RWI : Projektberichte

Rheinisch-Westfälisches Institut für Wirtschaftsforschung, Gesellschaft für Arbeits-, Reorganisations- und ökologische Wirtschaftsberatung and Society for Institutional Analysis, University of Applied Sciences, Darmstadt

INVERSI
Internalization versus Internationalization

A Framework of Action for National and International Environmental Policy against the Background of Increasing Globalization and the Development of Electronic Markets

BMBF Research Programme "Frameworks for Innovation Towards Sustainability"

Final Report

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1. Introduction and Theoretical Background

1.1 Issue and Objective

In the last fifteen years, the postulate of sustainable development has become an established general objective for social, economic and environmental policy in almost all the nations of the world. The scope and forms of use of natural resources and the use of the natural environment as a sink for residues from the economic system are inextricably intertwined with the ecological dimension of this vision. In this context, the consumption of raw materials for the manufacturing of new consumer goods and the treatment of residues and waste from used ones play a central role. In order to take environmental concerns into account, both, German waste management policy and EU environmental policies are following – with growing intensity in the course of time – the paradigm of the circular flow economy, and standardizing (extended) producer responsibility for the manufacturers or sellers of certain product groups.

The most important instrument they draw upon in the assignment of this producer responsibility is the take-back obligation aiming at the avoidance of waste, an increased economic efficiency, and ecological effectiveness of recycling and disposal. With these take-back obligations the disposal costs of the products and packaging material shall be charged to the responsible producers and distributors. Thus, the producers shall be encouraged to consider the aspects of disposal as early as in the stages of design and production and to develop relevant innovations. After take-back regulations for packaging, batteries, and end-of-life vehicles were introduced during the last years, now for waste electrical and electronic equipment the respective EC-directive (WEEE Directive)[1] was passed on 27 January 2003 which had to be transposed into national law until 13 August 2004.

The increasing globalization of markets as well as the internationalization of production could evoke that the assignment of product responsibility is undermined. Mainly the expected rapid increase of the electronic markets (Business-to-Consumer e-commerce, B2C) could lead to the situation that in future large proportions of trade flows will be distributed to consumers via direct cross-border marketing. If this proves to be the case, the parties responsible for environmental policy will be faced with the problem that an

[1] The Directive 2002/96/EU of the European Parliament and of the European Council of 27.1.2003 (Directive on waste electrical and electronic equipment (WEEE)), EU Abl. L 37/24.

internalization of negative external effects by the assignment of product responsibility will no longer be possible whenever

- no addressee can be identified within the sovereign territory, i.e. the manufacturer has no branch in the area covered by the regulation and no middleman in the form of an importer exists, and
- the consumer cannot be called upon to bear the disposal costs, or cannot be so called upon in a practicable and understandable manner.

The lack of harmonization of the relevant waste policies could provoke this problem within the European Union. The question of free-rider phenomena and distortions of competition on an international scale would arise. Another problem to be faced within this context could be the fact that the desired innovations with respect to an increased avoidance and a better disposal of waste products partially would not be realized. In trade within the EU, the solution to this problem would require a significant harmonization of policy in the national implementation of a corresponding directive. In international trade with states outside the European Union, a conflict between free trade and environmental protection could appear. Irrespective of the size of the economic relevance, from a legal point of view the principle of non-discrimination would be undermined.

Together with the discussion of the WEEE Directive above all the professional industrial associations Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI 2000) and Europäischer Verband der Maschinen-, Elektro- und Metallverarbeitenden Industrien in Brussels (ORGALIME 2000) reminded of the danger of a regulation defect and a possible distortion of competition caused by that. This is expected with an increased internationalization of the distance trade due to a growing utilization of the Internet, mainly in the case of electrical and electronic devices. The WEEE Directive includes this problem explicitly, but does not give any detail on the practical realization.

This research project deals with the adaptation and shaping of take-back obligations in view of the expected cross-border direct marketing. It includes

- the analysis of the innovation processes in the sectors affected by this problem,
- the examination of the empirical relevance of the regulatory defect of the take-back obligations,
- the evaluation of the respective results concerning consequences for sustainable development and the derivation of need for action, and

– the elaboration of possible solutions on a national and international level.

The structure of this report is as follows:

Chapter 1 shortly presents the concept of extended producer responsibility and outlines the theoretical background with respect to take-back obligations and innovation research in the context of institutional economics and sustainability issues.

Chapter 2 gives an estimation of the expected cross-border direct marketing and defines the scope of this research work. First an estimation of the expected cross-border marketing in total and also by product groups is made. Then the product groups for which cross-border B2C will become relevant, and which will be affected by existing or planned take-back regulations are determined. It is shown that such a phenomenon will be of no relevance for the take-back regulations concerning end-of-life vehicles and batteries, and the affected products but for the WEEE Directive, respectively the national transpositions and the affected electrical and electronic devices, and to a smaller extent for the packaging ordinance and packaging.

The following analysis (chapter 3) of the innovation processes induced by take-back obligations above all concentrates on the sector of electrical and electronic equipment. Packaging is considered to be of minor importance and is dealt with in form of an excursus.

Chapter 3.1 focuses on the analysis of the EEE[2] innovation system and its determinants. After describing the most noteworthy developments in the EEE innovation system, the market and the waste management situation especially for the WEEE related products is highlighted followed by a more detailed analysis of the WEEE/RoHS[3] regulation (chap. 3.1.4) in order to provide a basic understanding of the special interests of innovation actors concerning the implementation of these directives (chap. 3.1.5). Since besides the WEEE Directive the German Packaging Ordinance of 1991 is also affected by B2C, a short overview is given for it in chapter 3.1.6.

Subsequently – in a so called 'reference scenario' – the expected consequences of take-back obligations on innovations are presented and – assuming that a problem of cross-border direct trade does not exist – the conse-

[2] EEE = Electrical and Electronic Equipment.

[3] RoHS Directive: Directive 2002/95/EC of the European Parliament and of the European Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

quences for sustainable innovations[4] are described. Chapter 3.2 provides an analysis of the substantial innovation efforts in the EEE innovation system facing the WEEE/RoHS Directives both on an institutional as well as a technical/organizational level. First, the principal incentive features of the WEEE/RoHS are depicted as additional drivers within the institutional context (chap. 3.2.1). After describing the upcoming institutional changes following the implementation of the WEEE (chap. 3.2.2) a more detailed portrait of selected technical/organizational innovations is defined (chap. 3.2.3) followed by an ecological (chap. 3.2.4) and an economic evaluation (chap. 3.2.5). A short glance at the related packaging problems closes this chapter (chap. 3.2.6).

The evaluation concerning the ecological effectiveness (conserving resources and pollution reduction) and economic efficiency (like cost-efficiency of the take-back system as an institutional innovation, crucial aspects of cost/benefit relations of technological innovations on single disposal markets) is performed in a qualitative way. This is due to the fact that at the moment a great diversity of take-back systems in the EU emerges showing a large scope and options for possible innovations. Furthermore, the data situation according to already existing take-back systems[5] and upcoming solutions[6] is insufficient to evaluate them in a quantitative way.

In chapter 3.3 divergences from the ordinary incentive system are described by pinpointing selected distortions within the incentive mechanisms and possible alterations of these innovation outcomes. The focus will be on assuming a certain volume of economic distortions as the result of free-riding problems caused by B2C cross-border shipments. The regulatory defect, i.e. the insufficient assignment of disposal costs in the case of the cross-border direct marketing, is described in a so called 'defect scenario' by setting an upper and lower limit for the development of cross-border direct trade until 2010. Under the assumption of free-rider behavior within that margin, possible economically and ecologically undesirable effects are evaluated. Here on the one side, effects on national and international competitiveness of domestic manufacturers and distributors are shown if they are charged with the disposal costs of direct imports as well. On the other side the consequences for the innovations are outlined with which a stronger waste pre-

[4] In this study the terms 'sustainable innovation', 'innovation for sustainable development' and "'innovation for a sustainable economy' are used similarly. Innovation is defined for a sustainable economy as those in the field of products, processes, patterns of organization or behavior which contribute to reach goals connected with the concept of a sustainable development better – to a higher degree respectively to a more favorite relationship of costs and benefits – than before. (see in detail chapter 1.2.3)

[5] Like in Belgium, the Netherlands, Sweden etc.

[6] Like in Germany.

vention and better recycling should be achieved. In this context also innovations are mentioned which possibly may be left untouched due to market failure or failure of policies.

Chapter 4 at first gives an overview of approaches to transnational B2C-trade that have been made in the WEEE Directive so far. Starting from this portrait, the different actors involved in the process of designing, implementing, applying and enforcing this directive in order to ensure effective and coherent legislation throughout all Member States will be analyzed. As a result, the different interface problems appearing on different levels will become visible. So regulatory options and coordinative measures allowing to solve these interface problems satisfactorily to all actors will then be scrutinized successively. Finally, recommendations with respect to the different actors are given. At the end of this chapter solutions for packaging are discussed.

In chapter 5 conclusions are drawn for the further implementation of the WEEE Directive with respect to the cross-border assignment of disposal costs, and further research questions are presented. According to the results of this study major changes in the electronics industry innovation system take place at the moment which can be described as upcoming system innovations and substantial transition processes from a linear to a circular industry. Against this background the major challenges of these transition processes and some further research questions to be tackled in this area are put forward as well.

In principle presentations and analysis in this study are based on the situation in Germany. The innovation system of the EEE industry and the technical and organizational innovations caused by the take-back obligations, however, may only be seen within an international context and are presented without reference to a special country. The proposed solutions for the cross-border regulatory defect present approaches for transnational law-making within the EU assuming the cooperation of each country.

From a scientific point of view the project aims to analyze the genesis and the diffusion of innovations and their effects on sustainable development using a legal and an economic perspective. In particular the link between the shaping of framework conditions as well as regulation patterns and innovation potentials for sustainability is outlined. Thus, on the one side crucial thesis of institutional economics and innovation research (economic analysis of formal and informal regulations) will be examined, on the other side particular need for action for the individual participants and environmental and research policy will be shown and solutions will be derived.

The analysis of take-back obligations and their effects can be assigned to the ‘economic analysis of the waste law’. Thus, an analysis of the actual and

expected incentive effects of the instruments implemented with the take-back obligation will take place. To do this, the 'innovation system approach' is used as the innovative behavior of enterprises is not only determined by one or a few instruments of environmental politics but at the same time by their institutional context and their relation to other actors.

This study is based on the evaluation of the relevant legal and environmental economic literature, respective statistics and expert interviews with the European Commission, the German Federal Ministry of Environment (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit – BMU), the Federal Environmental Agency (Umweltbundesamt – UBA), manufacturers, retail traders, and disposers and their respective associations. The 'reference scenario' contains a qualitative evaluation of the development whereas the 'defect scenario' presents a combination of quantitative analysis and qualitative evaluation.

1.2 Theoretical Background

1.2.1 Take-back Obligations in Waste Management Policy

1.2.1.1 Product Responsibility in Germany

The product responsibility of waste management is based on Article 174, Para. 2 of the EU treaty[7], which codifies the polluter-pays principle. This means that the responsibility for environmental load rests upon the shoulders of those who cause the load, as well as those who have the possibility to contribute to an improvement. On the national level, the Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (Kreislaufwirtschafts- und Abfallgesetz – KrW-/AbfG)[8] aims at product responsibility. The main issues are among others the implementation of product responsibility for producers (§ 22 Producer responsibility for all stages of the life cycle of products), and the creation of an avoidance and obligation hierarchy. Hereby avoidance takes priority over use and disposal (§ 4), and re-use over utilization, whereas both are superior to disposal. (§ 22 (2)). Further, there are additional possibilities for the privatization of disposal. All who "develop, manufacture, process, and treat, or distribute" products are viable addressees of product responsibility and will in the following be addressed as a producer or distributor (§ 22 I 1

[7] Title XIX (XVI) „Environment", Art. 174: Consolidated version of the treaty for the founding of the EU; Changes through the treaty of Nica (EU Abl. No. C 325/33 of 24.12.2002) implemented.

[8] KrW/AbfG of 27.09.1994 (BGB1. I S.2705).

Krw-/AbfG). The dimension of product responsibility is defined through examples, and not on the basis of a legal definition (Kloepfer 2001:24). These include:

- the development, production and marketing of goods that can be re-used, and that are technically durable,
- priority for use of materials that are superior in terms of recyclability and innocuous disposal,
- labeling of products containing pollutants, and
- take-back, recovery and disposal of products after their use.

In terms of time, the product responsibility is not restricted to a certain stage; rather it refers to the whole life cycle of products ("from the cradle to the grave") (Messerschmidt 2000: 63).

The concretization of product responsibility will be mandated by statutory ordinances (§§ 23 and 24 KrW/AbfG). According to § 23 KrW-/AbfG the following possibilities exist: mandatory requirements regarding the condition and the use of products, prohibitions of certain products, as well as labeling obligations for the contained material, information on the return possibilities and return obligations, or about the value of a deposit.

On the other hand, §24 KrW-/AbfG authorizes the Federal Government to mandate statutory ordinances that concretize the product responsibility with respect to a take-back of products and the treatment of the waste. Thereby it will be provided that,

- manufacturers or distributors of certain products assume the responsibility for their return, which will be realized by suitable measures, especially by means of take-systems, or by levying a deposit,
- there are obligations to keep records of accepted waste material,
- the regulations on cost absorption for acception, recovery and disposal of accepted products will be met,
- take-back obligations will be imposed,
- the means and manner of take-back, such as the place of transfer, will be arranged,
- responsibility to waste management authorities for the collection of waste will be assigned.

These manifold possibilities to steer, guide or influence the behavior of economic actors can be found in the German take-back regulations. The implementation leads to substantial improvements in the disposal of waste material. By the privatization of the disposal it is intended to strengthen the polluter-pays principle (Clausen, Halstrick-Schwenk 2000: 139p.). Thereby, incentives will be created to contemplate the issues related to disposal already during construction, production and distribution. Meanwhile, take-back regulations have been enacted in Germany for three product groups: packaging waste, end-of-life vehicles, and batteries (compare chapt. 2.2) The EC-directive on waste electrical and electronic equipment had to be transposed EU-wide into national law by 13 August 2004.

1.2.1.2 Extended Producer Responsibility

The German principle of ”product responsibility“ corresponds to the concept of Extended Producer Responsibility (EPR) which is discussed on international level since the beginning of the nineties and which is the basis for measures in many countries. The OECD defines EPR ”as an environmental approach in which a producer's responsibility physical or/and financial is extended to the post-consumer stage of a product's life cycle.” It says that “there are two related features of ERP policy: (1) the shifting of responsibility upstream to the producer and away from municipalities and (2) to provide incentives to producers to incorporate environmental considerations in the design of their products” (OECD 2001: 18).

When the producer bears the responsibility for the product alone it is a matter of ultimate responsibility. Of great, especially practical benefit is the concept of shared or apportioned responsibility: “Not only close coordination between all actors in the product chain are regarded as an inherent part of EPR but also sharing responsibilities in a formal way” (OECD 2001 56f). The well-known model is shared responsibility between the municipal government and the producer. It is argued in addition that it should be born in mind that all actors in the product chain and in society must participate in order to optimize its effects. The distribution of responsibility should be based on the role of the actor in the product chain (OECD 2001: 56pp.). This leads to “apportioned responsibility” between the actors including retailers, consumers etc. as well. There it has to be born in mind that responsibilities must be appropriately shared without diminishing incentives placed on producers themselves. So governments need to select the responsibility model and assign responsibilities (ultimate, shared or apportioned) which are appropriate for the single country and the single product group. (OECD 2001: 62f).

In individual countries different implementations of the EPR with different distributions of responsibilities may be found. Thus, the relevant EC Directives for packaging, end-of life vehicles, and batteries were transposed in different ways, or national solutions to enforce the EPR already existed before the directives were passed. For the transposition of the WEEE Directive also different national solutions are to be expected, since various national take-back solutions already exist for these product groups[9].

1.2.1.3 Characterization of Take-back Obligations

Take-back obligations take a special form in the case of instruments targeting waste from the production range. By the take-back obligations, the producers and distributors are required to take back the products they have produced or distributed from final users at the end of the use phase. These instruments are enacted by the legislator; and they change the responsibilities for the disposal of the concerned products and packaging. While in markets without take-back obligations the owners of the products, or a corporate enterprise under public law are responsible for disposal, in markets with take-back obligations, producers and distributors are obliged to take back old products, being thus responsible for the disposal. Here it is not decisive that the addressee will physically collect the waste material, rather, that he assumes the economic (and legal) responsibility of the disposal. Take-back obligations thus can be regarded as a redefinition of the rights and obligations of disposing of the addressee (Holm-Müller 1993).

This in praxis involves the disposal of the waste concerned separate from other waste. Due to the take-back obligation, consumers have an additional alternative with respect to the disposal of their products, unless an obligation to return against the addressee of the take-back obligation is introduced newly or as a substitute for an existing obligation to return against a public waste disposal authority. In the case of a respective change in the rights and obligations of disposing of the producers and the consumers, the change can be interpreted as follows: With the purchase, the goods no longer leave the responsibility area of the producer or the distributor permanently (abandoning the warranty obligations for once). Rather, merely the right of utilization of the service units that are connected with the product are sold, while the ownership in the material is not transferred[10].

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[9] Compare i.a. OECD (2001) and the mentioned literature; Perchards (2004).

[10] Naturally, this interpretation should be approached from institutional economics, and not a legal perspective. In legal terms, the ownership of the producer ends with the transfer of the product to the distributor or consumer. Kloepfer/Kohls (2000: 1021) emphasize that the take back responsibility at this point did not have an influence, rather, it would do so only when the

The take-back obligation is suitable to deal with the effect disruptions of other instruments occurring especially in the waste management which prevent the transfer of steering impulses up to the producers. (Clausen 2000: 21-23; SRU 1998: Tz. 717; p. 405-406): Waste collection fees for waste from private households are generally paid for by the consumers, and not by the producers. Moreover, they are often independent from the material and the volume. On the one hand, this leads to the fact that, when choosing among goods available on the market, consumers do not acknowledge the disposal related aspects of products which were considered in the design phase. On the other hand, the consumers are not urged to put pressure on the producers to lower the costs connected with disposal (Fenton/Hanley 1995). Moreover, it usually comes to a wild dumping of waste or to a disposal via a collection system targeted for other waste (e.g., the disposal of electronic equipment over biological waste bins).

The negative external effects associated with waste disposal are not a priori internalized with take-back obligations. Alone, assigning disposal responsibility does not necessarily mean that the producer is confronted with disposal costs also including costs caused by negative externalities. This must be taken care of by other instruments such as waste delivery or recycling quotas.

The take-back obligations, as well as other instruments of extended producer responsibility are regularly applied on markets, which also – apart from the above mentioned effect disruption – cannot be considered to be perfect. They supplement a given institutional framework, or a specific regulation pattern, which in turn influence the effects. In particular,

- market failure and stimulus distortion within the disposal system: Examples for the packaging disposal system include the so called "interface zero", as well as the market power of the German DSD[11] and the warrantors.
- market failure and stimulus distortion in the rest of the disposal sector: Fully or partially not internalized external disposal costs of other product groups not being regulated by take-back obligations, as well as disposal prices that due to other reasons have not been set in accordance with the polluter-pays principle, can have undesired effects on the dis-

old equipment were given back by the distributor or final user, namely when the producers are not the regular owners.

[11] DSD = Duales System Deutschland AG, the "Green Dot" organization responsible for the take-back of packaging.

posal decisions or on the consumer's choice of the disposal method, and can thereby damage the effect of take-back obligations.

– the unenforceability of the obligations in terms of product responsibility: This effect disruption may occur not only due to the lack of enforceability in case of the foreign producers which is the issue of this study. The regulation of packaging is a prominent example of a similar problem: Here, a potential free-rider behavior should initially be prevented among others by a self-obligation of trade, to shift its assortment towards DSD licensed products – which was not acceptable due to cartel law (Bock 1996: 189). Also in the implementation of WEEE, the prevention of free-riding turns out to be a key issue.

1.2.2 Innovation Effect of the Take-back Obligations

1.2.2.1 Innovation and Environmental Policy

Within the neoclassical oriented environmental economy numerous criteria to evaluate the environmental instruments are used, besides the ecological effectiveness predominantly the so called 'static and dynamic efficiency' (i.a. Clausen 2000, Fees 1998). On the one side both efficiency criteria pose the question of whether external effects can be internalized by an instrument and at the same time the environmental goal can be achieved by minimal costs . On the other side they disclose whether the addressee will get (long-lasting) incentives to search for innovations, thus being successful beyond the original goal.

Conventional innovations are mostly technical improvements in the form of new products, processes, or new forms of organizations (OECD 1997: 8f., Hemmelskamp 1997: 484pp., Rennings 2000: 322):

– Product innovation comprises the creation and the market launch of new products or significant changes in the products as well as the technical improvement due to the use of new material or functional product parts.

– Process innovations encompass the transition to new or considerably improved production processes.

– Organizational innovation includes measures to improve the operational and organizational structures, the use of new management methods, the use of new trade and buying channels, etc.[12].

The economic innovation concept is extended by social and institutional innovations. The former concerns the forms of the cohabitation of humans and therein the represented norms and values, the latter concerns the institutional frameworks of a society. Social innovations aim at achieving changes in the behavior patterns, the patterns of consumption, and in the environmental awareness. Institutional innovations comprise changes of the so-called formal and informal regulations.

In this respect institutions are defined as a system of rules and standards to steer individual behavior in a certain direction. Institutions can be formal and informal, they may develop "spontaneously", i.e. organize themselves, or been set-up by an authority, as well as all combinations existing between them. Institutions may evolve market-external rules (brought out by non-market participants) or market-internal (brought out by market participants) (Figure 1).

Therefore the traditional environmental policies and their measures are to be characterized as changes in the formal regulations, and the change of informal rules as value changes. New decision-making bodies, consulting instances regarding the improvement of the foundations of decision-making and networks (institutional arrangements) count to the institutional innovations. Institutional innovations are connected with behavior based innovations (behavioral changes) and technical innovations (e.g. researchers and developers) via the changes of the informal regulations (customs and conventions).

Figure 1
Typology of institutions (with examples)

	formal	**Informal**
market-internal	general trading conditions, model contracts, DIN standards	Business habits
market-external	Private law, legal interferences into the private contract design	legally relevant, but unwritten conventions (good habits)

Source: Wegner 1998: 42.

[12] Organizational innovations are considered in the so-called Oslo Manual only casually (OECD 1997: 8, 88f.).

In the context of environmental instruments it can be assumed at first that every instrument, no matter whether it is induced by regulatory policy or market oriented, has got the potential to induce or promote innovations; an instrument will force addressees to take actions they would not have taken without it. (Jaffe/Newell/Stavins 2001: 23). The institutional framework of a corporation is changed. Thus, an adaptation of the production process or of the product design either is required under compliance aspects or will be economically profitable. Beyond this unique adaptation (innovation), the corporations furthermore have incentives to look for more profitable solutions. Thereby, it is assumed that in the case of dynamic efficiency instruments corresponding innovations are not only advantageous in the economic sense, but rather decrease the external effects too.

Whilst in the neoclassical oriented perception (which by assuming perfect information takes for granted that the minimal-cost-combination always can be realized) environmental policy has to lead necessarily to an impairment of the profitability of the enterprises, this must not be the case when the hypothesis of perfect information is dropped or the hypothesis about the principles of profit-maximization is relativized. Under such conditions, a change in the corporations´ regulatory framework by environmental policy could absolutely induce them to pursue new paradigms or development paths which lead to increased profits. These are possible with "win-win"-situations like those which are represented under the so-called Porter-Hypothesis.[13]

These considerations show that innovations can hardly be explained by only one reason; but rather that more factors interact and decide on the character and intensity of the innovations effects (Klemmer/Lehr/Löbbe 1999: 80ff.; Kemp/Smith/Becher 2000: 55pp.). Among these factors are to be counted, first of all, the market conditions, i.e. the structure and the intensity of the competition as well as the prices, including those on the intermediate up- and downstream markets. The incentives for innovation are not only determined by the market conditions, but in a broader sense the sectoral and also the conditions of all actors are relevant. Examples of these would include R&D-policy, education policy and industry policy of the country. The various policies and the connected institutions on the one hand affect the members of the innovation system providing incentives to innovate and on the other hand are influencing their innovation abilities. Therefore, successful innovation activities not only require appropriate incentives, but also the capability to grasp competency and knowledge of different sources of the

[13] Under the Porter-Hypothesis a strict national environmental policy can increase the corporations international competitive position. Cp. Porter/van der Linde (1995) in addition to Palmer/Oates/Portney (1995) and Taistra (2000) provides an overview.

problems, its integration into the own discussion and to shape the innovation process. This innovation process is not only successful against the background of specific institutional conditions, but typically also in cooperation with the members of the innovation system, like those authors emphasize who favor concepts of nationally organized innovation systems (e.g. Nelson 1993; Lundvall 1988: 1993). Nooteboom (2000: 916) outlines that, "innovation outcomes, on the level of firms, are to a large extent determined by the forms of co-ordination used for inter-firm relations, and that these forms of co-ordination are conditioned by institutions […]".

In more detail the **"systems of innovation"** approach stresses that "innovation processes are influenced by many factors: they occur in interaction between institutional and organizational elements which together may be called 'systems of innovation'" (Edquist 1996: 1). The new thinking about 'innovation' within the 'systems of innovation' approach may be characterized as follows:

- Innovation processes are non-linear, described as a complex process of emergence and diffusion of knowledge as well as the translation of these into new products, services, production processes etc. and characterized by complex interactive learning and feedback mechanisms and various relations between different actors (science, policy, firms, R&D-institutions, banks, intermediaries etc.).

- Innovation processes occur over time, whilst the policy perspective to influence innovation processes should regard the time perspective as essential within their governance concepts.

- Innovations are influenced by many factors; they may be technology driven, demand/market-driven, triggered by legislative or regulative issues, by legal conditions, rules and norms, or a result of a complex interrelation of intrinsic and extrinsic variables influencing the behavior of innovation actors.

- Innovation processes are rarely a result of a single firms operation but more and more a result of a closely meshed network of private and even public actors, since various kinds of knowledge, information and other resources are needed to generate, diffuse and use innovations.

- In the innovation process the individual innovation actors are interacting with each other to gain knowledge, exchange information and resources. The behavior of each of these different innovation actors is influenced and shaped by institutions, both formal and informal. Since these different innovation actors are operating also in different institutional contexts, the 'system of institutions' surrounding the innovation

processes is of utmost interest for the genesis, diffusion and use of innovations.

Against this background and coming back to the question of the innovation impact of the take-back obligation, an analysis, which solely focuses on this instrument, can reveal its innovation impact only insufficiently. Take-back obligations are not used as a single instrument but complement the existing regulation pattern with its institutions and instruments As the actual internalization of the external effects cannot be achieved by take-back obligations, as their function rather is bridging between the spheres of production, consumption and waste, the innovation effects must be evaluated against the background of further factors like the regulation pattern of the innovation systems, the institutional and market conditions or the waste sectors as well as the recycling and disposal prices[14].

Moreover in practice mostly not mere obligations for a take-back are pronounced, but rather further obligations and/or instruments are implemented. Examples for this are regulations like the German packaging ordinance (VerpackV) allowing a collective compliance of take-back- and disposal obligations, or those regulations more closely laying down the kind of disposal aimed at as re-use and recycling quota, or regulations which allow to define obligations of further groups of actors. Additions to the take-back obligation like the possibility for a collective compliance of the obligations, or standards for the treatment of old equipment etc. are provided for in the WEEE Directive too (chapter 3.1.4). Such constellations of actors can hardly be modeled adequately. Therefore, in the following only a few fundamental considerations on innovation effects of the take-back obligations will be made.

1.2.2.2 Take-back Obligations and Innovations

If through the take-back obligations the assignment of the disposal costs to the producers will be successful take-back obligations can contribute to permanently realize incentives and innovation effects of other instruments with a view to better recycling and disposal possibilities. As a first step the simplest constellation of an individual take-back responsibility is assumed, considering only producers and consumers of one single product. Further-

[14] It can be expected that the internalization of possible external costs of the disposal of products are of great importance for the strength and the direction of innovation incentives. An implementation of disposal costs according to the polluters-pays principle is connected with significant costs in the field of household devices but it is much easier to achieve in the commercial field as the volume there is generally higher and the structure less heterogeneous. As the take-back obligations assign responsibilities to the manufacturers, the distortions of the incentives with respect to domestic waste can be reduced.

more there should be an ex-ante independence of decisions which determine waste amount and waste disposal which will be overcome by the take-back obligation. However, as costs for collection, sorting, and recycling along with those for the enforcement of the regulations (transaction costs) are relevant for the assessment of the macro-economic advantages of a chosen disposal system, the results of an analysis of the innovation effects will only produce limited information.

Furthermore only such innovations with a direct connection to negative external effects and occurring during the phases of production or return/recycling are considered. For the one part these could be a change in the product design going along with reduced ecological problems during the disposal phase. Such environmentally relevant product innovations e.g. could contribute to an increased useful life (in a technical sense) or to improved dismantling characteristics. An environmentally relevant process innovation on the production level could be the reduction of the resource input e.g. through closed loop circulation allowing a re-use of cut off material. Above that companies could try to bring about improvements of its re-use and disposal capabilities. Such improvements could be e.g. processes for the (partial) automation of the dismantling of old products, for an improved material recognition, or for an improved extraction of secondary raw materials. Within this context the production related know-how generally is not simply transferable, i.e. the individual steps of recycling processes are not a mere reverse production process (Figure 2).

Figure 2
Environmental relevant product and process innovations

Level (Actor) → ↓ Form of innovation	(Manufacture/Production) (Producer)	Recycling (Recycler)
Product innovations	Increase of life span Improvement of design for disassembly, recyclability	Improvement of recycling output
Process innovations	closed-loop circulation within production plants	Improvement of separation, disassembly and recycling techniques

Independent from recycling and disposal costs the manufacturers basically have incentives for innovations too, on the one side aiming at a reduction of the take-back costs, and on the other side at a utilization of *waste products* coming anew into their area of responsibility[15]. The latter may be explained by the fact that manufacturers now receive waste products from which sec-

[15] This is valid only if the disposal costs are not completely paid by the consumers and their demand does not decrease.

ondary raw materials can be recovered to substitute primary raw materials. Therefore, under the conditions of a take-back obligation the rule of balancing marginal productivities production is based upon may lead to a changed relation of factor inputs respectively to production innovations.

Incentives for innovation for the manufacturers as a result of the assignment of producer responsibility will arise only if their disposal costs at least partly reflect the quantity or the quality of the old products to be disposed off. Then they basically have the chance to reduce the future waste management costs by changing their product design or packaging. For the extreme case of fixed recycling- or disposal costs, however, no or even less incentives for innovations will arise.

The new definition of disposal obligations of manufacturers and consumers as well as the set-up of separate disposal systems for individual product groups usually lead to a higher and more continuous volume of old products than it was to be expected previously. A grouping of the products to be disposed off through the manufacturer (or responsible specialized actors) leads to hope that during recycling processes minimum efficient input volumes and/or increased economies of scale will be realized. So, Hafkesbrink et al. (1998: 121) considered small take-back volumes an important cause for the fact that in the middle of the 1990s basically existing recycling techniques for the recycling of used electrical equipment were not widely used. Additionally such a high return of waste products may make a change of the recycling techniques beneficial, which due to previously high fixed costs had not been beneficial yet (example given in Clausen 2000: 104p.). This way an innovation impulse may be initiated at the same time focusing on process inventions and their diffusion.

The market conditions for used parts, secondary raw material, and waste to be disposed off should be equally important for innovation incentives. So, heavily fluctuating prices for raw materials increase the economic risks in the recycling sector. On the other hand tightened waste management conditions as implemented in the case of the German Technical Directive on urban waste (*TA-Siedlungsabfall)* are expected to have positive effects on the recycling sector. Also to be seen in this context is the opinion that the existing uncertainty as to the political influence on environmental regulations – e.g. existing in the case of disposal of electronic scrap since the first half of the 1990s – are a heavy obstacle for innovations and as a consequence lead to a general restraint for investments into sorting and recycling facilities (Hafkesbrink et al. 1998: 118, Blazajczak et al. 1999: 14)[16].

[16] Whilst in this context effects of instruments of environmental politics on the technical progress is the dominating aspect, also the general technical progress influences the performance

The market and contractual relationships of waste management systems embracing many manufacturers which need to be analyzed with respect to incentives as well have not been included yet into the considerations. Collective waste management systems in which many manufacturers can dispose off product waste, can be superior to individual take-back solutions especially with respect to collection and sorting costs, at least, as long as material or energetic recycling prevails over re-use of products and product components.

1.2.2.3 Innovation Effects of Cross-border Direct Marketing

A major problem of an appropriate cost assignment may be cross-border direct marketing. In this case producers abroad might be able to avoid paying the disposal costs of their products if they do not have a subsidiary in the area covered by the regulation. If they succeed in circumventing expenditures for taking-back and recycling, they will have immediate economic advantages. In these cases the domestic producers are also responsible for the non-assignable costs of these free-riders. As far as the assignment of all recycling costs to domestic actors leads to a level which might be market relevant this will result in an aggravation of the economic situation and the relative competitive position of those enterprises. These distortions of competition will have an impact on the behavior of the actors. A changed behavior of the producers/importers will affect

- the efforts to innovate in products and production processes and the institutional innovations as well as
- the attitudes and acceptance regarding the framework conditions and the pattern of regulation.

In reality, these aspects should be hard to separate from each other. Regarding the consequences of the defect on the innovation activities of the actors the direction of the change of behavior is a priori open. For those actors, that can shirk responsibility, it can be expected that they will have only small incentives to innovate. In the extreme example their behavior will remain unchanged. For domestic actors who do not or cannot act as free-riders the following forms of reaction are conceivable:

- no change of behavior or only minor innovation efforts,

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of instruments of environmental politics (Jaffe et al. 2001: 21). Examples for this are e.g. IT-technologies to facilitate monitoring or the collection of data through barcodes or similar devices relevant for waste management to facilitate sorting and recycling.

- stronger innovation efforts if the costs arising from development and reorganization of the production are lower than the difference between the new disposal costs and the disposal costs to be expected otherwise and
- free-rider behavior also inland. It has to be expected that in the case of market-relevant dimensions of additional disposal costs to bear the readiness of the domestic actors to abide the respective rules and regulations will erode and strategies of avoidance will be pursued.

The possible effects of behavioral changes caused by an insufficient assignment of disposal costs will be presented in the defect scenario in chapter 3.3.

1.2.3 Sustainability and Sustainable Innovations

For the last years sustainable development has become the key term denoting a future society and combining economic progress with the preservation of the environment and with social equity. The concepts worked out in this context in general have a normative basis which consists of the demand for justice in and between generations. Starting points for concepts on intergenerational allocation justice were reflections on the management of regenerative and non regenerative resources as well as the absorption capacity of environment media. The management rules (Daly 1990; Pearce, Turner 1990; Enquête-Kommission „Schutz des Menschen und der Umwelt“ des Deutschen Bundestages (Hrsg.) 1993 and 1994) developed then, however, have been only a first step of the realization of this vision. Based on the fact that the future development of a society may be affected by ecological risks and economic distortions as well as social tensions during recent years the importance of the last two points has been emphasized more and more. The pragmatic concept of the so called three pillar model follows these ideas which include the principal equity of ecological, economical and social aspects (Klemmer 1994; Klemmer 1999). The use of the three pillar model has significant advantages: the separate identification of ecological, social and economic objectives emphasizes their independence and equal importance. Furthermore it is an open approach as the elements of each pillar are not determined in advance, and so considering information problems and normative values and goals. Showing these three goals separately at first emphasizes their independence and at the same time addresses the interdependency – complementarities and conflicting goals. This model offers, however, opportunities for a constructive dialogue in the sense of a heuristic potential for the search for double or triple dividend-effects, but, at the same time, aggravates the problems of the appreciation of values and evaluation.

Accepting this concept the long term social development not only depends on natural or ecological capital stock but also on social capital stock. Economic development without intergenerational allocation conflicts is ensured only when at least one of these determinants for development increases and/or a substitutability of these stock figures may be presumed, or when innovations are able to surpass bottlenecks which result when one of these factors will impede the development.

Although decisions about the use of instruments in ecological policy have been made presumably all times not only against the background of their ecological effects but also regarding micro- and macroeconomic effects, the decision problem changes fundamentally when the concept of sustainability is included. This trichotomy of goals implies for the evaluation of the effects of instruments of ecological policy as well as for innovations in general that all three dimensions have to be included explicitly. Innovations for a sustainable economic behavior as they are in the centre of the BMBF research program: [riw][17] can be distinguished from other innovations by a combination of the traditional innovation concept with the goals of a sustainable development. This, however, calls for a combination of two levels of goals, viz, on the one hand the level of innovating actors and on the other hand the macroeconomic goals of a sustainable development. Like changes which are felt as innovations on the microeconomic level must not be innovations in the strict sense on the macroeconomic level, but rather the expression of the diffusion or imitation, it is possible that innovations introduced by single actors are not in accordance with the goals of sustainability.

Single actors or groups of actors in the enterprise sector innovate if they expect (microeconomic) advantages (OECD 1997: 16). For example process innovations of a company like the improvement of the closed loop circulation of materials decrease the production costs at a given level of output and are at the same time a successful environmental process innovation. Equally, improvements of the products as low levels of energy or water consumption by electric household appliances can lead to gains in market share. Technical innovations like these are usually accompanied by behavioral and institutional innovations. In companies mainly legal requirements and regulations in this field are the reason and starting point for respective activities. But in recent times also intrinsic motivations like a rising environment consciousness are playing a bigger role. If private households/consumers change their bundle or basket of goods with respect to their utility it is called (behavioral) innovations. They can, for example, change their mobility patterns

[17] The BMBF research program: [riw] comprises several research projects on various issues of "framework conditions for innovation towards sustainability" (BMBF – Bundesministerium für Bildung und Forschung – Federal Ministry of Education and Research).

and use the bicycle or form car pools for commuting to work instead of relying on their individual car. They also can change their attitude towards the ownership of goods by leasing instead of buying large household appliances or cars or share their use with others (car-sharing resp. the multiple use of appliances in a multi-party house. Such behavioral innovations are generally called social innovations (Rennings 1999: 24 refering to Scherhorn et al. 1997: 16).

In the typical trichotomy of the groups of actors finally (by neglecting non-profit organizations) the government sector especially in his role remains as legislator in the field of the environment. These innovations in the framework conditions caused by laws, directives etc. can be understood as formal institutional innovations[18].

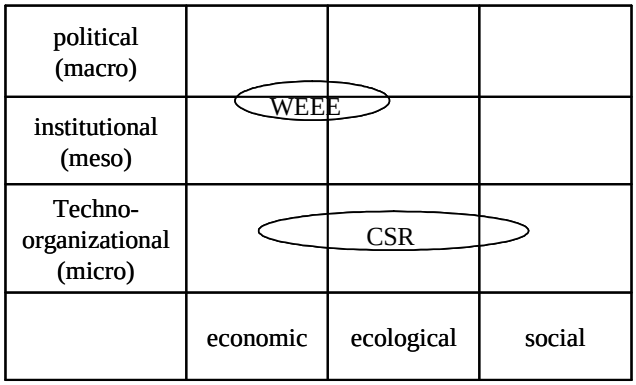
Relying on these considerations innovations for a sustainable economy may be defined as those in the field of products, processes, patterns of organization or behavior which contribute to achieve goals connected with the concept of a sustainable development to a higher degree resp. to a more favorite relationship of costs and utility than before. Because innovations can possibly touch several dimensions of sustainable development, a consideration of positive and negative contributions to reach the target is necessary in order to distinguish macro economically reasonable from macro economically not desirable innovations. Innovations for a sustainable development are, therefore, a subset of innovations as explained before.

Thus, looking back at the definition of "system innovations" "sustainable system innovations" in that context may be defined as a particular kind of system innovation, comprising economic, ecological and social aspects as well as organizational, institutional and even political elements (see chapter 1.2.2.1). The portfolio of sustainable innovation is depicted in figure 3.

Sustainable system innovation takes place at different levels, influencing each other: the micro-, meso- and macro-level and comprising economic, ecological and social aspects (Rotmans et al. 2001). The micro-level (*niches*) relates to individual actors, companies and technologies, the place where novelties are invented, tested and exploited. The meso-level (*regimes*) relates to networks, communities and organizations, institutional arrangements, dominant practices, rules and shared assumptions. On this level, also technology regimes, production regimes, user regimes and policy regimes are distinguished (Kemp and Loorbach 2003: 9). The macro-level (*socio-*

[18] Institutional innovations of an informal character would concern conventions and customs and usually do not have their seeds in public acting.

Figure 3
Portfolio of sustainable system innovations



Source: Hafkesbrink (2004).

technical landscape) comprises conglomerates of institutions and organizations (e.g. a nation) and relates to material and immaterial elements like material infrastructure, political culture and coalitions, social values, macro economy, demography and the natural environment (Kemp and Loorbach 2003: 9; Meyer-Stamer 2003).

The matrix may be used as a descriptive tool to compile different system innovations according to their priorities as well as a heuristic tool to assess the impacts of a particular innovation with respect to the categorization. As sketched in figure 1 (p. 22), the WEEE Directive may be mapped as a political/institutional innovation comprising primarily economic and ecological issues. Corporate Social Responsibility programs (CSR) of companies may be indicated as organizational system innovations comprising economic, ecological and social concerns.

But the realization and evaluation of the effects of an innovation with respect to the goals of a sustainable development are connected with major assessment problems. This can be seen by the fact that several indicators including physical and non-monetary ones are in use instead of a single highly aggregated one. The use of measuring concepts with several indicators does, however, not necessarily means that the problems of evaluation and weighting are solved. This is also true for the widely used concept of the *UN Commission on Sustainable Development*, which distinguishes between driving force-, state- und response-indicators and includes all three dimensions of the basic concept of sustainability (see for details chapt. 3.2).

1.3 Methods

The project "INVERSI" uses different methods dealing with the afore outlined problem of evaluating the consequences of the change of specific framework conditions on innovation systems, especially on the free-rider problem within take-back obligations caused by cross-border B2C. The underlying methodological approach is based on a comparison of two scenarios evaluating and describing the innovation system of the electronics industry with respect to framework conditions and the resulting innovation processes.

(a) Reference scenario:

The so called reference scenario is based on the assumption that there is no free-rider problem due to cross-border B2C which will cause distortions of competition within the industry and thus induce consequences for sustainable innovations. Assuming this a "status-quo" of the development of innovations which presently is to be seen under the existing and foreseeable regulatory context of market and other framework conditions is described.

The analysis of the innovation processes at first is based on a record showing the major technological, organizational and institutional innovations during the last 15 years. The reference period for this is the time frame for the implementation of the WEEE on a European level, including the time period from 1991 on when the first draft of such a take-back regulation was published in Germany.

The method for this was an expert delphi involving the expertise of 25 experts from the EU thematic network "ECOLIFE" within a three step survey regarding the importance of innovations for design, production processes, useful life, end-of-life, and management of the innovation process in the electronics industry. The three survey steps were (1) recording and describing the innovations of the respective field, (2) grouping of the 120 innovations into 45 groups which with respect to their relevance for the sustainable development were rated as important or very important, and (3) an assessment of the need for action for the further development of these innovations as a substantial contribution to sustainable development[19].

(b) Defect scenario:

The so-called defect scenario is based on the assumption that activity disruptures caused by free-riders due to cross-border B2C will occur if not explicitly considered within the implementation of the WEEE Directive. The

[19] Detailed results are published in Hafkesbrink et al. 2004.

consequence will be a distortion of competition as the (foreign) supplier can offer his products at a price exclusive of disposal costs with domestic actors having to carry these costs. Secondary statistics of the German Federal Statistical Office (Statistisches Bundesamt) especially data on production and foreign trade as well as studies on cross-border distance trade with particular respect to the development of e-commerce were analyzed to assess the empirical relevance of the activity defects of take-back obligations.

To be able to assess the quantitative defect with respect to the distortions of the disposal costs in connection with the WEEE Directive and the packaging ordinance[20] for the EEE market supply in Germany a projection of the overall volume of the respective disposal costs was undertaken based on estimated values of the disposal costs for single products being projected.

Assuming a certain range with plausible upper and lower limits for the future development of e-commerce, and also assuming a certain opportunistical free-rider behavior, then upper and lower limits for quantitative distortions in the assignment of disposal costs were assessed which then were the basis for the evaluation of resulting incentives or obstacles for innovation.

The evaluation of the results with respect to sustainability and the derivation of the necessary need for action were based on discussions with experts. For this purpose a number of experts from politics, as the EU-Commission, BMU and UBA, industry associations and companies (producers, disposers, recyclers, service suppliers, etc.) and research institutions were interviewed. Based on empirical surveys and own legal considerations finally solutions to solve the free-rider problem on a transnational level were developed and introduced into the ongoing discussion on the implementation of the WEEE Directive. For this reason the respective results of the project "INVERSI" were presented to the Technical Adaptation Committee of the EU (TAC)[21].

Insofar with respect to transferring results of scientific research work into policy making approaches for practical solutions of the implementation of the WEEE Directive were given. In doing so the research group on purpose left the path of mere scientific analysis and observation in favor of an active presentation of suggestions.

[20] As all electronic equipment introduced into the market also need packaging the shipments of goods at the same time fall under the WEEE-take-back-regulation as well as under the packaging ordinance (VerpackV) causing corresponding disposal costs within both regulatory systems.

[21] This was done on 17 March 2004.

2. Scope of the Subject Studied

2.1 Identification of Relevant Product Groups

This study deals with the deficiency of effects of a take-back obligation caused by cross-border trade of the product groups concerned. This kind of distribution belongs to distance trade which is characterized by the regional distance between the buyers and the sellers. Alongside the traditional mail order business this is generally the case for electronic commerce. In traditional mail orders the purchases are made by written or telephone order and the delivery of goods by mail or parcel service, whereas in electronic commerce offer and order are handled by a technical device which renders online-trade possible. Consultation, delivery and payments can be made either in the traditional fashion or by way of electronic assistance. Relevant for the question of allocation of responsibility for the product is the (non virtual) trade between business and consumer (B2C). Therefore, the suppliers in cross-border trade comprise of institutional mail-order business, stationary trade which uses e-commerce as an additional pillar and manufacturers that supply directly to consumers without intermediary trade (Müller-Hagedorn 2000). The trade flows of the latter are commonly cited as direct marketing. In the context of this study the notions of distance trade and direct marketing are used synonymously.

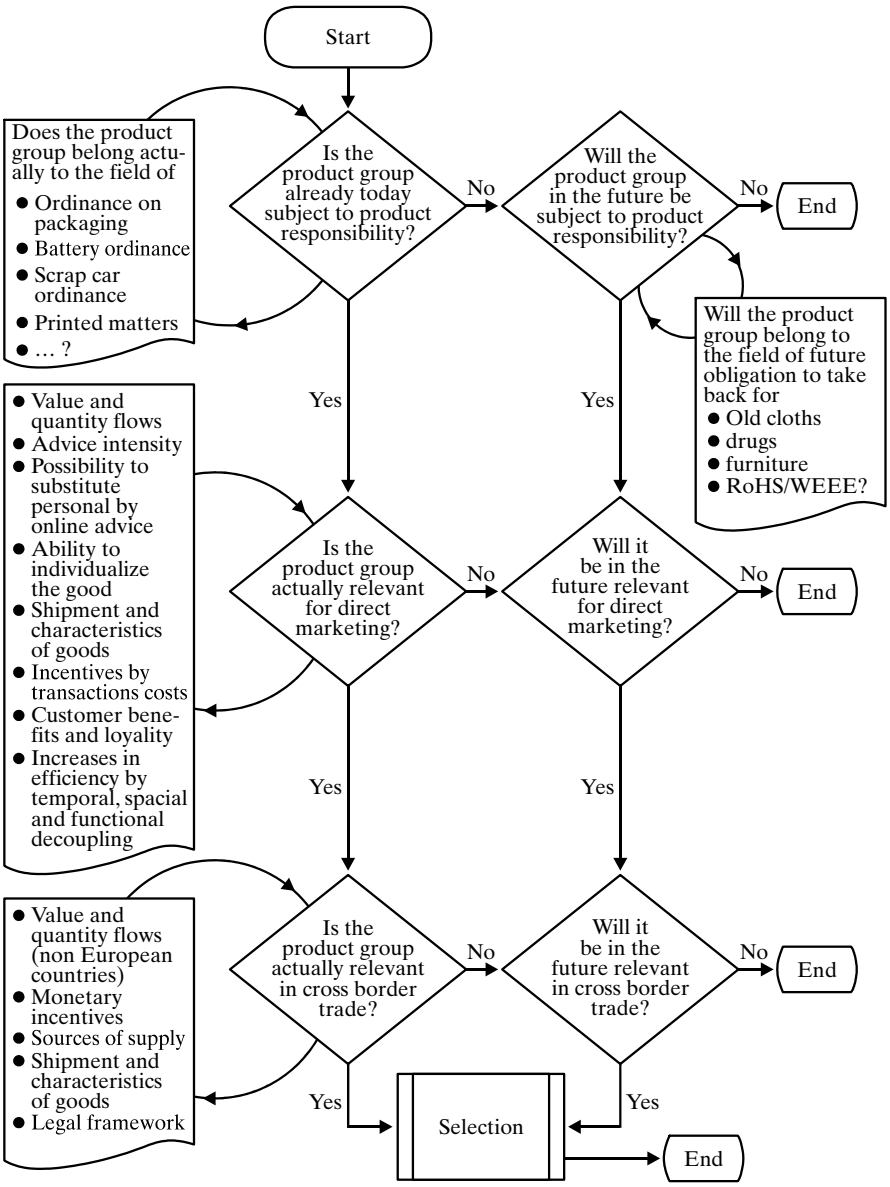
For the assessment of a potential flaw in the framework conditions of the innovation system and the resulting direct and indirect economic, ecological and social consequences caused either by evasion activities or by omitted innovations by the actors of the innovation system it is necessary to make an estimate of the volume of the traded goods concerned. In order to identify the product groups relevant for the study several filters can be used (Figure 4). Regarding the aim of the study, the focus lies on groups of products which

- are relevant for waste legislation, i.e. which already fall under the take-back legislation either by European or national law or which could fall under the legislation in the future;
- are or will be relevant in the future for direct mailing for B2C and distance selling, in which particular products count that
- play a role in cross-border trade.

These aspects lead to a raster scan of single questions for the assessment of product groups which is depicted in figure 4.

Figure 4

Raster scan for the identification of product groups relevant for the study



The relevance of waste legislation arises from the current and future legal situation concerning take-back obligations.

2.2 Existing and Planned Take-back Obligations

The scope of this project is primarily defined by the current and future legal situation with respect to take-back obligations. The German Ordinance on the Prevention of Packaging Waste (Packaging Ordinance) which was enacted in 1991[22] was one of the first examples of extended producer responsibility (EPR). An amendment of the Packaging Ordinance was passed in 1998. This amendment was necessary in order to fulfill the requirements of the European Packaging and Packaging Waste Directive (94/62/EC)[23] and of the German KRW-/AbfG as well as to eliminate regulatory gaps (compare chapter 3.1.6). In the meantime the packaging-directive is transposed into national law of all (old) Member States. For the disposal of cars the German End-of-life Vehicle Act (AltfahrzeugG)[24] was passed in 2001. With this the EC Directive on end-of life vehicles was transposed into national law[25]. The EC Directive on Waste of Electronic and Electrical Equipment (WEEE) which was passed on 27 January 2003 has to be transposed into national law until 13 August 2004[26] (compare chapter 3.1.4). To regulate the disposal of used batteries the "Ordinance on the Return and Disposal of Used Batteries and Accumulators (Battery Ordinance – BattV) was passed in 2001[27]. With this the respective EC-directive 91/157 EEC was transposed. In the meantime a draft of a new EC-directive on batteries was presented on 21 November 2003[28].

The promoting of further take-back obligations for other products e.g. old textiles, wood etc does not belong to the priorities of the EU-waste policy in the foreseeable future[29]. Above that there are no hints to be found in actual

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[22] The Packaging Ordinance came into effect for transport packaging in December 1991, for secondary packaging in April 1992 and for sales packaging in January 1993.

[23] The Directive 94/62/EC was last amended by the Directive on Packaging and Packaging Waste 2004/12/EC of 11 February 2004.

[24] German ordinance regulating the disposal of end-of-life vehicles of 21 June 2002.

[25] Directive 2000/53/EC of the European Parliament and Council of 18 September 2000 on end-of life vehicles (ABl. EG Nr.L 269 S.34.).

[26] Directive 2002/96/EG of the European Parliament and Council of January 27th 2003 on Waste of Electronic and Electrical Equipment (WEEE)), EG ABl. L 37/24.

[27] BGBl. I page1486, most recently amended by the Act of 9 September 2001 (BGBl. I page 2331).

[28] Proposal for a Directive of the European Parliament and of the Council on Batteries and Accumulators and spent Batteries and Accumulators (2003/0282 (COD)) adopted on 21 November 2003.

[29] This was stated in an interview with the EU-commission on 27 June 2002.

policy and action programs of the EU that such regulations are on the Agenda. Instead the EU now prefers a holistic approach with concepts like integrated product policy and life-cycle analysis.

2.3 Relevance of Cross-border Business to Consumer E-Commerce (B2C)

E-commerce as the act of purchasing goods and services which is performed by a customer via the Internet, is still a field of the economy where reliable statistical data are scarce (UNCTAD 2003: 16 – 17). Most of the time, the only sources are figures published by market research companies. According to such estimations the total volume of e-commerce worldwide has amounted to 1.7 tn. US-$ in the year 2003 with an expected increase up to 2.5 tn. US-$ in 2004 and even up to 3.8 tn. US-$ in 2005. The share of Western Europe for 2003 is calculated at between 477 and 516 bn. US-$ and expected to more than double in 2005 which would signify a share of 30 % of total global e-commerce. However, the institutions publishing these estimations agree that only about 10-15 % of it can be attributed to B2C-e-commerce – a relation that is not expected to change in the near future (TNS Infratest/IIE 2004: 220 – 223). For the year 2007 the turnover in total e-commerce in Western Europe is forecasted to even 2,423 bn. € (EITO 2004).

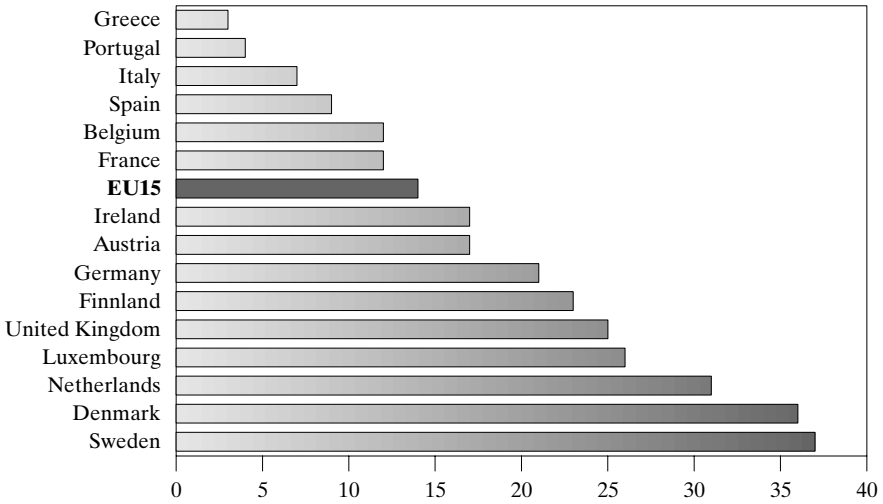
For the German market estimations of online trade with consumers have assumed in the last years a market volume of 4 to 6 bn. € (ECC 2003, HDE 2001, 2002). The Federal German Statistical Office (Statistisches Bundesamt) estimated the B2C-turnover with goods in Germany in an order of magnitude of about 6 bn. € in the year 2002 as a minimum level (Petrauschke 2003). However, the association of German direct marketers has published for the year 2003 a total turnover (without digital services and travel) of only 3.6 bn. € which is, nevertheless, three times more than in the year 2000 (bvh 2004, anonymous 2004a). However, EITO has published much more optimistic figures for e-commerce-turnover in Germany – including travel services in March 2004. According to those estimations Germany held 29 % of the total e-commerce-turnover 477 bn. € in Western Europe or 138 bn. €. Germany's share of B2C-turnover is set remarkably high at 15.4 bn. € in 2003 (EITO 2004: 21 table 3).

In general, different studies act on the assumption that the B2C-e-commerce will continue to grow considerably over the next few years, although the estimations have become more reserved than before (European Commission 2001a: 25, NFO Infratest 2002: 343ff., TNS Infratest/IIE 2004: 264, table 264). Especially the number of online-shoppers is still rising with the increasing use of the Internet by customers (Enigma GfK/TNS Infratest 2004: 8) and is expected to continue. As the Eurobarometer published in March

2004, Germany is still lacking behind countries like the United Kingdom or the Scandinavian countries in purchases on the Internet (Figure 5).

Figure 5

EU15 citizens who have purchased on the Internet
2003; in %



Source: European Commission (eds.), Issues relating to business and consumere-commerce, 2003:3.

The relations between countries have not changed essentially in the last years. In a study commissioned by the European Commission published in November 2002, only 5 % of private households in Germany declared to use the Internet frequently for purchases, additional 23 % occasionally and additional 24 % rarely. With these shares Germany ranked, however, clearly above the European average (EOS Gallup Europe: 2002:50). As these shares had not changed significantly since the preceding survey in mid 2001 these results supported the view that some of the recent hopes regarding a more dynamic evolution of the Internet as a distribution channel to consumers could not have been fulfilled until now.

The European Commission therefore assumes the combination between conventional channels of distribution and the possibilities opened up by the Internet with the so-called "Bricks and clicks – Models" the current most promising solution for further proliferation of online-trade (European Commission 2001a: 12). This view is shared by the German Retailers Association (HDE) that expects total online turnover in Germany to rise by 18 % to 13 bn. € in 2004 with multi-channel shops being the main winners (anonymous

2004b). Expectations of EITO for 2007 are even higher with 48 bn. € online-shopping turnover and additional 40 bn. € offline-turnover by 16 mill. cross-channel shoppers who have been influenced by information and price comparisons via the Internet before actually buying in a traditional shop (EITO 2004: 181 figure 14). The "Bricks and clicks – Models", however, do not usually belong to the cross-border distance trade, because it can be assumed that the shops will be located close to the customers.

In traditional mail order business, the so-called "Multi-Channel-Retailing", the Internet is a new but essential addition to the business and is regarded as nurturing growth (BVH 2001: 2p.). By using this new technology the possibility is opened-up to gain new customers and to foster customer loyalty. The customer's electronic order is followed by the same sequence of services as with an order based on a catalogue via telephone, fax or letter. All the existing structures beginning with the reception of the order, customer care, stock-keeping and logistics to the after-sales-activities remain unchanged.

The relevance of single groups of products in direct marketing meanwhile can be traced, at least for Germany, fairly well on the basis of ongoing surveys. Data published in mid-October 2003 from the GFK Web*Scope-Study show that in the first half-year 2003 2.4 bn. € were spent on buying goods via Internet. Compared to the same period one year earlier, German private households increased their purchases via Internet by 27 %. This would equal a total turnover of online-sales for 2003 of at least 5.3 bn. €. Last year's volume of 4.7 bn. would be outdone by 0.7 bn. €. In this estimation it is assumed that the frequency of purchases (purchases per customer) as well as the average sum spent online will remain unchanged. Therefore, the increase will only be the result of an increasing number of Internet-users. However, if like in the first half of 2003 both the frequency of purchases as well as the average sum spent online continues to rise it is possible that the total turnover will even amount to 5.7 bn. € (GFK 2003a). It should, however, be taken into account that services rendered online play an important role in that development. In November 2003, the association of German Direct-Marketers (Bundesverband des Deutschen Versandhandels e.V.) published an estimation for the year 2003 of the volume of turnover by e-commerce in Germany excluding digital services and travel bookings of only 3.6 bn. €. This would mean that in comparison to the year 2000 e-commerce turnover would have more than tripled. Measured by the total turnover in direct marketing of 21.3 bn. € the share of Online-Shops would have risen by 17 %. The share of e-commerce of the total German retail turnover of 365 bn. € amounts meanwhile to 1 %.

As explained with figure 1, the relevance of groups of products in total direct-marketing is determined by a series of different factors, like:

- The target group: does the product appeal to the (currently still dominating) age group of Internet-users up to age of 45 years?
- The need for consultation of the group of products: can it be expected that the product can be sold by way of direct marketing without personal consultation by sales agents? Hence, could the product also be sold by means of a classical catalogue? Could the consultation of the buyer as an accompanying service in the act of selling possibly be emulated in electronic fashion? Or, on the contrary, can services complement a certain type of product delivery best by using electronic media?
- The ability of the product to be individualized: is the product or the group of products likely to be individualized, i.e. for a layout specific for the respective client, and could it, therefore, be especially apt to be marketed directly?
- Shipment and characteristics of the product: which role do shipping distances or special characteristics play for the product, for example the possibility to digitalize it, the durability of the product and its handling which depends greatly on its size and weight?
- Incentives given by transaction costs: to which degree could direct mailing cut transaction costs?
- Client benefits: could client benefits be increased distinctly by decoupling the interaction between seller and buyer in time and space?

These criteria have been met for many years and have remained almost unchanged for the same group of products. Represented by several similar surveys the following table cites the list of products sold most frequently online published by AGIREV (Arbeitsgemeinschaft Internet Research e.V.) in its Online Coverage Monitor ORM 2003 II. The target group of this survey was 17.59 mills buyers who had made purchases of at least one product in the last 12 months via the Internet.

But if not the frequency of purchases but the breakdown of turnover by products is considered, the result changes due to the average prices of products traded. In this category clothing and shoes had the highest share in 2003 with 11.5 %, followed by PC-accessories with 10.8 %, consumer electronics/ photo/ video with 8.7 % whereas books including cards and journals with 6.1 % and CDs/CD-ROM with only 4.1 % are lagging behind (TNS Infratest/IIE 2004: 275).

Table 1
Products most frequently bought via Internet in Germany
2003, in %

Books	44.1
Music-CDs	34.9
Clothing, Shoes	31.4
Gifts	28.0
Admission-tickets	22.2
Computer-Hardware, accessories	22.2
CD-ROMs, DVDs	20.6
Train-tickets	19.8
User-software	19.7

AGIREV 2003.

The diversity of the products successful in e-commerce shows that there seems to be no general and simple rule whether a product can be marketed successfully via the Internet or not. However, it seems to be beyond dispute that the reasons for that kind of success can be found to a certain extent in the nature of the products themselves: the sooner the potential buyer can determine the use and the quality of the product, the easier it is to be sold over the net. It is only on that basis that potential price advantages of direct-marketing can be unfolded to the customers. On the seller's part there are also logistic factors which are important for success in direct-selling via the net. Specific examples of business models show that by using adequate logistics even perishable goods like flowers can be sold successfully. However, these examples of success were scarce until now and the importance of adequate logistics is more clearly shown by the lack of success of e-commerce business models previously. Although the factors of customer convenience and time saving may play a favorable role for success, the importance of logistics can best be demonstrated by the numerous insolvent Internet-grocers, in particular in the U.S, which have occurred in recent times. Especially the additional costs of transport and delivery of cooled and frozen products should not be underestimated in deliberating the potential success of products suitable for selling by e-commerce.

But there are also products which have played only a subordinate role in direct-marketing until now, but which meet, in principal, the requirements of a product to be marketed successfully via the net, and, hence, possess considerable sales potential. Currently the best example for this group of products is auto parts. This is the result of a survey made in the context of the Online Shopping Survey (OSS), a joint survey by NFO Infratest and ENIGMA GfK, in which in February 2003 a total of 1,010 German Internet-

users between 14 and 69 years of age were asked via telephone inquiry about their use of the Internet. One-third of those using the Internet had acquired auto parts in the preceding year and one-seventh of these – in total 1.5 mills Germans – had purchased these parts via the Internet. This equals a turnover of almost one bn. € (GFK 2003b). The survey further concludes that it is to be expected that this market will expand even more in the future because an additional 2.7 mills Internet-users are expecting themselves buying auto parts by e-commerce in the future. The commerce of cars is currently assisted by the Internet mainly as a channel and a tool of information about the multifaceted possibilities to equip the car of one's choice quietly at home. As in Germany the network of stationary car sellers is relatively tight, therefore the attractiveness of ordering directly online in the future will mainly depend on whether the consumers could realize price rebates by doing so. Currently, i.e. in the first half of 2004, about 19 % of new cars are sold over the Internet in Germany according to the Online Shopping-Survey 2004 by Enigma-GFK and TNS-Infratest (Anonymous 2004c).

2.4 Product Groups with Cross-border Relevance

For the assessment of the cross-border relevance of products traded via the Internet it is not possible to revert to statistics as it is with foreign trade in general. According to a study commissioned by the European Commission published at the end of 2002 7 % of German private households made purchases from foreign suppliers by way of the traditional mail order business and 15 % by way of e-commerce. Although it has not been disclosed to the extent of revealing the number of households that undertake both forms of purchasing (Press and Communication Directorate-General, Public Opinion Analysis Unit (ed. 2002): 8-11). However, by judging such data one has to bear in mind the warning by OECD that it is sometimes difficult for the household to know where the Internet-supplier is actually located because the country of the location of the enterprise and of the web-site are not necessarily identical (OECD 2002: 68).

Relevant in the context of possible regulation deficiencies caused by take-back obligations are only cross-border flows of goods without interpolation of a German distributor. After all, almost half of German households which had bought online declared to have done this at least once through a foreign supplier (EOS Gallup Europe 2002: 62). In relation to total turnover, however, the share of this kind of purchasing from private customers in another country is still very low: based on a survey with General Managers and Marketing Directors an EU-study estimates that in the 12 months between mid 2001 and 2002 only 3 % of the purchases made by consumers via the Internet were made outside of their own country (Press and Communication Directorate-General, Public Opinion Analysis Unit ed. 2002: 25). These

findings comply with statements by the interested associations as for example the European Association of the Direct-Mailing Business (AEVPC) which asserted in a discussion held in the context of this study that from total distance trade in Europe only 3% is expected to be cross-border distance trade.

Independent from the data situation that is far from being satisfactory, it can be asked which factors may lead to success in cross-border trade via Internet. The most important of these factors are supposed to be:

Import promoting circumstances:

- Monetary incentives: a price differential to other countries, which leads to economic advantages for the customer by buying in another country.
- Source of supply: the foreign country is the only source of supply for the product.

Import inhibiting circumstances:

- Legal framework: for example import and customs regulations, for example import and tariff regulations, warrantee and guarantee regulations which impede cross-border direct-mailing.
- Language and cultural factors: different cultural background which has an effect on the tastes of consumers in combination with language barriers.

Furthermore, some of the factors already important in direct inland marketing can become even more crucial in cross-border trade like shipping costs, perishables in longer transport, banking fees of international money transfer etc.

Cultural factors, divergent styles, different technical standards, logistical problems and lack of security in legal issues play an important role in international distance trade in general and consequently also in Internet assisted trade. It can be expected that the products which will be most successful would have a certain degree of homogeneity and are known internationally, e.g. services mainly in tourism[30] but also goods which are most suited for Internet-based business like books and entertainment storage media like CDs and DVDs. Technical goods also have a good chance of success. From the electrical and electronic sector these comprise computer hardware, en-

[30] According to the GfK-WebScope the pages with domain-names other than the German ".de" most popular with German Internet buyers are all offering travel and tourist services: lufthansa.com, ryanair.com followed by hlx.com. (Hapag Lloyd).

tertainment devices, communication devices and other small electrical devices. However restrictions originating in differing technical standards will first of all have to be overcome completely because compatibility with standards is one of the most fundamental preconditions for gaining greater importance in cross-border trade.

In principal, goods which are not only relatively homogenous but where the difference in prices between countries is high will have good chances for international success. In Europe, this can currently be observed for example in the marketing of cars even by the same producers which have given birth to the phenomenon of re-importing. However, this business is at present almost totally in the hands of specialized dealers. Whether or not this market will also become a field of Internet-assisted import by private consumers in the next few years will largely depend on the possibility of the automotive industry to persevere its policy of market closure by regional price differentiation last but not least against the massive opposition of the European Commission. If a softening in the market closure would occur, consequences also for the trade of auto parts could not be excluded because in the last few years an antithetic evolution of national price level for cars and parts could be observed. According to this an opening of the European automotive market which would lead to an equalization of national price levels for cars would, sooner or later, also make price incentives disappear for the import of parts.

Like recent surveys show, for markets which are not characterized by a very limited number of producers like the car market it will be crucial for the success in cross-border trade if the trust of consumers can be created in the suppliers without subsidiaries in the country of the customer. Doubts that will have to be overcome exist mainly in the extent of consumers' rights after sales like complaints, returns, reimbursements, product liability and guarantees and, not to forget, the ability to enforce these rights in courts in another country. In contrast, practical problems for example with the delivery of the products are considered by the consumers as minor. But language problems were explicitly excluded from the practical problems to be considered by the consumers asked in the survey (Press and Communication Directorate-General, Public Opinion Analysis Unit ed. 2002: 39, OECD 2002: 70). A similar skeptical assessment of the present trust of consumers has been made by OECD in the context of an evaluation of its own efforts during the last years to encourage e-commerce (OECD 2003: 4–5).

Positive transaction costs which have come about through the described uncertainties, underlines that price differences will play a decisive role in shaping the decision of private households to make purchases in another country. Goods suited for the sale via the Internet will have to be much

cheaper in a foreign country to be considered as an attractive alternative. As evident from the reasonably small present volume of Internet-based cross-border distance trade it shows that such huge price differences that would be able to overcome the uncertainties of consumers appear not to be widespread at the moment. This view is backed by a study commissioned by the European Commission for the period between March 1999 and March 2000 on price differences in the European Single Market which has, unfortunately, only included foodstuffs and electronic machines. Interestingly in contrast to the background of possible negative consequences of effect deficiencies of take-back obligations is the fact that the price level on the market for electrical machines in that period was the lowest in Germany. The basket of commodities contained 10 selected electrical machines and Germany had the lowest prices for 3 of them among all the countries studied being about 20 percentage points below the European average (European Commission 2001b: 18–19). So far, e-commerce has not yet become "a borderless market" (GFA Management 2002: 48). To which extent a possible unequal implementation of the European take-back regulation for electrical machines by certain countries could widen or reverse existing price differences will be an empirical question which will be answered by future.

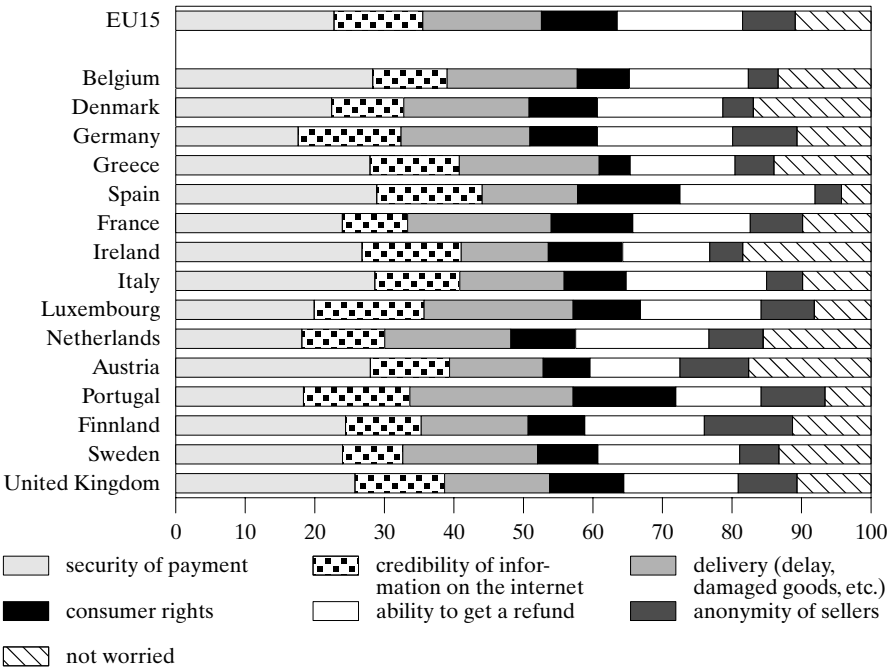
These findings have been sustained by the recent Eurobarometer and the results of customers concerns about buying on the Internet (Figure 6).

The main concerns of the potential online shoppers are unchanged: security of payments, credibility of information on the Internet, delivery (delay, damaged goods etc.), consumer rights, ability to get a refund and the anonymity of the sellers. These concerns, although not evenly distributed all over Europe, leads to a higher level of trust of buying goods and services which are not liable to the WEEE. The latter goods represented in the Eurobarometer by the categories "PC, laptop/software" on the one hand and "domestic electrical appliances" on the other hand are still somewhat lagging behind in consumers' confidence (Figure 7). These results are consistent with findings of econometrical studies for the U.S. and Austria that show how important brand-names still are in the consumer choice behavior on the Internet even if shop bots are used. Trust in a well known good performance of a known company plays an important role in the consumers' decisions where to buy their respective goods (Brynjolfsson/Smith 2000; Schmitz/Sint 2003).

Figure 6

Concerns about buying on the internet

2003; in %

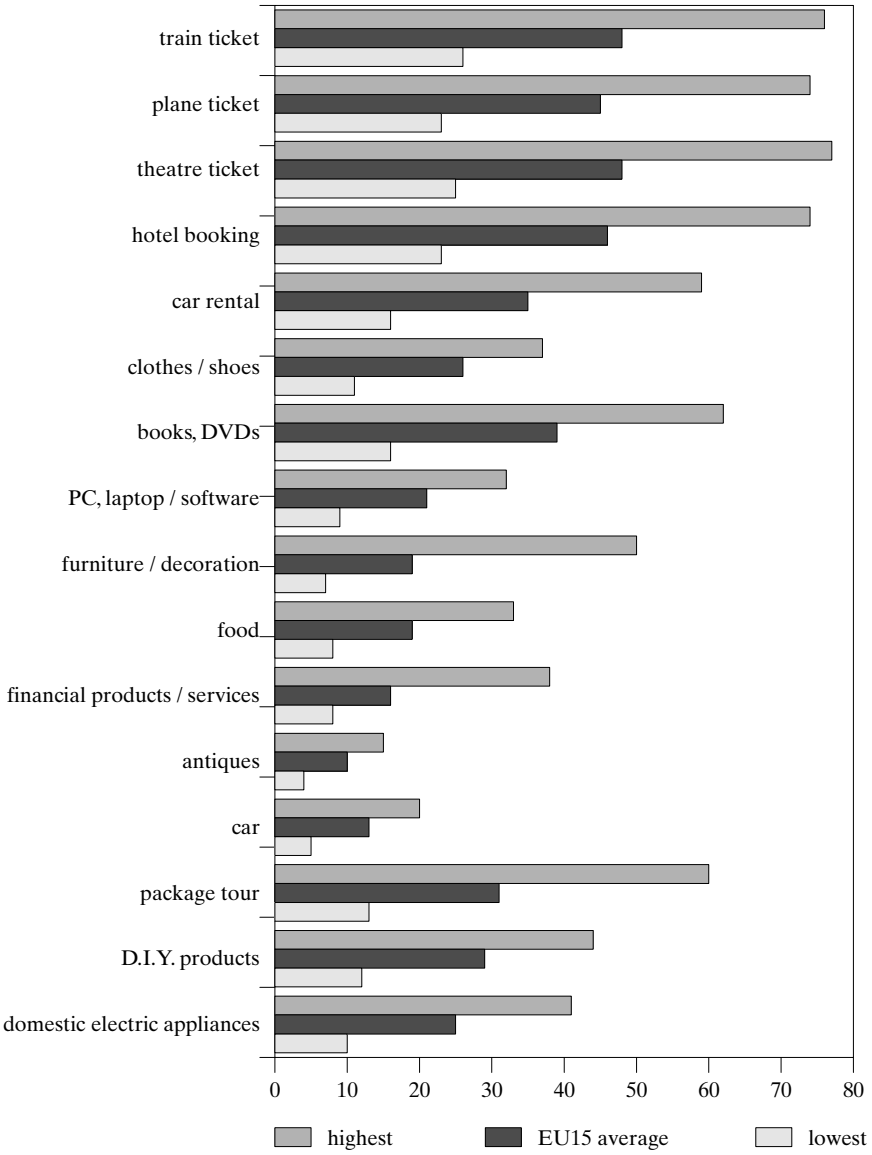


Source: European Commission (eds.), Issues relating to business and consumere-commerce, 2003:3.

Figure 7

Confidence relating to purchasing over the Internet

2003; in %



Source: European Commission (eds.), Issues relating to business and consumere-commerce, 2003:15.

The future growth of cross-border trade will most probably continue to be determined by the evolution of B2C. Traditional ways of distribution will, in comparison, gradually lose much of their importance. But presently there are no indications that private households will use electronic media as frequently for purchases in foreign countries as it was expected only a few years ago. In the last few years large direct-marketing companies have increasingly engaged to establish affiliates or to co-operate with national partners in foreign markets in order to better meet customers' needs. This is especially important for example when it comes to national differences in style and taste of the customers but mainly to stand in for warrantees and guarantees which are expected. It can be assumed that this will be the strategy of choice especially of big companies. Small suppliers, however, may even have problems to make them visible in the flood of information of the Internet. Their chances would improve if they were able to present themselves on Internet-platforms like for example ebay.

Ebay, the largest market-place for online-business in Germany, had more than 10 mills customers in 2002, followed by Amazon with 8 mills, with a distant rank behind – with all having between three and 4 mills online-buyers – Quelle.de, Otto.de, Tchibo.de, and Conrad.de. Small suppliers but also large companies have discovered ebay meanwhile more and more as a distribution channel for themselves. Outdated products, bargain offers from other countries or high stocks can be sold at lower cost by using such a platform. But new products yielding high profits remain reserved to the traditional channels of distribution (Anonymous 2003a). In order to meet this new demand, ebay has opened-up the opportunity for ebay-traders to establish a so-called shop on the platform. But this opportunity is in principal available to everybody. Regarding possible regulation deficiencies in the context of take-back obligations the earlier discussion is interesting as to what extent those small commercial suppliers, who are also from other countries and try to enter the German market can first of all be detected and then be submitted to the regulations which are in force for German suppliers (Anonymous 2003b). This problem arises if commercial suppliers do not or only vaguely reveal their true character on ebay.

Commercial dealers are obliged, even if they are distributing via ebay – to respect certain legal requirements. This is especially true in the given context for the Distance Selling Act (German 'Fernabsatzgesetz') enacted in 2001 which has been created as a special law for consumer protection in e-commerce and which is based upon the European directive on distance selling of 1997. A business under the criteria of §15 II of the German income tax law (EStG) (independence, sustainability, and profit orientation) has to fulfill the regulations of the Distance Selling Act - especially regarding consumer protection even when selling on ebay. Additional to the guarantee for

24 months the consumer is entitled to a return privilege within two weeks which according to a ruling of the BGH[31] extends to three months if the seller did not explicitly point this possibility out before the act of purchase[32].

The willful neglect of certain cost factors which the business is legally obligated to – to which in the future the waste disposal costs arising from take-back obligations could also possibly belong – contain the danger of distortion of competition. However, for the foreseeable future the distortion arising from the concealment of being a commercial agent on ebay should be much greater from the avoidance of value-added tax than from the circumvented costs of waste disposal. Currently, the fiscal authorities are showing considerable efforts to learn the ropes of those free-riders. The business principles of ebay concerning transparency offer good possibilities to be successful. A lot will depend on the future design of the take-back obligations in how far Internet platforms like ebay will be a possibility for commercial agents to evade the costs of take-back obligations in cross-border trade.

Coming back to the question of which kind of products will have the best chance of being successful in exporting to the final consumers in the future it should be stated after all the foregoing considerations that it will first of all be those products which are already best sold: books, CDs and DVDs. Other than these goods first of all electrical and electronic small appliances will have the best chances. This would be possible especially with products that incorporate national tastes and preferences like cooking with gas vs. electricity or appliances for preparing coffee or baking bread. The same should be true for shoes and clothing as well as food and beverages, for example wines. These products could be attractive to consumers in other countries in which the offer is much less diversified. This view has been sustained by a recent survey in which more than 60 % online-shoppers praised the large assortment of products available as the most important advantage of e-commerce (TNS Infratest/IIE 2004: 276). This attitude of consumers is certainly not limited to shopping in the own country but even more valid worldwide if the other problems could be solved sufficiently. As it had been pointed out earlier, the prospects of the future cross-border online-trade of cars will mainly depend on the policy of market segmentation and pricing by

[31] German Federal Supreme Court (Bundesgerichtshof).

[32] A further example for the adaptation of the legal framework by the harmonized implementation on the national level of European ordinances constitutes the law enacted on 22 May 2001 on the electronic signature which is destined to create the decisive foundation for the increase of electronic commerce and considerable increases in efficiency in economy and administration. As a complement and based on this law, the law concerning "Anpassung der Formvorschriften im Privatrecht", enacted on 1 August 2001, gives the electronic signature the same legal effect as the hand-written signature.

the car manufacturers and also the outcome of the constant struggle of the EU-Commission to force them to remove trade barriers in the European single market. There could be also some chances of an increase in cross-border B2C in selected market niches like antiques and collectibles, the field of exchange with which ebay originally started.

If it would be possible to overcome language barriers, problems in gaining the confidence of customers for example regarding warranties and return privileges in the future also internationally these kinds of products would be first candidates for the enlargement of cross-border business via the Internet – especially if substantial difference in the price levels of countries would occur. Further considering the fact that for the time being the vast majority of the possible clientele among the regular users of the Internet are rather young and fairly well funded it seems to be appropriate to study the question of possible market distortions caused by nationally different implementations of the European take-back obligation regulation by using the example of selected products from the computer hardware and the consumer electronics sector. Having said this, it has to be underlined that any forecast about the evolution of cross-border B2C in general as well as broken down by types of products remains highly speculative.

2.5 Take-back Obligations with Cross-border Relevance

With respect to end-of life vehicles producers of cars do not see such an allocation problem in the case of disposal costs of cars bought via cross-border distance trade – being only a few of them on the market and due to their representation in all countries[33]. Car producers – when asked – are never interested in the number of cars they have to take-back on a national level but only in overall European data. For them the problem of take-back is only one of logistics and the different disposal costs in the individual countries. Above that cross-border distance car sales will not be of great relevance in the future. Private buyers above all will obtain information on the supply via Internet. But they will prefer to buy regionally meaning that they do not buy in areas other than those close to the border, and hence preferring local dealers. High quantities of Internet trade of cars may be caused by commercial grey importers. There it is conceivable that dealers buy large quantities due to the low prices abroad.

In the case of batteries it must be differentiated between the direct return of batteries and the return of batteries left in old electrical and electronic equipment. A problem of assigning disposal costs could only arise for those

[33] Source here and for the aspects to follow is a telephone interview with Marketing Systems Essen in April 2003.

batteries which are imported by way of direct marketing of electronic equipment. This share should be rather small. It may not be expected that batteries as such will be bought abroad. An inquiry with GRS Batterien (the respective take-back system in Germany) evidenced that this question will be solved within the transposition of the WEEE Directive.

The regulation of packaging appears to be of particular interest in the context of cross-border distance trade because all products sold need packaging, and in this case because of protection purposes a packaging exceeding the need of packaging common in the case of normal retail packaging. Here a conflict might be conceivable. Electrical and electronic small appliances are products which are expected to reach a higher degree of cross-border B2C sales. Furthermore the directive explicitly requires a solution of this problem.

For the purposes of this study the field of end-of life vehicles and batteries will not be further analyzed. Packaging will be dealt with in excursuses; within the underlying context, they do play a certain role for the calculation of competition distortions, but for the interdependencies of the changed framework conditions and innovation no substantial findings are to be expected as the main innovation forces due to the Packaging Ordinance at least in Germany became evident since the early 90s. A changed innovative behavior concerning packaging as a consequence of non-assignment of disposal costs should be rather unlikely within the underlying context. So the main topic is the WEEE Directive respectively its national transposition as an impact for innovations within the context of the innovation system.

After having presented recommendations for a solution of the problem of cross-border distance trade as required by the WEEE Directive possible solutions for a similar problem with packaging and batteries are considered shortly. Batteries are included at this place as the new draft of a EC-directive on batteries includes – analogeous to the WEEE – with its definition of producers sales by cross-border direct marketing as well (chapter 4.6.1).

3. Analysis of the Innovation System of the Electrical and Electronics Industry

Chapter 3 will focus on the analysis of the EEE innovation system. First a short review of the development of the EEE innovation system demonstrates that due to numerous serious alterations of the institutional context the way of how innovation is generated and disseminated has considerably changed within the past 10-15 years (chap. 3.1). According to upcoming environmental legislation an alteration both of the configuration of innova-

tion actors as well as a change in basic economic processes (shift from linear to circular economics) and as a result changes in innovation and innovation management was induced (chap. 3.1.1). After describing the most noteworthy developments in the EEE innovation system, the market (chap. 3.1.2) and the waste management situation (chap. 3.1.3) is highlighted. A more detailed analysis of the WEEE/RoHS regulation (chap. 3.1.4) follows in order to provide a basic understanding of the special interests of innovation actors concerning the implementation of these directives (chap. 3.1.5). Since besides the WEEE especially packaging is also affected by B2C, a short note is also given for the German Packaging Ordinance of 1991 (chap. 3.1.6).

Chapter 3.2 provides an analysis of the substantial innovation efforts in the EEE innovation system facing the WEEE/RoHS Directives both on institutional as well as technical/organizational level. First the principal incentive features of the WEEE/RoHS are depicted (chap. 3.2.1) within additional drivers of the institutional context. After describing the upcoming institutional changes following the implementation of the WEEE – (chap. 3.2.2) – a more detailed portrait of selected technical/organizational innovations is delineated (chap. 3.2.3). This is followed by an ecological (chap. 3.2.4) and economic evaluation (chap. 3.2.5). A short look at the related packaging problems closes this chapter.

In chapter 3.3 divergences from the ordinary incentive system are described by pinpointing selected distortions within the incentive mechanisms. The focus will be on assuming a certain volume of cross-border B2C and showing the consequences for the disposal costs which might be avoided by free-riders.

3.1 Institutional Context of the Innovation System

3.1.1 Development of the EEE Innovation System Actors Configuration

According to Metcalfe, *"a national system of innovation is that set of distinct institutions which jointly and individual contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer knowledge, skills and artifacts which define new technologies (*Metcalfe 1995: 462f).

A review of the development of the innovation system of the electrical industry at the turn of the century shows that the innovation system became substantially more complex in the transition from the last decade of the 20th to the first decade of the 21st century based on the structure of the actor

configuration. The following figure (see Figure 8) displays the typical actor configuration up to the end of the 90s, which - regarding the industrial processes - can be represented as linear progressions of different added value and EOL processes.

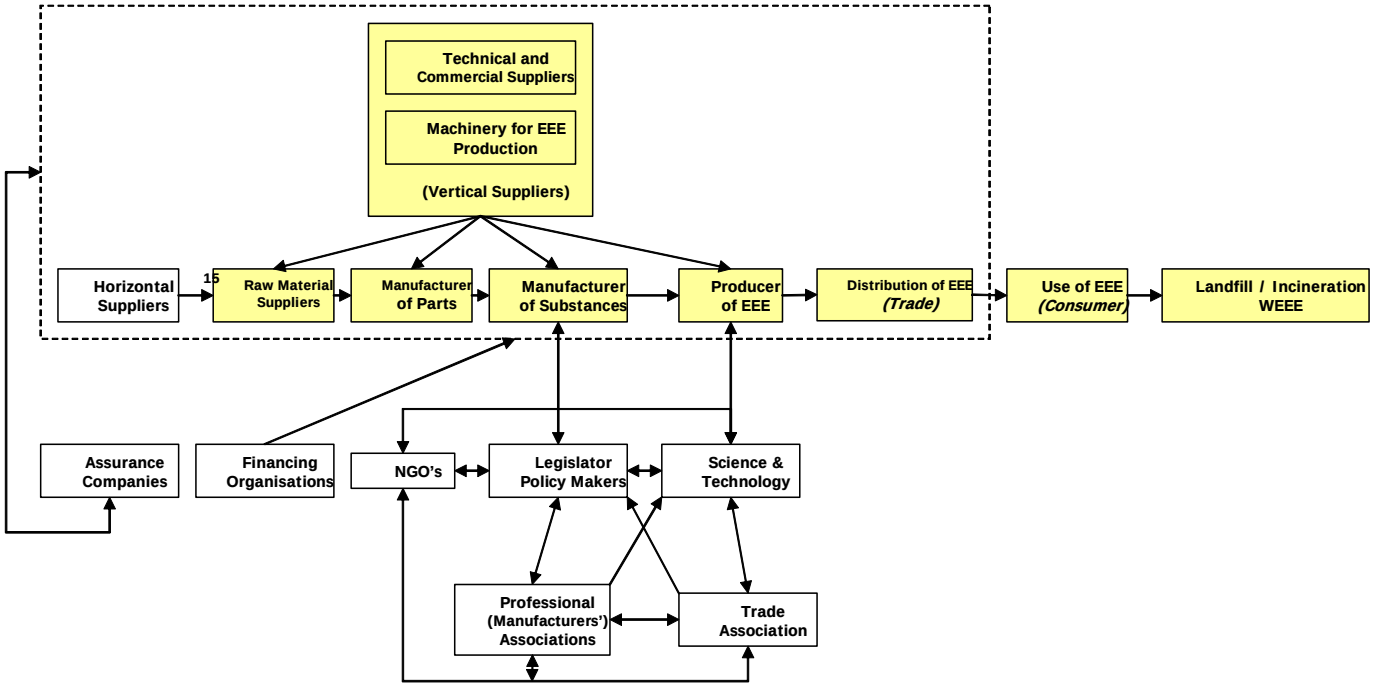
The substantial innovation drivers in this innovation system are economic incentives such as "Market Pull" (demand changes, price signals etc.), as well as "Technology Push" as incentive on the part of the research (e.g. microelectronics), which jointly stimulate development of new products and procedures.

In the transition to the first decade 21st century the innovation system exhibits a strongly extended actor configuration, due to the development activated over the regulation context to a cycle economy: starting from an original linear supply and value added chain, new actors from the range of the waste management, and the recycling economy, as well as new service-providers from the re-use area step in.

As displayed in Figure 9 after the millennium turn the EEE innovation system presents itself as a complex system of actors and institutions. Those actors are at first the large OEM (Original Equipment Manufacturers) of electronic devices (such as Sony, Philips, Sharp, Miele etc.), their suppliers in the supply chain, e.g. components manufacturers (like Infineon, ECM, AMD, Bosch, Intel), 2nd tier suppliers like the chemical industry or subassembly manufacturers, research and development institutes, technology transfer companies, consultants, banks, assurance companies, recycling and re-use companies, maintenance and repairing service providers, logistics companies, manufacturing devices providers, waste processing companies etc.

Between all actors mentioned there are interconnections like "normal" transactions in the relationship between manufacturers and customers as well as institutional arrangements to co-ordinate the innovation process (professional organizations like the EECA (European Electronic Components Manufacturers), BITKOM, ZVEI or R&D networks (ECOLIFE-thematic network). The innovation process is influenced by all these actors. The examples given later demonstrate the systemic character of the innovation process in the electronics industry (chapter 3.2).

Figure 8
The EEE innovation system before the millennium turn



From Figure 9 it is also derived that the knowledge genesis and knowledge conversion for the production of innovations take place in a complex network from different actors, who bring their different core capabilities together into the innovation process. Besides the complexity of the actor configuration, the complexity of the incentive structure and the driver for innovations rise as well. By anchoring the EPR principle (extended producer responsibility) towards the manufacturers, the innovation system is globally directed to a stronger environmental and sustainability orientation. As a central actor of the innovation system the manufacturer without doubt dominates the direction of the innovation. The genesis and conversion of innovations in the range of the technology, the organization of added value chains, the implementation of cycle processes, even the new forming from relations to final customers in the B2B (Business to Business) and B2C (Business to Consumer) areas however carry themselves out in networks of manufacturers, equipment industry, recyclers, transport providers, service-providers, research-, science- and consulting institutions.

The complex network of communication reflecting specific interests of each innovation actor is displayed in figure 10 and connected to the figure above:

To the classical drivers e.g. demand for new functions, new opportunities through technology push, new drivers step in like for example the WEEE- and the RoHS Directives, which partially strengthen or weaken classical drivers respectively change their direction and intensity with the consequence that emphasis in the innovation development shifts as the result of changes in innovation management and evaluation questions beyond. Here the core authority of the manufacturer is not sufficient anymore. For a design for recycling it is detailed information for the disassembly processes, for the separation, for the disposition of materials in end-of-life treatment etc. that is needed. To that extent the knowledge of recycling enterprises about the innovation process becomes indispensable.

The transition to the new actor configuration carried itself out gradually, beginning round the early 90s as a reaction to the announcement of environmental political regulations within the range of the closed loop recycling management, and is not yet terminated. To that extent Figure 9 represents rather a snapshot. In particular, the development of new business models beginning in end of the 90s will merge still additional actors into the innovation system, which at present either do not play any role in the innovation system of the electrical industry or do play only a remote one.

Figure 9
The EEE innovation systems after the millennium turn

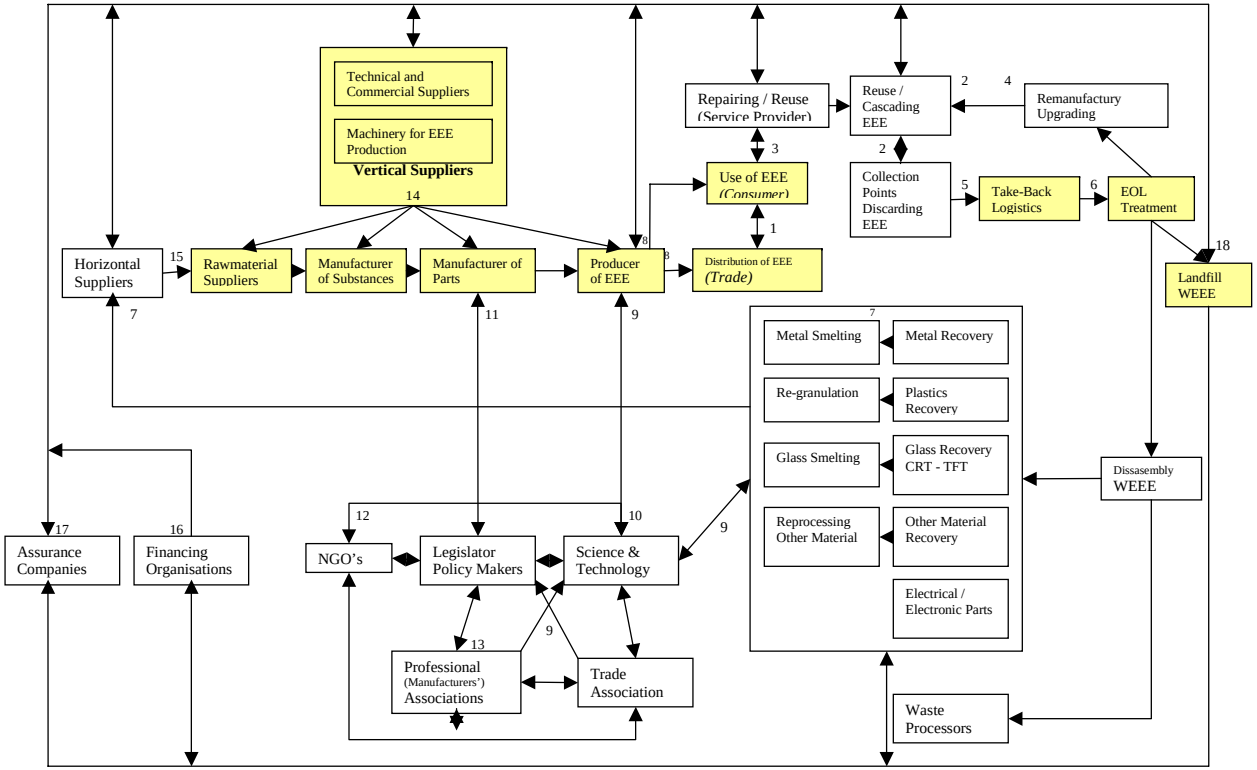


Figure 10
Interests of innovation actors in the new EEE innovation system

1. Good relationship between price and quality, good product delivery and service around purchasing process.
2. Low costs for discarding WEEE, avoidance of hassle with products to be discarded.
3. Low costs for repairing EEE products, good quality maintenance and upgrading opportunities.
4. Serving for additional markets and make profit with remanufactured products intensifying the Customer relationship via leasing (e.g. copying machines)
5. Assuring a constant WEEE stream, low costs for collection and take-back logistics, high profit for service providing of take-back.
6. Good prices for WEEE at the point of giving it to recycler.
7. Good price / quality relationship for secondary raw material, optimization of economic value recovery by low cost handling of WEEE, improving technology for recycling, energy recovery, minimize final disposal costs etc.
8. Design for functionality and customer value, avoiding hassles with disturbing contents in the EEE products, designed for recyclability to avoid high costs of disassembly and raw material recovery, designed for remanufacturing and Reuse according to new business models (i.e. leasing).
9. Developing End-of-life technologies, selling innovative ideas to the different stakeholders (i.e. strategies for sustainable developments, tools and instruments for EEE innovation management.
10. Enabling re-application options or upgrading of secondary materials.
11. Concerns about environmental / sustainability issues, dealing with waste problems, lack of Landfill space / Incineration capacity, giving incentives to other stakeholders to direct their behavior towards sustainability.
12. Concerns about environmental / sustainability issues, reduction of hazardous substances and conservation of resources.
13. Influencing policy makers and legislation process to safeguard economic value of their members, providing tools and services to their members to enhance business and presenting environmental as well as sustainability performance of their industry.
14. Providing (new) machinery to manufacturers of EEE aligning (new) requirements of production processes (i.e. lead-free soldering).
15. According to 7. good price / quality relationship of raw materials, parts and subassemblies fulfilling the requirements of EPD, labeling (i.e. declaration of products' contents).
16. Making profit by financing individual stakeholders in the EEE innovation system, assuring economic value by providing consultancy services.
17. Making profit by selling insurance products and services to individual stakeholders developing new products and services according to new business models in the supply chain (i.e. leasing, insurance tariffs attached to individual environmental performances and risks of stakeholders).

(No. 1-17 is referring to the relationships depicted in figure 9.)

3.1.2 Market Volume and Market Structure in Germany

The following electrical and electronic devices are included in the WEEE Directive and are further specified in appendix IA:

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

The products categories 1, 2, 4, and 7 are generally used in households, whereas categories 8, 9 and 10 are used commercially. Categories 3, 5 and 6 include products, which are used in both domestic and commercial environments.

As the appropriate official statistical data is relatively highly aggregated, the respective product volume from the WEEE Directive – as like other relevant information – is hard to ascertain. In this context, it would be desirable to have statistical data on the level of products – that is the so-called nine-digit level of the systematic of national accounts (Wirtschaftszweigsystematik, WZ 93). Unfortunately in many cases, detailed disaggregated data on this level are not available due to confidentiality reasons. The analysis of the more aggregated level of product classes, that is the four-digit-level of the statistics, circumvents the confidentiality problem but generally overestimates the output[34]. The inquiry therefore must limit itself to analyze all the available data to define the extent of the amount of output and market volume and to approximate the further development.

Besides the official data also information from the respective industrial associations Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI), the Bundesverband Informationswirtschaft, Telekommunikation und Neue Medien e.V. (BITKOM), the European Information Technology Observatory (EITO) and the Bundesverband Technik des Einzelhandels e.V. (BVT) may be used. The data collated by the associations are inclusive of value added tax. In some cases this could have impact on the level of

[34] This observation is also applicable for the association's data.

output and turnover data. Therefore, the comparability with official data is usually a difficult process.

The depiction of the output levels for goods that are concerned by the WEEE Directive occurs with the help of two different estimation approaches that lead to a range of output results. Due to some of the data remaining confidential, the results based on the nine-digit level of the WZ 93 are the lower boundary of activities (”bottom up“-estimation). The top boundary of output is in comparison determined from a ”top down” – estimation from the ZVEI and EITO data.

In 2001, the production statistics revealed that for the concerned goods, the output value totaled 43.8 bn. € (see Table 2), which corresponds to 41.7 % of the total output on the four-digit level of product groups. More than half of the production belongs to electrical domestic devices as well as information technology and telecommunication devices. The products specified in the WEEE Directive, comprise of a large quantity of the four-digit level output. This applies especially to electrical household appliances, information technology and telecommunication devices, monitoring and controlling instruments as well as medical devices. Whereas the product groups of the electrical and electronic tools as well as automatic dispensers encompass only a small amount of the concerned goods in the directive.

Table 2
Output of goods affected by the WEEE Directive
Germany 2001

No. from app. IA of the WEEE Directive	Product name	Selected goods				Total of product group[3]
		Production statistics[1]		ZVEI product classification[2]		
		Bn. €	Share in %	Bn. €	Share in %	Bn. €
1, 2	Large and Small Household Appliances	7.9	17.9	8.2	15.9	9.0
3	Information Technique and Telecommunications Equipment	17.1	39.1	26.6	51.6	26.5
4	Electronic Entertainment Devices	1.5	3.5	3.3	6.3	4.8
5	Lighting Equipment	1.6	3.7	3.6	7.0	4.2
6	Electrical and Electronic Tools	1.0	2.3	1.0	2.0	21.7
7	Toys, Leisure and Sport Equipment	0.3	0.7	-	-	1.6
8	Medical Devices	5.2	11.8	5.0	9.8	10.0
9	Monitoring and Control Instruments	8.9	20.4	3.8	7.4	14.2
10	Automatic Dispensers	0.2	0.5	-	-	13.2
	Total	43.8	100.0	51.5	100.0	105.2

Own calculations from official data, ZVEI data and EITO data. – [1]Bottom-up approach, based on nine-digit level of products of the product classification GP 2002. – [2]Top-down approach, based on ZVEI data and EITO data. – [3]Based on four-digit level of product classes.

Although the collected data from the ZVEI and EITO do not mention output of toys, leisure and sports equipment, as well as automatic dispensers, the results of the output regarding the concerned goods for 2001 reveals that the output of such goods valued 51.5 bn. €, which is higher than official statistics. Electrical and electronic tools like medical devices in the amount of

the production correspond to the official data but in many of the other categories output is higher.

For the take-back of old devices only those goods are of relevance that are sold in Germany. These goods constitute the domestic market provision. It is defined as domestic products with addition of imports of similar goods minus exports. The market provision for the respective goods from the WEEE Directive, realized 45.8 bn. € in Germany in 2002, which is about 41 % of the domestic market provision of all electrical machineries and 4 % of all mining and manufacturing. The domestic market provision in Germany primarily includes the categories of electrical household appliances (13.9 %), information and telecommunication devices (52.5 %) as well as electronic entertainment devices (16.6 %) (see Table 3). Within Western Europe[35] the market volume for IT and telecommunications equipment was estimated to be about 115 bn. € in 2002 and for electrical household appliances about 26 bn. €. The market share for Germany was 22 % for IT and telecommunication devices and 25 % for electrical household appliances.

The total decline in the market provision of nearly 15 % in the period between 1996 and 2002 was, above all, due to the fall in demand of information and telecommunication technology over the last few years (of 30 %)[36]. Admittedly an interpretation is difficult, as the information and communication technology field has simultaneously had a significant price fall over the past few years. Because decreasing prices c.p. lead to an increase in demand, different effects could have compensated or even strengthened each other. Either decreasing prices did not compensate the decreasing demand, or the prices have dramatically dropped so much that the turnover of the products is lower than before, even though the number of sold products has in fact increased.

The amount of import and export of the concerned goods in this field shows the intensive trade relationships of the Germany Economy. All in all, the balance of trade for these goods shows a deficit of 4.9 bn. €. The results reveal the sound international competitive position of the German manufacturers but also show, at the same time, the strong presence of foreign manufacturers. Within the categories of electronic entertainment devices as well

[35] EU-15 Member States plus Norway and Switzerland.

[36] Compare the remarks for selected products in the appendix.

Table 3
Market volume of goods affected by the WEEE Directive
Germany 1996–2002

No. from app. IA of the WEEE Directive	Product name[1]	Output		Exports		Imports		Domestic market provision	
		2002	Changes '96–02	2002	Changes '96–'02	2002	Changes '96–'02	2002	Changes '96–'02
		Bn. €	%	Bn. €	%	Bn. €	Percent	Bn. €	Percent
1, 2	Large and Small Household Appliances								
	Small Electrical Household Appliances	2.4	5.6	2.4	63.7	1.8	49.0	1.9	-9.6
	Large Electrical Household Appliances	6.2	22.6	3.8	77.9	2.1	26.8	4.5	-1.8
3	Information Technique and Telecommunications Equipment	15.3	-	13.4	-	22.2	-	24.0	-30.0
4	Electronic Entertainment Devices								
	Consumer Electronics	3.4	1.4	4.6	66.0	8.9	71.0	7.6	33.1
5	Lighting Equipment								
	Electric Candlesticks	2.5	2.8	1.2	45.8	1.2	30.8	2.5	-1.7
	Electric Lamps	1.1	-4.0	1.6	66.7	0.6	56.8	0.1	-78.2
6	Electrical and Electronic Tools								
	Electrical Tools	1.0	15.7	1.2	40.0	0.7	11.4	0.5	-19.1
7	Toys, Leisure and Sport Equipment	-	-	-	-	-	-	-	-
8	Medical Devices								
	Electric Medical Devices	5.4	65.8	4.9	74.3	2.5	87.3	3.0	68.5
9	Monitoring and Controll Instruments								
	Measuring, Test and Analytical Instruments	3.7	48.7	3.9	82.6	1.9	58.9	1.7	10.4
10	Automatic Dispensers	-		-		-		-	
	Total	40.9	96.3	37.1	165.1	42.0	234.0	45.8	-14.8
	For information purpose:								
	Total Electrical Machinery	120.5	31.5	109.3	77.3	101.4	80.0	112.6	30.4
	Total Mining and Manufacturing	1,296.4	140.5	664.4	228.8	516.7	200.8	1,148.7	125.8

Own calculations from ZVEI data. – [1] On basis of ZVEI product classification. – [2] Estimation from EITO data.

as monitoring and controlling instruments the average export quotas are clearly exceeded. Here there are more goods being exported than those being produced inland. This means that some of the imports are being further processed or remaining unaltered and simply being sold, under a different brand name[37]. On the contrary, electrical household goods like information technology and telecommunication devices have a less than the average export quota. Foreign manufacturers clearly dominate the market for information and telecommunications devices as well as electronic entertainment devices.

In 2002, private households purchased technical consumer goods[38] to an amount of 36.3 bn. € (inclusive of value added tax). From this amount the spending per capita in Germany amounts to an average of 440 Euros[39] (BVT 2003: 27). In the past few years, the market for electronic products was more and more characterized by digitalization as well as an advanced convergence of products, systems, contents and applications. The total turnover in the retail sales in 2002 added up to 19.3 bn. € (see Table 4), which is over 1 bn. € less than in the previous year. Given the price decline in nearly all products, the retail industry experienced a reduction in turnover, despite the increased number of units sold. Only in some fields, especially in growing markets, higher average prices were obtained due to technical superiority and advancement as well as product design. In total the pricing showed a clear polarization between qualitative high-classed and high-priced goods and devices with basic functions in the lower price segment. (BVT 2003: 28).

Table 4
Market for consumer electronics
Germany 1999–2002; Turnover incl. tax

	1999	2000	2001	2002
	Bn. €			
Electronic Entertainment	8.4	8.7	8.4	8.2
Home Computer incl. Peripherals	6.7	8.1	8.1	7.8
Telecommunication	1.6	2.9	2.9	2.2
Videogames	0.7	0.9	1.0	1.1
Total	17.4	20.7	20.4	19.3

BVT (2003)

[37] The amount of the so-called re-exports cannot be quantified in the available data.

[38] Technical consumer goods consist of the categories consumer electronics (electronic entertainment, entertainment software, telecommunication, personal computer and multimedia devices), electrical household goods as well as amateur photograph goods.

[39] This covers the population of 82.4 mills in 2002.

In nearly all fields of technical consumer goods there is a growing level of equipment per household as well as an increase in the number of multi-equipment to be listed. In some cases, where old products are being substituted by technical innovations, this makes up a growing market potential. For products like cooling devices, televisions and telephones – including mobile telephones – there is an increase in demand due to the substitution need (BVT 2003: 16 pp.).

Many of the manufacturers are attributed to small and medium size enterprises ("SME"). As the turnover tax statistics shows about 87 % of all manufacturers belong to SME, however, they only obtain between 13 % and 25 % of the total turnover of the WEEE product groups. Often these SME are specialists, who produce specific components or highly specialized products and as a result only cover a small range of products of a group. Generalists, who make up a wide range of a product group, are found solely in the field of small electrical household devices.

It is not unusual that manufacturers leave the market by way of own choice, takeover or the sale of the business. Fluctuation information from the business in the relevant product group is not available. The statistics of the trade register shows the registered, the deregistered operations and any changes in registrations only up to a two-digit level.

The classical retail channel is carried out from the manufacturer over the wholesaler and the retailer to the final consumer. An intermediary trade over many retail levels, where the goods cross multiple borders is not uncommon. An alternative to the classical retail channel is direct sales. This is where the goods are supplied directly to the consumer and the intermediary is left out.

With the exception of electronic entertainment goods, which are generally sold by specialized markets and department stores/direct mail senders, retailers are the most important channel. 79 % of electronic entertainment devices and 25 % of small electrical household appliances were sold by specialized markets. Generally only a small number of goods are sold via consumer markets/Cash & Carry. Only small electrical household appliances are sold to a great extent through this retail channel (23 %). The turnover of department stores and direct mail senders includes between 15 and 20 % of electronic entertainment and electrical household devices.

Typical for trade via discounters like Aldi, Lidl and others, is the sale of so-called no-name products and trademarks. Often these goods are delivered from foreign manufacturer and sold via spot-business. In the meantime this is an important retail channel for the concerned products. Even bulky electrical household appliances are included in this type of business.

To summarize the remarks on market volume and market structure, the supply side on the one hand can be characterized by dynamic prices that make it difficult to evaluate the future market development for goods concerned by the WEEE Directive. The competition between local and foreign suppliers is severe, because there is a strong presence of manufacturers from abroad in all categories concerned. Normally the products are sold via classical retail channels. New types of retail channels, like sales via Internet, are used only seldom and if so, only for adequate products. On the other hand, demand for goods included in the WEEE Directive is on a relatively low level. Private households already show a high level of equipment, even with IT products. The consequence is that only new products or the need of substitution lead to an additional demand.

3.1.3 Waste Volume and Waste Disposal Situation

Currently, the total volume of electrical and electronic waste in Europe is estimated to amount to approximately 8 million tons, with most of this amount being disposed off at disposal sites. Due to the ever increasing variety of electrical and electronic products along with the shorter use phases, this amount is expected to increase by 3-5% in the future. The entire volume of old electrical and electronic devices in Germany is currently estimated to total roughly 1.8-2.0 mills tons per year (Umweltbundesamt 2000). The breakdown of this amount is approximately 46 % household appliances, 24 % electronic entertainment devices and 9.6 % information and communication technology devices[40]. As a result of the existing disposal and recycling practices and the exporting of used appliances to other countries, only 20 % of the potentially existing volume is currently being collected by the recycling plants from which 60 – 70 % is being collected separately by municipalities. In 1999 nearly 319,000 tons of electrical and electronic waste from sorting and dismantling plants were handled in Germany (Statistisches Bundesamt 2002). According to the ZVEI statement from 2005 on approximately 1.1 mills tons of electrical and electronic waste per year are expected. This is estimated to encompass 72 % household appliances, 10 % electronic entertainment devices, 11 % IT, and telecommunication devices and 5 % small household appliances. From 2005, the total waste disposal costs are expected to be between 350 and 500 mill. € per year. This includes 42 % large household appliances, 26 % electronic entertainment devices, 26 % IT, and telecommunication devices, and 7 % small household appliances

[40] Estimation of the total waste volume are estimations of the potential waste, which means they take into account the product life cycle. They have to make assumptions concerning the expected life duration, i.e. on the remaining time in the households (usage time, and hoarding) and a possible following re-utilization (passing on of devices to schools). Thereby is also the explanation of the vast range of existing forecasts (Hafkesbrink et al. 1998).

(Table 5) (ZVEI 2004). In contrast to the figures of the ZVEI disposers estimate the disposal costs for the future WEEE only to be 250 mills € (Explanatory statement ElektroG – Begründung ElektroG 2004). The amount of potential WEEE (the future historical waste) in Germany on 13 August 2005 (the enactment date of the national law, see chapter 3.1.1.3) is estimated to amount to approximately 7-8 mills tons, with the EU total stock being 25 %. The amount of waste disposal costs is estimated to be between 2.5 and 3.5 bn. € (Rockholz 2003).

Table 5
Waste volume and disposal costs for electrical and electronic equipment in Germany

	Expected waste from 2005	Expected total costs from 2005
Total	1.1 mills tons per year	350 to 500 mills € per year
of which	in %	in %
Large household appliances	72	42
whereof		
cooling appliances	18	
consumer equipment	10	26
whereof		
television sets	7.3	
IT-and telecomm. Equipment	11	26
small household appliances	5	7
Whereof		
vacuum cleaners	2.5	
other equipment	2	13

Own calculations according to ZVEI (2003).

Even more than the waste volume itself the pollutant content of the electronic devices plays a problematic role (Hafkesbrink et al. 1998). Amongst chemical elements and compounds of the old electronic devices there are numerous organic pollutants and heavy metals. Due to the variety of materials and the pollutant content, many problems arise in respect of plastics. The different functional requirements the devices' components have to meet have led to a great variety and a high input of e.g. hazardous flame retardants as well as to permanent changes in the composition of plastics.

Amongst the components and assemblies, the printed circuit boards inside the devices are the most complex and problematic parts of all. The assembled resistors, condensers, semi-conductor components, and coils contain different elements, and pollutants. There are extensive ecological problems that are associated with the disposal and also the utilization of cathode-ray tubes above all due to the content of e.g. lead and further heavy metals in the luminescent material. Liquid crystal displays (LCD), especially used in the field of information technology and consumer electronics along with light emitting diodes (LED) contain extremely toxic substances. Bar shaped compact fluorescent lamps contain specific additives and require to be deposited at hazardous waste sites only. Devices which contain electrical wir-

ing made from copper alloy are often coated with tin-lead alloy. Colored synthetics like polyethylene and PVC which contain flame retardants are used for insulation.

On the whole, nearly all electrical devices are differently, but consistently containing significant amounts of toxic substances. Computers (servers, PC's and monitors) contain, above all, electrical components, printed circuit boards, cathode-ray tubes and non-flammable plastic compounds; moreover, notebooks possess LCD's. Consumer electronics with their electronic components, cathode-ray tubes, non-flammable synthetic materials and LCD-displays, as well are a potential burden for the environment. In addition to those, light-emitting diodes are being used more frequently, for example for the control of the operating state. In large household appliances there are increasingly – besides large amounts of metal parts – (non-flammable) plastics to be found as well as condensers. Noteworthy is the diffusion of electronic components and control systems in devices, which enhance the usage and also the convenience of the appliance and last not least protect the environment (through the optimization of the energy and water consumption). Old cooling devices are a problem due to the CFC contents.

According to the waste management situation, there is a great variety in Europe. Whereas countries with take-back regulations maintain relative sophisticated disposal systems with high disposal standards there are hardly any facilities in countries like Greece and Spain. Due to the announcement of a take-back ordinance in Germany in 1991 and the ongoing discussions about the passing of such a law the disposal standards in Germany are already relatively high as well.

Current waste management situation in Germany: Household waste bins are still the main outlet of disposal of the old electrical devices. However, in the mean time, the separate collection of refrigerators and large household appliances is nearly found everywhere in municipal waste management. The waste removal situation is very different in the federal states of Germany, so for example there are different ways of categorizing the old devices in each state (e.g. Brandenburg: 2 categories, Sachsen-Anhalt: 9 categories). The disposal is financed by general waste fees, seldom by bulky waste fees. Occasionally the final user is required to pay a direct fee for the removal of small electrical devices. Additionally, the fees vary considerably between the German states and between the municipalities within each state (Albrecht 2003).

In former years the market for recycling activities was dominated by medium sized firms. After the announcement of the first draft of an electrical and electronic scrap ordinance in 1991 large corporations started joining the

market as they considered the recycling of electrical scrap as an attractive and fast growing business. The structure for the acquisition, treatment and recycling of old electronic device is still dominated by medium-sized firms. Due to an extensive material and treatment knowledge, these enterprises have started to exploit vast potentials of valuable substances in this market segment. In the hope for politically set unified quality standards, remarkable investments have been undertaken in modern treatment plants. In Germany 319,000 tons of electrical and electronic waste were sorted and dismantled in 282 plants in 1999. In 2002, 286 enterprises were counted (Statistisches Bundesamt 2002; bvse 2003).

There are local and regional suppliers who cover the whole spectrum of treatment, disposal and marketing of components and material fractions. Amongst them are medium-sized firms and affiliated businesses. There are specialized businesses for large areas with special technical treatment procedures (e.g. display screen glass). And there are also a number of trading and logistic enterprises. The association of the disposers (bvse), mentions about 300 dismantling firms, which partly use their own logistics to collect devices, dismantle and prepare them for further treatment or re-use. Under these businesses fall medium-sized businesses, charitable organizations with approximately 50 workshops (Werkstätten) and 20 collection points, independent charities and affiliated businesses (bvse 2003).

The task of the disposer of the old electronic devices includes the collection, dismantling along with the machine processing and the extraction of the secondary raw materials using the appropriate mechanical, chemical and thermal procedures and finally the disposal of the non-utilizable fractions. The dismantling includes the separation of the recyclable components and the removal of the harmful substances (PCB-containing, condensers, mercury switches and the sorting in coarse fractions (FE- and NE-metal parts), authentic plastics, plastic compounds, and components like the circuit board and cathode-ray tubes and housings containing harmful substances. Such dismantling is generally performed manually due to the variety of the material and the complex structure of the equipment. The coarse fractions then can be either re-used or recycled directly or will be processed by a more sophisticated separation technique to recover more genuine parts. For the machine processing further special equipment is used in addition to the large shredder facilities (e.g. for refrigerators, monitors, cathode ray tubes etc.). Large shredding plants are above all used for white goods. The processing there mainly consists of a multiple stage comminution and sorting of the material. The sorting is performed with magnets and other specialized techniques (e.g. eddy-current belts). The treatment of these includes shredding the devices to smaller pieces and sorting the materials. Additional thermal and chemical procedures for metal containing fractions are used.

They are mostly in granule form and thus can be used for the production of secondary raw materials. Metals are further processed in smelting and metal separating plants, where it is important that the metals are free from halogenated-organic parts. The development of recycling techniques for plastics is not yet developed enough. At present the practice of raw material recycling dominates (Behrend 1996: 39pp.; bvse 2003).

3.1.4 Regulation Framework

3.1.4.1 EC Directives on Waste Electrical and Electronic Equipment (WEEE Directive) and the Restriction on the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive)

The EC-Directive on waste electrical and electronic equipment was passed on 27 January 2003 after a long discussion and has to be transposed into national law by 13 August 2004. The primary purpose of the directive is the prevention of WEEE, in addition to the promotion of re-use, recycling, and other forms of recovery, in order to reduce the disposal of waste (Art.1 WEEE). Last but not least it is considered as one of the means of encouraging the design and production of EEE which take into full account their repair, possible upgrading, re-use, disassembly and recycling (recital 12 WEEE).

These goals shall be achieved by a variety of measures. Thereby, the Member States must ensure that by 13 August 2005

- producers assume responsibility for certain stages of the disposal of waste (principle of producer responsibility),
- a separate collection of waste from private households is performed, and final holders and distributors can return old equipment free of charge,
- producers establish appropriate systems for the treatment of waste; these systems can be set up individually or collectively, and
- producers finance the disposal themselves.

The WEEE Directive distinguishes with respect to financing between historical waste i.e. products put on market before 13 August 2005, and new waste. The responsibility for financing of the historical waste will be assumed by one or more systems to which all producers contribute to in proportion to their relative market share. In the case of new waste, all producers will be responsible for financing the operations relating to the waste

caused by their own products. Placing their products on the market, producers must provide a guarantee that the financing is ensured (Art.8 WEEE).

Table 6
Targets of the WEEE Directive
Quotas for recovery, re-use and recycling

	Recovery (in %)	Re-use and Recycling (in %)
Large household appliances, Automatic dispensers	80	75
IT and telecommunications and Consumer equipment	75	65
Small household appliances, Lighting equipment, E&E tools, toys, leisure and sports equipment, monitoring and control instruments	70	50
Gas discharge lamps	-	80

Source: WEEE Directive.

Within the settings of the WEEE Directive, particular instruments play the role of a substantial supplement to the above measures, such as the stipulation of quotas. Member States must ensure that by 31 December 2006, at the latest, a rate of separate collection of at least four kilograms on average per inhabitant per year of WEEE is achieved. Obligatory quotas will also be introduced for recovery and recycling: both targets shall be adapted by 31 December 2008 considering technical development (Table 6).

The following requirements must be met for disposal: best available technology shall be used for the treatment of old equipment. The disposal facilities shall meet certain technical standards (Art. 6 (1)). There are additional requirements concerning labeling: all producers must be identifiable by the labeling of the products sold after 13 August 2005, in order to ensure the planned financing (Art. 11(2)). New equipment must be marked by an appropriate symbol (a crossed-out wheeled bin) (Art. 10 (3), Annex IV), so that final users can identify them. In addition, there are a number of informational requirements. Detailed information on re-use and treatment of new devices must be presented to disposers. (Art. 11 (1)). Private users shall be informed about the obligation to collect WEEE separately, the return and collection systems available to them, and also about the potential effects on environment and human health. (Art. 10).

A crucial point of the directive is securing effective monitoring by the Member States. They shall draw up a register of producers and collect in-

formation, including substantiated estimates on quantities and categories of electrical and electronic equipment put on the market, as well as on old equipment collected, re-used and recycled and on collected waste exported.

The disposal problem arising from products of cross-border distance trade is explicitly addressed in the WEEE Directive. According to Article 8 (4), Member States shall ensure that producers supplying electrical and electronic equipment by means of distance communication also comply with the requirements set out in this Article for the equipment supplied in the Member State where the purchaser of that equipment resides. Also, by Article 12 (1) Member States shall ensure that producers supplying electrical and electronic equipment by means of distance communication systems provide information on the compliance with the requirements of Article 8 (4) and on the quantities and categories of electrical and electronic equipment put on the market within the Member State where the purchaser of that equipment resides (compare chapt. 4).

A major addition to the WEEE Directive is the RoHS Directive[41]. The target of the RoHS as a 'single-market directive' is to achieve a harmonization of the legislation in the Member States with respect to the use of harmful substances that are found in electrical and electronic equipment. Thereby, it is hoped the RoHS Directive will account for an environmentally friendly disposal of old electrical and electronic equipment. The scope of the RoHS Directive comprises the same product groups as the WEEE Directive with the exception of medical technology and monitoring and control equipment. The Member States shall ensure that lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr-VI), polybromated biphenyl (PBB) and polybromated diphenyl ether (PBDE) are substituted by alternative chemicals by 1 January 2006. Exceptions being the deletions of the substitution or agreement of new maximum concentration values in accordance with the technical developments and new scientific findings will be allowed. The use of certain not substitutable substances, such as lead used as radiation protection, is regarded as an exception within the framework of RoHS Directive.

3.1.4.2 Implementation of the WEEE Directive in Germany

Although the WEEE Directive lays down essential criteria at community level to reach an EU wide harmonization, flexibility still remains for the states when transposing it into national law. Therefore, the legal and economic background, peculiarities and experiences will be taken into account

[41] Directive 2002/95/EU of the European Parliament and the Council of 27.01.2003 about the restriction of the use of certain harmful chemicals in electrical and electronic equipment (RoHS), EU ABI. L 37/19.

with the implementations on a national level. Especially concerning the realization of producer responsibility and the intended take-back systems there are a wide range of solutions which may be observed in the different Member States by now.

The German government will transpose both WEEE- and RoHS Directives into a law pursuant to the Closed Substance Cycle and Waste Management Act. The key points for this have been provided by BMU in May 2003 (BMU 2003). On 9 July 2004, a draft of an 'Act on the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment Electrical and Electronic Equipment (Electrical and Electronic Equipment Act – ElektroG)' was published. The transposition shall be made closely following the directives. Additional national goals are:

- solutions compatible with competition,
- activating private responsibility, and
- taking into account the proven elements in waste management.

Based on the principle of shared responsibility the law will lay down the obligations of those participating in the product chain. The municipal waste management agencies retain responsibility for the collection of all waste equipment from private households (§ 9). Owners of WEEE are required to place it in a separate collection to that from unsorted municipal waste. The local authorities can decide on a return or collection system. No charges may be levied for returns of private owners at collection points. The local authorities must inform private households about this obligation, in addition they have to inform them i.a. about options in their district for the return or collection of waste and the collection symbol, i.e. the crossed-out wheeled bin. (§ 9 (2)). At least 4 kg of WEEE must be separately collected from private households per inhabitant per year in Germany as a whole, but there is no minimum target given for local authorities.

Adapted to the most recent methods of treatment, the municipal waste management agencies shall hold the waste equipment ready for collection by producers – sorted in six product categories (§ 9 (4)). These categories are:

- Large household appliances,
- Refrigerators and freezers,
- IT and telecommunications equipment, consumer equipment,
- Television sets and computer screens,

– Lamps containing mercury, and

– Small household appliances, lightning equipment, electric and electronic tools, toys, sports and leisure equipment, medical devices, monitoring and control instruments, automatic dispensers.

The municipal waste management agencies shall report to the "Joint Center" (§14) when a collection volume in the containers type 1 till 3 of at least 30 m^3 has been reached that containers are ready for collection. For the containers type 5 and 6 the respective collection volume has to be at least 15 m^3, and for the containers type 5 3 m^3 (§9 (5)). In addition, distributors may voluntarily accept returned WEEE as well as producers voluntarily may organize the return of the WEEE of their own and set up and operate take-back systems taking responsibility at that stage already.

Given the high number of producers, along with great quantities and numerous types of products, the implementation and monitoring of producer responsibility is extremely complex. Therefore, to ensure competition in this field, registration and coordination of collection will be the industry's own responsibility undertaken by way of a private "Gemeinsame Stelle" ("Joint Center") organized under private law and financed by the industry (§6). This way,

– the individual market experience of producers will be utilized to achieve optimal efficiency concerning registration and monitoring and thus solving the free-rider problem,

– producers will be required to organize in a competitive way the collection of waste equipment in the "Joint center" from local authorities; to ensure that no waste equipment is left behind and that the collection of waste equipment will proceed under the same conditions for all producers.

The disposal services themselves will be organized in a decentralized way Manufacturers have to conclude contracts for disposal individually but are as well allowed to fulfill their obligations by collective systems. In order to fulfill the public functions of registration and co-ordination of the collection of WEEE a due authorization is required. Therefore, the ElektroG is based on the following organizational model: A central register is commissioned with the registration of the producers, the assigning of a registration number, the examining of the guarantees for the performance of the disposal services and the reporting of the registered producers to the "Joint Center" (§16). Additionally The Central Register shall assign to each producer the collection point where he can collect certain amounts of waste after having examined the respective calculations (statistical/mathematical basis) for the

collection of the "Joint Center". This Central register shall be the Federal Environmental Agency (UBA).

The producers will be required to establish a private "Joint Center" the main task of which will be to support the Central Register by calculating the producers´ collection share of WEEE from private households and the collection duties (time and locality). In addition it shall publish the registered producers (§ 14). In order for the "Joint Center" to additionally assume the tasks of the Central Register, the former is authorized to take over registration and coordination of collection (§ 17).

The project organization "Electrical Appliance Register" "Elektro-Altgeräte Register" (EAR), which was established on 2 June 2003 by the producer associations ZVEI and BITKOM has started to set up such a "Joint Center" which will have to ensure (as authorized by UBA) that all producers fulfill their obligations (EAR Altgeräte Register 2004).

With respect to the requirements concerning the marking of the products the German draft legislation does not specify any further details than the WEEE Directive. It says that EEE placed on the market after 13 August 2005 must be marked in such a way that the producer may be easily identified and that it is recognizable that the equipment is placed on the market after that date. Additionally the EEE must be marked with the symbol of the crossed wheeled bin (§7). With respect to the guarantee the draft remains vague too when requiring by each producer an annual insolvency proof guarantee regarding funding of return and disposal of WEEE (§6(3)).

Producers of EEE are required to take back WEEE from users other than private households without charging them, and to take over treatment and recovery only for those products placed on the market after 13 August 2005. But users are responsible for the disposal of equipment placed on the market before this date. The parties are free to arrange otherwise.

3.1.4.3 The WEEE Take-back System in Germany

The WEEE Directive and the corresponding German law may be considered an institutional innovation. During the next years it will lead to the build-up of complex systems of co-operation between the involved actors with different partners in each case and also with different levels of legal validity. Institutional arrangements and settings, dominant practices, rules and shared assumptions will change. A dynamic interaction of institutional change and technological change will start, changing all market- and actors-configuration substantially.

For disposal services the actors co-operate at different stages of the material flow, either alone or with partners:

- Collection of waste equipment at the collection points possibly with pre-sorting (final users, municipalities and/or disposers contracted by them, retail trade),
- Setting rules, registration, co-ordination and monitoring by the EAR (EAR as a corporate body, producers, logisticians, disposers, guarantors),
- Authorization of the EAR and enforcement of the regulations (Federal Environmental Agency – UBA),
- Collection, recycling and disposal performed individually or by collective systems (producers, logisticians, disposers).

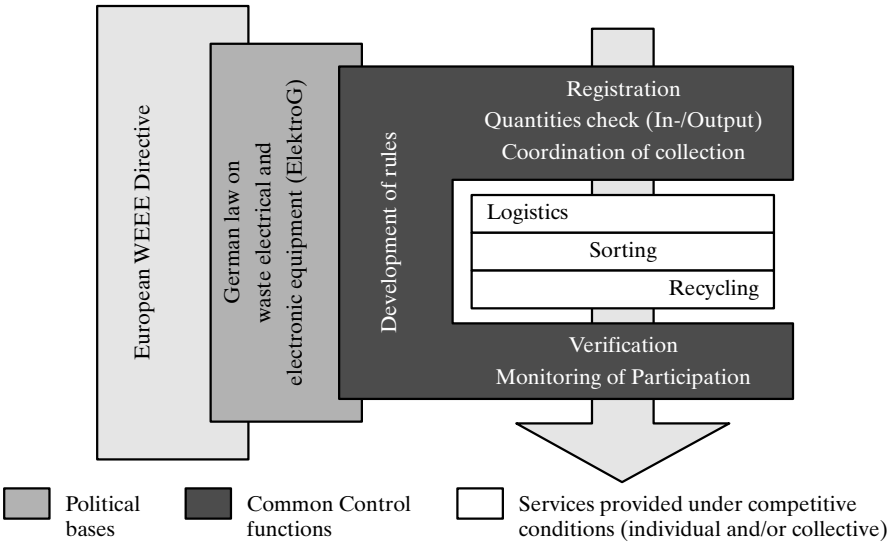
Private final users hand over their WEEE to municipal collection points, or the devices are picked up by the municipalities. The municipalities themselves or the disposers contracted by them in addition have to accept waste equipment which was taken back by distributors on a voluntary basis. About 2000 transfer points are planned. At present there are some 3000 collection points (so-called yards for material to recover – Wertstoffhöfe) (Figure 12) (Schnurer 2003).

The project organization "Electrical Appliance Register – EAR founded on 2 June 2003 by industry associations ZVEI and BITCOM has started to build up a registration and co-ordination center. This "Joint Center" as an agency authorized by the UBA has to ensure that all producers fulfill their take-back obligations. For this purpose the EAR has to determine the obligations of each responsible entity, to verify the fulfilling of their obligations, and if necessary to enforce them. Within the legal framework the "Joint Center" will develop the necessary rules and regulations which requires an interpretation and/or a specification of this legislation (Figure 11).

With that the industry is granted free hand within the legislation framework for independent action. Working groups (sector boards for individual product groups) will set up operating rules separately for the individual product groups. Then the rules will be checked for compatibility and compliance for all groups. At the moment the EAR still is a project organization. After authorization in August 2004 the status will change and operations will start. It is planned that all producers within the purview of the regulation/law become partners in this organization. The EAR shall have some 12 employees (Theusner 2003, EAR Elektro-Altgeräte Register 2004).

Figure 11

Tasks of Electrical Appliance Register



Source: EAR Elektro-Altgeräte Register 2004.

In future the "Joint Center" will be responsible to ensure the registration, the coordination and also the monitoring (the survey of data on quantities and categories of devices from selling until the disposal and the balancing of these data), so to ensure that the individual producers fulfill their obligations. This way also the problems of the disposal costs of so called no-name products which cannot be attributed to a specific producer, and of abandoned products (orphans) the producers of which are no longer in the market at the time of disposal will be solved. So a free-riding will be prevented.

Within this co-ordination task the EAR will be informed of containers ready to be picked up and according to a specified scheme to request the producers and/or contracted disposal plants to collect the containers. From the municipal collecting points the devices will either be transported directly to the disposal facilities or to places of transshipment of the producers where they may be further pre-sorted and then transported to the disposal facilities.

To ensure a smooth operating many regulatory problems will have to be solved by the EAR. Among them, being a substantial prerequisite for the operation, are flexible definitions of "type of equipment". In this case a

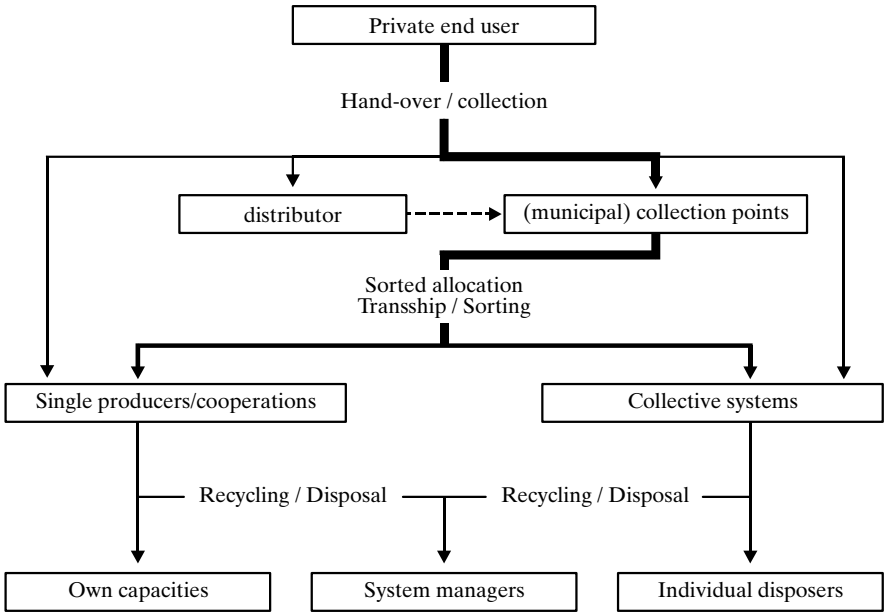
legal definition would be soon outdated by reason of the rapid technological development (BITKOM/ZVEI 2003). The development of suitable guarantees for the financing of taking back waste equipment and its treatment too is within the responsibility of the producers and will be performed in co-operation with the financing and banking industry[42].

The disposal services themselves, i.e. return, sorting, re-utilization and recycling will be performed under competitive conditions (Figure 12). The performance (individually or by collective systems) will be regulated by contracts between producers and disposers. The disposal service itself will be performed in producer-owned facilities or in facilities of single disposers (acting as individual entrepreneurs) or through system managers. Here separate contracts for logistics re-utilization/recycling and complete solutions are conceivable. Feasible as well are take-back solutions of producers including own collection points for WEE for final users. Industry already announced to set up facilities and systems for pick up, collection and re-utilization, using both ways: for some branches individually and for some encompassing several branches. Common structures and systems will be operated for practical and financial reasons for a number of products, not only for historical waste but also for new waste equipment (BITKOM/ZVEI 2003: 5). At producer level purchasing associations, e.g. the "Pan-European Purchasing Association", emerge: They are a loose co-operation of presently 4 producers who will buy disposal services on a common basis and on a European level to achieve savings because of the then bought quantities, with the co-operation basically also being open for small enterprises. As at present it is expected that disposal services are contracted on an overall-coverage-basis and that individual disposers are not capable to provide such verification financially strong big businesses as system managers push their way into the market. Producers will conclude contracts with them. These system managers again will enter into subcontracts with smaller disposers to perform the actual disposal services (Theusner 2003). Medium-size enterprises also will be active partly directly co-operating with other medium size enterprises. Such co-operations between medium-size enterprises have been common for the last 10 years to elude own capacity limits (Telephone interview with bvse 2003 of 2 December 03).

[42] As feasible guarantees are considered: as collective guarantees e.g. an earmarked separate estate (sector or industry funds) or participation in a collective financial system and/or inter-generation contract supplemented by a reassurance); as individual guarantees earmarked separate estate e.g. blocked-bank-account (Frey 2004).

Figure 12

Survey Material Flow



According to bvse (Habel 2003).

In the case of equipment sold after 13 August 2005 financial means will pass from the final user with the purchase of the equipment through the distributors to the producers. In case of acting individually these will finance return, sorting and treatment directly, in the case of acting via collective systems the financial means will flow indirectly through common operative systems. Additionally the producers have to bear the costs of the "Joint Center". In the case of historical waste equipment (including no-name and orphaned products) the money will flow from the producer, relative to his market share, into a fund out of which the disposal activities will be paid (Schnurer 2003; BITKOM/ZVEI 2003).

3.1.5 Actor Constellations and -Interests with Respect to the WEEE

The WEEE Directive is an example for the concretization of the principle of producer responsibility within the European waste policy. By a bundle of measures focusing on the individual responsibility of producers the avoidance of WEEE shall be achieved along with an improved re-utilization and

recycling of this waste. Above all with the concept of producer responsibility incentives to promote appropriate design and production of electrical devices shall be given. With the WEEE Directive the physical and financial responsibility for the disposal of waste devices is shifted from local waste management authorities to private enterprises. At the same time according to the principle of shared responsibility the actors within the product chain are obliged to contribute to the achievement of the goal. This implementation on a national level is the subjects of ongoing debates since there are far reaching problems to be solved. Among these are definition problems (type of equipment), depth of sorting in the collection process, agreement on state-of-the-art technology, agreement upon registration, marking, guarantee, monitoring questions, etc. Because of different national starting conditions this transposition into national legislation will occur in different ways throughout the EU. The individual responsibilities, however, should be set in such a way that not only the desired incentives for the producers will be kept but along with setting up obligations for other actors their interests should be taken into account as well to optimize the effects.

Each group of actors involved in the WEEE implementation has its own goals. This is true for the European legislator with his specific focus on harmonization, and also for the national environmental policies with their individual aspects. This is valid for the consumers who want to maximize their benefit, and also for the companies taking part in the product chain. Companies experience environmental goals as framework conditions they have to comply with in a cost efficient way in addition to the whole compound of regulatory, technological and marketing conditions. Additionally due to an increased environmental consciousness during the recent years, producers have started putting environmentally friendly products on the market as well as using 'eco-efficiency' as a marketing instrument. Associations of producers, trade, logistics, disposers, through their influence try to safeguard the economic interests of their members, and to provide services for them. These interests of the major actors, legislators, consumers, producers, logisticians/disposers, and local authorities are shown for the transposition of the WEEE Directive into national legislation in the case of Germany (Figure 13), although the main characteristics will be the same everywhere especially concerning the sharing of responsibility between municipal waste management authorities and producers.

Additionally, the success of a take-back system finally depends on the degree the interests of the actors are addressed by the obligations. In the interest of the consumer is the option of a convenient returning of the WEEE in the first place, free of charges. The goal of the producers is to keep the disposal costs as low as possible, and only to bear the disposal cost for their

Figure 13

Extended producer responsibility with respect to WEEE and the interests of actors involved

National Policy

Avoidance, re-use and high quality recovery

Design for environment

Competition on disposal markets

European Policy

Harmonization of national regulations

Avoidance, re-use and high quality recovery

Design for environment

Producers

Polluter oriented cost-assignment

Consideration of existing collection systems

Take-over of costs from collection points

Large companies

Area-wide disposal with few partners (economies of scale)

Competition in the course of time

Harmonization of standards and definitions within MS of EU

Medium sized companies

Remaining on the market

Retail trade

Consideration of existing collection systems

Voluntary participation with cost reimbursement

Logisticians / disposers

High market share of WEEE

High turn-over with sales of secondary materials

Large companies

Area-wide disposal with few partners (economies of scale)

System managers with regional partners

Harmonization of standards and definitions within MS of EU

Medium sized companies

Inclusion of decentralised collection structures

Ensuring of high quality standards

Municipal waste management

Consideration of existing collection systems

Take-over of collection costs by producer

Private end user

Convenient returning of WEEE

Returning free of charge

own products and not the costs for no-name products or abandoned products. The producers consider this goal achieved with the individual producer responsibility. They also favor the concept of the planned shared producer responsibility, with the local waste management authorities further performing the collection and the corresponding financing of the waste equipment.

Their major point is that that they cannot actively influence this cost portion. Whereas large producers (global players) favor an overall coverage of areas with few regional contractors (economies of scale), small producers on the other side emphasize the importance of competition. It is their interest to remain in the market. Retailers as far as possible do not want to take over responsibility for WEEE and offer a voluntary contribution of service oriented trade companies in the take-back process. They request a take-back system cost-neutral to them as they see no room for an additional cost burden (HDE 2003; HDE and BVT 2003).

The local authorities accept the system of the shared product responsibility according to which they are responsible for the collection of the devices. They, however, favor a take over of the collection costs through the producers and thus a reduction of the financial burden for the budget of the communities. The logisticians/disposers want a high market share in collection/dismantling of used devices and a good price/cost relationship for secondary material. Large companies want to realize this by co-operating with few large partners or in the role of system managers. Medium sized disposal companies above all want to include existing decentralized disposal structures avoiding cartels and so to keep these capacities already existing on the market. They also want to see their interests safeguarded within the implementation of quality standards so ensuring the high German disposal standards.

Through the implementation of the individual producer responsibility national politicians want to achieve a high degree of waste avoidance and recycling quota. From an economic point of view to secure competition and thus cost-efficiency they, in addition, last but not least, represent the interests of medium-sized companies. For the European environmental policy harmonization above all plays an important role. It is considered a major prerequisite to achieve the goals of avoidance and recycling optimally. Recital 8 of the WEEE Directive outlines that different national policies hamper the effectiveness of recycling policies and makes this a crucial reason for initiating the directive (Chapt. 4).

Other actors and above all large producer express their interest in the harmonization. Global players are very much interested in a far reaching international coordination concerning the aspects of registration, guarantee, and monitoring, including an exact definition of the term “producer”. The rea-

son for this is the large volume of cross-border trade frequently not going through regular channels and also not turning up regularly. Individual producer responsibility and a causation based cost assignment (and thus the solution of the free-rider-problem too) can only be achieved if all parties concerned are included in harmonizing these processes. Within this context also the problem of cross-border distance trade (although a relative small problem compared with the overall free-rider-problem) – a central focus of this paper – has to be considered. Large distributors as far as they are concerned within the purview of this directive should have a similar point of view and also large disposers as they are interested in a solution guaranteeing a proper reimbursement of the disposal costs. Additionally they will be interested to provide disposal services on an international level, alone or together with business partners.

Because of the differing national transpositions a wide variety of implementations is expected leading to coordination and cooperation problems. It becomes obvious that facing increasing international product and waste flows in the course of the WEEE implementation, coordination on a supranational level, between national legal systems, between private organizations and/or private actors is crucial.

3.1.6 Situation for Packaging

The German Ordinance on the Prevention of Packaging Waste (Packaging Ordinance) was enacted in 1991[43] as one of the first examples of extended producer responsibility (EPR), i.e. as a policy tool in which producers are required to be financially or physically responsible for their products after their useful life. An amendment of the Packaging Ordinance was passed in 1998 and came into effect in August 1998. This amendment was necessary in order to fulfill the requirements of the European Packaging and Packaging Waste Directive (94/62/EC) and of the German Product Recycling and Waste Management Act (Kreislaufwirtschafts- und Abfallgesetz) as well as to eliminate regulatory gaps. Another amendment to simplify deposits on drinks containers was approved by the German Cabinet in June 2003 changing the rules setting deposits on certain single-use beverage containers. If these changes will pass through all parliamentary chambers, it is likely to take effect from spring 2004.

The overall target of the Packaging Ordinance is the prevention of packaging waste. As for the rest, the re-use and recycling of packaging has priority over the disposal. This reflects Germany's adherence to the waste hierarchy.

[43] The Packaging Ordinance came into effect for transport packaging in December 1991, for secondary packaging in April 1992 and for sales packaging in January 1993.

In terms of the particular contents, the general requirements for manufacturers and distributors of packaging from this directive are that packaging has to be manufactured and distributed in such a way, that

- packaging volume and weight are limited to a minimum, necessary to guarantee product qualities and consumer acceptance,
- re-use or recycling should be possible and
- environmental impacts of recycling or disposal should be as small as possible.

With these requirements the legislator emphasizes the product responsibility of the affected firms. But they are not legally binding; instead they are merely guidelines (Flanderka 1993: 5f).

The prevention target of the Packaging Ordinance shall be achieved rather indirectly by take-back and recycling obligations for the manufacturers and distributors of packaging. They are obliged to take back used packaging free of charge and to arrange for it to be re-used or recycled. These obligations can be transferred to a third party. Through this command and control instrument the legislator tries to get the packaging industry, the consumer goods manufacturers (filler/bottler) and the retail trade to take measures for the prevention of packaging waste.

The ordinance classifies packaging into three categories: transport, secondary and sales packaging. This distinction is very important, because while the manufacturers and distributors of transport and secondary packaging are not exempted from the take-back obligations, an escape-clause exists in case of sales packaging. The take-back obligations for sales packaging are ruled out, if the affected companies join one or more nation-wide collection system(s) – the so-called Dual System -, which guarantee(s) a regular collection of used packaging at or near the households. Two demands are made:

- On the one hand the recycling quotas have to be fulfilled. Since 1998 for aluminum, plastics and composites a 50 %, for paper/cardboard a 60 % and for tinplate and glass a 70 % recycling target exists.
- On the other hand the system has to be harmonized with the existing collection, sorting and recycling systems of the local authorities.

It is important to mention here that **material recycling is mandatory**, which is not even an integrated solid waste management approach. Since the amendment of the Packaging Ordinance came into effect, a limited permission for energy recovery exists for plastic packaging. At least 60 % of the plastic recycling quota has to be fulfilled by mechanical recycling. Beyond this mechanical recycling quota the cleaner type of recycling (mechanical

recycling, feedstock recycling or energy recovery) according to § 6 Abs. 1 Kreislaufwirtschafts- und Abfallgesetz (Product Recycling and Waste Management Act) has priority.

As a reaction to the emerging Packaging Ordinance with its escape clause for sales packaging, 95 leading companies of industry and retail trade founded in 1990 an organization entitled the "The Green Dot – Dual System Germany – Society for Waste Prevention and Secondary Material mbH (the so-called DSD)[44]. The objective of DSD is the building up and maintenance of a system for the collection, sorting and recycling of sales packaging. Meanwhile, the Dual System is implemented nation-wide. In accordance with the local authorities of the rural districts and towns, the DSD has made contract agreements with waste management companies covering the collection and sorting of packaging waste.

In principle, there are two basic types of collection systems in the contractual districts:

- The curbside system, in which lightweight packaging (tinplate, aluminum, plastics and composites) is collected in yellow bins or bags from households by the responsible waste management company.
- The drop-off respectively bring collection system, in which especially glass – sorted according to color – and paper/cardboard packaging are collected near the households in containers or at recycling stations.

Waste glass is transported via preparation facilities to glassworks; paper/cardboard and lightweight packaging are transported to sorting plants. Paper is sorted according to the German standard quality list; the lightweight packaging is sorted at sorting facilities into different material fractions as specified by DSD. After this, bales of the sorted fractions are transported to the recycling plants, where recycling products or secondary raw material are manufactured.

Here the so-called acceptance and recycling guarantors working as recycling brokers play a major role. These companies contractually guarantee to DSD a proper recycling of the sorted packaging. Depending on the fraction, these companies are subsidiaries of the corresponding packaging manufacturers or firms, especially founded for the recycling and marketing of the sorted material[45].

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[44] In 1997 more than 600 companies had a share in DSD. Due to the multitude of shareholders the DSD was transformed into a stock company on January 1st, 1997. For more details about the history of the DSD's origins see e.g. Philipp1993: 36ff.

[45] For detailed information on the acceptance and recycling guarantors see DSD Internet homepage: http://www.gruener-punkt.de.

To finance the Dual System the fillers must pay a license fee for the usage of the registered trademark "Green Dot", which means the right to participate in the Dual System[46]. The license fee of the DSD takes account of the actual waste management costs of the different packaging materials, including financial subsidies for plastic recycling[47]. The license fee is a composition of a material-specific weight fee and a volume- or area-specific item fee.

3.2 Expected Innovation Impacts of the WEEE/RoHS Directives

In this chapter the development of technological, organizational, institutional and personal innovations are described assuming a successful solution of B2C cross-border shipments and free-rider problems in the context of the WEEE implementation. Under this precondition, no distortions of the ordinary incentive mechanisms as referred to impacts of external innovation drivers on the genesis and implementation of innovations in the EEE innovation system are expected. First a short glance on the development of the innovation system will show an increasing complexity of the systems infrastructure at the millennium turn, second the description of single drivers impacting the innovation processes make clear that the WEEE/RoHS is only one, but the main driver of the innovation system directing the innovation actors towards sustainability.

3.2.1 Development of the Innovation Drivers

Innovations are not a result of a linear process, which begins with R&D and ends with the successful conversion of new products or procedure in the market. Rather act numerous drivers from the surrounding field of the actors in the innovation system, the institutional conditions of the actor configuration, co-operation- and competition structures beside classical drivers such as demand changes and technology development on the genesis and conversion of innovations.

In Figure 14 the substantial innovation drivers in the innovation system of the electrical industry are simultaneously specified:

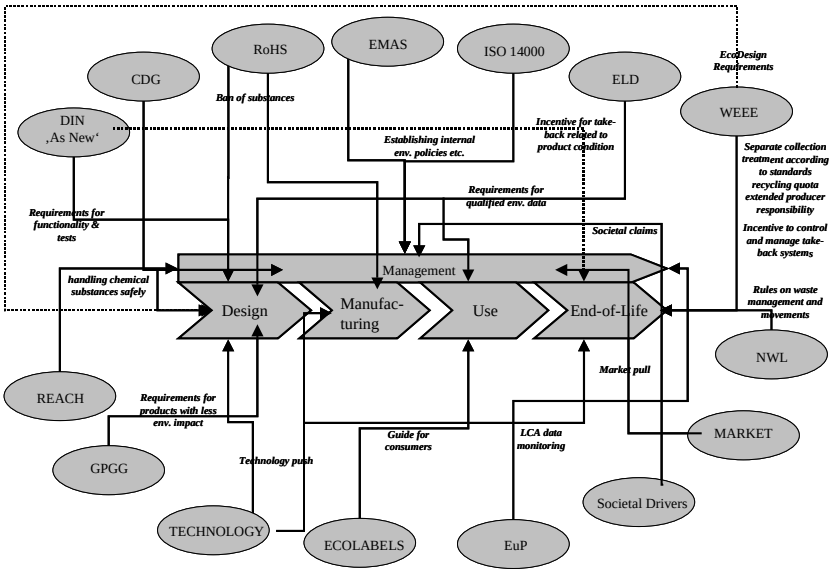
The **WEEE Directive** take-back obligation obviously influences different stakeholders of the innovation system by introducing direct and indirect

[46] Generally the consumer goods manufacturer applies for the "Green Dot". In case of imported goods either the German importer or the European exporter is the licensee. Companies located outside the European Community cannot apply. In case of service packaging the packaging manufacturer is responsible for the registration. Until the beginning of 1998 the number of licensees has increased up to 17,234. See DSD 1998: 20.

[47] For details see Staudt, E.; Hafkesbrink, J; Rebhan, A.; Siebecke, D. (1993).

requirements. It does so as a result of different direct legal obligations to be fulfilled, such as collection and recycling *quotas*, the implementation of the '*producer responsibility principle*' and *financial responsibility* for take-back systems, the definition of certain *standards* for the waste management and several requirements concerning *labeling* of products and *monitoring* of data and mass flows. Manufacturers of electrical and electronic equipment are burdened with the costs of collecting their end-of-life equipment leading to considerable pressure on re-structuring the product design (for easy disassembly to decrease disassembly costs), the end-of-life (EOL)-management by establishing new logistical concepts, take-back systems and recycling systems, the innovation management by introducing new environmental oriented requirements like Design for environment (DfE) within the supply chain etc.

Figure 14
Innovation drivers in the Electronics Industry Innovation System



The **RoHS Directive** operates with *prohibitions* and restricts the use of certain hazardous substances in electrical and electronic equipment, as for instance lead, mercury and other heavy metals with a considerable impact on the manufacturing process and recycling requirements.

The **EuP-directive** places a strong burden on companies that produce energy-intensive products to meet *environmental requirements* and targets in the product's design, production, and end-of-life phase. The EuP requires an assessment of ecological profile of equipment (LCA) regarding raw material, acquisition, manufacturing, packaging, transport, distribution, installa-

tion, maintenance, use, and end-of-life. At each phase of this manufacturers are required to assess consumption of materials and energy, emissions to air and water, pollution, expected waste and recycling/re-use.

The upcoming chemical regulation **REACH** (**R**egistration, **E**valuation, **A**uthorization and Restrictions of **Ch**emicals of the EU) asks for a registration of all relevant chemical substances in the supply chain. Manufacturers and importers have to demonstrate in a registration dossier that they are managing their chemical substances safely. Companies will be required to register all substances produced or imported in volumes of 1 ton and more per year per manufacturer or importer in a central database run by an independent agency to be created. This will cause transaction costs of running the database on these substances as well as increase the supply chain pressure on suppliers.

GPGG (Green Purchasing Guidelines of Governments) in place are still increasing the demand for products and services with a lower overall environmental impact. These guidelines put pressures on producers to develop products and services with a lower environmental impact, e.g. through setting up principle criteria related to electricity consumption in different operational modes for PCs, monitors and copiers, the prohibition of certain materials in production and packaging such as halogenated polymers and carcinogenic, mutagenic and teratogenic substances, a guarantee on longevity, and the responsibility for appropriate disposal resting with the supplier.

The **CDG** (Customer Guarantee Directive) requires that consumer goods conform to the contract of sale, that the consumer goods are repaired or replaced, or a refund given, if a defect becomes apparent within 2 years of delivery and that contractual guarantees comply with certain criteria. This places a heavy burden on design for quality and functionality.

The **DIN "As New" standardization** is still in progress: it concerns the dependability and quality of products containing re-used parts and places additional requirements for functionality and tests.

The focus of **ISO 14000** f is on establishing internal policies, procedures, objectives, and targets, and on pursuing continual improvement. Compliance with applicable laws is mandatory, but the use of the standard is voluntary, and there is a self-declaration option. It applies to both product- and service-related industries. **EMAS** goes beyond ISO 14000: Organizations registering to EMAS must be able to demonstrate that they have identified and know the implications to the organization of all relevant environmental legislation and that their system is capable of meeting these on an ongoing basis. The focus is on initial environmental review, active involvement of employees, and making relevant information available to the public

Ecolabeling: there are three types of Ecolabels, Type I-Ecolabeling according to ISO 14024, Self-declared Claims (Type II-Ecolabeling) according to ISO 14021 and Environmental Product Declaration (Type III-Ecolabeling) according to ISO 14040. Type I is a guide for consumers in that it identifies products as being less harmful to the environment compared to other, similar products fulfilling the same function (i.e. German Blue Angel, Nordic White Swan etc.). Type II sets up requirements for self-declared environmental claims including statements, symbols and graphics on products or services, which are not certified by an independent third party (i.e. ”recyclable”, ”biodegradable“ as examples of statements; ”Mobius Loop“ as an example of a symbol). Type III requires a set of quantified environmental data consisting of pre-set categories of parameters based on Life Cycle Assessment according to ISO 14040.

The **ELD** (Energy Labeling Directive) requires that appliances shall be labeled to show their power consumption in such a manner that it is possible to compare the efficiency with that of other models (appliances for domestic household use).

Electrical and electronic equipment will be affected by Integrated Product Policy (**IPP**) as well. It represents a new approach for product related environmental policy and advocates life-cycle thinking which means that consideration is given to the whole of a product's life cycle from cradle to grave. And seeks to minimize environmental degradation by looking at all phases of products´ life cycle and taking action where it is most effective (design, manufacturing, use, disposal). IPP is flexible as for the type of policy measures to be used, working with the market where possible. The commission wants existing instruments to become more market oriented like environmental management systems, labeling and information concerning the product's cycle. Within the IPP the coordination between the measures shall be improved to use synergies. The IPP communication of 18 June 2003 is part of the Commissions efforts to achieve the goals set down in the EU’s 6th Environmental Action Program and to fulfill the commitments made by the EU at last year's World summit on sustainable development in Johannesburg (http://europa.euint/comm/environment/ipp.).

Besides the legislative or institutional framework conditions there are of course ***market and technology drivers,*** influencing a company’s strategy. ***Customer demands***, i.e. customer satisfaction, fashions and user requirements rank on top of these drivers placing burden primarily on product and service design but also on corporate information and communication policy. Beyond the product and service price, in the last decade also ”green” competitive elements came into place as the result of an increasing awareness of customers on ecological sound products. From the marketing perspective

eco-efficiency as a tool to compete on the market was regarded as more and more important, if competition on prices proved to be without effect. "***Demand pull***" as an indicator to assess the external innovation driver "market" has therefore to reflect the absorbability and demand-elasticity of innovations within the consumer markets, it has to depict customers' behavior and attitudes regarding problems of sustainability and the willingness of customers to pay for green products. Another driving force are *market prices*, especially for secondary materials like plastic resins versus market prices of virgin plastic resins determining the absorbability of recycling material from WEEE.

The availability of new technology also plays an important role as innovation driver following the idea that new technologies are driving the products that are created (**'*technology push*'**). For the electronics industry innovation system these technology drivers play a dominant role in the innovation process, such as further development in miniaturization, upcoming microsystems- and nano-technologies, new wireless communication, technological integration of functions a.s.o.

Another important driver for innovation is the ***market situation*** and especially the 'supply chain pressure', caused by increased burden placed on the focal manufacturers. Empirical evidence on this driver is given by the fact that tools for supply chain management such as 'Eco-design with suppliers' are gaining more and more importance since manufacturers have recently been back-shifting compliance duties to their suppliers to a greater extent.

There are also a series of ***societal drivers*** with the result of increased awareness of environmental problems among producers and consumers, caused by the public debates following environmental accidents (e.g. Three Mile Island and Chernobyl, Exxon Valdez, Brent Spar), a fear of scandals (like the problem of trans-boarder waste shipments to Eastern Asia) and 'stakeholder claims' (such as local, national or international NGO's activities).

To analyze the different impacts of these drivers on a corporate level, one has to recognize that there are obviously different levels of determination (output obligations, process obligations, input obligations etc.), and that a certain directive or other policy instrument doesn't affect the business as a whole but more detailed business processes and their respective stakeholders on a more disaggregated level.

For the examination of impacts on the stakeholders different **strategies** it is essential to analyze, whether the drivers are supposed to affect mainly the technology strategy (introduction of new key-technologies), the product strategy (e.g. concerning functionality), the service strategy (product-service shift), the manufacturing strategy (question of decentralization of sub-

assemblies, impact on the supply chain), the market strategy (for instance as a result of selective obligations on white, brown or grey goods), the recycling strategy (level of disassembly, recovery and end-of-life treatment), a.s.o. For instance on the **product design** side the challenges to manage, implement and to organize Eco-design principles are targeted by different external drivers, at least jointly by customer requirements on function and fashion as well as by the actual legislative context. The cumulative impact on design might cause increasing requirements on the design for dismantling (WEEE-impact), to use fewer components or certain materials (WEEE- and RoHS impact), to use recycled materials (WEEE-impact, green marketing), removal of hazardous substances (RoHS impact), increased energy-efficiency (EuE-impact), a.s.o. According to this, extensive changes have been observed and are still to be expected in all areas of design, according to[48]

- the choice of materials and components (avoidance of hazardous substances, minimization of scarce natural resources, minimization of the energy-content in conversion from raw materials, design for less production waste etc.),
- production (identification of implications of design decisions for major changes in the production process, potential environmental issues and impacts from the production process, including energy use.),
- distribution (minimization of product size and weight, optimization of transport/distribution in relation to fuel use and emissions, elimination of packaging if possible),
- use (technical issues in design for energy efficiency include like design with a 'sleep' mode, selecting the lowest appropriate power devices, influencing suppliers to design more energy efficient components, use of low voltage logic, avoiding cooled fans or air conditioning),
- end-of-life (design strategy for end-of-life concerning electronic scrap, re-use and recycling).

To sum up, the dynamic effectiveness as referred to the dynamic incentive impact especially of the WEEE Directive on the further genesis of related innovations is supposed to be very high, since industry has developed numerous programs for R&D and implementation efforts for new technologies and organizational structures to cope with the WEEE requirements in the long run[49].

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[48] See the SMART ECODESIGN GUIDE of CFSD, http://www.cfsd.org.uk/etmuel/index.html.

[49] See Hafkesbrink et al. 1998.

Following the stakeholder approach, the innovation impacts described in the following chapters will be clustered into relevant parts of the value-chain according to the steps design, manufacturing, use of EEE, end-of-life and management (as a cross-lateral task).

3.2.2 Development of Technical and Organizational Innovations

3.2.2.1 Review of Innovation Activities before the Millennium Turn

Still before the announcement of the first draft of an electronics scrap regulation in Germany in the year 1991, to the topic material recuperation and solution of disposal problems in the end-of-life range, substantial innovations have been realized, whose initiation is considerably due to economical incentives. In the center were located technical solutions from the range of the sorting, conditioning and recycling techniques for metal waste, process technique for the recycling of plastic wastes, the processing of galvanic baths and etching solutions as well as the thermal waste treatment. In the years 1991 to 1993, not least as a reaction to the announcement of the first draft of the electronics scrap regulation, were developments in the end-of-life range strongly intensified, in particular to the topics of the dismantling, conditioning and utilization of construction units (e.g. circuit boards and printed circuits) and materials (thermoplastic group materials, metals, multi material mixtures etc.), the analysis of application statistics (e.g. with microelectronic elements and printed circuit boards), the problems of the plastic recognition and plastic recycling as well as first appendages to disposal respectively recycling-fair organization.

At least temporarily since then apart from the manufacturers of electrical and electronics devices the enterprises of the disposal and recycling economy also reacted to the announcement of environmental political regulations, since they expected an increasing demand for their achievements from the stronger adjustment of the market for electrical and electronic (old) devices with at least stable price level. They developed new procedures for the recognition and separation of the materials and for the recycling respectively disposal and have accomplished pilot projects respectively demonstration projects and in individual cases established extensive capacities (above all: shredders). Under the pressure of over-capacities in the dumpsite range and the resulting drastic price purge, the intensity of these activities diminished however for some time recognizably; some waste management companies consider already closing their plants. Soon – particularly after coming into force of the TA settlement waste – however, rising landfill respectively disposal costs have to be added, which will make dismantling and recycling strategies again more profitable.

Starting from 1994 the innovation activities diversify increasingly and lead to tendentiously more extensive project initiatives strengthened in the front-end range. To them belonging are particularly the fields of the recycling respectively disassembly-friendly development and construction, the production of tools and analysis helpers (software for DFE; Design For Environment, economic analyses of the disassembly depth, analyses of the recycling ability etc.) projects for partial automation (disassembly, dismantling) and improved partial recognition, systems to the secondary raw material use, DFE and recycling, selected individual products with high mass accumulation (greener television etc.), single techniques for improvement of the separation.

Starting from 1995, a certain concentration of problems of the material flow management shows up and an intensified effort over front-ends solutions within the range of the construction and production, connected with a transition to questions of the upgrading, re-use, use intensification and life span extension of products.

These innovation activities find their continuation since 1998 in the two large thematic networks of the European Union, ECOLIFE I ("Closing the Loop of Electr(on)ic Products and Domestic Appliances. From Product Planning to End-Of-Life Technologies") and since the year 2002 with ECOLIFE II (ECO-efficient LIFE cycle Technologies. From Products to Service Systems), which were activated over the WEEE particularly as reaction to the discussion over IPP, RoHS and EuP. The thematic emphasis and desired innovation directions of these networks are to be taken from the figures 15 and 16.

Parallel to the activated innovation projects in the R&D phase, various innovations in the management systems of the actors having taken part in the innovation system were activated as well, primarily within the range of the manufacturers, e.g. by changes in the external communication and in the participation in inter-organizational working groups, changes of the in-plant innovation management and strategic planning, changes of organizational planning instruments, in particular in the construction, the introduction of environmental oriented in-plant incentive systems, changes of the marketing activities or for instance the introduction of new further training programs.

Figure 15
Emphasis topic tables of the European Union network: ECOLIFE I

Eco-design
- Elaboration of a Best Practice Guide,
- Design implication of EOL processing.

Closing the Cycle
- Quality Aspects,
- Communication & Marketing,
- Logistics,
- Qualification.

End - of - Life Aspects:
- Identification & Sensors,
- Separation Technologies,
- Health & Safety,
- Financial Aspects,
- Re-Use & Upgrade,
- Management & Strategies.

Source: SAT, Vienna 2002.

Figure 16
Emphasis topic tables of the European Union network: ECOLIFE II

ECOLIFE II: Focus on the product-service life cycle of electr(on)ic products

From products to new eco-efficient customer driven services:
- ⇨ **Product Re-design**
- ⇨ **Function Innovation**
- ⇨ **Service System Innovation**
- ⇨ **Crosscutting: Information/knowledge Management**

Source: SAT, Vienna 2002.

ECOLIFE II takes up in particular new concepts for the equipment use, for which on the opinion of experts another long-range potential for innovation activities is seen. In the center there are new product service combinations, which are directed towards the extension of the product life span and staggered array and less on recycling and improvement of the utilization.

3.2.2.2 New Orientation of Innovation Activities after the Millennium Turn

As a matter of fact, in the electronics industry innovation system, a global strategic re-orientation has taken place since the early 90s (Hafkesbrink et al. 1998) affiliated with new requirements throughout the whole supply chain, placing new challenges on networking with new business actors (like waste-management companies, recycling industry), changing manufacturing

processes and product design (e.g. for energy-efficiency), thinking green and changing innovation management procedures, developing new business-models for a product-service shift a.s.o.

Starting with the new millennium an outline of a new innovation paradigm turned out in the EEE innovation system: a global orientation towards sustainable development.

Figure 17 depicts a selection of 45 out of 120 innovations, rated as most important for the electronics industry as the result of an experts delphi within the above mentioned ECOLIFE 2 network.

Some of the technologies / innovations mentioned in table 1 are narrow in scale and scope (like a particular plastic separation technology), others are complex because as a pre-condition for their diffusion, an extensive alteration of business structures, management procedures and infra-structural conditions has to be worked out in the innovation system (for example: new utilization concepts and product-service shifts require a complex co- operation of various innovation actors along the supply-chain involving additional actors from service and maintenance). Insofar these innovations cover the whole range of different innovation types, such as technological innovation (i.e. further development of a certain recycling technology, EcoDesign-Tools), organizational innovation (new logistic concepts for take-back systems, new green management tools), personal innovation (i.e. new education and learning concepts) and systemic institutional innovation (new business models).

Selected current innovation trends in design, manufacturing, use, recycling and management are described in the following chapters[50].

[50] For more detail see Hafkesbrink et al. (2004).

Figure 17
Innovations in the electronics industry innovation system rated as most important

	Design	high	med	low		Use	high	med	low
Dialog	Ecological idea dissemination through the supply chain	9	5	4	Dialog	Customer Information and Education on usage	11	5	3
	Eco-Co-Design with Suppliers	9	6	4		Communication of products impacts to the consumer	9	5	4
	Management of Eco-Cost Reduction with Suppliers in manufacturing & design	7	7	4		Understanding Customer Behaviour And Communication with Customers	10	5	2
	Communication strategies among companies	7	6	4	Strategy	Energy Efficiency in Use	12	3	4
	Information dissemination to SME	7	6	4		New Business Models (Leasing etc.)	9	5	4
						Recovery / EOL	**high**	**med**	**low**
Strategy	Design for Environment	14	4	2	Dialog	Information communication between Electronics Industry and Recyclers	12	2	3
	Design for chemical content	4	10	5	Strategy	(Cost Effective) EOL and Recycling Technologies	13	5	1
	Design for EOL, dis/assembly	10	5	3		Standards and Technical Specifications for Recycling	8	8	2
	Integration of DFE in conventional management systems	8	6	5		Logistical concepts concerning collection of used electronics	10	8	1
	Substitution of hazardous materials (e.g. BFR, VOC's, semi-conductors) in products	10	9	0		Market development for recyclates	9	8	1
	Renewable materials	5	10	4	Tools	Disassembly Analysis	5	10	4
						Automatic disassembly technologies	7	7	5
Tools	LCA/LCC including simplified LCA	7	8	5		Recycling of materials and components, special interest: PCBs, Copper/Glass, Packaging materials	7	8	3
	Database on Materials/Components for DFE	11	5	4		Development of (public) take-back schemes for EOL	12	3	3
	Life Cycle Engineering	8	6	5		**Management**	**high**	**med**	**low**
	New Substrates for PWB	3	13	4	Dialog	Supply Chain Management	11	5	1
	Halogen-free flame retardants	6	10	4		Knowledge Management, Knowledge Transfer and distribution	9	6	2
	New Flame retardants materials	10	5	3		Education and Training	9	7	1
	Manufacturing	**high**	**med**	**low**	Strategy	Legislation monitoring of RoHS, WEEE, IPP, EEE etc.	8	7	3
Dialog	Dissemination of best industrial process	10	7	1		Ensuring legal Compliance	7	6	3
Strategy	Substitution of hazardous materials in production	10	7	2		Green Strategy making and Green Innovation Management	6	7	5
	IPPC	4	9	3	Tools	Consultation between Industry and Government	9	5	5
	Improved Manufacturing of materials, components & subassemblies	4	10	4		Roadmaps, performance measurement			
Tools	Lead-free soldering	12	4	3		Eco-Mapping of drivers (Government, Customers, NGO's)	4	9	4
	Eco-Efficiency of Manufacturing	7	7	5		Ensuring legal compliance of suppliers	6	9	3

This table comprises the results of a technology experts delphi (32 experts), conducted in 2003 in the ECOLIFE thematic network (see for details, ECOLIFE II – Eco-efficient life cycle technologies – State-of-the-art technology report in the Electronics industry innovation system (Hafkesbrink et al. 2004)). The outstanding innovation topics are emphasized with dark grey color.

3.2.2.3 Current Innovation Patterns in Selected Areas of the Value-chain

Design

Innovation trends in the area of design are characterized by the attempt to intensify **communication towards the supply chain**. Many companies are not aware of the forthcoming legislation, and for those who are it is not well understood. Suppliers are beginning to communicate the requirements of the directive and general issues related to eco-design but only to those high up in the supply chain (1st or 2nd tier). In that sense supply chain pressure is more of a driver than legislation at the current time. Information exchange turns out to be the key to the success of eco-design along the supply chain.

Current innovation developments are directed to easy to use tools and information to make eco-design more a feature of everyday design and manufacture. This development is also connected with the evolvement of eco-design standards and requirements along the supply chain with the goal to let these requirements become part of the standard supply chain agreements and contracts. The main challenge in the innovation process is to develop easy to use tools and methods that do not require specialist expertise and that especially integrate the supplier's environmental performance to his turnover. The next innovation step is already looming on the horizon: **management of eco-cost reduction with suppliers**. OEM's currently are looking for new dialog tools to manage eco-cost reduction with their suppliers. This development is not triggered by external sources like legislation, customers, competitors or stakeholders, but by supply chain goals such as cost reduction linked to environmental improvements and vice versa. First case studies within a specific sector of the supply chain (PCB production) show that the concept might be put in practice, presupposing that a simplified tool can be developed to produce insights into the mass balances of the suppliers.

In the area of **Eco-design strategies** the current innovation trends lead to a considerably widened scope of applied Eco-design. Since it started years ago as a pure technical issue it is now affecting all business aspects and the complete value chain. This anchoring of Applied Eco-design in the business is also a 'cultural process', its access is also strongly linked to the mindset of people. This makes that its introduction takes time and that while introducing the concepts they change simultaneously. Innovation in eco-design strategies today is directed towards new levels of eco-design looking for alternative fulfillment of functionality using selected LCA data. A further innovation driver comes from technical universities developing new levels of eco-design for functionality completely fitting into sustainable society involving a complete life cycle analysis.

Innovation in **Design for Chemical content** (DfC) drives currently towards an improvement of the controlling of chemical contents all along the supply chain since it will become more and more decisive for the electronics industry facing the RoHS, the EU white paper on a Strategy for a Future Chemicals Policy, PVC bans etc.

Innovation efforts in **Design for End-of-Life** currently try to work out measures to be able to reach the recycling targets set by the WEEE Directive, especially to find a combination between selective manual dismantling and mechanical treatment that is appropriate under eco-efficiency aspects.

Life Cycle Analysis (LCA) is no longer an academic issue today. Innovation efforts are mainly to be found in the development of LCA tools. Many large companies conduct LCA studies to analyze their systems/products and let their results influence new developments. Nevertheless, of the thousands of electrical and electronic products put on the market in Europe to date, only a tiny percentage have had any form of LCA or LCC carried out as part of their design and development. The use of LCA in SMEs is still quite rare, but due to the pressure from OEMs, future directives, (e.g. the EuP) and the fact that high quality background data will become more and more available on a broad basis and relatively low priced, LCA will become increasingly accepted. The expected improvements of sustainability indicators are very high since a broad application of LCA also within SMEs will dramatically shift the orientation of designers towards DfE and will show up in resources reduction as well as improved energy efficiency of products, etc. Various aspects of innovation in the context of LCA application are:

- Implementing LCA into DfE due to a poor linkage of these tools
- Database on materials since a reliable database is crucial for the further dissemination of LCA tools; innovation topics are full integration of technical, economical and social criteria into LCA, which is still an issue of basic research
- Environmental benchmarking defined as being at a basic research stage since there are further methodological problems expected to be that will hinder the application and diffusion of environmental benchmarking.

Manufacturing

In manufacturing there are ongoing innovation efforts in the following areas:

- ***Lead-free soldering:*** this issue seems overall to be solved in a theoretical way. Theoretical results are now being implemented into industrial use

in the electronic manufacturing industry. Although the results seem promising, the consequences on e.g. efficiency in industrial application are not known.

- ***Eco-efficiency:*** there is still a lack of common understanding of eco-efficiency as an operational strategy for manufacturing as well as a lack of agreement on how to measure eco-efficiency as an indicator and its interpretation. Some of the eco-efficiency initiatives are being developed and tested in industrial application, and the number of initiatives is growing.

- Cleaner production is a rather mature theoretical concept. Such initiatives are being promoted to industry and strategies and are being disseminated around the industrialized world, as well as in developing countries. Innovation efforts are directed towards the application of cleaner production methods in SMEs.

- Rapid manufacturing of finished products is a technology that is currently at the birth stage. Industrial applications have been made within the area of rapid prototyping. Thus the technology is applied to the manufacturing of prototypes during product development. Large scale manufacture of tailor-made products is not industrialized.

- Virtual manufacturing: virtual manufacturing is a well proven technology with growing adoption in manufacturing industry. The development trend is to include new aspects in the model making the model behavior converge towards the behavior of real objects.

Use

The area of use is subject of different innovations mainly directed to improve energy efficiency. Selected items are:

- **Customer information & communication of product impacts**: innovation efforts are mainly focused on improving the information policy of industry. Up to now only large-scale companies provide sustainability reports on a regular basis.

- **Energy-efficiency** providing "enabling technologies": this is the main issue to be tackled by future research and dissemination activities. High potential for energy saving enabling technologies exists, which has not been fully exhausted yet. Main innovation goals are directed to the further development of enabling technologies, such as the switch to LCD technology, improvements in fuel cells, the generation and storage questions for solar cells and human power, improvements for portable sources of energy as a substitution for Li-Ion Batteries, further minia-

turization and the implementation of nano-technologies etc. which are not solved concerning their corresponding problems.

- **New Business Models**: The evolution and diffusion of new business models for sustainable service systems in the electronics industry depends on radical changes in economic paradigms and requires a change in the perception and in the behavior of all actors involved in the innovation system. Current innovation efforts are the development of PSS (products-service systems), functional sales (via leasing etc.) etc.

Recovery and End-of-Life

The main innovation efforts today turn up in the further development of **identification and sensor technologies** to increase the speed of on-line recognition, to enhance hybrid sensors, that integrate different specific sensors, for recognition of diverse material families (polymers, metals and inorganic additives, organic additives, halogens and halogenated substances…), to improve dark polymer recognition and overcome recognition faults due to dirt, external impurities or labels and to build and refine libraries with reference materials. Furthermore specific innovation efforts are to be found in the improvement of non-destructive (semi-) automated separation, disassembly, CRT-handling, etc.

Management

In the area of management, complex institutional innovations are on the business agenda containing

- changes in external communications,
- changes to internal innovation management and strategic planning,
- changes to organizational planning instruments,
- introduction of construction principles or Design for Environment (DFE),
- introduction of internal environmental incentive systems,
- changes in marketing, and
- introduction of new training programs.

The main challenge which is currently taken up by the innovation actors, is to develop transferable tools for an implementation of these changes in SMEs since large-scale organizations are more and more involved, SME involvement however is almost in its infancy.

In the next chapter, a short glance will be put on the question, how these innovation efforts are expected to contribute to sustainable development in the EEE innovation system.

3.2.3 Evaluation of Innovations According to Sustainability

3.2.3.1 Evaluation Overview

Accepting the three pillar concept as a specification of sustainability, indicators have to be defined and verified which not only describe the stock of ecological but at the same time the stock of economic and social capital or although this is hardly ever possible measure the losses of substance or investments into these stocks. Such abstract principles are not directly applicable for the analysis of concrete questions. So a specific innovation system like the one of the electronics industry needs a certain break-down of these principles into specific and operational indicators. These indicators are manifold and have at least – according to the three pillar concept to provide information on the impact of innovations on economic, ecological and social improvements.

Ecological improvement: These indicators are defined in relation to the use of natural resources and capability of the environment to absorb emissions. The connections between the economic system and the environment can be expressed by the indicators

- *De-Materialization*, i.e. a certain positive relation of material input and output,
- *De-Toxification*, i.e. a certain decrease in the amount of hazardous substances,
- *De-Energization* (or de-carbonization), i.e. improvement in the relation of energy input and output (energy-efficiency).

Economic improvement: The indicators chosen here do not only show the consequences for economic variables but express at the same time a linkage to ecological variables and make an evaluation between both objectives possible:

- *Efficiency*, i.e. a certain positive relation of costs and benefits in monetary terms,
- *Productivity*, i.e. a certain positive relation of output and input in quantitative terms,

– *Transaction costs*, i.e. the amount of costs originated for contractual agreements, information processing, data monitoring etc.

Social improvement:

– *Encouragement of learning* and education in the society,

– *Improvement of job security* of employees involved,

– *Improvement of health security* of employees involved and of applicants.

Based on these indicators, also combined indicators such as ratios linking economic and ecological issues may be used. A very prominent example of a combined indicator is the ratio "Eco-efficiency" defined as the relationship of an environmental impacts indicator to a cost indicator (environmental gain/costs) (Huisman 2003).

These indicators have to be broken down further to describe the effects of an electronics industry innovation system. Empirical evidence on the ecological and economic effects of especially the WEEE within the electronics industry innovation system is given in the following chapters. According to the scope of the INVERSI study, the indicators for "social improvement" were not examined in detail.

The following matrix displays the contribution of selected technological, organizational, institutional and personal innovations to the indicators presented above (Figure 18). Important causes and effects are picked up in the following chapters describing the leverage effects of these innovations on sustainability indicators.

Figure 18
Expected impacts of EEE innovation topics on sustainability indicators

expected strong impact
expected medium impact
expected low impact
expected indifferent

	Innovation topics in the Electronics Industry Innovation System	Sustainability Indicators: Econom.				Ecological				Social			
		Efficiency	Productivity	Transaction Costs	...	De-Materialization	De-Toxification	De-Energetization	...	Health & Safety	Working Conditions	Encouraging Learnin	...
Design	Ecological idea dissemination through the supply chain	medium	medium	medium		medium	medium	medium		medium	medium	medium	
	Eco-Co-Design with Suppliers	low	low	low		medium	medium	medium		low	low	strong	
	Management of Eco-Cost Reduction with Suppliers in manufacturing & design	medium	medium	medium		strong	strong	strong				medium	
	Communication strategies among companies	low	strong	strong		medium	medium	medium		medium	low	strong	
	Information dissemination to SME	low	low	medium		medium	medium	medium		low	low	medium	
	Design for Environment	strong	low	low		strong	strong	strong		low	low	low	
	Design for EOL, dis/assembly	low	strong	low		strong	low	low		low	low	low	
	Integration of DFE in conventional management systems	strong	strong	medium		medium	medium	medium		low	low	low	
	Substitution of hazardous materials (e.g. BFR, VOC's, semi-conductors)	strong		low			strong			strong	strong	low	
	Renewable materials	low	low			strong		strong					
	LCA/LCC including simplified LCA	low	low	medium		medium	medium	medium		low	low	medium	
	Database on Materials/Components for DFE	low	low	medium		medium	medium	medium				medium	
	Life Cycle Engineering		strong	medium		medium	medium	medium		medium	medium		
	New Substrates for PWB	strong	medium	low			strong			medium	medium		
	Halogen-free flame retardants	strong	medium	low			strong			medium	medium		
	Mercury Free Light for Flat Panel Monitors	strong	medium	low			strong			medium	medium		
	New Flame retardands materials	strong	medium	low			strong			medium	medium		
Manufacturing	Dissemination of best industrial process	medium	medium	low		medium	medium	medium				medium	
	Substitution of hazardous materials	strong	medium				strong			medium	medium		
	IPPC	strong	strong			medium	medium	medium				medium	
	Improved Manufacturing of materials, components & subassemblies	strong	strong			medium	medium	medium				medium	
	Lead-free soldering	strong					strong						
	Eco-Efficiency of Manufacturing	strong				strong							
Use	Customer Information and Education on usage	medium		medium				strong		medium		strong	
	Communication of products impacts to the consumer	medium		medium				strong		medium		strong	
	Understanding Customer Behaviour And Communication with Customers	medium		strong				strong		medium		medium	
	Energy Efficiency in Use	medium		medium				strong				medium	
	New Business Models (Leasing etc.)	strong		strong		medium	medium	medium			medium	medium	
Recovery / EOL	Information communication between Electronics Industry and Recyclers	medium		medium		medium	medium					strong	
	(Cost Effective) EOL and Recycling Technologies	strong	strong			medium							
	Standards and Technical Specifications for Recycling	strong	strong			medium	medium	medium			low		
	Logistical concepts concerning collection of used electronics	strong				medium					low		
	Disassembly Analysis	medium	medium			medium						low	
	Recycling of materials and components, special interest materials	medium				medium	medium	medium					
	Development of (public) take-back schemes for EOL	strong	strong	strong		medium					low		
Management	Supply Chain Management	strong	strong	strong									
	Knowledge Management, Knowledge Transfer and distribution	medium		medium				medium		medium	medium	strong	
	Education and Training	medium		medium				medium		medium	medium	strong	
	Legislation monitoring of RoHS, WEEE, IPP, EEE etc.	medium		medium						medium	medium		
	Ensuring legal Compliance	medium		medium		strong	strong	strong		medium	medium		
	Green Strategy making and Green Innovation Management	medium	medium	medium		medium	medium	medium			low		
	Ensuring legal Compliance of Suppliers			low		strong	strong	strong					

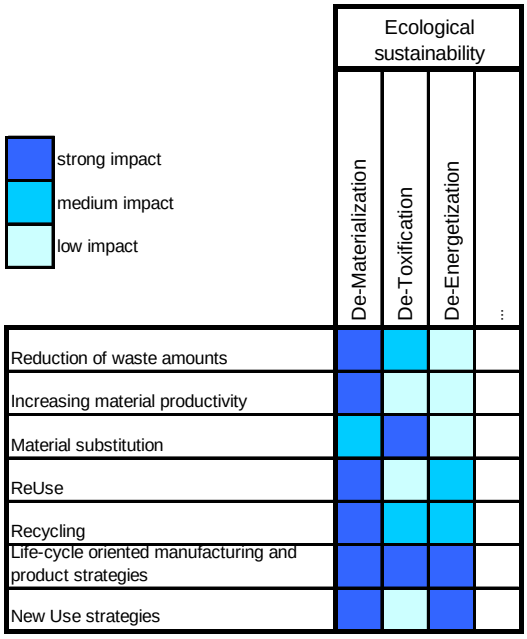
Qualitative evaluation following the ECOLIFE 2 State-of-the-Art Report (Hafkesbrink et al. 2004).

3.2.3.2 Ecological Innovation Impacts

Within INVERSI several investigations have been carried out (evaluation of data collections and literature, visiting of conferences, leading of interviews) to gain empirical evidence on indicators of ecological improvement, which in this case means a specification predominantly in respect to the goals of the WEEE Directive. At the moment even for the past only a few quantitative indicators are available which allow an assessment on an aggregate level

(European Environment Agency 2003). In the future the monitoring system of the directive will give the necessary information.

Figure 19
Leverage effect of sub-indicators to the superior sustainability indicators



Qualitative evaluation following the ECOLIFE 2 State-of-the-Art Report (Hafkesbrink et al. 2004).

The empirical results for the indicators "De-Materialization", "De-Toxification" and "De-Energization" show that in future a considerable improvement in ecological sustainability is supposed to be achieved. The status of these indicators is measured against the following sub-indicators assuming that these sub-indicators are contributing in various ways to the superior sustainability indicators (Figure 19):

(1) Reduction of waste amounts

(2) Increasing material productivity

(3) Material substitution

(4) Re-use

(5) Recycling

(6) Life-cycle oriented manufacturing and product strategies

(7) New use strategies

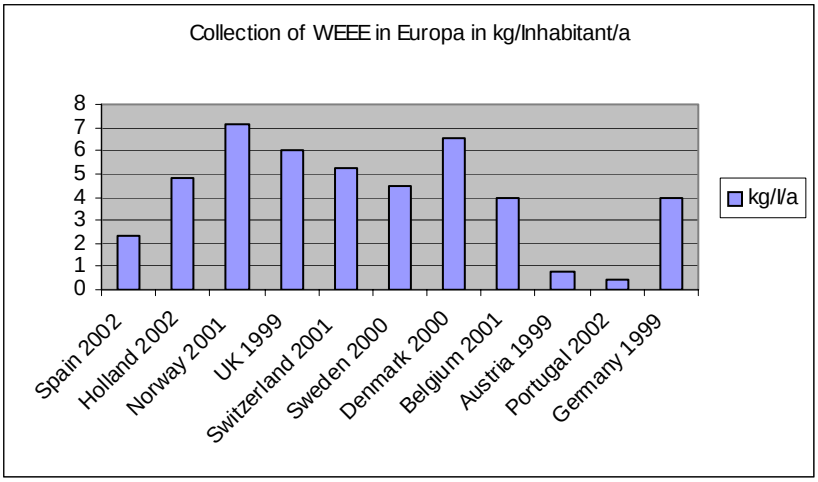
Ad (1) Reduction of waste amounts

A considerable reduction of nowadays disposed waste amounts will be obtained through the binding **legal compliance** to the WEEE and RoHS by all actors affected by the directives. On an operational level the dematerialization impacts will be obtained by the implementation of **new recycling technologies** as well as collection and logistic systems under the WEEE Directive on a national scale. From August 2005 on, after the implementation of take-back systems in all EU Member States, a re-direction of the global substance and material flows will be put in place, protecting WEEE from being land filled or incinerated. Most of the now disposed materials will be collected and recovered according to the quotas of the WEEE.

In the EU in 1998 about 6 mills tons of electronic waste have been disposed, most of them via landfill. The total amount of WEEE generated in the EU is estimated at 6.5 to 7.5 mills tons per year in the late 1990s increasing by 16 to 28 % every five years. With a collection goal of 4 kg/I/an about 1.5 mills electronic devices are separated from the existing waste disposal. Various estimates of the quantity of WEEE indicate that the collection target of 4 kg per inhabitant constitutes only 25 % of the overall annual generation of this waste. The collection results obtained so far, however, may not supersede the fact either that this volume is usually achieved with the collection of white goods, TV-sets, monitors etc. Most of the small electronic devices such as mobile phones and in particular devices fitting in normal garbage cans are still stored elsewhere in the households or are disposed with the municipal solid waste. As a result, the recycling quotas obtained so far for the single categories are evaluated as partly problematical. Actual figures of collection of WEEE in selected European Countries are depicted in Figure 20.

Since the WEEE and the RoHS Directives as well as other issues of the regulative context strongly force the industry to change design features of their products towards environmentally sound items, the further diffusion of innovations like "Eco-Supply chain management", "Eco-Design" and related tools (like LCA) will substantially contribute to increasing ecological improvements in the long run as well. Eco-Supply chain management as referred to **"Management of eco-cost reduction with suppliers"** at first will

Figure 20
Collection of WEEE in Europe in kg per inhabitants per year



Source: own compilation based on data of each country.

play a major role in de-materialization efforts. It is expected that a better interlocking of substance flow management aspects across the supply chain will decrease material consumption in the whole innovation system. Also a broader dissemination of **Applied Eco-Design** will contribute strongly to sustainable development in the electronics industry innovation system, since an in-depth embedding into the business of OEMs and the innovation processes along the supply chain will increase ecological (de-materialization) and social (avoidance of harmful substances) benefits and – as long as the double-dividend effects are still to be expected – economic benefits (cost reduction as the result of decreased resources consumption). For **Design for chemical content** the evaluation is based on the fact that controlling chemical content will become more and more decisive for the electronics industry supply chain facing the RoHS, the EU white paper on a Strategy for a Future Chemicals Policy, PVC bans etc. Again, the suppliers and customers perspective is supposed to be in an early adaptation stage, and the need for action with respect to further innovations in that area accordingly high, since an elimination of hazardous chemicals out of the supply chain will dramatically increase ecological and social benefits.

For **Design for EOL/disassembly** the evaluation depicts a slightly different diagnosis: tools are well developed and are located in an advanced adoption stage in the innovation process. According to the mandatory sustainability indicators, design for EOL is still to be evaluated according to its eco-

efficiency. Manual disassembly is very costly, and can therefore be applied only to a limited number of product categories. Furthermore, disassembly in most cases has to be subsidized or even cross-subsidized, which might be difficult in competitive recycling markets. Finally the in-depth disassembly might not gain environmental benefits, since the energy to be spent on the disassembly process might exceed a reasonable amount.

Eco-efficiency in manufacturing has also been on the basic research agenda for some years. Several definitions of the interpretation of the concept of eco-efficiency have been made. Some of the eco-efficiency initiatives are being developed and tested in industrial application, and the number of initiatives is growing[51]. Thus, it is expected that a further dissemination of "eco-efficiency in manufacturing" will have substantial de-materialization impacts since the use of resources in manufacturing processes will be further optimized.

Ad (2) Increasing material productivity

First is to be noticed that the WEEE collecting goal of 4 kg/capita is an absolute number, which does not consider the historical WEEE or the efforts of the industry to increase material productivity (de-materialization via miniaturization) (Stevels 2003). This development was started independently from the introduction of take-back regulations and producer responsibility following the technology push factor "Increasing the technical efficiency by increasing miniaturization". The WEEE Directive respectively its national transpositions flank this Technology Push however additionally, last but not least motivated by "Green marketing" of the producers.

Numerous product examples of the big actors like Sony, Phillips and Electrolux today are commercially exploited with green arguments. For example, each new product generation of mobile audio and video devices (for instance Walkman, Handy cam, Discman) is smaller and lighter[52]. In addition, by replacing hardware with software and e-solutions an increasing de-materialization takes place, substituting physical products with electronic. Furthermore by the substitution of hardware by software or through e-business solutions an increasing de-materialization is to be observed by substitution of physical products with the help of electronic, environmentally

[51] See for details selected R&D projects within the BMBF funding program "INA"-Instruments for sustainable development", i.e. INPROCESS, the initiatives of the Wuppertal Institute etc.

[52] The first model of a handy cam developed by Sony in 1985 still weighed 1,970 g, the model of 1995 weighed only 800 g, a reduction of approx. 60 %. While mobile phones had a volume of approx. 1,100 cm^3 in 1985, the volume today is only 100 cm^3 with a weight of less than 100 g (without batteries).

more compatible product-, distribution- and use alternatives, for instance in the area of replacement of answering machines by service solutions e.g. from the German Telecom (t-NetBox). In this manner e.g. by a complete substitution of all conventional answering sets in households of the German Federal Republic (approx. 18 mills) by such Internet solutions, 99% of the energy expenditures required by the Standby function could be saved with the effect that about 600,000 tons fewer carbon dioxides would be ejected. In addition the consumption of 9,600 Terajoule primary energy would be saved, which corresponds to about 30% of the annual requirements of a large coal power station (Quack et al. 2001: 36). A further example of dematerialization by increasing the material productivity is to be seen in Internet-supported services of the life span extension and re-use of products e.g. over the Internet stock exchanges ebay or goIndustry (Fichter, K. n.d.).

Ad (3) Material substitution

In ecological matter, the existing strategies of material substitution contain both positive qualitative and quantitative effects. Material substitution does not only mean the substitution of hazardous with non-hazardous substances (lead-free solders, displacement of toxic developers and fixative solvents, substitution of solvent-containing cleaners in copying machines etc.) but also the replacement of heavy with lighter materials (for instance optimization of the counterweights in washing machines, development of flat screens, etc.). This strategy could change the problem from a quantitative to a qualitative one.

The technology of "lead-free soldering" for instance is presently at the market diffusion level. Actions required are the complete industrial implementation of lead-free soldering technologies at large and, specially, at small and medium enterprises and also the industrial availability, more in Europe and America than in Japan, of the suitable solders, specific boards and particular components that supports the lead-free soldering practices. Additionally, the advance in quality assurance of lead-free soldering processes (ranging from solders themselves to components and products) at low cost, and the definition of the lead-free solder standard alloy or alloys are desirable. Complementary, the definitive confirmation of the diminution of negative effects on environment and human health of the lead-free solders when compared with the traditional lead containing solders and restrictive legislation on restriction of use of lead and lead compounds will be helpful.

In Japan the introduction of a high recycling fee on lead containing electronics products in April 1991 released enormous efforts for its substitution; the mobilization effect here however is essentially based on voluntary self obligations of the large multinational electronics companies. The JEIDA (Japan Energy and Industrial development Association) as well as the JIEP

(Japan institutes OF Electronics Packaging) at that time developed standards for lead free soldering as well as a Environmental Road mapping, particularly for small and medium-size enterprises.

Ad (4) Re-use

Due to the fact that the innovation cycles of electronic devices become shorter and shorter (in particular within the range communication and entertainment electronics), new equipment generations with new or extended functions keep coming to the market, which do not replace the basic functions of the predecessor generation, but only supplement them (e.g. audio-visual communication with mobile face-to-face phones). This development as well as flanking sales promoting measures (e.g. subsidization of mobile phones by the net providers) lead to the fact that the actual service life and the possible life span particularly talking about electronic small devices diverge more and more.

On this background strategies for the re-use of electronic devices or components directly contribute to close the loops on a high utilization level. In fact, there is an evolving market for the re-use of electronic devices and components in Germany. Computers placed out of industrial service are handed on to schools and other social institutions. On the Internet market place ebay, approx. 500,000 auction offers for used devices from the areas audio, electronic devices, TV-sets, video and electronics are constantly to be found. The actual size of the re-use market can hardly be measured; reliable data and information are missing. In selected market segments, specialized market participants are operating to exploit re-manufactured mobile phones, PC's, single modules and components, offering their products and services (spare part services etc.) in a world wide context. Companies like Kodak, IBM and Hewlett Packard have been running concepts of re-manufacturing for years following economic arguments, for instance in the area of copying machines (re-use of parts, such as ventilators) and servers (IBM). The refilling of toner cartridges belongs to one of the standard operations running a copying device today.

The ecological sustainability of re-use is quite obvious: resources savings in the manner of re-use of devices, construction units, functional groups or as secondary raw material avoid and reduce environmental impacts caused by renewed energy and material consumption for the production and processing of primary raw materials. Meanwhile there are doubts about re-use strategies whenever it has to be ascertained, that e.g. the energy efficiency, material productivity etc. of follow-up generations of products are superior to those old products, whose life cycle is appropriately extended. Anyway an individual evaluation must take place here, which considers the environmental impacts of the production, the use and end-of-life of the products, as

well as side effects such as additional transportation expenditures for repairing and primary energy consumption resulting there (Van Oers et al. 2002: 40).

Ad (5) Recycling

The evaluation of the ecological sustainability of the goals and mechanisms implemented via the take-back regulations is however still conflicting for another reason. The recycling industry has considerably improved the recognition and separation technology shifting to semi-automated processes and thereby improved economic efficiency leading to a double dividend in environmental and economic matters. But, according to the state-of-the-art of recycling technology, not all of the extensions in sorting and disassembly depth are supposed to be eco-efficient, i.e. the additional benefit resulting from a more in-depth disassembly must be paid with a substantial cost enhancement.

The still largest problem in the recycling is the recognition and separation of plastics, due to approx. 60 different kinds of plastics, the incorporated flame retardants, other additives (pigments, stabilizers etc.) and other contaminations (labels, foam, metal foils etc.). Technology leaders in the plastic recycling, like the American company MBA Polymer in California, today offer up to 100 products as secondary granulates at each purity stage desired. Critical issues are however (see Biddle, M. 2003; Taylor 2002: 23 pp.) that

- although the separation e.g. of plastics with and without flame retardants turns out well, an assortment within the group of plastics contaminated with flame retardants is still extremely difficult,
- an economically acceptable solution compellingly presupposes a large-scale recycling of plastics (economies of scale),
- white secondary granulates can not to be manufactured economical sound and to that extent innovation readiness of the manufacturer (e.g. layer technique with differentiated layer structure) is presupposed.

In addition, low prices for primary materials are restraining the development of a stable secondary raw material market and the exploitability of secondary raw materials is limited as the result of further restrictions (e.g. standards and regulations). However, especially after the RoHS implementation, the amount of hazardous substances polluting the environment will decrease. This concerns in particular cadmium, lead and mercury e.g. from batteries, from fluorescent tubes, toxic organic compounds from liquid crystal displays, polychlorated biphenyl e.g. from condensers, fluorine chlorinated hydrocarbons from coolers, flame retardants and heavy-metall-

iferous additives from plastics, gallium arsenide from light emitting diodes up to asbestos in older household appliances.

The achievement of ecologically lasting effects in connection with the implementation of the WEEE in the Member States might finally also depend on whether the implementation follows an equally authentic standard in technologies, more or less valid all over Europe. The WEEE prescribes that electronics devices must be led in authorized treatment and recycling plants. Additionally the assignment of BAT (Best Available Technology) is demanded. According to the opinion of experts the spectrum of the procedures existing at present regarding the quality of the recycling however varies around the factor 10-15, based on the cost differences in the procedures. On this background problems are faced up that – dependent on the standards which will be implemented in the individual countries of the European Union – a quite different price structure of recycling will show up (regarding capital and personnel costs) and as a result material-streams will possibly follow dumping prices connected with transportation procedures and further emission loads (Fröhlich 2003: 8f).

Ad (6) Life-cycle oriented manufacturing and product strategies

Facing the implementation of the WEEE Directive, most of the large manufacturers have recognized that with product innovations a life cycle perspective is important, to consider for instance improvements in end-of-life phases regarding their effects on other phases of the life cycle. This becomes more and more important, if one considers that the environmental effects of electrical appliances result on average only to about 2-5% from the end-of-life phase, to 10-35% from production, to 5-15% from packing and transport, but to 50-80% from the use phase. At the same time, by making more and more use of LCA Tools (life cycle analyses), more profound decisions on the design of new products or product changes will be obtained, e.g. with respect to energy, i.e. if – related to new products – for instance the energy consumption would decrease noticeably during the utilization phase in relation to the past product or the choice of a substitute material along its "ecological backpack". This re-orientation gradually holds introduction in all enterprise functions,

- on strategic level with the question, whether the enterprise wants to position itself at all in the range of the re-manufacturing business (e.g. Kodak, IBM),
- in the product management with the question, in which way product specifications or the product design are affected,
- in the procurement with the question, whether suppliers have to be changed or whether requirements for suppliers should be changed, and

- in the production e.g. consequences from the conversion of lead free soldering for the production etc..

Ad (7) New use strategies

While the aspects of ecological sustainability specified so far as expected trends in the context of the implementation of the take-back regulation were related to effects from the re-design of products (material substitution etc..), and to end-of-life questions, the focus of new use strategies lies on the utilization phase of products, thus on that phase, in which usually the largest environmental impacts in the product life cycle show up. The implementation of these new use concepts and strategies (multiple use, community use, use cascades, leasing, use instead of possession) requires a by far more comprehensive innovation development. Here new thinking of all market actors is required. Manufacturers have to re-think business processes to shift earning possibilities from "old economies strategies" (earnings as a result of shortening the innovations cycle) to "new sustainable economies strategies" (earnings as a result of life time extension, energy minimization, intelligent services, etc.). The users must reorient their opinion that it is less important to be the owner of a product (possession-thinking), than to buy and use its functions (need satisfaction).

In the B2B range the conversion of such system innovations at present is already standard in some areas (example: leasing of copiers), in the B2C-range it is still only at the very beginning. Innovative enterprises recognizing advantages e.g. the customer relationship management and competitive advantages via quality differentiation, to that extent are experimenting with new business models (e.g. contracting models, leasing for white goods) or think about technical innovations (functional substitutions respectively development of self-controlled intelligent functions e.g. within the range of energy optimization, development of multi-functional devices e.g. within the range of kitchen electrical appliances) and/or extend their product offer by additional services (repairing, maintenance etc.). If the linkage to the take-back regulation does not seem evident at first sight, then – according to statements of the innovation actors – the present recognizable developments are however the consistent continuation of the measures discussed before. On this background leasing concepts and products with defined multi-generation or cascade use are to be rated – similar to the packaging ordinance – as a "multi-trip system" in any circumstances as result of innovation strategies of the manufacturers for the fulfillment of the requirements of the

WEEE implementation, even if the clearly extended regulation context of WEEE (i.e. IPP, EEE etc.) must be considered[53].

3.2.3.3 Economic Innovation Impacts

The evaluation of the innovations induced by the WEEE-transposition with respect to consequences on sustainable development from the economic point of view will be focused on the following aspects[54]:

- economic efficiency of the chosen take-back system as an institutional innovation: i.e. *prices for disposal services* reflecting effective disposal costs, *competition* to ensure efforts to optimize these costs, and the *solution of the free-rider problem*. However, with respect to being evaluated as sustainable innovation the environmental benefits have to be set off.
- an appropriate *cost/benefit ratio* in the individual disposal markets. Here above all of interest are technical solutions in connection with organizational innovations induced by the WEEE-transposition (economies of scale), especially
  - the realization of costs of the required recycling quota of the WEEE Directive in connection with the treatment obligations versus the corresponding benefit to the environment, and
  - the costs of sorting waste equipment according to producers and types of equipment versus the positive effects of product design for disassembly and recyclability. In that sense the role of eco-design or DfE (Design for Environment) is stressed since even under terms of 'efficiency' the WEEE Directive is expected to improve the end-of-life performance by reducing disassembly costs of the WEEE (chapter 3.2.3.3.5).

3.2.3.3.1 Costs and Prices for Disposal Services

According to the ZVEI the total annual disposal costs for WEEE in Germany are expected to be between 350 and 500 mills € during the next years. According to disposers they are estimated to be only 250 mills €. With these figures industry gives a broad range for the expected costs which shows the

[53] I.e. the innovation strategy is no longer due only to the WEEE Directive, but is a result of the incentives of a complex bundle of regulations and market requirements (multi-impulse thesis; see Klemmer/Lehr/Löbbe 1999).

[54] The study is focusing on the evaluation of the take-back systems as an institutional evaluation, since the economical assessment of new business models and new use strategies etc. are not feasible at this moment due to the lack of appropriate data.

uncertainties about what will happen in the concrete implementation process. The costs include collection and sorting (from the municipal collection points onwards), treatment and overhead costs (like the costs caused by the EAR). Costs due to the collection from private users by municipalities are not included in these figures. They are estimated to amount up to half of total disposal costs.

Table 7
Range of total disposal costs

WEEE-categories / sub groups		total costs (€/kg)		
		min.	max.	av.
1a	Large household appliances	0.20	0.42	0.31
1b	CFC containing cooling appliances	0.61	1.28	0.86
2	Small household appliances	0.42	0.55	0.52
3a	IT and telecommunications equipment	0.42	0.77	0.59
3b	Screens from personal computers (CRT's)	0.63	0.79	0.73
4a	Consumer equipment (excl. TV)	0.42	0.77	0.63
4b	Television sets (CRT's)	0.62	0.79	0.69
5	Lightning equipment (incl. fluorescent tubes)		0.88	
6	Electrical and electronic tools	0.42	0.55	0.50
7	Toys, leisure and sports equipment	0.42	0.74	0.63
8	Medical devices	0.36	0.72	0.54
10	Automatic dispensers		0.42	

Source: Canneman, Geerts 2003.

For the actual average disposal costs of the national take-back systems which joined together in the WEEE-Executing-Forum figures are presented from 0.30 € per kg for large household appliances to 0.86 € per kg for CFC containing cooling appliances. For most of the other product categories costs are said to be between 0.50 and 0.60 € per kg. Costs above average have to be born for the disposal of screens from PCs and Television sets with about 0,70 € per kg[55] (Table 7). The differences between the chosen disposal modes are partly considerable. From these average costs of household appliances and consumer electronics, about half of the costs account for treatment and final disposal, just under one third for collection and transport and the rest for other costs. Only with large household appliances (without CFC) collection and other costs account for about 80 % (Table 8).

[55] The WEEE-Executing-Forum represents a group of at the time 9 collective take-back systems in 6 countries of the EU. Goal of the forum is it to improve the efficiency of the systems by exchanging experiences and benchmarking (Canneman, Geerts 2003).

It is expected that due to the required recycling quotas and treatment standards and system costs these average costs will partly increase considerably.

Table 8
Composition of disposal costs

Category	Collection* and sorting	Treatment	Overhead/Promotion	Total
Freezers / Fridges	0.25	0.45	0.16	0.86
Washing machine/Dryer	0.14	0.06	0.11	0.31
Small white goods	0.18	0.22	0.12	0.52
TV	0.19	0.40	0.10	0.69
Small brown goods	0.17	0.36	0.10	0.63

Source: Stevels 2003. – *from municipalities onwards.

3.2.3.3.2 Competition as an Indicator of Take-back Systems Efficiency

The possible solutions of the implementation of the WEEE Directive may be grouped into the following types of take-back systems:

– Individual producer solutions, in which producers directly contract with the logisticians and disposers, and

– Collective systems as branch- or product solutions for which producers convey the performance of their obligations to a collective system,

and several mixed solutions based on the above mentioned groups. For new WEEE in Germany a mixed system of collective and producer-related solutions is expected. The co-ordination of the transport from the municipal collection points to the places of trans-shipment and sorting will be performed by the EAR. This solution was chosen to avoid distortion effects on competition in this market. For the logistics to the treatment facilities and the treatment services themselves the producers contract with their disposers individually or in a collective manner (by different kinds of collective systems and co-operations).

Each of the two systems has advantages and disadvantages which – based on the respective situation of the product group – may lead to a different evaluation. Above all ensuring efficiency through competition is put forward as an advantage of the model of individual producer solutions. According to this, producers may choose partners from all suppliers of take-back systems and as well build up own systems. Besides, they do not have to bear any administrative burden caused by a system (Hieronymi 2002). With respect to environmental benefits especially here positive effects for an improvement of eco-design in the sense of the WEEE Directive can be ex-

pected especially if solutions of separate recovery of own products can be realized. On the other hand, it is put forward that the administrative costs in this case are much higher for the producers than those caused by a collective system. The producers to a higher degree must take care of the requirements of the WEEE Directive i.e. of all contracts with municipalities, disposers, retailers, logisticians, etc. individually covering the whole area (BDO Auxilia Treuhand GmbH 2003: 100; Böhm 2004). As particular disadvantage is considered that a distortion of competition will probably occur due to the required geographical coverage in view of a varying population density and waste volumes in suburban and rural areas. (Hieronymi 2002). Furthermore, the small and medium-sized firms in general should not be in a position to offer the required geographical coverage.

A collective system as full service consortium should be able to offer a full geographical coverage without such negative effects on competition (Hieronymi 2002). Also, the administrative costs for the producers were much lower as the main part of the management was taken over by the system managers. The costs for the producers would be limited to notification and payment of membership fees (BDO Auxilia Treuhand GmbH 2003: 100). Of disadvantage would be the set up of a management and the supervision of the management of the system and its drive for independence with own interests. Also collective systems would tend to charge too high prices, especially when producers do not have any alternative. A further disadvantage put forward is that regional disposers (corporations or caritative organizations) will not or to a lesser degree be considered by such systems and the influence of large disposers would be dominating (Hieronymi 2002). An individual cost assignment seems to be possible in a collective system too. It depends on the calculation of internal calculation prices. Even an assignment with costs of ones own products seems to be possible in future as a respective software for this sorting of products already exists (Stevels 2003a).

Preconditions for an efficient WEEE disposal and the main reason for collective systems or other co-operations between actors are economies of scale[56] (Stevels 2003b). They are defined as the availability of large enough volumes of WEEE in a certain geographical region to make collection, transport and processing worthwhile. Positive effects of increased economies of scale will be evident in almost all parts of the recycling value chain. This is valid for the bargaining power of recycling systems and their overhead costs, for the return logistics as well as end-of-life processing. Without large enough volumes of WEEE, a not fully used capacity of end-of-life

[56] For economies of scale and take-back obligations in general see e. g. Clausen 2000.

processing lines or technologies could lead to economic disadvantages with processing costs per kilogram getting too high. Besides economic aspects, it also concerns the environmental impact. For instance, transport of WEEE cannot be justified looking at its fuel and material use if it is not balanced by other environmental benefits (Stevels, Huisman 2003).

Based on the experience gained in other European countries, in which take-back systems had been operating for several years, some conclusions as to efficiency may be drawn. Almost all these countries, to be named are Sweden (EL Kretsen), Norway (EL Retur), the Netherlands (NVMT for all products except for IT-devices), Switzerland (SWICO) and Belgium (Recupel) chose a collective system upon which the producers conferred all their obligations. Exceptions are EuroVironment in Norway and ICT Milieu in the Netherlands (both only for IT-devices) where most tasks are contracted directly between the involved actors (Perchards 2004; Hieronymi 2002a).

Most collective systems are financed by a system of visible fee. With this, the costs are charged to the producers by way of fixed, previously defined fees per unit, based on the average recycling costs per type of devices and the sold quantity. In contrast, in Sweden and Switzerland as a rule, in Norway only in the case of IT-devices, the actual costs are allocated to the producers according to their market share. Actual cost figures prove that collective systems –when financed through a visible fee as in Belgium and the Netherlands – charge higher disposal costs than when financing disposal by a cost share system according to the market share of the producers. So the costs in systems with visible fees were four to eight times higher than in Sweden (Interview with Elektrolux 2003). To avoid risks, the expected average disposal costs originally were estimated very generously. Particularly because of the economies of scale NVMP allowed getting relatively lower prices from recyclers, than budgeted, there was a financial surplus in the first years of operation. By this, in the Netherlands alone for "White goods" funds amounting to 12 mills € had been accumulated. Meanwhile the fees were reduced in the Netherlands. For the disposal of some smaller WEEE there is nothing to pay. In Belgium fees for smaller WEEE are still high (Hieronymi 2002a).

Only Recupel in Belgium charges disposal of IT-devices on the basis of a visible fee. Experiences of Hewlett Packard (hp) during the last years indicate that the take-back costs in Belgium are 18 times as high as the costs charged by ICT- Milieu. In the case of Norway, threatening to co-operate with the alternative system, El Retour reduced prices for the disposal of IT devices by 45%, breaking off with visible fee (Hieronymi 2002a). Considering these experiences during the last years the decisive factor for efficiency – more than the visible fee – seems to be competition: be it by another collec-

tive system or by other possible individual solutions. As a visible fee is only feasible as an interim solution in a few years it will cease to be an alternative for charging new WEEE in the future.

An evaluation of the German system is hardly possible, as even the rough features still are not clear. Yet criteria for competition which have to be met before a system can be called efficient can already be named (i.a. Clausen, Halstrick-Schwenk 2000):

– competition between several (at least two) systems,

– competition on the demand and the supply side of disposal services, open markets for future market entries, and

– competitive tendering procedures and limitation of the contractual life if because of ecological or economic necessities co-operative systems in the form of a monopoly are inevitable.

The range of possible co-operations for the producers can be estimated to be quite large but compliance with the national and the European cartel laws has to be ensured. The EU-legislation has a hierarchy: EC-treaty and thereby also the cartel law (here Art. 81 and 81 EGV) supersede the WEEE Directive. In addition, EU legislation supersedes national legislation[57]. Competition aspects are included in the WEEE Directive. The prevailing principle of the producer responsibility (recital 19) implicitly contains, that co-operations are not allowed to lead to restraints on individual take-back systems or on other co-operations existing at the same time. Above that recital 20 says that collective financing schemes should not have the effect of excluding niche and low-volume producers, importers and new entrants (Heistermann 2003). The EAR must be considered a particular problem concerning the cartel law. But the Federal Cartel Office assumes that the arrangements with the EAR will not have considerable consequences on the individual product markets concerned (Heistermann 2003).

The disposal services in Germany will take place within a special framework determined by the EAR where

- registration and monitoring as a prerequisite to ensure financial responsibility of producers, and to control fulfillment of objectives (quota etc),

[57] At this point of time the companies do no longer have a chance to hide behind national legislation (permitted cartels). The decision of the European Court of Justice in the case "CIF" as of Sep 9, 2003 lines out that a national competition authority may not apply a national ordnance in conflict with European law.

- coordination of collection logistics without having distortion effects on competition, and
- concrete rule setting for the handling of the disposal services

take place. With some quantitative environmental objectives given the planned German system requires the achievement of a certain environmental level but within these limits offers the opportunity to find an adequate solution for each product and/or group balancing economic and environmental aspects. It leaves the choices to the producers. They can check if an individual or a form of a collective solution or co-operation is more appropriate. The decision will depend on weighing up economies of scale versus possibilities to realize low disposal costs using advantages of eco-design of own products and respective (own) appropriate treatment facilities. With respect to increasing positive environmental effects an individual solution seems to be more promising, especially in the case of producers being charged with the costs of their own products.

The future will show to which extent chances for an individual solution will be used, whether collective solutions will be preferred, how the benefit for the environment will be; whether, finally, the results justify the setting up of such an elaborate system.

3.2.3.3.3 The Solution to the Free-Rider Problem

The industry associations estimate that 20 to 40 % of the sold electrical devices are not sold through regular channels. Examples for this are sales by companies which are on the market for a short period of time only or spot sales from dubious sources from abroad. To this belong sales from cross-border Internet marketing as well, yet are only a small part of it. So a high potential of free-riders is expected (Theusner 2003). In the case of historical old equipment, the free-rider problem is solved insofar as the annually arising disposal costs are assigned to the producers relative to their market share, meaning that they cover the disposal costs of no-name products and orphaned products as well. In the case of new WEEE the solutions above all depend on the successful registration of all producers, the notification of all products marketed by them, and on the required guarantees.

The prosecution of the free-riders will be a prominent task of the EAR. This requires that some 20,000 market participants and their sales shall be supervised. It is expected that companies active in these markets fulfill a supervisory function themselves ("systematic denunciation"). It hardly will be possible to identify and register all distributors. Problems may arise for example in the case of importers of small quantities, e-commerce and companies, which are only on the market for a short period (Rockholz 2003, Theusner

2003). The goal can only be to keep the number of free-riders as low as possible. A petty limit for free-riders is expected to be set in the rules of the EAR by industry. Exceeding this limit should provoke action of the EAR. Other institutional arrangements were already made to supervise free-riding, for example within the "WEEE Executive Forum" aiming among others goals to provide advisory services to companies in the field of disposal.

The approach chosen for the solution of the free-rider problem in Germany seems to be a promising one. With the EAR the industry itself is authorized with the tasks of the national register and thus can be creative to find optimal solutions. International readiness for co-operation should alleviate this problem.

3.2.3.3.4 Economic Efficiency of High Recycling Quota

The development of recycling technologies during the recent years was quite progressive. Based on the experience in other countries with the recycling of WEEE it can be seen that the quota required by the WEEE will be met. Technical problems with reprocessing only exist in the case of plastics. But the improvements with respect to sortability, dismantling and reprocessing may only be called eco-efficient if they do not go along with a high cost increase (Huisman 2003, Stevels and Huisman2003). For consumer electronics in the Netherlands, recycling studies on eco-efficiency based on existing information and experience were carried out. For the individual analyses it was differentiated between precious metal dominated products, metal dominated products, glass dominated products, and plastic dominated products. The authors, in their final conclusions from the studies on the achieving of the environment goals of the WEEE Directive, criticize the weight-oriented definition of the recycling goals within the WEEE. They argue that these goals do not adequately take into account the environment pollution potential, and that as a result the efforts for recycling would lead into the wrong direction. This could result in economically counterproductive consequences. A typical example would be the precious metal dominated products. The example of mobile phones shows that an orientation on the environmental goal of the directive requires a recycling of plastics from mobile phones being given the top priority, and that recycling of gold and palladium based on the weight portion in the mobile phones is much less important. When weighted with the environment pollution potential of these materials it becomes evident that the environment pollution profile of Gold and Palladium is 1 to 2.5 mills times higher than that of plastics[58]. A quota weighted

[58] Measured at the Dutch eco indicator.

with the environment pollution profile would give these materials the top priority within recycling (Stevels 2003). The recycling of these precious metals would lead to proceeds showing that their processing will be eco-efficient.

In the case of metal dominated old electrical devices as e.g. DVD players there is no such contradiction of a goal including the environment pollution potential with the required re-utilization and recycling quota of the WEEE Directive. Here, eco-efficiency because of the proceeds from sales – even though being lower – seems to be given. Neither a contradiction in the case of glass dominated products like monitors or TV-sets does occur. According to the Dutch studies under the assumption that glass will re-used to a higher extent (reapplication) the eco-efficiency goal will be met.

In the case of plastic dominated devices like printers or portable audios on the other side it is regarded as very difficult to achieve the WEEE quota at all. Increasing the recycling quota is as well connected with a high increase of costs. But it is to be differentiated in products with large size housing, with medium and low size housing. Recycling of large size housing is still better than incineration for large plastic housings, for medium size it is hardly, for small housings it is not. Small proceeds can be expected at best for large housing equipment (Stevels and Huisman 2003).

The studies in the Netherlands for TV-sets and portable audios as an example show how strong the costs may increase in the case of an improvement of the reprocessing, and what this means for the relationship of environmental benefit and costs (eco-efficiency). Compared are the cost of the end-of-life treatment, the corresponding recycling quota and the costs per kilogram of recycled waste equipment (Tables 9 and 10) The data for TV-sets show that the eco-efficiency of the end-of-life treatment increases with the amount of money spent (Stevels, Boks 2003). The maximum in eco-efficiency is reached when approximately 10 € is spent; when the WEEE requirement of 75 % recovery is fulfilled the eco-efficiency is already over its top. The situation is more complex for portable audio products. First of all eco-efficiency of this audio product is lower than for TV-sets in the high recovery region, just spending money on shredding and separation is most eco-efficient but results in less than 1 kg of material per Euro spent. Even by spending twice as much money (additional disassembly compared to standard shredding and separation) the current WEEE target is not yet attained and the eco-efficiency is already over its top.

Table 9
Eco-efficiency of TV-sets

Money spent on end-of-life treatment (€/kg) (prices in the Netherlands)	Recovery % scored (WEEE definition)	Eco-efficiency kg/€	Logistics and Treatment
0.18	0	0	Logistics only
0.35	26	0.74	Only metals recycled
0.50	62	1.24	Approx. current disassembly practice
0.70	78	1.11	More disassembly
0.70	88	0.98	Detailed disassembly done.

Source Stevels 20003c.

Table 10
Eco-efficiency of portable audios

Money spent on end-of-life treatment (€) (prices in the Netherlands)	Recovery % scored (WEEE definition)	Eco-efficiency kg/€	Logistics and Treatment
0.18	0	0	Logistic only
0.35	32	0.91	Shredding and separation
0.75	51	0.68	
1.35	77	0.75	Includes disassembly

Source Stevels 20003c.

Although these results only represent consumer electronics they pinpoint the problems which occur in other sectors as well. Conclusions may be drawn for other product categories as well referring to their material composition. For small household appliances there will be increasing costs because of dismantling and low return rates as the share of (precious) metals does not play a significant role and small plastic housings prevail. The situation is different with large household appliances because of easy dismantling and high recycling value due to high metal content. Concerning IT-equipment to aim for a high recycling quota seems more likely worthwhile

due to precious metals and better re-using and recycling possibilities for components.

Altogether an eco-efficiency is not necessarily given when achieving the required quota and particularly in the case of plastics it is a big problem. There seem to be large differences between product groups. Besides that the weight-oriented definition of the quota often does not reflect environmental impacts.

3.2.3.3.5 The Role of the Eco-Design

One of the crucial intentions of the producer responsibility of the WEEE Directive is to give incentives to producers to improve product design by charging the disposal costs of preferably their own products to them. This way they shall increase the disassembly possibilities of their products, improve the quality of the treatment and by that decreasing the disposal cost which, however, partly may require separate treatment facilities. Choosing an individual solution may depend on one side on the costs for the sorting being estimated to be lower than the positive effect expected to result from a disassembly friendly product design, thus reducing the disposal costs in total (besides other reasons like economies of scale).

The costs of separating and sorting this new waste equipment in the sense of the WEEE Directive depend on the labeling chosen and its legibility. According to BITKOM and ZVEI (BITKOM/ZVEI 2003) a producer related sorting in treatment facilities will only be possible in long-term when technically feasible and economic sorting techniques and methods for the recognition and sorting of brands will be available. With the transponder (ID-unit) a solution promising for the future is being discussed. This system of a machine-legible product identification (producer and product) by a chip is technically possible though, but too expensive for the time being. To make the installation of an ID-unit beneficial the transponder in addition to the environmental protection information should have other information as to service and maintenance. The transponder could be used in some years when the new waste equipment will have gained a more prominent role within the total WEEE scrap. At this point of time reasonable scanners and labeling solutions have the disadvantage that a product-related separation would not be possible without pre-sorting. For this reason e.g. the barcode as a solution for the future is no longer discussed. Presently however, this is no fundamental problem as the historical waste equipment for which a sorting is not required will be dominating in the next years. The WEEE-share of producers in the collection containers at first will be estimated based on

statistical methods and so the (individual) producer responsibility will be met with the take-back of a share in the equipment mix[59].

The question if an improved product design in the sense of a design for recyclability can be achieved by way of producer responsibility carried out in an individual manner – apart from the costs of an exact producer-related sorting – is to be seen differently for single product groups. Again results of Dutch studies are taken as an example for the consumer electronics sector. Several case studies to analyze influences of eco-design for the four above mentioned product groups were done (Huisman and Stevels 2003; Stevels and Huisman 2003a 5pp.). The studies evaluated and generalized the role of design with regard to the improvement of the end-of-life-performance. According to their results as main design strategies to decrease disposal costs they suggested the reallocation of materials to obtain cleaner fractions and to improve unlocking properties of parts and components to have less cross contamination of fractions and to decrease disassembly time of products. At the same time also development- and market stages of the products must be differentiating factors for eco-design decisions. As a result of eco-design not only the costs of average treatment have decreased during the last years. But also the spread in costs among brands has been substantially reduced. But there seems to be a high likelihood that a certain amount of treatment costs will remain which cannot be bridged any more by good eco-design (Stevels 2003).

According to these authors nevertheless the role eco-design can play is overestimated as the share of disposal costs compared to value is very small (chapt. 3.3), and that there are other kinds of restrictions limiting the freedom for design for end-of-life activities: design changes concerning functionality, legal requirements (like obligation to use flame retardants). These design rules often are conflicting with others: So for instance modular designs are advantageous for re-use and recycling but generally require more material (Stevels, Boks 2003). Companies like Sony on the other hand think the competition pressure for consumer electronics to be that high that even a possibility for minimal reduction of the disposal costs may be seen as decisive that even eco-design for recyclability may be beneficial[60].

In research projects by Boks (Stevels 2003c and the according reference there), however, it is shown that organizing take-back systems in such a way that they have sufficient economies of scale is more important for economic efficiency than carrying out appropriate design for recycling. Based on such observations and on the fact that design has to be seen primarily from a

[59] Interviews with Sony, Electrolux, and Recupel in 2003; BITKOM/ZVEI 2003: 5.

[60] Interview with Sony 2003; Stevels 2003.

functionality perspective and with respect to environmental aspects from a life cycle and not just from an end-of-life perspective alone according to Stevels large parts of industry have pleaded very strongly to allow the execution of producer responsibility in collective systems.

For large household appliances according to Electrolux[61] not much improvement with respect to eco-design for recyclability may be expected. For these appliances disassembling of products put on the market now and some years ago does not show a great difference. Click and screw mechanisms already would be common in appliances sold now. So, in this sector, these producers needed not to be interested in an allocation of the costs of their own product but could accept the average costs for products as share in a product mix. The importance of eco-design in this sector would rather have to be seen in "green marketing". As for small household appliances the situation should be more or less the same as for consumer electronics. The situation however seems to be different for IT devices. During the last years this industry gained a lot of experience with establishing take-back systems for their own products to re-use and recycle them. So here sorting according to producers and even to products of these producers could be seen worthwhile.

To what degree in the end the old equipment will be sorted and the disposal costs of their own products be allocated to the producers depends on the information stated on the label or ID-unit of the products: whether the basis for the labeling will be the product category or more detailed the individual products, and whether the exact date of putting the product on the market will be shown. In this respect the draft of the German ElektroG requires for the label only the producer to be shown and to indicate whether the product was sold after 13 August 2005 and thus makes possible collective solutions with hardly any sorting. So, the legislator does not attach great importance to a producer responsibility as an individual incentive for the improvement of the design for environment for the next years. But the producers are free to add further information to the label to keep the possibility of individual recycling solutions open for their own products.

3.2.3.4 Conclusions for Effects on Sustainable Development

At this point of time it cannot be said whether the expected take-back system with all its innovations will be sustainable as a whole.

– Presently only broad outlines of the system may be seen. Many possible strategies and options with a wide cost spectrum are revealed.

[61] Interview with Electrolux 2003.

- A positive aspect is that due to experiences gained with take-back systems in the past competition is considered to be essential, and that, visible fees being no longer permitted for new WEEE effective disposal costs are to be taken.
- It appears to be an appropriate solution to avoid free-riding as far as possible.
- The legislator allows the individual producer responsibility being performed via individual and collective solutions. It is still fairly vague which mix of different solutions will emerge. Also for the single product groups it is not evident yet if an individual solution will encourage an eco-design for disassembly/recyclability with disposal costs being only one factor to determine the direction of product design. Even if this will be the case it is not sure whether this will be more efficient than a collective system with the advantages of the economies of scale. Above that it is not evident, if improvements of the environment resulting from individual solutions will exceed those of collective solutions. Studies in the Netherlands on consumer electronics for example rather indicate the opposite.
- It seems to be a good decision of the legislator to leave the solutions up to the producers' responsibility. The question of whether such a costly system will be justified and also a colorful range of solutions adapted to the situation of individual products will be the result or but yet simple collective solutions will be preferred in the first place remains to be seen.

3.2.4 Packaging Excursus

The innovation impacts of the German Packaging Ordinance (VerpackV) have to be differentiated on the one hand according to the categories of packaging (transport-, secondary- and sales packaging) and on the other hand according to the supply or value added chain of production, use and end-of-life of packaging.

In an early OECD study[62] it is reported that by 1993, the volume of packaging materials in circulation in Germany was reduced by 500,000 tons. Since the passing of the German Packaging Ordinance the per capita packaging was reduced by 15 kg. "The reduction reflects the elimination of some types

[62] For details see OECD ENV/EPOC/PPC()/)21/REV2, 12-May-1998: 25pp.

of unnecessary packaging, such as shrink or blister packaging, and the increased use of refillable packaging"[63].

In the area of transport packaging the German Packaging Ordinance has accelerated considerably the trend towards multi-trip systems, especially in the food sector. Since the retail sector as one of the main affected parties used its demand power to establish particular requirements concerning packaging downstream in the supply chain, a huge amount of transport packaging has been saved and/or substituted by multi-trip systems[64]. In the end-of-life management sector or pool solutions have been established (e.g. in consumer electronics, electronics, lightning, installation, furniture, office) organizing the take-back and re-use of transport packaging (Meinecke 1996: 102pp.).

In the area of secondary packaging the German Packaging Ordinance has led to a comprehensive cessation of these packaging[65]. Even in this area the retailers exerted strong pressure on the packaging suppliers by analyzing their merchandise mixes and setting up requirements to refrain from secondary packaging. As a result, approximately 90% of the secondary packaging has disappeared from the market. In those segments where secondary packaging was necessary due to functional requirements, the material input was decreased dramatically and plastics were substituted by paper and cardboard packaging.

In the area of sales packaging the innovation impacts of the German Packaging ordinance may not be separated exactly from ongoing efforts of the producers to decrease material costs by reducing the material input. Impacts on the adoption and diffusion of innovative packaging are supposed to take place in those segments, where the demand elasticity does not allow for shifting the license fee of the Green Dot to the consumer by rising the product price or in those cases were the license fee counts for a major portion of the product prize. At the end-of-life stage, new structures of collection, sorting, re-utilization of sales packaging have been established, especially in the area of plastics recycling[66]. With these changes a series of innovative developments in the logistics as well as separation and reprocessing technologies went along with ongoing developments up to now. The German Packaging Ordinance has influenced and accelerated the invention, adoption and diffu-

[63] ibid.

[64] cf. Reactions on take-back obligations for transport packaging Costa 1995: 73ff.

[65] See Staudt et al. 1997: 55 with additional bibliographic hints.

[66] New processes for the conversion of waste plastics to create new markets for secondary materials, recovering of oil, gas and chemicals (pyrolysis, hydrogenation, gas synthesis), use of plastics as a reducing agent in steel production, separation processes for mixed plastics.

sion of new technologies in the waste management sector to a considerable amount. It should be notices that by setting up the Dual System (Green Dot) the German Packaging Ordinance has initiated an institutional innovation in the waste management sector. The ecological effectiveness and economic efficiency of the system (especially according to plastic waste management), however, has to be questioned. Due to improvements of the German collection, sorting and recycling system DSD was able to reduce the costs of the license fees by an average of 20 per cent between 1998 and 2002. In 2002 the DSD AG reimbursed license-fees of about 87 mills € to their customers. The total costs of the Green Dot System was 1,874 bn. €, which is approximately 23.13 € per capita. Despite these reductions, and with respect to eco-efficiency, within the SOFRES study it was examined that the German packaging waste management system is rather inefficient compared to other systems in place in the UK, France and the Netherlands, especially for glass-, plastics and tinplate recycling (Taylor, Nelson, SOFRES consulting 2000):

Table 11 displays the indicator used in the SOFRES study to evaluate the eco-efficiency of the take-back systems with respect to different material fractions. The indicator is a ratio between:

- the numerator: quantity of energy saved during recycling (compared to production from virgin materials), and
- the denominator: net recycling costs (total expenses – market revenues).

Whilst in Germany recycling of paperboard and aluminum allows to save one unit of energy (1 GJ) at the lowest cost (8 €/t), the highest costs per unit of energy saved are for plastics (19 €/t) and glass (39 €/t) as well as tinplate (20 €/t).

The high costs in Germany are explained partly

- by "old contracts", negotiated by DSD when they were in a weak negotiating position,
- by additional costs (e.g. for cleaning around the collecting points, and
- by the nature of the collection system.

Table 11
Cost-benefit ratio of household packaging waste recycling

Glass	**Recycling rate**	**€/GJ primary**
France	48	6
Germany	83	19
Netherlands	84	2
UK	26	14
Plastics	**Recycling rate**	**€/GJ primary**
France	5	27
Germany	69	39
Netherlands	0	n.a.
UK	0	n.a.
Paper/board	**Recycling rate**	**€/GJ primary**
France	11	19
Germany	91	8
Netherlands	46	4
UK	0	n.a.
Tinplate	**Recycling rate**	**€/GJ primary**
France	45	12
Germany	77	20
Netherlands	70	4
UK	0	n.a.
Aluminum	**Recycling rate**	**€/GJ primary**
France	7	-1
Germany	63	8
Netherlands	0	n.a.
UK	28	-12

Source: SOFRES, 2000: 19.

The monopoly commission has criticized in their expert report ”Competition problems of closed-loop economy“ the lacking competition in the waste management sector , which is based especially on the behavior of the Duales System Deutschland AG (DSD). ”The establishment of competitive dual systems or similar institutional settings for ‚self disposing’ was hampered in the past by the fact that the license contract of DSD has defined the fees independently from the real waste management services and costs with the result that there was no real incentive for producers and distributors to fall back upon other waste management suppliers”, it says in a press release. Competitors of the DSD-system should get the opportunity – by joint use of the collection system – to profit from the synergies at this stage. As a competition inhibiting issue also the particular prescriptions of the Packaging Ordinance itself is criticized. Thus the prescription of global coverage obstructs market access for competitors of the Green Dot. Those competitors should get an authorization for collecting sales packaging even if they do not cover an entire state but only a rural district or a county town.

To sum up: with respect to the central problem of this study i.e. cross-border B2C and free-rider problems, the area of sales packaging is more or less uninteresting. The essential innovations as the result of the regulation were implemented within the 90s. Through the license fee no substantial enrichment is to be expected. Incremental innovations in the market of packaging today are induced by market incentives. Due to its principal structure, the system is not awarded with outstanding eco-efficiency. With respect to the defect scenario it may be assumed that no impacts on innovation are to be expected, but distortion of competition may occur.

3.3 Effects of Free-rider Behavior on Competitiveness Regarding Cross-border Trade

3.3.1 Theoretical Considerations

Producers who market products by cross-border distance trade without having a settlement in the purview of the regulation have direct economic benefits. As free-riders these importers can avoid the expenditures for the taking-back and the recycling of the products distributed by them. These costs are imputed additionally to the domestic producers. This results in a preferential treatment in competition of the direct-marketers. It may be expected that the actors who can elude the producer responsibility will have only minor or no incentives to make respective innovations in the waste sector because of the lack of cost pressure.

In the case the yields achieved by avoiding paying disposal costs will become a market relevant factor, the behavior of the domestic actors will be affected which may lead to distortions of competition. A change in their behavior will especially influence

- the efforts to innovate in products and production as well as organizational innovations, and
- the attitude and acceptance regarding the framework-conditions and the pattern of regulation.

In reality, these aspects will hardly be separable. The dimension of costs which have to be born by domestic producers additionally will also be influenced by the take-back system which has been introduced. In the case of a collective system (monopoly) like in the domain of packaging, the DSD, these costs can be attributed to the producers on an equal basis. In a mixed system (for example several individual producer arrangements combined with collective arrangements) as expected under the terms of the WEEE Directive individual producers which are able to realize a solution just for

their own products could even avoid additional costs. To bear the costs of free-rider behavior a collective solution would have to be found.

The following reactions to the rise in recycling costs with respective consequences for the domestic competition are supposed:

- The enterprises will try to raise prices. The success will depend on the price-elasticity of the respective demand, i.e. if consumers notwithstanding the rise in the price will buy these products inland or order them abroad or even abstain from buying.
- If the attempt to shift the costs to the product prices will not be successful, the consequence for the enterprises will be first of all lower profits and, hence, a lower profitability. In the medium term, this could lead to a problematic position in competition which may even result in having to reduce the production capacity. In any case, the leeway for any new innovation would be narrower. Concerning environmental innovations in the waste sector there may be
  - no changes in the attitude of domestic producers or at least weaker efforts to innovate as originally planned as well as
  - stronger efforts to innovate, namely if the costs of development and changes of production are lower than the difference between the new costs of waste management and the costs of waste management to be expected alternatively.
- Another possible alternative for the producers is the circumvention of the regulation. First of all a virtual relocation of the distribution systems in order to sell the products via the Internet is conceivable. A simultaneous relocation of the entrepots however seems to be rather unlikely because this would add transport as another important expense factor. Such a strategy would only be of advantage if the differences in sales prices between the two countries would be considerable. The marketing across the border seems to be a possible strategy first of all for small firms. Large firms, especially the so-called global players, on the contrary, have subsidiaries in every country and feel respective consequences everywhere. A further possibility for them would be to try to reach a solution on a private basis in the context of cross-border compensations between the national take-back systems.

The following quantitative and qualitative considerations should demonstrate the relevance of this problem in the domain of old electrical and electronic equipment for which the WEEE Directive explicitly requires a solution. A further look is directed on the domain of packaging.

3.3.2 Volume of Not-attributable Recycling Costs for Product Groups in Cross-border Direct Marketing

Depending on the volume of recycling costs which are not attributable because of cross-border direct marketing, there will be distortions of competition in the market of electrical and electronic goods. These distortions might prompt competitors to adaptation reactions which might impede the aspired steering effects of the law. Decisive for the incidence of market-relevant effects will be the volume of cross-border direct marketing and in this context the volume of recycling costs, which need to be shared by the domestic suppliers. Below, the respective volume of the accruing recycling costs is estimated exemplarily for selected groups of electrical and electronic goods that are relevant in B2C.

These costs are, beforehand, hypothetically not assignable because in reality the WEEE Directive needs to have a solution to this problem in the course of the national transposition. Every product under the WEEE Directive and the corresponding national take-back legislation, however, is packed as well. This may increase the competitive distortion already caused by unregistered EEE in addition. This is the reason why the costs which accrue in the disposal of the respective packaging of these machines are taken into consideration as well.

Table 12 shows for the respective groups of EEE for the year 2001 the consumed quantities together with their value and the expected disposal costs of packaging as they have been documented by the Company for Research of Packaging (Gesellschaft für Verpackungsmarktforschung – GVM). The calculation of the disposal costs of the electrical devices themselves was based on the respective quantities consumed and the current average unit costs for disposal; the latter being own calculations based on informations provided by EUWID[67] and different recycling firms. It has to be underlined that these costs do not accrue in the same year because the electrical equipment will be disposed off only after a more or less long lifespan.

[67] Europäischer Wirtschaftsdienst.

Table 12
Estimation of the disposal cost of WEEE for cross-border B2C
Data for 2001

	Market volume		Disposal costs								
			total				of B2C				
							EEE			Packaging	
	volume in 1,000 items	value in 1,000 €	EEE	Packa-ging of EEE	total	Share of pack-aging in %	B2C (5% of total) in 1.000 €	Share of disposal costs in market volume	Cross-border B2C (5 % in B2C)	B2C (5% in total)	Cross-border B2C (5 % in B2C)
Telecom-munication	310,140	14,766,354	31,047	3,869	34,915	10,0	1,746	0.2	78	193	10
Audio and video de-vices	57,964	2,847,436	100,89	11,609	112,399	9,4	5,620	3.9	252	580	29
PC and PC-components	82,411	14,683,085	253,24	21,930	275,854	7,4	13,793	1.9	635	1097	55
Other small appliances	5,047	900,503	8,170	422	8,592	4,7	430	1.0	20	21	1
Sum	455,562	33,197,378	393,930	37,830	431,760	8,1	21,588	1.3	985	1,891	95

Own calculations according to GVM.

In 2001 in the product groups mentioned about 456 bn. devices with a total value of more than 33 bn. € were bought in Germany. The costs which will accrue in the following years for the disposal of these electrical and electronic devices, can be estimated – on the basis of today's unit costs – with 394 bn. € (not including return costs and transaction costs). This is only 1 % of the domestic market provision (3.5 % Audio- and Video equipments, 3.5 % PCs, 1.7 % for other small electrical appliances 0.9 % and 0.2 % for telecommunication devices), which can be used as an indicator for the total turnover inland from domestic and foreign production. Compared to an operating margin of 2 to 3 % this order of magnitude is, however, not to be neglected. This shows, in fact, a possible economic advantage of direct marketers based in another country. Costs for the disposal of packaging are, as expected, with about 8 % compared to the costs of the recycling of the devices relatively small.

In the following, estimations of the potentially not assignable costs of disposal on the basis of assumptions concerning B2C, especially cross-border B2C at today's level are presented. For some groups of products there are hardly quantitative hints concerning the actual importance of the turnover made "online" or concerning shares of total turnover. In the majority of existing market studies rankings of the product groups bought are included (GfK 2002, ENIGMA GfK 2003). Together with PC-hardware and accessories which in all studies rank in the top-ten of the customers' favorites also telecommunication devices, audio- and video sets and other small electrical devices are represented. However, the studies do not provide information concerning turnover by single product groups. Results of a HDE survey for the year 2001 show a share of Internet-purchases of total purchases in consumer electronics of less than 1 % (ECC 2002). Even those product groups

that are most likely to be traded online according to this survey rarely reached shares of more than 2 % of total turnover. Information on cross-border trade for which a share of about 3 % of total B2C-turnover is given is even less. However, the importance of the groups under consideration should be greater because their chances on the market seem to be above average. The upper limit for the current situation therefore seems to be firstly a share of 5 % of B2C in market provision and secondly a share of 5 % of cross-border B2C-trade in total B2C, the latter being the potential "Free-rider-share" (Table 12). Under this assumption the distortions caused by missing take-back regulation should be of hypothetical nature. They should be with a share of 0.25 % in total disposal costs in the range of about 1 mills €. This sum seems to be relatively small. For a few direct-marketing firms located in another country economic advantages would result, respectively economic disadvantages for domestic producers in the same segment of the market. However, there would be little relevance for the market because of the small market share of these marketers and the low amount of costs that would have to be born additionally by the domestic distributors and producers.

Only a couple of years ago, the future development of online-trade was considered as being very dynamic. Meanwhile, the forecasts have become more modest. With defining the margin concerning the possible future development in the following the dimension of the potential non-assignable costs is roughly estimated up to the year 2010.

As the HDE still predicts a share of 6 to 10 % of B2C-turnover in the total turnover of retail trade in 2010, the lower limit for the product groups under consideration in this study is set as a share of 10 % of B2C in the total turnover (including the direct marketing by producers themselves). Concerning the importance of cross-border marketing for B2C, i.e. the potential share of free-riders 10 % seems to be plausible. By way of multiplication of both numbers a share of about 1 % of non-assignable disposal costs at the total costs of disposal results (Table 13).

Table 13
Assumptions concerning the development of a possible share of non-allocable disposal costs in the total disposal costs until 2010
in %

	Lower Limit	Upper Limit
Share of B2C in the total turnover of electrical and electronic goods	10	30
Share of cross-border direct distance trade in B2C-turnover, corresponds to the free-rider share	10	30
Both multiplied is the share of products in total turnover the disposal costs of which may not be allocated to the producers	1	9

The upper limit for the share of B2C at the total turnover of the product groups is set to 30 %. A share of this dimension has been considered as being possible in the year 2003 as late as in the year 2000 by ZVEI and ORGALIME for these products. The share of cross-border turnover at B2C-turnover has been expected as being at the same level of 30 %. From these numbers a share in total disposal costs amounts to some 9 % (Table 14).

These considerations demonstrate that a distortion of competition in disfavor of enterprises taking part in a disposal system and also bearing the non-assignable disposal cost will only take place if cross-border trade would increase to a great extent, which seems to be rather unrealistic in this dimension.

Additional distortions of competition due to the fact that B2C cross-border traded electrical devices will also import packaging which has to be disposed inland can be rather neglected on a quantitative basis (Table 14). This view is supported by the fact that the task force created by the DSD in 2000 when a rapid increase of cross-border B2C still had been assumed for finding ways to deal with this additional packaging has remained rather inactive considering the rather modest volume of the products actually imported. However, it has to be stated that, in principle, a certain additional amount of market distortion has to be calculated as coming from the side of packaging if the basic problem of the European harmonization of the transposition of the WEEE Directive will not be solved in a proper manner.

Table 14
Domestic market provision for personal computers
Germany 2000 – 2002

	2000	2001	2002
	Turnover inclusive tax in mills €		
Home PCs	5,984	4,264	3,384
Notebooks		1,429	2,274
	Sold units in thousands		
Home PCs	4,572	4,010	3,340
Notebooks		720	1,060
Average prices in €			
Home PCs	1,309	1,063	1,013
Notebooks		1,985	2,145
	Level of equipment per 100 households		
Notebooks	5.5	6.1	7.9

BVT (2003), own calculations.

3.3.3 Effects on Competition Using Examples of Selected Products

3.3.3.1 Market Development of Selected Products

The essential determinants for the reactions of enterprises are:

- the level of disposal costs: transaction costs (including costs of institutional innovations like register and monitoring, costs of systems), collection, disassembling, treatment, recycling,
- the prices of the product groups: the relation of the recycling costs in relation to the original , price differences between countries and
- the scrap value of the equipment and proceeds from recycling.

The quantitative considerations concerning the reactions of enterprises and the effects on competition are discussed for the example of selected consumer electronics products and ICT-products. Decisive for the selection is on the one hand their large proliferation in private households and on the other hand to choose high priced as well as low priced appliances. Against this background, the following products have been chosen: mobile PCs (notebooks, laptops) as example of a high-price product the proliferation in private households of which is increasing at a fast pace and the DVD-player as an example of a consumer electronics product which has become rather inexpensive. Additionally, printers have been selected because this device is an example for a joint product which not only gains importance as a periphery-device to home-PCs also as the proliferation of digital photography acquired an increasing importance as output device for digital pictures. Moreover, printers are to be found in the lower as well as in the upper price segment according to the technique used for printing. As a fourth example, additionally, portable audios have been chosen. Especially in this group small and very reasonable devices are to be found which are particularly relevant for B2C.

Mobile PC

Comparatively high prices made mobile PCs unattractive for private use at the time of their introduction into the market – if they did not serve as a status symbol for well-off people. Due to their mobility these computers were used almost exclusively for business purposes. Only an increasing offer of mobile PCs in the lower price segment of about 1,000 € led to a wider proliferation. The advantage of these devices besides their mobility is mainly their compact, place-saving construction. However, at the same time, this is also a disadvantage because they are able to be upgraded with rising demands because they come to the market as finished products.

The development of the market for mobile PCs since 2000 turned out to be opposite to the general development of the market for PCs (Table 14). Due to the increasing demand for mobile PCs together with a tendency to a more significant equipment of the devices themselves it was possible to realize higher average revenues on the market.

The prices for mobile PCs range – depending on the equipment and age of the model – between 500 and up to almost 5,000 € (Table 15). However, devices for private use generally range only between 1,000 and 2,000 €. Whereas the evolution of price indices[68] published by the Federal Statistical Office (Statistisches Bundesamt) shows only the drifting down of prices of home computers in general, the data of associations confirm the stabilizing development of prices of mobile devices.

Table 15
Range of prices for selected products in Germany
in €

	Inquiry period	Lower price limit	Upper price limit
Mobile PCs (Notebooks, Laptops)			
Quelle	Nov. 2003	1,000	3,000
Internet (Kelkoo.de)[1]	Nov. 2003	530	4,934
Printers			
Karstadt	Dec. 2003		
- Ink jet printers		99	499
- Laser printers		299	679
Internet (Kelkoo.de)	Dec. 2003		
- All types[1]		49	8,499
DVD players			
BVT	2002	400	750
Stiftung Warentest	Dec. 2002	150	700
Quelle	Nov. 2003	70	400

[1]Most of supplied devices at prices between 1,000 € and 2,000 € for a mobile PC and between 50 € and 650 € for printers. Own inquiries.

Because of the relatively higher price level of mobile PCs, it may be assumed that additional recycling costs caused by free-riding in cross-border B2C-trade will hardly harm the revenues of producers or marketers and, consequently, the consumer prices regarding this special aspect should remain stable. However, here it is not being taken into account how intensive the pressure of competition by the different providers of these appliances really is and how large the leeway of pricing effectively is.

[68] The assignment of mobile PCs to a price index of the Statistisches Bundesamt is not unambiguously possible because the product prices included in price indices in question refer to more general categories of products.

Printers

Printers today are used on the one hand as output devices for text and pictures and on the other hand increasingly also for photos. The most prevalent printing techniques are ink-jet and laser printing. Today, ink-jet printers are exclusively color printers whereas the relatively expensive color printing technique of laser printers is used in particular for commercial purposes. But black-and-white laser printers do increasingly prevail also in the private sphere.

The number of printers offered on the German market has been declining in the year 2002 for the first time since 1998 declining with -12 % compared to the year before. Printers compared to home computers have a longer useful life. Due to this development there is a certain (momentary) saturation of the market. The simultaneous decline of prices by 4.3 % has increased the competition pressure even more and has reduced the turnover with printers by 16 % to 5.8 bn. € (Table 16).

Table 16
Domestic market provision for printers
Germany; 2000–2002

	1998	1999	2000	2001	2002
Value (in mills €)	1,928	2,472	2,648	2,648	2,224
Numbers (in k units)	3,993	-	5,964	6,632	5,834
Mean value (in € per unit)	483	-	444	399	382

EITO (2003).

Private consumers buy more and more printers with laser technology because of the low level of prices. The evolution of prices is, however, driving closer to a minimum level defined by production costs. The trend to digital cameras leads at the same time to an increase in demand for high quality photo-printers equipped with separate color cartridges (BVT 2003: 36). The unequal evolution of prices of ink-jet and laser printers is expressed clearly by the official consumer price indices. Whereas the prices for ink-jet printers dropped by 35 %, the decline at laser printers has been in the same period markedly smaller with 7.7 % to 93.5 %.

The price span of printers (Table 15) varies depending on the printing technique. For the use of private households ink-jet printers are offered on the market at prices between just 100 € and about 500 €, whereas laser-printers start at about 300 €, expensive devices cost about 700 €. The price level of laser printers depends very much on the capability of printing in color.

DVD-players

DVD-players are devices that first of all reproduce pictures and sound but also music. External devices are part of HiFi- or home-cinema sets. The advantages of DVD-players compared to VCRs are the better quality of pictures and sound as well as their greater callousness compared to video-cassettes. Additionally, those devices possess improved basic functions and more extra-functions than VCRs.

The DVD-player has proven to have a great potential of growth among consumer electronics. The amount of demand counted by devices has more than tripled only since 2001. Their turnover in the year 2002 rose in spite of a considerable drop in prices caused by low-price offers by marketers that do not belong to the sector of consumer electronics by more than 81 % (BVT 2003: 31 f.). VCRs are less substituted by this evolution than by the increasing proliferation of DVD-recorders.

Low-price offers coming from outside of the specialized retail sector put much pressure on the prices of DVD-players since their introduction to the market in 1997[69]. The introduction into the market of DVD-recorders elevates somewhat the average price level of consumer electronics (BVT 2003: 31). Whereas the price span for DVD-players in the year 2000 has been in the range of 400 – 750 €, it shifted downwards considerably to about 70-400 € since then (Table 15).

Table 17
Domestic market provision for DVD players
Germany 2000–2002

	1997	1998	1999	2000	2001	2002
Value (in mills. €)[1]	-	61	112	249	403	725
Numbers (in k units)	3	60	150	700	1,570	4,900
Mean value (in € per unit)	-	1,023	750	356	257	148

BVT (2001 and 2003). – [1]Turnover inclusive tax.

The high interest of consumers in these devices is also reflected in the index of equipment of private households with DVD-players by 14.1 % (BVT 2003: 16).

[69] Because in the official statistics DVD players are only represented together with other devices from consumer electronics and those appliances are on the market only for a few years these data only show a very imprecise picture of the evolution of their prices.

Portable Audio Sets

The product group of portable audios contains a lot of different types of portable devices such as small radios and radio-recorders, cassette-recorders (the so-called walkman), portable CD- and DVD-players as well as devices which offer a combination of all these functionalities. Beside these more traditional products also portable MP3-recorders, mini-disc players and recorders that use different types of memory cards belong to this group.

Data from the gfk show that the sales volume of portable audios has decreased since 1995 by 32 % from 712 bn. € to 483 bn. € in 2002. In the past two years, only MP3-players and portable CD-players show an increase in sales volume and in their market share, because of decreasing prices and a strong increase in demand. Most of the other products of this group like radio recorders, stereo pockets and portable MD players have been sold less and have lost market share.

For the individual products of this group no data for prices and disposal costs are to be found. Instead of a price an average value per device has been chosen.

3.3.3.2 Estimation of the Impacts of Free-riders on the Competitiveness of Manufacturers/Distributors

Free-riders who avoid paying the disposal costs of their products experience an economic advantage. So the competitiveness of products from domestic manufacturers/distributors will be negatively influenced, if the turnover of free-riders reaches a certain threshold and becomes relevant for the respective market. Therefore, it shall be estimated which additional burdens producer will have to bear, if (a) the share of free-riders on domestic market provision increases and (b) the calculated disposal costs per unit rises. Finally possible conclusions for competition within the concerned product categories will be drawn taking into account the obtained results together with other information.

Additional disposal costs from free-riders may be – at least partly – compensated by proceeds from secondary resources. The amount of these proceeds depends on the materials used for products as well as on the market prices for primary and secondary resources. Proceeds for secondary resources reduce gross disposal costs per unit, and therefore have a direct impact on the extent to which additional disposal cost can be compensated. The difference between gross disposal costs and gained proceeds for secondary resources is called net disposal costs per unit. Because manufactur-

ers/distributors only have an indirect utilization of these proceeds, net disposal costs are exogenous for them.

Price deviations for secondary resources influence the impacts of free-riders on domestic manufacturers/distributors very much. Because these prices are not analyzed here, proceeds for secondary resources are assumed to be constant. For this reason, in the following the impacts of free-riders on net disposal costs will be investigated for selected products. Although the calculations lead to a steady-state solution, the abilities of interpretation are not restricted, because they are focused on product prices and not on sold quantities per period, so these quantities have no influence on the results. Initially for the investigation only the impacts on the share of free-riders of net disposal costs are taken into account. Especially, it is assumed that the share of free-riders has no effect on process and/or product innovations. Such innovations for example could improve recycling characteristics and/or reduce the input of raw materials, which both lead to decreasing disposal costs and therefore would have feed-backs on the relevance of free-rider effects.

In a formal aspect, additional disposal costs from free-riders DC_{Unit}^{FR} can be written as a function of disposal costs per unit DC_{Unit} and the share of free-riders on domestic market provision mp_{FR}:

$$DC_{Unit}^{FR}(DC_{Unit}, mp_{FR}) = DC_{Unit} \frac{mp_{FR}}{1 - mp_{FR}}$$

This representation shows that (i) for given disposal costs per unit additional costs from free-riders can be obtained from the ratio of the share of free-riders to the share of registered manufacturers/distributors. Therefore, the quantitative market volume as well as the total disposal costs has no relevance. Changes of the additional costs are non-linear because the denominator "share of the registered manufacturers/distributors" $(1 - mp_{FR})$ will decrease if the share of free-riders is growing. It is also clear that (ii) relative changes of additional disposal costs, which come from a rising share of free-riders, are independent from product prices as well as from the disposal costs per unit, and hence are the same for all products (see column "Free-rider portion" of Table 18). Finally, the formal relation shows that (iii) variations of disposal costs per unit lead to proportional changes of the additional disposal costs if the share of free-riders remains constant.

The results show the additional disposal costs for different free-rider portions. They are shown in Euros per unit, relative to the original disposal costs per unit and as relative effects on product prices. This way the additional costs per unit can be qualified and for the different products possible distortions of competitiveness can be shown. For the selected products the disposal costs per unit vary between 0.40 € for portable audios and 10 € for a mobile PC. Relative to product prices the share of these disposal costs dif-

fers from 0.5 % for a mobile PC to 1.3 % for printers. On its own these ratios are not an adequate benchmark for evaluating the economic impacts of recycling-quotas or additional costs of free-riders, because during the product life-cycle these ratios will rise due to decreasing prices.

Table 18
Additional disposal costs for producers caused by cross-border distance trade

	Average sales price	Total disposal costs per unit		Free-rider portion[1]	Additional disposal costs per unit (average)		
	in €	in €	in % of price	%	in €	in % of costs	in % of price
Mobile PCs	2,145	10.00	0.5				
				1.00	0.10	1.0	0.005
				5.00	0.53	5.3	0.025
				9.00	0.99	9.9	0.046
DVD players	148	1.13	0.8				
				1.00	0.01	1.0	0.008
				5.00	0.06	5.3	0.040
				9.00	0.11	9.9	0.076
Printers	382	5.00	1.3				
				1.00	0.05	1.0	0.013
				5.00	0.26	5.3	0.069
				9.00	0.49	9.9	0.129
Portable audio sets[2]	40	0.40	1.0				
				1.00	0.00	1.0	0.010
				5.00	0.02	5.3	0.053
				9.00	0.04	9.9	0.099

BVT (2003), Huisman (2003), own calculations. – [1]Free-rider portions of the upper and lower limit scenarios (see text). – [2]Hypothetical average value.

Additional disposal costs from free-riders are redistributed to the inland manufacturers/distributors and therefore are increasing disposal costs per unit. With an expected range for the free-rider portion between one and nine per cent for the future the average disposal costs per unit will increase between 1 % and 9.9 %. The additional costs depend on the actual disposal costs per unit thus for mobile PCs with 0.10 € to 0.99 € they show the highest amount. For a distortion of competitiveness the impacts on prices are important. These impacts can be demonstrated by the ratio from specific dis-

posal costs to product price. The higher the cost coefficient the higher are price effects from free-riders. Although the cost effect for a mobile PC is the highest, the impact on its product price in the range of 0.005 % to 0.05 % is the smallest, whereas printers with 0.013 % to 0.13 % show the largest effects on prices, because their coefficient for disposal costs is the highest of all selected products.

It may be expected that the disposal costs will increase considerably in the course of the years as the WEEE sets high quotas for recycling and re-utilization which will require an improvement of the cost-intensive dismantling. The impacts of increasing disposal costs on profitability can be shown by the example of portable audio sets. An investigation for the Netherlands (Stevels/Boks 2003) is expecting a quadruplicating of the specific disposal costs per unit from now 0.40 € to then 1.60 €, if the WEEE recycling quotas will take in effect. This would be 4 % of the product price. Additional costs from free-riders would also be quadruplicated in the range of 0.02 € to 0.16 € per unit with respect to the different free-rider scenarios because higher disposal costs lead to a proportional increase in additional costs. Further, the effects on prices would rise by the same factor that would be between 0.04 % and 0.4 %. However, it has to be recognized that the results from the Netherlands were gained from gross disposal costs. Although in principle the effects on costs and prices could partly be compensated by proceeds from secondary resources; for portable audio sets these proceeds would be less than for more metal dominated products like DVD players. All in all, this example illustrates that a strong increase in disposal costs per unit induced by quotas of the WEEE Directive would naturally also boost free-rider effects. But the real burden for inland manufacturers/distributors would have a relatively low level.

For the competition situation of the products concerned by the WEEE Directive, these results show that the higher the ratio of disposal costs per unit and product price is, the higher is the pressure on manufacturers from increasing prices. With decreasing product prices and low profit margins as well as increasing recycling quotas this pressure will increase. In principle the profitability of a product will suffer in such a case. Although for all products concerned by the WEEE competition pressure is high while prices are tending to fall, the results for different free-rider portions show that the effects on profitability, which can be expected, remains restricted. Nevertheless, it cannot be excluded that losses in profitability could be significant for products of some manufacturers/distributors. However, this would mean a distortion of competitiveness if competitors would gain advantages from free-rider behavior.

Finally, it has to be recognized that product prices are a benchmark that gives only restricted information for evaluating distortions in competitiveness, because reliable statements on price margins are impossible. Since profitability data for single products are not available, it cannot be shown if increasing costs must lead to increasing prices or if they can be compensated by lower profit margins.

In general with respect to the reaction of firms on the WEEE Directive it may be expected that smaller firms try to act as free-riders to avoid paying the disposal costs of their products. They might try to shift their sales organization abroad selling products by Internet and leaving their distribution centre(s) inland. Although, in this case, relatively low effects on prices have to be compared with the costs of reorganizing sales and distribution structures. In contrast, bigger firms with plants in many countries may be more interested in lobbying to improve the regulations of the WEEE Directive, especially to solve the free-rider problem by a transnational strategy because they are aware of the consequences everywhere.

4. Transnational Product Responsibility in View of the Free-Rider Problem

4.1 Introductory Remarks

Increasing trade streams routed directly to private consumers (i.e. from business to consumer – B2C) by border crossing distribution channels create a regulatory problem to be solved in the transposition of the WEEE Directive. Solutions are explicitly required there. The problem has to be addressed in joined efforts of national and supranational legislators. The necessary standardization and monitoring process needs a cooperation of public authorities and private organizations.

In view of Environmental Product Regulation, transnational B2C-transactions create interface problems on different levels of legislation, standardization, monitoring and enforcement. In coping with these interface problems new legislative tools and cooperation mechanisms are to be developed. Regarding the trade of electrical and electronic equipment (EEE) one of these tools is a guarantee each producer[70] has to provide when placing a

[70] Concerning the Art. 8 (4) WEEE Directive "´producer´ means any person who, irrespective of the selling technique used, including by means of distance communication […] (i) manufactures and sells electrical and electronic equipment under his own brand, (ii) resells under his own brand equipment produced by other suppliers, a reseller not being regarded as the ´producer´ if the brand of the producer appears on the equipment [..], or (iii) imports or exports

product on the market in order to show that the management of the deriving waste (WEEE) will be financed by him[71]. To secure the producer responsibility also across borders in order to prevent free-riding, transnational law making is required.

Art. 8 (4) WEEE[72] obliges Member States to ensure producers' financial guarantee also when supplying their electrical or electronic equipment (EEE) across borders. Thus a new type of transnational legal obligation is considered: producers are no longer only subject to their national legislation, but shall have to comply also with the product related environmental rules in the purchaser's country, independently of having a subsidiary there. However, this European directive does not offer any detailed framework on how to establish these transnational duties. The implementation needs a harmonized structure to overcome the impediments resulting from the numerous interfaces, which have to be passed until the different national law systems of each Member State work properly in order to reach the directive's aim: cross-border product responsibility. Main interfaces in this context are:

4.1.1 Legal interfaces: The Financial Guarantee and its Enforcement

It has to be decided if the financial guarantee has to be provided in the Member State of the producer or the purchaser.

The guarantee is aiming at refunding the costs of waste management. Therefore, the national implementation of this directive must contain an entitlement against the producer, also across borders.

4.1.2 Practical Interfaces: the Monitoring System

According to Art. 11 (1.2) WEEE, a monitoring system enabling the evaluation of compliance with the requirements from Art. 8 (4) WEEE must be installed in every Member State. This needs to monitor data about the EEE when put on the market and when given back as WEEE.

The better the guarantee systems between the Member States cooperate, the less effort is needed with respect to the monitoring system. This coop-

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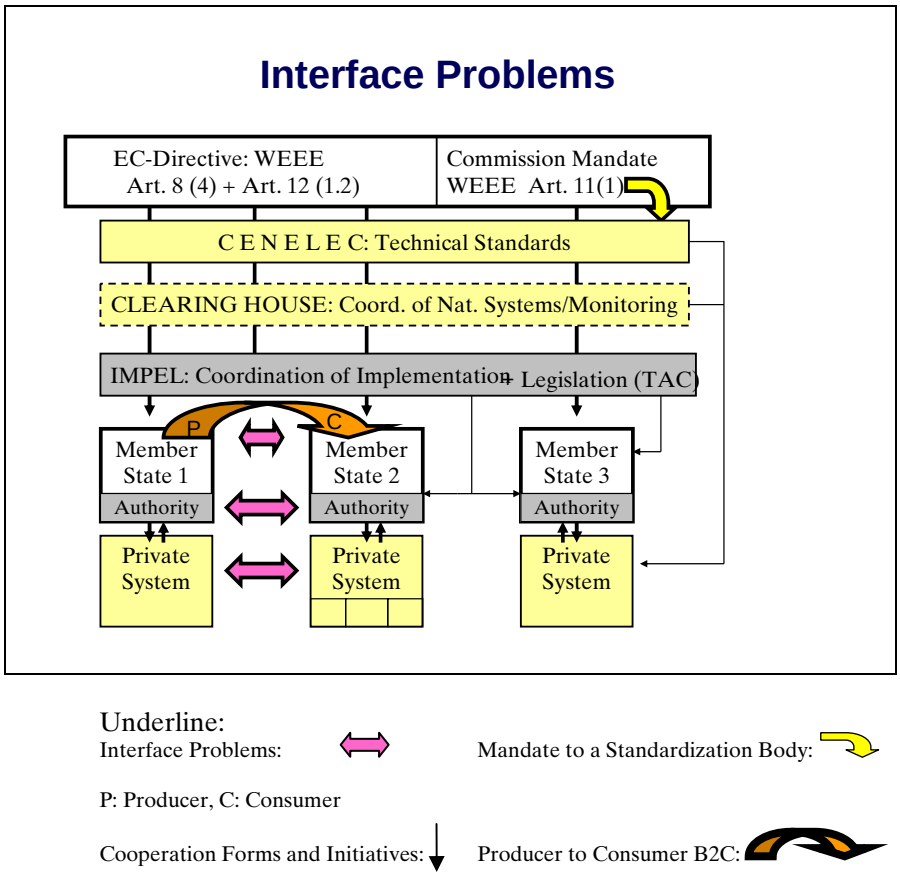
electrical and electronic equipment on a professional basis into a Member State." In the following: ´producer´ or ´Art. 8 (4)-producer´.

[71] Art. 8 (2) WEEE Directive.

[72] Art. 8 (4) WEEE Directive: "*Member States shall ensure that producers supplying electrical or electronic equipment by means of distance communication also comply with the requirements set out in this Article for the equipment supplied in the Member State where the purchaser of that equipment resides*".

eration can only be reached under the pre-requisites shown in the illustration below: in a vertical view, standardization of the different details is needed. Regarding technical issues, such as the unequivocal marking of EEE, European standards could be promoted by the Commission (Art. 11 (2) WEEE). On the basis of a mandate this could be developed by CENELEC[73].

Figure 21
Interface problems concerning cross border B2C in implementing the WEEE Directive



In a horizontal view, the close cooperation of all Member States is necessary. This must start at the latest when implementing the directive, especially with respect to future enforcement tools, and can be supported by

[73] Comité Européen de Normalisation Électrotechnique; European Committee for Electrotechnical Standardization.

IMPEL[74]. Regarding the monitoring system that will need data exchange between Member States, a central European clearing house may be helpful to coordinate the different national systems. Finally, optimizing cross-border product responsibility by means of transnational law making could conclude with institutional innovations allowing a better harmonized implementation of future European legislation. Therein the need for a coordinated national implementation should be considered already while designing a directive and by regarding the need for cross-border cooperation in enforcing the deriving national legislations. This is stressed already in the final report of the IMPEL Better Legislation Project: "Effective Enforcement needs a good legal base" (IMPEL 2003).

Against this background, the following text shows which approaches to transnational B2C-trade have been made in the WEEE Directive so far. Starting from this portrait, the different actors involved in the process of designing, implementing, applying and enforcing this directive in order to ensure effective and coherent legislation throughout all Member States will be analyzed. As a result, the different interface problems appearing on different levels will be visible. Regulatory options and coordinative measures allowing the solution of these interface problems to all actors will then be scrutinized successively. Finally, recommendations with respect to different actors will be given.

4.2. The Transnational Approach of the WEEE Directive

In the context of the discussions on an "Integrated Product Policy"[75] the WEEE Directive is designed on the basis of the concept of producer responsibility. Recital 20 explicates: In order to give maximum effect to the concept of producer responsibility, "each producer should be responsible for financing the management of the waste from his own products". The wording "*each producer …*" clarifies the concept on which Art. 8 (4) WEEE is based: producer responsibility is not meant as a collective accountability, rather the directive asks for a cost allocation on an *individual* level.

To realize this approach two conditions have to be fulfilled: Firstly, all products put on the domestic market *and* all products sent cross-border by export or e-commerce has to be addressed by the regulation. And secondly, the mechanisms regarding the financing of WEEE management have to be

[74] European Union Network for the Implementation and Enforcement of Environmental Law.

[75] General information on IPP can be found at http://europa.eu.int/comm/environment/ipp/home.htm; for a critical review in the context of the existing legislation c.f. the contributions in: Führ 2000.

set at the Community level (recital 19) to avoid side step reactions of the producer. In addition, the financing schemes have to contribute to high collection rates, as well as to the implementation of the principle of producer responsibility (recital 19).

So the provisions of the WEEE Directive are intended to regulate also the effects of transnational B2C-trade of EEE[76]. With respect to the directive's aim of securing an environmentally sound disposal of WEEE, one of the effects of transnational trade of EEE is the "transnational existence of WEEE"; i.e. when reaching the end-of-life, the waste from the electric appliances is located in the purchaser's Member State, and not any longer in the Member State of the producer. Taking into account that the WEEE Directive has to be transposed into national legislation of every Member State, this rises the question about which of the national WEEE implementations should be the leading one: theoretically the disposal could be subject either to the WEEE implementation of the producer's Member State or of the purchaser's Member State.

This question is answered in Art. 8 (4) WEEE. Thereafter Member States have to ensure that producers supplying electrical or electronic equipment by means of distance communication also comply with the requirements set out in Art. 8 WEEE for the equipment supplied in the Member State where the purchaser of that equipment resides. Thereby the wording "where the purchaser of that equipment resides" indicates that a producer from a foreign Member State has to comply also with the transformed legislation within the purchaser's state. This requires that the producer becomes subject to the legislation of the purchaser's state. Therewith, the directive's approach to transnational trade creates a need for "transnational law making" as it requires tools which secure that a producer from one Member State will comply with the WEEE specific legislation of another Member State.

One of these tools is the financial guarantee each producer has to provide when placing a product on the market showing that the management of all WEEE will be financed by him (Art. 8 (2) WEEE). Naturally, also the provision and enforcement of this guarantee have to be maintained across borders, i.e. transnationally.

The provisions in Art. 12 (2.1) WEEE have been made exactly to this effect. They require that Member States ensure that producers provide information

[76] Moreover, recital 20 asks for a general transboundary mechanism securing the allocation of the costs of waste management to the producer, may the product have entered the other Member State by direct B2C-trade or in any other way (for a proposal to address this problem see chapter 5.1).

on the compliance with the requirements of Art. 8 (4) WEEE and on the quantities and categories of EEE put on the market of the Member State where the purchaser of that equipment resides. Here the WEEE Directive demands a monitoring system that allows tracing the environmentally sound management of WEEE across all Member States. Therewith the duty to provide the financial guarantee according to Art. 8 (4) WEEE and the duty to provide information about cross-border sales of EEE according to Art. 12 (2.1) WEEE are the main tools under the regime of the WEEE Directive in order to secure producer responsibility also across borders between Member States. They are in the center of the directive's approach to transnational trade.

In fact, it has to be pointed out who will be subject to these duties. The definitions in Art. 3 lit. (i) sub point (iii) WEEE indicate that 'producer' also means any person who, irrespective of the selling technique used, including by means of distance communication in accordance with Directive 97/7/EC of the European Parliament and of the Council of 20 May 1997 on the protection of consumers in respect of distance contracts, imports or exports electrical and electronic equipment on a professional basis into a Member State. As it is pointed out clearly, the disposal obligations set out in the WEEE Directive must be complied with also in terms of cross-border B2C electronic commerce. Therefore any individual within the EU who offers EEE via e-commerce is a "producer" in the WEEE legislation (this person could be named as "cross-border B2C-producer" or "Art. 8 (4)-producer".

This opinion is also underlined by recitals from both, the WEEE Directive and the directive on the protection of consumers in respect of distance contracts: The first one states that the provisions of the WEEE Directive should apply to products and producers irrespective of the selling technique, including distance and electronic selling (recital No. 9 of WEEE Directive). Here, it is also said that the obligations of producers and distributors using distance and electronic selling channels should, to the extend as is practicable, take the same form and should be enforced in the same way in order to avoid other distribution channels having to bear the costs of the provisions of this directive concerning WEEE for which the equipment was sold by distant or electronic selling. Therewith, the obligations of providing both, a financial guarantee (Art. 8 (4) WEEE) and information about cross-border sales (Art. 12 (1.2) WEEE), apply also to producers who trade EEE across borders by means of distance communication.

Moreover this consequence can also be derived from the directive on the protection of consumers in respect of distance contracts: Here recital No. 2 states that consumers should be able to have access to the goods and services of another Member State on the same terms as the population of this

state. With regard to the WEEE Directive, consumers need to have access to (free of charge) disposal services. With respect to the cited recital, this access needs to be maintained on the same terms even if the consumer is a citizen of a different Member State than the producer. Thus, the producer is responsible for the provision of an equivalent disposal service (or at least for a contribution to it) also in the purchaser's Member State.

The WEEE Directive has made a clear approach to also handle transnational trade with several specific stipulations (Art. 8 (4) and Art. 12 (2.1) WEEE). This demonstrates that under the WEEE-regime transnational trade will be followed by securing also transnational producer responsibility. Indeed, the very existence of these obligations, commanding to Member States to ensure that foreign producers comply with the requirements in the purchaser's Member State, do not assure their adherence. Furthermore, this requires a successful implementation of these specific transnational duties together with the implementation of the complete WEEE Directive. Evidently, this aim can be reached only with help of transnational law making.

However, before any transnational law can become effective, it must be examined which different actors will participate in the process of developing, applying and enforcing it. Moreover, it has to be considered that these actors operate on different organizational levels, due to the transnational approach. Precisely under these particular circumstances interfaces will appear which hamper the effectiveness of transnational law unless they are not designed well. Therefore, in a next step, the process of transnational law making will be examined with special regard to the different actors and the organization level they are integrated in. Therewith, interfaces between different actors and different organizations on different levels will become visible. This will allow gaining an insight into possible cooperation and incentives for the single actors.

4.3. Options of Cooperation Forms and Incentives for Actors concerning the Interface Problems

A first view on the different actors and organizations that are involved in the process of transnational law making (here: the implementation of Art. 8 (4) and Art. 12 (1.2) WEEE, supported by the mandate given by the commission to CENELEC to support the implementation of WEEE) is shown in figure 21 (p. 145) illustrating the interface problems, which can rise from many diverse organizational and institutional relations.

From a vertical view the organizational aspect becomes evident as European and national organizations are involved. As far as the transposition

and implementation in the Member States are concerned, cooperation forms between national bodies and private actors are needed (Figure 21).

From a horizontal view the need for co-ordination between the 25 Member States becomes obvious. This may require a cross-linking of diverse, in some cases already existing, national WEEE-regimes in the different Member States. Therefore a harmonized implementation of the WEEE Directive throughout all Member States would be necessary.

The pretentious process of transnational law making exposes many levels to be considered. As a general rule in environmental legislation the specific alliance between regulatory aspects on the one hand and scientific technical aspects on the other hand must be regarded. In the context of waste from electrical and electronic equipment this means e. g. the need for an unequivocal mark of the traded appliances (Art. 8 (2.2) and Art. 11 (2) WEEE), which is a crucial precondition for a system that is able to track waste streams across all European Member States. Thus, the successful implementation of the WEEE Directive is also highly dependent on a well developed technical realization of two items: firstly of the marks themselves and secondly of devices which can read them still when the appliances will be given back at the end of their life what may be 8 – 15 years after they have been put on the market. This causes the need for EU wide technical standards. Therewith the implementation of the WEEE Directive also needs a defined procedure prescribing how and where these standards will be developed. Theoretically such standards could be developed by the European Committee for Electrotechnical Standardization (CENELEC). Organizationally, CENELEC would then need an official mandate from the European Commission assigning this task on the record. Until now, Art. 11 (2) WEEE just mentions that the Commission shall promote the preparation of European standards for this purpose.

Another technical challenge is the EU wide co-ordination of the monitoring system in line with Art. 12 (1.2) WEEE. As the WEEE Directive has to be transposed into national law of all Member States before it becomes effective, it is likely that every Member State will have its own national monitoring system. In terms of cross-border trade, monitoring systems of two different Member States will have to interact in processing data about the original EEE and the deriving WEEE. This requires at least a certain degree of compatibility by different national systems. Alternatively, a European Clearinghouse could serve as a central organization, sparing the trouble of every Member State contacting every other.

Other interface problems can result from the fact that the legislation is not applied properly, whereas when it is not applied it needs to be enforced. Hence, in order to secure EU wide product responsibility, transnational

tools allowing the enforcement of national legislation across borders, i.e. even on the territory of a foreign Member State are necessary.

Finally, interface problems can emerge from a level that somehow overlays all the levels mentioned before. It results from the fact that the whole line of actors – European and national regulators and enforcement officers as well as producers, distributors, consumers and disposal sites – is influenced by any decision made on one of the other levels. Additionally, these different actors, each reacting on different incentives, may also interact among one another.

Regarding these different levels where interface problems can appear it becomes obvious that their solution and already their deeper analysis need to consider legal, technical and socio-economic aspects. Thus, a first view will focus on regulators and the addressees, describing rather legal interfaces. Then, proceeding from a more applicatory point of view, rather practical interfaces are analyzed. Actor specific incentives will be regarded in both views.

4.3.1 Legal Interfaces

4.3.1.1 Fundamental Aspects

Legal interfaces arise from the vertical distribution of competences (EU level and national level) wherein the EU directive has to be transposed, as well as from the horizontal level where the results of this transposition must allow a frictionless cooperation between the Member States. But already before, i.e. during the design of the directive, European legislators have to ensure that the directive's content and structure will meet the demand for regulation in the chosen area. Whenever transnational effects, such as cross-border trade in this case, shall be regulated with help of a directive this attempt may cause a certain conflict with respect to the nature of a directive as set out in Art. 249 sec. 3 EC: Whereas a regulation is binding in its entirety and directly applicable in all Member States (Art. 249 sec. 2 EC) a directive is binding only each Member State to which it is addressed, but leaves the choice of form and method to national authorities (Art. 249 sec. 3 EC). This choice allows Member States to create different national legislations whereas in terms of transnational regulation common or at least harmonized instructions are required.

4.3.1.2 Transposition of Art. 8 (4) WEEE Directive

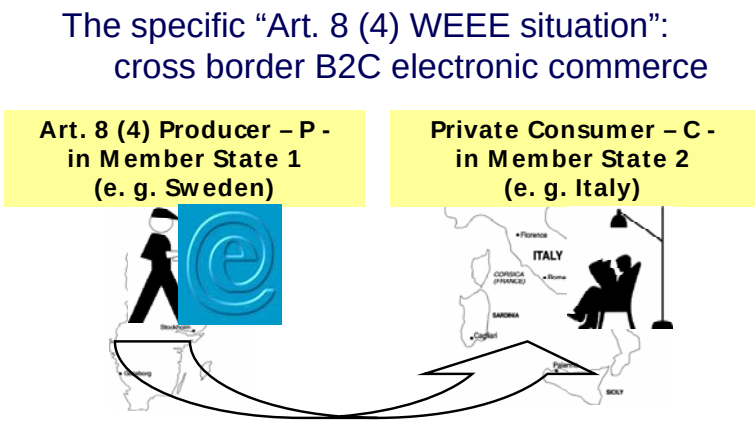
Apart from this fundamental consideration, transposing the Art. 8 (4) WEEE demand into national law requires a very particular and new type of

transnational law making: "*Member States shall ensure that producers supplying electrical or electronic equipment by means of distance communication also comply with the requirements set out in this Article* (i.e. marking their products and providing the guarantee in order to finance the waste management) *for the equipment supplied in the Member State where the purchaser of that equipment resides*".

4.3.1.2.1 Conflict with the Principle of Territoriality?

The realization of this specific obligation cannot be reached by an insulated transposition into the different single national law systems. Much more every Member State must secure that its national EEE suppliers will become a possible subject to the equivalent transposition of the WEEE Directive of every other Member State. If for instance, as it is shown in figure 22, a Swedish producer supplies EEE to a private consumer to Italy, according to Art. 8 (4) WEEE he (the Swedish supplier) must be made responsible for the treatment of the deriving WEEE in line with the national,

Figure 22
Cross-border B2C electronic commerce needs cross-border product responsibility
– a Swedish EEE supplier subject to the Italian transformation of the WEEE Directive



Producer's direct supply by means of distance communication, i.e. C orders directly from P in Sweden (e.g. by e-mail) who directly delivers to C in Italy.
P does not have any business agency in Italy → P is "not legally existent" in Italy and thereby no subject to the Italian transformation of the WEEE directive.
So the Swedish legislation has to secure that the Swedish producer also complies with the Italian transformation of the WEEE directive.

i.e. Italian transformation of the WEEE Directive. This will be possible only, when the Swedish producer becomes a subject to the Italian WEEE legislation. With respect to the constitutional principle of territoriality, where a country's jurisdiction is limited to its own territory, the establishment of such a cross-border product responsibility is a new challenge. In any case, this particular requirement must be met by the national implementations of the WEEE Directive in order to set the Art. 8 (4) WEEE obligation alive within Member States.

4.3.1.2.2 Conflict with the Principle of Clarity and Certainty of the Law?

Besides the principal of territoriality another fundamental constitutional principle could be affected: the principle of clarity, accuracy and legal certainty. The demand that a producer be a possible subject to the legislation of his customer's Member State, the transposition of Art. 8 (4) WEEE will lead to the fact that a producer will become subject to the legislation of all the states to which he exports EEE by means of distance communication, as far as these states are EU Member States (Figure 22). If he trades EEE into all Member States he will even be subject to the specific national WEEE legislation of all European Member States. Assuming that EEE is traded by means of distance communication from every Member State into every other Member State, this would mean that the specific national WEEE legislation of every Member State will be applicable within every other Member State. Thus, 25 different national WEEE legislations will be applicable within every Member State at the same time side by side and it will be left to the single producer to find out which one is applicable to him.

This question must then be answered by retracing which EEE was sent by the producer to which Member State. If – as described in the example above – it was Italy, where he had sent EEE to, the WEEE instructions from the Italian transposition of the WEEE Directive would be relevant for him with respect to the financial guarantee. If this producer had sent different EEE to another Member State (e.g. Spain), he would be – at the same time – subject to the Spanish WEEE transposition. At the moment those two EEE-products are ready for dispatch, two different legal systems are to be followed.

4.3.1.3 Guarantee (Art. 8 (2.2) WEEE) in B2C: Cross-border Product Responsibility as a New Challenge

A further legal interface problem results from producers' duty to provide a financial guarantee according to Art. 8 (2.2) WEEE. The importance of this guarantee can only be understood with the directive's primary aim in mind:

The predominant goal of the WEEE Directive is to ensure producers' responsibility for the financing of the collection, treatment, recovery and environmentally sound disposal of WEEE from private households (Art. 8 (1) WEEE, recital 20). A crucial aim behind this is the encouragement of the design and production of such EEE which take into full account and facilitate their repair, possible upgrading, re-use, disassembly and recycling (see Art. 1, Art. 4 and recital No. 12 WEEE). Thus, product responsibility is a strategic measure to realize product related environmental policy, focusing a "design for the environment". In the center of this strategy is the connection between the cost of collection, treatment and disposal of WEEE on the one hand and the design and construction of the goods on the other hand. Being successful the approach will conclude with increasing life cycles of EEE. The other main intention is solving the free-rider problem: A producer's company may not be existent any more when the appliances at the end of their lives will be given back as WEEE. Therewith, the guarantee is also meant to secure the polluter-oriented financing of waste treatment independently from a further existence of the responsible producer.

As the directive does not prescribe explicitly where the guarantee must be given, two options seem to be possible: Theoretically, the producer could provide the guarantee either in his home Member State or in the purchaser's. The advantage of providing it in his home Member State is that the producer did not have to contact any foreign institutions but could comply with this duty rather easily. But there are some disadvantages which are an obstacle to that as shown below.

The directive aims at a return of WEEE free of charge (Art. 5 (2) WEEE). Hence, in terms of cross-border trade the WEEE will likely be given back in the purchaser's Member State, also in order to save any further transportation expenses. This implies that the treatment of waste will in most cases take place in the purchaser's country.[77] Therewith a person within the purchaser's Member State will be dependent on the financial guarantee given according to the rules, namely the one executing the environmentally sound treatment and disposal in line with Art. 6 WEEE. As the guarantee's purpose is to refund the waste treatment, its funds need to be available for this particular disposer. If the guarantee is provided in the producer's country, the disposer will be refunded only with help of a cross-border entitlement as the money he needs, still is in the producer's Member State. So it seems to be more probable, that the guarantee must be given in the purchaser's country in order to avoid the construction of a cross-border entitlement. Indeed,

[77] To give the right incentives for an environmentally sound product design the financial guarantee must be calculated on the basis of real waste costs. That means the waste management costs in the purchasers country must be taken as a basis for the guarantee.

this is possible only unless it impinges on the basic principle of the free movement of goods and services.

Another argument in favor of the opinion, that the guarantee should be provided in the purchaser's country, can also be drawn from the wording of Art. 8 (4) WEEE *("comply with the requirements of Art. 8 in the Member State where the purchaser resides")*. According to the WEEE Directive, the provision of the guarantee itself is a requirement of Art. 8 WEEE (see Art. 8 (2) sub (2) WEEE). If now, according to Art. 8 (4) WEEE, the requirements of Art. 8 shall be complied with in the Member State where the purchaser resides; this can only mean that the guarantee must be provided in the purchaser's country.

In any case, by implementing the WEEE Directive, it must be considered that every decision on the guarantee's location will have further effects on both, producers and disposers. These effects must then be regarded on the national level within the respective WEEE legislation.

4.3.1.4 Transboundary Enforcement

Another legal interface derives from the fact that the national WEEE legislations must provide tools which allow the enforcement of product responsibility across borders. If e. g. the Swedish producer refuses to provide the equivalent financial guarantee for the EEE he exported to Italy, enforcement tools must be available which enable national authorities to enforce the duty of providing this guarantee against the Swedish producer. Thus, first of all the national implementations must ensure that producers within their home country have to seriously fear the enforcement of such obligations, which base on a foreign legislation. Secondly, it must be decided if the sanctions will be enforced by the national authorities, by the producer's or the purchaser's Member State (see below). This decision requires the participants to consider many aspects parallel to the decision on where to provide the guarantee (see above).

Given that the WEEE will probably be treated within the purchaser's Member State, the enforcement of the equivalent guarantee will be the primary concern of the national authorities of this nation. They will fear the disposal of WEEE as unsorted municipal waste in their home Member State and, thus, these circumstances will probably be a stronger incentive to the national authorities in the purchaser's country than to the ones in the producer's country. In this constellation the national authorities of the purchaser's country have to enforce their national law on the territory of the producer's home country, which is a foreign territory to them. This type of enforcement would mean another break of the principle of territoriality as

authorities don't have the power of authority to enforce their law on a sovereign foreign territory. Staying with the given example, due to the principle of territoriality, Italian authorities would not be able to enforce their national (Italian) WEEE legislation on the Swedish producer, as they do not have the power to enforce Italian law against a person outside Italy.

Alternatively, this enforcement could be realized by the national authorities of the producer's Member State, who do possess the necessary authority power. Of course, in addition to the missing incentive to do so (see above), they would now have to enforce a foreign law against a person within their home territory (the Swedish authorities had to enforce the Italian WEEE regulation against the Swedish producer in Sweden). This new type of cross-border enforcement needs an agreement of the Member States on a coordination of their national authorities in order to establish efficient and effective enforcement procedures.

4.3.2 Practical Interfaces: The Monitoring System (Art. 12 (1) WEEE)

Besides the legal level, impeding interfaces also appear on the practical level where the national legislation has to be applied. In the center of this application is the monitoring system as demanded by Art. 12 (1.2) WEEE. It is meant to enable the evaluation of compliance with the requirements from Art. 8 (4) WEEE. According to Art. 12 (1) WEEE, this monitoring system must be installed in every Member State.

In terms of cross-border trade, monitoring systems of two different Member States will have to interact. It is obvious that this interaction requires at least a certain degree of compatibility of the two systems. From a technical point of view, the easiest way of course would be the existence of identical or at least highly similar monitoring systems in every Member State (also suggested by Fischer (2004: 14)).

In order to enable the tracing of WEEE streams across Europe, data must be collected when EEE is put on the market and when given back and treated as WEEE.

Assuming that the monitoring systems of different Member States will not be completely identical, predefinitions must be made with respect to these data and their handling. In so far, it can already be stated that tracing will be possible only by means of a well organized data management system. This requires that the data will be processed or at least standardized by central institutions (clearinghouses) which could either be established within every single Member State or on EU level. Independently from their organization in detail (which will be referred to in chapter 4.2), equivalent data have to

be notified to these central institutions when EEE is put on the market and when it is given back as WEEE.

4.3.2.1 Data to be Notified when EEE is Put on the Market

Art. 11 (2) WEEE demands that any producer of an electrical or electronic appliance put on the market after 13 August 2005 be clearly identifiable by a label on the appliance. Furthermore, it is necessary that producers are enrolled in the register according to Art. 12 (1) WEEE. Additionally, Art. 8 (2) requires that each producer provides a guarantee when placing a product on the market. However, the directive does not provide any information with respect to the perceptibility of this information for consumers. In order to create a special incentive for producers to comply with these demands, perceptibility of this information for customers should be assured by means of the national legislation. Also with respect to recital No. 15 WEEE stating that consumers have to actively contribute to the success of this system, consumers' knowledge of these information could be meaningful in different ways. Knowing that the producer has provided the guarantee, the customer could conclude that waste from appliances of this producer will be treated according to the rules unless the verification of the guarantee was forged. The proof that the guarantee was given properly only consists in the producer's enrollment in the national register. This implies that customers need to have access to the registration data as well. Therewith, the unequivocal mark of EEE shall contain both, an identification of the producer (producer ID) and a verification of the given guarantee.

In addition, the monitoring system requires information on the categories of the traded EEE as specified in Annex IB of the directive. This information, which becomes important in terms of the waste treatment, is also part of the identification of an appliance and should therefore be presented on the mark as well.

Finally, Art. 11 (2) WEEE requires a mark on the appliance specifying that it was put on the market after 13 August 2005. Indeed, it also states that this information shall enable the date upon which the appliance was put on the market to be determined unequivocally. Therefore it is not enough to know if the appliances were sold before or after 13 August 2005; the precise date would be necessary. The knowledge about the precise date is also needed with respect to the verification if under the WEEE regime lifetimes of EEE will increase. Therefore, national legislations should ask for the precise date when EEE was put on the market.

Recapitulating, when EEE is put on the market, producers need to be enrolled in the register, must have provided the financial guarantee, and need

to show when and what category of EEE was sold. This information needs to be observed by the monitoring system and has, therefore, to be notified to the competent central institution. In addition, consumers' knowledge thereof could give an incentive to producers to comply with these requirements. Therefore the information should also be perceptive for consumers. This is why they should be presented within the unequivocal mark of EEE which is required by Art. 11 (2) WEEE.

As an EU wide monitoring system needs the readability of these marks in every Member State, they have to be at least compatible within the whole union. Therefore a certain level of standardization is necessary.

4.3.2.2 Data to be Notified when EEE is Given Back as WEEE

When the appliances are given back at the end of their lives and turn from EEE into WEEE, the financial guarantee has to stand the test. As prescribed in Art. 8 (2) sub (2) WEEE, it must now serve to finance the management of the WEEE which will probably take place in the purchaser's Member State.

The national WEEE management system has to find out which percentage of the WEEE is derived from foreign producers. Therefore, when WEEE is given back, data about amount, category and the responsible producer (i.e. origin of the appliance) must be notified. The purchaser's state then needs to align these data with the producer specific and guarantee specific data. Details on this exchange depend on which decisions will have been made on the question where to provide the guarantee. If the guarantee is already provided in the purchaser's country, this data exchange does not necessarily have to be a cross-border data exchange. This, however, would also require that the producer be also enrolled in the national register of the purchaser's Member State.

These data can also serve as a basis for a profound estimation of future costs of waste management and to plan the necessary facilitations for collecting and treating the waste in the Member State of the purchaser.

It has to be mentioned again that the structure of the monitoring systems also depends on the implementation of the guarantee. The better the guarantee systems in the single Member States co-operate, the less effort is needed with respect to the monitoring system.

4.3.3 Conclusions with Respect to the Different Interfaces

The B2C-obligation within the WEEE Directive represents a new development in the operating method of legal systems known so far: Firstly, a citi-

zen is subject not only to the legislation of his home country but also to foreign legislation. Indeed, this constellation was known as an exception from the principle of territoriality before, for instance (beside the VAT-System, c.f. chapter 5.1) within social security schemes as also mentioned in the regulation (EEC) No. 1408/71 of the Council of 14 June 1971 on the application of social security schemes to employed persons and their families moving within the Community. Under this regulation it was already possible that a person who was insured in his home country only, could become subject to a foreign health insurance scheme by legal fiction. This exception is limited to emergency cases only in order to guarantee the needed medical treatment and thereby the social security of invalid persons also in another than their home country (Becker 2003: 2275).

However, the second break in the principle of territoriality appears where a foreign legislation is meant to be applicable on the home territory of a person. Regarding the social security example, the person himself moved from one state into another and moved thereby from the purview of one national legislation into another. Also here, as in all legal systems known before, the location of the addressee (*subject of law*) decided on the equivalent legislation to be applied (if the person was in Sweden, no other law than Swedish would have to be applied; if the person had moved to Italy, it would have to be Italian law). Hence, only one national legislation was to be applied at a time. In contrast hereto under the WEEE regime as described above, many different national legislations shall become applicable on the same territory. Moreover, the decision which one is to be applied in a certain case will no longer be dependent on the location of the subject, but on the final location of the traded EEE, which will transform into WEEE later on. This *object of law* turns out to be the crucial condition deciding on the applicability of a certain foreign regulation on the territory of the producer's Member State. Without leaving his home country, the producer will have to comply with WEEE legislations from many foreign Member States. The decision on which legislation is the right one to be applied in a single case could be gained with help of the matrix shown below.

Table 19
The destination of exported EEE decides on the applicability of foreign law in the producer's home Member State (MS)

IF	EEE export to	{*a foreign MS*}	THEN	comply with	{*the nat. legislation of this MS*}
IF	EEE export to	Italy	THEN	comply with	*the Italian WEEE legislation*
IF	EEE export to	*Spain*	THEN	comply with	*the Spanish WEEE legislation*

According to Art. 8 (4)-producers supplying EEE by means of distance communication need to keep track of every destination state they have sent their appliances to. It needs to be elucidated which legal and practical provisions must be fulfilled in order to meet the demands from this particular legal interface.

Thirdly, the enforcement of transnational law also means a violation of the principle of territory. Either the authorities have to enforce their own law on foreign territory wherefore they need the support of the law enforcement authorities of the country of destination. In the other case they have to enforce foreign law against a person within their home territory. Both forms need completely different institutions and incentives for all actors involved.

In the light of this background it becomes evident, that the WEEE Directive has left a broad need for adaptation in form and content between all affected organizations and actors. Particular problems rise from the number of uncertainties appearing on many different levels which can mutually hamper an effective implementation process. For instance, as long as it is not mutually decided by all Member States where the guarantee shall be given and in which national register the distance seller has to enroll, it is impossible to develop a sufficient data design for the monitoring system. This opacity may also be continued on the national level as it has been described in the final report of the IMPEL better legislation project: "If legislation is initially unclear […] the usual practice of Member States has been to adopt much of it word for word into national legislation, including terms that lack clarity." (IMPEL 2003: 17, 18). Therefore, it has to be feared that Member States, instead of gaining a common decision on these questions, could transpose these obligations by simply demanding what is already demanded in the directive itself: that all producers must give a guarantee and must be registered and that distance sellers need to comply with these requirements in the purchaser's country. Thus, the basic decisions needed to evoke EU-wide product responsibility would still not be taken because of a vast and unsorted need for harmonization between all types of institutions (national legislators, national authorities, national systems, standardization institutions …) in the Member States.

This new type of cross-border enforcement needs to be sorted out conscientiously before implementing the directive.

Therefore, when attempting to transpose the WEEE Directive into national law, national governments need to consider all the interdependencies mentioned so far, in order to realize step by step both, the different interfaces themselves and the numerous impediments they can cause when they are not thought-out well. Only then can regulatory options and coordinative measures in order to overcome the identified impediments be developed.

4.4. Regulatory Options and Coordinative Measures

In the following paragraph, suggestions will be made how to handle the identified interface problems under the existing WEEE Directive. In a first step solutions for the problem will be put forward and discussed. Then it will be shown which actors would be competent for the proposed solutions (Table 19).

4.4.1 Solutions to the Legal Interface Problems

4.4.1.1 Proposals Regarding "The Art. 8 (4) WEEE Problem"

With reference to Art. 8 (4) WEEE three legal problems have to be discussed in detail.

Firstly, it can be argued that the transposition of Art. 8 (4) WEEE by instituting a duty on the domestic cross-border "B2C-producer" to obey the law of the purchaser's state may conflict with the constitutional principle of territoriality as a generally accepted principles of international law. This argument is in the context of WEEE not very striking since a transposition of an EC directive is at stake[78].

Against this background it is – secondly – questionable from a regulatory-technical point of view whether a conflict with the principle of territoriality is to be envisaged since the transposition of Art. 8 (4) can be realized by means of a legal command within the WEEE transformation of every Member State, validating the WEEE transformation of the other Member States. Hence the legal order to the domestic citizen derives from the national legislator saying that the Art. 8 (2)-guarantee is to be given under the national transposition of the purchaser's country.

> Technically, e.g. from a German point of view, the following stepwise approach could be used: The German law, deriving from the WEEE transposition, contains – beside a provision transforming the

[78] In the literature it has been shown that the application of this principle is always combined with the danger to hinder a state's integration into international communities inadequately and by that to antagonise a needed opening of the national legal order (Becker 2003: 2272; Louven/Louven 1991: 500, 501). So exceptions from this principle seem to be proportionate where the nation's interest in its sovereignty is preponderated by its interest in being integrated successfully into an international community. Apart from that, exceptions have already been made, where the application of this principle has obviously hampered the Art. 18 EC right to move and reside freely (e. g. in Art. 22 (1) and 3 of the regulation (EEC) No. 1408/71 of the Council of 14 June 1971 on the application of social security schemes to employed persons and their families moving within the Community).

Art. 8 (4) – in addition an enabling statute[79] with respect to the competent Federal Ministry in order to officially publish the relevant WEEE-legislation from every other Member State within the Federal Register. From the perspective of the producer it will reduce transaction costs if every publication in here has to be translated into German before.

In order to avoid multiplied translation efforts, a central translation and exchanging service could be established with the support of the Commission or the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL). The latter is experienced at ensuring a more effective application of environmental legislation, and therewith also familiar with specific problems resulting from transposing European directives into national legislation. As a result of such a central translation service every producer will have direct access to the relevant WEEE legislation of every other Member State with relatively low transaction costs.

Finally, it must be examined whether the transposition of Art. 8 (4) WEEE will lead to a conflict with the constitutional principles of clarity, legal coherence and consistency. At first, the applicability of different foreign legislations on the territory of the producer's Member State at the same time seem to impinge on the principle of legal coherence. This usually guarantees the addressee of a law that, within a single territory, he has to comply with one specific regulation only so that he can easily see which law is applicable to him. Indeed, when amplifying the producer's situation it becomes clear that, with respect to a certain exported appliance, he has to comply with one certain legislation only: The destination of the exported device decides on the legislation that has to be complied with. As EEE can have one destination only, the producer also must comply with one specific legislation only, namely the one that is valid in a given location. Thus, once this decision has been made, by finding out in which Member State the EEE is finally located, no conflict with the principle of legal coherence can be affirmed. The only problem remaining is the challenge for producers to obtain the respective foreign legislation in a language they can understand.

Succeeding to these proposals, all constitutional and democratic requirements are met. In such a way all identified legal interface problem could be solved.

[79] Optionally, the opportunity for an official statement could be given to the Lower House of the Federal German Parliament before the publication, so that its function as legislature was secured as well.

4.4.1.2 Proposals Regarding Cross-border Enforcement

Regarding the challenge of cross-border enforcement, the transposition of the WEEE Directive must ensure that a uniform decision will be made on the question which national authorities will be competent for the respective enforcement: the national authorities in the purchaser's state, who then would have to enforce their national law on the territory of the producer's Member State which is foreign to them (possibility no. 1); or alternatively the national authorities of the producer's Member State who could act with the needed sovereignty but who then would be in charge of applying foreign law within their home Member State (possibility no.2).

Since enforcement by public law in a foreign state always needs the assistance of the authorities in the producers state, the second possibility is preferable[80].

Whatever the decision will be, it will create a new demand for training the European enforcement officers who act on behalf of their national authorities. They firstly must become aware of this new situation in which they either have to enforce their national law on a foreign territory (possibility no. 1), or in which they have to sanction breaches of foreign legislations in their home Member State (possibility no. 2). In any case, this type of enforcement requires the officers' familiarity with the specific WEEE legislation of every single Member State. This can be reached only by a high degree of international exchange with their colleagues from every other foreign authority. Moreover, international coordination and official assistance between these national authorities are necessary. With regard to the efforts essential to establish this coordination, a central organization would be helpful. Here also, IMPEL, with its expertise and experience especially in the field of enforcement, could serve as coordinating institute.

4.4.2 Proposal for the Solution to Practical Interface Problems

The solution to the practical interface problems requires substantial effort on different organizational levels. Of great importance is also the problem of transnational data transfer.

4.4.2.1 Organizational Questions

Firstly, the unequivocal mark of EEE must be realized technically. With respect to recital No. 4 WEEE, this standardized labeling should already be

[80] This solution also is in line with the VAT-system concerning direct transboundary trade, c.f. chapter 5.1.

developed in the light of future demand, i.e. it should allow the collection of all necessary data for life-cycle analysis. This demand could be met by a technology called "Radio Frequency Identification" (RFID-tags). These tags or any other unique mark have to be attached to each appliance inseparably during the production process at the latest when the EEE is put on the market. As these marks need to be read within every Member State, they have to be standardized within the Union.

At this point, it must be decided which organization shall execute this standardization process. As mentioned before, this could be the European Committee for Electrotechnical Standardization (CENELEC). Of course, such a decision had to be taken on the European legislative level and in case CENELEC is chosen, an official mandate from the Commission is necessary[81].

Further, technical details on how to provide the guarantee must be defined. A practical strategy could be as follows: After the producer has provided his guarantee to the competent institution within the purchaser's state, he receives an official guarantee number (verification) from there (as described in chapter 3.1.3). The verification could be arranged as a combination from letters and numbers, indicating the EEEs' destination state. For example, a Swedish producer who wants to export EEE to Italy needed "to buy Italian Numbers in Italy" which could look like "IT xxxx". This number had to be presented on the mark of the EEE when put on the market. In case the appliance is too small, or the presentation is impossible due to other reasons, this number must be presented to the customer by other means, e.g. by printing it on the bill. In any case, the number must be visible to the customer, in order to be able to recognize that the producer at least seems to have provided the guarantee.

As the customer can be sure of this guarantee only, i.e. if the producer has enrolled in the national register, this information must also be perceptible to the customer. This could be reached by the following method: Enrolling into the national register, producers could receive an EU-wide WEEE specific registration number (e.g. "WEEE xxxxxx"). This identification number, that could be part of the producer's corporate identity and therefore appear whenever he acts on business (e.g. on business papers, on the company's website …) allows the customer to rely on the guarantee verification. Alternatively, the national register could also be published on an official website.

[81] The existing mandate to CENELEC would have to be examined whether it is sufficient for the standardization of the uniform label.

Moreover, the same technical aspects have to be defined with respect to the usage of the financial guarantee when the appliances are given back as WEEE. Therefore the verification number must be scanned from the WEEE into the monitoring system of the purchaser's country. Then the responsible producer can decide if he wants to take back the WEEE and treat it himself or if his financial guarantee shall be used in order to finance the treatment. If he decides on the former, his verification number will be deleted from the competent institute and he will not have any further obligations to comply with. If he decides on the latter, he has to finance the treatment of the WEEE resulting from his product within the purchaser's country (according to Art. 8 (4) WEEE). Therefore the foreign disposer will make a draft on his financial guarantee.

Indeed, all the technical and organizational aspects mentioned so far will be realized only if the respective actors are obliged to do so. This is why the relevant legislative systems (national and European) have to prescribe these technical and organizational details. Certainly, these detailed prescriptions need to be in line with broader legal principles. For instance, with regard to the fundamental principle of the free movement of goods and services, it is not possible to prescribe a special technique used for the unequivocal mark (e. g. RFID). Also the prescription of a certain type of guarantee on the level of national legislation is possible only in line with Art. 8 WEEE[82].

Technical and organizational demands which can and must be prescribed by the national legislation are:

1. details on the needed content of the unequivocal mark on EEE (producer ID, guarantee verification, EEE category (ANNEX IB), date when product was put on the market[83]);

2. details on how to provide the financial guarantee:
   - procedure ("bargain" of verification numbers),
   - arrangement (WEEE specific registration number),
   - institution in charge (national authority or private organization),
   - perceptibility of the identification/registration number to customers and organizations thereof (e. g. publication of the national register

[82] As specified in Art. 8 (2) sub (2) the guarantee can be given in different forms (in appropriate schemes for the financing of the management of WEEE, a recycling insurance or a blocked bank account).

[83] For the reasons see chapter 4.3.2.1.

of the identification numbers and producers' duty to show the registration number as part of their corporate identity);

3. details on how to "use" the financial guarantee when WEEE is given back:
   - technical procedure (e.g. scanning of verification numbers),
   - enforcement of the guarantee (e.g. if foreign legislation in the home country, or the national legislation in foreign countries is applicable).

4.4.2.2 Organization of the Data Transfer

Moreover, the national legislation must prescribe that certain data have to be notified to the competent clearinghouse in order to enable an effective and efficient data management across borders. Indeed, before these prescriptions can be realized, Member States have to agree on one of the following three versions these clearinghouses could be realized in. This suggests, before the transposition of the WEEE Directive into national legislation can begin, major consultations between the Member States are necessary, in order to decide on one of these versions. All of them presume that every Member State has its own national clearinghouse, which will process data notified from the producers. Differences consist with regard to the data exchange, which could be executed between national clearinghouses directly or with help of an additional Central European Clearinghouse.

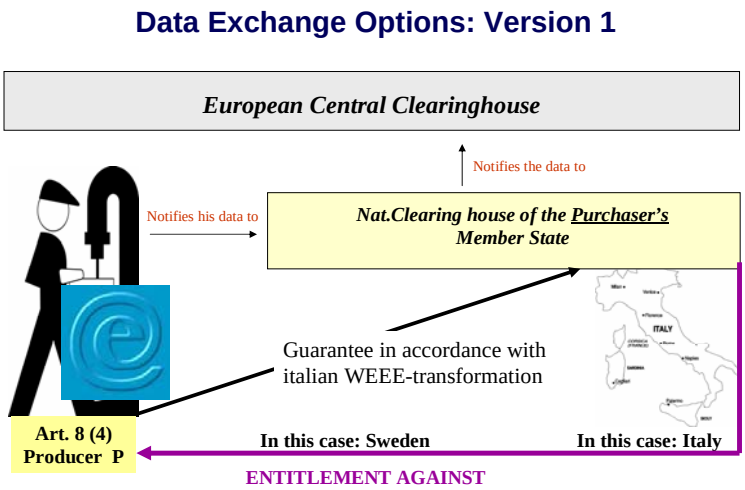
In version 1 (Figure 23), the producer notifies data on the amount and category of the EEE he put on the market of a foreign Member State to the national clearinghouse of the purchaser's Member State. This includes providing financial guarantee for the waste management of WEEE, with respect to the legal provisions of the purchasers´ Member State. These data are then forwarded to a European clearinghouse, which acts as an EU wide coordination center and will harmonize all data from different Member States. Thereby the European Clearinghouse, which receives data from all national clearinghouses, provides an EU-wide overview on all products as well as waste flows.

Disposers who treat WEEE in the purchaser's country have to identify the responsible producer by means of the verification number on the WEEE. Later, they have to refer to their national "home clearinghouse" in order to get their disposal costs compensated. The "home clearinghouse" then has to enforce these financial demands against the responsible producers on the basis of their provided guarantees.

Concerning the data stream and the guarantee there is a direct interaction between Art. 8 (4)-producer with the WEEE-system of the purchasers country. It can be advantageous that the data are given directly to the authority in charge of the financial guarantee of the waste management. The disadvantage of this version is the producers interacting with National Clearinghouses in 24 foreign countries into which they export their EEE by means of B2C-trade. They have to know the legislation of all these Member States and to deal with foreign languages. Thus, this version requires high administrative and intellectual efforts and high expenses for the producers, not only with respect to the needed efforts in translating. In addition it is more difficult to verify the given data, because for the authorities in the countries of

Figure 23
Data exchange options regarding the organization of clearinghouses: version 1

Data Exchange: Version 1



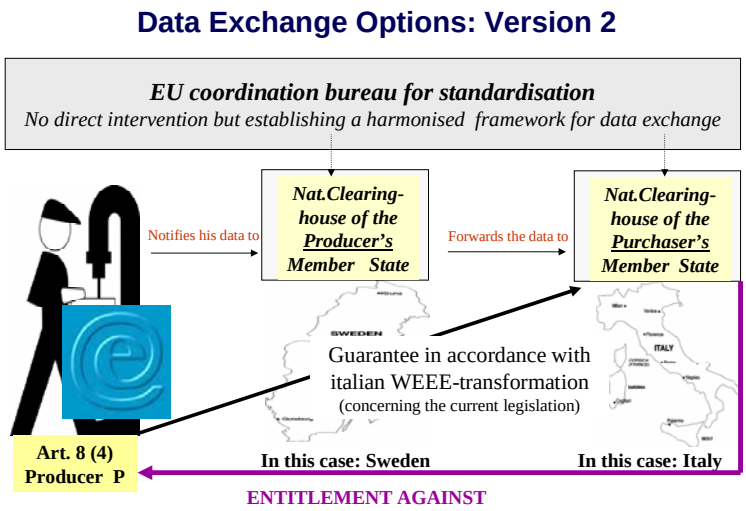
destination it might be problematic to estimate whether the data of the producers of the origin countries are plausible and to identify free-riders. It will also be difficult to secure technical adaptations in the different Member States (e. g. ensuring that producers will be able to use harmonized data models, software …). Further on, this version is also very demanding to the

national clearinghouses, which have to deal with producers from up to 24 different countries.

In version 2 (Figure 24), the Art. 8 (4)-producer is obliged to notify the data about amounts and categories of his products to his national clearinghouse only. This is then in charge of forwarding these data to the particular clearing house of the purchaser's Member State. Obvious advantage of this version is the direct interaction between producer and his own national clearing house as well as the lower administrative costs levied upon producers. At the same time compliance can be monitored more easily. Problematic could be that the national clearing house has little incentive to ensure compliance with the law of another Member State.

Figure 24
Data exchange options regarding the organization of clearinghouses: version 2

Data Exchange: Version 2



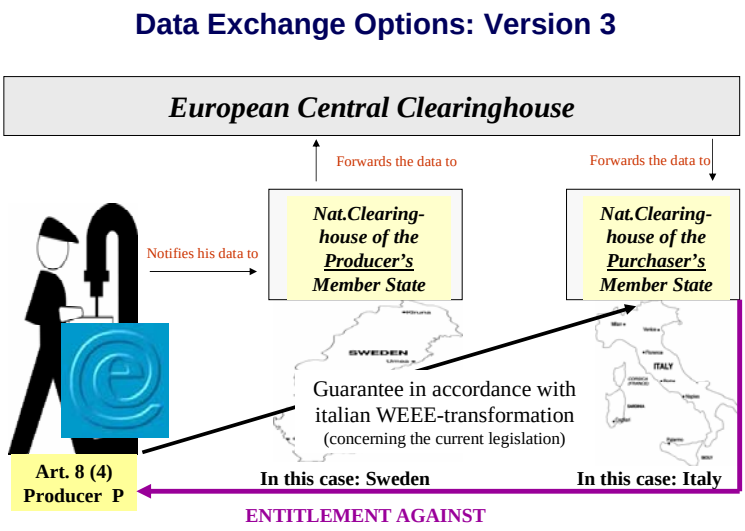
By the current legislation the producer has to interact with the authorities of the purchasers´ country by giving the guarantee. This can be avoided only by a modified legislation, i.e. analogous to the VAT legislation (see chapter 4.5.1).

In this version, there is a much need for coordination between the national Clearinghouses of the Member States concerning the data streams. All im-

mediate harmonization activities are left to these national clearinghouses. In this case, the central EU institution merely serves as coordination bureau for EU wide standardization, establishing the harmonized framework for data exchange without any direct intervention into the system. Apparently, this version charges the national clearinghouses with high administrative efforts of being in touch with the national clearinghouse of every other Member State.

Figure 25
Data exchange options regarding the organization of clearinghouses: version 3

Data Exchange: Version 3



In version 3 the Art. 8 (4)-producer's obligations stay the same (notification of data to his national clearing house only), but the essential data alignment is now executed by a European Central Clearinghouse (Figure 25).

The settlement of the core harmonization actions at EU level implies the following advantages: Firstly, direct access to all relevant data would be possible at EU level with only minimum time delay. Secondly, the data streams could be used for the report from the single Member States to the European Commission as requested by Art. 12 sec. 1 subsection 3 WEEE. Finally, in this version possible defects in the aspired controlling of the addressees of the WEEE Directive could become transparent much faster.

By the current legislation the producer has – like in version 2 – nevertheless, to interact with the authorities of the purchasers´ country by giving the guarantee. This could be avoided only by a modified legislation i.e. analogous to the VAT legislation (chapt. 4.5.1).

In conclusion, version 3 offers some advantages. The decision which version should be favored depends on the political decision whether the necessary degree of harmonization including the fiscal compensation between Member States shall be provided by the national clearinghouse of each Member State or by an European Central Clearinghouse. Whatever the decision will be, the existence of an EU-wide harmonized framework is a crucial precondition to the implementation of EU-wide producer responsibility for WEEE.

Once this political decision is made the national legislation has to define a number of specific details regarding its national clearinghouse. Thereby, it must be decided on the legal form (sovereign or private), on the competences and warranties it should have and how it will be financed.

In addition, legislation on the national level must also stipulate sanctions in line with Art. 15 WEEE which can be carried out against possible attempts to circumvent the cross-border product responsibility.

4.4.3 Approaches to Solve the Problems of Transnational Law Making

In the following the actors and tasks in solving the WEEE-Art. 8(4)-problem are shown (see Table 20 below). The approach is based on the potential transposition of the WEEE like shown in version 3, with national Clearinghouses in every Member State and a European Central Clearinghouse, because of the advantages of this version.

Table 20
Actors and tasks in solving the WEEE-Art. 8 (4) problem

	Registration of Producers* in the Purchaser's MS	Guarantee Provision within the Producer's MS	Guarantee Provision within the Purchaser's MS	Organization of EEE Data when put on the market of the Purchaser's MS	Organization of WEEE Data when entering the waste management in the Purchaser's MS	Guarantee Enforcement in the Producer's MS
EU Legislation		be modified **				
Nat. Legislation in the Producer's MS	refer to ↓	refer to ↓	refer to ↓	refer to ↓	refer to ↓	
Nat. Legislation in the Purchaser's MS	prescribe	prescribe	prescrive	prescribe which data have to be notified	prescribe which data have to be notified	
IMPEL	coordinates the implementation and enforcement	coordinates the implementation and enforcement	coordinates the implementation and enforcement			coordinates a common framework + information exchange
CENELEC				standardizes the technical aspects of these 2 elements which are part of the mark of EEE		
EU Clearing House	has to monitor	has to monitor	has to monitor	standardizes exchangeable data format and monitors data streams		
Nat. Authorities in the Purchaser's MS	have to check	have to observe	have to check			realize
Nat. Authorities in the Producer's MS	have to observe	have to check	have to observe			assist in realizing
Private Institutions in the Purchaser's MS	have to observe	have to observe	have to observe	have to gather and organize data	have to gather and organize data	Realize
Private Institutions in the Producer's MS	have to observe	have to observe	have to observe	have to gather and organize data	have to gather and organize data	assist in realizing
Nat. Waste Management Systems					read producer specific and waste specific information from the unequivocal mark → result: allocation of costs to responsible producers	
Producers*	have to register	have to provide	have to provide	have to notify		have to finance waste treatment
Consumers	can control	can control	can control			

* Producer in this context exclusively means Producers supplying EEE across borders between Member States by means of distance communication [Art. 8 (4) producer]. – ** The WEEE Directive has to be modified (i.e. according to the VAT legislation, c.f. chapter 5.1) if the guarantee shall be given by the producer to the national authority in the producer's country.

4.5. Recommendations

As a result, the following recommendations can be made:

4.5.1 Recommendations with Respect to Legislation on the European Level

With respect to the legislation on the European level more precise defaults relating to the core of the WEEE regime and the monitoring system would be helpful. Indeed, such a strategy could lead to an infringement with the directive's nature as set out in Art. 249 (3) EC. On the other hand it was already stated within the WEEE Directive that essential criteria should be laid down at Community level (recital No. 8 WEEE). Moreover, Member States cannot benefit from a directive's legislative flexibility any more when this leads to harmonization efforts, which are impossible to be realized on the Member States' level as it is the case here. Especially the need for unitary decisions of all Member States (as on the questions which version of monitoring system is needed, where distance sellers have to provide their financial guarantee and which national register they have to enroll in) show that on these items a European decision is necessary. This could have been provided in a specific framework under the WEEE Directive, or even within a regulation. In any case the specific effects resulting from the "Art. 8 (4) demand" need to be rethought in order to find out how its harmonized transformation into national law can be realized by Member States.

Where uncertainties can appear on many different levels and lead to a mutual obstruction in the implementation process, this danger must already be identified while designing the directive. It must then provide a defined procedure arranging the order in which the uncertainties have to be eliminated. Without that, every actor involved may wait for the other to start.

The legal provisions concerning the financial guarantee and the marking of the products are essential to enforce producer responsibility. But these provisions might not be sufficient to realize individual producer responsibility in a way to give adequate incentives to producers for improving their product design. Individual producer responsibility can be achieved only if there will be a producer specific cost allocation of the waste management costs. Like first approaches concerning the implementation of the directive on national level reveal, there are only little incentives to realize a producer specific cost allocation because of the additional substantial efforts necessary like recording every waste product, tracing the respective producer and the knowledge of the producer specific costs of each product group. So if effective results concerning the improvement of the product design are achieved, and the additional costs seem to be reasonable, additional legal

proposals are reasonable. The provision concerning the producer specific cost allocation of the waste management costs has to be laid down at Community level, to secure that all Member States will incorporate this approach.

To ensure that the notification of the product streams as well as the provision of the guarantee – in accordance with the Member State of destination – can be given to the national Clearinghouse of the producer´s country, the WEEE Directive has to be modified. The new design could be realized i.e. along the lines of the European Scheme on Value Added Tax Directive (VAT-Directive[84]) and its application to distance trade in the Member States (in Germany: § 3c Umsatzsteuergesetz 1999). According to the provisions of this regulation exported products are not taxed in the state of origin but in the state of destination. Within the state of destination all products are taxed at the same rate. The supplier is obliged to transfer the specific VAT of the purchasers' country to the authorities of his residential state. A transfer system is established between the tax authorities of Member States.

This approach ensures neutrality of the tax system despite differing national tax rates of the VAT (Reiß 1999: 127), reduces the transaction costs of the suppliers and allows an enforcement within the given national administrative system.

Transferring this approach to WEEE, a producer exporting in other Member States must be held responsible for the disposal costs in the country of destination. Within a Member State the disposal cost are roughly the same, but across countries they vary depending on the institutional setup of the system of collection, as well as on provisions regarding the disposal itself. In such a system, a precise monitoring must provide information on all products exported within a certain period. In order to do so, all appliances must be tagged to allow tracking the producers, who then are held liable for the disposal costs of their products. In analogy to the European VAT-system it is possible to introduce also a clearing system as well as minimum thresholds of exported products among the Member States to avoid excessive bureaucracy.

A central translation and exchanging service should be established with the help of the Commission or the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) in order to avoid multiplied translation efforts. With such a central translation service, every

[84] The Council Directive (2001/115/EC) regarding invoicing requirements for the Member States is intended to simplify and harmonize VAT regulations across the Member States. Businesses operating in EU Member States should have simplified invoicing regulations and procedures harmonized at EU Community level as of January 2004.

producer will have direct access to the relevant WEEE legislation of every other Member State with relative low transaction costs.

4.5.2 Recommendations with Respect to National Legislation

It was shown before, that the transposition of Art. 8 (4) WEEE will not lead to a conflict with the constitutional principles of clarity, legal coherence and consistency. The destination of the exported devices shall decide on the legislation that has to be complied with. Thus, the producer must comply with one specific legislation only (the legislation of the purchaser's Member State). Once this decision has been made by finding out in which Member State the EEE is located finally, no conflict with the principle of legal coherence can be affirmed.

Regarding the legislation on the national level, it has become evident that the transposition of a directive with reference to transnational law making cannot succeed by Member States acting individually. Therefore, the need for early interactions between Member States should be considered already while designing the directive, providing defined procedures in order to organize and promote communication.

Regarding the challenge of cross-border enforcement, the transposition of the WEEE Directive must ensure that a uniform decision will be made on the question which national authorities will be competent for the respective enforcement. If the individual producer responsibility will be generally enforced in all Member States, all producers have to be registered, all products have to be marked and a financial guarantee has to be provided. This could be done in the producers` country (including the guarantee only if Art 8 (4) of the WEEE Directive is changed accordingly). In this case, the national authorities of the producer's Member State would act with the needed sovereignty, but would then be in charge of applying foreign law within their home Member State. This type of enforcement requires the officers' familiarity with the specific WEEE legislation of every Member State. With respect to cross-border enforcement of national legislation the need for coordination on the EC-Level became evident. Only on this level the necessary exchange between authorities of Member States can be realized. Moreover, the adaptation of technical aspects, such as central translations of national legislation, can be provided only here.

4.5.3 Recommendations Concerning the Role of Producers and Private Systems

Under the WEEE regime, especially under national legislation deriving from transposing Art. 8 (4) WEEE, producers need a good regulatory un-

derstanding in order to find out which legislation they have to comply with. This firstly requires producers' readiness to admit to transnational legislation at all. Even if some producers may do so, it cannot be expected that they will become legal experts. This is why it will be likely that most producers will need assistance in finding out which legislation they have to comply with. Industry associations should prepare in order to provide this assistance.

In order to comply with the WEEE Directive, Germany plans to set up a "Joint Center" to be organized and financed by the producers that will operate as an agent of the state. The "Joint Center" registers all producers and organizes the monitoring process. Within such a setup conflicts among the producers and the office will be less likely as within a solely state-operated agency. This could have the advantage that information will be shared more extensively while state administration will be relieved of an additional duty. At the same time, such a privately organized system needs to double-check incentives for all actors in order to ensure compliance with the directive. Such incentives can be enhanced through transparency of registration on the web, as well as by establishing an open system of tracing product flows across borders given that a large share of market for electrical and electronic appliances is consumer oriented and easily influenced by consumer awareness.

4.5.4 Recommendations Concerning the Role of Consumers

WEEE provides appropriate measures, which shall be adopted by the Member States to encourage consumers to participate in the collection of WEEE and to facilitate the process of re-use, treatment and recovery (recital No. 15 and Art. 10 (2)). Against this background, the national legislation should secure that consumers have access to all data needed to evaluate whether an Art. 8 (4)-producer complies with the basic demands from the WEEE Directive (especially the registration of producers and the guarantee verification).

As a result, consumers and consumer organizations can be enabled to control the functionality of the guarantee system, e.g. by means of testing purchases in order to find out if the declared information can be confirmed. Moreover, the transparency resulting from this data access should not only avoid the trade of appliances without any given guarantee (free-riders), but also informed consumers can consciously decide which producer they want to trade with.

4.6. The Approach of the Directive on Batteries and the Directive on Packaging and Packaging Waste

4.6.1 Directive on Batteries

4.6.1.1 Background

The EU-market for batteries amounts to 870,000 tons of automotive batteries and accumulators, mainly lead-acid batteries. About 190,000 tones of industrial batteries and accumulators were sold in 2002, mostly lead-acid batteries and accumulators (96%) and a small percentage of industrial nickel-cadmium (NiCd) batteries (2%). Additionally up to 160,000 tones of portable consumer batteries and accumulators, approximately 72% non-rechargeable portable batteries and 28% rechargeable batteries have been placed on the market every year. These batteries contain metals, which might pollute the environment at the end of their life cycle. Mercury, lead and cadmium are seen as most dangerous substances.

4.6.1.2 The Current Legislation and the New Proposal

The Commission has prepared a revised version of the 1991 Directive on Batteries and Accumulators. This new legislation will replace the current legislation concerning the management of spent batteries, which is regulated by the Council Directive 91/157/EEC on batteries and accumulators containing certain dangerous substances as amended by Commission Directive 98/101/EC. This Directive was supplemented by Commission Directive 93/86/EEC laying down marking requirements for batteries and accumulators covered by Directive 91/157/EEC, which addresses the issues of their separate collection and heavy metal content.

The current legislation does not prescribe measurable and verifiable instruments in order to prevent uncontrolled disposal of batteries and accumulators into the environment. As a result, Directive 91/157/EEC brought about an harmonization of the laws of the Member States. But there are divergent approaches in the Member States, and the overall collection efficiency of spent batteries and accumulators in the Community is very low. Thus, in 2002, out of the 160,000 tones of portable batteries and accumulators sold in the EU, more than 70,000 tones (45.5 %) went to final disposal like landfill or incineration. In addition, the current legislation raises several concerns about the environmental risks and the little effectiveness of battery management. This means, it only covers batteries and accumulators containing *certain* but not all types of metals, thereby reducing the effective waste management of *all* batteries. Further, the current legislation only limits the marketing of batteries and accumulators containing more than 0.0005% mer-

cury from January 2001, although all battery types emit heavy metals when not properly recycled. And it does not contribute to a reduction of the disparities between national systems for collecting and recycling systems for batteries.

Thus, the objectives of the provisions have not been fully obtained. Also, Directive 2002/96 on waste electrical and electronic equipment (WEEE Directive) underlines that there is still need to revise the current battery Directive.

The draft Directive (Proposal for a Directive of the European Parliament and of the Council on Batteries and accumulators and spent Batteries and Accumulators (2003/0282 (COD)) adopted on 21 November 2003 sets minimum rules for national collection and recycling schemes in particular, the draft Directive demands the collection and treatment of *all* batteries and not only of the hazardous batteries. The objectives of the directive are to ban the land filling or incineration of all portable, automotive and industrial batteries; to set up national collection systems allowing consumers a return of their spent batteries free of charge and to set a collection target for consumer batteries of 160g per inhabitant per year (corresponding to 4-5 portable batteries per person per year). Furthermore, the producers shall be made responsible for costs related to collection, treatment and recycling.

The background of this Proposal is the Sixth Community Environment Action Program (6 EAP) which lays down the key environmental objectives and priorities for the next ten years starting 22 July 2002. To support the sustainable use and management of natural resources and waste, the 6 EAP (Article 8 (1) third and fourth indent of the 6 EAP) identifies four specific objectives, including *"a significant reduction in the quantity of waste going to disposal and the volumes of hazardous waste produced, while avoiding an increase of emissions to air, water and soil"* and *"encouraging re-use for wastes that are still generated: the level of their hazardousness should be reduced and they should present as little risk as possible, preference should be given to recovery and especially recycling; the quantity of waste for disposal should be minimized and should be safely disposed of (…)."* The proposal is also based on the Community Strategy for waste management of 30 July 1996 (COM (96)399 final, 30.7.1996), which stresses the need to reduce the quantities of hazardous substances in production processes and waste.

The policy instrument now chosen is a new directive which will establish an EU-wide framework for national battery and accumulator collection and recycling schemes, and guarantee the proper functioning of the internal market in these products. The directive leaves it up to the Member States to choose the most appropriate implementation measure at the lowest compliance cost. Hence, Member States can use existing collection infrastructure,

for the collection of spent batteries and accumulators, or infrastructure which are already or will be set up under other pieces of Community legislation such as Directive 2000/53/EC on end-of-life vehicles and Directive 2002/96/EC on waste electrical and electronic equipment.

4.6.1.3 The Proposition of a Transnational Valid Producer Responsibility in the WEEE and in the Battery Directive

In view of the question of transnational law making one has to differentiate between the producer responsibility within the legislation of the WEEE Directive and the producer responsibility in the battery directive. The WEEE Directive stipulates individual producer responsibility which can function only if it can be enforced transnationally. Article 8, para. 4 demands that the producer comply with the legislation of the purchasers' Member State: "*Member States shall ensure that producers supplying electrical or electronic equipment by means of distance communication also comply with the requirements set out in this Article for the equipment supplied in the Member State where the purchaser of that equipment resides.*" (Directive 2002/96, Art. 8, para. 4). And under recital No. 9 it says: "*The provisions of this Directive should apply to products and producers irrespective of the selling technique, including distance and electronic selling. In this connection the obligations of producers and distributors using distance and electronic selling channels should, as far as is practicable, take the same form and should be enforced in the same way in order to avoid other distribution channels having to bear the costs of the provisions of this Directive concerning WEEE for which the equipment was sold by distant or electronic selling.*" The Proposal of the battery directive is far less precise. Though the definition of the term of producer in the directive includes – analogical to the WEEE – the B2C e-commerce across borders ("*the selling technique …, including by means of distance communication")*, there is no further instruction whether and how the producer will comply with the legislation of the purchasers country. Concerning the financing of the management the proposal says: "*Basic principles for financing the management of spent batteries and accumulators should be set at Community level. Financing schemes should help to achieve high collection and recycling rates and to implement the producer responsibility principle.*" (Recital 13). On financing the waste management of the batteries Article 22 of the proposal reads as follow: "*In line with Directive 2002/96/EC, producers are required to provide a guarantee for the financing of the waste management of batteries and accumulators when placing those products on the Community market. Moreover, Member States should draw up a register of producers placing their products on the national market. These measures should prevent free-riders.*"

Concerning the WEEE Directive, the individual producer responsibility aims to give incentives for a new product design to extend the life cycle, to simplify the disassembling of the equipment and to force the re-use of the components. Thus, the WEEE Directive stipulates a better design *and* wants to secure the financing of the waste management by the producer. The battery directive predominantly wants the latter.

4.6.2 Directive on Packaging and Packaging Waste

4.6.2.1 Background

The Packaging Directive[85] aims to harmonize national measures concerning the management of packaging and packaging waste. On the one hand, it wants to prevent any impact thereof on the environment of all Member States as well as of third countries, or to reduce such an impact thus providing a high level of environmental protection, and, on the other hand, to ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition within the Community (Art. 1 (1)). Therefore, the directive lays down measures aimed, as a first priority, at preventing the production of packaging waste and, as additional fundamental principles, at re-using packaging, at recycling and other forms of recovering packaging waste and, hence, at reducing the final disposal of such waste.

The Packaging-Directive of the European Union "covers all packaging placed on the market in the Community and all packaging waste, whether it is used or released at industrial, commercial, office, shop, service, household or any other level, regardless of the material used." (Article 2 (1) Directive 94/62/EC)

Directive 94/62/EC was last amended by the Directive on Packaging and Packaging Waste 2004/12/EC of 11 February 2004 to harmonize national targets for the recycling of packaging waste, taking into account individual circumstances of each Member State, and to provide further clarification on definitions (recital 13). Because these objectives can be better achieved, by reason of the scale of the action, at Community level, the new directive gives i.a. quotes for recovery and recycling. No later than 31 December 2008 the Member States have to attain the following targets (article 6):

- 60% as the minimum weight of packaging waste will be recovered or incinerated at waste incineration plants with energy recovery;

[85] Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, O.J. 1994, L 365 of 31/12/1994, p. 10.

- between 55% as the minimum and 80% as the maximum by weight of packaging waste will be recycled;
- the following minimum recycling targets for materials contained in packaging waste will be attained:
  - 60% of weight for glass;
  - 60% of weight for paper and board;
  - 50% of weight for metals;
  - 22,5% of weight for plastics, counting exclusively material that is recycled back into plastics;
  - 15% of weight for wood.

4.6.2.2 The Producer Responsibility Principle of the Packaging Directive

The Packaging Directive 94/62/EC is generally known as the "first producer responsibility directive", because the Directive put the burden for recovery and recycling on the producer. However, the term "producer responsibility" was not used in the wording of the Directive, and it was not explicitly said that the financing of the prevention, recycling and treatment of waste had to be shouldered by the producer of the waste. Concerning the economic instruments packaging directive 94/62/EC merely says that "*the Council adopts economic instruments to promote the implementation of the objectives set by this Directive. In the absence of such measures, the Member States may, in accordance with the principles governing Community environmental policy, i.a., the* ***polluter-pays principle****, and the obligations arising out of the Treaty, adopt measures to implement those objectives.*" (Art. 15)

In the new Packaging Directive 2004/12/EC, the responsibilities of the producers are specified as follows: "*The operators in the packaging chain as a whole should shoulder their shared responsibility to ensure that the environmental impact of packaging and packaging waste throughout its life cycle is reduced as far as possible*" (recital 8). Further, the Member States have to ensure that preventive measures are implemented which may consist of national programs or projects "*to introduce producer responsibility to minimize the environmental impact of packaging …"* and concerning the prevention *"the Commission shall, as appropriate, present proposals for measures to strengthen and complement the enforcement of the essential requirements and to ensure that new packaging is put on the market only if the producer has taken all necessary measures to minimize its environmental impact without compromising the essential functions of the packaging" (Art. (3)).*

4.6.2.3 Producer Responsibility – also Across Borders

The first legislation incorporating producer responsibility was the Packaging Ordinance in Germany, which came into force in 1991 and was amended in August 1998. In the scope of the Packaging Ordinance (VerpackV 1998), all producers, importers and sellers considered as residents in Germany who are selling their goods there (Art. 2 (1)). Following the principle of territoriality, non-German producers are not affected by German legislation.

Although the take-back obligations for the distance selling (§ 6 Abs. 1 (7), VerpackV) include these producers in the wording of the law, but they are not subject to the legislation and therefore enforcement is not possible since they reside outside of Germany[86]. The national legislation is thus not applicable i.e. to cross-border e-commerce products. This means that the intension of an implementation of the European Packaging Directive in all Member States without problematic interferences cannot possibly be reached without further support by transnational law making (preferably in the context of an amended Directive).

Although the Packaging Directive gives no specific instructions concerning the cross-border B2C e-commerce, it is obviously against the intention of this directive, if packaging and packaging waste would be regulated neither by the law of the Member State of the supplier nor by the legislation of the purchaser. On the other hand, the Commission has to confirm that the transposition of the new directive does not constitute a disguised trade restriction between Member States.

4.6.3 Considerations concerning Cross-border Producer Responsibility

Generally, it seems helpful in the middle and long term that the legislation on waste products not only pursues the same ambition, but also uses the same form of regulation to accomplish this. This approach helps to minimize uncertainty on how to fulfill the obligations; and the financing of the waste management of every waste product would be handled in the same way. Further, the necessary framework and the kind of institutions needed to fulfill the obligations of the WEEE could be used for the waste management of all kinds of waste products. This could induce efficiency advantages.

Transposing the individual producer responsibility across borders, the principle of the equal treatment of market participants has to be considered.

[86] The private take back system („Duales System Deutschland“ – DSD) is facing great difficulties in executing their demands on foreign suppliers; when asked, what they are doing about this problem, the meaningful answer is: “a lot”.

This can be fulfilled only if the producer of the products turning into waste can be traced transnationally. Otherwise there would be the risk of producers sending their products across borders, i.e. acting as free-riders to the financing of the waste management in the purchasers´ Member States.

The transposition of an individual producer responsibility requires a highly complex product and waste stream monitoring (analogous to the WEEE – the batteries have to be marked with an electronically readable tag, giving information concerning the producer and the appropriate kind of the waste treatment), as well as a cross-border enforcement and therefore new organizations, institutions and further training for the actors involved. Thus, the efforts and costs have to be balanced for the achievement of objectives. Concerning batteries, innovative design developments by the transposition of individual producer responsibility is more or less improbable at the moment and the reduction of harmful substances can be reached more effectively by the targets specified in the relevant EC-legislation.

This leads to the general conclusion that criteria should be developed to consider in which circumstances and for which kinds and amounts of waste or products individual producer responsibility (also across borders) would be effective, and in which cases collective producer responsibility may be more desirable.

5. Conclusions

Conclusions of the INVERSI project are developed into two directions:

(1) INVERSI has presented "transnational law making" as a necessary approach for a solution of the free-rider problem due to B2C cross border shipments in the electronics industry. To draw conclusions for the further transposition of the WEEE Directive with respect to the cross-border assignment of disposal costs and for further research questions, at first a look at the basic principle of the WEEE Directive is necessary: the extended producer responsibility. In addition and for the purpose of this study an even wider context is required: extended transnational producer responsibility. Both issues are shortly reviewed to set the scene for the study's proposals to meet these challenges and to develop further scientific research topics to be treated in the future.

(2) The main results of the INVERSI study on the development of innovation processes have pinpointed some major changes in the electronics industry innovation system, described as upcoming system innovations and substantial transition processes from a linear to a circular industry. Against this background this chapter will also deal with the major chal-

lenges of these transition processes and raise some further research questions to be tackled in this area.

5.1 Extended Producer Responsibility

Extended producer responsibility (EPR) is the basic principle of European waste policy. The OECD defines it "as an environmental approach in which a producer's responsibility physical or/and financial is extended to the post-consumer stage of a product's life cycle" (OECD 2001: 56). It includes "(1) the shifting of responsibility upstream to the producer and away from municipalities and (2) the provision of incentives to producers to incorporate environmental considerations in the design of their products". In this context the concept of shared responsibility primarily means the sharing of responsibilities between the municipal government and the producer. But furthermore all actors in the product chain are expected to participate according to their role in this chain in order to optimize its effects (OECD 2001: 56ff). In individual countries different realizations of the EPR with different distributions of responsibilities are to be found. The respective EC Directives on packaging, end-of-life vehicles, and batteries differ in their interpretation and have been transposed in various ways as well as diverse national solutions are to be expected for the transposition of the WEEE Directive.

Against this background the (individual) producer responsibility within the WEEE Directive comprehends the obligations "for producers or third parties acting on their behalf setting up systems to provide for treatment and recovery" (Art. 6 and 7 WEEE Directive) (physical responsibility) and for each producer "providing a guarantee when placing a product on the market to ensure financing its collection, treatment and disposal" (Art. 8 (2,3)) (financial responsibility). In compliance with achieving certain objectives as recycling quota and treatment standards it tries to achieve

- cost reduction for collection, treatment and disposal by competition on disposal markets,
- prevention of free-riding a problem which in the case of electrical and electronic equipment (EEE) is even more complex as for other products due to the number of no name products and abandoned products, and to their long lifespan,
- encouraging a respective eco-design: Producer responsibility is seen "as one of the means to encourage the improvement of the respective eco-design of the products taking into full account and facilitate their repair, possible upgrading, re-use, disassembly and recycling" (recital 12).

The Battery and Packaging Directives (the same applies to the corresponding German ordinances) differ from the WEEE Directive insofar as (individual) producer responsibility in these cases aims at collective solutions. EOL-eco-design is not important in the sense it is for WEEE[87]. Reduction or prevention of hazardous substances in batteries as main objective in this area are reached by setting targets. Concerning batteries and packaging, innovative design developments by the transposition of individual producer responsibility in the strict sense seems improbable and even nonsensical regarding the issue of detailed marking and sorting.

That the disposal prices are realized in a situation of competition and are reflecting the effective costs and that thus incentives for a design change will be possible is considered as an advantage of the individual solution. Changes in the eco-design lead to an improved re-use, recovery and to a greater success on secondary markets, however, they depend on further conditions:

- The quantity to be disposed must be large enough to benefit from the economies of scale;
- The costs for a separate collection and/or sorting of own products (i.e. the set-up of an own collection system for these products and/or the sorting of the electronic scrap arising at the disposers according to own products before they will be taken over for treatment by producers) must be over-compensated by the positive effect of the reduction in disposal costs in relation to total and improved turnover on the secondary markets.

Theses cost/benefit situations within EOL, however, are only one determining factor for the development of the product design as corresponding determinants e.g. for the use phase or functional aspects play an important role. They have to be considered as well.

If such conditions are not met, collective systems appear to be more suitable. Here also a sorting of the products according to their producers is required to assign the costs - on which the guarantee is based - in accordance with the returned scrap portions of the individual producers. The volumes of these portions are expected to be the result of statistical calculations. As all products are expected to be treated together in the same recycling facility of a disposer it must be supposed that the advantages of an improved product design may only be partly, if at all, be taken into account so that average

[87] Although after establishing the new weight oriented license fee system of DSD in the German Packaging Ordinance, which followed the polluter-pays principle as much as possible, considerable efforts to improve the design of packaging could be observed.

cost would be calculated. With the registration a producer based cost apportioning will be achieved. But incentives for a corresponding product design would be absent. Besides an internal attribution of disposal costs also a producer-based grouping must be made with respect to charging the benefits from secondary material to the individual producers.

For an ecological assessment the environmental relief to be expected from the individual alternatives must be taken into account. Although with an improved EOL-design a reduced consumption of resources and a reduction of emissions in particular due to an improved closed loop circulation and a strengthened avoidance of waste may be expected. Corresponding environmental reliefs may also be achieved with an improved eco-design e.g. during the use phase because of reduced energy consumption and also because of economies of scale. In the latter case larger transportation lots and thereby less transports, larger facilities and a better utilization lead to a reduced input of energy and material and also lower emissions. It is a priory open which effect will prevail.

The practical implementation should differ a great deal in the case of the individual products. German politics with its model leaves a lot of room for the producers with the hope that individual solutions should prevail as far as possible. Other countries favor collective solutions to a greater extent. Existing research results and practical experience with take-back obligations in other countries lead to different results for single products groups. For individual producers within the IT-technology branch the development of recycling oriented design seems to be well developed and beneficial. Companies gained experience with take-back concepts, re-use and recycling; in the case of consumer electronics the research results rather do not indicate advantages of a corresponding eco-design, but more of economies of scale.

One of the main hypotheses of this study is that due to increasing cross-border B2C a growing assignment defect of take-back obligations is to be expected. Currently, a free-rider problem due to cross-border B2C does not seem to be relevant. With a share of disposal costs of EEE estimated to amount to only around 1% compared to the market supply (based on actual costs) and for selected products with a range from some 0.5 % for a mobile PC to about 1.3 % for a printer and about 1 % for a portable audio. Direct traders from abroad might have small economic advantages by evading the charges. But regarding the hardly noticeable volume of cross-border B2C at the moment the additional cost burden for domestic producers can be neglected. It is expected that the disposal costs will increase considerably during the next years due to the high recycling quota set by the WEEE Directive - at least for some products. Thus, disposal costs might become a decisive category for their producers and cross-border trade a real advantage.

But still then, cross-border trade has to increase strongly before the costs to be born additionally by domestic producers will be of any relevance with respect to a distortion of competition on the respective market. Negative impacts on innovations are not to be expected.

5.2 Transnational Producer Responsibility

According to future scenarios, B2C will increase in the next years and - accompanied by harmonization processes – cross-border B2C sales as well. Facing these expectations, a solution should be worked out prior to increasing assignment defects coming up as a real problem. The WEEE Directive requires a solution for the implementation.

5.2.1 The study's proposal for further WEEE implementation

- Transnational law making is necessary in order to enforce individual producer responsibility. Such transnational law making requires organizations and agencies for the registration of producers, for the monitoring of product and waste flows, and for implementing financial guarantees etc. It also includes all necessary institutions, i. e. command-and-control-policies, as well as incentive instruments etc.

- Individual producer responsibility includes that every producer is financially liable for the waste management of his products. Therefore all producers must be registered, regardless of whether the products are destined for the national market or long distance trade across borders within the EU. In addition, the producers must mark their products so that waste can be traced back to them. Such tracing will be possible if electronic or other tags provide producer data so that collection, treatment and disposal costs can be recollected from them. Such tags should unequivocally provide the date on which the appliance was put on the market. It is not sufficient to know if the appliances were sold before or after 13 August 2005 when product tags are mandatory. Instead the precise date would be necessary to ensure full cost coverage of producers within a given time period. The knowledge about the precise date is also necessary to verify if under the WEEE regime life times of EEE will increase. National legislation should demand the precise date of market appearance of the EEE.

- Such provisions (concerning the registration of all producers and marking of all products) ensure the equal treatment of all producers. Of course, the producers will have to cover the differing costs of treatment across the receiving countries. But within the receiving country, all producers will face the same burden for an equivalent appliance.

- The general directive's objective of enforcing producer liability is reached by this approach to a higher extent as this form of implementation functions for all forms of trade (B2B, B2C, private import of EEE, etc.). At the same time a different form of labeling depending on the form of trade (cross-border B2C versus other forms) is avoided. Obstacles for the Common Market deriving from the implementation of Art. 8 (4) WEEE in an isolated form could be reduced. For that matter an amendment of the WEEE Directive is recommendable.

- The efforts of implementing transnational producer responsibility are reasonable when an individual producer responsibility or a mechanism for individual cost coverage by the producer is intended. As a consequence, this form of transnational law making is only sensible if innovations of product design can be expected. This depends on the available and future technologies, financial conditions, and future environmental objectives. Furthermore it is necessary to consider thresholds of minimum amounts of WEEE and minimum sizes and weights of appliances to avoid excessive bureaucratic cost. To sum this up, the development of transnational product responsibility should depend on certain criteria which specify whether an individual producer liability is necessary or not. If these criteria are fulfilled a tagging of products and a registration of producers should be legally enforced across borders of Member States.

- Such an individual producer liability across borders can be designed in analogy to value added tax (VAT). According to the value added tax regulation in the EC all producers are obliged to pay the VAT of the receiving country for all products sold there. This VAT is transferred to the local fiscal authority of the suppliers´ Member State. A clearing process between the Member States ensures that revenues will go to the receiving country. This mechanism transferred to the WEEE Directive would require every producer of EEE to provide a financial guarantee by the national authority in his country for the cost of treatment and disposal of WEEE of the receiving country.

  The national authorities in the producer's Member State have to transfer the guarantees for the products exported to the other Member States through their national agency which collect such guarantees, and organize and finance the treatment and disposal of WEEE.

- As soon as EEE becomes WEEE, electronic tags provide the necessary information to identify the relevant producer and to turn in the guarantee for cost collection. Actual cost collection will take place in the producer's home Member State. The collected funds will be transferred to the Member State which treats and disposes of the WEEE.

- If innovations in product design to improve re-use or recycling processes cannot be expected at all or only in a few product groups, and/or a cost-benefit-analysis comprising all determinants would suggest that a collective waste treatment with cost assignment based on statistically calculated shares of waste is sufficient compared with a cost assignment based on an effective evaluating of the tags then the relatively high cost of electronic tags can be foregone. In such circumstances all producers are responsible for the costs of treating and disposing WEEE collectively and must find criteria to share such costs. In such a situation tracing back of products across borders will be impossible. However, it is possible that individual Member States will have higher costs than revenues from national producers as cross-border trade is not covered. Free-riding of foreign producers might occur. Such collective producer liability is currently enforced for batteries as well as packaging.

- The WEEE Directive aims at securing EU-wide product responsibility. This cannot be achieved effectively by Member States acting individually. The transposition of Art. 8 (4) WEEE needs a well adjusted and EU-wide coordination of national legislation accompanied by a standardized data exchange between the national guarantee-mechanisms and the waste management systems.

Next Steps to go for WEEE Solution

To improve a harmonized form of transnational law the following measures will have to be undertaken:

1. The implementation of Art. 8 (4) has to be harmonized and coordinated throughout the EU. Therefore
   a) the responsibilities have to be determined,
   b) a uniform system for the data transfer has to be developed, and
   c) a system for providing a transboundary guarantee has to be established.

2. The marking of the EEE has to be standardized (concerning the technology of the data collection and data entry as well as concerning the necessary information contained in the tag).

3. A WEEE-Amendment has to be established, to cover all transboundary movements of EEE after placing on the market by the producer. This will be necessary to strengthen the individual producer responsibility and to diminish the distortion of the common market (c.f. conclusion 4).

   Further on the WEEE-Amendment should include that a financial guarantee can be given in (the national or private authority of) the *pro-*

ducer's Member State. In this case the producer can register and enroll the data concerning his products he put on the market as well as provide the financial guarantee in *his* Member State (Figure 6).

5.2.2 Open Questions and Research Topics with Respect to the WEEE Implementation

The implementation efforts in the Member States so far were directed towards meeting the transposition deadline of 13 August 2005. Besides operational implementation of the transnational producer responsibility (see above), there are future research questions concerning mainly two issues:

(1) Up to now, there is no clear picture about the effectiveness and eco-efficiency of take-back systems in operation. Studies on existing WEEE schemes are more or less of descriptive nature (Perchards 2004) or are using only one-dimensional evaluation indicators like "effectiveness in Collection and Treatment"[88] or "cost-effectiveness in Collection and Treatment"[89]. A complex indicator system for the evaluation of the consequences of take-back regulations for the innovations system, the induced innovations and the impacts on ecological and economic (and social) aspects of sustainability is necessary. More advanced evaluation eco-efficiency methodologies are already available (Huisman 2003), but have not been applied in comparative WEEE-studies across the EU so far. On this background and in view of the amendment process of the WEEE Directive and the RoHS Directive, a considerable political need for action is to be ascertained. Evaluation criteria should be incentives for end consumers to bring back EOL devices, opportunities for controlling and avoidance of free-riders, incentives for design for environment, the transaction costs of the systems, the accounting implications on tax reserves etc., the eco-efficiency ratio as the relation of costs/kg and environmental revenue, legal liability of the system, labeling efforts and information flows, intrinsic dynamics of the system for an optimization of eco-efficiency, promotion of competition etc.[90].

(2) In Annex II and III the WEEE Directive requires a selective treatment and technical requirements of WEEE and fixes a "state-of-the-art" according to "best available technologies". In this respect, a big gap between the Annex II/III requirements and the daily practice is to be ascertained. According to technical differences throughout Europe, risks

[88] By evaluating indicators like "geographical coverage", "WEEE collection volumes", "recycling performance".

[89] By using the indicator "costs per kilogram".

[90] See also wko.at/up/enet/stellung/eagfinanzbeiratfolien.ppt for similar evaluation criteria.

of counter-productive transportation throughout Europe may occur following price-downgrades of WEEE treatment. Uncertainties with the recyclers are presently leading to lack of investments. Inefficiencies due to the treatment rules of Annex II/III WEEE are to be expected. Amendments of the WEEE with respect to Annex II/III should be based on scientific and technical progress and should be applied very soon.

5.3 Innovation Processes in the Electronics Industry

5.3.1 System Innovation: A System under Transition

The Electronics Industry Innovation System is a 'system under transition' with manifold incremental, radical and even system innovations. Transition takes place at different levels, influencing each other: the micro-, meso- and macro-level (Rotmans, Kemp, van Asselt 2001). The **micro-level** (*niches*) relates to individual actors, companies and technologies, the place where novelties are invented, tested and exploited. The **meso-level** (*regimes*) relates to networks, communities and organizations, institutional arrangements, dominant practices, rules and shared assumptions. On this level, also technology regimes, production regimes, user regimes and policy regimes are distinguished (Kemp and Loorbach 2003: 9). The **macro-level** (*socio-technical landscape*) comprises conglomerates of institutions and organizations (e.g. a nation) and relates to material and immaterial elements like material infrastructure, political culture and coalitions, social values, macro economy, demography and the natural environment (Kemp and Loorbach 2003: 5; Meyer-Stamer2003).

In the EIIS, transition takes place at all these different levels and this study presented some of the ongoing developments, which account for the 'system innovation' in the EIIS: on the micro-level changes in the corporate innovation strategies take place, including sustainability aspects more and more into the regular innovation management procedures. On the meso-level a dynamic interplay of institutional change and technological change takes place, modifying the entire system of waste and recycling management and at the same time, changing the market- and actors-configuration substantially. On the macro-level the expectations and requirements of society regarding sustainable development are an important driver.

5.3.2 Governance Transition

Looking back at the historical WEEE implementation during the last two decades, the governance arena was set up subsequently to direct the innova-

tion system towards the new paradigm of a circular and sustainable electronics industry and thus to a huge system innovation.

The implementation process of the WEEE Directive and the RoHS Directive on a European level took about 10 years considering the starting point as to be the European Commission's "Priority Waste Streams" project and the working group, which started in 1994/1995 without their predecessors. Apart from the date of entry into force for the WEEE and RoHS[91] and from the final date for implementation in the Member States[92] the implementation process over time switched more and more to participatory elements of discussion and consulting to fix the minimum requirements on the EU level in a broad consensus. Furthermore it should be pointed out that decision-making is still an ongoing process since suggestions for improving the WEEE Directive and RoHS Directive are discussed permanently within the further implementation process[93].

Especially the implementation on the national level is subject of ongoing debates, since there are far reaching problems to be solved in adjusting the EU directives to national details. Although, to reach a EU wide harmonization, the WEEE contains mandatory provisions, for the national implementation process there still exists a wide range of solutions, as may be observed in the different Member States by now (Perchards 2004).

5.3.3 Technological Transition

Looking back on the last 2-3 decades, the technological regime transition in the EIIS describes a change from a more or less stable socio-technical configuration to another.

The EIIS before the millennium change was devoted to a stable functional trajectory, based on the ICT paradigm up to the late 90s. Relying on a huge preceding technology push provided by the dramatic progress in microelectronics, it developed as a result of constant incremental innovations such as step-by-step improvements of technology (i.e. improvements of technical efficiency of parts), products (improvements of functions to better fulfill consumer needs, i.e. white goods), and – driven by increasing demand – framed a vast time-to-market innovation regime combined with a linear 'throw-away'-economy.

[91] Date of entry into force = 13.02.2003

[92] Final date for implementation in the Member States = 13.08.2004

[93] This is done within the TAC – Technical Adaptation Committee of the EU.

Radical innovations (e.g. analog – digital shift, broadband communication, etc.) have provided the set for changing the trajectory in the last 5 years leading to a great choice of various possibilities in the lay-out of new business models. In so far the digital revolution forms a **new paradigm with service extensions** (GPS, interactive TV etc.) and it is expected that the new paradigm provides persuasive advantages in terms of economic sustainability.

At the same time, due to the implementation of a new governance portfolio (WEEE, RoHS and EuP), a shift in the fundamental set-up of the value-added chain was introduced, moving the EIIS **from a linear to a circular value-added chain** and unfolding the need for additional service systems to close the loops at different stages of an electronic or electrical product, i.e. small loops in the use phase by setting up **new business models and product service systems** (PSS) such as maintenance, upgrading and re-use services, as well as large loops by introducing take-back and waste management services to close the material circle. This set the scene for introducing new recycling technologies and take-back systems (according to the WEEE) as well as new manufacturing processes according to the phase-out of certain hazardous substances (RoHS) to comply with the legislative requirements. It required also the involvement of new core competencies and knowledge from new innovation players into the EIIS.

In the technological transition process the EIIS proves to be receptive to involve new players and that – how the work on the sociology of technologies puts it[94] – suitable technological choice is made within 'systems' or 'networks', that "involve not only the firms which manufacture the technological products themselves, nor just their suppliers and large customers, but an extended and heterogeneous array of investors, regulators, unions, professional associations, government departments, research, educational and political organizations" (Stirling 2004: 30)[95].

5.3.4 Transition of Belief Regimes

System innovations for sustainability almost always are directed towards less resource intensive regimes, and they are facing complex problems, since they are expected to change the environmentally significant (and in even longer terms the inter-generational significant) **behavioral attitudes of different stakeholders** of an innovation system. In that sense, system innovations bring out and lead to paradigm shifts in the society, marking a new trajectory for a long wave of development, where incremental and even

[94] A comprehensive overview on this issue is given by Stirling (2004: 30 ff).

[95] Ibid, p. 30.

radical innovations may take place without changing the fundamental corridor of development. Following this innovation paradigm, it is obviously the design tradition – as a result of a stable socio-technical configuration in the last 2-3 decades – that led to the functional trajectory of the EIIS as described above and to a cognitive lock-in from the design side. At the same time, consumer needs at first glance are changing rapidly (fulfillment of new needs like mobile communication, remote access to personal data) but their habits became fixed in longer waves of development ("ownership is better than occupancy"). So it is explicable that fundamental changes in satisfying consumer needs did not appear on the agenda except when customers explicitly addressed new ways of need satisfaction, like it happened already early in the B2B area with leasing concepts of computers and result-oriented services, for instance in the machine building industry in the provision of operating supplies.

The shift in belief regimes obviously takes more time to take place than the technological regime shift. At the same time, the belief shift needs additional incentives from the socio-technical landscape, i.e. from the macro-level of society (development of a new common understanding) and must be supported by other meso-level policy measures (e.g. education, R&D-programs etc.). This, actually, is an ongoing process for instance in Germany and on the European level, as targeted research and development programs are implemented to promote the search for socio-ecological solutions and new sustainable business models[96].

Another major belief shift is needed when looking at new business models like PSS. The evolution and diffusion of these new business models for sustainable service systems in the electronics industry depends on radical changes in economic paradigms and requires a change in the perception and in the behavior of all actors involved in the innovation system.

This in mind, it is obvious that within system innovations like the evolvement and diffusion of new business models or PSS, a co-evolution of technological regimes, institutional regimes, behavioral and cultural regimes have to take place, since in particular new use-systems need behavioral changes on the side of the users. Also – coming back to the differentiation of the micro-, meso- and macro level of transition - it appears to be quite certain that the belief regimes on the meso-level are expected to gain superior attention, since the normative rules and shared assumptions are the main important drivers of the demand side of new business models.

[96] As an example the new R&D program "PRONA" launched by the German BMBF in 2004 is expected to cover a great deal of the overriding questions to progress in the long-term vision for sustainable development.

5.3.5 Research Questions

On this background the transition process will lead only to a real sustainable electronics industry, if the shifts in technological, belief and governance regimes will be better inter-related one after another. This is – analyzed as one of the overriding problems in this paper – supposed to be the overall task for an improvement of the transition process in the EIIS.

First of all there are indications of transition barriers as a result of a malfunctioning co-evolution of the regimes by now:

- The present regulation framework seems to partly hinder the development of new business models. When lining-up additional legislative obligations in a specific innovation system to increase the steering effect of an initial policy instrument, policy makers should be aware of already installed technological or cognitive trajectories and path dependencies as well as of the already chosen way of industry moving forward. Cumulative intensity of regulation has to be evaluated according to these policy timing issues, since two or more regulations lined-up in the same innovation system may be indifferent, complementary, additive or even conflictive towards each other. Within the governance regime of the EIIS there is no clear picture up to now, of how to evaluate the cumulative intensity of the regulation context with respect to the question, if the portfolio is facilitating or hindering the development of sustainable business models. In so far, the governance regime is only fairly settled to modulate beliefs and technological choice towards sustainability in this point.

- In other areas of the governance regime, e.g. educational policy or R&D-policy, the timing of measures to promote the development of more sustainable business models does not fit with the ongoing shift in technological regimes. For instance research is far too much focused on technological aspects and less on integrating socio-ecological and economical aspects up to now. Unfolding technological diversity does not sufficiently go hand-in-hand with sociological investigations of how society shifts their choice of technologies.

- The technological regime shift is not sufficiently co-ordinated with the changes in belief regimes. As mentioned above the shifts in consumer needs obviously follow shorter innovation cycles than the shift in ownership habits, the shifts in design ethics or principles and shifts in fundamental business strategies ('time-to-market' versus 'multi-cascade innovation systems with longer life cycles'). Obviously the governance approaches of promoting education towards sustainability come somewhat late.

- The international nature of the transition is not sufficiently tackled in the research arena, and in the transition management. Since it may be assumed that the EU will become more and more important in environmental and sustainability policy making, the problem of transnational of even global innovation systems (like the EIIS) and their transition within the context of the multi-layer governance structure of EU – Nation States – Further federal structures with Nation States (regional and local level) is more than open question in transition management and transition theory. In addition the co-evolution of different belief regimes according to international diversity in cultures and otherwise distinct socio-technical regimes and landscapes and technology regimes is not treated sufficiently up to now. Especially the diffusion of EEE products in different societies under the normative direction of sustainability may need a decisive co-ordination of different belief regimes according to different societies. This is referred to as the relation between horizontal and vertical structuring of system innovation. Of special interest is also the role of standardization in the co-evolution of technological and belief regimes[97].

  Within the technological regime there is a substantial lack of evaluation methods to assess the sustainability effects of new business models. In that sense, the extension of indicator systems is desirable to also record behavioral changes from stakeholders towards sustainability. Also the impacts of increasing transaction costs in setting up new business models have to be evaluated more in depth.

  To sum it up: a vast transition barrier is to be constituted in the only moderate co-evolution of the transition regimes. This even may be broken down to the level of *niches* as the place of putting innovations like new product-service systems into practice: a comprehensive business model comprising new use patterns, ownership models, the involvement of innovation actors originally not on the set, need to be co-ordinated like a bicycle chain – you may turn it only all in once.

In view of these transition barriers, selected recommendations may be drawn for the practical transition management of the EIIS and for further research in transition theory:

(1) The transition of the EIIS towards sustainability now needs a particular form of lock-in management (Faber, Rood, Ros 2003). This lock-in management has to care for keeping in lane with the unfolded technology regime and their embedded instruments of dialogue, strategy and tools. The

[97] See Shove, E. (2002) on these topics.

pathway to resources protection, energy saving, prolongation of use- and life cycles, recovery of resources, intelligent ways of need satisfaction may not be deserted. The EuP directive may be a lever to install a lock-in management between the EU and Member States to foster and consolidate the implementation process of eco-design requirements of energy using products, because it will further promote life cycle thinking of all innovation actors. More transnational networks compound of industry and research agents have to be set up to learn about the further implementation of the regulatory framework (like a RoHS-network, a EuP network) since the mutual implementation benefits of joint action in industry are expected to be very high.

(2) Research on transition management and transition theory has to cover different aspects related to the

- timing of transition management: when to start, how to set up a transition arena, whom to involve, how to impose the need for systems change and to detect time windows for a paradigm change?
- instrumentation of transition management: what to do in particular phases of the transition (choice of instruments like technology assessment, delphis, scenarios, funding programs, standardization, cluster-management etc.)?
- target regimes of transition: how to encourage bottom-up activities like networks on a local and regional level, involving research on social and institutional aspects of transition (Rotmans, Kemp, van Asselt 2001: 15) and how institutions and behaviors change?
- co-evolution aspects of transition: how to set up links for an interaction of technology, belief and governance regimes, what are the indispensable systems of interaction?
- management processes: how to better co-ordinate governance action between the parties involved (question how to co-ordinate people, who do not co-ordinate their activities at all)?

A study of historical transition processes using the concepts of the transition theory would give more insights in the dynamics and steering capability of transition. Especially the dynamics of regime changes and the role of technology (enabling role, disabling role), role of belief and value systems, role of governance should be investigated in ex-post analyses.

Bibliography

AGIREV (2003), Online Reichweiten Monitor ORM 2003 II. http://www.agirev.de/download/AGIREV_ORM2003_II.pdf from 11 November 2003.

Albrecht, G. (2003), EU-Direktiven WEEE und RoHs. Stand, Inhalte und Anforderungen bei der Umsetzung in nationales Recht in Deutschland. Vortrag gehalten auf dem Workshop "Delegieren und Handeln – WEEE und RoHS in der Elektronikindustrie. Strategien für Unternehmen zur Umsetzung von Produktverantwortung, Produktrücknahme und Stoffverboten. Veranstaltet vom Fraunhofer Institut Zuverlässigkeit und Mikrointegration (IZM) am 21. November 2003 in Berlin.

Anonymous (2003a), Ebay wächst weiter in Deutschland. 7.11.2003. - http://www.ecc-handel.de/aktuelles/cont_layout.php?id=1068213616 - from 14 November 2003.

Anonymous (2003b), Begleiterscheinungen des gewerblichen Handels bei eBay. 15.09.2003. - http://www.ecc-handel.de/best_practice/1063630803/ - from 14 November 2003.

Anonymous (2004a), Die E-Commerce-Umsätze 2003 boomten nicht nur im Weihnachtsgeschäft. http://www.ecc-handel.de/aktuelles/archiv/1074761886.php - from 1 July 2004.

Anonymous (2004b), Kräftige Umsatzsteigerung beim Online-Shopping. - http://www.ecc-handel.de/aktuelles/archiv/1069429728.php - from July 1st 2004.

Anonymous (2004c), Studie Online Shopping Survey 2004: Autohandel im Internet boomt. - http://www.handwerk-info.de/122115.html - from 1 July 2004.

Atkinson, G. et al. (1997), Measuring Sustainable Development – Macroeconomics and the Environment. Cheltenham: Edward Elgar.

BBE-Unternehmensberatung (2003), E-Commerce – Absatz- und Geschäftskanal Internet. http://www.handelswissen.de/servlet/PB/menu/1009905/ - from 14 November 2003.

BDO Auxilia Treuhand GmbH (2003), Bericht über die Studie zur Evaluierung von Systemvarianten und Finanzierungsmodellen zur Umsetzung der Richtlinie 2002/96/EG über Elektro- und Elektronik-Altgeräte Wien.

Becker, U. (2003), Gesetzliche Krankenversicherung im Europäischen Binnenmarkt. NJW 2003: 2272 – 2277.

Behrend S. et al. (1996), Umweltgerechte Produktgestaltung . ECO-Design in der elektronischen Industrie. Berlin: Springer.

Biddle, M. (2003), Recycling plastics from durable goods: Challenges and opportunities, in: International Electronics Recycling Congress, January 13-15, 2003 Basel, Switzerland.

Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V. (BITKOM) (2002), Was beinhalten die EU-Richtlinienvorschläge? Wie kann die praktische Umsetzung erfolgen? Vortrag gehalten beim 11. Treffen des Netzwerks Innovative Kreislauftechnologien beim Fraunhofer Institut Materialfluss und Logistik (IML) am 19. März 2002 in Dortmund.

Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V. (BITKOM), Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI) (2003), Rücknahme elektrischer und elektronischer Altgeräte in Deutschland. Gemeinsames Positionspapier von ZVEI und BITKOM zur Umsetzung der Richtlinie 2002/96/EG des europäischen Parlamentes und des Rates vom 27. Januar 2003 über Elektro- und Elektronikaltgeräte (WEEE-Richtlinie). Berlin Frankfurt, Köln vom 20. August 2003. http://www.zvei.org.de. from 2 January 2004.

Blazejczak, J. et al. (1999), Umweltpolitik und Innovation – Politikmuster und Innovationswirkungen im internationalen Vergleich, Zeitschrift für Umweltpolitik und Umweltrecht 22 (1): 1-32.

Bock, M. (1996), Entsorgung von Verkaufsverpackungen und Kartellrecht, in: Wirtschaft und Wettbewerb (WuW) 46 (3): 187-203.

Böhm, P. (2004), Take-back Systems and Recycling in the White Goods Sector. Vortrag auf dem 3rd International Electronics Recycling Congress 14-16 January 2004 Basel.

Brand K.-W. u.a. (2002), Nachhaltigkeit und abfallpolitische Steuerung. Der Umgang mit Kunststoffabfällen aus dem Verpackungsbereich, Berlin (Analytica).

Brynjolfsson, E., Smith, M. D. (2000), The Great Equalizer? Consumer Behavior at Internet Shopbots. Working Paper Sloan School of Management - http://ebusiness.mit.edu/erik/TGE%202000-08-12.pdf - from 1 July 2004.

Bundesministerium für Umweltschutz, Naturschutz und Reaktorsicherheit (BMU) (2003), Eckpunkte künftiger Rechtsvorschriften zu Elektro- und Elektronikaltgeräten in Deutschland. April 2003, Berlin.

Bundesverband Technik des Einzelhandels e.V. (BVT) (2000), Domestic Appliances in Germany. Consumer Goods Europe, No. 450.

Bundesverband Technik des Einzelhandels e.V. (BVT) (2001), Consumer Electronics in Germany. Consumer Goods Europe, No. 459.

Bundesverband Technik des Einzelhandels e.V. (BVT) (2003), Marktbericht 2002/2003. Köln.

Bundesverband des Deutschen Versandhandels (BVH) (2004), Versandbranche beendet das vergangene Jahr uneinheitlich. Pressemitteilung des Bundesverbandes des Deutschen Versandhandels vom 08. März 2004 - http://www.versandhandel.org/presse/2004/pressemitteilung08032004.htm - from 1 July 2004.

Bundesverband Sekundärrohstoffe und Entsorgung e.V. (bvse) (2003), Die WEEE-Umsetzung in Deutschland: Wettbewerb eröffnet Chancen und Wachstum. Das bvse-Konzept. Bonn: bvse. - http:/www.bvse.de from 18 June 2003.

Bundesverband Sekundärrohstoffe und Entsorgung e.V. (bvse) (2003), bvse begrüßt Abstimmung zur europäischen Elektron(ik)schrott-Richtlinie vom 17. 12. 2002.- http:/www.bvse.de from 18 June 2003.

Cannemann, G. (2003), Success factors and actual results of take back systems in Europe in: Proceedings of the International Electronics Recycling Congress January 13-15 Basel, Switzerland.

Clausen, H. (2000), Rücknahmeverpflichtungen als Instrument von Abfallwirtschaftspolitik, Umwelt- und Ressourcenökonomik 13, Münster.

Costa, C.; Franke, A. (1995), Handelsunternehmen im Spannungsfeld umweltpolitischer Anforderungen. Der Weg von der Abfall- zur Kreislaufwirtschaft in der Distribution. München, 1995, p. 73ff.

Duales System Deutschland (DSD) (Hrsg.) (1998), Geschäftsbericht 1997. Köln.

EAR Elektro-Altgeräte Register (2004), Das EAR-Projekt. Stand 4. Juni 2004. - www.ear-project.de, from 15 July 2004.

ECC (2003), Umsätze in Euro im B2C-E-Commerce in Deutschland. 19.2.2003. - http://www.ecc-handel.de/downloads/files/pre_2003/erkenntnisse/1040290862.pdf from 27 February 2003.

ECC (2003), Umsätze in Euro im B2C-E-Commerce in Deutschland. 19.2.2003. http://www.ecc-handel.de/downloads/files/pre_2003/erkenntnisse/1040290862.pdf - from 27 February 2003.

Edquist, C. (1997), Systems of Innovation: Technologies, Institutions and Organisations, London and Washington, p. xiii (Preface).

EITO (2003), European Information Technology Observatory 2003. Frankfurt: EITO.

EITO (2003), European Information Technology Observatory 2003. Frankfurt: EITO.

EITO (2004), European Information Technology Observatory 2004. Frankfurt: EITO.

ENIGMA GfK (2003), Online Shopping Survey. Eine Studie von ENIGMA GfK und NFO Infratest (April 2003). - www.enigma-gfk.de from 1 July 2004.

ENIGMA GfK/TNS Infratest (2004), Online Shopping Survey, Welle 2, März 2004 – www.enigma-gfk.de - from 1 July 2004.

Enquête-Kommission „Schutz des Menschen und der Umwelt“ des Deutschen Bundestages (Hrsg.) (1993), Verantwortung für die Zukunft – Wege zum nachhaltigen Umgang mit Stoff- und Materialströmen. Bonn.

Enquête-Kommission „Schutz des Menschen und der Umwelt“ des Deutschen Bundestages (Hrsg.) (1994), Die Industriegesellschaft gestalten. Perspektiven für einen nachhaltigen Umgang mit Stoff- und Materialströmen. Bonn.

EOS Gallup Europe (ed.) (2002), Internet and the Public at large. Flash Eurobarometer 135. Brussels, http://europa.eu.int/comm/public_opinion/flash/fl135_en.pdf - from 1 July 2004.

Europäische Kommission (Hrsg.) (1997), Panorama der EU-Industrie 1997. Brüssel.

European Commission (ed.) (2001), The Impact of the E-economy on European Enterprises: Economic Analysis and Policy Implications. Brussels: COM (2001) 711 final.

European Commission (ed.) (2001a), The Impact of the E-economy on European Enterprises: Economic Analysis and Policy Implications. Brussels: COM(2001) 711 final.

European Commission (ed.) (2001b), Internal Market Scoreboard 8. - http://europa.eu.int/comm/internal_market/en/update/score/score8en.pdf from 15 February 2003.

European Commission (ed.) (2004), Issues relating to business and consumer e-commerce, 2003 – 3. Executive summary. Brussels - http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_201_executive_summary.pdf - from 1 July 2004.

EUWID (Europäischer Wirtschaftsdienst), lfd. Jahrgänge. Hrsg. von Europäischer Wirtschaftsdienst GmbH, Gernsbach.

Faber, A., T. Rood and J. Ros (2003), Evaluation of early processes in system innovation, at: http://www.fu-berlin.de/ffu/akumwelt/ bc2003/download/ Faber_ full. pdf , from 12 May 2004.

Feess, E. (1998), Umweltökonomie und Umweltpolitik. München: Vahlen.

Fenton, R., N. Hanley (1995), Economic Instruments and Waste Minimization. The Need for Discard-relevant and Purchase-relevant Instruments, in: Environment and Planning 27 (8): 1317–1328.

Fichter, K. (n.d.), E-Commerce und Umwelt, in: Politik Digital - http://www.politik-digital.de/edemocracy/wissensgesellschaft/nik2.shtml from 5 August 2004.

Fischer, H. (2004), Zur Umsetzung von EG-Richtlinien für Elektro- und Elektronikgeräte. UPR 200: 12-16.

Flanderka, F. (1993), Verpackungsverordnung. In: Brück W, F. Flanderka (Eds): Verpackungspraxis (VP-Recht). Loseblatt-Ausgabe. Hüthig. Heidelberg p. 5f.

Franck, E.P., T. Bagschick (1998), Ökonomische Überlegungen zur Produktverantwortung. Zeitschrift für Betriebswirtschaft (ZfB) 68 (7): 663-681.

Frey, O. (2003), Von der EU-Richtlinie über Elektro- und Elektronik-Altgeräte (WEEE) zur Umsetzung in nationales Recht. Ein Überblick. Vortrag gehalten am 27. Juni 2003 in Düsseldorf. - http//.www..ZVEI.de. from 2 January 2004.

Frey, O. (2004), Aktivitäten der Hersteller. Vortrag gehalten am 22. Juni 2004 in Fürth -. www.zvei.org. from 15 July 2004.

Fröhlich, G. (2003), Hoffnung auf steigende Mengen und Augenmaß bei der Umsetzung, in: Recycling-Magazin 01, 2003: 8-9.

Fues, T. (1998), Das Indikatorenprogramm der UN-Kommission für nachhaltige Entwicklung, Frankfurt: Peter Lang.

Führ, M. (ed.) (2000), Stoffstromsteuerung durch Produktregulierung, Baden-Baden: Nomos.

Gesellschaft für Verpackungsmarktforschung (GVM) (2002), Special Report of Data, Wiesbaden.

GFA Management (2002), Ex-ante Impact Assessment of the options outlined in the Green Paper on EU Consumer Protection. Final Report. EU-Commission, Brussels http://europa.eu.int/comm/consumers/cons_int/safe_shop/ fair_bus_pract/green_pap_comm/studies/gfa_report_en.pdf.) from 15 May 2003.

GfK Marketing Services GmbH (2002), gfk-webgauge Frühjahr 2002. Nürnberg: gfk.

GfK Marketing Services GmbH (2003a), e-Commerce legt weiter zu. Pressemeldung 14.10.2003 - http://www.gfk.de/index.php?lang=de&contentpath=http %3A// www.gfk.de/suche/search.php%3Fps%3D10%26o%3D0%26m%3Dall%26ul% 3Dwww.gfk.de%26words%3Dweb+scope from 14 October 2003.

GfK Marketing Services GmbH (2003b), e-Commerce mit Autozubehör an der Schwelle zum Milliardengeschäft. Pressemeldung, 9. Juli 2003 - http://www.enigma-institut.de/download/pd-OSS-03-07-09-fin.pdf. from 14 October 2003.

Habel, A. (2003), Richtlinie des europäischen Parlamentes und des Rates über Elektro- und Elektronikaltgeräte. WEEE (Waste electrical and electronic Equipment). Inhalte, Konsequenzen, Position des bvse, Bonn.

Hafkesbrink, J. et al. (2004), State-of-the-Art Technologies in the Electronics Industry Innovation System – Dialog, Strategies and Tools towards Sustainable Development, Interim Report to the European Commission (www.aroew. de/ ecolife /ecolife2/D7report.htm).

Hafkesbrink, J. et al. (1998), Abschätzung der innovativen Wirkungen umweltpolitischer Instrumente in den Stoffströmen Elektroaltgeräte/Elektronikschrott. Untersuchungen des Rheinisch-Westfälischen Instituts für Wirtschaftsforschung (RWI), Heft 26, Essen.

Hauptverband des Deutschen Einzelhandels (HDE) (2001), HDE-Umfrage. eCommerce 2001 (B2C). www.einzelhandel.de/servlet/PB/m...2732_pdruckvorlage. html from 12 December 2001.

Hauptverband des Deutschen Einzelhandels (HDE) (2001), HDE-Umfrage. eCommerce 2001 (B2C): 1-3. www.einzelhandel.de/servlet/PB/m...2732_ pdruckvorlage.html from 6 December 2001.

Hauptverband des Deutschen Einzelhandels (HDE) (2002), IT im Einzelhandel – Wertschöpfung, Kommunikation, e-Commerce Ergebnisse einer HDE-Umfrage unter 1200 Einzelhandelsunternehmen. Pressemitteilung, 11. November 2002. www.einzelhandel.de/servlet/PB/menu/1013624_pdruckvorlage_11/druckvorlage .html from 27 February 2003.

Hauptverband des Deutschen Einzelhandels (HDE) (2003), Position des HDE zur Richtlinie des europäischen Parlaments und des Rates über Elektro- und Elektronikaltgeräte http://www.hde.de/servlet/PB/menu/1001597-pdruckvorlagel1/ druckvorlage.html from 14 November 2003.

Hauptverband des Deutschen Einzelhandels (HDE) und Bundesverband Technik des Einzelhandels e.V (BVT) (2002), Elektronik-Schrott: Verursacherprinzip muss gelten. Köln 10.4. 2002, http://www.bvt-ev.de/main04-1.htm; from 14 November 2003.

Heistermann, F. (2003), Möglichkeiten und Grenzen kollektiver Rücknahmesysteme für Elektronik-Altgeräte aus kartellrechtlicher Sicht. Vortrag gehalten auf der Euroforum-Konferenz zum Thema Elektro- und Elektronik-Altgeräte am 2. und 3. Dezember 2003 in Düsseldorf.

Hemmelskamp, J. (1997), Umweltpolitik und Innovation – Grundlegende Begriffe und Zusammenhänge. Zeitschrift für Umweltpolitik und Umweltrecht 20: 481–511.

Hieronymi, K. (2002), Die WEEE-Direktive aus der Sicht der Hersteller. Vortrag gehalten beim 11. Treffen des Netzwerks Innovative Kreislauftechnologien beim Fraunhofer Institut Materialfluss und Logistik (IML) am 19. März 2002 in Dortmund.

Hieronymi, K. (2002a), Norway, Switzerland, Netherlands, Sweden, Belgium, who has the best WEEE-implementation?, in: Proceedings of the International Electronics Recycling Congress January 9-11 2002 Davos, Switzerland.

Holm-Müller, K. (1993), Neudefinition von Eigentumstiteln zur Lösung umweltpolitischer Probleme: Die Rücknahmeverpflichtung im deutschen Abfallgesetz, in: Jahrbücher für Nationalökonomie und Statistik 215, H. 5–6: 480–496.

Huisman, J. (2003), The QWERTY/EE Concept. Quantifying Recyclability and Eco-efficiency for end-of-Life Treatment of Consumer Electronic Products. Delft: Dissertation Delft University of Technology.

Huisman, J., A. Stevels (2003), Balancing Design Strategies and End-of-Life Processing. Manuscript.

IMPEL (2003), Effective Enforcement Needs a Good Legal Base: the Final Report of the IMPEL Better Legislation Project, Number 13, 2003 - http://europa.eu.int/comm/environment/impel/pdf/better_legislation_report.pdf from 5 August 2004.

Interseroh (2004), State-of-art of Collection Logistics March 1st, paper presented at the SCARE Confeerence, 2004 Budapest Hungary.

Jaffe, A.B., R.G. Newell, R.N. Stavins (2001), Technological Change and the Environment, Faculty Research Working Paper Series RWP00-002, John F. Kennedy School of Government, Harvard University.

Kemp, R., K. Smith, G. Becher (2000), How Should We Study the Relationship between Environmental Regulation and Innovation?, in: J. Hemmelskamp, K. Rennings, F. Leone (eds.), Innovation-oriented Environmental Regulation, ZEW Economic Studies 10, Heidelberg: Physica.

Kemp, R., D. Loorbach (2003), Governance for Sustainability Through Transition Management, paper for EAEPE 2003 Conference, November 7-10, 2003, Maastricht, The Netherlands, (http://meritbbs.unimaas. nl/rkemp/ Kemp_and_Loorbach.pdf), from on 1 May 2004.

Klemmer, P. (1999), Nachhaltigkeitspolitik – eine ordnungspolitishe Würdigung . In: M. Junkernheinrich (ed.), (1999), Ökonomisierung der Umweltpolitik. Beiträge zur volkswirtschaftlichen Umweltökonomie. Angewandte Umweltforschung 15. Berlin: Analytica: 99-106.

Klemmer, P. (1994), Nachhaltige Entwicklung aus ökonomischer Sicht. Zeitschrift für angewandte Wirtschaftsforschung 7 (1): 14-18.

Klemmer, P., U. Lehr, K. Löbbe (1999), Umweltinnovationen: Anreize und Hemmnisse, Innovative Wirkungen umweltpolitischer Instrumente 2, Berlin: Analytica.

Kloepfer, M. (2001), Produktverantwortung für Elektroaltgeräte. Schriften zum Umweltrecht Band 106. Berlin: Duncker & Humblot.

Kloepfer, M. und M. Kohls (2000), Abfallrechtliche Produktverantwortung für Fremdgeräte, DVBl:. 1013–1025.

LAEKEN (2001), The Future of the European Union – Laeken Declaration on 15 December 2001.- http://europa.eu.int futurum/documents/offtext/doc151201_ en.htm from 5 August 2004.

Louven, K., C. Louven (1991), Das Territorialitätsprinzip im Internationalen Sozialrecht. NZA 1991: 497 – 501.

Lucassen, W.H.P. (2002), Solutions on WEEE to the Industry, in: Proceedings of the International Electronics Recycling Congress January 9-11 2002 Davos, Switzerland.

Lundvall, B.-Å. (1988), Innovation as an Interactive Process – From User-Producer Interaction to National Systems of Innovation, in: G. Dosi et al. (eds.), Technical Change and Economic Theory, London/New York: Pinter Publishers: 349-369.

Lundvall, B.-Å. (1993), User-Producer Relationships, National Systems of Innovation and Internationalization, in: D. Foray und C. Freeman (eds.), Technology and the Wealth of Nations. The Dynamics of Constructed Advantage, London/New York: Pinter Publishers: 277-300.

Meinecke, I. (1996), Die deutsche Verpackungsverordnung und die mittelständische Verpackungsindustrie. Auswirkungen und strategische Reaktionsmöglichkeiten. Aachen, 1996: 102ff.

Menell, P. S. (1990), Beyond the Throwaway Society. An Incentive Approach to Regulating Municipal Solid Waste, in: Ecology Law Quarterly 17 (4): 655–739.

Messerschmidt, K. (2000), Ökologische Produktregulierung im deutschen Umweltrecht, in: M. Führ (Hrsg.), Stoffstromsteuerung durch Produktregulierung – Rechtliche, ökonomische und politische Fragen, Umweltrechtliche Studien 26, Baden-Baden: Nomos: 57–83.

Metcalfe, S. (1995), The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives, in: Stoneman, P. (ed.): Handbook of the Economics of Innovation and Technical Change, Blackwell/London 1995, pp. 409-512.

Meyer-Stamer, J. (2003), Understanding the Determinants of Vibrant Business-Development: The Systemic Competitiveness Perspective, (http://www. mesopartner.com/publications/ Systemic_WIRAM.pdf), from 2 May 2004.

Müller-Hagedorn, L. (Hrsg.) (2000), Zukunftsperspektiven des E-Commerce im Handel, Frankfurt am Main: Deutscher Fachverlag.

Nelson, R.R. (ed.) (1993), National Innovation Systems: A Comparative Analysis, New York: Oxford University Press.

NFO Infratest (Hrsg.) (2002), Monitoring Informationswirtschaft. 5. Faktenbericht 2002. München: NFO.

Nooteboom, B. (2000), Institutions and Forms of Co-Ordination in Innovation Systems. In: Organization Studies 21 (5): 915-939.

OECD (1996), Draft of Revised Chapter IV of the Oslo Manual – Basic Definitions. DSTI/EAS/STP/NESTI(96)8/PART4. Paris: OECD.

OECD (2001), Extended Producer Responsibility. A Guidance Manual for Governments. Paris: OECD.

OECD (2002), Measuring the Information Economy. Paris: OECD - http://www. oecd.org/pdf/M00036000/M00036089.pdf, from 16 May 2003.

OECD (2003), Consumers in the online marketplace: The OECD guidelines three years later. Report by the Committee on Consumer Policy on the Guidelines for Consumer Protection in the Context of Electronic Commerce. JT001386-46. 03-Feb-2003. (http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/af6ec39d8631ca3ac1256cc2005c0edf/$FILE/JT00138646.PDF, from 16 May 2003).

OECD ENV/EPOC/PPC()/)21/REV2, 12 May 1998, p.25 ff.

ORGALIME (2000), Proposal for a Directive on Waste Electrical and Electronical Equipment (COM(2000) 347 final), 13.6.2000. The impact of electronic commerce. ORGALIME Information Paper (5 September 2000). Brussels. (http://www.zvei.org/umwelt/altgeraete/dokumente/E-Commerce_E_20000905.PDF - from 2 May 2003.

Ossenbühl, F. (1999), Entsorgung von Elektroaltgeräten – Verfassungsrechtliche Zulässigkeit von Rücknahmepflichten, Rechtsgutachten im Auftrag ZVEI, Oktober 1999 -http://www.zvei.org/umwelt/default_altgeraete.htm and http://www.zvei.org/news/Presseinformationen/2000-02/Pr11_2000.htm, from 16 May 2003.

Palmer, K. L., W. E. Oates und P. R. Portney (1995), Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm? Journal of Economic Perspectives 9 (4): 119–132.

Pearce, D.W., K.R. Turner (1990), Economics of Natural Resources and the Environment. New York: Harvester Wheatsheaf.

Perchards (2004), Transposition of the WEEE Directive in other EU Member States. – http://www.dti.gov.uk/sustainability/weee/perchardsreport.pdf from 5 August 2004.

Petrauschke, B., S. C. Kaumanns (2003), Informationstechnologie in Unternehmen in WISTA 2/2003 Wiesbaden: 106-114.

Philipp, A (1993), Duales System, Rücknahmepflicht und Pfandregelung. Eine vergleichende Untersuchung unter besonderer Berücksichtigung des Einzelhandels. Mainz.

Porter, M. E. und C. van der Linde (1995), Toward a New Conception of the Environment-Competitiveness Relationship. Journal of Economic Perspectives 9 (4): 97–118.

Press and Communication Directorate-General, Public Opinion Analysis Unit (ed.) (2002), Public Opinion in Europe: Views on Business-to-Consumer Cross-Border Trade. Standard Eurobarometer 57.2, Flash Eurobarometer 128. Brüssel - http:// europa.eu.int/comm/consumers/cons_int/safe_shop/fair_bus_pract/ green _ pap_ comm/studies/eb57-fb128_final_report_en.pdf. from 16 May 2003.

Quack, D., Gensch, C.O., Otto, T. (2001), Telekommunikation und digitale Produkte, in: UmweltWirtschaftsForum 9 (3): 36.

Reiß, W. (2001), Umsatzsteuerrecht, 7. Auflage, Köln: Alpmann und Schmidt.

Rennings, K. (1999), Bausteine einer Umweltinnovationstheorie und -politik – Neoklassische und evolutionsökonomische Perspektive, in: ders. (Hrsg.), Innovation durch Umweltpolitik, Baden-Baden, Nomos: 15-46.

Rennings, K. (2000), Redefining Innovation – Eco-Innovation Research and the Contribution from Ecological Economics. Ecological Economics 32 (2): 319–332.

Rockholz, A. (2003), Vortrag gehalten auf dem Eurochambres workshop on the implementation of the Directives on Waste Electrical and Electronic Equipment (WEEE) am 24. Juni 2003 in Brüssel.

Rotmans, J., R. Kemp, M. van Asselt (2001), more evolution than revolution – transition management in public policy, foresight / vol. 03, no. 01, feb. 01, p. 005, (http://www.icis.unimaas.nl/publ/downs/01_12.pdf), from 2 May 2004.

Scherhorn, G., L. Reisch, S. Schroedl (1997), Wege zu nachhaltigen Konsummustern – Überblick über den Stand der Forschung und vorrangige Forschungsthemen, Marburg: Metropolis.

Schmitz, St.W., P.P. Sint, (2003), B2C eCommerce Strategy and Market Structure: The Survey Based Approach. DIW-Discussion Papers Nr. 323. Berlin.

Schnurer, H. (2004), Regelungen der WEEE sollen bei Umsetzung nicht verschärft werden. In Re Nr. 47 v. 18.11.2003, S. 21.

Shove, E. (2002), Sustainability, system innovation and the laundry, published by the Department of Sociology, Lancaster University, Lancaster LA1 4YN, UK, at http://www.comp.lancs.ac.uk/sociology/papers/shove-sustainability-system-innovation.pdf, from 7 May 2004.

SMART ECODESIGN GUIDE of CFSD (2004), http://www.cfsd.org.uk/etmuel/index. html from 7 May 2004.

SRU – Der Rat von Sachverständigen für Umweltfragen (Hrsg.) (1998), Umweltgutachten 1998, Stuttgart: Metzler-Poeschel.

Statistisches Bundesamt (Hrsg.) (2002), Umwelt Abfallentsorgung. Fachserie 19, Reihe 1, Berichtsjahr 1999, Stuttgart: Metzler-Poeschel.

Staudt, E. et al. (1997), Die Verpackungsverordnung. Auswirkungen eines umweltpolitischen Großexperimentes. Schriftenreihe Innovation: „Forschung und Management“, Band 11. Bochum 1997, S. 55ff. with additional bibliographic hints.

Stevels, A. (2003), Lessons learned from 10 years take-back and recycling. In: Proceedings of the International Electronics Recycling Congress, January 9-11 2002 Davos, Switzerland.

Stevels, A. (2003a), Lösungsstrategien der Konsumgüterhersteller. Vortrag gehalten auf dem Workshop „Delegieren und Handeln – WEEE und RoHS in der Elektronikindustrie. Strategien für Unternehmen zur Umsetzung von Produktverantwortung, Produktrücknahme und Stoffverboten. Veranstaltet vom Fraunhofer Institut Zuverlässigkeit und Mikrointegration (IZM) am 21. November 2003 in Berlin.

Stevels, A. (2003b), Take back and Recycling of Consumer Electronics at work in the Netherlands. Manuscript.

Stevels, A. (2003c), Is the WEEE Directive EcoEfficient?, in: Proceedings of the International Electronics Recycling Congress January 13-15 2003 Basel Switzerland.

Stevels, A., C. Boks (2003), On the Effectiveness of the currently proposed EU Environmental Directives and Policies for Electronic Products. AB17-GO2-5051-187. Manuscript.

Stevels, A., J. Huisman (2003), An Industry Vision on the implementation of WEEE and RoHS. Manuscript.

Stevels, A., J. Huisman (2003a), WEEE und RoHS Lösungen der Konsumgüterhersteller. Vortrag gehalten auf dem Workshop „Delegieren und Handeln – WEEE und RoHS in der Elektronikindustrie. Strategien für Unternehmen zur Umsetzung von Produktverantwortung, Produktrücknahme und Stoffverboten am 21. November 2003 in Berlin. Veranstalter: Fraunhofer Institut Zuverlässigkeit und Mikrointegration (IZM).

Stirling, A. (2004), Diverse Designs: fostering technological diversity in innovation for sustainability, Paper submitted to BMBF/ESRC/RIW/EC conference on 'Innovation, Sustainability and Policy', Kloster Seeon, Germany, May 2004, p. 30ff.

Taistra, G. (2000), Die Porter-Hypothese zur Umweltpolitik. Wiesbaden: Deutscher Universitäts-Verlag.

Taylor, B. (2002), Providing a home, in: Recycling today, November 2002: 23ff.

Taylor, Nelson, SOFRES consulting (2000), Cost-Efficiency of Packaging Recovery Systems – The Case of France, Germany, The Netherlands and the United Kingdom (http://europa.eu.int/comm/enterprise/environment/reports_studies/studies/study00cost-eff_sofres_502038.pdf) from 7 May 2004.

Theusner, H. (2003), Ziele, Aufgaben und Organisation eines nationalen Registers für Elektroaltgeräte. Vortrag gehalten auf dem Workshop „Delegieren und Handeln – WEEE und RoHS in der Elektronikindustrie. Strategien für Unternehmen zur Umsetzung von Produktverantwortung, Produktrücknahme und Stoffverboten. Veranstaltet vom Fraunhofer Institut Zuverlässigkeit und Mikrointegration (IZM) am 21. November 2003 in Berlin.

TNS Infratest/IIE-Institute for Information Economics (2004), Monitoring Informationswirtschaft, 7. Faktenbericht 2004: E-Commerce. Eine Sekundärstudie und Ergebnisse einer Expertenumfrage im Auftrag des BMWA München, April 2004 – http://193.202.26.196/bmwi/Faktenbericht_7/pdf/FB7_EK_E-Commerce.pdf – from 7 July 2004.

Tobias, M. (2003), Konsequenzen der WEEE/RoHS für die deutsche Elektronikindustrie am Beispiel der Informations- und Kommunikationsbranche. Vortrag gehalten auf dem Workshop „Delegieren und Handeln – WEEE und RoHS in der Elektronikindustrie. Strategien für Unternehmen zur Umsetzung von Produktverantwortung, Produktrücknahme und Stoffverboten. Veranstaltet vom Fraunhofer Institut Zuverlässigkeit und Mikrointegration (IZM) am 21. November 2003 in Berlin.

Umweltbundesamt (UBA) (Hrsg.) (2000), Daten zur Umwelt 2000. Berlin.

UNCTAD (2003), E-Commerce and Development Report. Internet Edition. Complete Version – http://www.unctad.org/en/docs//ecdr2003_en.pdf – from 7 July 2004.

United Nations Division for sustainable Development, Agenda 21 (n.d.). – http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter4.htm, from 7 August 2003.

Van Oers, L., R, Kleijn, E. van der Voet (2002), Dematerialisation for urban waste reduction: Effectiveness and side-effects, CML-SSP Working Paper 02.001, Leiden, September 2002.

Wegner, G. (1998), Entstaatlichung der Umweltpolitik durch innere Institutionen?, in: Formelle und informelle Institutionen – Genese, Interaktion und Wandel, ed. by G. Wegner and J. Wieland, Marburg 1998.

Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI), GfK Marketing Services GmbH (2003), Zahlenspiegel des deutschen Elektro-Hausgerätemarktes 2003. Frankfurt und Nürnberg.

Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI) (2003a), Statistischer Bericht 2002/2003. Frankfurt.

Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI), GfK Marketing Services GmbH (2003b), Zahlenspiegel des deutschen Elektro-Hausgerätemarktes 2003/2004. Frankfurt und Nürnberg.

Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI) (2000), EU-Pläne zur Elektronikentsorgung und Elektroaltgeräte-Verordnung in Deutschland: Fehlende Rechtssicherheit und massive Wettbewerbsverzerrungen für die Elektroindustrie unakzeptabel - Erfordernisse des E-Commerce nicht berücksichtigt. ZVEI 12/2000 (http://www.zvei.org/news/Presseinformationen/2000-03/Pr12 _2000.htm.