Individual producer responsibility through “smart labelling” of electrical and electronic Equipment

Summary
of the project

Efficient Logistics and Recycling
through integrated Application
of Smart Labels for Electronic Waste (ELVIES)

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Contents

0 Introduction

The WEEE Directive[1], passed in 2003, and its transposition into national law, establishes a system for the "take-back" of waste electrical and electronic equipment (WEEE). The EC thereby pursues ambitious objectives of waste and product policy. The directive is a key building block in the concept of an Integrated Product Policy (IPP).

The research project "Efficient Logistics and Recycling through integrated Application of Smart labels for Electronic Waste" (ELVIES)[2] examines the extent to which an identification and information system can contribute to the optimisation of waste disposal processes and a better fulfilment of the objectives of the WEEE Directive. The point of departure of the research project is the theory that the introduction of an identification and information system strengthens the individual producer responsibility and encourages the reuse and repair of waste electrical equipment. It is also a question of what information is needed from the stakeholders along the product chain in order to realise the standard requirements contained in the WEEE Directive. Whether and the extent to which the introduction of an identification and information system requires amendment of the WEEE Directive itself, will also be discussed.

In the following, the main research findings are summarised.

1 Legal framework

The WEEE Directive pursues two aims: Alongside waste management goals in the more specific sense of Art. 1 sentence 1, more far-reaching goals of product policy are also included: Art. 1 sentence 2. The second recital points out that "the achievement of sustainable development calls for significant changes in current patterns of development, production, consumption and behaviour (…)". Thereby it is emphasised that all stakeholders in the value chain must contribute to the fulfilment of the goals in sentence 2. Nevertheless, the producers remain

1 Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) OJ L 37, 13.2.2003, pp. 24–39.

2 The research project, sponsored by the Federal Ministry of Education and Research, was completed in cooperation between the University of Applied Sciences Bingen (I.E.S.A.R), the Universities of Pforzheim (IAF) and Darmstadt (sofia) between November 2005 and May 2008. The Independent State Centre for Privacy Protection Schleswig-Holstein contributed expert advice on issues of data protection. Producers of electrical and electronic equipment, recovery businesses and a repair business as well as several software and technology companies took part in the project as business partners. A project committee with representatives from two producers, the Federal Environmental Agency, the Central Association of Electrical Technology and Electronics Industry (ZVEI), the Swiss Federal Laboratory for Material Testing and Research (EMPA, St. Gallen) as well as the RAL Quality Association Dismantling of cooling units, provided content-based support with regard to the research project and guaranteed quality assurance for its duration.

the main addressees of the directive because they have the greatest opportunities to contribute to meeting the goals of Article 1.[3]

The first place of the contributions to product responsibility in the 12th recital of the Directive is occupied by *function-maintaining* measurements such as "repair" and "upgrading" as well as "reuse"; only subsequently are the *material-maintaining* measurements mentioned in the form of "disassembly and recycling". In practice, however, the ranking is exactly the opposite.

The cooperation of the actors intended by WEEE is not taking place to the required extent. One cause of this is insufficient information and communication mechanisms as well as a lack of incentives.

1.1 Individual producer responsibility

The financial product responsibility is laid down by Art. 8 paragraph 1 of the WEEE Directive: The producers are required to "provide at least for the financing of the collection, treatment, recovery and environmentally sound disposal". This cost attribution mechanism is the main instrument for the implementation of product responsibility: The producers bear the cost for the collection of electrical and electronic equipment from the collection facilities as well as for their treatment, recovery and disposal.

Art. 8 paragraph 2 regulates the cost attribution of new devices[4] and lays down in sentence 1 that "each producer shall be responsible for financing the operations referred to in paragraph 1 relating to the waste from his own products".[5] Hence, the directive aims at attributing costs to the each individual producer that were specifically caused by "*his own products*".

To be sure, sentence 2 states that: "The producer can choose to fulfil this obligation either individually or by joining a collective scheme." The articulation "this obligation", however, makes it clear that the directive holds on to the individual attribution. It is solely a question of the way in which the addressees fulfil the duty imposed on them: Namely, not every producer must individually take back his devices and create a reverse logistics system; rather, they can also organise this together, as long as the individual cost responsibility is maintained.

This is also shown in the obligation laid down in Art. 8 paragraph 2 subparagraph 2, in which the producer must provide "a guarantee when placing a product on the market", which assures that the elements of the WEEE system "relating to this product will be financed". The guarantee refers to *a specific device* of a single producer. This is also confirmed by sentence 5 of the 20th recital: "Each

3 See especially recital 12.

4 New devices are those which were placed on the market after 13.8.2005.

5 See also recital 20 sentence 3: „In order to give maximum effect to the concept of producer responsibility, each producer should be responsible for financing the management of the waste from his own products."

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

The financial guarantee that producers must provide for the disposal of his product should also guarantee in terms of time concerns that the producer can meet his product responsibility for his equipment, especially the duty of recovery and disposal, even when he has pulled out of the market (e.g. due to bankruptcy). In this way, the directive aims at countering a "collectivisation" of producer responsibility. This also makes clear the individual character of the financial producer responsibility.

Contrary to the intention of the individual financing responsibility, however, the unspecific attribution has, – at least in Germany – become the rule: even though every producer should be liable only for "his own products", in practice he is liable for an undifferentiated mixture of devices. In this way, the key financial steering mechanism ultimately has (almost) no impact. The incentive effect intended by the legislator does not reach the primary addressees: influencing producer behaviour by means of cost attribution is not taking place.

There is also a lack of concrete mechanisms in the WEEE Directive that address *function-maintaining* objectives. The directive only contains an unspecific promotion duty by the Member States and a prohibition of certain technical measures that prevent devices from being reused (see recital 14). Instruments that explicitly aim at encouraging "repair" and "upgrading" are not contained in German law.

1.2 Reuse

The aspect of reuse is part of the producer responsibility toward environmentally-oriented product design (Art. 4 WEEE Directive) and is the primary objective of community waste policy.[6] However, a separate reuse quota is not provided for. Nevertheless, Art. 5 paragraph 4 sentence 3 strives for an optimisation of the disposal system, also with regard to reuse. In addition, Art. 7 paragraph 1 sentence 2 demands that "priority to the reuse of whole appliances" is given and Annex II, No. 3 lays down that the treatment of devices "shall be applied in such a way that environmentally-sound reuse and recycling of components or whole appliances is not hindered." In Germany, therefore, "[w]here technically and financially feasible, a check must be made prior to treatment as to whether the waste equipment or individual components thereof can be sent for reuse."[7]

The question of who has to conduct this test is just as open as the question of whether a technically and economically feasible reuse is possible.

6 See recital 4 WEEE directive.

7 Art. 11, paragraph 1, of the German Electrical and Electronic Equipment Act (ElektroG), as of 23.03.2005.

2
Practical experience/Implementation

2.1
Implementation of financial product responsibility in Germany

Under the German take-back system the electric waste from private households is dropped off at collection points managed by the public waste management authorities. The producer has the duty to collect and dispose of containers of waste equipment, which are separated into five different collection groups. This step causes the lion's share of the costs of the reverse logistic system.[8,9] The Clearing House assigned for the coordination of collections determines, on the basis of a specific calculation method,[10] the equal allocation – in terms of time and place - of the collection duty to all registered producers and their respective share of the sales.[11]

For devices placed on the market after 13 August 2005, the producer can choose between two methods[12]: He can either opt for a calculation made according to the share of his clearly identifiable waste equipment based on the total amount of waste equipment per equipment type; the latter is conducted by scientifically recognised statistical methods; or – and this is currently the practiced method – choose the calculation of his share of the total quantity of electrical and electronic equipment per type of equipment placed on the market in the previous calendar year. This means that for old and new waste equipment, the collection duty and therefore the cost distribution are carried out on the basis of the sales share. [13]

The first option for individual cost attribution is currently not being used by producers because it involves a significant amount of work and has statistical problems. In particular, small producers once again have significant disadvantages because they would have to analyse huge amounts of waste in order to

8 Art. 8 (1) is not very precise: The obligation of the producer begins when the WEEE from private households is "deposited at the collection facilities, set up under Article 5(2)". The wording is open to interpretation, also including the costs of – separate and function-maintaining – collection. This point should be clarified in the WEEE revision.

9 Art. 10 (1) 1 ElektroG of the German Electrical and Electronic Equipment Act (ElektroG), as of 23.03.2005. Federal Law Gazette BGBl. I pp. 762-774.

10 EAR (Stiftung Elektro-Altgeräte Register) 2005: http://www.stiftung-ear.de/e1767/e1044/e2235/051123Berechnungsweise_ger.pdf (18.02.2008).

11 In practice, however, there remain important doubts as to whether the applied calculation method is justified; several analyses came to the conclusion that the method disfavours small producers, see on this: Hottenroth, Schäfer, Schmidt: Herstellerverantwortung beim Recycling von Elektro- und Elektronikaltgeräten, [Extended producer responsibility in WEEE recycling] Horizonte. Vol. 32. In print. http://www.koord.hs-mannheim.de/horizonte/index.html.

12 See Art. 14 paragraph 5 sentence 3 of the German Electrical and Electronic Equipment Act (ElektroG).

13 According to the statistical data of the German Federal Environmental Agency (Umweltbundesamt) about 1.6 million tons of new electric and electronic equipment has been brought onto the market and 750,000 t of waste has been collected in 2006 (Umweltbundesamt, 2008: Drei Jahre ElektroG: Bundesumweltministerium und Umweltbundesamt ziehen positive Bilanz. Presseinformation Nr. 19/2008. Berlin).

obtain reliable statistical results (because WEEE is only to be expected in small quantities from such producers in the total amount of waste).

In effect, the possibility of individual product responsibility is thus running empty.

The automatic recording of devices at collection points or at treatment facilities would greatly simplify the establishment of a producer's share of an equipment type. Regarding this, corresponding suggestions will be made in chapter 4.

2.2 Deficit Analysis

The following deficits have been found in the practical implementation of the directive in Germany:

- An expansion of repair services or the replacement parts market is not ascertainable.
- Avoidance and reuse of waste equipment has been – especially in the B2C area – only insufficiently realised.
- Due to the incomplete reporting of disposed quantities, the monitoring of material flows is difficult.
- Information for reuse facilities, treatment facilities and recycling facilities is only being made available by a few producers and the information that is being provided is often not sufficient.
- The collective producer responsibility has the effect that producers do not have any incentives to design their products in a longer-lasting or recycling-friendly manner.
- Inadequate selective treatment in large technical facilities.

Figure 1: Examples of mixed collection of collection groups 5 and 3 (authors' own pictures: July 2007)

3
Optimisation

In view of the waste policy objectives, the following demands can be made on a disposal process that does as much justice as possible to the intentions of the WEEE Directive:

- Priority of reuse of equipment
- Destruction-free collection of reusable equipment
- Collection according to the specific disposal needs of the equipment
- Removal of reusable components
- Systematic removal of harmful substances in special treatment processes
- High extraction of reusable materials while achieving a high added value
- Feedback of advantages from recycling-friendly construction to the producers.

For the implementation of such an optimised disposal process, there is a considerable need for information on the part of the participating stakeholders. The information can be divided into:

- equipment-specific information,
- process-specific information and
- market information.

Figure 2 shows an optimised disposal process in view of waste industry objectives with the principal need for information shown as a flow chart.

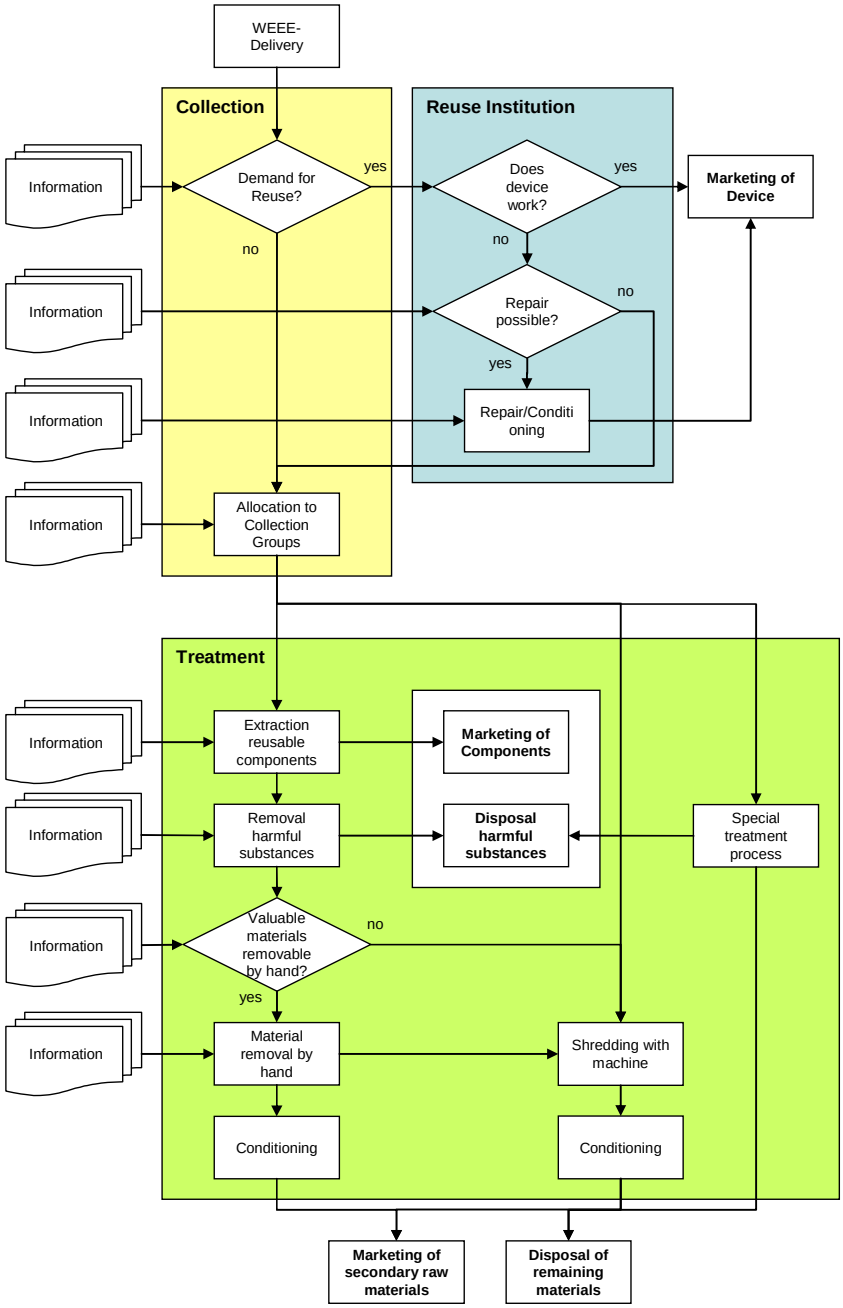

Figure 2: Flow chart of information needs in the disposal phase

3.1
Structure of an identification and information system

A basic requirement for reaching the objectives of the WEEE Directive is that the actors along the life cycle of a product have access to the required information that they need in accordance with Art. 1 of the WEEE Directive "to improve environmental performance". In order to fulfil this, Art. 11 paragraph 2 of the WEEE Directive requires that "any producer […] is clearly identifiable by a mark

on the appliance". Besides this, according to paragraph 1, it must be assured that certain information is "made available to reuse centres, treatment and recycling facilities by producers of EEE in the form of manuals or by means of electronic media (e.g. CD-ROM, online services)." In practice, however, a suitable operationalisation is missing that would provide for the supply of information at the lowest possible transaction cost. Experience with the current labelling obligation shows that the simple placing of information on electrical devices does not enable this goal to be reached. What is needed instead is the machine-based recording and automatic processing of the relevant information. The prerequisite for this is a machine-readable coding of equipment.

An identification system in the area of electrical waste must be usable for a very wide range of products; it must be reasonably priced and robust. There is the option of using a *pure identification* system and storing the needed product information in databases. In the area of retail trade, the **E**uropean **A**rticle **N**umbering (EAN) has been introduced the most effectively and is basically also suitable for the area of electrical waste.

3.2
Technical aspects of an identification and information system

For the identification of products, there are different technologies available:

1. Optical systems with a bar code or 2D-Code (DataMatrix) (left picture of Figure 3).
2. Electronic system with **R**adio **F**requency **I**dentification (RFID) (right picture of Figure 3).

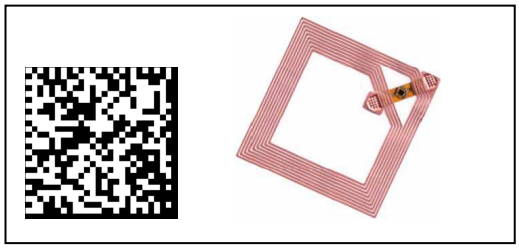

Figure 3: Data-Matrix and RFID tag as available technologies for product identification

In this project, it was elaborated that due to technical and economical reasons, an optical coding is more suitable. With a clear identification of waste equipment according to equipment type (thus not specific to individual equipment), the basic requirements of an identification system can be fulfilled.

Since only an identification code is on the label, it is necessary to store the rest of the information in databases. Application-orientated software links the databases with a background system for the identification.

With an identification and information system and the related electronic data exchange, there is still a need for standardisation – on the one hand in terms of product identification and on the other hand in terms of product-specific information that goes beyond product identification.

4
Design options of an identification and information system

By the use of identification and information systems, the following objectives can be reached:

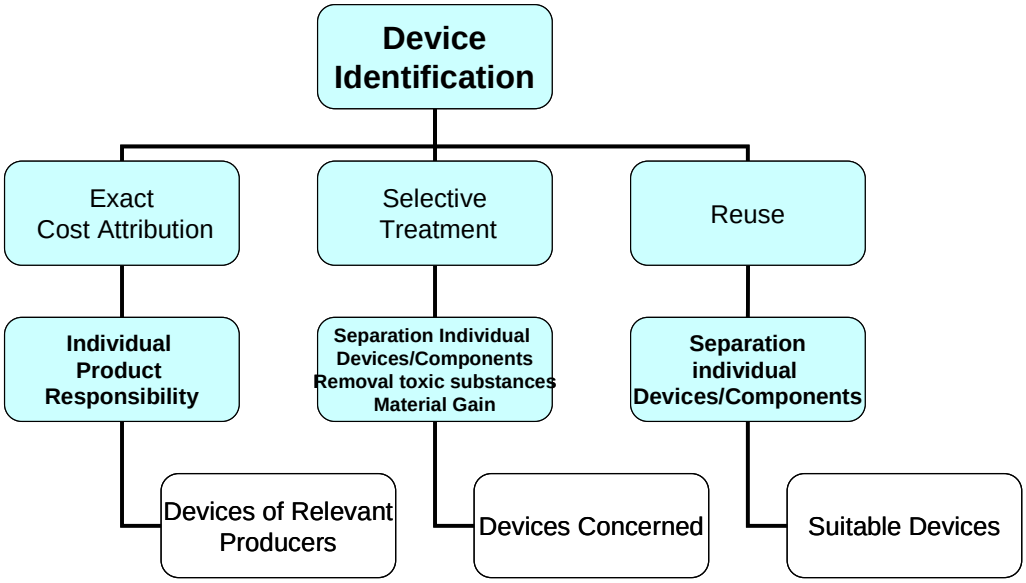

Figure 4: Application areas of an identification and information system

4.1
Design variations: Three scenarios

With regard to the introduction of such an identification and information system, there are various options with different infeeds and, as a result, different effects. Here, three alternatives are presented in the form of short scenarios:

- Voluntary identification and information system
- Obligatory identification and information system
- Expanded information obligations

The scenario of the "Voluntary identification and information system" is based on the current legal regulations in Germany and is mainly geared towards market-oriented effects. Scenario 2 describes the binding introduction of an identification and information system and the resulting possibilities and effects. Scenario

3 optimises the procedure regarding the effects on the environment by including further EU regulations and market-based instruments in the procedure.

In either case, producers will continue to be collectively responsible for certain fractions of the resulting electrical waste because they are not yet readable by the machines and are thus not identifiable. After a transitional period, collective responsibility would only apply to small fractions (very old waste equipment, damaged or removed labels, and equipment parts) for the procedure in a mandatory scenario. In contrast, in a voluntary scheme individual and collective producer responsibility would continue to exist in parallel.

The main question is whether a voluntary identification and information system would be suitable or whether obligatory participation in the system is more appropriate.

4.1.1
Scenario 1: Voluntary identification and information system

In the first scenario, an identification system creates the prerequisite in order to enable the calculation of the collection duty for new waste equipment according to the share of the producer's clearly identifiable waste equipment.[14] Machine-based identification thereby substitutes sorting by hand as the basis for the statistical extrapolation of all electrical equipment of a producer that is actually accumulated for disposal. Producers are free to decide whether they want to participate in the system or not. They can also limit their participation to certain products or product groups.

For the information system, the participating producers provide the following information about their product: *Producer*, *product type* and *product weight*.

The scanning of the product code takes place at the primary treatment centre in order to pool quantity-based reporting. Consequently, these treatment centres must be equipped with scanning devices.

Through the implementation of the system, investment costs accrue for the scanning devices and for the change of calculation methods and the connected software adaptations. The payment of these costs and the obligation of first treatment centres can, on the one hand, be legally regulated or, on the other hand, be regulated in a purely market-based way.

This scenario is based on the current German system and is therefore especially suited to implementation in that country.

There are some doubts as to whether the WEEE Directive as it stands gives sufficient incentive for producers to participate in a voluntary system. Calculations

[14] For a detailed description see Hottenroth, Schäfer, Schmidt: Herstellerverantwortung beim Recycling von Elektro- und Elektronikaltgeräten, [Extended producer responsibility in WEEE recycling] Horizonte, Vol. 32. (ISSN: 1432-9174) Mannheim, in print. http://www.koord.hs-mannheim.de/horizonte/index.html.

show that the cost-saving incentives when opting for an individual scheme are currently rather minimal in terms of the prices for WEEE disposal.

Thus, a major producer with a high market share in Germany and a national sales volume of about 4 billion Euro in equipment category 3 (information and communication technology) would have annual waste disposal costs of just under 1.6 million Euro. If an identification and information system is implemented according to Scenario 1 this producer only has to pay for the waste disposal corresponding to the weight of his own equipment. The costs of waste disposal (100 Euro per tonne) and fees (57 Euro per collection) remain the same. Model calculations with an interest rate of 5% show that over a period of nine years he would only save around 700.000 Euro, in other words not even 100.000 Euro a year on average. Compared to his annual waste disposal costs, which are currently 1.6 million Euro, and his annual sales of 4 billion Euro, this amount is not very much of an incentive.[15]

4.1.2
Scenario 2: Obligatory identification and information system

According to the agreed standards for machine-based identification of electrical and electronic equipment, an identification and information system for *all* new equipment placed on the market is bindingly introduced in the second scenario. The *producers* must place a machine-readable identification label on all new products brought on the market. A link to information in a background system (database) is possible via this label, in which producer, equipment type, model, equipment weight and, if necessary, information about required selective treatment. On a voluntary basis, producers can, in addition, give further information such as dismantling instructions.

It is thereby guaranteed that, after a transitional period, nearly all[16] returned equipment can be clearly identified and equipment-specific information can be accessed with the help of a database. In this manner, it is possible to exactly attribute the equipment delivered to the primary treatment centre to the producers; as a result, the disposal costs can be rather divided according to the polluter pays principle. Contrary to voluntary participation, after a transitional period no sorting work is needed in this scenario.

Already at the **collection points**, a sorting of waste equipment according to treatment demands is made possible with the coding, for example:

- for potential reuse,
- for manual dismantling to remove harmful substances,

[15] See Hottenroth, Schäfer, Schmidt, Herstellerverantwortung beim Recycling von Elektro- und Elektronikaltgeräten, [Extended producer responsibility in WEEE recycling] Horizonte. Vol. 32, Mannheim, in print. http://www.koord.hs-mannheim.de/horizonte/index.html.

[16] Apart from very old waste equipment and equipment where labels or transponders have been damaged or removed.

- for manual dismantling to extract reusable material; or
- for machine-shredding.

The sorting at collection points prevents the usual mixing of problematic[17] and unproblematic waste equipment that occurs today; and guarantees the correct storage of sensitive equipment such as monitors, fluorescent lamps, etc. Disposal costs can be directly allocated to the producers using the identified equipment from primary treatment centres and can be differentiated according to specific costs (e.g. for necessary special treatment).

4.1.3
Scenario 3: Expanded information obligations

The third scenario requires the implementation of the identification and information system described in scenario 2. Besides the current objectives of the WEEE Directive, this scenario includes the intentions of the Eco-Design Directive[18]. The goal is to optimise product life cycles. In addition to cost allocation according to the polluter pays principle, an improvement of product quality under consideration of ecological criteria is made possible as well as lengthening the use phase of electrical and electronic equipment.

In order to increase reuse and thereby increase the use phase of the eligible equipment, a "market value databank" is created in this scenario, which is based on the current monetary value of the device and its consumption data[19]. This continually updated database, which is for example offered by interested parties (resellers, exporters or service providers), makes it possible for collection points, primary treatment centres, and reuse facilities to assess the market capability of used electrical devices, based on their economic and ecological traits. With the applied code on market-capable products, the products can be identified and possibly reused.

4.2
Costs

The costs for the introduction of a product identification and information system in the area of electrical and electronic scrap are comprised of the following:

- Labels on every product placed on the market,

[17] The term refers to such equipment for which a selective treatment (for the whole device or for device components) is required according to today's legal regulations. In the system described here, future regulations can also be integrated without much additional effort.

[18] Directive 2005/32/EG of the EUROPEAN PARLIAMENT AND THE COUNCIL from July 6th, 2005 for creation of a framework for the setting of requirements for environmental design of energy-driven products and for the amendment of directive 92/42/EWG of the Council as well as the directives 96/57/EG and 2000/55/EG of the European Parliament and the Council.

[19] Comparable databases already exist for used automobiles; see also http://www.schwacke.de/index.php (15.02.2008).

- Scanning devices at collection points and primary treatment centres,
- Conveyer belt units (see report "Technical Options") for a few large plants,
- Conversion of collection points to sorting centres,
- Software development, and
- Compilation of product data and making these data available.

In total, it is estimated that about 4.4 million Euro is needed for public waste management services (collection points) and 2.2 million Euro for the primary treatment centres plus respective costs for the installation of the system are estimated as one-time investment costs for the introduction of such a system. Producers incur continual costs for fitting equipment with the necessary label. Compared to the financial burden that producers have to carry under the existing WEEE system in Germany this would lead to an increase of the overall disposal costs of 1.5% to 3.5% over the next 10 years.

4.3
Required Legal Adaptations

For scenario 1, no amendments of the WEEE Directive are necessary. According to the system design, an adaptation of the national legal regulations might be appropriate.

The implementation of Scenarios 2 and 3 is only possible after amendment of the WEEE Directive and national laws.

The information and labelling obligations of producers in Art. 11 paragraph 2, for example, would have to be expanded accordingly. The directive does indeed contain the obligation of clear producer identification, but without being linked with a corresponding information system. Also, the obligation of primary treatment centres and collection points to create the technical prerequisites for equipment identification and to integrate these into their operation would have to be included (for example, with a new Art. 11 paragraph 3).

For a meaningful use of the background system, an additional prerequisite would be that the data fields and contents are standardised. An expansion of the standardisation mandate for the Commission in Art. 11 paragraph 2 sentence 3 of the WEEE Directive would be helpful.

Whether the directive should more clearly prioritise individual producer responsibility in the objectives should also be considered. Art. 8 paragraph 2 sentence 2 would need to be changed accordingly. In any case it would strengthen the financial incentive if the producer responsibility established in Art. 8 (1) also included the costs arising from the (reuse-friendly) handling of WEEE at the collection facilities.

In Scenario 3, producers would also be required to enter material and consumption information in internet-based databases according to the Eco-Design Direc-

tive. The Eco-Design Directive already makes it possible to require producers of components or component groups to provide details about material composition as well as consumption of energy, materials and/or resources to the producer of the final product. In addition, producers can be required to provide further consumption information in the course of completion measurements.

5
Recommendations for Action

The introduction of an identification and information system can greatly ease the implementation of individual producer responsibility and therefore contribute to the implementation of the polluter pays principle in the area of electrical and electronic waste disposal. It also supports the principle that preventive action should be taken and that environmental damage should be rectified at source as a priority (Art. 174 (2) EC).

From an environmental perspective, a comprehensive information system also makes sense in the long run. In particular, it would significantly ease meeting the environmental objective of the promotion of reuse and could contribute to a differentiated perspective in this area which pays attention to the whole product life cycle. The rejection of certain harmful substances would be also be secured in the long term. It must be taken into account that in the future, new or other substances could become important in the treatment or recovery processes of waste equipment. Besides this, equipment identification at collection points makes it easier in the long term to monitor the flow of waste equipment (see figure 5). This includes the shipment of e-waste from the EU to other regions. The identification system would facilitate a more effective monitoring of the waste stream.

Finally, brand protection could become easier if clear producer identification is guaranteed.

With the current structure of disposal costs for electrical waste equipment, however, no significant increases in efficiency for producers can be expected by such a system. If, though, the prices of secondary raw materials increase and proceeds from the recovery of equipment are to be expected, the interest of producers in such an identification and information system and individual cost attribution could increase.

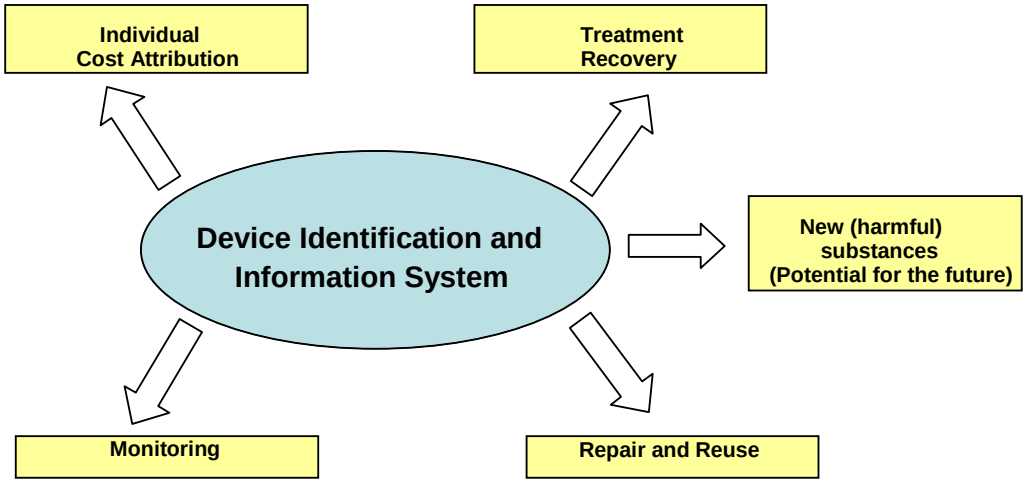

Figure 5: Benefits of an identification and information system

The introduction of binding legislation on a European level would be necessary in order to make complete use of the advantages of such an information system.

This would lead to a distinct change of the current practice of collective cost attribution. The objection that a forced individual cost attribution would be put into effect even though the directive provides for freedom of choice for producers[20], can be countered: In effect, the implementation of the directive in Germany has led to collective financing, which especially burdens small and middle-size businesses. At present, it is practically impossible for single producers (even for the big suppliers) to exercise the legal option of individual producer responsibility using economically feasible means. The identification and information system suggested here creates the technical and economical prerequisites in the first place in order to enable implementation of individual producer responsibility.

The current implementation of the WEEE Directive in the German Electrical and Electronic Equipment Act (ElektroG) – as well as its transposition in the other EU Member States – focuses mainly on the recovery of material and energy. For the reduction of waste flows by product-policy measurements (increasing the life cycle and reuse of electrical equipment), sufficient instrumental design is missing. This deficit is already embedded in the directive and continues to have an effect in the German Electrical and Electronic Equipment Act. Forgoing instrumental design of these objectives would be unsatisfactory.

Compared with the introduction of reuse quotas, the implementation of which would incidentally be very difficult, an information system is by far the better alternative. In the end, an information system is an important prerequisite for the increase in repair and reuse that is also called for in the directive.

[20] Which is, incidentally, not convincing in our opinion, see chapter 1.1 above.