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Individual Financial Guarantee for Future Waste Electrical and Electronic Equipment

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Nordic Environmental Co-operation

The Nordic Environmental Action Plan 2005-2008 forms the framework for the Nordic countries' environmental co-operation both within the Nordic region and in relation to the adjacent areas, the Arctic, the EU and other international forums. The programme aims for results that will consolidate the position of the Nordic region as the leader in the environmental field. One of the overall goals is to create a healthier living environment for the Nordic people.

Nordic co-operation

Nordic co-operation, one of the oldest and most wide-ranging regional partnerships in the world, involves Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland. Co-operation reinforces the sense of Nordic community while respecting national differences and similarities, makes it possible to uphold Nordic interests in the world at large and promotes positive relations between neighbouring peoples.

Co-operation was formalised in 1952 when *the Nordic Council* was set up as a forum for parliamentarians and governments. The Helsinki Treaty of 1962 has formed the framework for Nordic partnership ever since. The *Nordic Council of Ministers* was set up in 1971 as the formal forum for co-operation between the governments of the Nordic countries and the political leadership of the autonomous areas, i.e. the Faroe Islands, Greenland and Åland.

This report provides theoretical basis for different approaches to producers individual financial guarantees related to the WEEE-directive. It has no legal status, nor does it reflect or limit its member countries official opinions on implementation of the subject in practice.

Table of Contents:

Executive Summary

Abstract

We propose a model to cover producers' future liabilities for the proper treatment of waste electrical and electronic equipment based on current payment of a guarantee according to sales of the product. The payment should be based on current treatment costs of the product, and be reimbursed when the product is properly disposed of as waste or exported for reuse. The return on the capital in the fund should be released to producers annually, regular cost adjustments should be made, and the accumulation of fund due to less than 100 percent collection rates should be reimbursed periodically and used to mitigate the risks of increasing treatment costs. The scrap material value of the product could eventually be accounted for in the guarantee payment.

Background

Waste electrical and electronic equipment (WEEE) has increased dramatically over recent years within the European Economic Area (EEA). Much of this waste is potentially damaging for humans and the environment if not collected and treated in a sound manner. EU-directive 2002/96, which is to be implemented by all EEA member states by August 13, 2005, places full financial responsibility of the management of WEEE on producers and importers, and aims to protect consumers from the risk that a producer exits on the market without fulfilling these financial obligations. The directive calls for a financial guarantee provided by producers at the time that electrical and electronic (EE) products are placed on the market.

The Nordic Council of Ministers has asked ECON to develop a method for calculating producer contributions as a financial guarantee that would cover the collection and treatment of WEEE from private households, as provided for in article 8 in the EU directive.

Problem statement

Recommend a method for calculating the contribution of producers/importers of EE products to a (individual) guarantee fund, and test that the method is sustainable over time.

Conclusion and recommendations

A payback as you go (scrap) model

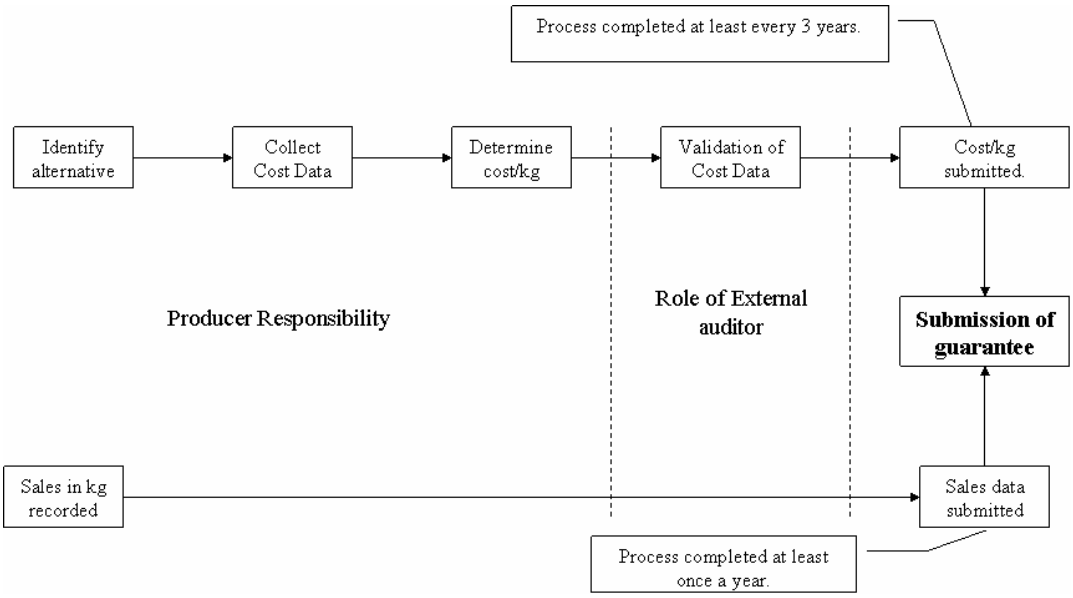
We propose that the producer or importer should (at least once a year) submit a guarantee payment for current sales, per kilogram or unit of the product into a fund to cover future liabilities when the products end up as waste. When it is documented that the product has been either collected as waste and treated in a proper way or exported for reuse, the producer is reimbursed according to the weight or number of products disposed of. A transition period allows for a build up of the fund, following which producer contributions and reimbursements are made based on current sales and current treatment, respectively.

Products are not directly tied to the later treatment of its resulting WEEE. That is to say, when a producer is reimbursed for the disposal of a given product, it will not be known when the product was placed on the market nor the contribution made at the time. By making reimbursements subject to actual WEEE collected and treated, the model provides for incentives for high collection rates. In addition, it eliminates the need for detailed product lifespan data, but requires that the treatment of WEEE is recorded and reported to the authorities (see Figure A).

All relevant alternative costs should be covered by the guarantee payment

The guarantee provided should be sufficient to cover the costs of the collection, transportation, treatment and administration of the individual producers' WEEE in the event that the individual's system breaks down. Thus, it is the price of this alternative, which should guide authorities in determining the cost base for individual guarantee contributions. When collective systems for collecting, transporting and treating WEEE exists (as in Norway and Sweden), or a viable insurance product is available, the prices charged by these systems could be used as a base for the calculation of the payment into the fund. When alternative systems do not or only partly exist, cost estimates of the various components will have to be found from various sources. In the event that the expected cost to society differs from the costs of the individual system, an adjustment should be made to the individual data. The burden of identifying alternative systems and collecting relevant cost data should be placed on producers, to the greatest degree possible. An external auditor should verify (at least) all cost data.

Figure A Determining the guarantee contribution for each product.



Individual producer contributions to the fund should be based on current costs. Since the development of future treatment costs and the lifespan of the products are uncertain, costs and thus fund contributions should be adjusted over time according to new information. Such adjustments should be made at least every 3 years, but preferably annually.

The Return on capital in the fund should be reimbursed…

The fund should be placed in a blocked bank account or similar mechanism in order to protect against bankruptcy. If the return on the capital is left in the fund indefinitely, the balance will be higher than necessary and represent an un-necessary cost for producers. We therefore find it reasonable that the return be released to the producer on an annual basis.

…as should funds resulting from less than 100 percent collection

Collection rates will in most cases be less than 100 percent. For instance, rates that would likely fulfil the EU target of 4 kg per person (an estimated 30 percent of that which is put on the market in Norway) could imply a significant and unnecessary build up of capital. We therefore recommend that a periodic adjustment mechanism be used to prevent a costly build up of the fund. This mechanism could also be used to mitigate the risks of increasing treatment costs.

Scrap value could be accounted for

For some products the scrap material value, for instance from sales of the metal contained in products which show up as WEEE, could be significant. Thus, excluding the scrap value from the calculation of producer

contributions might represent a significant cost to producers and lead to an unnecessary accumulation of funds. On the other hand, however, one of our case studies shows that inclusion of scrap material value in the calculations of fund contribution could lead to the risk that the fund will not serve as a full guarantee for outstanding WEEE over time due to fluctuating scrap material prices and exchange rates. Thus, how to treat the scrap material value when calculating the financial guarantee should be decided on a case-by-case basis, taking into account the availability of cost data with or without scrap material values, the risk of large fluctuations in payments, the risk that the fund will not fulfil its obligations and the risk of building large amounts of "dormant" capital.

A flexible model to cover future liabilities

Based on careful considerations and two case studies it is our view that this model is flexible enough to cover future liabilities and provide incentives for producers to ensure high collection rates over time. Although treatment costs have been declining over the short lives of the collective systems in Norway and Sweden (since 1999 and 2000 respectively), costs could increase in the future due to among other things new environmental laws and/or regulations. However, frequent adjustments to the cost base of the payment calculation should follow from new cost information. Further, the accumulation of capital in the fund due to less than 100 percent collection rates, together with the periodic adjustment, should mitigate the risk of not covering increasing future costs, while at the same time minimizing the amount of ‘dormant’ capital in the fund and thus reducing unnecessary costs for producers.

Norsk Sammendrag

Resymé

Vi foreslår en modell for å dekke det fremtidige, finansielle ansvaret for behandling av elektrisk og elektronisk produktavfall basert på innbetaling av en garanti ut fra løpende salg av produktet. Innbetalingen bør baseres på løpende behandlingskostnader for produktet og tilbakebetales når produktet er behandlet som avfall på en forsvarlig måte eller eksportert for gjenbruk. Avkastningen på kapitalen i fondet bør utbetales til produsentene på årlig basis, regelmessige justeringer av kostnadsgrunnlaget for innbetalingene bør gjennomføres, og akkumuleringen av kapital i fondet på grunn av at mindre enn 100 prosent av produktene samles inn bør utbetales periodisk og brukes til å redusere risikoen for økte behandlingskostnader over tid. Verdien av skrapmateriale fra produktene kan eventuelt inkluderes i grunnlaget for garanti-innbetalingen.

Bakgrunn

Avfall fra elektrisk og elektronisk utstyr (WEEE) har økt dramatisk i de siste årene innenfor EØS-området. Mye av avfallet er potensielt skadelig for mennesker og miljøet dersom det ikke blir innsamlet og behandlet på en forsvarlig måte. EU-direktiv 2002/96, som skal implementeres av alle EØS-land innen 13. august 2005, legger fullt finansielt ansvar for håndteringen av WEEE på produsentene og importørene for å beskytte forbrukere og myndigheter fra risikoen for at produsentene går ut av markedet uten å oppfylle sine finansielle forpliktelser. Direktivet krever at produsentene stiller en finansiell garanti når elektriske og elektroniske (EE) produkter legges ut på markedet.

Nordisk Ministerråd har bedt ECON om å utvikle en metode for beregning av garantibeløpet som produsentene skal betale. Beløpet må kunne dekke innsamlingen og behandlingen av WEEE fra private husholdinger i samsvar med artikkel 8 i EU-direktivet.

Problemstilling

Foreslå en metode for beregning av garantibeløpet for produsenter/importører av EE-produkter for et individuelt garantifond, og teste at metoden er bærekraftig over tid.

Konklusjoner og tilrådninger

En ’payback as you go’ modell

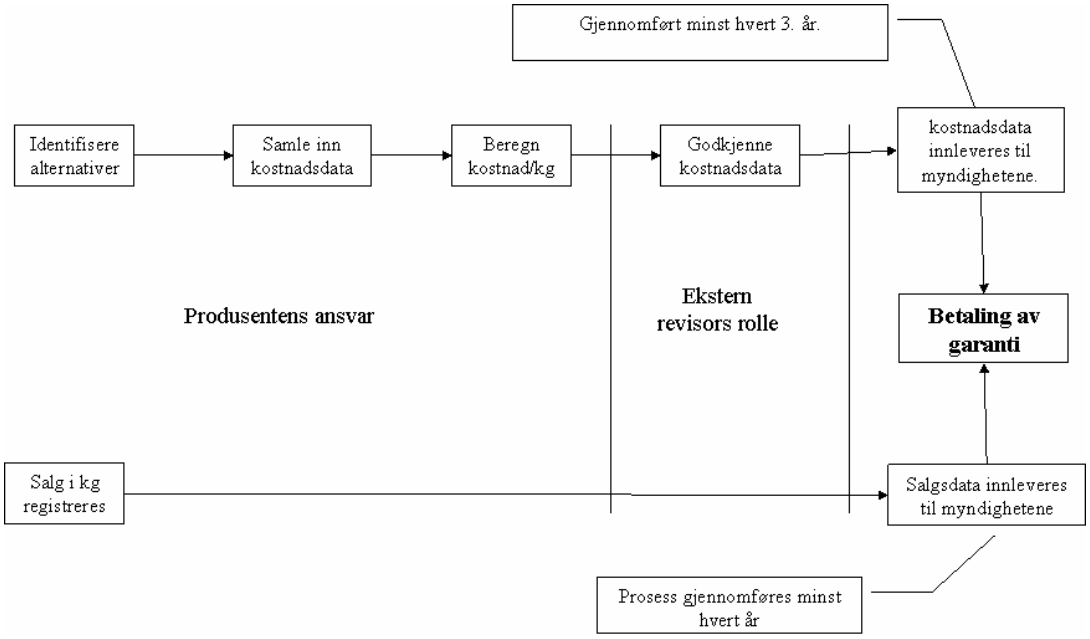
Vi foreslår at produsenten eller importøren minst en gang per år innbetaler en garanti når produkter er lagt ut på markedet, basert på vekt (per kilo) eller enheter solgt, for å dekke fremtidige innsamlings- og behandlingskostnader som oppstår når produktene ender opp som avfall. Når det er dokumentert at produktet enten har blitt innsamlet som avfall og behandlet eller eksportert for gjenbruk bør produsenten få tilbakebetalt garantibeløpet basert på vekten eller antallet av produkter som er tatt hånd om. Etter en viss overgangsperiode for en oppbygging av fondet kan innbetaling og tilbakebetaling basert på løpende salg og løpende behandling foregå.

Produktene er ikke direkte bundet til den senere behandlingen av det samme produktet som avfall. Det betyr at når en produsent blir tilbakebetalt for håndteringen av et gitt produkt vil det ikke være kjent når produktet ble lagt ut på markedet eller hvor mye som i sin tid ble innbetalt i garanti. Ved å gjøre tilbakebetalingen avhengig av reell mengde innsamlet og behandlet WEEE bidrar modellen til gode insentiver for å oppnå høye innsamlingsrater. I tillegg eliminerer modellstrukturen nødvendigheten av detaljerte levetidsdata for produktene, men krever at behandlingen av WEEE er registrert og rapportert til myndighetene (se Figur A).

Alle relevante alternative kostnader bør være dekket av garantiinnbetalingen

Garantien bør være stor nok til å dekke kostnadene ved innsamling, transport, behandling og administrasjon av den individuelle produsentens WEEE i tilfelle det individuelle systemet bryter sammen. Derfor er det kostnadene til det beste alternative behandlingssystemet som bør legges til grunn for innbetalingen til det individuelle garantifondet. Når kollektive systemer for innsamling, transport og behandling av WEEE eksisterer (som i Norge og Sverige), eller et mulig forsikringsprodukt er tilgjengelig, kan prisene i disse systemene brukes som basis for beregningen av garanti-innbetalingen. Når slike systemer ikke eksisterer eller bare delvis finnes vil det være nødvendig å estimere kostnadene ved å nytte ulike kilder. Når de forventede kostnadene for samfunnet avviker fra de individuelle kostnader bør en justering av de individuelle data gjennomføres. Ansvaret for identifisering av alternative systemer og innsamling av relevante kostnadsdata bør i størst mulig grad plasseres hos produsentene. Alle kostnadsdata bør godkjennes av en ekstern revisor.

Figur A Beregning av innbetalingen for hvert produkt



Innbetalingen til fondet bør baseres på kostnadsnivået når produktene legges ut på markedet. Siden de fremtidige behandlingskostnadene samt levetiden av ulike produkter er usikker bør kostnadsbasis justeres over tid når ny informasjon oppnås. Slike justeringer bør gjennomføres minst hvert 3. år, og helst årlig.

Avkastningen av fondet bør tilbakebetales…

Fondet bør plasseres på en sperret bankkonto eller tilsvarende for å beskytte kapitalen fra potensiell konkurs. Dersom avkastningen aldri blir tilbakebetalt vil balansen av fondet bli høyere enn nødvendig, noe som betyr en unødvendig kostnad for produsentene. Det er derfor rimelig at avkastningen tilbakebetales til produsenten på årlig basis.

… det samme bør akkumulasjon som følge av innsamlingsgrader mindre en 100 prosent

Innsamlingsgraden vil i de fleste tilfeller være mindre enn 100 prosent. For eksempel vil rater som sannsynligvis vil oppfylle EU-målet på 4 kg per person innsamlet (estimert til 30 prosent innsamling av det som er lagt ut på markedet i Norge) forårsake en betydelig og unødvendig akkumulering av kapital i fondet. Det er derfor foreslått at en periodisk justeringsmekanisme blir brukt for å hindre en slik kostbar akkumulering. Denne mekanismen kan også bli brukt for å redusere risikoen i forbindelse med en økning av behandlingskostnadene over tid.

Verdien av skrapmaterialet kan eventuelt inkluderes i beregningsgrunnlaget

For noen produkter kan verdien til skrapmaterialet, for eksempel fra salg av metall som er gjenvunnet fra WEEE, være betydelig. Derfor kan utelatelse av denne verdien fra beregningen av garantibeløpet utgjøre en betydelig kostnad for produsentene og resultere i en unødvendig oppbygging av kapital i fondet. På den andre siden viser en case-studie i rapporten at å inkludere verdien av skrapmaterialet i beregningen kan resultere i en økt risiko for at fondet ikke vil dekke de fulle kostnadene for utestående WEEE over tid som følge av svinginger i skrapmateriellpriser og valutakurser. Behandlingen av verdien av skrapmaterialet i garantiberegningene bør derfor avgjøres i det enkelte tilfellet basert på tilgjengeligheten av kostnadsdata med og uten verdien av skrapmaterialet, risikoen for store fluktuasjoner i innbetalingene og for at fondet ikke vil bli i stand til å dekke nødvendige forpliktelser samt risikoen for å bygge opp store mengder ”sovende” kapital.

En fleksibel modell for å dekke fremtidig finansielt ansvar

Basert på en grundig analyse og to casestudier er det vår konklusjon at den foreslåtte modellen er fleksibel nok for å dekke fremtidig finansielt ansvar for produsentene og skape insentiver for å sikre høye innsamlingsrater over tid. Selv om behandlings-kostnadene har sunket i den korte tiden de kollektive systemene i Norge og Sverige har eksistert (henholdsvis siden 1999 og 2000), er det mulig at kostnadsnivået vil øke i fremtiden blant annet som konsekvens av nye miljøkrav. Justering av grunnlaget for beregningene av garantbeløpet bør gjennomføres når ny informasjon om kostnadene fremkommer. Videre kan akkumulasjonen av kapital i fondet som følge av innsamlings-rater mindre enn 100 prosent bidra til å redusere risikoen for ikke å kunne dekke en økning i fremtidige kostnader samtidig som en minimerer mengden av ”sovende” (og kostbar) kapital i fondet.

1 Introduction

1.1 Background

Waste electrical and electronic equipment (WEEE) has increased dramatically over recent years within the European Economic Area (EEA). Much of this waste is potentially damaging for humans and the environment if not collected and treated in a sound manner. Following the principle that the polluter pays, EU-directive 2002/96 (the directive), ratified on February 13, 2003, aims to "reduce WEEE, while encouraging the reuse and recycling of EE equipment, and improving the environmental performance of all operators involved in the life cycle of EE equipment." In particular the directive places full financial responsibility of the management of WEEE on producers and importers, and aims to protect consumers from the risk that a producer exits the market without fulfilling these financial obligations. To this end, the directive calls for a financial guarantee provided by producers at the time that EE products are placed on the market, thus protecting consumers from the financial burden of managing the waste, which will eventually result from these products.

Member states and producers are currently attempting to interpret, as well as influence, that which constitutes such a financial guarantee. Some have argued that a financially sound independent treatment company, owned by producers, provides a sufficient guarantee that the collection and treatment of WEEE will be financed in the event that one of the member producers enters bankruptcy. Others have argued, for competitive reasons, that *every* producer should be required to provide an individual guarantee for its production, allowing producers to enter and exit collective systems. At a minimum, producers choosing an individual system must be required to provide a financial guarantee when the products are placed on the market, if the requirements of the EU directive are to be met. Thus, according to the EU directive, member states must have in place a framework for an individual financial guarantee for those producers who choose an individual treatment system, and potentially those participating in collective systems, depending on the interpretation of the EU directive. This report thus aims at providing guidance in establishing this framework.

1.2 Scope of the Report

In preparation for the directive's implementation, the Nordic Council of Ministers has asked ECON to formulate a method for calculating produ-

cer contributions as a financial guarantee that would cover the collection and treatment of WEEE, as provided for in article 8 in the EU directive. The calculation method is to have the following fundamental properties:

- It is to provide both authorities and producers in the various member states with guidance in this calculation.
- It is to be specific enough for a straightforward implementation but general enough to be applied to member states with differing capacities and regulations.
- It is to ensure compliance with the directive for an indefinite period of time in the future.

It is first and foremost the objectives, requirements and responsibility distribution (outlined below) put forward by the EU directive that our model aims to fulfil. Within this framework, it is our aim to formulate a model which 1) is simple to implement by both authorities and producers, and 2) allows producers and importers the greatest possible flexibility so that the objectives and requirements of the directive can be met in the most efficient manner possible. Below, we highlight the aspects of the directive that are of particular relevance for the formulation of individual financial guarantees.

1.3 The WEEE Directive

EU-directive 2002/96, which is to be implemented by all countries within the EEA by August 13, 2005, dictates that producers and importers of electric and electronic (EE) products are responsible for the collection, treatment and environmentally sound disposal of WEEE resulting from their consumer products deposited at collection facilities. The directive allows for both collective and individual solutions for fulfilling this responsibility. In addition to financing issues, the directive provides guidance on rules governing the recovery, treatment, information disclosure and reporting, and inspection and monitoring.

The directive implies varying degrees of change for individual states. Both Sweden and Norway, for example, implemented collective schemes in 2001 and 1999, respectively, thus already placing these financial responsibilities on producers. In fulfilling the requirements of the EU directive, however, Nordic countries must also provide for the possibility that producers choose an individual system. Irrespective of the design of the financing scheme, producers are to “provide a guarantee when placing a product on the market showing that the management of all WEEE will be financed.” This guarantee is to ensure that society does not assume the financial burden of the WEEE resulting from the outstanding products of a producer, which enters bankruptcy. Thus, in the event that a producer

chooses an individual system, the producer must provide an individual financial guarantee covering its own products.

The directive notes that "[b]asic principles with regard to the financing of WEEE management have to be set at Community level." It stipulates only that appropriate financing schemes are to contribute to high collection rates and the implementation of producer responsibility. Thus, either a collective or an individual financing scheme can be chosen. Particular aspects of the directive which must be considered in the design of any individual financing scheme is outlined in the following sections.

1.4 National Legislation and Scope

The directive calls on member states to ensure that, by August 13, 2005, "producers provide at least for the financing of the collection, treatment, recovery and environmentally sound disposal of WEEE from private households deposited at collection facilities", allowing for producers/importers or third parties acting on their behalf to fulfil these responsibilities. The directive dictates that national legislation is to ensure that all producers and importers, including those importing through distance selling are included in the scope of the eventual financing scheme. To be sure, producer is defined as "anyone who places a product on the EU market for the first time." Though this definition encompasses both producers and importers, we simply use the term 'producers' in the remainder of this report.

The directive also sets targets for WEEE recovery and holds member states responsible for the creation of a register of producers and the collection of information pertaining to quantities and categories of EE equipment produced and collected as waste.

While the financing of each step in the management of WEEE is to be provided by producers, the directive states that "the producer should be able to choose to fulfil this obligation either individually or by joining a collective scheme." It is then expected that producers will choose the most efficient and least costly option for fulfilling the requirements set forth by the directive. Thus, state legislation is to provide for both possibilities.

While the directive applies to nearly all EE products,[1] it mandates a financial guarantee, provided by producers, which cover consumer (private) products only. Finally, producers are able to choose from a range of financial instruments when providing for this guarantee, including blocked bank accounts or insurance schemes. We do not provide specific recommendations to this end, but simply observe that given the nature of

[1]See Annex 1B of the directive.

guarantee, the instrument should allow for an easy flow of capital in and out of the fund.

1.5 Producer Responsibilities

The producer is responsible for the financing of the collection and disposal of all historical and future waste, and providing necessary documentation. This obligation can be fulfilled by the producers themselves or by third parties acting on their behalf.

- **Historical Waste** (products sold *before* August 13, 2005). The responsibility of the management of historical waste is to be shared by all existing producers, each contributing proportionately to a collective financing scheme *at the time the cost arises*. Note that this report does not address the calculation of this contribution.
- **Future Waste** (products sold *after* August 13, 2005). Individual producers are to provide financial guarantees for its products *at the time it places these products on the market* (i.e. the principle of individual producer responsibility). This guarantee is to ensure that future financing liabilities of a given producer are covered in the event that it goes out of business. Individual guarantees can take the form of participation in appropriate schemes, recycling insurance or a blocked bank account.
- **Documentation.** The directive (Article 12) calls on Member states to collect information from producers regarding the quantities and categories of electrical and electronic equipment put on their market, collected, recovered and exported. In order to ensure individual producer responsibility, the directive calls for producers to clearly mark their products. Member states are then subject to various reporting requirements established by the Commission. (See Article 12)

1.6 Methodology

There is little precedent in establishing an individual financial guarantee of the sort presented in this report. Furthermore, though the directive is specific on many of the issues already outlined, there remain some ambiguities with regards to the establishment of an individual guarantee system. Thus, careful analysis and numerous consultations with various potential stakeholders have contributed to the recommendations provided in this report. In particular, close cooperation with the client, the WEEE Group of the Nordic Council of Ministers has been maintained throughout the process.

As a result of this analysis and consultation process, the report establishes a method for calculating producer contributions, and specific recommendations as to the implementation of the individual guarantee system. In order to test the robustness of the calculation method, we have conducted 2 case studies and a series of sensitivity analyses, based on limited data and a set of plausible assumptions. Though the lack of historical data has been constraining, our evaluation is that the assumptions made in extrapolating the data suffice in determining the models robustness.

1.7 Structure of Report

In the following chapter, the principles, which should guide any model eventually chosen for the guarantee system are presented. These principles are based first on compliance with the EU directive, and second, on minimizing the burden on producers and administrators. In Chapter 3, discuss the important issue of determining producer contributions to the guarantee fund are discussed and recommendations are given. In Chapter 4, discuss two potential models differentiated by the reimbursement triggers are broadly discussed - highlighting the strengths and weaknesses of both - and our recommendation is provided. In Chapter 5, the robustness of the recommended model and calculation method is tested with two case studies and a series of sensitivity analyses and our conclusions are provided. Finally, the basic case study data and assumptions are presented in Annexes I and II.

2 Guiding Principles

Any guarantee system which fulfils the requirements of the EU directive will provide for a sufficient guarantee to cover the future treatment liabilities implied by outstanding products at all times. However, once this requirement is met, an efficient guarantee system should place as little financial burden as possible on producers. In addition, the model should look to minimize documentation and administrative costs for both state authorities as well as producers. Thus, the overriding guiding principle of the guarantee system can be defined as: *minimizing the burden on producers, subject to the fulfilment of the EU directive while avoiding administrative costs.*

In Chapter 5, we revisit the principles outlined in this chapter when we test the robustness of the model with two case studies and a series of sensitivity analyses.

2.1 Fulfilling the EU Directive

In fulfilling the EU directive, the guarantee system must:

1. Have enough capital at all times to cover the future liabilities implied by the outstanding products of the producer.
2. Provide incentives for reduced WEEE and high collection rates
3. Avoid free-riders

The first condition is critical for compliance with the directive, which requires an initial build up of the guarantee fund. This is due to the fact that most of these products are used for many years, and their existence implies a future treatment liability. However, these future liabilities will depend on the collection and treatment cost per kg (or unit), which has many components and can only be estimated. In order to resolve this uncertainty, it has been determined that the fund should be able to cover future liabilities implied by the *current costs* of collection and treatment. [2] Thus, the guiding principle for the model should be that:

[2]See Guiding Principle 5 for argument for using current costs.

Guiding Principle 1

> There should be enough capital in the fund *at all times* to cover the future WEEE liabilities implied by the producers' currently outstanding products at current costs. [3]

One of the primary aims of the EU directive is to instil incentives for reduced WEEE and the environmentally sound disposal of a significant portion of WEEE. Indeed, by placing the financial burden of WEEE treatment on producers, the directive goes a long way in providing for this aim. It is particularly relevant for the guarantee system when determining how to manage non-collected WEEE. One hundred percent collection rates are unrealistic, yet producers are expected to provide a guarantee for all products placed on the market. In addition, producers cannot be expected to have control over the final disposal of their products by consumers.

Guiding Principle 2

> While the system should look to minimize the burden on producers, it should look to avoid any perverse incentives leading to 'too much' WEEE or 'too little' collection and treatment.

Many producers consider free riders a major problem in collective systems, and cite this issue as the primary reason for considering an individual system. Technically, the producer registry mandated by the directive is to address this issue. Once the directive takes force, however, the free-rider problem will likely continue to be an issue with regard to the treatment of historical waste and on-going collective systems. In addition, in the event that collective systems run parallel to individual systems, a new type of free-rider problem could surface – one where the collective system is collecting the waste of producers who technically run their own treatment systems.

Regarding the guarantee fund, (at least) two issues thus need to be addressed;

- Should all producers be required to set aside an individual financial guarantee, or should the requirement only apply to those choosing an individual treatment solution? and;
- With respect to an individual system, how should the payback of the guarantee deal with waste treated by a collective system?

[3] In later chapters we discuss methods for minimizing the amount in the fund, while conforming to this guiding principle.

The former is an issue of great importance but outside the mandate of this report. The latter issue, on the other hand, is an issue taken up in section 5.3.

2.2 Minimizing the burden on producers

Within the framework of the EU directive outlined above, the guarantee system should look to minimize the costs to producers while maximizing flexibility. Particularly relevant to the latter is producer's ability to enter and exit collective (individual) treatment systems. Thus, the primary issue regarding flexibility is identifying which producers will be required to establish an individual guarantee.[4] And, as mentioned above, this issue is outside the scope of this report. Minimizing the cost of the fund on producers, however, is of utmost importance for the design of the guarantee system.

The capital, which is set aside as a guarantee, in many cases will be substantial. This 'dormant' capital will represent a significant cost for producers and likely lead to increased prices for consumers. As will become apparent in later chapters, there is a real risk that the guarantee fund will experience a costly and inefficient perpetual build up. If not properly addressed, this possibility would likely lead to either a very costly system or the exclusion of an individual systems as a viable option all together.

Guiding Principle 3

> Subject to Guiding Principle 1, the accumulation of capital over time should be minimized.

2.3 What matters: Alternative costs

The purpose of the individual guarantee is to ensure that authorities do not assume the financial liabilities of WEEE in the event that a producer exits the market. That is to say, the guarantee provided should be sufficient to cover the costs of the collection, transportation and treatment of the individual producers WEEE in the event that the individual system breaks down. In this event, it should be assumed that an alternative system (existing or not) would have to be used. Thus, it is the price of this alternative, which should guide authorities in determining the cost base for individual guarantee contributions.

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[4]As noted previously this will depend on the relevant authorities interpretation of the directive. In particular, it will depend on whether or not *all* producers/importers will be required to provide an individual guarantee.

When might the costs of the alternative differ from those of the individual system? It is intuitive that a producer will likely choose an individual system because he believes that his WEEE can be managed at less cost than the alternative. Viewed in this respect, it could be reasonably expected that the alternative costs will be at least as high as those of the individual system. In particular, if there is no domestic capacity for treating a certain class of WEEE, the cost of the alternative system could be significantly higher than the costs of the individual system.

Guiding Principle 4

> Whenever possible, it is recommended that the costs of alternative collection and treatment system(s) be utilized as the cost base in determining the producers contribution to the fund. When these costs are unavailable, the costs of the individual system should form the point of departure, but should be adjusted to reflect the likely higher costs for authorities.

Further, it is recommended that the burden of identifying alternative systems and collecting relevant cost data should be placed on producers, to the greatest degree possible.

2.4 Some time aspects

In this section, we identify two important time considerations to be made with respect to establishing a guarantee;

- uncertainty considerations, and
- the short- vs. long-term evolution of the guarantee fund

First, the model must address the uncertainty, which accompanies a guarantee system where payments made today are to protect against financial liabilities tomorrow, which could deviate from expectations. Thus, in a world of perfect foresight the guarantee provided today would be based on the treatment costs foreseen at the date of the products disposal. However, there are two sources of uncertainty, which cannot be perfectly foreseen: the development of treatment costs and the lifespan of the product.

In Sweden and Norway at least, treatment costs (pr. kg) have steadily declined over much of the life of their respective collective systems. However, in calculating a guarantee contribution, it would be unreasonable to assume that this trend will continue. In particular, such an assumption would expose authorities and consumers to a higher risk that they will be forced to assume some of the liabilities of future WEEE.

With this background, the cost base of calculating the producer's contribution should follow:

Guiding Principle 5

> Individual producer contributions to the fund should be based on current costs.

The second time consideration is that the model must allow for an initial build up of the guarantee fund at early stages, while preventing an unnecessary perpetual build of the fund in the long run. Thus, during a period following the initial contributions to the fund, little or no reimbursements should be made. This follows logically from the fact that products, which are guaranteed, will not return as waste for a period of time. This build-up is necessary for fulfilling Guiding Principle 1, which states that the expected future WEEE liabilities must be covered by the current balance of the fund at all points in time.

2.5 Minimizing administrative costs

Regardless of the model, the guarantee system will have a number of documentation requirements. Records of sales, WEEE collected and treated, second-hand products exported and treatment costs are examples of likely documentation required. Furthermore, in some cases, it may be desired that documentation is confirmed by external auditors, as recommended in this report. State authorities will also have documentation and monitoring responsibilities.

Guiding Principle 6

> The administrative costs, for both authorities and producers should be minimized, while ensuring that the requirements of the directive and any other relevant state objectives are met.

Guiding principles 1–6 thus provide the framework for both building the model and testing its sustainability. The case studies and sensitivity analysis, in particular, rely on these principles in testing the robustness of both the calculation method and the recommended pay-back-as-you-go model.

3 Determining Fund Contributions

In this chapter, we provide guidance for determining individual contributions to the fund, under two distinct circumstances:

- there exists at least one clear alternative to the individual system for the collection, transportation and treatment of the WEEE
- there exists no clear alternatives

It is obvious that in the first case, the determination of the contributions to the fund will be a much simpler task. In this chapter we address both possible circumstances. This chapter is intended to be user friendly for authorities, producers and auditors (external parties who confirm producer cost data). In particular, we provide the following:

- The equation, and a description of its components, to be used in determining a producer's contribution in a given year for the placement on the market of a given product.
- Guidance as to the identification and delineation of responsibilities of producers, external auditors and authorities.
- Guidance in determining the cost component of the producer's contribution in a set of 4 potential scenarios
- A checklist to be utilized by the producer and external auditor for determining the completeness of the producer's contribution determination

3.1 Determining the Contribution

Based on consultations with relevant stakeholders, the contribution of a given producer to the individual guarantee in a given year resulting from the placement on the market of a given product will be determined by:

Equation 1: Determining producer contribution[5]

$$\textbf{(1)}\quad PC = Sales\left(ColC + TranC + TreatC + AdmC - Vscrap\right)SocC$$

[5]It should be noted that this is a static equation. That is to say that the components of the equation will need to be updated on a regular basis. In later chapters we make recommendations for these updates.

The variables are described in Table 3.1. This equation can accommodate two approaches;

- **The weight of sales (in kilograms) is used to determine producer contributions.** In this case, each cost component will reflect costs per kg. There appears to be a consensus in the industry that the most important determinant for the costs of handling WEEE when it comes to volume is the weight (measured in kg.*). Further, the directive states that this approach should be applied where possible. Thus, it is recommended that this is the approach used.*
- **The number of units sold is used to determine producer contributions.** Both collective systems in Sweden and Norway quote prices in per unit cost. Authorities may wish to allow producers to choose between a weight-based vs. unit-based calculation, so long as documentation is provided (see below).

Table 3.1 Components of producer contribution

Variable	Abbr.	Description
Producer Contribution	PC	Dependent variable. Total contribution of producer or importer for a given product in a given period.
Sales	Sales	As noted above, this will either be sales in kilograms or number of units. The cost base will then follow accordingly.
Collection Costs*	ColC	The cost of receiving the WEEE of the given product from end users.
Transportation Costs*	TranC	The cost of transportation of the WEEE of the given product, including before and after treatment.
Treatment Costs*	TreatC	The cost of treating the WEEE of the given product in an environmentally sound manner
Administration Costs*	AdmC	Any additional administration costs, not included in other cost components.[6]
Value of Scrap Material**	VScrap	Where authorities determine it necessary, this value may be set to zero, no matter the actual value.
Cost to Society adjustment	SocC	In the event that the expected cost to society differs from the costs of the individual system, an adjustment will have to be made to this cost data. If, for example, there is, in fact, no difference between these costs, then SocC = 1. And if the expected society costs is higher than individual costs, SocC > 1.

* All costs are to be based on current costs (at the time of contribution) and expressed either per kilogram or per unit.

** VScrap should also be expressed either per kilogram of per unit placed on the market.

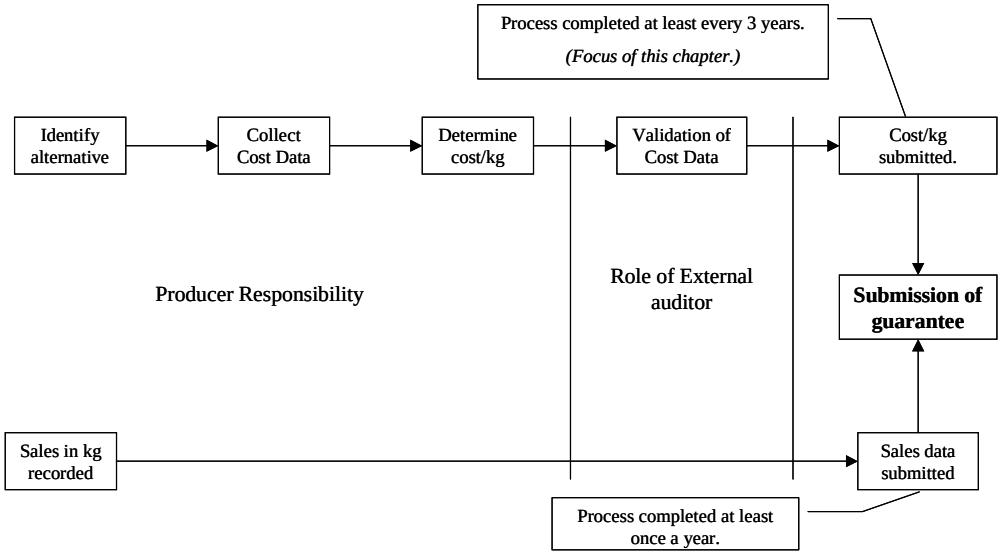
Thus, the total contribution to the guarantee fund of a given producer/importer, in a given period would equal the simple summation of Equation 1 over all categories products placed on the market.

[6]Note that in addition to this administrative cost component, one party will be responsible for paying for an external auditor (see next section) to verify cost data. In particular, we recommend that producers bear this cost.

3.2 Responsibilities

In the process of determining producer contributions to the guarantee fund, the variables identified above must be determined, confirmed and the contribution calculated and submitted, following the process depicted by Figure 3.1:

Figure 3.1 Determining the contribution for each product



It is the potential costs to society that would result from the collapse of an individual system that should determine producer contributions. Thus, the producer, an external auditor or the authorities must identify both the best alternative, as well as the relevant costs. In particular, the degree to which this burden is placed on producers must be a strategic decision. It is recommended here that producers bear as much of this burden as possible. However, in the next section, we allow for 4 potential scenarios, which provide for a range of potential responsibility distributions.

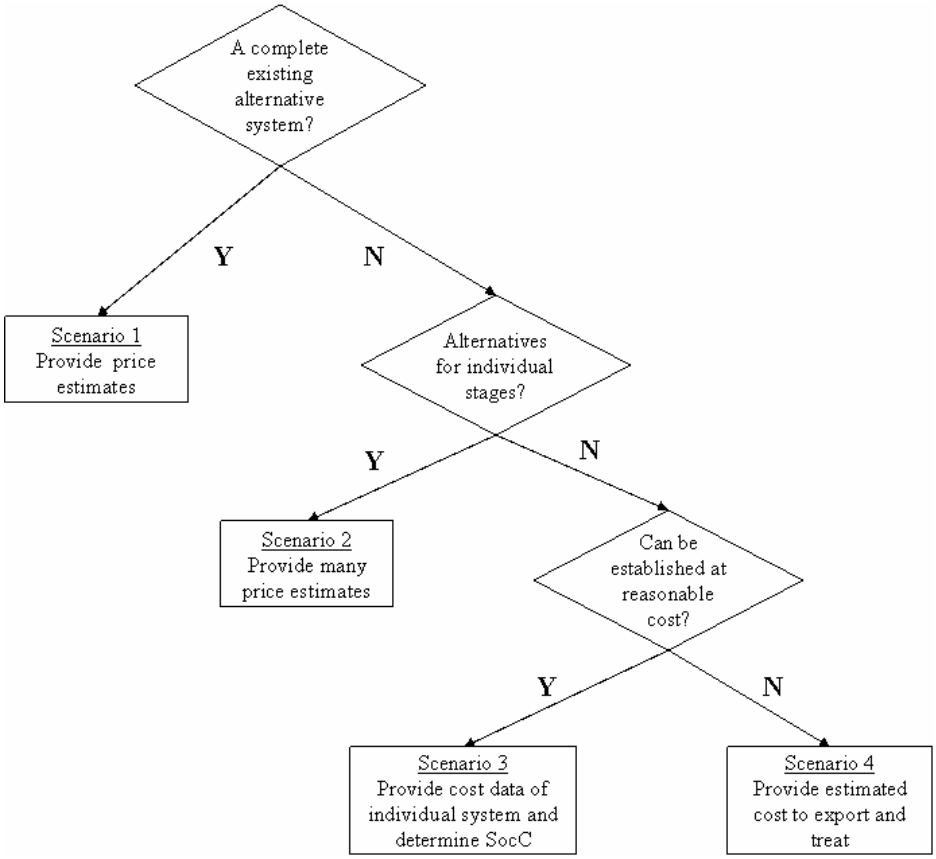
In the process illustrated by Figure 3.1, it is recommended that each contribution to the guarantee fund be accompanied by the submission of sales data. Cost data, on the other hand, could be submitted less often. This conforms to the difficulties associated with determining the relevant costs. Nonetheless, it is recommended in section 5.3 that cost adjustments be made on a regular basis. The next section takes up the issue of determining the cost components of Equation 1 under various scenarios.

3.3 Sources for Cost Data

As already noted, we make an important distinction between instances where there exists an obvious alternative to the individual system for the

management of a class of WEEE and one where there exists no obvious alternative. This distinction implies important differences in the process of gathering necessary cost data for determining the producer guarantee contribution. This section, thus, addresses both possibilities, following the decision tree in Figure 3.2.

Figure 3.2 Determining the source of cost data



The boxes in Figure 3.2 represent the entire set of scenarios, each characterized by different data sources and the need for different guarantee calculation techniques. Which scenario prevails will depend on three factors:

- the class of WEEE resulting from a given product,
- the domestic capacity to treat this class of WEEE, and
- the responsibility distribution regarding the burden of identifying alternatives and obtaining cost data.

Below, we first address scenarios 1 and 2, where alternative costs should be readily available for calculating guarantee contributions. We then allow for the possibility that these costs are not readily available; when scenarios 3 and/or 4 prevail for at least one of the stages of the management of a class of WEEE. In Table 3.2 we provide a summary of the scenarios along with the corresponding responsibilities.

Finally, in Table 3.3, we provide a checklist for the documentation that should be submitted to external auditors for validation of the cost data that will form the basis for the guarantee contribution.

3.3.1 Existing alternative(s)

Scenario 1

In both Sweden and Norway, collective systems for collecting, transportation and treatment of WEEE have been in place since 2001 and 1999, respectively. In these and potentially other Nordic countries, the complete management of many classes of WEEE can be carried out by *one* system. So long as these systems continue to operate, obtaining a cost estimation for an alternative to an individual system will be comparatively straightforward. In addition, insurance products may emerge which provide a guarantee for the management of WEEE[7], thus also making this scenario possible.

Thus in EU member states where such systems are in place, it should be possible to obtain price estimates, which include all relevant costs. Further, because this is the alternative available to authorities in the event that the producer exits the market, no adjustment factor (SocC) is needed. This estimate should provide separate data as to the expected value of scrap material (an issue taken up in section 5.4). Lastly, the role of the external auditor should be to ensure that the alternative system is indeed a viable alternative for the given class of WEEE and that the entire management process is accounted for in the alternative system.

Scenario 2

In other instances, one system, which can carry out the entire process, may not be an alternative. However, there may exist alternatives for each individual stage of the WEEE management process (e.g. collection, transportation and treatment). In this case, the alternatives and the corresponding costs of each stage will have to be identified by either producers or authorities.

As in scenario 1, these costs will represent more or less the alternative cost to authorities. However, in this case, the administration costs of ensuring the complete management of the WEEE could be significant. Thus an adjustment may be needed to the variable SocC. Here, the external auditors will play a more important role in ensuring that all stages are accounted for (See Table 3.2).

[7]These insurance products could provide insurance for the future management WEEE in the event that a producer exits the industry, functioning much like the model discussed in this report. In addition, insurance products could protect against cost increases (see section 5.3).

It should be noted that it is possible that scenario 2 prevails for some of the stages (e.g. collection and transportation), while either scenario 3 or 4 prevails for other stages (e.g. treatment).

3.3.2 No existing alternative

Scenario 3

Regarding this scenario, member states have a strategic decision to make as to the burden to be placed on producers in identifying alternative WEEE management systems. If it is determined that producers should *not* bear this burden, one could expect scenario 3 to dominate and contributions will be based on the costs of the individual system, plus an adjustment to reflect the cost of the alternative. Put simply, if producers are not required to identify an alternative system, they will likely not do so, and will simply submit cost data. If, on the other hand, producers are *required* to identify an alternative system(s) and the corresponding cost, scenario 3 would necessarily be eliminated as a possibility. In this case, a producer would not be allowed to place a product on the market unless it identified a method of managing the resulting WEEE. This report allows for both alternatives.

In the event that no alternative is readily available for at least one of the stages of the management process, the costs associated with building up such capacity must be determined and SocC be set accordingly. Again, whether the producer or the authorities are to provide for this estimate, is a strategic question to be addressed by authorities.

Irrespective of the strategic decisions named above, scenario 3 implies that contributions should be based on the costs of the individual system but should allow for the additional cost of the capacity building that would be required in the event of the collapse of the individual system.

Scenario 4

In some cases, the most cost effective solution may be to export a class of WEEE for treatment. In this case, the relevant alternative cost will include the cost of exporting, in addition to the other standard costs, but should be accounted for by the cost components identified in Table 3.1. In the event that no domestic capacity for treatment of a class of WEEE exists, it will likely be possible to export the WEEE.

Therefore, in the event that producers are *required* to provide for the costs of an alternative system, the cost of exporting could be used when the producer is unable to identify an alternative satisfactory solution. If such a requirement is not made, on the other hand, this alternative could be used to determine the SocC adjustment.

Table 3.2 Summary of scenarios and responsibilities

	Description	Relevant Costs	Producer Responsibility	Role of external auditor
Scenario 1	There exists a readily available alternative system for the *complete* management of the class of WEEE.	The costs of the alternative system. Should separate scrap value if possible.	Provide written price estimate from alternative system.	Limited. Confirm that entire management of WEEE is properly accounted for.
Scenario 2	Alternatives are readily availability for the *individual stages* of the management of the class of WEEE.	The costs of the alternative systems. Should separate scrap value if possible.	Provide written estimates from alternative systems.	Confirm that the *entire* management of WEEE is properly accounted for and prices estimates are valid.
Scenario 3	No alternative exists (at least not identified by producer) for one or more of the stages, but could be established at reasonable cost.	The costs of the individual system plus an adjustment (SocC > 1).	Provision of (estimated) cost data of individual system. Broken into components identified in Equation 1.	Confirm validity of cost data. Estimate adjustment needed to reflect capacity building needed, if this estimate is not required of the producer.
Scenario 4	Exporting WEEE is best available alternative.	All standard costs plus exporting costs. Treatment costs should reflect those of foreign providers. AdmC reflect additional documentation requirements.	Provide relevant cost categories, particularly costs pertaining to export.	Ensure that all stages are accounted for and costs are valid. Ensure that exportation is viable.

3.3.3 Classifying products

One final data consideration is the division of WEEE classes when determining costs. When determining costs it will be necessary to delineate between classes, and thus grouping products with similar WEEE together, awarding them the same cost value. Thus, when determining the number of classes there is a trade-off to be made: accuracy of cost data v. administrative costs. Ideally, the cost data would be as accurate as possible, thus necessitating a large number of groups. However, in practice collecting and obtaining detailed cost data would likely prove costly and time-consuming, if not impossible.

Again, this issue becomes particularly troublesome when there is no existing capacity for treating a given class of WEEE. In this case, each individual producer may look to provide its own classification system. However, it is our determination that this does not pose such a significant challenge. As long as auditors can verify that the given class of WEEE will be properly treated at the cost provided, a lack of a defined classification system will not have much significance. In particular, we strongly recommend auditors to utilise and compare cost data from existing collective systems in Norway and Sweden (also in the Netherlands and Britain). Comparisons between like products in the same member state could also serve as a tool in evaluating the cost data. The classification system provided in the EU directive could assist with this comparison.[8]

[8]See Annex 1B of the directive.

It has thus been our determination that costs do not vary so widely so as to justify the creation of a nationwide product classification system pertaining to WEEE.

3.4 Validation Checklist

Before submitting the final cost/kg of the collection and treatment of a given product to authorities, producers should be required to have their cost estimates confirmed by an external auditor. The auditors should ensure that the reported cost per kg (or unit) would provide for the complete management of the WEEE resulting from the product, in an environmentally sound manner should the individual system collapse.Table 3.3 provides for the documents to be submitted by producers, along with the minimum requirements of these documents. Once validated, the cost component should be submitted to the relevant authorities and serve as the cost basis for the calculation of the guarantee contribution. In subsequent periods, sales data will be combined with the cost data to determine Equation 1 (the producer's contribution).

Table 3.3 Document checklist for validation of cost data

Document	Purpose	Minimum Requirements[9]
WEEE Management Cycle	Ensure that calculated cost provides for complete management of WEEE.	Total cost/kg of treating the given WEEE should be provided When required, all stages of the *alternative* management of WEEE are accounted for, ***otherwise;*** All stages of the management of WEEE accounted for in the *individual* system Each stage conforms to state regulations and provides for the complete environmentally sound management of the given WEEE
Cost Breakdown	Provide for transparency and simpler evaluation by external auditors.	Total cost divided into the components identified in Table 3.1 Inclusion/exclusion of scrap value such that cost calculation conforms to state regulations
Supporting Documents	Ensures that alternative(s) is in fact realistic for given class of WEEE	Confirmation of availability of collection/transportation/treatment capacity. Confirmation of external price/cost estimates Supporting documents will be particularly important when exporting is the best (only) alternative

3.5 Chapter Summary

This chapter has presented the calculation method for determining producers/importers contributions into the individual guarantee fund. Further, it

[9]These requirements apply to the costs of the identified alternative when required by state regulations. Otherwise requirements refer to costs of individual system.

has allowed for flexibility, with the background that each member state will likely have unique capacity, and rules and regulations. Thus, the process will follow the general time-line (top to bottom):

- **Cost base determination**: This is the process outlined in this chapter. Once this cost base is calculated, confirmed by external auditors and submitted to authorities, it should be used in conjunction with regular sales data to arrive at the relevant contribution. It is recommended in this report that this procedure be completed at least every 3 years, and preferably every year.
- **Sales**: Sales data, in kilograms or number of units, are to be recorded and submitted to authorities on a regular basis. This data is then paired with the cost base which authorities should already have, and the contribution should be calculated.
- **Contribution**: Each time that sales data is reported, a contribution should be made to the individual financial guarantee.
- **Reimbursement**: The trigger, which leads to the producer being reimbursed is the topic of the next chapter, where we present two potential models, for which the primary distinction is the trigger for reimbursement.

In the following chapter, we address the issue of reimbursement, thus completing the cycle of the individual financial guarantee. We then test our model and contribution method in Chapter 5.

4 Guarantee Models: The Basics

In this chapter we identify two alternative models, which could serve our purpose; a lifespan model, and a pay-back-as-you-go (or pay-back-as-you-scrap) model. Below, we briefly present the fundamentals of each model and arrive at the recommendation that the pay-back-as-you-go model suits the issues at hand best. Exactly how the model would function in practice is illustrated by the case studies in the following chapter.

4.1 Lifespan model

The primary difference between the two models identified in this report is the trigger, which leads to the producer's reimbursement. In order for deposited capital to serve as a guarantee, it should, theoretically, be blocked until the WEEE resulting from the product is treated. One approach is to estimate the life span of the product and once that life span has passed, the capital would be reimbursed. A lifespan approach would naturally set the estimate equal to the average lifespan of a given product.

Thus, in this model, the producer's contribution would be made at the time of sale as a function of Equation 1. Once the estimated average lifespan of the product has elapsed, the producer's contribution (plus return and any other adjustments) is reimbursed. Two major weaknesses of the model can be identified:

- **Lack of proper incentives.** One of the primary objectives of the directive is to create incentives for producers to both reduce WEEE and collect and treat as much of its WEEE as possible. This model lacks strong financial incentives to this end. Instead of ensuring that the WEEE is collected and rewarding producers accordingly, this model allows for reimbursement according to a set schedule rather than as a reward for pursuing these objectives.
- **Heterogeneity and data deficiencies.** There are a huge number of diverse EE products, each with its one estimated lifespan. There are also significant differences between product brands. Further, these life spans have proven to change significantly over rather short time periods. These factors would lead to a requirement of large amounts of data, if the data is to be accurate and current. Thus, the data requirements under this model would likely not be as simple as would first appear.

It is our evaluation that the pay-back-as-you-go model, described below, would perform much better on these fronts.

4.2 Pay-back-as-you-go model

This model is distinguished from the 'lifespan model' in that producers are reimbursed according to actual WEEE collected and treated. In addition, in this model, products are not directly tied to the later treatment of its resulting WEEE. That is to say, when a producer is reimbursed for the disposal of a given product, it will not be known when the product was placed on the market nor the contribution made at the time. Here, a transition period allows for a build of the fund, following which producer contributions and reimbursements are made based on current sales and current treatment, respectively.

By making reimbursements subject to actual WEEE collected and treated, this model provides for much more conducive incentives than does the lifespan model. In addition, it eliminates the need for detailed lifespan data. Further, the data requirements of this model conform to the reporting requirements of the directive, as laid out in Article 12. It is concluded that the perverse incentives implied by the lifespan model and these data collection and reporting considerations make the pay-back-as-you-go model the clear choice.

In the next two chapters, we explore some important aspects of this model which are yet to be determined. First, we illustrate these issues through two case studies and sensitivity analyses, and present potential solutions. These issues follow directly from the principles identified in Chapter 2 and include:

- Minimizing the amount of 'dormant' capital in the fund, while providing a sufficient guarantee at all times.
- Distributing the return resulting from capital placed in the guarantee fund.
- Responding to future developments in collection and treatment costs (increasing/decreasing), while basing producer contributions on current costs.
- Preventing the perpetual accumulation of the fund where contributions will be made on 100 percent of sales, while reimbursements will be made on less than 100 percent of the products.
- Accounting for the export of second hand products.
- Managing the variability of the value of scrap material.

5 Case Studies and Sensitivity Analyses

This chapter is divided into two case studies; displays (CRT, LCD, etc.), and; refrigerators. For each case study we conduct a sensitivity analysis in order to illustrate the importance of, and potential solutions to, the issues identified at the end of the previous chapter. Further, these solutions will be evaluated in light of the principles identified in Chapter 2.

The ‘display’ case study is designed so as to address the trade-off between ensuring sufficient capital in the fund while preventing a perpetual and unnecessary accumulation of capital. The ‘refrigerator’ case study, on the other hand, is intended to address the issue of dealing with revenues from sales of scrap material.

Before moving on to the case studies, we provide an overview of the methodology used.

5.1 Scope of Case Studies

The purpose of the case study is to ensure that the payback-as-you-go model and our contribution calculation method are sustainable over time. To this end, the development, over time, of the following variables are followed and/or analysed:

- Producers (annual) contributions to individual guarantee fund
- Reimbursements (annual) to producers following confirmed collection and treatment of WEEE
- Accumulation of capital in individual guarantee fund
- Evolution of the future treatment costs implied by currently outstanding products
- WEEE collection rates
- Price of scrap material

It is particularly the accumulation of capital in the individual guarantee fund that is of interest. In the case studies below, and the subsequent sensitivity analyses, the evolution of this variable is evaluated in light of principles outlined in Chapter 2.

5.2 Case Study Methodology

The purpose of the case studies is to ensure that the payback-as-you-go model and our contribution calculation method are sustainable over time. In order to test this, we rely on the very limited amount of historical data available from the Swedish (for the display case study) and the Norwegian (for the refrigerator case study) collective systems. We then make a range of plausible assumptions in order to extrapolate data points both back in time and forward in time to compensate for the limited data. In particular, we deemed it necessary to provide data for at least the average lifespan of the respective products.

Though the case studies depend largely on assumptions, we view this approach as fitting for the issues at hand. First, the assumptions made in the case studies are designed so as to address the critical aspects of the performance of the model over time. Further, we can identify no other critical aspects of the model not addressed by the set of assumptions. Second, while historical data would provide us with one possible scenario, a sensitivity analysis would still be required in order to prepare for other potential future scenarios. Thus, even if a complete historical case study could be conducted, assumptions would have to be made in order test other potential developments in evaluating the robustness of the model. Finally, whenever possible, we have based assumptions on trends in the data and consultations with actors in the industry.

Thus, we have determined that limiting the number of case studies in order to analyse the consequences, and proper policy responses, of various future scenarios is the best approach for the case studies. Further, we do not view the limited data availability as a major hindrance in drawing relevant conclusions.

Finally, two important notes regarding the interpretation and comparability of the case studies should be made. First, as is noted in the text below, the absolute monetary size of the variables is *not* important for the interpretation.[10] Thus, for illustrative purposes, we have chosen to use Euros in the first case study and Norwegian crowns in the second, which has no implications whatsoever for the interpretations of the case studies nor the recommendations, and should be disregarded for simplicity. Second, as was noted in the presentation of the cost calculation method, Equation 1 can accommodate the use of either the weight of sales or the number of units in its formulation. In accordance with this, the display case study employs kilograms of products placed on the market, while the refrigerator case study employs the number of units (see Annexes I and II).

[10] It should be noted that data provided from the collective systems in Norway and Sweden have been used, and thus the accumulation of this fund represents the products of all members in the collective system. Therefore, the absolute amount in the fund is of little meaning for our analysis.

5.3 Case Study 1: Displays

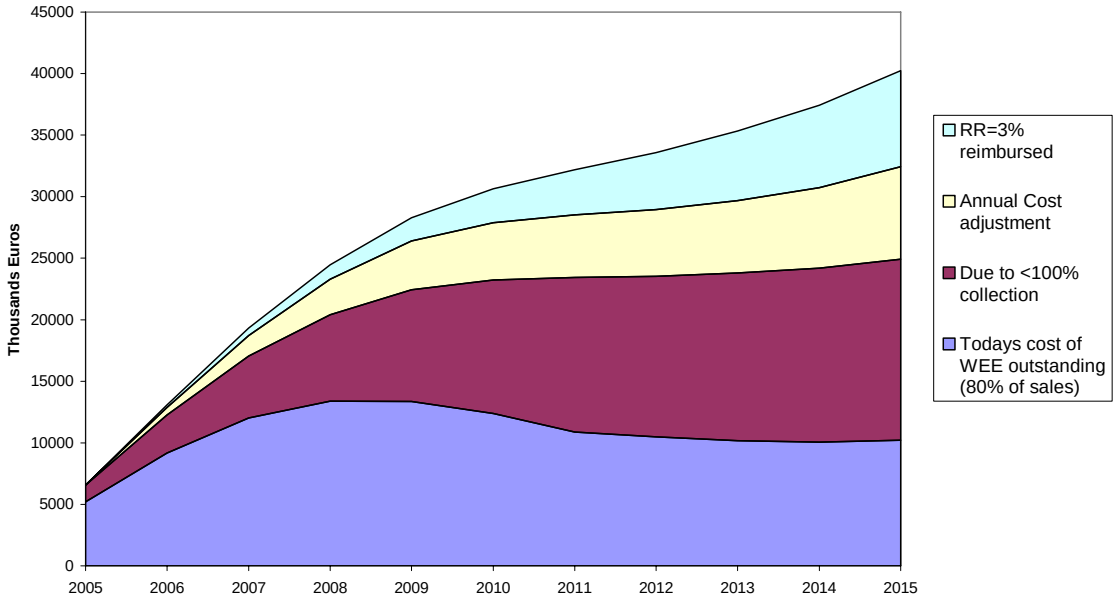
The basic data for this case study and the assumptions are provided in Annex I. As noted above, the two variables of particular interest are i) the accumulation of the guarantee fund and ii) the future WEEE management costs implied by currently outstanding products. This case study, has the following general characteristics/ assumptions:

- Sales of displays fluctuate a bit in the early years, and 5 percent annual growth for the remaining years has been assumed.
- We have assumed, based on the data, that there is a learning curve, and that collection and treatment costs decrease in initial years and remain constant for later years (after 2011).
- We assume a 7-year life-span (in accordance with available data).
- We assume an initial build up of the fund, with a very low collection rate in the early years of the fund. This collection rate climbs steadily until 2011 at which point collection rates are set equal to 80 percent[11] (based on data from Norway).

Based on these assumptions and the data presented in Annex I, we can determine producer contributions and reimbursements, and thus the net contribution to the fund for each year. Accordingly, we can follow the accumulation of the fund over time, which is done in Figure 5.1. In addition, as described below, we are able to identify the important components of the fund's accumulation. In particular we provide an explanation of the components of this accumulation, and provide relevant recommendations in the analysis below. For the remainder of the report we label this initial analysis as the *'base case'*.

[11] In particular, the collection of WEEE in later years is set equal to 80 percent of the products placed on the market 7 years earlier, which is the expected lifespan of the product.

Figure 5.1 Individual Guarantee Fund Accumulation (see explanation of components below)



As noted above, the important aspect here is not the absolute amount of accumulation, but the fact that without any adjustments the fund will perpetually increase, far beyond what is necessary and efficient, thus violating Guiding Principle 3. That is to say, if the assumptions made in Annex I were to hold, and no further adjustments were made to the cost base of producer contributions nor, were periodic adjustments made to producer reimbursements, the balance of the fund would be far greater than needed for providing a full guarantee for the entire period. In order to analyse potential solutions to preventing this unnecessary build up, we identify 4 components of the fund's accumulation: (from bottom to top in the figure):

- The **blue area** represents the *future* financial liabilities implied by *currently* outstanding products at *current* costs. Thus, this area represents the expected financial liabilities that would remain at any point in time if a producer were to exit the market. Thus, this area should be interpreted as the minimum required balance of the fund at every point in time; (Guiding Principle 1).[12]
- The **red area** represents the amount in the fund never reimbursed due to the difference between the contributions for 100 percent of products placed on the market and < 100 percent of products

[12] Technically, this area represents the costs associated with 80 percent of sales. As explained later, this is because 100 percent collection rates are unrealistic, and each country will have its own targets. In Norway, for example, the collection rate was approximately 80 percent.

treated.[13] That is to say, it can be expected that the fund will build up due to contributions determined by 100 percent of products placed on the market, while reimbursements are determined by a proportion less than 100 percent.

- The **yellow area** represents the accumulation in the fund that is a result of falling treatment costs, and a lack of cost adjustment.[14] That is, all else equal, the future liabilities implied by the *current* costs of treating future WEEE are falling while contributions continue to be based on outdated (high) cost estimates. As a result, the fund is increasing at a rate higher than future liabilities.
- The **turquoise area** represents the accumulation of the fund due to return on capital (RR). Each year, the capital in the fund will earn a return, and if not reimbursed, this will lead to an increase in the fund over time.

Another interpretation of the yellow and turquoise areas is that they represent the build up of the fund, which could be prevented by cost adjustments and reimbursement of the return, respectively.

Thus the case study here demonstrates that without adjustment, the fund provides a full guarantee but appears to be heading towards a perpetual build up in the long run. The build up beyond that which is necessary in providing a guarantee is due to: i) less than 100 percent collection rates, ii) decreasing costs and lack of cost adjustments, and iii) a build up of the return earned on the capital in the fund. In the remainder of this case study, we address the issue of minimizing the fund's accumulation, while ensuring its role as a guarantee.

The amount of capital that these components represent, and indeed the sign (+/-), is primarily a result of the assumptions made in Annex I. However, it can be expected that the issues highlighted here will be critical components in ensuring that the principles identified in Chapter 2 are met, in any potential scenario (see sensitivity analysis below). In particular, it is clear that the perpetual accumulation of the fund, which would have resulted from this case, would have been extremely costly for producers, and would have clearly violated Guiding Principle 3.

In Table 5.1, we provide our recommendations regarding the build up of the fund beyond what is required of a guarantee. As the table illustrates, resolving the issues of the return on capital and decreasing costs is a straightforward exercise compared with the issue of < 100 percent collections rates.

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[13] This corresponds then with the fact that authorities cannot expect 100 percent collection rates. Thus, in the current case study, this area is associated with 80 percent collection rates.

[14] Technically, this area represents the amount that could be saved if cost adjustments were made every three years.

Table 5.1 Preventing a perpetual and costly build-up of an individual financial guarantee

Source of 'costly' accumulation	Recommendations
Return on Capital	Return should be reimbursed to producer/importer on, for example, an annual basis.
Cost development	Cost adjustments should be made, at least every 3 years, following the calculation method set out in Chapter 3. This case study, and the sensitivity analysis below, demonstrates the sensitivity of the model to cost changes. The importance of cost adjustment will, arguably, be even more important in the event that costs are increasing, as this puts the role of the fund as a guarantee in jeopardy. (See section 5.3.1)
Less than 100 percent collection rates	In order to prevent this build up, while maintaining proper incentives, it is recommend that a collection target be set for producers, and so long as that target is met[15], the following *periodic adjustment* is made regarding the capital in the fund which represents the WEEE outstanding: In the event of increasing costs, additional funds should be retained in the fund accordingly, thus mitigating authorities' risk of increasing costs. This point is taken up in Section 5.3.1. Authorities may want to consider that a portion of these funds also be released to any collective system (e.g. in Sweden and Norway), because 1) all producers have an obligation to share the responsibility for products not accounted for by an individual producer and 2) it can be expected that these systems will collect and treat some portion of the producers products, even with an individual system. Finally, the remaining capital in the fund resulting from a collection rate between the target (exogenously determined) and 100 percent should be reimbursed to the company through a periodic adjustment to the fund – i.e. periodically adjusting producer reimbursements, which are otherwise determined solely by (costs*WEE treated), up or down accordingly.

While the reimbursement of the return and cost adjustments can be made regularly, correcting for less than 100 percent collection is a bit more troublesome. However, as outlined in the table, the periodic adjustment implied by such a correction could also provide authorities with a risk-mitigating tool. In the remainder of the report, the process outlined in i-iii is labelled as the '*periodic adjustment*' to the fund. In addition, in the sensitivity analysis below, we compare various scenarios with the results of this initial case study (without any adjustment), which we label as the '*base case*'.

5.3.1 Sensitivity Analysis: Preventing perpetual fund accumulation

In the following sensitivity analysis, we test the uncertainties of the model (costs and collection rates), while holding other variables constant. In this section, it is assumed that the recommendations of Table 5.1 are taken up, thus preventing much of the 'unnecessary' build-up presented in the base case. *In particular, we assume that the return on capital is reimbursed and that cost adjustments are made before the analysis of the va-*

[15] This target should be based on the amount of products placed on the market when the WEEE currently being treated was produced. That is to say, the collection target for displays (with a life span of 7 years) in 2008 should be a function of the sales in 2001.

rious scenarios. The guiding principles outlined in Chapter 2 serve as our evaluation tools.

Cost development paths

In the base case outlined above, the data suggested that the costs of managing WEEE decreased during the early years of the system, a trend strengthened by our assumptions.[16] There are many potential risk factors that could lead to the opposite scenario in the future. For example:

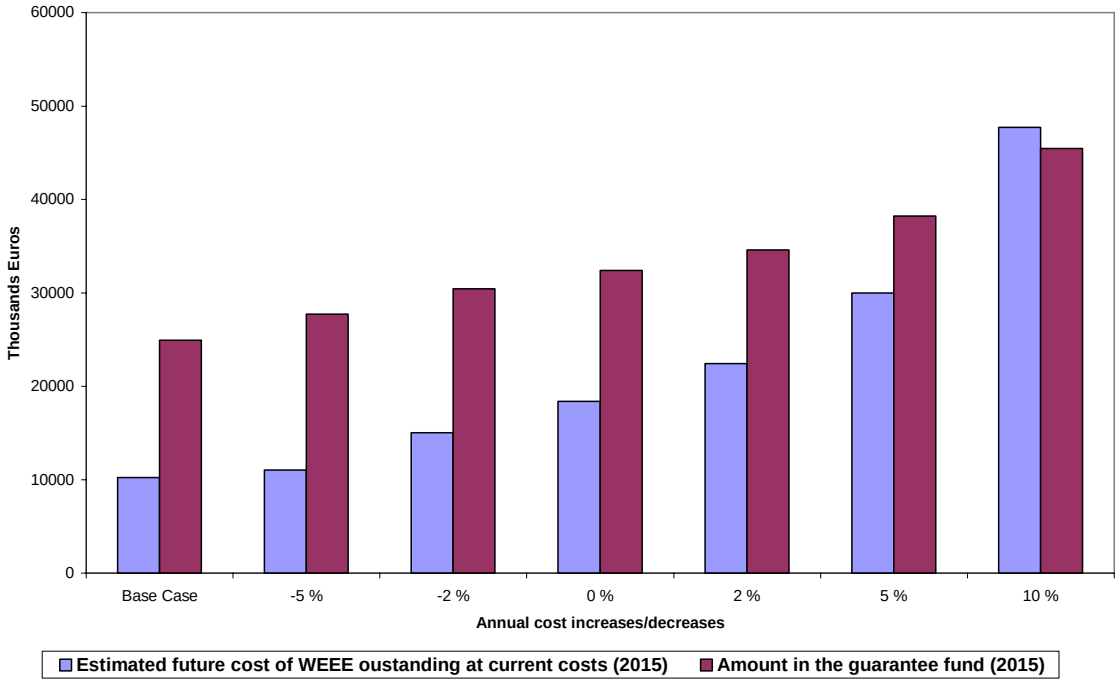
- New laws and regulations could significantly increase the treatment costs of certain classes of products. (This source poses the greatest risk).
- The data which is available show that much of the cost reductions were due to reductions in administration costs, which could be explained by a process of learning by doing. One could expect this effect to disappear over time.
- It is very probable that transportation costs will increase over time.

Figure 5.2 illustrates potential scenarios where collection and treatment costs take various development paths over time. In particular, the figure illustrates the amount of capital in the fund against the WEEE liabilities implied by outstanding products *in the final year of the case study, 2015*. That is to say, it demonstrates the sensitivity of the model in providing a *full* guarantee under various cost development paths.

As noted above, in arriving at the numbers depicted by Figure 5.2 it has been assumed that both the return on capital is reimbursed and cost adjustments are made annually. The figure illustrates the amount in the fund versus expected future liabilities, *before the periodic adjustment is made.* Thus, the figure shows that so long as annual cost increases are less than (approximately) 10 percent, there would be enough in the fund to provide a *full* guarantee and, in most cases, additional funds. Thus, in this case, annual growth rates in costs of less than 10 percent would imply the need for a periodic adjustment, where the producer receives additional reimbursement (seeTable 5.1).

[16]See Annex I.

Figure 5.2 The long-run performance of the model in providing a full guarantee for outstanding WEEE under various cost development scenarios



In order to illustrate the message of the graph, we elaborate on the example of 10 percent annual growth in costs. Imagine that a display is put on the market in 2008. At the time this display is put on the market, the cost/kg stands at 1,08 euros and it is assumed that this cost will hold over the expected life of the display (7 years). Contributions to the fund are made accordingly. However, due to the 10 percent annual growth in costs, the cost of treating this display in 2015 has increased by nearly 95 percent, and those put on the market in 2009 by 76 percent, etc. As a result, in 2015, the future cost implied by outstanding products *at current costs* exceeds the amount of guarantee available in the fund. The opposite will hold when costs decrease, as in the base case. As illustrated by the graph, however, the risk that increasing management costs leads to insufficient capital in the fund is quite low, primarily due to a less than 100 percent collection rate.

A policy option to counter the risk depicted in the example described above would be to determine the periodic adjustment only once changes in costs are determined, thus partially mitigating the risk of fluctuating costs (as recommended in Table 5.1). That is to say, in years that the costs increase, a downward adjustment in the overall reimbursement could be used to compensate, and vice versa. If used effectively, larger reimbursements can be used to offset significant cost decreases while maintaining the correct incentives, thus providing for Guiding Principle 2

and Guiding Principle 3. This is the recommendation provided in Table 5.1

Figure 5.2 demonstrates that by using the periodic adjustments in this manner, the fund maintains adequate capital to provide a full guarantee for outstanding products, at modest cost increases.[17] Very significant cost increases over time, however would lead to insufficient funds to provide for a full guarantee, even with annual cost adjustments. In the case of 10 percent annual increases, there would not be sufficient funds for a full guarantee for outstanding products for the latter 4 years of the 11-year case study. This would violate Guiding Principle 1. Nonetheless, such large increases in costs would be difficult for any guarantee model to properly manage.[18]

Finally, it should be noted that only constant growth rates in costs have been considered in this analysis. However, it may well be the case that there is a shock which causes a spike or severe dip in prices. In this case, the logic presented here will be directly applicable.

Less than 100 percent collection

Figure 5.3 illustrates a similar analysis to that above, where various collection rates are accounted for. It is important to recognise that these rates are only partly under the control of the producer. Further, authorities will also have an important role in achieving higher rates of WEEE.[19] Therefore, it should not be expected that the producer is capable of collecting 100 percent of the WEEE resulting from its products, no matter the incentive scheme. In this analysis, as in the base case, we have assumed that the collection rate is equal to a member state's target. Thus, in order to meet Guiding Principle 1, the guarantee only needs to be enough to ensure the collection and treatment of the relevant percentage of products.

An additional consideration is the issue of second hand exports. These exports can be interpreted as a component determining the collection rate. Thus, the analysis which follows is directly applicable to the issue of handling second hand exports. To be certain, in a situation where large portions of EE products are exported to second hand users, this in effect will reduce the collection rate, thus potentially resulting in an unnecessary build up of the fund. It is recommended here however, that in order to receive reimbursement from the fund, producers should be required to provide documentation of such export, thus also complying with the directive.

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[17] A 5 percent annual increase would lead to a relatively large cost increase of 63percent over the 11 years of the case study.

[18]However, one insurance company in the Nordic countries is prepared to provide a product to producers which would guarantee up to a 150 percent increase in costs.

[19]It is up to member states to determine the targets and implement necessary legislation to see that these targets are met.

The EU directive currently sets a target of 4 kg of WEEE collected within the country per capita per year. This would represent approximately 32 percent of 12.6 kg/person that was collected in Norway in 2004. In fact, it is estimated that 80 percent of WEEE was collected in Norway in 2004, and this figure entered our base case scenario. Nonetheless, one could expect a wide range of collection rates across member states. Thus, Figure 5.3 illustrates the amount of capital in the fund beyond the future WEEE liabilities implied by outstanding products, at various collection rates. This is, again, before any periodic adjustment to the fund.

Figure 5.3 The long-run performance of the model in providing a full guarantee for outstanding WEEE under various collection scenarios

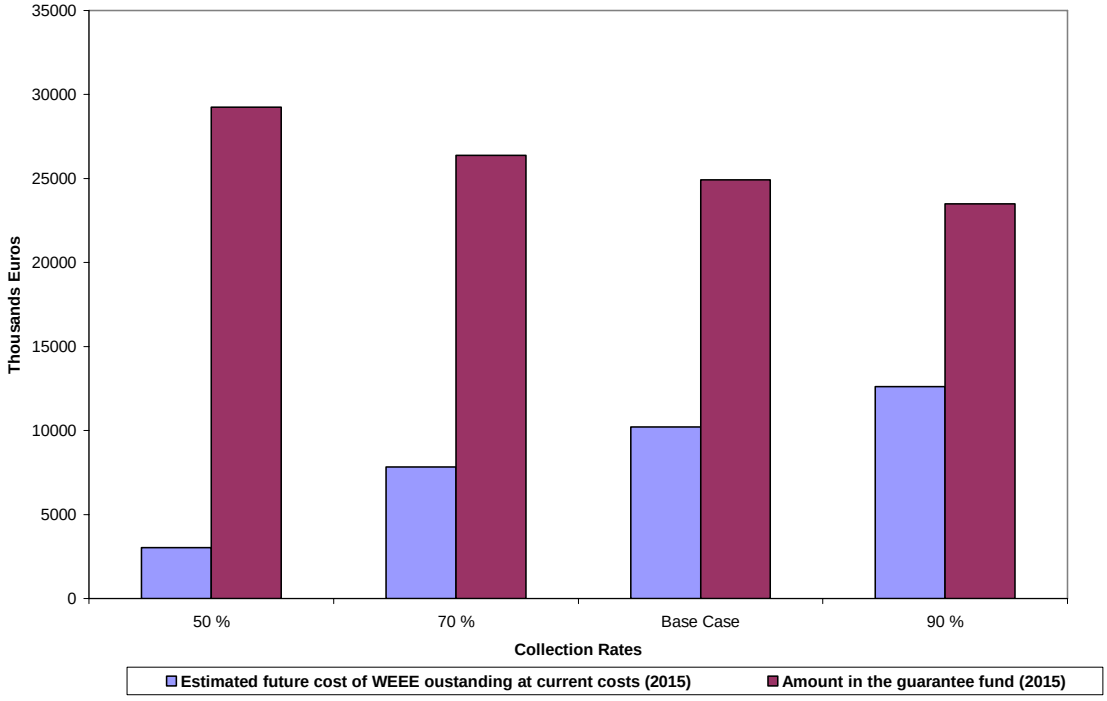


Figure 5.3 illustrates the fact that higher collection rates result in a 'more efficient' fund. That is to say, a greater portion of the capital in the fund will represent a true guarantee against future WEEE liabilities. Thus member states with low targets (near 4 kilograms) should be particularly concerned with preventing this costly build up. In fact, the figure demonstrates that collection rates, which would likely fulfil the directive's requirements, would lead to very large excess capital in the fund, thus violating Guiding Principle 3. This demonstrates that without effective periodic adjustments to the fund, the model is very sensitive to the rate of collection. However, with the exception of periodic adjustments, there is little that can be done to prevent this build up, while conforming to the directive and providing proper incentives.

Beyond the recommendations provided inTable 5.1, the following conclusions can be drawn from the 'display' case study:

- While the cost development and return on capital pose risks to the sustainability and efficiency of the model, mitigating most of this risk is relatively straightforward.
- Mitigating the risk of perpetual accumulation due to a collection rate of less than 100 percent, on the other hand is not so straightforward. However, if used properly, the 'periodic adjustment' process proposed here would allow authorities to use this accumulation and subsequent reimbursement as a tool in i) mitigating the risk of increasing costs, and ii) forcing producers to pay their share of the collective burden.

5.4 Case Study 2: Refrigerators

There is currently a debate as to whether or not the scrap value of WEEE should award producers a lower guarantee contribution. On the one hand, it can be argued that this value is already calculated into (i.e. subtracted from) the alternative treatment costs and thus is included in the estimate of the potential costs of authorities. On the other hand, it can be argued that the prices of this scrap material are so volatile that they should not be used in calculating a guarantee. In this section, we first compare the sustainability of the model when the value of the scrap material is included in the calculation (a situation where the alternative price (i.e. the price charged by a collective system) is simply used) and when it is excluded (as determined by authorities). Second, we provide a sensitivity analysis where the value of the scrap material is allowed to take various development paths.

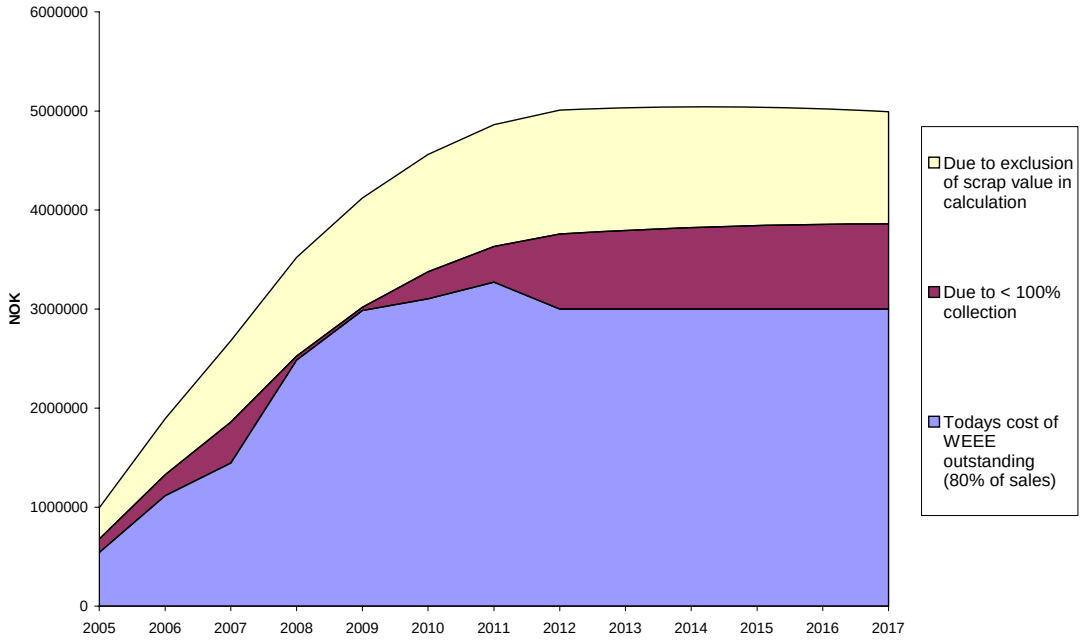
This case study is designed so as to allow for an interpretation very similar to that of the display case study. However, this case study is distinct in the following ways:

- We assume constant sales of 10,000 refrigerators a year, using the number of units in our sales figures rather than weight, as in the 'display' case study.
- We use unit costs rather than costs per kilogram for the management of the WEEE.
- We compare the accumulation of the fund in the instance where scrap value is included in the calculation of producer's contribution and in the instance where it must be excluded.

- We assume that the cost of collection and treatment vary with the value of the scrap material.[20]
- We assume that the return on capital is reimbursed to the producer and that annual cost adjustments are made before the accumulation of the fund is determined. Thus Figure 5.4 and Figure 5.1 appear quite different.

Thus, Figure 5.4 illustrates the sustainability of the fund in both the situation when the scrap value of WEEE is taken into account (when calculating the contribution and reimbursement), and when it is not.[21] In particular it demonstrates that when the producer is not permitted to include the scrap value of the product into the calculation of the contribution, he will be forced to make a larger per unit contribution to the fund, leading to a greater accumulation of the fund. A description of the components of the fund's accumulation is provided below.

Figure 5.4 Accumulation of the individual guarantee fund, when scrap material is included and when it is not



As noted above, the figure represents two scenarios; when the scrap value is included in the calculation of the producer's contribution, and when it is not. In particular, the yellow area (top) represents the net difference in

[20] In particular, we use the value of iron, which composes 80 percent of the material in a refrigerator.

[21] See Annex II for details.

the fund's accumulation between the two scenarios. The components of the figure can be described as (from bottom to top in the figure):

- The **blue area**, as in the display case, represents today's cost of the future WEEE liabilities implied by products currently outstanding. (See section 5.3 for further interpretation.) An important note here is that this cost is intended to represent the true (or realized) cost of treating WEEE. In practice, one could expect that the scrap is sold and the cost would thus include the scrap value. Accordingly, the blue area is the cost, including scrap value, of managing WEEE.
- The **red area**, as in the display case, represents the additional accumulation of the fund primarily due to collection rates < 100 percent, *when scrap value is included* in the calculation of the producer's contribution. Thus, the combination of the **red and blue areas** represents the accumulation of the fund with *scrap value included* in the calculation.
- The **yellow area** (top) represents the *additional* accumulation to the fund *when scrap value is excluded* from the calculation of the producer's contribution. Thus, the combination of the **blue, red and yellow areas** represents the accumulation of the fund when *scrap value is excluded* from the calculation.

Figure 5.4 demonstrates that in both cases the fund would have proven sustainable – a balance greater than the financial liabilities implied by outstanding products at all times, thus complying with Guiding Principle 1.[22] However, regarding an unnecessary build of the fund (Guiding Principle 3), there is a trade-off: while including the scrap value in the calculation allows for a more efficient accumulation of the fund, there would have been a significant risk that it would have come up short of a full guarantee in a number of years (2005-2009). Thus, as reflected in the previous case study, further increasing treatment costs would have likely reduced the balance of the fund below the amount needed to provide a full guarantee in some or all of these years. This would have also been likely if the value of the scrap material had fallen significantly. This latter issue is taken up in the following analysis.

5.4.1 Sensitivity Analysis: Scenarios for scrap material value

In this analysis, we assume that the scrap value is included in the calculation (i.e. subtracted from the treatment costs) and test the sustainability of the model, given different developments in the value of scrap in the refri-

[22]Note that today's cost of WEEE outstanding is based on prices with Elretur, which is assumed to have scrap value incorporated, which is represented by the blue area.

gerator. The assumptions and descriptions of the calculations used are provided in Annex II.

Figure 5.5 presents a set of similar scenarios to those presented in the sensitivity analysis regarding displays, with the value of scrap material as the variable of interest. Here, it is assumed that the (net) collection and treatment costs vary proportionately with the scrap value of iron, which composes over 80 percent of an average refrigerator.[23] Thus, as a result of variable scrap iron prices, the net costs of managing the WEEE will also vary, creating a risk for the sustainability of the fund over time, directly comparable to the risk associated with variable developments in costs analyzed in the previous section.

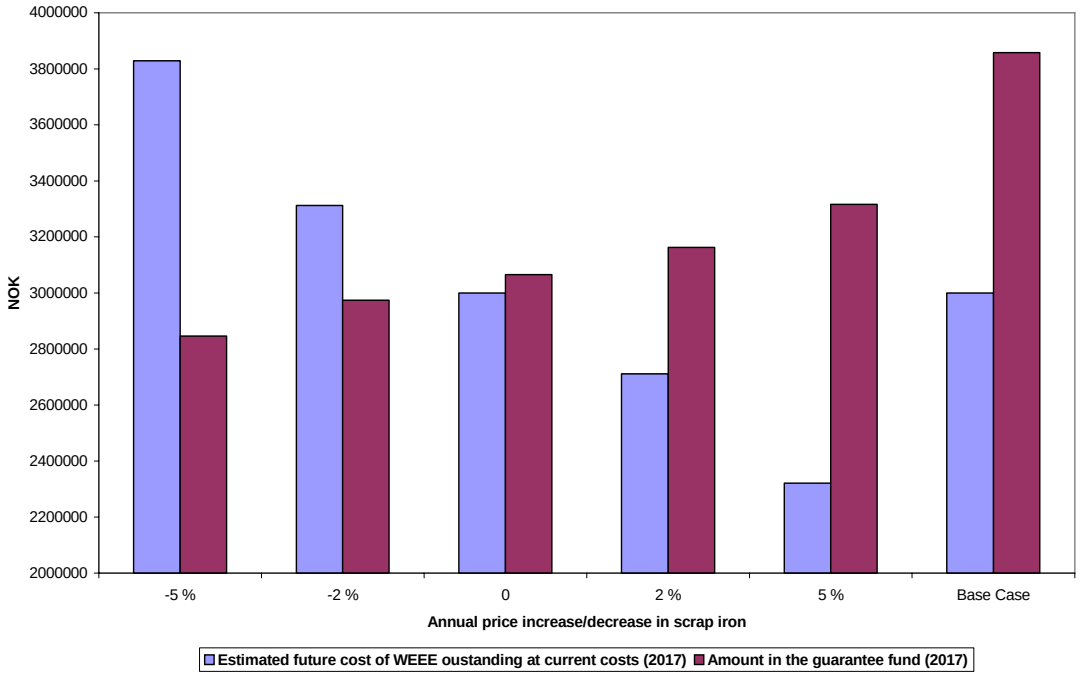
It should be noted that because this material is traded on the world market, fluctuating exchange rates will also have an influence on the price they are awarded on the market, which makes it even further difficult to predict the price development. As indicated by the data in Annex II, the value of the scrap iron component of the refrigerator implied by the price of scrap iron and the exchange rate has proven relatively volatile, a pattern which shows no sign of disappearing. Based on the data and qualified assumptions[24] one can identify two periods; i) between 2005 and 2009, a period over which the value of scrap iron in a refrigerator decreased by nearly 22 percent and; ii) between 2010 and 2012 when the value was assumed, based on experiences, to have increased by nearly the same amount.[25] As already indicated, in period (i), we would expect the costs of WEEE management to increase, while in period (ii) the costs would likely decrease (i.e. an inverse relationship between scrap material value and management costs).

[23]This is based on data provided to us by a waste management company.

[24]Assumptions which reflect the perceptions and experiences of knowledgeable stakeholders.

[25]Note that the data has been adjusted forward and that this data represents actual historical data.

Figure 5.5 The long-run performance of the model in providing a full guarantee for outstanding WEEE under various development scenarios for scrap value



As illustrated by Figure 5.5, if the assumptions identified in Annex II were to hold over the period of the case study and the value of the scrap iron in a refrigerator were to fall by 2 percent annually (taking account for exchange rates), the fund would not be sustainable in the long-run, i.e. Guiding Principle 1 would not be satisfied. This is due to the resulting increase in treatment costs caused by a decrease in scrap value. A 2 percent annual fall in the value would lead to an 18 percent decrease in the value of the scrap material over the course of a life span of 10 years, which does not seem entirely unrealistic.

Thus, given these assumptions, the sustainability of the guarantee appears quite sensitive to the price of scrap iron and thus the exchange rate as well. Of course if the assumption that the treatment costs moved 1:1 with the scrap value price was relaxed, some of this sensitivity would disappear.

There are arguments both for and against including the scrap value in the calculation of the contribution. Both alternatives are provided for in Equation 1.[26] In order to help guide the debate as to their inclusion/exclusion, we can draw the following conclusions from this case study:

[26] This would entail setting ScrapV = 0, or ScrapV > 0.

- A significant cost will be imposed on producers by not allowing them to include the scrap value in the calculation of its contribution (in the case study, approximately 25 percent of accumulated capital in the fund was due to the exclusion of the scrap value in the calculation). This would then represent a significant amount of 'dormant' capital.
- If, on the other hand, scrap value is included in the calculation of the contribution, there is a much greater risk that the fund will not fulfil the requirement of a full guarantee at all times.
- In particular, by including the value of the scrap material you introduce two new sources of uncertainty: the price development of various materials and the future exchange rate. However, to our knowledge the price of existing collective treatment alternatives in Norway and Sweden have fluctuated very little, if at all, despite some fluctuation in the value of scrap material.

Thus, how to treat the scrap material value when calculating the financial guarantee should be determined on a case-by-case basis, taking into account, among other considerations, the availability of cost data with or without scrap material values, the risk of large fluctuations in payments, the risk that the fund will not fulfil its obligations and the risk of accumulating large amounts of "dormant" capital.

Finally, though the number of variables analysed in these case studies has been limited, we feel that we have been able to capture the important risks to the sustainability of the model. A particular variable not addressed in the sensitivity analysis, is the uncertainty regarding the development of sales. This uncertainty however, will only have a scalar effect on the outcomes already described. That is to say, increasing/decreasing sales should not impact the sustainability of the model in its own right. It will only dampen/weaken the effects analysed here. If, for example sales are particularly high in a situation where costs are increasing, the fund will be particularly low compared with estimated future liabilities in later years.

5.5 Conclusions and Operationalisation

In both case studies, our proposed calculation method combined with the pay-back-as-you-go model proved sustainable and adequate for the entire period of both case studies. That is to say there existed enough capital in the fund to provide a full guarantee for reasonable rates of collection. Further, given our recommendations, they performed relatively efficient, i.e. the amount of capital beyond the guarantee was limited.

However, it was clear that the sustainability and efficiency of the fund will be exposed to a number of risks which could lead to either insufficient funds for a full guarantee or perpetual growth in the fund. Nonethe-

less, a number of recommendations have been made with the aim of mitigating these risks, with relative success.

Regarding the future operationalisation of the individual financial guarantee in member states, this report should provide authorities with a tool in addressing the following issues:

- Developing a model (responsibilities and time-line) for determining both the cost base for contributions and the actual contributions.
- The components of the equation used to determine the individual contribution.
- Determining cost data sources and managing the potential difference between individual producer costs and the potential costs of authorities.
- Determining the sensitivity and risks of the guarantee when evaluating specific methods of administering the guarantee fund.

Thus, in addition to the specific recommendations provided throughout the report and summarized in Table 5.2, a general conclusion from the two case studies, and the subsequent sensitivity analyses, can be made; the development of the variables identified in this report should be followed closely and subsequent adjustments to the calculation and reimbursements should be made on a regular basis. This will help ensure both compliance with the EU directive and reduce the burden on producers.

Table 5.2 Recommendation Summary

Issue	Considerations	Recommendations
The burden of identifying alternatives and gathering data	By placing this burden on producers, the administrative costs of authorities are minimized and it prevents the sales of goods for which there is no alternative capacity to manage the resulting WEEE. Authorities may determine that it is unreasonable to place this burden on producers. This responsibility distribution will have consequences for the source of cost data.	It is recommended that producers bear as much of this burden as is possible.
Return on capital in fund	If left in the fund indefinitely, the balance in the fund will be higher than necessary This 'dormant' capital represents a cost for producers	It has been determined most reasonable that this return be reimbursed to the relevant producer on *an annual basis*.
Uncertain cost development	Given that contributions are based on current costs, there is a risk that there will be 'too much' or 'too little' in the fund. The sensitivity analysis demonstrated that this risk could be significant.	It is recommended that the cost base for calculating the guarantee be adjusted accordingly, for example once a year.
Less than 100 percent collection rates	Collection rates, which would likely fulfil the EU target of 4 kg per person could imply a significant and unnecessary build up of capital in the guarantee fund.	It is recommended that a periodic adjustment mechanism be used to prevent a costly build up. Further this mechanism could be used to mitigate the risks of increasing treatment costs.
Second hand exports	Significant amounts of second hand exports could lead to a significant and unnecessary build of the fund.	It is recommended, in accordance with article 10 of the directive, that documented exports lead to the reimbursement of the producers. The accumulation of capital due to any undocumented exports should be accounted for in the previous recommendation (less than 100 percent collection rates).
Accounting for Scrap Material Value	The exclusion of scrap value from producer contributions could represent a significant cost to producers. Due to fluctuating prices and exchange rates, the inclusion of scrap material increases the risk that the fund will not serve as a full guarantee for outstanding WEEE.	Should be determined on a case-by-case basis, taking into account the availability of cost data with or without scrap material values, the risk of large fluctuations in payments, the risk that the fund will not fulfil its obligations and the risk of accumulating large amounts of "dormant" capital.

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Annex I: 'Display' case study data and assumptions

Table AI.1 provides the data on which the 'display' case study was based. The data points for the highlighted years (2008-2011) are based on data available for the years 2001-2004.[27] The remaining years required a number of assumptions (see Table AI.2).

Table AI.1 Data for 'display' case study.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Put on the market	8441	8441	8441	7962	8256	6618	6949	7296	7661	8044	8446
Treated	338	644	1223	2324	4426	4775	6176	6753	6753	6753	6370
Cost/KG	0,81	0,73	0,67	0,61	0,55	0,50	0,45	0,45	0,45	0,45	0,45

Table AI.2 Assumption for 'display' case study.

Variable	2005-2007	2012-2015
Put on the Market	Constant, based on data from 2000 (= 2007)	5 percent annual growth
Treated	Assume a gradual build of 'future waste' treated, based on 2001-2002 (= 2008-2009) growth rate	Assume 7-year life-span. Thus collection and treatment set equal to 80 percent of sales (kg) 7 years earlier.
Cost/Kg	From 2001-2003 (=2008-2010), costs decreased at annual rate of 10 percent, primarily due to reduction in administration costs. Thus, we assume a 'learning curve' and that trend holds also for this period.	In accordance with future uncertainties and Guiding Principle 5, we assume constant future costs.

Further in order to allow for the implications of less than 100 percent collection rates, an additional assumption was required. Based on data provided for the Norwegian collection system, it was assumed that 80 percent of WEEE would be the target for collection. Thus, in both case studies, the variable 'today's cost of outstanding WEEE' is calculated using the formula:

Today's cost =Products (in units or kg) currently outstanding*.80*Today's costs (per unit or kg)

In this way, the fact that a portion of the guarantee will never be claimed could be illustrated. This, however, does not imply that the producer

[27]The source of this data is to be kept confidential.

should necessarily be reimbursed for that which is never collected (20 percent in this case), but instead implies that a strategic decision as to what should be done with this capital must be made. It is, however, strongly recommended that the issue be addressed, as this could result in a significant and perpetual build up of the fund.

Annex II: 'Refrigerator' case study data and assumptions

The relevant data for refrigerators were exceptionally difficult to obtain. Therefore, this case study required additional assumptions than those required in the 'display' case study. The highlighted data points in Table AII.1 are based on actual data from 7 years prior (i.e. the data from 2012 is taken from data in 2005). The adjustment forward is for illustrative purposes only. The remaining cells follow the assumptions presented in Table AII.2.

Table AII.1 Data for 'refrigerator' case study

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Put on the Market	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Treated	0	1000	1500	2000	4000	5000	6000	7000	8000	8000	8000	8000	8000
Cost/kg	67,79	74,37	67,23	90,35	94,74	89,96	89,60	80,00	80,00	80,00	80,00	80,00	80,00
Iron Price/MT	108,30	94,15	95,88	74,90	92,56	101,82	112,00	123,20	123,20	123,20	123,20	123,20	123,20
Exchange Rate	7,58	8,01	8,80	8,97	6,94	6,66	6,08	6,28	6,28	6,28	6,28	6,28	6,28
Iron per Refigerator (kg)	38,35												

Table AII.2 Assumptions for 'refrigerator' case study

Variable	Assumption
Put on Market	Randomly chosen at 10,000 units, and assumed constant.
Treated	Build up assumed, reaching 'full capacity' of 80 percent in 2006.
Cost/Kg	Elretur's price in 2005 (= 2012) was 80 NOK.[28] We then made the following assumptions: We base changes in costs on the movement of scrap iron prices. That is to say, if the price of iron increases by 10 percent, the price of collection and treatment decreases by 10percent.[29] **In the case where scrap value enters the calculation of the contribution**, it is assumed that this value is factored into the Elreturs price, as it is well known that the resulting scrap material in this system is resold when it is profitable. **In the case where scrap value does *not* enter the calculation**, it is assumed that the cost of the WEEE management equals the price quote *plus* the value of the scrap iron in the refrigerator. This, however, would likely be the upper limit of such a cost change. Nonetheless, in terms of the analysis, the important point is that by not allowing the inclusion of the scrap value in the calculation, the contribution will be larger – by how much is not so important in illustrating the point.
Scrap Iron Price per metric tonne	Data for the US are available for the years of 1998-2002 (= 2005-2009) by the United States Geological Services.[30] For the period 2002-2005 (= 2009-2012), we have assumed an annual growth rate of 10 percent in prices. For 2005-2010 (= 2012-2017), we have assumed constant prices.[31]

[28] See Elretur (2005).

[29] Though this will likely *not* be true in practice, the point is that the costs are expected to decrease if the price for scrap iron increases, and vice versa. The actual proportions are not important to illustrate the necessary points.

[30] See USGS (2005).

Variable	Assumption
Exchange Rate	Source: Federal Reserve Bank of New York (2005).
Iron per refrigerator (kg)	WEEE management company. Confidential.

For assumptions regarding 'today's cost of WEEE outstanding' see description in Annex I. Also note that currencies in this case study are expressed in NOK rather than Euros, as in the 'displays' case. Again, because the sales data is randomly chosen, the actual amounts are not important. However, by choosing to use NOK in this case study, we are able to also capture the impact of exchange rate fluctuations.

[31]These assumptions reflect the observations of actors in the market that prices have increased markedly in recent years but appear to be stabilizing at a higher equilibrium than that of some years ago.