries where two schemes exist they are because of a divide via product sectors, e.g. NVMP and ICT Milieu in the Netherlands, SWICO and SENS in Switzerland. Tojo also cites concerns by competition authorities regarding visible fee systems in the Netherlands, namely that they are fixed and non-negotiable⁷¹.

FES outlines two sides to the argument over competitiveness. Producers argue that multiple competing solutions are the way to drive improvements in service and reduce costs. And those contracts should be tendered on a commercial basis, also being allowed to operate across borders. Legislators and scheme managers believe that national PRO contract negotiation gives them economies of scale, that central control is needed, and clarity of the system are most effective at providing a take-back service, as well as enforcement requirements and addressing free riders. A preference for monopolistic compliance schemes does exist from, for example, Philips, however, expressing that they need rigorous control and transparency. In terms of exerting some competitive pressure, in the FES study producers identify Recupel, NVMP, and SWICO as good candidates. However, increased satisfaction was shown towards schemes such as El Kretsen and El Retur, calling competitive schemes then unnecessary.

Hieronymi and Schneider state that a “monolithic consortium” as such will require disposal costs to be paid upfront without consideration if, how, or when it will reach its EOL. The authors point out that this arrangement fails to motivate design for recycling or encourage investment in improved recycling technologies. Furthermore, resulting from this structure, material recovery costs are not transparent.⁷²

FES makes another distinction related to some extent to business profitability. Producers regard take-back as necessary part of business with the understanding that customers pay for it in the end. However, schemes are either using a visible fee where customers cover all costs (NVMP, Recupel, El Retur, and SWICO), or are not using visible fees with costs being embedded in product price (ICT Milieu, El Kretsen), as shown in Table 4-3. Note, besides the

⁶⁹ Loen, Frans. (2004, July 14). Sony International Europe. Personal interview.

⁷⁰ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 31-32.

⁷¹ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 204.

⁷² Hieronymi, K. and Schneider, A. (2003). How the European Union’s WEEE Directive will change the market for electronic equipment – two scenarios. p. 81-2. In R. Kuehr and E. Williams. *Computers and the Environment: Understanding and managing their impacts*. Kluwer Academic Publishers and United Nations University.

ICT Model where actual costs are billed, El Kretsen uses non-visible fees for system operation. The systems that do not have visible or non-visible fees do require internalization of costs into the product price. Tojo makes a key point about visible fees, “from the viewpoint of promoting upstream changes, what matters most is whether or not the producers, not consumers, pay the actual cost of recycling.”⁷³ In actuality, producers will always pass the costs to the customers somehow.

Toffel summarizes funding structures as it relates to incentives for design change, stating “manufacturers cannot recoup their investment on the revenue side via a smaller upfront fee, providing a price advantage and the opportunity to expand sales.” Due to the practical monopolistic conditions, producers are required to pay the same upfront fees regardless of brand or respective recycling costs.⁷⁴ In Table 4-3, the funding mechanisms are described.

Table 4-3 Scheme funding structures⁷⁵

Type	<u>Visible fee per product</u>	<u>Visible fee per product</u>	<u>Non-visible fee per product</u>	Actual costs billed in arrears	Producer return share in arrears
Covers	Future and historic waste	Current waste	Current waste	Current waste	Current waste
Divided	Current market share	Current market share	Current market share	Current market share	Sorted producer return share
Reserves	Reserve funds built up; fees <i>should</i> decline as historical waste amounts decline	Operating reserve fund, surplus returned at end of defined period	Operating reserve fund, surplus returned at end of defined period	Operating reserve fund, below in months	N/A
Scheme	NVMP, Recupel, El Retur - Hvitevareretur	SWICO	El Kretsen, El Retur - Elektronikkretur	El Kretsen (ICT Model) (6), El Retur (IKT Retur, IT Retur) (12), ICT Milieu (0)	ICT Milieu up until 2003

Another view comes from the European Committee of Domestic Equipment Manufacturers (CECED). They oppose making producers responsible for historic waste retroactively, and stand by the application of a visible fee in order to cover the costs of recycling historic waste. It is argued that in the coming years, most of what will be returned will be “historic” waste, and the fees will increase customer awareness, revealing the true environmental costs.⁷⁶ It appears this is the predominant view in the brown and large white goods sector, and a reason why visible fees are allowed for a period of eight to ten years under the WEEE Directive.

However, EEB acknowledges these arguments, but remains to believe producers should internalize, not externalize waste management costs, and do this in a flexible and efficient

⁷³ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. viii.

⁷⁴ Toffel, M. W. (2003). The growing strategic importance of end-of-life product management. *Cal. Mgt. Rev.*, 45(3), p. 108.

⁷⁵ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 8,19-20.

⁷⁶ CECED. (2004). *Frequently asked questions about the household appliance industry’s appraisal of Directive 2002/96/EC on WEEE*. http://www.ceced.org/energy/take_back.html [2004, September 11].

manner. Internalization of costs will gain a more direct effect, and will put pressure on both designers and EOL operators to improve.⁷⁷

Given that the compliance schemes are all national monopolies, one then should also consider the level of competitive tendering within the schemes themselves. According to FES, the majority of transport and treatment operations are outsourced on 2-3 year contracts to commercial operators. PROs describe themselves as demonstrating “system plurality” through this competitive tendering process for services. In Table 4-4, it is shown that the number of these service providers varies by country. Schemes also vary in the level of involvement in EOL operations. For example, Recupel and NVMP handle logistics, and limited transport in the case of Recupel, however, El Retur and ICT Milieu outsource all logistics, transport, and recycling.

Table 4-4 Number of outsourced service providers⁷⁸

Country	Scheme	Number of Treatment	Number of Transporters	Allocation criteria	Logistics outsourced
Belgium	Recupel	5	1	Technical	Some
Netherlands	ICT Milieu	1	1	National	Yes
	NVMP	4	3	Regional/Technical	Some
Norway	El Retur	6	5	Regional	Yes
Sweden	El Kretsen	33	na	Regional/Technical	Yes
Switzerland	SWICO	15	7	Regional	Some

From the findings of FES, a couple points are made about competitiveness in EOL operations. Resulting from the possibility of a concentration of power as well as risks involved with future tendering, most schemes are using multiple recyclers and transport providers based on regional and/or technical specialization. According to FES, the schemes that have a competitive tendering process have reduced costs substantially, however, others that have a single supplier do not have similar reductions. ICT Milieu is given as an example as the latter. In the case of SWICO, the 15 treatment suppliers have contracts with up to 40 dismantling and treatment operators.

In national schemes, service providers risk disappearing due to length of contracts and/or sole operators as a result of tendering processes, therefore, affecting level of competitiveness. On the contrary, a system with multiple consortia may form shorter contracts with service providers; therefore, discouraging investment in improved technology by recyclers⁷⁹.

Tojo describes how part of the above played out in the Netherlands regarding tendering processes, where large-scale recyclers were left with the only contracts. Large-scale operations were said to have the capacity to meet the demand, and contracts were made with them rather

⁷⁷ European Environment Bureau. (2001). *Towards waste-free electrical and electronic equipment*. <http://www.eeb.org/publication/general.htm> [2004, September 11]. p. 21.

⁷⁸ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 19.

⁷⁹ Van Rossem, Chris. (2004, August 13). IIIIEE. Personal interview.

than smaller recyclers all getting a share. Financial difficulties, bankruptcy, or the closing of business operations was the result in some cases.⁸⁰

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-5:

1. Multiple consortia (and/or producers themselves) under NCH, existing with general contractors, will facilitate competitiveness among EOL operations;
2. Cost comparisons do not yet exist for comparing a national PRO to a market share based competitive scheme, so the benefit is less clear over schemes having competitive tendering and multiple service providers (“system plurality”), then billing for actual costs in arrears allocated by producer market share;
3. Reserve formation should be avoided, and producers should internalize costs, not externalize them with visible fees paid by customers, in order to realize changes in product design and recycling technologies. EOL operations are internalized when producers make accruals in the form of financial guarantees.

Table 4-5 Impact upon business competitiveness

System	Impact upon business competitiveness
Market share with NCH in (D, F, UK)	+ Facilitates competitiveness among EOL operations; Accruals made by producer(s) as a financial guarantee; No visible fees and all collected waste is considered current waste; Clear benefit over reserve forming schemes; Benefit over national scheme where it can be argued other service providers disappear due to length of contracts / sole operators;
	- Less clear benefit over schemes billing for actual costs in arrears allocated by producer market share.
IPR 1 - Return share statistical sampling	+ Same as above; As amounts of historical waste decline, benefits may appear if return share is less than market share.
	- Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	+ Same as above.
	- Same as above.
IPR 3 - Returns only - sort by consortia at sites	+ Same as above; May realize returns from environmentally conscious design changes.
	- Same as above.
Direct customer arrangement or collection events	+ Collection and treatment is contracted in the competitive market, outside of any scheme (NCH or PRO) a producer may be part of, so no anti-competitive issues.; May realize returns from environmentally conscious design changes.

⁸⁰ Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* p. 202.

PRO - Return share with producer liability	<p>⊕ Accruals made by producer(s) as a financial guarantee; No visible fees and all collected waste is considered current waste, then billed to producers in arrears; Clear benefit over reserve forming schemes; One national (or by sector) scheme exists, however, competitive tendering and multiple service providers ("system plurality") are key requirements - competitiveness among EOL operations are facilitated; As amounts of historical waste decline, benefits may appear if return share is less than market share;</p>
	<p>⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share; Risk service providers disappear due to length of contracts / sole operators.</p>

4.4 Level of administrative complexity

As discussed in Chapter 2, the following factors make up the criterion:

- Spending on employees
- Any operations, e.g. logistics provision
- Monitoring of participation
- Auditing
- Compensation to retailers/municipalities

According to FES, a number of factors can reflect the overall level of administration. The number of employees, and level of financial and information flows are two factors. The first factor is reflected in the number of full-time employees, ranging from 25 (plus a 12 man board of directors) at Recupel to 1.7 at ICT Milieu. The second factor contributing to administrative complexity is the financing and logistics for collection before recycling operations. Presently some schemes are also paying municipalities for space at collection sites, and/or compensating retailers, or charge for doorstep collection on a limited basis. Relating to the role PROs have in monitoring participation and auditing in the schemes, a relationship between closer monitoring and increasing costs exists. Comparably, Recupel has several full time auditors whereas El Kretsen operates with little producer oversight.⁸¹

Regarding collection, "Member States shall ensure availability and accessibility of the necessary collection facilities [...]," according to Article 5(2) of the WEEE Directive. Therefore, compensation to local or regional governments for collection sites is not part of the legislation. In the case of retailer compensation a question remains. The Directive states in Article 5(2), "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 [...]."⁸² The wording "at least" may be interpreted that producer responsibilities can be more than mere collection. In 2002, ICT Milieu used 25% of total revenues as compensation to regional collection and sorting depots⁸³. So this becomes an aspect for measuring cost effectiveness given the significant amount of compensation.

⁸¹ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 33-34.

⁸² Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 7-8.

⁸³ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 73.

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-6:

1. Less overhead exists for a national clearinghouse concerning financing since there are no financing requirements (other than registration fees) compared to compliance schemes (e.g. no visible or non-visible fees will require less administration with a NCH);
2. NCH has no other service provision (e.g. logistics, enforcement), otherwise, collusion;
3. No concerns with a NCH system for compensation - the WEEE Directive has no requirement for producers to compensate collection sites and/or retailers for collection; What about “at least” in Article 5(2)b?

Table 4-6 Level of administrative complexity

System	Level of administrative complexity
Market share with NCH in (D, F, UK)	+ Low overhead compared to compliance schemes; Allocation by software should be cost-effective; Sales data reported to NCH based on weight by WEEE category;
	- General contractors must maintain connections to entire geographical region.
IPR 1 - Return share statistical sampling	+ Same as above.
	- Added administrative costs for sampling method, and for recyclers for reporting return share.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	+ Same as above.
	- OPTION 1: Minor administrative costs for <u>recyclers</u> for reporting return share, though RFIDs will help automate the process;
	- OPTION 2: Administrative costs for <u>collection sites</u> for reporting return share, though RFIDs will help automate the process.
IPR 3 - Returns only - sort by consortia at sites	+ Same as above.
	- Administrative costs for collection sites for reporting return share, though RFIDs will help automate the process; High administrative costs for sorting by consortia in separate containers.
Direct customer arrangement or collection events	+ GCs just pickup from the event site and treat; Low number of employees compared to most compliance schemes; Low overhead compared to compliance schemes;
	- For collection events coordinated with retailers or municipalities, publicity campaigns are significant costs; For direct customer arrangement, the reverse logistics has high levels of administration and costs associated.
PRO - Return share with producer liability	+ No visible fees will require less administration; Will act as register for products placed on market - sales data reported to PRO based on weight by WEEE category; PRO has no reserve fund management requirements since producers are billed in arrears; Calculation of return share by statistical sampling and/or by RFIDs will add costs, though absorbed by all producers;
	- Management overhead is a concern, however GCs will have similar requirements for contracting service providers on a national basis; May control logistics provision or other services, may vary from case to case if PRO is enforcement body.

4.5 Equity of scheme for stakeholders

As discussed in Chapter 2, the following factors make up the criterion:

- Scheme participation fees
- How revenues are raised
- Determination of product category fees
- Compliance costs in working hours
- Level of free-riders

FES outlines issues over equity, mostly in terms of how specifically producers are affected by different schemes, with other stakeholders being recyclers, customers, municipalities, and authorities. The majority of the operational funding comes from producers with the biggest market share; however, other fees may affect SMEs disproportionately. For example, the amount of participation fees for the scheme may generate some concerns over equity, especially with SMEs.⁸⁴

Regarding product fees where applicable, as noted in Table 4-3, a range of structures exists for product fee allocations among the schemes including:

- Fixed fees applied to products by categories or sales price;
- Real costs calculated monthly and divided by market share;
- Preliminary costs (per unit, per kg or %of sales value) fixed for the year and difference settled when compared with actual costs at year-end.

As an example, ICT Milieu and El Kretsen (ICT Model) avoid accruals and reserve forming, and charge for actual costs. This model is highly favored by ICT producers⁸⁵. Whereas, Recupel uses the visible fixed fee system where producers only have the burden of reporting since customers cover all costs. PROs make efforts to attribute treatment costs to individual products, however, from an administrative perspective; complexity increases with an increase in the number of product groups. Product banding therefore takes place, however to a varied extent, e.g. El Kretsen has up to 50 product groups. FES states that there are some producer complaints due to product categorization, related to the administrative complexity of the El Kretsen reporting and fee structure.⁸⁶ However, one can conclude there will be fewer cross-subsidies in this situation compared to schemes with fewer product groupings.

Other equity concerns are the amount of compliance costs (in terms of working hours). According to FES, producers are satisfied with schemes as they are set up to address brown and white goods, generally, visible fee based systems. These schemes addressing brown and white goods have a relatively higher amount of historic waste than IT goods. Similarly, producers are also pleased with schemes that are addressing IT goods, generally, non-visible fee systems. ICT sectors are said to have more limited historical waste responsibilities. Since

⁸⁴ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/wcee/> [2004, July 13]. p. 36.

⁸⁵ Loen, Frans. (2004, July 14). Sony International Europe. Personal interview.

⁸⁶ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/wcee/> [2004, July 13]. p. 7, 36-39, 56, 105.

the respective producers were giving input on the setting up of these schemes, they should be pleased, however; issues arise when those producers have to participate in both. In turn this is why El Kretsen has multiple financing systems, and why ICT Milieu and NVMP operate separately.⁸⁷

In the case of SONY, participation in both schemes in the Netherlands is necessary, and of course with Recupel. One aspect remaining significant is the attachment of these fees for retailers to new products sold in these countries. For SONY there are between 100 and 200 IT products put on the market in Belgium, so this adds some administrative burden.⁸⁸

The levels of free riders that are being subsidized affect the scheme equity. In 2002, El Kretsen noted that 90% of the WEEE market was covered. ICT Milieu estimated 80-90% of ICT producers are participating in the scheme in the Netherlands. Recupel has estimates by sector: 95% household appliances, 85% small domestic appliances, 80% A/V equipment, 60% IT, telecoms, office equipment, and 70% electrical tool / garden equipment.⁸⁹

In Article 8(2), the Directive states that a [financial] “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.”⁹⁰ A key aspect for equitable conditions for “future” waste is the guarantee ensuring producers will not be left to finance WEEE left by producers no longer in the market.

Lindhqvist and Lifset discuss the implementation of EPR for EOL vehicles in Sweden, presenting options carmakers have for financing. Only one manufacturer/importer has chosen recycling insurance, with the rest choosing to create reserves in company accounts. The reserve amount is shown to taxation authorities and financial auditors assure that this liability is appropriate.⁹¹ As of early September 2004, discussions are still undergoing on the possibilities for financial guarantees for the WEEE Directive.

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-7:

1. Concerning equity, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share – NCH system highly dependent on optimized software allocation from NCH for pickup locations and treatment;
2. Shift to reliance on accurate amount of financial guarantees by producers in case of insolvency; Depending on how financial guarantees are calculated, cross-subsides are possible - increasing number of specific product breakdowns is preferred over fewer divisions;

⁸⁷ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 36-38.

⁸⁸ Loen, Frans. (2004, September 3). Sony International Europe. Personal interview.

⁸⁹ Future Energy Solutions. (2003). *Study into European WEEE schemes*. <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13]. p. 38, 56.

⁹⁰ Council Directive 2002/96/EC of 27 January 2003. Amended by 31:12:2003. p. 10.

⁹¹ Lindhqvist, T. and Lifset, R. (2003). Can we take the concept of individual producer responsibility from theory to practice? *J of IE*, 2(2) p. 4-5.

3. Both a NCH system and PRO scheme should allow producers to carry out collection events and/or direct customer arrangements, and reconcile this with their obligations;
4. System equity achieved either by software allocating pick-ups (e.g. urban, suburban, rural, remote sites) with (NCH system), or by sharing costs of collection and treatment on a national basis (National PRO scheme);
5. Initially, a share of other waste will have to be allocated to producers choosing return share - at some point all waste should be accounted for financially - return share may then be beneficial over market share.

Table 4-7 Equity of scheme for stakeholders

System	Equity of scheme for stakeholders
Market share with NCH in (D, F, UK)	<p>⊕ No fixed fees based on units, weight, or sales price; Orphans are shared equally; Free-riders addressed by authorities?; Fair amount of registration fees to NCH for producers; Software allocates pick-up; Producers can carry out own collection events and/or direct customer arrangements;</p>
	<p>⊖ Shift to reliance on accurate amount of financial guarantees by producers; Concerning equity, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share.</p>
IPR 1 - Return share statistical sampling	<p>⊕ Same as above; Initially, a share of other waste will have to be allocated to producers choosing return share - at some point all waste should be accounted for financially - return share may then be beneficial over market share.</p>
	<p>⊖ Same as above.</p>
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	<p>⊕ Same as above.</p>
	<p>⊖ Same as above.</p>
IPR 3 - Returns only - sort by consortia at sites	<p>⊕ Same as above; No software allocation for equity needed, will have containers by consortia at all collection sites nationally.</p>
	<p>⊖ Same as above.</p>
Direct customer arrangement or collection events	<p>⊕ Outside of any scheme (NCH or PRO), there is no concern over equity for stakeholders;</p>
	<p>⊖ Concerns over appropriate reporting of collected and treated amounts may be justified; Unclear how this form of collection will coordinate with the software allocations.</p>
PRO - Return share with producer liability	<p>⊕ No fixed fees based on units, weight, or sales price; Orphans are shared equally; Free-riders addressed by authorities?; Fair amount of registration fees to PRO for producers; System equity by sharing costs nationally; Producers can carry out own collection events and/or direct customer arrangements; Initially, a share of other waste will have to be allocated to producers choosing return share - at some point all waste should be accounted for financially - return share may then be beneficial over market share.</p>
	<p>⊖ Shift to reliance on accurate amount of financial guarantees by producers;</p>

4.6 Compliance with WEEE Directive

As noted previously, and briefly outlined in Section 1.1, the requirements by producers involve the financing of separate collection, treatment, and recovery of WEEE. Information

requirements for users, treatment facilities, and for reporting purposes are also needed on the part of producers. This criterion will serve as a basis for the acceptability of any system dealing with “future” waste.

Table 4-8 Compliance with WEEE Directive

System	Compliance with WEEE Directive
Market share with NCH in (D, F, UK)	⊕ All obligations can be met. - Physical: Separate collection, treatment, recycling and recovery - can set up / operate individual take back systems for WEEE from private households and others; Financial: financing waste from own products allowed on individual basis; Old-for-new financed; Informative: WEEE marking, treatment information to facilities, report input/output;
IPR 1 - Return share statistical sampling	⊕ Same as above.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	⊕ Same as above; More effective at communicating EOL information via RFIDs.
IPR 3 - Returns only - sort by consortia at sites	⊕ Same as above; More effective at communicating EOL information via RFIDs.
Direct customer arrangement or collection events	⊕ Same as first.
PRO - Return share with producer liability	⊕ Same as first.

4.7 Effectiveness in improving environmental performance

As discussed in Chapter 2, the following factors make up the criterion:

- Environmental sound management of WEEE
- Environmentally conscious design by producers

As already mentioned, improving environmental performance is viewed from either improvements made towards Environmentally Sound Management (ESM) of WEEE, or through environmentally conscious design by producers. From the first perspective, one should determine to what level a system is promoting improvements in collection and mainly treatment operations, i.e. eco-efficiency of the EOL processes. For the latter, is the system able to stimulate design changes that improve the eco-efficiency of the EOL operations?

As Huisman states, the relationship between the amount of environmental gain vis-à-vis costs of take-back and recycling systems is a key issue for set up. Developed in his research, a two-dimensional graph represents this relationship, including one axis with economic costs and revenues, and a second showing environmental burden or gain. Huisman proposes the use of the QWERTY/EE concept, as it is termed, to analyze changes in eco-efficiency, e.g. take-back system operations, introduction of new technologies, changing collection infrastructure conditions, and/or determining routes for WEEE. An example is given for recyclers to use

the tool to help predict system costs and effects of potential investments on eco-efficiency. Furthermore, producers may use QWERTY/EE to assess the EOL aspects of their products, with a possibility for designers to gain direct feedback, not to mention predicting EOL costs for their product, a way to audit recyclers.⁹²

Huisman's research deserves a closer look as it highly relates to the overall effectiveness of a take-back system. Findings from the research importantly identify collection and treatment priorities for the highest environmental gain per money invested⁹³. Besides these priorities, a discussion with the author highlighted questions on the eco-efficiency of some disassembly operations required by Annex II of the WEEE Directive⁹⁴.

Pertaining to the second point on environmentally conscious design, three strategies are identified by Huisman regarding design improvements for EOL, 1) Reduce or replace amounts of critical (harmful) materials, 2) Reallocating materials to obtain cleaner fractions, and 3) Improving separation of parts and components.⁹⁵ Huisman applied product redesigns for four different product types to the QWERTY/EE tool. As he stated, the outcome was "design plays a limited but not negligible role in environmental performance of products in end-of-life." The main options identified for improvements are enabling plastic recycling, achieving improved fractions from shredding, and reduction of disassembly times. Huisman notes the limiting factors preventing meeting of the design goals as, e.g. costs, functional requirements, safety regulations, and short development cycles.⁹⁶

Also confirming this point, Bodenhofer states that if the recycling route is the same a producer cannot get awarded for design. However, if the product has value producers should try and "get a hold of it", in some way provide the means to do so.⁹⁷

Regardless of the previously mentioned limitations, Huisman shows that significant improvements can come from optimizing for end-of-life costs. It is noted that in a system where producers fund take-back themselves there are two main ways to decrease costs, 1) WEEE fractions should be optimized to recover economic value, e.g. precious metals, and 2) Decrease disassembly times due to the direct link to labor costs. In the research, large differences in disassembly times were shown between similar product types.⁹⁸

The last point to mention from Huisman is the suggestion for EOL costs to be determined upfront. Instead of a division of total system costs by market share, an alternative is noted. Only possible in the national collective schemes, estimates on actual EOL costs could be made, therefore, rewarding eco-design by individual manufacturers.⁹⁹ However, imagine that

⁹² Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 125.

⁹³ Ibid. p. 292-4.

⁹⁴ Huisman, J. (2004, July 29) Personal interview.

⁹⁵ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 221.

⁹⁶ Ibid. p. 215.

⁹⁷ Bodenhofer, Karl. (2004, July 29). Sony International Europe. Personal interview.

⁹⁸ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 242-3.

⁹⁹ Ibid. p. 309-10.

in total, the number of products to set these fees on could number in the hundreds, so this would be a significant administrative burden¹⁰⁰.

What then would happen in practice? If producers are negotiating with the national collective scheme on end-of-life costs, this seems to imply a reserve forming scheme. Otherwise, could producers use the calculated costs to set aside their own financial guarantee, and, subsequently, the actual billing for system costs would have to match? For “future” waste, an assumption is made here that producers will choose to maintain control of the financial liability rather than put funds into any collective fund management. At this time, the author fails to see how this EOL cost determination can be applied in a decentralized NCH system.

In an article describing a concept of third party demanufacturing, Spicer expresses the risk of having one actor set prices for EOL, a point also addressed in the analysis in Section 4.3. In the proposal, there is an appeal by Spicer to settle EOL costs *upfront* and transfer the physical liability to the Producer Responsibility Provider (PRP). As Spicer puts it, “end-of-life will be completely internalized as a cost of production determined by design.”¹⁰¹ It is an interesting way to approach design change indeed, but its drawbacks outweigh the benefits. It is suggested there would be numerous PRPs, however, it is believed by the author that the reliance on a transfer of funds in the beginning rules this option out entirely for many producers.

Elements of differentiated fees can be seen in the German Dual System for packaging waste. The fees paid for packaging vary based on material type and mass, leading producers to optimize packaging, e.g. material choice, more lightweight, refillable. More complex products such as EEE pose different challenges, and no attempts are put forth yet to do this in a relevant way.¹⁰²

Key points from the evaluation are below, and those related to systems presented in Chapter 3 are in Table 4-9:

1. Unclear if NCH system promotes improvements in collection and mainly treatment operations, i.e. eco-efficiency of the EOL operations - depending on short term (likely) or long term contracts, are treatment improvements stimulated?;
2. Until NCH / allocation method is proven, collection is believed to be better optimized by a national PRO scheme;
3. No *direct* financial feedback to producers for environmentally conscious design (benefits only shared by all producers), with possible exceptions being sorting, direct customer arrangements, or negotiations and billing in relation with PROs; Will not stimulate design change significantly;
4. By in large, the level of informational feedback on design change up to producers.

¹⁰⁰ Schnieder, Andreas. (2004, September 10). Sony International Europe. Personal interview.

¹⁰¹ Spicer, A.J., et al. (2004). Third-party demanufacturing as a solution for extended producer responsibility. *J CP*, 12, p. 39-44.

¹⁰² Lindhqvist, T. and Lifset, R. (2003). Can we take the concept of individual producer responsibility from theory to practice? *J of IE*, 2(2) p. 4.

Table 4-9 Effectiveness in improving environmental performance

System	Effectiveness in improving environmental performance
Market share with NCH in (D, F, UK)	⊕ May promote limited improvements regarding extracting more value from WEEE;
	⊖ Unclear if system promotes improvements; <u>No direct financial feedback to producers for environmentally conscious design</u> ; Level of informational feedback on design change up to producers.
IPR 1 - Return share statistical sampling	⊕ Once RFIDs appear in products an opportunity to measure product lifetimes;
	⊖ Same as above.
IPR 2 - Return share of RFID tagged only – OPTIONS 1 & 2	⊕ Same as above.
	⊖ Same as above.
IPR 3 - Returns only - sort by consortia at sites	⊕ Sorting by consortia at collection sites, in theory, allows producers to isolate their products to some extent, so <u>this is an opportunity to stimulate design change with a NCH through direct FINANCIAL feedback to producers for environmentally conscious design</u> ;
	⊖ Unclear if system promotes improvements; <u>Unclear if there are significant differences to differentiate producers by¹⁰³</u> .
Direct customer arrangement or collection events	⊕ Direct customer arrangement, in theory, allows producers to isolate their products to some extent (of course if they are return customers), so <u>this is an opportunity to stimulate design change with a NCH, through direct FINANCIAL feedback to producers for environmentally conscious design</u> ; However, are there significant differences between producers? ¹⁰⁴ A possible link for reuse (remarketing) or Product Service Systems (PSS);
	⊖ Unclear if system promotes improvements; Collection events will not stimulate design change significantly – For collection events with mixed waste, <u>no direct financial feedback to producers for environmentally conscious design</u> ; Level of informational feedback on design change up to producers.
PRO - Return share with producer liability	⊕ Longer term contracts are likely, and may generate system improvements in treatment operations; Until NCH / allocation method is proven, collection is believed to be better optimized by PRO scheme; RFIDs in products provide an opportunity to measure product lifetimes;
	⊖ Will not stimulate design change significantly; <u>No direct financial feedback to producers for environmentally conscious design</u> ; Level of informational feedback on design change up to producers.

4.8 Summary of evaluation

The evaluation is summarized in this section, and looks at the benefits and risks mainly for producers for each individual system as already mentioned above. The section of the decision tree representing each system precedes the summary of each. For example, Figure 4-1 shows the present systems in Europe that are analyzed in the thesis. Recupel (PRO managed collective fund), is a reserve forming scheme, whereas El Kretsen and ICT Milieu (Producer

¹⁰³ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 215, 241-3.

¹⁰⁴ Ibid.

liability) either have limited operational contingencies that are returned, or bill producers in arrears, respectively.

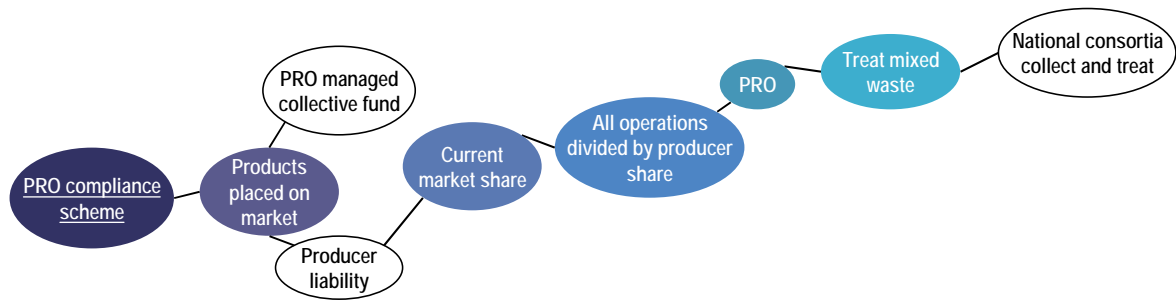


Figure 4-1 Present compliance schemes in Europe

Recupel

- ⊕ Producers only have the burden of reporting unit sales, since the customer at the point of sale covers all costs; Responsible for meeting collection and recovery targets; Responsible for environmental performance of treatment operations; NOTE: Regarding targets and standards, PROs only carry out responsibilities producers still have;
- ⊕ System equity achieved by dividing total costs on a national basis – no site allocation is needed;
- ⊕ Collection and treatment operations believed to be optimized on regional basis – no transport redundancies;
- ⊖ Visible fee / fund forming systems (also NVMP), do not give producers control over costs, compared to a NCH system where costs are more directly controlled; Lacking transparency of operational costs / level of accruals;
- ⊖ Level of competitiveness relies on tendering processes; Risk exists for other capable service providers to disappear due to length of contracts / sole operators;
- ⊖ Level of overhead for monitoring compliance, auditing, and consumer awareness is significant;
- ⊖ System makes no allowance for direct customer arrangements or collection events on the part of individual producers;
- ⊖ Does not stimulate design change.

El Kretsen

- ⊕ Other than operational contingencies, where differences are settled at years end, no reserve forming exists, so beneficial over reserve forming schemes; ICT model bills in arrears on actual costs of operations; Responsible for meeting collection and recovery targets; Responsible for environmental performance of treatment operations; NOTE: Regarding targets and standards, PROs only carry out responsibilities producers still have;
- ⊕ System equity achieved by dividing total costs on a national basis – no site allocation is needed;

- ⊕ Specificity of unit-based fees, for the preliminary cost model, prevents cross-subsidies within category;
- ⊕ Collection and treatment operations claim to be optimized on regional basis – no transport redundancies;
- ⊖ Does not give producers control over costs, compared to a NCH system where costs are more directly controlled;
- ⊖ Level of competitiveness relies on tendering processes; Risk exists for other capable service providers to disappear due to length of contracts / sole operators;
- ⊖ Does not stimulate design change.

ICT Milieu

- ⊕ Bills in arrears on actual costs of operations, so beneficial over fund forming schemes; Responsible for meeting collection and recovery targets; Responsible for environmental performance of treatment operations; NOTE: Regarding targets and standards, PROs only carry out responsibilities producers still have;
- ⊕ System equity achieved by dividing total costs on a national basis – no site allocation is needed;
- ⊕ Collection and treatment operations believe to be optimized on regional basis – no transport redundancies;
- ⊖ Does not give producers control over costs, compared to a NCH system where costs are more directly controlled;
- ⊖ Level of competitiveness relies on tendering processes; Risk exists for other capable service providers to disappear due to length of contracts / sole operators;
- ⊖ System makes no allowance for direct customer arrangements or collection events on the part of individual producers;
- ⊖ Does not stimulate design change.

Among present national systems, the FES surveys note that producers are *mostly* pleased with operations. Especially since schemes have divided financing for short-lived ICT products and long-lived brown and white goods. Where separate financing is not in place, two schemes operate by the different product categories. Those schemes with long-lived products, that reflect a higher “historic” waste burden, want to avoid covering the burdensome costs of waste. Therefore, costs are passed on to customers. The displeasure comes from schemes, such as Recupel, that are building what is believed to be excessive funds from visible fees for treating waste. As the Directive requires a phase out of any visible fees in a period of 8 or 10 years depending on category, perhaps, it is recognized that as long as customers pay for all costs no mechanism exists for producers to make design improvements, i.e. not having control of costs means realizing financial benefits is prevented.

Because no fund forming exists, the Dutch ICT and Swedish systems are good operational models in the eyes of producers, even given the concerns over tendering processes. Notably, El Kretsen allows ICT producers a “self declaration” to reconcile their financial obligations to

the scheme. Producers can submit proof of recycling activities done only at the sale of new products, and receive a refund for the activities.

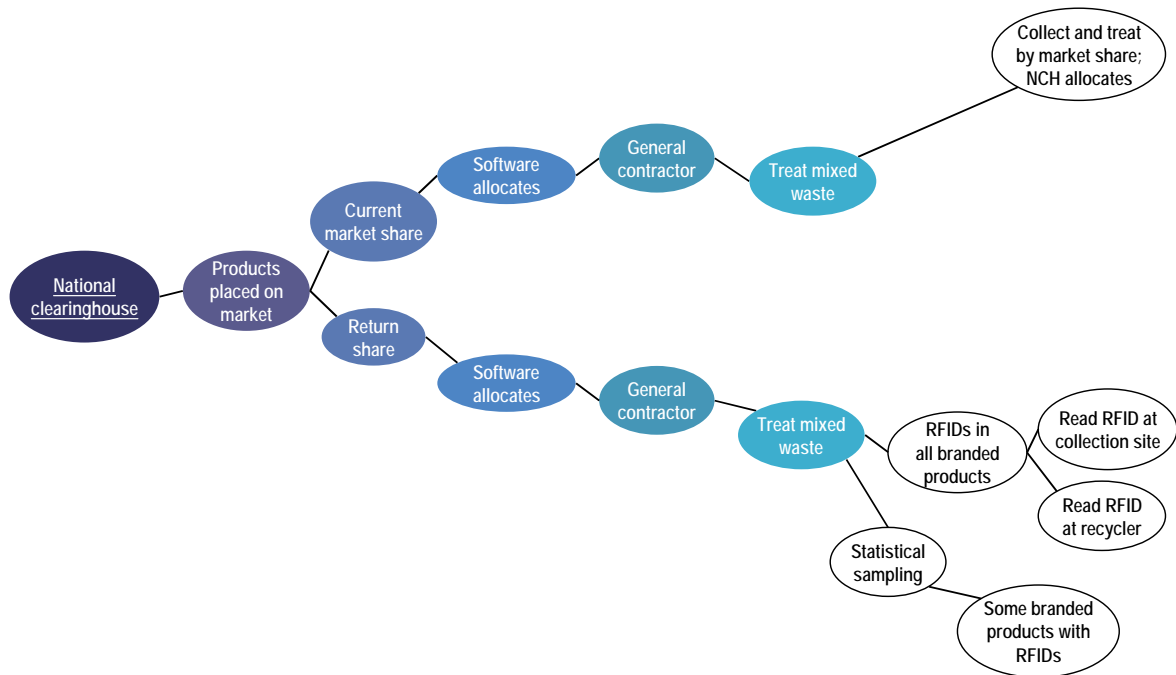


Figure 4-2 Options for market and return share under NCH

Market share with NCH

- + Transparency achieved by direct invoicing from GC;
- + Facilitates competitiveness among EOL operations; Accruals made by producer(s) as a financial guarantee; No visible fees and all collected waste is considered current waste; Clear benefit over fund forming schemes; Benefit over national scheme where it can be argued other service providers disappear due to length of contracts / sole operators;
- + Low overhead compared to compliance schemes; Allocation by software should be cost-effective; Sales data reported to NCH based on weight by WEEE category;
- + No fixed fees based on units, weight, or sales price; Orphans are shared equally; Free-riders addressed by authorities?; Fair amount of registration fees to NCH for producers; Software allocates pick-up; Producers can carry out own collection events and/or direct customer arrangements;
- + All WEEE obligations can be met;
- Less clear benefit over schemes billing for actual costs in arrears allocated by producer market share;
- General contractors must maintain connections to entire geographical region;
- Shift to reliance on accurate amount of financial guarantees by producers;

⊖ Unclear if system promotes improvements; No direct financial feedback to producers for environmentally conscious design; Level of informational feedback on design change up to producers.

IPR 1 – Return share statistical sampling

⊕ Initially, a share of other waste will have to be allocated to producers choosing return share - at some point all waste should be accounted for financially - return share may then be beneficial over market share;

⊕ Once RFIDs appear in products an opportunity to measure product lifetimes;

⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share, however, as amounts of historical waste decline, benefits may appear if return share is less than market share; Added costs for determining return share by sampling method covered by producers.

IPR 2 – Return share of RFID tagged only – OPTIONS 1 & 2

⊕ OPTION 1: Added costs of readers to recyclers easily absorbed; OPTION 2: Direct calculation of return share, compared to RFID readers at recyclers; More effective at communicating EOL information via RFIDs.

⊖ OPTION 1: Minor administrative costs for recyclers for reporting return share, though RFIDs will help automate the process; Delay in calculation of return share, compared to readers at collection sites capturing real-time data; OPTION 2: Administrative costs for collection sites for reporting return share, though RFIDs will help automate the process.

Summarizing the three systems just presented, the key point regarding the set-up of a NCH with a scheduled allocation method is exclusivity of contracts is avoided. In other words, a producer or consortium is prevented from “cherry-picking,” i.e. when collections and treatment are performed only where economies of scale exist. Already businesses are seeing the potential in reverse logistics or “extended supply chain” management. Eckerth presents a method of using key performance indicators to steer these networks, e.g. volume collected related to volume available, volume dismantled related to workload needed, etc¹⁰⁵. Given this situation, with producers potentially “waste hunting,” it is shown the system set-up needs to facilitate equitable conditions.

All options under a NCH, where systems are decentralized, ask producers to address: reporting procedures, treatment standards, cross-border movements, and treatment contract lengths, *more so* than with national schemes. PROs now carry out these responsibilities producers still have, however, in a decentralized system a more direct relationship exists. Producers must meet recovery targets and remain liable for sub-contractors to follow treatment standards under a NCH.

Positive points made on competitiveness remain the same in IPR 1 and 2, and having the same set-up with a NCH is required. Return share should be seen as a progression from a

¹⁰⁵ Eckerth, G. (2004). Supply chain management in take back of WEEE. In *Electronics Goes Green 2004+*, September 2004, Berlin, p. 241. Stuttgart: Fraunhofer IRB.

market share based system, of course, when it will be beneficial for producers to do so. At present, the calculation of return share from a mixed stream of WEEE at the recycler, eventually by RFID tags, is believed to be the ideal way for estimating a producer’s share. Herein lies the benefit for producers, especially if producers have longer lived products and/or other business models are created that prevent products from reaching the typical EOL channels.

IPR 3 – Returns only - sort by consortia at sites

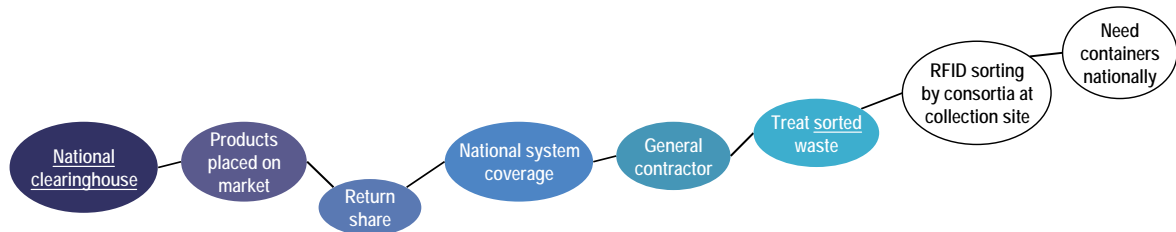


Figure 4-3 Returns only under NCH, sorting by consortia at sites

- + GCs negotiate and contract for sorted waste only; Transparency achieved by direct invoicing from GC; No software allocation for equity needed; More effective at communicating EOL information via RFIDs;
- + Sorting by consortia at collection sites, in theory, allows producers to isolate their products to some extent, so this is an opportunity to stimulate design change with a NCH through direct FINANCIAL feedback to producers for environmentally conscious design;
- In order to remain effective in collection and compliant with WEEE Directive, producers must have national coverage with containers at collection sites / retailers; Allocated a share of “others” if they exist;
- Significant costs for administration and technical requirements at sites, plus space concerns for both sites and retailers; Though RFIDs will help automate the process, high administrative costs for sorting by consortia in separate containers.
- Unclear if system promotes improvements; Unclear if there are significant differences to differentiate producers by.

Conclusions drawn by the author are a system that requires the sorting on the part of either customers or individuals operating collection sites, is expected to be impractical and too costly. With doubts shown in the research over significant differences between producers between the same types of products, the advantages of this system are unclear.

Direct customer arrangement or collection events

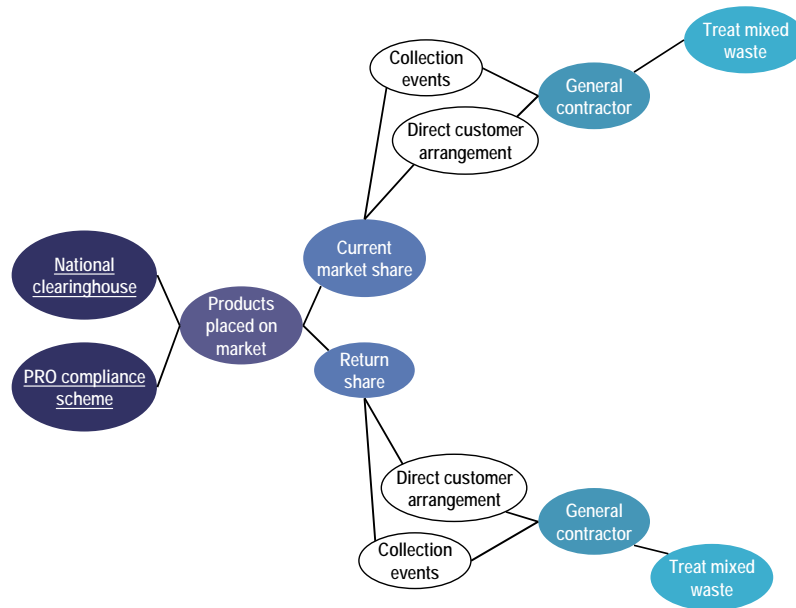


Figure 4-4 Direct customer arrangement and collection events under NCH and PRO

- ⊕ Both NCHs and PROs should recognize amounts of WEEE collected and treated, and reconcile this with the producer obligations, either according to market (or) return share; Some SME's may be able to fulfill obligations entirely through this means; Low overhead compared to compliance schemes;
- ⊕ Both are arranged by producers, cost effectiveness may be assumed; GCs negotiate and contract for collected waste in the competitive market, outside of any scheme (NCH or PRO) so no anti-competitive issues; Transparency achieved by direct invoicing from GC;
- ⊕ Direct customer arrangement, in theory, allows producers to isolate their products to some extent (of course if they are return customers), so this is an opportunity to stimulate design change with a NCH, through direct FINANCIAL feedback to producers for environmentally conscious design; A possible link for reuse (remarketing) or Product Service Systems (PSS);
- ⊖ Unless other value added benefits, e.g. marketing events bringing new sales, OR customer acquisition / retention via pickups, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share;
- ⊖ For collection events coordinated with retailers or municipalities, publicity campaigns are significant costs; For direct customer arrangement, the reverse logistics has high levels of administration and costs associated;
- ⊖ Concerns over appropriate reporting of collected and treated amounts may be justified; Unclear how this form of collection will coordinate with the software allocations – may lead to equity issues;
- ⊖ Unclear if system promotes improvements; Collection events will not stimulate design change significantly - no direct financial feedback to producers for environmentally conscious design; Level of informational feedback on design change up to producers; For direct customer arrangement, unclear if there are significant differences to differentiate producers by.

While collection events will offer a mixed stream of waste, direct customer arrangements offer an opportunity to receive back a larger portion of one’s own products. Of course contingent on the relationship a producer has with customers, this can be achieved by various ways. Leasing contracts, more common in B2B, already exist. Mail back systems are common in the US, and other situations can be imagined with retailers. Toffel writes on the topic of product recovery, reviewing literature that suggests whether or not producers should move in this direction. As decision-making criteria, Toffel describes forecasting methods that look at product durability, obsolescence rates, product complexity, length of design cycles, and reason for redesign¹⁰⁶. Concerning models for reuse and repair, the Association of Cities and Regions for Recycling (ACRR) present the recognized benefits, especially the social objectives¹⁰⁷.

Arguably, what remains a good reason for direct customer arrangements is that producers may benefit from environmentally conscious design from their products previously placed on the market. Further research should be performed on what products may fit this model.

PRO - Return share with producer liability

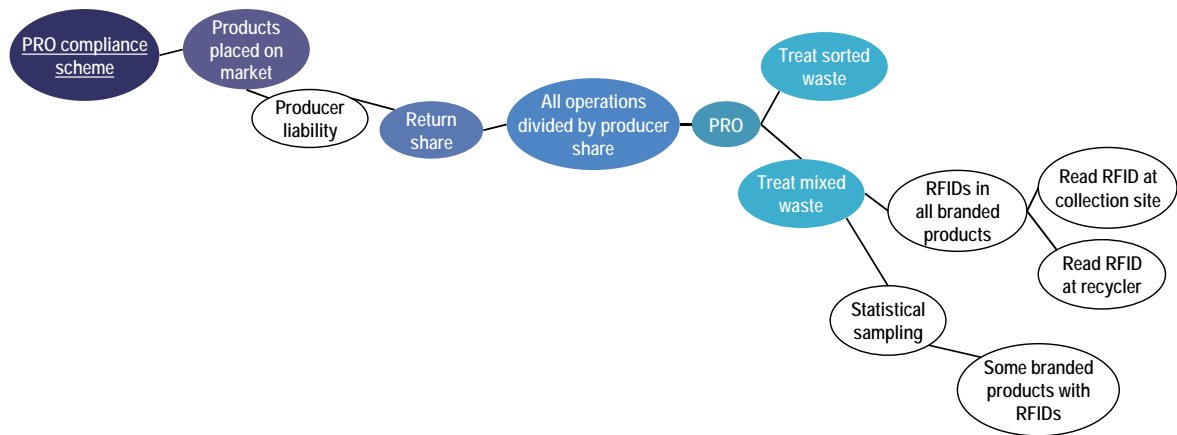


Figure 4-5 Return share with producer liability under PRO

- + PROs must meet recovery targets, and require sub-contractors to follow treatment standards; NOTE: Regarding targets and standards, PROs only carry out responsibilities producers still have;
- + Accruals made by producer(s) as a financial guarantee; No fixed fees based on units, weight, or sales price and all collected waste is considered current waste; One national (or by sector) scheme exists, however, competitive tendering and multiple service providers (“system plurality”) are key requirements - competitiveness among EOL operations is facilitated;
- + Will act as register for products placed on market - sales data reported to PRO based on weight by WEEE category; Clear benefit over reserve forming schemes; PRO has no reserve fund management requirements since producers are billed in arrears; Calculation of return share by statistical sampling and/or by RFIDs will add costs, though absorbed by all producers;

¹⁰⁶ Toffel, M. (2004). Strategic management of product recovery. *Cal. Mgt. Rvw.*, 46(2). p. 135-6.

¹⁰⁷ Association of Cities and Regions for Recycling. (2003). *The management of Waste Electrical and Electronic Equipment: A guide for local and regional authorities.* <http://www.acrr.org/publications/tech-reports.htm> p. 66-71.

- ⊕ Orphans are shared equally; Free-riders addressed by authorities?; Fair amount of registration fees to PRO for producers; Possible differences in producer costs from software allocations under NCH are avoided due to sharing of all costs on national basis = system equity; Producers can carry out own collection events and/or direct customer arrangements;
- ⊕ Longer term contracts are likely, and may generate system improvements in treatment operations; Until NCH / allocation method is proven, collection is believed to be better optimized by PRO scheme; RFIDs in products provide an opportunity to measure product lifetimes;
- ⊕ Financing option: If negotiating amounts required for financial guarantees with PRO, when product placed on market, this is an opportunity to stimulate design change with a PRO through direct FINANCIAL feedback to producers for environmentally conscious design, however, a link to billing must occur – not considered workable at this point.
- ⊖ PROs MAY have to encourage participation adding extra costs;
- ⊖ Initially, less clear benefit over schemes billing for actual costs in arrears allocated by producer market share, however, as amounts of historical waste decline, benefits may appear if return share is less than market share; Sorting option: Significant costs expected to sort by brand;
- ⊖ Risk service providers disappear due to length of contracts / sole operators;
- ⊖ Management overhead is a concern, however GCs will have similar requirements for contracting service providers on a national basis; May control logistics provision or other services, and may vary from case to case if PRO is enforcement body;
- ⊖ Shift to reliance on accurate amount of financial guarantees by producers;
- ⊖ Will not stimulate design change significantly; No direct financial feedback to producers for environmentally conscious design; Level of informational feedback on design change up to producers; Sorting option: Unclear if there are significant differences to differentiate producers by;
- ⊖ Financing option: Expected administrative burden for differentiated fees to outweigh benefits.

Finally, looking at a PRO that bills on return share by producer, one can see an optimal situation for a national scheme. ICT Milieu was basically operating as such until January 2003, and stopped for reasons pointed out in the beginning of Chapter 4. However, it is believed by the author, that *these points are sufficiently addressed by financial guarantees, and the fact that no brand sorting will take place*. Remaining concerns are over the level of competitive tendering processes, and hence the cost effectiveness. These concerns are addressed by design of the NCH system and are expressed in Table 4-10.

As a result of the previous Sections 4-1 to 4-7, a personal evaluation by the author, the summary of systems brings together these judgments to help illustrate perceived differences. Again, in an attempt to communicate systems that are more positive towards both meeting the goals of stakeholders (mainly producers) and the aim of the Directive. The final summary of the systems alongside the criteria serves to recognize opportunities and risks, and not to provide a quantifiable, scientific assessment.

Table 4-10 Summary of systems with key criteria

System	Effectiveness in collection and treatment (meet law)	Cost effectiveness in collection and treatment	Impact upon business competitiveness	Level of administrative complexity	Equity of scheme for stakeholders	Compliance with WEEE Directive	Effectiveness in improving environmental performance	Summary
Market share with national clearinghouse - (D, F, UK)	•••	•••••	•••••	•••••	•••••	•••	•••	Liable for recovery targets and treatment standards: Unclear if system promotes improvements: What benefit over schemes billing in arrears?
IPR 1 - Return share statistical sampling	•••	•••••	•••••	•••••	•••••	•••	•••	Same as above: Return share may eventually be beneficial to market share.
IPR 2 - Return share of RFID tagged only	•••	•••••	•••••	•••••	•••••	•••	•••	Same as above: Return share may eventually be beneficial to market share.
IPR 3 - Returns only - sort by consortia at sites	•••	••	•••••	•••	•••••	•••	••••	Same as above: Return share may eventually be beneficial to market share: Significant costs for sorting with what benefits? (e.g. costs, design).
Direct customer arrangements or collection events	•••	•••	•••••	•••	•••••	•••	••••	Same as above: Cost effectiveness of arrangements and events is questionable.
PRO - Return share with producer liability	•••••	•••••	•••••	•••••	•••••	•••••	•••••	PRO carries out responsibilities for targets & standards: Return share may eventually be beneficial to market share
EI Kretsen - (Sweden)	•••••	•••••	•••••	•••••	•••••	•••••	•••	Level of competitiveness questionable: For ICT individual producer take-back recognized.
ICT Milieu (the Netherlands)	•••••	•••••	•••••	•••••	•••••	•••••	•••	Level of competitiveness questionable: Individual producer take-back unrecognized.
Recupel (Belgium)	•••••	•••	•	•••	•	•••••	•••	Level of competitiveness questionable: Reserve forming: High overhead: Visible fees: Producer take-back unrecognized.

• Negative ••• Uncertain ••••• Positive

What can be gained from looking at both Table 4-10 and 4-11 is two paths can be pursued, depending on the operational results of the NCH. The author believes the success of the system is contingent on how these risks are addressed for a decentralized system:

1. Differing reporting procedures and quality of data, whereas PRO ensures presently;
2. Questionable practices of small (or any) producers, disregard of environmental concerns, e.g. are eco-efficiency of EOL operations such as transport optimized;
3. Cross-border movements, still meeting treatment standards;
4. Treatment contract length, ability to stimulate system improvements;
5. Article 10(4), underestimating difficulty in encouraging participation.

Producers will always seek to lower EOL costs since they are controlled. However, since the costs are in fact controlled, continual improvements in value recovery from WEEE may compensate for this risk. Due to the fact that producers will be directly liable for environmental performance of EOL operations, and the image consciousness they have, it is expected that these risks will not materialize. Therefore, what is represented in Table 4-10 would change, namely, the decentralized system would look more positive towards meeting the goals of the WEEE Directive. *And most importantly, it would show the benefits a return share system with a NCH has over a national PRO.* As shown in Table 4-11, namely, that due to the set-up of the system, competitiveness is inherent by design, so the “Impact on business competitiveness” and, therefore, “Cost effectiveness in collection and treatment” obtain a completely positive outlook.

Table 4-11 Risks to address with decentralized system

System	Effectiveness in collection and treatment (meet law)	Cost effectiveness in collection and treatment	Impact upon business competitiveness	Level of administrative complexity	Equity of scheme for stakeholders	Compliance with WEEE Directive	Effectiveness in improving environmental performance
Market share with national clearinghouse - (D, F, UK)	● ● ● **	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● **	● ● ●
IPR 1 - Return share statistical sampling	● ● ● **	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● **	● ● ●
IPR 2 - Return share of RFID tagged only	● ● ● **	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● **	● ● ●
PRO - Return share with producer liability	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ●

** Producers will always seek to lower EOL costs within their control. A NCH system looks more positive towards meeting both the goals of business and the WEEE Directive if the risks recognized by the author do not materialize. Therefore, the benefits of a return share system with a NCH, over a national PRO, are more explicit due to the set-up of the system that is competitive by its design.

● Negative ● ● ● Uncertain ● ● ● ● ● Positive

5 Conclusions

Given the thesis is written in close cooperation with an electronics producer, the practical result of the research is an assessment of options producers have regarding national implementation of the WEEE Directive. The usefulness is also extended to individuals that are part of the legislative process in the Member States. The methodology chosen allows the researcher to understand the views of a group of producers, regarding WEEE implementation in this case, therefore, helping to inform other producers and legislators. Further, there is a distinct opportunity for a researcher to become a catalyst for some creative processes within, as in this thesis.

Given the circumstance of being in cooperation with one producer, remaining impartial is always challenging. It is acknowledged that competing views will always exist, and the thesis represents these differences when known. Understanding the reasoning behind these differences is in fact an aim of the research. If a wider scope is chosen, there is a benefit of representing other views through more personal interviews, rather than merely literature reviews. The synthesis of the research may then be deemed much more representative of wider views on the subject. On one hand, working closely with a producer is beneficial, but at the same time views from others, e.g. governments and recyclers, should not be neglected. Especially in times of legislative processes, the chosen approach is valued for bringing together different views of producers as well as identifying opportunities and risks for system directions.

From the analysis of present WEEE take-back systems in Europe as well as the knowledge gained from ongoing developments in other Member States, some conclusions can be made on the transition from “historic” to “future” waste. As the WEEE Directive outlines the option for producers to fulfill their obligations either individually or collectively, the question arises how Individual Producer Responsibility (IPR) for waste from private households can be done in practice. B2B models are not assessed by the research; however, influences may exist in both directions according to the system set-up. After identifying key performance criteria, identifying IPR systems, and followed by system evaluations, the conclusions of the author are as follows.

1. Ensure free access to waste

Setting aside other differences, a national collective scheme, by its design, prevents IPR from taking place in an equitable manner. Producers may of course collect and treat their share of waste, however, national consortia may prevent free access to this waste. This is due to the fact that national consortia already have networks of collection sites, especially, where economies of scale exist in urban areas. One should consider the differences of costs to collect in rural and remote areas.

Therefore, there should be free access to waste, preventing a consortia or producer(s) from maintaining complete control of pick-ups in municipalities and/or regional areas. This can be achieved by applying the concept of the National Clearinghouse (NCH) in a country. As proposed in Germany, France, and the UK, the NCH will act only as, 1) a register of producers, 2) will allocate collections in an equitable manner, and 3) then report collections and treatment to authorities. The “cherry-picking” concern is addressed, and by design the system will allow individual producer(s) to fulfill their obligations by the scheduled allocations assigned to them, or to reconcile differences from their direct customer arrangements or retail collection events.

2. Both NCH model and national schemes remain viable

At present the author believes both decentralized and centralized systems remain viable for cost-effective implementation of the WEEE Directive. Cost comparisons of the two directions simply cannot be made at this point, however, there is a belief that due to the set-up of a NCH with multiple producer consortia seeking multiple service providers, this will bring competitiveness to EOL operations. Producers can at least control EOL costs to a greater extent than under a national consortium. Some risks do exist for producers under a decentralized NCH system, such as, 1) new responsibilities for meeting collection and recovery targets, 2) ensuring environmental standards of facilities, and 3) relatively shorter service contracts that may prevent environmental performance improvements.

Though from the literature, by in large, producers seem pleased with the operation of most national schemes; however, questions remain on the level of competitive tendering processes and “system plurality.” Until further developments are made, the author believes the benefits in the national scheme situation are, 1) PROs carry out responsibilities (that producers still technically have) for meeting collection and recovery targets, and environmental performance of treatment operations, 2) If actual costs are billed to producers with no reserve forming and “system plurality” exists, the benefits of multiple competing consortia will not be clear *until* cost comparisons can be made. However with the national schemes, the main risks are, 1) that competitiveness will not be sufficiently stimulated, and 2) service providers may disappear due to length of service contracts.

3. Ensure financial guarantees are representative of future liabilities

Success of the NCH system relies on financial guarantees being made by all producers. Producers report their sales to the NCH, and subsequently place a financial guarantee for this amount. Depending on how guarantees are calculated, cross-subsidy is possible, so an increased number of specific product breakdowns is preferred over fewer divisions. Furthermore, the average product’s lifetime will be key for calculations. Discussion is still presently taking place on how to producers should set the guarantee, and in what form it should be in. However, it is believed by the author that producers will manage the guarantee like any other liability, and retain the funds themselves. Financial auditors are then required to assure that producer assets that are earmarked for EOL WEEE remain protected from insolvent conditions or exit from the market.

4. Return share helps achieve a greater level of IPR

By acknowledging that there will be a declining trend in “historic” waste beginning after 13 August 2005, it is reasonable to believe that there will be a point when this share of waste, that will have to be split among producers, will be of small consequence. Furthermore, all other waste should be accounted for financially if guarantees function as planned. Here there is an interest for IPR, described as, when a producer is responsible for EOL management for its own *return share* of WEEE collected in a waste stream remaining unsorted by brand. At some point, it would be rational for producers to cover the costs associated with their own return share if it is less. First through statistical sampling, then through the use of RFID tags, a reasonable estimate can be made, so producers can determine this share.

It occurs to the author that this method of calculation could stimulate reuse and remanufacturing efforts on the part of producers. And it appears other business models

become appealing that slow down a product’s eventual EOL. However, at least two negative aspects are imagined. First, since export of WEEE products will reduce this share, there is a fear that products may make their way to parts of the world where environmentally sound management fails to exist. And second, the fact that energy use can have the highest environmental burden from a life-cycle perspective for electronics, shows energy efficiency should be continually addressed, and depending on business models, reuse could negatively impact needed improvements.

5. Stimulating environmentally conscious design is challenging in unsorted waste

In an unsorted, mixed waste system the benefits are shared by all producers, so no direct financial feedback exists. Differentiated fees, as proposed in the thesis, have the potential for sending signals to designers in the beginning. However, this implies that a scheme with non-visible fees such as El Kretsen, would determine fees for each product. Sufficient reason should exist before carrying out a task with such a high administrative burden, namely, that EOL costs for producers actually vary within the same product type.

Other than sorting by consortia at collection sites, noted as a direction for IPR, there is at least one reasonable way for producers to attain financial feedback for design change, and this is through direct customer arrangements. Undoubtedly, there will always be a mixed waste stream otherwise producers would never gain new customers, but it is believed that some customer arrangements may be more effective at reclaiming their same brands. Although the costs involved in this model may be prohibitive, the key point is that in these arrangements producers will contract treatment operations for a more defined group of products. Though this is still contingent on the producer benefit from actual variability in EOL costs within the same product type as noted above.

Finally, a roadmap as found in Chapter 6, is useful at describing requirements to achieve a greater level of IPR. From the setting up of a national clearinghouse, to methods for calculating a return share, it can be used to guide producers and governments step-by-step towards a more optimal take-back system.

6 Roadmap for transition to “future waste” systems

Finally, after the concluding points from the research, some recommendations can be made for the transition towards individual producer based responsibility. In this chapter, the following research question is addressed:

What are the practical steps from “historical” waste, market share based, collective schemes towards individual producer based recycling systems for “future” waste from private households?

Given that the WEEE Directive is a form of extended producer responsibility, whereby a producer’s obligation includes a product’s end-of-life, this now becomes part of business. From the producer standpoint, it helps to establish a goal where one wants to be in the future, and then use a backcasting approach to determine the steps needed to realize the goal. The goal expressed by Sony for EOL is to, 1) have competitive market conditions, 2) have control over these costs, 3) pay only for their own return share, and 4) to be able to achieve returns on environmentally conscious design¹⁰⁸. This goal is believed to help producers achieve a level of IPR not yet realized under present systems, and the roadmap in this chapter helps envision how this can happen.

The first step towards realizing this goal is to create a system where competitiveness is ensured. Helping to achieve this is the National Clearinghouse (NCH), which is described in detail in Chapter 3. Multiple producer consortia are assigned scheduled allocations of WEEE from a range of areas (e.g. urban, suburban, rural, remote), so no “cherry-picking” occurs. A NCH is the only way for producers to fulfill obligations on an individual basis in a fair, equitable manner. Imagine a continuum with one national PRO on one side and a fully competitive market on the other. The national PRO divides all costs according individual producers, whereas a fully competitive market would allow, in theory, for producers to pick up WEEE from the most cost-effective areas, e.g. large cities. In the latter case, there would be no free access to waste, as some producers would maintain control over certain areas. What a NCH does is somewhere in between, as it allows more than one consortia and allocates the share of waste to the respective members based on the geographical differences. Therefore, there is free access to waste, transparency, and a level of control over costs.

After the formation of, and successful operation of a NCH, there is an interest to move away from covering EOL costs based on present market share. The rationale is if producer’s products come back at different rates, i.e. the product lifetimes differ or market saturation; they should only be required to collect and treat their return share. In the draft German WEEE legislation, a return share is proposed¹⁰⁹. As of September 2004, no version is yet in English. Assuming producers will choose this method only when their return share is less than their present market share, there are financial benefits for that producer. Whether intended or not, this method of calculation could stimulate reuse and remanufacturing efforts on the part of producers. Interestingly enough, it appears other business models become appealing that may prevent products from reaching EOL.

¹⁰⁸ Schneider, Andreas. (2004, September 2). Sony International Europe. Personal interview.

¹⁰⁹ Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. (2004). <http://www.bmu.de/de/1024/js/download/electro> [2004, September 2].

As the evaluation in Section 4.8 shows, the national PRO remains to be a viable option to some degree, to meet the same goals of producers. It can also be concluded that, depending on the country, a national PRO may be more ideal than multiple producer consortia. Present national schemes claim to facilitate competitive tendering processes, they bill producers for actual costs in arrears, and it is possible for a PRO to move towards billing on return share, given the proposals made in Chapter 3. It could also be reasonable to have kind of a hybrid system, where a national PRO carries a given group of categories, and other categories are competitive, i.e. mobile phones or other high value products¹¹⁰.

Last, is the interest for producers to gain returns on environmentally conscious design efforts. The key point here is when recycling costs are to some extent controlled; these design changes then become part of the business. In an unsorted, mixed stream of WEEE the benefits only accrue to all producers, as costs are all shared. Only two methods are seen to regain a large proportion of one's own products, and subsequently attain some level of financial feedback. One is as the author terms it, "IPR 3 – Returns only – sort by consortia at sites," and the other is through "Direct customer arrangements." From the analysis of the author, it is suggested to not go in the direction of sorting by consortia, for reasons found in Section 4.8. Direct customer arrangements remain interesting, though must be balanced by the costs involved in getting one's own products back. Each product type has unique characteristics that may or may not fit this system, and this will require further research.

Before the roadmap in Table 6-2, developed by the author, it helps to establish a list of things to avoid in Table 6-1, to illustrate some directions that became clear to the author and are not explicit in the roadmap.

Table 6-1 What **not** to do for "future" waste

- ✘ Given the understanding by the author, in practice, national PRO systems will not provide a fair means for implementation because individual producers will not have fair access to waste;
- ✘ If no reasonable difference exists regarding EOL costs from producer to producer by *product type*, there is no reason to sort WEEE (IPR 3) or use differentiated fees;
- ✘ National PRO schemes that don't support competitiveness among EOL service providers should be avoided;
- ✘ Reserve forming schemes with visible fees, in practice, only externalize EOL costs and does not require producers to internalize costs, where change is only possible; Visible fees should eventually be phased out to encourage producers to collectively make improvements.

Table 6-2 Roadmap from "historical" to "future" waste

From 15 August 2004 – Towards IPR:

1. Establish national clearinghouse to act as a register for products put on the market by category, including those by distance communication. (Article 12)
2. Select general contractors for producer consortia that will be responsible for finding

¹¹⁰ Schneider, Andreas. (2004, September 3). Sony International Europe. Personal interview.

- EOL service providers on a national basis;
3. For transparency of EOL operations, seek to have all service providers obtain ISO 14001 certification or equivalent and perform systematic audits;
 4. Description and underlying assumptions are needed for the allocation software that will generate equitable conditions for scheduled pick-up;
 5. How software will reconcile differences with individual producer initiated collection events and direct customer arrangements, e.g. geographical;
 6. Producers and governments should determine, along with financial auditors, options for financial guarantees since a common standard is needed to estimate producer liability; Assure they will cover all "future" waste, since systems will be dependant on funds to treat WEEE for producers no longer on the market;
 7. Product returns, by specific type, need to be measured in order to provide accurate data for calculation of financial guarantees, e.g. product lifetimes;
 8. Depending on interpretation of Article 10, producers may be required to provide some or all of the information for users, therefore, in part responsible for meeting collection targets;
 9. Begin performing comprehensive sampling to determine trends in "historic" and "future" waste returns; as amounts of "historic" waste decline producers may then switch to financing a share of waste via actual return share (note: if less than current market share);
 10. Determine how to calculate statistical share of product returns by comprehensive sample design; representative samples of product returns performed (e.g. cluster or stratified sampling) taking into account, for example, geographical location and time of year;

Focus on national schemes:

11. Analyze tendering processes of national compliance schemes, and determine if changes can be made to stimulate competitiveness;
12. Producers should initiate steps to move national schemes towards billing on actual costs, divided first by market share, then return share in future, and retention of financial guarantee, in the form of accruals, by the producer themselves;
13. National schemes should act as register ensuring producers free access to waste, i.e. producer initiated collection and treatment is reconciled with their obligations;
14. Determine if national schemes will apply software allocation method, in order to coordinate with producer-initiated pick-ups, and prevent "cherry picking";
15. As suggested by Huisman, determine if EOL operational costs can be projected by using QWERTY/EE ¹¹¹– first for different product types, then possibly between

¹¹¹ Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. p. 309.

manufacturers of same product type.

From 15 August 2005 – Towards IPR – Begin the following (as part of producer obligations):

1. Producers to place identifiable mark (crossed-out wheeled bin) on products put on the market after 13 August 2005;
2. Standards should detail how service providers should calculate the mass of WEEE when entering and leaving facilities; also calculation of rates of recovery and component, material, and substance reuse and recycling. (Article 7);
3. Producers should ensure recovery targets are met under national clearinghouse system (Article 7);
4. Producers ensure EOL treatment operators meet obligations for inspections (Article 6);
5. Under NCH system, producers should maintain pressure on authorities to enforce participation;
6. Producers to provide reuse and treatment information for new products put on the market.

From 15 August 2005 – Towards IPR – *Beyond* producer obligations

7. Begin collecting real, comparable data on costs of collection and treatment in competitive market, outside of a national compliance scheme; can be done through collection events or business-to-business arrangements;
8. Begin exploring direct customer arrangements for cost-effectiveness, taking into account other benefits of the service. Direct customer arrangements allow producers to reclaim own products, among others depending on situation; Opportunity exists for reuse, remanufacturing/remarketing, or negotiated treatment operations, though contingent of economies of scale; Collections recognized in countries with NCH;
9. Run trial with collection events to compare costs of fulfilling obligations on an individual producer basis versus through a consortium under a NCH (or with PRO for that matter);
10. Run field trial with RFIDs; place tags on goods at collection sites and coordinate with specific dismantlers to determine readability and any technical /procedural issues that occur;
11. Producers should foster communication between relevant EOL operators (e.g. dismantling, material and energy recovery), so as to meet goals of Article 4 on product design – the facilitating of dismantling, reuse, recycling, and recovery;

From 15 August 2006 – Towards IPR – after one years operation

1. Once NCH system is running in some countries, subsequently, letting cost comparisons be made, decisions can be made on whether to enter countries with national consortia and form another producer consortia;
2. When standards are developed for RFIDs in consumer products, begin tagging key

new products where return share is predicted to be less than present market share;
pay attention to benefits other than EOL.

From August 2007 – Towards IPR

1. Eventually all products sold should, at least, have RFID tags that can be read outside of a mixed container.

From August 2008 – Towards IPR

1. Begin finding RFIDs in products allowing measurement a limited amount of returns; data taken from all dismantling or treatment facilities, that all should be outfitted with readers – will gain a more representative sample; some manual identification of brand and marked-out wheeled bin is required due to missing tags;
2. Once RFIDs are found in products, accuracy increases for calculating amounts of financial guarantee; AND communication of EOL treatment information is more efficient;
3. OPTION: Install readers at all collection sites to measure returns, but at present not considered feasible.

2009-2010 – Towards IPR

1. Increasing numbers of products are being returned with RFID tags;
2. Amounts of historical waste have declined, (e.g. for consumer electronics, small white goods), and a return share may be beneficial for some producers;

2010-2013 – Towards IPR

1. Historical waste still being returned for large white goods and brown goods;

15 August 2013

1. Visible fees shall be discontinued with exception of Category 1 of Annex IA (10 years).

Bibliography

Apple. (2004). [Online]. Available: <http://www.apple.com/environment/recycling/nationalservices/us.html> [2004, September 1].

Association of Cities and Regions for Recycling. (2003). *The management of Waste Electrical and Electronic Equipment: A guide for local and regional authorities*. [Online]. Available: <http://www.acrr.org/publications/tech-reports.htm> [2004, September 11].

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. (2004). [Online]. Available: <http://www.bmu.de/de/1024/js/download/electro> [2004, September 2].

CECED. (2004). *Frequently asked questions about the household appliance industry's appraisal of Directive 2002/96/EC on WEEE*. [Online]. Available: http://www.ceced.org/energy/take_back.html [2004, September 11].

Council Directive 2002/96/EC of 27 January 2003 on Waste Electrical and Electronic Equipment (WEEE). OJ L 37, 13.2.2003. [Amended by 31:12:2003].

Council Directive 2002/95/EC of 27 January 2003 on the Restriction Of the use of certain Hazardous Substances in electrical and electronic equipment (ROHS). OJ L 37, 13.2.2003.

Commission Proposal COM(2000)347 final. *Proposal for a European Parliament and Council Directive on waste electrical and electronic equipment, and on the restriction of the use of certain hazardous substances in electrical and electronic equipment*.

Dell. (2004). [Online]. Available: http://www.dell.com/us/en/dhs/topics/segtopic_dell_recycling.htm [2004, September 1].

Eckerth, G. (2004). Supply chain management in take back of WEEE. In *Electronics Goes Green 2004+*, September 2004, Berlin, p. 241. Stuttgart: Fraunhofer IRB.

El Kretsen. (2003). *Annual report - Collecting and recycling of electrical and electronic products in Sweden*. [Online]. Available: <http://www.el-kretsen.se> [2004, August 23].

Elektro-Altgeräte Register. (2004). [Online]. Available: <http://www.ear-projekt.de> [2004, September 1].

Ernst & Young. (2003). *European overview of producer responsibility organisations and bodies assuming producer responsibility in managing end-of-life products*. [Online]. Available: <http://www.ademe.fr/anglais/publication/vaoverview.htm> [2004, July 13].

European Recycling Platform. (2004). [Online]. Available: <http://www.erp-recycling.org/> [2004, August 30].

European Environment Bureau. (2001). *Towards waste-free electrical and electronic equipment*. [Online]. Available: <http://www.eeb.org/publication/general.htm> [2004, September 11].

Future Energy Solutions. (2003). *Study into European WEEE schemes*. [Online]. Available: <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13].

Fischer, Frank. (2004, September 23). webix. Personal interview.

HP. (2004). [Online]. Available: <http://www.hp.com/recycle> [2004, September 1].

Hieronymi, Klaus. (2001). Implementing the WEEE Directive. In *IEEE International Symposium on Electronics and the Environment*, May 2001, Denver, CO, USA, p. 220.

Hieronymi, Klaus and Schneider, Axel. (2003). How the European Union's WEEE Directive will change the market for electronic equipment – two scenarios. p. 73-86. In R. Kuehr and E. Williams. *Computers and the Environment: Understanding and managing their impacts*. Kluwer Academic Publishers and United Nations University.

Huisman, Jaco. (2004, July 29). TU Delft. Personal interview.

Huisman, Jaco. (2003). *The QWERTY/EE Concept: Quantifying recyclability and eco-efficiency for end-of-life treatment of consumer electronic products*. Delft: DfS.

IBM. (2004). [Online]. Available: http://www.ibm.com/ibm/environment/products/ptb_us.shtml [2004, September 1].

- Lindhqvist, Thomas. and Lifset, Reid. (2003). Can we take the concept of individual producer responsibility from theory to practice? *Journal of Industrial Ecology*, 2(2), 3-6.
- Loen, Frans. (2004, July 14). Sony International Europe. Personal interview.
- Loen, Frans. (2004, July 30). Sony International Europe. Personal interview.
- Loen, Frans. (2004, September 3). Sony International Europe. Personal interview.
- Loen, Frans. (2004, September 10). Sony International Europe. Personal interview.
- Moreau, Ray (ray@swix.ws). (2004, August 4). FW: Office Depot Electronics Recycling. Email to Sean Skaling (sean@greenstarinc.org).
- OECD. (2001). *Extended producer responsibility: A guidance manual for governments*. [Online]. Available: <http://www.oecd.org> [2004, July 13].
- OECD. (2003). *Technical guidance for the environmentally sound management of specific waste streams: Used and scrap personal computers*. [Online]. Available: <http://www.oecd.org> [2004, July 12].
- OECD and UNDP. (2002). *Sustainable Development Strategies: A Resource Book*. Paris: OECD and New York: UNDP. [Online]. Available: http://www.nssd.net/res_book.html [2004, June 27]. p.171-6.
- Office Depot. (2004). [Online]. Available: <http://www.officedepot.com/recycle> [2004, September 1].
- Perchards. (2004). Transposition of the WEEE Directive in other EU Member States. [Online]. Available: <http://www.dti.gov.uk/sustainability/weee/> [2004, July 13].
- Recupel. (2003). Annual report. [Online]. Available: <http://www.recupel.be> [2004, August 23].
- Scientific American. (2004, January). RFID: A key to automating everything.
- Schneider, Andreas. (2004, September 2). Sony International Europe. Personal interview.
- Schneider, Andreas. (2004, September 3). Sony International Europe. Personal interview.
- Schneider, Andreas. (2004, July 5 – August 25). Sony International Europe. Personal interviews.
- Schneider, Andreas. (2004, September 10). Sony International Europe. Personal interview.
- Spicer, A.J., Johnson, M.R. (2004). Third-party demanufacturing as a solution for extended producer responsibility. *Journal of Cleaner Production*, 12, 37-45.
- Strategic Electronic Waste Policy Forum. (2004). National Clearinghouse Discussion Paper. [Online]. Available: <http://www.pswg.org.uk/sewpcf/nch.htm> [2004, August 29].
- Toffel, Michael W. (2003). The growing strategic importance of end-of-life product management. *California Management Review*, 45(3), 102-129.
- Toffel, Michael W. (2004). Strategic management of product recovery. *California Management Review*, 46(2). p. 120-141.
- Tojo, Naoko. (2004). *Extended Producer Responsibility as a Driver for Design Change – Utopia or Reality?* IIIIEE Dissertations 2004:2. Lund: IIIIEE, Lund University.
- Van Rossem, Chris. (2004, August 6). IIIIEE. Personal interview.
- WEEE Executing Forum. (2004). [Online]. Available: <http://www.weee-forum.org> [2004, September].