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Wirtschaftsforschung, Gesellschaft für Arbeits-,  
Reorganisations- und ökologische Wirtschafts-  
beratung 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 – Summary



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Phone +49 (0) 201/81 49-0, Fax +49 (0) 201/81 49-200, e-mail: rwi@rwi-essen.de

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Project Team:

**Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)**

Marianne Halstrick-Schwenk (Coordination), Ronald Janßen-Timmen,  
Dr. Markus Scheuer, Dr. Hartmut Clausen

**Gesellschaft für Arbeits-, Reorganisations- und ökologische  
Wirtschaftsberatung mbH (ARÖW)**

Dr. Joachim Hafkesbrink, Markus Schroll

**Society for Institutional Analysis, University of Applied Sciences, Darmstadt**

Prof. Dr. Martin Führ, Jaqui Dopfer, Stefanie Merenyi

## **1. Scope and Content of the Study**

In order to take account of environmental concerns of sustainable development both, German waste management policy and EU environmental policy are following the paradigm of the circular flow economy, and standardizing (extended) producer responsibility for the manufacturers or sellers of certain product groups. Take-back obligations are considered an essential instrument within this context to improve both, ecological effectiveness and economic efficiency of the avoidance, recycling and disposal of waste. With being charged the disposal costs of their products, producers are forced to include aspects of disposal already during the stages of design and production. After take-back regulations for packaging, batteries, and end-of-life vehicles were introduced during the last years in Germany last but not least as the transpositions of corresponding EC Directives, now the respective EC Directive on Waste of Electronic and Electrical Equipment (WEEE Directive) had to be transposed into national law until 13 August 2004.

Such charging, however, is questioned when products are distributed to consumers through direct cross-border distribution channels, especially the electronic markets (Business-to-Consumer e-commerce, B2C) which are supposed to increase rapidly. If producers are situated outside the purview of the regulation, the disposal costs cannot be assigned to them. Then, the problem of free-rider phenomena and distortion of competition arises and possibly the desired innovations with respect to an increased avoidance and a better disposal of waste products may not be realized.

In trade within the EU, the solution to this problem would require a significant harmonization of policy. The WEEE Directive includes the problem explicitly, but does not give any detail on the practical solution. In international trade with countries outside the European Union, a conflict between free trade and environmental protection could appear.

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 economic relevance of this regulatory defect, and the evaluation concerning consequences for sustainable innovations, and
- the derivation of need for action and the pointing out of possible solutions on a national and international level.

Presentations and analysis in this study are mainly based on the situation in Germany. The innovation system of the electrical and electronic (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.

This study is based on the evaluation of the relevant legal and environmental economic literature, respectively statistics and expert interviews with the European Commission, the German Federal Ministry of Environment (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.

## **2. Theoretical Background: EPR, Innovation and Take-back Ordinances**

Extended producer responsibility (EPR) is the basic principle of European and German waste policies. The OECD defines it “as an environmental approach within which a producer’s responsibility, physical or/and financial, is extended to the post-consumer stage of a product’s life cycle”. 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 governments and the producers. 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. In Germany this concept corresponds to the concept of “Produktverantwortung” of the Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (KrW-/AbfG). The concretization of “Produktverantwortung” (product responsibility) has to be mandated by statutory ordinances (§§ 23 and 24). Besides take-back obligations as one of the most important instruments mandatory requirements regarding the condition and the use of products, prohibitions of certain products, as well as labeling obligations for the contained material etc. can be chosen (§ 23).

Economic innovations are mostly considered as technical improvements in the form of new products, processes, or new forms of organizations. This innovation concept is extended on the one side by social innovations, i.e. the norms and values of a society aiming to achieve environmentally friendly patterns of consumption. On the other side the concept is extended by institutional innovations concerning the institutional frameworks of a society. They comprise changes of the so-called formal and informal regulations. In this respect institutions are defined as a system of rules and standards steering individual behavior in a certain direction. The traditional environmental policies and their measures are to be characterized as changes in the formal regulations.

If through the take-back obligations the assignment of the disposal costs to the producers will be successful this instrument can contribute to permanently realize incentives and innovation effects with a view to better recycling and disposal possibilities. Such innovations on the production level

could consist of changes in the product design contributing to an increased useful life (in a technical sense) or to improved dismantling characteristics. An environmentally relevant process innovation could be the reduction of the resource input e.g. through closed loop circulation. Correspondingly, on the level of recovery product- and process innovations 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.

Take-back obligations complement the regulation pattern of environmental policy with its institutions and instruments. The innovation effects therefore must as well be evaluated against this background and in the context of further factors like the regulation pattern of the innovation systems, the institutional and market conditions of the waste sectors and also the recycling and disposal prices.

Innovations are assigned a central role with respect to sustainability. They are assumed to be keys factors for the solution of many conflicts and for the mobilization of synergies between environment, economy and society. Analogously to the three-pillar-model an evaluation has to consider that sustainable innovations are not only innovations which lead to a better achievement of environmental objectives but at the same time lead to innovations with positive effects on economic and/or social goals.

In the case of cross-border distance trade, distributors outside the purview of the regulation have the chance to avoid the payment of the disposal costs. If they are successful they have direct economic advantages, and the domestic actors have to pay these costs additionally. As far as market relevant effects develop, distortions of competition will emerge with consequences for the behavior of the companies and governments in the importing countries. A changed behavior of the domestic actors particularly concerns innovation efforts in the field of end-of-life eco-design and improvements concerning material consumption as well as the attitude and the acceptance concerning the regulative patterns.

### **3. Relevant Products Groups in the Context of Possible Regulation Deficiencies of the Take-back Obligations**

Regarding the aim of this study, the focus is on product groups which already fall or in the future will fall under a take-back legislation and are or will be relevant for cross-border distance selling, mainly B2C. Distance trade 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. For this question the (non virtual) trade between business and consumer (B2C) is relevant. The sellers in cross-border distance trade comprise distributors and manufacturers that supply directly to consumers without a domestic intermediary.

According to estimations by market research companies the total volume of e-commerce worldwide is expected to increase up to 2.5 trillion US-\$ in 2004 and even up to 3.8 trillion US-\$ in 2005, the share of Western Europe being

30 %. However, only about 10 – 15 % of total global e-commerce can be attributed to B2C-e-commerce. Estimations of online trade with consumers in the last years have assumed for Germany a market volume of 4 to 6 billion €. The Federal German Statistical Office estimated the B2C-turnover with goods in Germany in an order of magnitude of about 6 billion € in the year 2002 as a minimum level. Whereas the association of German direct marketers has published for the year 2003 a total turnover (without digital services and travel) of only 3.6 billion € which, nevertheless, is three times more than in the year 2000. In general, the existing studies assume that the B2C-e-commerce will continue to grow considerably over the next few years.

The relevance of single product groups in direct marketing meanwhile can be traced fairly well on the basis of ongoing surveys. The criteria for successful direct marketing have been met best so far by: books, music-CDs, clothing and shoes, gifts, admission-tickets, computer hardware, CD-ROMs etc. The best examples of products which have only played a subordinate role until now, but which meet, in principal, the requirements of successfully being marketed via the Internet are auto parts.

Relevant in the context of possible regulation deficiencies caused by take-back-obligations are only cross-border flows of goods. The share of this kind of purchasing from private customers in another country is still very low; only 3 % of the total distance trade was estimated to be made cross-border.

Cultural factors, language problems, divergent styles, different technical standards, logistical problems and lack of security as to legal issues play an important role in international distance trade in general and consequently also in the Internet-assisted trade. It can be expected that besides items not deliverable within the countries (like antiques and exotica) the products which will be most successful will have a certain degree of homogeneity and are known internationally. According to this products which probably are most suitable for Internet-based business are books and entertainment storage media like CDs and DVDs. Technical goods also have a good chance of success. These comprise especially goods from the EEE sector like computer hardware, entertainment devices, communication devices and other small electrical appliances. The most important condition for growth will be that restrictions originating in differing technical standards will have to be overcome first.

The future growth of cross-border trade will most probably continue to be determined by the evolution of B2C. But presently there are hardly any indications that private households will use electronic media as frequently for purchases in foreign countries as was expected only a few years ago. In the last few years large direct-marketing companies have increasingly been engaged to establish affiliates or to co-operate with national partners in foreign markets in order to better meet demand. It can be assumed that especially big companies will choose this alternative. Small commercial suppliers, however, may even have problems to make themselves visible in the flood of information available in the internet. Their chances will improve if



they present themselves on Internet-platforms like for example ebay. And there will probably be the greatest chances for future growth. Nevertheless any forecast about the development of cross-border B2C in general as well as broken down by types of products remains highly speculative.

Concerning the relevance of regulations for this study with respect to end-of-life vehicles producers do not see any allocation problems 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. In the case of batteries a problem of assigning disposal costs could arise for those batteries which are imported by way of direct marketing of electrical and electronic equipment (EEE). This share should be rather small. It may not be expected that batteries will be bought abroad on a large scale. The regulation of packaging appears to be of interest in the context of cross-border distance trade because all products sold need packaging, and in this case due to protection purposes a packaging exceeding the need of packing common in the case of normal retail packing. Here a conflict may be conceivable. Electrical and electronic small appliances are products which are expected to reach a higher amount of cross-border B2C sales. Furthermore the directive explicitly requires a solution to 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 excursus as they do play a certain role for the calculation of distortions of competition. A changed innovative behavior concerning packaging as a consequence of non-assignment of disposal costs should be rather unlikely. So the main topic is the WEEE Directive resp. its national transposition as an impact for innovations within the context of the innovation system.

#### **4. Analysis of the Innovation System of the Electronics Industry (EIS)**

##### **4.1 Market- and Waste Situation and Regulation Framework of the EIS**

The market supply for the goods affected by the WEEE Directive is estimated to be about 45.8 billion Euros in Germany in 2002. Among these are mainly electrical household appliances with a share of 13.9 %, IT and telecommunications devices with a share of 52.5 % and consumer electronics with a share of 16.6 %. Within Western Europe the market volume for IT and telecommunications equipment was estimated to be about 115 billion Euros in 2002 and for electrical household appliances about 26 billion Euros, the respective market share for Germany being 22 % and 25 %. The **market situation** may be described by the fact that the market segments are more or less dominated by a few global players although most of the manufacturers are small and medium size enterprises (“SME”). 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 with the goods crossing borders more than once is not uncommon. Sales via the Internet (B2C) will gain more and more importance in the future.

According to the **waste situation**, currently, the total volume of electrical and electronic waste in Europe is estimated to amount to approximately 8

million tons per year, whereof about 1.8 arise in Germany. About 80 % of this waste volume is 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 will increase by 3-5% in the future. According to the ZVEI from 2005 on approximately 1.1 million tons of electrical and electronic waste per year are expected in Germany, the total waste disposal costs are expected to be between 350 and 500 million Euros per year. Even more problematic than the waste volume itself is the pollutant content of the EEE. Especially printed circuits from computers, cathode rays from monitors and CRT's, LCD-displays, and LEDs, and also the various plastic compounds with harmful additives and auxiliary materials (flame retardants, heavy metals, etc.) are considered particularly problematic. The waste management situation in Europe is characterized by a great variety. Whereas countries with take-back regulations maintain relatively sophisticated disposal systems with high 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.

The WEEE Directive as one of the decisive elements of the EEE **regulation framework** is an example for the concretization of the principle of extended producer responsibility within the European waste policy. The primary purpose 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. Furthermore with the concept of individual producer responsibility incentives to promote appropriate design and production of electrical devices shall be given (Art. 1). These goals shall be achieved by

- a separate collection of waste from private households, the return of old EEE free of charge for holders and distributors,
- the establishment of treatment systems for old EEE, set up individually or collectively, and
- the financial responsibility for new WEEE<sup>1</sup> to be ensured by a guarantee.

This is supplemented by other instruments e.g. legal requirements (recycling targets, special treatment standards). The WEEE Directive addresses products and producers independent from the selling method, including the supply of devices by means of distance communication. Thus, producers are responsible for the financing of take-back and disposal of goods sold via cross-border B2C e-commerce as well.

Although the WEEE lays down essential criteria at community level to reach an EU-wide harmonization there remains flexibility for the states to take their own legal and economic background, peculiarities and experiences into account. Therefore a wide range of solutions will exist in the dif-

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<sup>1</sup> Whereas the financing of the historical waste i.e. products put on market before 13 August 2005 will be assumed by one or more systems to which all producers have to contribute to in proportion to their market share.

ferent Member States. In addition many co-ordination problems between the involved actors emerge. To this belong definition problems (type of equipment), depth of sorting within the collection process, agreement on the state of the art of technology, agreement on registration, marking, guarantee and monitoring questions. It more and more becomes evident that for the implementation of the WEEE Directive a co-ordination on a supranational level, between national legal systems, between private organizations and/or private actors is crucial in face of increasing international product and waste flows.

Against this background above all global players express their interest in the harmonization i.e. they 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”. Within this context of harmonization the solution of the free-rider problem in general and the problem of cross-border distance trade – the latter a central focus of this paper - has to be considered.

#### 4.2 Expected Innovation Impacts of the WEEE Directive – ‘Reference Scenario’

Due to numerous serious alterations of the institutional context the way of how innovation is generated and disseminated in the EEE market has considerably changed within the past 10-15 years. According to upcoming environmental legislation especially due to the WEEE Directive, an alteration both of the configuration of innovation 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 were induced.

Knowledge genesis and knowledge conversion for the production of innovations nowadays take place in a complex network of different actors, who bring their different core capabilities (recycling and logistics, service provider, rep-processors etc.) together into the innovation process. Besides the complexity of the actor configuration, the complexity of the incentive structure and the drivers for innovations rises as well. By anchoring the EPR principle 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 undoubtedly 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 of relations to final customers in the B2B (Business to Business) and B2C (Business to Consumer) areas, however, take place in networks of manufacturers, equipment industry, recyclers, transport providers, service-providers, research-, science- and consulting institutions.

As depicted in figure 1, the **WEEE Directive** quite obviously influences different stakeholders of the innovation system by introducing direct and indirect 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 ‘*principle of producer responsibility*’, the definition of certain *standards* for the waste management, and several requirements concerning

labeling of products and the monitoring of data and mass flows. Manufacturers of EEE are burdened with the respective disposal costs leading to considerable pressure on re-structuring the product design to facilitate disassembly, the end-of-life (EOL)-management by establishing new logistical concepts, take-back and recycling systems, the innovation management by introducing new environmental oriented requirements like Design for environment (DfE) within the supply chain etc.

Figure 1  
Innovation drivers in the electronics industry innovation system

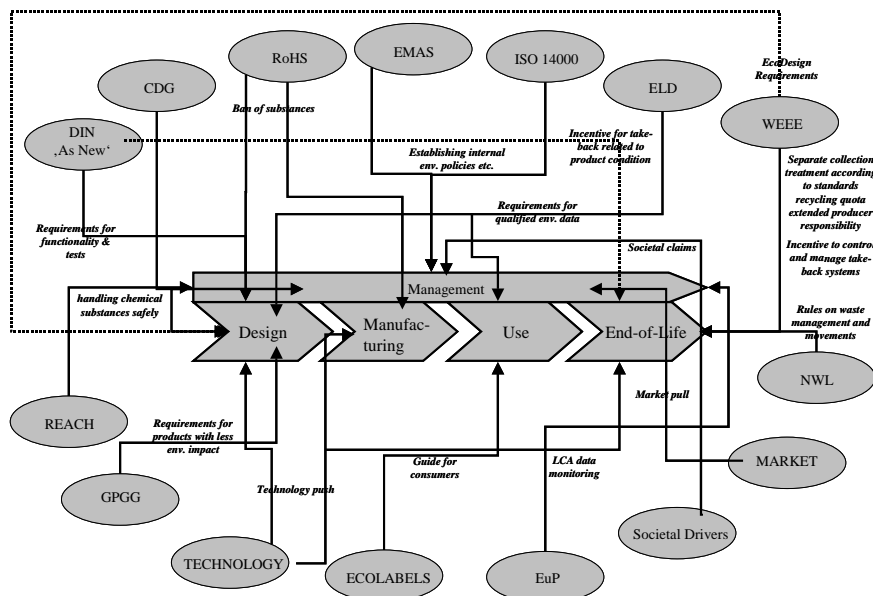


Figure 2 depicts a selection of 45 out of 120 innovations, rated as most important for the electronics industry as the result of an experts delphi within the ECOLIFE 2 network of the EU. These innovations are more or less all attributed to the changes in the governance regime of the EIIS following initial incentives of the WEEE/RoHS Directives and additional legislation. The innovations in figure 2 are directly related to sustainability indicators. Thus the leverage effects of these innovations according to an improvement of different economic, ecological and social indicators are displayed at the same time.

Figure 2  
Expected impacts of EEE innovation topics on sustainability indicators\*

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

\*Qualitative evaluation following the ECOLIFE 2 State-of-the-Art Report. This table comprises the results of a technology experts delphi (32 experts), conducted in 2003 in the ECOLIFE thematic network.

#### 4.2.1 Ecological Innovation Impacts

Figure 3 displays further subordinate indicators corresponding to the superior sustainability indicators “De-Materialization”, “De-Toxification” and “De-Energization” showing that in future as a result of a broad diffusion of these innovations a considerable improvement in ecological sustainability is supposed to be achieved:

Figure 3  
Leverage effect of sub-indicators to the superior sustainability indicators

	Ecological sustainability			
	De-Materialization	De-Toxification	De-Energetization	...
Reduction of waste amounts	strong impact	medium impact	low impact	
Increasing material productivity	strong impact	low impact		
Material substitution	medium impact	strong impact	low impact	
ReUse	strong impact	low impact	medium impact	
Recycling	strong impact	medium impact	medium impact	
Life-cycle oriented manufacturing and product strategies	strong impact	strong impact	strong impact	
New Use strategies	strong impact	low impact	strong impact	

A considerable **reduction of nowadays disposed waste amounts** will be obtained through the binding legal compliance to the WEEE- and RoHS Directives by all actors affected. On an operational level the de-materialization 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.

**Increasing material productivity:** As the result of pressures from the regulatory framework, especially the WEEE Directive, numerous product examples of the big players 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, and Discman) is smaller and lighter. In addition, by replacing hardware with software and e-solutions an increasing de-materialization takes place, substituting physical products with electronic. A further example of de-materialization 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 go Industry.

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 by 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 by 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.

Strategies for 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, video and electronics are constantly to be found. In selected market segments (mainly IT, telecommunication), specialized market participants are operating to exploit re-manufactured mobile phones, PCs, 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 **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. 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. This may enhance the use of secondary raw material even in the plastics sector in future.

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.

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.

#### 4.2.2 Economic Innovation Impacts

Essential for the economic efficiency of the chosen take-back system are **prices for disposal services** reflecting effective (individual) disposal costs of the producers, **competition to ensure** efforts to keep the disposal costs as low as possible and the **solution of the free-rider problem**. 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 individual partners or partners from all suppliers of take-back systems and as well build up own systems. 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. **Economies of scale** are preconditions for an efficient WEEE disposal and the main reason against individual solutions and for collective systems. Positive effects of increased economies of scale will be evident in almost all parts of the recycling value chain. Furthermore the positive environmental impact of economies of scale (e.g. less transport) may even outweigh the environmental benefits of individual solutions.

Another important efficiency indicator is the “**solution of the free-rider problem**” by the take-back scheme, in the case of WEEE due to no-name products and abandoned products a considerable problem. 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. This requires that e.g. in Germany 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, and companies which are only on the market shortly.

The required recovery quota of the WEEE Directive in the individual disposal markets should be achieved by an appropriate *cost/benefit ratio*. As indicator for the relation between ecological and economic impacts “**eco-efficiency**” is named. According to studies in the Netherlands, the weight-oriented definition of the recycling goals within the WEEE Directive does not adequately take into account the environment pollution potential, as a result the efforts for recycling may lead into the wrong direction with economically counterproductive consequences. As typical examples are stated the precious metal dominated and plastic products. Furthermore the recycling potential of the concerned products has to be considered to a greater extent.

The question whether an improved **EOL-eco-design** will be achieved by way of producer responsibility carried out by an individual solution - apart from the high costs of an exact producer-related sorting - is to be seen differently for single product groups. Results of Dutch studies for the consumer electronics sector show that the role eco design can play is overestimated. The share of disposal costs compared to value is very small and other kinds of restrictions are limiting the freedom for design for end-of-life activities like design changes concerning functionality, or legal requirements (e.g. obligations 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. 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.



#### 4.3 Effects of Free-rider Behavior on Competitiveness Regarding Cross-border Trade – ‘Defect Scenario’

Depending on the amount of recycling costs not attributable due to cross-border direct marketing, distortions of competition in the market of EEE may arise and prompt competitors to adaptation reactions which may impede the aspired steering effects of the take-back regulation. In 2001 in telecommunications, audio-/video devices, PC and PC-components as well as in other small appliances, about 456 million items with a total value of more than 33 billion € were sold 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 billion € (not including return costs and transaction costs)<sup>2</sup>. This is only 1 % of the domestic market provision, but compared to an operating margin of e.g. 2 to 3 % this order of magnitude, however, is not to be neglected and shows, in fact, a possible economic advantage of direct importers. But as currently indicators show hardly any actual significance of cross-border B2C the disposal costs having to be born in addition by domestic producers can be neglected.

With setting margins for a possible future development for B2C and cross-border B2C ideas for a volume of these potentially not chargeable costs until the year 2010 shall be gained. The German trade association HDE estimates a share of 6 to 10 % of B2C trade in the overall turnover possible in 2010 which is assumed as lower limit for the product groups under review. Concerning the importance of cross-border sales in the B2C the free-rider share is estimated to amount to 10 %. By multiplying the two factors the resulting share of non-allocable disposal costs in the overall disposal costs can be given with about 1 %. The upper limit of the B2C in the overall turnover of the product groups is considered to be some 30 %. This figure was thought to be possible for these products by ZVEI for 2000 and ORGALIME for 2003. The share of cross-border turnover also was set at 30 %. This results in a share in the total disposal costs of 9%. Both settings for the cross-border trade are rather optimistic figures, to get an idea from which order of magnitude disposal costs having to be born in addition may become a problem.

These considerations demonstrate that a distortion of competition in disfavor of the domestic enterprises by bearing potentially non-assignable disposal costs as well will only take place if cross-border trade would increase greatly, which seems to be rather unrealistic to such a degree.

Additional distortions of competition by the fact that B2C cross-border traded electrical devices will also include packaging which has to be disposed inland can be rather neglected on a quantitative basis. This view is supported by the fact that the task force created by the DSD in the year 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

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<sup>2</sup> They have to be regarded as hypothetical costs since the WEEE Directive requires a solution of this problem when implemented into national policy.

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.

As the disposal costs of the individual products differ clearly the impact of free-riders on competition was shown by the example of mobile PCs, DVD players, printers and portable audio sets. For these products the share of disposal costs in product price per unit varies between 0.5 % for mobile PCs and 1.3 % for printers. The expected free-rider portions being between 1 % and 9% of the domestic market provision additional disposal costs would be within a range from 0.005 % to 0.05 % for mobile PCs and 0.013 % to 0.13 % for printers being of no actual importance for these products either.

It may be expected that the disposal costs will increase considerably in the course of the years to come as the WEEE Directive sets high quota for recycling and re-utilization which will require an improvement of cost-intensive dismantling. The smaller the products the higher the expected cost increase possibly will be. For portable audio products for example a quadruplicating from 0.35 € per kilo to 1.35 € per kilo must be expected to approximately meet the quota according to a Dutch analysis. And as all products under review are under a high competitive pressure along with tendentially decreasing prices as well, the problem will be even larger. An economic advantage of free-rider behavior due to cross-border sale will be there. But nevertheless, even then disposal costs to be born in addition by domestic producers will distort competition only in the case of an extreme increase of these kinds of sales. A problem may be seen for small and cheap devices.

As a reaction to a distortion of competition it may be possible that smaller firms will try to act as free-riders avoiding paying disposal costs for their products. They may try to relocate their sales organization (virtually) to foreign countries leaving their distribution center(s) inland. Considering the transport costs of reorganizing distribution as well such changes do not seem worthwhile. To avoid upcoming distortions, large firms with plants in many countries are more interested and engaging in lobbying to improve the regulations of the WEEE Directive, especially in solving the free-rider problem by a transnational strategy, as they feel the consequences everywhere.

Innovation behavior in general is not expected to be a subject of change assuming that action thresholds are not exceeded to an extent that innovation actors are encouraged to desert existing technological and belief paradigms.

##### **5. Transnational Law Making in View of the Free-rider Problem**

In view of Environmental Product Regulation transnational B2C-transactions create interface problems on different levels. Main interfaces in this context are, firstly, the legal interfaces concerning the financial guarantee to be provided by manufacturers within the WEEE implementation and its enforcement. These interface problems derive from the fact that national

WEEE legislations must provide tools which allow the enforcement of product responsibility also across borders. This means that producer shall become subject not only to the legislation of his home country but is also obliged to follow the provisions of the state where the purchaser resides. Therefore it must be decided e.g. if the sanctions will be enforced by the national authorities of the producer's or the purchaser's Member State.

Secondly another relevant interface problem addresses the actual implementation like the necessary transnational monitoring and data management systems for the product and waste streams. To enforce the financial guarantee a monitoring system must be installed in every Member State, enabling the evaluation of compliance with the requirements from Art. 8 (4) WEEE. This requires a monitoring of data about the EEE as to the time of marketing and when returned as waste. Therefore an unequivocal electronically marking of EEE is necessary, containing e.g. information about the producer and the product category.

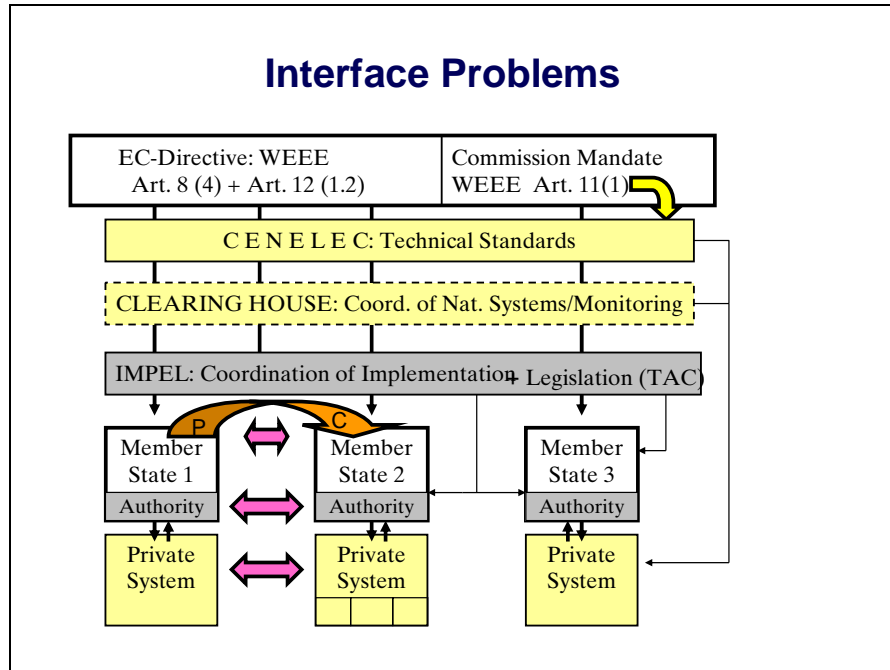
In coping with these interface problems new legislative tools and co-operation mechanisms are to be developed. Regarding the trade of EEE one of these tools is the financial guarantee each producer<sup>3</sup> has to provide when placing a product on the market in order to show that the management of the deriving waste (WEEE) will be financed by him and free-riding<sup>4</sup> of producer is prevented. Art. 8 (4) WEEE obliges Member States to ensure producers' guarantee also when delivering their EEE across borders. The guarantee is aimed at refunding the costs of waste management in the purchaser's country. Therefore the national implementation of this directive must contain an entitlement against the producer, also across borders. Transnational law making of the WEEE Directive represents a break in the operating method of legal systems known so far in the environmental policy. A new type of transnational legal obligation is considered: producers shall no longer be subject to their national legislation only, but shall have to comply also with the product related environmental rules in the purchaser's country, independently of having a business agency there. The second break appears when not longer the location of the addressee (*subject of law*) decides on the equivalent legislation but the *object of law*. This means, the final location of the traded EEE, transformed to waste, decides on the applicability of a certain foreign regulation on the territory of the producer's Member State.

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<sup>3</sup> Concerning the 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 electrical and electronic equipment on a professional basis into a Member State.”

<sup>4</sup> So called free-riding would happen, if the producer of the EEE (which turned to WEEE) should not exist any more or should try to prevent to be pursued.

Figure 4  
**Interface Problems Concerning Cross Border B2C in Implementing the WEEE Directive**



Underline:

Interface Problems:

Mandate to a Standardization Body:

P: Producer, C: Consumer  
 Cooperation Forms and Initiatives:

Producer to Consumer B2C:

However, the WEEE Directive does not offer any detailed framework on how to establish these transnational duties. To allow a harmonized implementation of future European legislation and an optimizing of cross border product responsibility new co-operation forms between the actors and authorities of different Member States have to be established and institutional innovations are needed. A close and proactive co-operation of all 25 Member States respectively of their authorities and private systems is necessary. To solve or at least to reduce horizontal interface problems in vertical view a standardization of several details is needed. Regarding technical issues, as e. g. the unequivocal electronic marking of EEE (Art. 11 (2) WEEE), European standards could be promoted by a mandate given by the Commis-

sion to CENELEC<sup>5</sup> to support the implementation of WEEE. The implementation and enforcement of law could be supported by IMPEL<sup>6</sup>. And regarding the monitoring system and the data management a central European Clearing House might be helpful to coordinate the different national systems.

The legislation on the European level needs more precise defaults if and what kind of transnational law making is necessary. This will be contradictory to a directive's nature as set out in Art. 249 (3) EC, but Member States can not 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. Especially the need for unitary decisions of all Member States shows that on these items a European decision is necessary<sup>7</sup>. 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 directive 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 can lead to a mutual obstruction in the implementation process, this danger must already be identified while designing the directive. It then must provide a defined procedure arranging the order in which the uncertainties have to be eliminated. Without that, each actor involved may wait for the other to start.

Regarding the legislation on the national level it has become evident that the transposition of an EC Directive with any reference to transnational law making can not be successful by Member States acting separately. Therefore the need for early interactions between all Member States should be considered already during the design of such a directive by providing defined procedures in order to organize these communications. With respect to a cross-border enforcement of national legislation the need for co-ordination on the EC-level is evident. Only on this level the necessary exchange between authorities of all Member States can be realized. Moreover the adaptation of technical aspects, such as central translations of national legislation, can be provided only here. In this context the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL), already experienced in this field, should be integrated at an early stage.

Under the WEEE regime, especially under national legislation derived from transposing Art. 8 (4) WEEE, producers need a good regulatory understanding in order to find out which legislation they have to comply with. This requires a producers readiness to adapt to different national legislations in general. Even if producers may do so, it can not be expected that they will become legal experts. This is why it will be likely that most produc-

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<sup>5</sup> Comité Européen de Normalisation Electrotechnique; European Committee for Electro-technical Standardization.

<sup>6</sup> European Union Network for the Implementation and Enforcement of Environmental Law.

<sup>7</sup> Examples are how the monitoring system should be designed, where distance sellers have to provide their financial guarantee and into which national register they have to enrol.

ers will need assistance in finding out which legislation they have to comply with. Industry associations should be ready in order to provide this assistance.

With respect to consumers recital No. 15 and Art. 10 (2) WEEE provide appropriate measures which shall be adopted by the Member States, to stipulate consumers' participation in the WEEE management. Against this background the national legislation should secure that consumers will have access to all data which is needed to evaluate if an Art. 8 (4)-producer complies with the basic demands from the WEEE Directive (especially the registration of producers and the guarantee verification). So consumers and consumer organizations can be enabled to control the functionality of the guarantee system, e. g. with help of testing purchases in order to find out if the declared information can be confirmed. Moreover the transparency resulting from this data access should also avoid the trade of appliances without any given guarantee (free-riders), as well informed consumers can consciously decide which producer they want to trade with.

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 flows 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 in a way the waste can be tracked back to them. Such tracing would be possible if electronic or other tags would provide producer data, so that collection, treatment and disposal costs can be recollected from the producer. Such provisions (concerning the registration of all producers and marking of all products) ensure 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 (transboundary B2C versus other forms) is avoided. Obstacles for the Common Market derived from the implementation of Art. 8 (4) WEEE in an isolated form could be reduced. For that reason an amendment of the WEEE Directive is recommendable.

The efforts of implementing transnational individual producer responsibility are high. They are reasonable when an individual producer liability including 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 and for which products or kind of wastes 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. If innovations of product design or in the utilization of products can not be expected or if the amount of products or their weight is negligible, a cost-benefit-analysis could suggest that a collective waste treatment liability is superior to an individual producer liability. In such circumstances all producers are responsible for the costs of treating and disposing WEEE collectively and must find criteria to share such costs. This can also include cross-border trade, by making an assumption on the amount of exported products. Such collective producer liability is currently enforced for batteries as well as packaging. The relatively high cost of electronic tags can be foregone in such cases and the efforts of monitoring the transnational product and waste streams as well as to manage the transnational data exchange will be much more less. But it is possible that individual Member States will have higher costs than revenues from national producers as cross-border trade is not covered, because a fixed code to share the costs is less accurate and less flexible than the producer specific allocation. And free-riding of foreign producers might occur more easily, because of the absence of the additional control by the tags (and a guarantee is not required).

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. Between the Member States a clearing process 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. 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.

The WEEE Directive aims to secure EU-wide producer responsibility.. Therefore, the transposition of Art. 8 (4) WEEE needs a well adjusted and EU-wide coordination of the national legislation accompanied by a standardized data exchange between the national guarantee-mechanisms and the waste management systems. Transnational law making under the regime of the WEEE Directive can be successful only with help of every actor involved and by the awareness of joint responsibilities of the various European institutions and the Member States.

To improve a harmonized form of transnational law the following measures have to be undertaken: First the implementation of Art. 8 (4) has to be harmonized and coordinated throughout the EU. Therefore the responsibilities have to be determined, a uniform system for the data transfer has to be developed and a system for providing a transboundary guarantee has to be established. Second, the product marking (what technical form and which tag content might be necessary) has to be standardized.

A further result of the study is the recommendation of a WEEE Amendment. The distinction between transboundary EEE-movements caused by B2C-transaction and after sales border crossing is problematic for the internal market (due to the need of specific labeling in enforcing Art. 8 (4)) as well as in regard to the objectives of the WEEE Directive. This problem could be solved by an EU-wide uniform labeling and registration of all EEE-products. This WEEE-Amendment will allow covering all transboundary movements of EEE after placing on the market by the producer and thus strengthen the individual producer responsibility as well as the principle “*that these measures avoid distortions of the internal market and do not hinder compliance by other Member States with this directive.*” (Directive 2004/12/EC, Article 6 (10)).

## 6. Further Questions and Research Topics

Conclusions of this study with respect to further research questions concern two issues:

- a) Further implementation of the WEEE/RoHS Directives, and
- b) Transition of the EIS towards sustainability.

Ad (a) The implementation efforts in the Member States up to now were directed towards meeting the transposition deadline of 13 August 2005. Besides issues of the operational implementation of the transnational producer responsibility (chapt. 5.), future research questions mainly concern 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 or are using only one-dimensional evaluation indicators like “effectiveness in collection and treatment”<sup>8</sup> or “cost-effectiveness in collection and treatment”<sup>9</sup>. A complex indicator system for the evaluation of the consequences of take-back regulations for the innovation 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, but have not been applied in comparative WEEE studies across the EU so far. Against this background and in view of the amendment process

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<sup>8</sup> By evaluating indicators like “geographical coverage”, “WEEE collection volumes”, “recycling performance”.

<sup>9</sup>By using the indicator “costs per kilogram”.



of the WEEE- and the RoHS Directives a considerable political need for action is to be ascertained. Evaluation criteria should be incentives for final 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.

(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 of counter-productive transportation throughout Europe may occur following price-downgrades of WEEE treatment. Uncertainties with the recyclers are presently leading to a 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.

Ad (b) Further research questions concern the transition of the EIIS towards sustainability:

The EIIS is a ‘system under transition’. The governance regime of the WEEE/RoHS and further elements of the regulatory framework have been the initial incentives to start moving the EIIS towards more sustainability. Transition takes place at different levels, influencing each other: the micro-, meso- and macro-level. 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 (changes in belief regimes). On the meso-level a dynamic interplay of institutional change and technological change takes place with manifold incremental, radical and even system innovations (changes in technological regimes), modifying the entire system of waste and recycling management as the result of the WEEE 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.

But there are indications of transition barriers as a result of a malfunctioning co-evolution of the technological regime, the belief regime of customers and the governance regimes by now:

- The present regulation framework seems to partly hinder the development of new business models, which are the consequent continuation of efforts of the innovation actors to move towards saving resources beyond take-back and recycling. 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. Cumulative intensity of regulation has to be evaluated according to these policy timing issues, since two or more regulations 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 this question.

- 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 up to now is far too much focused on technological aspects and less on integrating socio-ecological and economic aspects.
- The technological regime shift is not sufficiently co-ordinated with the changes in belief regimes. Shifts in consumer needs obviously follow shorter innovation cycles than the shifts 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. Since it may be assumed that the EU will become more and more important in environmental and sustainability policy making, the problem of transnational or 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 within nation states is more than an 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 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.
- 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.

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. This lock-in management has to care for keeping in line with the unfolded technology regime and their embedded instruments of dialogue, strategy and tools. The 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 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 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.