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Perspectives

Combating Material Leakage: a Proposal for an International Metal Covenant

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Abstract

This paper addresses future perspectives for the management of resources on an international level. Failures of international open markets result in significant material leakage. Here, taking the example of material used vehicles, we develop elements of an international metal covenant that should allow for a more sustainable management of global material flows in that area. Our proposal is based on two principles: any regulation should actively seek industry participation, taking advantage of business interest in supplying a sufficient quantity of materials while lowering materials costs; and it should also address public issues such as sustainability of recycling and waste. In this paper we first analyse contracts as a tool for bridging gaps in knowledge when multiple actors are involved. We then give empirical evidence for material leakage in the case of used vehicles from Germany, before outlining the elements of a proposed international metals covenant. Finally, we analyse potential impacts and discuss legal and institutional issues.

Keywords: Material flows, metals, vehicles, knowledge, covenant.

TABLE OF CONTENTS

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1. INTRODUCTION

For decades growth in wealth and wellbeing has been based on the increasing and unsustainable use of resources (Bringezu & Bleischwitz, 2009; European Commission, 2011). Facing scarcities of supply along with sustainability challenges, much more efficient methods of turning waste into secondary resources are required. In particular, such methods should avoid the common "downcycling" of materials, in which the quality of the material is reduced with each cycle. For a long time, such concepts of keeping materials in closed circuits have been seen in a local and national context only: historically, waste policy has been considered a responsibility of local governments or councils. Accordingly the regulative framework that has emerged aims at preventing environmental burdens on-site (Kranert & Cord-Landwehr, 2010).

The creation of global material cycles should be considered as a new challenge to the paradigm of a "recycling society"–a concept flagged by the European Commission and others (European Commission, 2005; Fischer & Davidsen, 2010). A fresh look at metals and their role in any such recycling societies seems necessary for two reasons. First, it is difficult to imagine that metals could be replaced by renewable raw materials produced locally on a sustainable basis. Thus, countries poor in raw materials resources (such as Germany) will have to deal with a sustainable use of metals. Secondly, international markets for used products are a reality, so that domestic recycling will encounter considerable obstacles. Increasing demand for resources and low recycling rates for metals (UNEP 2011) require an international perspective. The present article will address this issue, taking the subject of used vehicles as an example. Internationally scattered markets are characterized by insufficient recycling capacities and techniques in some regions. As a consequence, considerable material losses and negative environmental impacts have become evident.

This is a primary reason why a better *international* management of metal markets is at stake (Crowson, 2011; Hagelüken, 2011). The authors' considerations start with a number of knowledge problems. As a rule, the buyer of a used product does not know which materials are contained in the product. At the same time, it may be assumed that the material losses observed today are to be attributed to a lack of management and that the development of appropriate mechanisms could well mobilize actors who are interested in the completion of material cycles. Such steering function could be assumed by an international metal "covenant" as a specific voluntary, but binding form of environmental agreement (Bressers, 2003), which could prove the basis for a cooperation of industry and governments. It has been the authors' intent to develop basic elements of such an agreement and to discuss critical aspects as well as possible consequences.

2. COOPERATION AGREEMENTS TO SOLVE KNOWLEDGE PROBLEMS

The starting point for our considerations is the hypothesis that the lack of complete global material cycles for materials contained in end-of-life products is caused by knowledge problems and transaction costs. On the one hand, recycling markets have failed to work properly because an asymmetrical distribution of information between recyclers and industry purchasing secondary raw materials has been impairing efficient agreements. On the other, the governments are lacking sufficient information that would be needed to correct the existing market failure in an optimal way by direct regulation.

Neither governments nor enterprises have the knowledge required to initiate and implement long-term changes towards sustainability. Rather, it is necessary to develop joint mechanisms, taking into account strategic interests and options for action (Bleischwitz, 2004; de Bruijn & Tukker, 2002; Grin *et al.*, 2010). "Industrial transformation goes beyond the notion of eco-efficiency and beyond the domain of individual actors. It is about system innovation, both technological and institutional," (de Bruijn & Tukker, 2002, p.8). Regarding the problems considered in the present publication, we will focus on innovations that reduce material intensity. The concept of "responsible corporate governance" aims at a concentration of potential self-interests of industry and their merging by means of suitable incentives (Bleischwitz, 2007).

The development of cooperative approaches to material flow innovations may also be substantiated from the waste management perspective. In this context, considerations are based on the fact that so far, recycling rates for certain substances contained in end-of-life vehicles (ELVs) have been too low because potential recycling activities that would have been profitable both from the ecological and economic perspective were overlooked. Reasons for this include the costs to enterprises associated with obtaining the required information on quality features of recycled products and materials that would allow them to conclude contracts recognized as favourable for all parties involved. In contrast, the European ELV Directive (Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on ELVs) has encouraged cherry-picking by single actors in recovery processes preceding the waste management stage — for example, only taking out valuable components like radios. Such practice has been aggravating a shift of the environmental problem due to the export of used cars into countries without sufficient waste infrastructures. As a consequence, overcoming knowledge deficits becomes an independent regulatory objective–not as a sufficient, but a necessary precondition in order to improve the market efficiency.

In the context of imbalances of information, the operational rationality of maintaining established design and production processes should be pointed out. This is attractive for

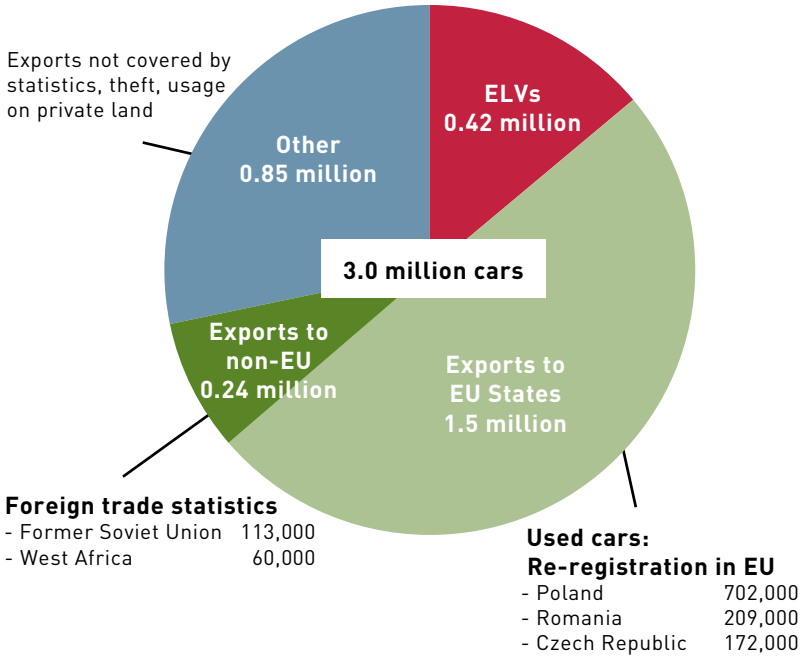

Figure 1. Fate of vehicles definitively de-registered in Germany in 2008
Source: UBA & BMU 2011

enterprises because it allows them to maintain existing production facilities and processes as well as supplier relationships. To summarize, the consequences of imbalances in information have systemic dimensions in several respects:

- Under the prevailing conditions, high follow-up costs in the form of environmental damage, social costs and market distortion are generated on an international level.
- International follow-up costs result in distortions on the domestic market for material efficiency and resource conservation.
- The potential for future innovative paths of recovery and sustainable resource management is impaired.

Hence, the quest for better governance required against this background should aim to:

- abolish the present sharing of knowledge about international material flows along the product utilization chain involving industrial stakeholders in the fields of automobiles, metal and recycling; and
- develop knowledge on sustainability potentials.

3. USED CAR EXPORTS AND MATERIAL LOSSES AS A PROBLEM FIELD

Vehicle recycling harbours a considerable potential for material efficiency and resource conservation. The volume of ELVs generated within the EU will increase from the current 10 million tons to 14 million tons in 2015 (EEA, 2008). ELVs contain a great number of materials. Among these are material fractions including rare metals, which already today may be recovered in a profitable way, but also toxic substances posing considerable risks to humans and the environment. Thus, the link between material efficiency and resource conservation becomes inseparable: it is profitable for individual enterprises, and it is required from the environmental angle. If the promotion of metal recycling included only those options that are profitable for enterprises, the problem of negative environmental impacts due to harmful substances and disposal would remain unresolved on an international level. It follows that a covenant in this field will have to deal with both, concentrating the interests of the industries involved and taking care of public matters. At the same time, deficits in product policy become evident: such policy is too wide-meshed for the special cases of individual metals, and it has to comply with the principle of territoriality, which is deficient in the presence of internationally open markets.

In Germany, only a small share of de-registered vehicles is recovered inside the country. This is why innovative instruments should primarily aim at recycling standards in the countries of destination (see Lucas & Wilts, 2009). In 2008, no more than about 15% of the 3 million definitively de-registered vehicles were recovered in Germany (see Figure 1). Vehicles exported from Germany to EU-10 countries[1] are often purchased for reuse by third parties in non-EU countries. In 2008, Kazakhstan represented the most important country of destination quantitatively for used car exports from the EU.

1 i.e. new member states from Central and Eastern Europe.

For EU member states, it may be assumed that due to the implementation of the ELV Directive, high-quality recycling technologies will be used at least in the medium term. However, a major share of used cars will directly, or after another utilization phase in the EU-10 countries, end up in countries not committed to the ambitious recycling targets of the European ELV Directive. Even in large cities such as Moscow, a mere 10,000 out of 130,000 de-registered vehicles were recycled in 2009 (Lucas & Wilts, 2011). At the same time, there has been a variety of illegal or tolerated practices to "dispose of" motor-vehicle bodies and parts in backyards, on roadsides, on secluded sites, or illegal dumps.

These lacking or insufficient international recycling infrastructures result in irretrievable losses of raw materials. Hence, there are systematic deficits in recording export flows of used vehicles and indications of probable law infringements. The resulting responsibility loopholes lead to considerable interruptions in the cause-effect chain: the ambitious objectives of the ELV Directive, *viz*. to achieve product design enhancements and ensure environmentally sound recovery after use on the basis of producer responsibility, are undermined by insufficient control of vehicle flows and enforcement deficits (SRU, 2008, p.732). Presently, the objectives and obligations of product responsibility stop at the borders of the EU member states. Consequently, the aims should be that (a) export is no longer used as a cost-effective option to evade producer responsibility and (b), potentials for material efficiency and resource conservation may be opened up also on an international level. Therefore, enhanced incentives should be created for shifting producer responsibility towards material responsibility. This need for innovative instruments can be linked to the general discussion about critical metals like rare earths– the EU wants to develop new approaches to mobilize end-of-life products and develop international networks in order to secure the supply of these metals for the European industry.

4. A PROPOSAL FOR A FUTURE INTERNATIONAL METALS COVENANT

In the following, based on the deficits observed and the limits of direct regulation regarding the recycling of exported vehicles, a covenant is outlined that has the objective of enhancing material efficiency and resource conservation in this field of action. Covenants represent a combination of elements of direct governmental regulation and self-regulation by industry in specific countries relevant for the export and import of ELVs. In principle, covenants may be characterized by the following elements:

- industrial sectors commit themselves to achieving long-term goals;
- these goals are negotiated in cooperation with the responsible authorities in the public sector;
- in return, the public authorities commit themselves to creating appropriate framework conditions and to omitting further direct regulatory measures for the contract period;
- covenants are concluded as private law contracts between all parties involved. Such contracts include both sanction mechanisms in case the stipulated goals are not achieved, and options to adapt the terms and conditions in case of changing framework conditions.

The covenant's goal (to be agreed upon) should be to contribute to the completion of material cycles in the field of exported used cars. Depending on the type of material, such material cycles should be established on different spatial levels. While recycling standards are defined for steel car bodies in the countries of destination, enhanced recording and monitoring will provide for the return of certain resource-intensive fractions such as copper or platinum group metals (PGMs) on an international level. The covenant's approach is based on the emergence of economic incentives for the recycling of such fractions, together with appropriate framework conditions.

In principle, the covenant should agree upon a sufficiently long period warranting stable long-term framework conditions for the enterprises involved to ensure amortization of the necessary investments. The exact write-off period will have to take into account the specific situation of ELV disposal in the individual countries of destination, in analogy to the transition periods for EU-acceding countries to implement the ELV Directive.

It is important that all obligations of the contracting parties be precisely and verifiably defined. In the context of this covenant, goals should be defined on four levels: (1) completion of industrial material cycles, (2) recycling standards, (3) enhanced monotoring and reporting, (4) enforcement and sanctions. This can be outlined as follows:

4.1 CLOSING OF INDUSTRIAL MATERIAL CYCLES INCLUDING CONSUMPTION

In addition to the targets fixed by the ELV Directive regarding the recycling of a certain share by weight of an ELV, the covenant should define standards specific to groups of materials and intermediate targets for the completion of industrial material cycles. These should be based on the quantities currently used, establishing high-quality recycling and recovery procedures. The life-cycle approach should apply material flow concepts such as the Total Material Requirement (Bringezu & Bleischwitz, 2009). The number of potentially relevant materials includes copper and PGMs because each of these makes a decisive contribution to the profitability of ELV recycling. In addition, with particular reference to copper, they require extensive dismantling of the vehicle, thus automatically creating incentives for a sorted recovery of other material groups. To this aim, material-specific recovery rates could be defined as medium-term targets. In the long run, however, it is intended that self-supporting innovation processes be

initiated, providing effective incentives to exceed predefined recovery rates. (Rates may definitely be suitable for directing innovation processes towards a sustainable development. However, they should be prevented from developing a life of their own as a target, because as such they could potentially become an obstacle to eco-friendly product design.) In the context of the covenant, industrial partners would commit themselves to recovering a certain (to be negotiated) percentage of metal fractions contained in these vehicles, including the exported vehicles.

4.2 RECYCLING STANDARDS

For the recycling industry in the countries of destination, such commitment by the automobile industry would ensure a defined input for treatment facilities in the sector of base metals. Such facilities should be constructed in these countries of destination for the exported vehicles, at least for the first stages of recovery. Regarding the recovery of ELVs, it has to be taken into account that although the recycling of materials will lead to considerable resource savings, the treatment procedures proper will be associated with substantial environmental impact potentials, for example if oil and other operating liquids are directly discharged into sewer systems.

This is why the recycling industry should also be committed to high environmental standards in the countries of destination, including for example compliance with the requirements for treatment facilities according to the German ELV Ordinance (*e.g.* under § 5 para 3, a permission under building law; or the removal of operating liquids, see Berninger, 2009, p. 495). Of course, these and many other requirements have to be adapted to the conditions prevailing in the countries concerned,

Among other facts, it has to be taken into account that so far, there is no established system of experts who could carry out such controls. Thus, a further requirement is to develop funding schemes for measures of capacity building and measures to establish basic institutions. If such capacities and institutions could be set up, they will also contribute to environmental governance in general and thus phase out dumping practices at least in the medium term (*e.g.* when it comes to the reduction of harmful substances in ELV cars). Indeed this is also a case where compliance, monitoring and transparency matter.

4.3 ENHANCED MONITORING AND REPORTING

As a prerequisite for efficient resource management in the field of ELV recycling, the contracting parties should agree upon a system for monitoring the actual material flows in the ELV sector including exports within the EU. Many of the data required have already been recorded. However, networking and data exchange should be enhanced, while data protection is observed.

Above all, precise and binding reporting obligations for the contracting parties involved should be agreed upon in the covenant. This should, on the one hand, improve information exchange between manufacturers, recyclers and public sector authorities in order to identify possible efficiency potentials and promote innovation processes. On the other, publication of the reports is also intended to exert pressure on individual stakeholders in the case of failure to sufficiently meet their obligations.

In addition to compulsory reporting, the covenant should also establish provisions facilitating the access to information for all contracting parties involved in order to ensure an improved adaptation of recycling to the quality requirements for the use of secondary raw materials. These could include for example subject-specific working groups or disclosure of certain manufacturing standards. In order to ensure efficient monitoring, the covenant must include obligations for the private companies to participate in the funding of such a system.

4.4 ENFORCEMENT AND SANCTIONS

Facing diverging economic interests of the different actors, past experience with regard to covenants has shown a lack of public control and insufficient provisions for discouraging free-rider behaviour of single stakeholders to constitute the critical points of the instrument (Bressers, 2003). As a matter of principle, a covenant should therefore include options to impose sanctions for non-compliance by means of civil action to enforce contract penalties.

In case of repeated failure to comply with the goals defined, there should be provisions to sanction the contracting parties concerned by means of publicity and economic penalties, if need be. In the event that manufacturers fail to meet their obligations, a binding procedure for the settlement of disputes should have been introduced. The latter could define the options of a stringent direct regulation (*e.g.* with high recovery rates). A possible preliminary stage could consist, for example, in the option to exclude enterprises or industries from public research funding. Another measure to be considered could consist in a ban on such enterprises or trade associations from participating in the development of binding standards.

5. THOUGHTS ON POTENTIAL IMPACTS: CONSEQUENCES OF AN INTERNATIONAL METAL COVENANT

As far as we know, no international covenant between several states and industrial sectors has been concluded thus far. This is why concrete practical experience is still lacking. Also in Germany, no concrete covenants have yet been established. However, conclusions may be drawn both from the discussion on sectoral agreements in international climate policy and the experience with national environmental agreements, notably

in the Netherlands. The Dutch Target Group Policy encompassing more than 100 sectoral agreements concluded since 1989 has been part of a long-term (2020-oriented) national environmental policy plan. The results of the Target Group Policy have met with a predominantly positive response both by public authorities and industry and also by environmental governance research (*e.g.* Elzen *et al.*, 2004). The success of such approaches towards a transition management lies mainly in an enhanced cooperation between different industrial sectors (*e.g.* Kemp, 2010).

5.1 RECOVERY OF RAW MATERIALS–A SCENARIO

Both the course and results of a negotiated solution are difficult to predict. For this reason, we develop in this section a scenario that is based on the principles of sustainable resource management and on the notion of material responsibility, and which is intended to promote optimal and appropriate mining, production and use of raw materials for the benefit of society while safeguarding environmental objectives (Minsch *et al.*, 2000).

Within this scenario, a covenant is to be agreed upon between Germany and the ten most important countries of destination of used car exports (Kazakhstan, Guinea, Russia, Belarus, Serbia, Benin, Bosnia-Herzegovina, Tajikistan, Angola and Nigeria). The covenant should comprise agreements on the copper and PGM fractions: while PGM recycling, mainly from catalytic converters, already constitutes a profitable business, the recycling of copper especially in smaller components (*e.g.* from wiring harnesses) requires a preceding extensive dismantling of the vehicle or ends up in the shredder residue (Brahmst, 2006). For an estimate of the potential of this instrument, the entire range of EU exports (passenger cars, both diesel and petrol driven vehicles) is to be taken into account since, as a matter of course, it is assumed that not only German ELVs will be recycled in the countries of destination. Based on evaluation of the 2007 EU foreign trade statistics, calculations resulted in a total of 8,029,000 vehicles for all ten countries of destination.

With regard to PGMs, the covenant is mainly aimed at a reduction of transaction costs in the cross-national recycling value chains. By means of improving the flow of information, it is intended to enhance the existing system and recover secondary raw materials in a technically optimized way. Their utilization course is subject to international monitoring. At the end of the utilization phase, the catalytic converters are disassembled, collected and transferred to a high-quality treatment facility in Europe. Each catalytic converter contains between 1 and 15 g of PGMs, a value that may vary considerably depending on the type of car (diesel or petrol, cubic capacity, age) and usage behaviour (dissipative losses in operation). In Eastern Europe, the incentive for systematic collection has been on the increase along with the share of ELVs equipped with a catalytic converter. Nevertheless, Hagelüken and Buchert (2010) have estimated that on a global level, only about 50% of the PGMs used can be recovered at present.

In the context of the present paper, it is assumed that an increase in high-quality recovery to at least 75% could be achieved by the development of appropriate redistribution systems in the countries of destination. In this way, an additional quantity of about 7.5 tons of PGMs could be recovered in the contracting states. Assuming a 50:50 ratio of platinum and palladium used in a catalytic converter, this volume of PGMs is currently worth about EUR 19 million. These initially low revenues require hardly any investment since presently, the existing integrated smelters still have sufficient capacities (Johnson Matthey, 2010, p.23).

For the fraction of copper, it shall be assumed in addition that the covenant will not only envisage measures that may be profitably implemented in the short term, but on an intermediate and long-term basis may contribute to enhancing competitiveness by way of learning and innovation processes. A starting point for such processes may consist in the recovery of copper contained in ELVs: to date, copper has not been recovered separately in the countries of destination considered and therefore is subject to dissipative losses during the shredding process. Currently, a quantity of about 22 kg copper is spent per new vehicle. By 2025, however, a continuous increase to 40 kg is to be expected due to the increasing use of electronics in cars (Lucas *et al.*, 2007).

For this scenario, it may be assumed that in the future, the 75% copper recovery rate currently achieved in Germany will be reached on an international level for 50% of vehicles. By 2016, this share is envisaged to increase to 95% (according to the total rate of 95% stipulated by the ELV Directive). On this basis and taking into account increasing total quantities, quantities used and quantities recovered, the additional quantity of copper recycled in 2030 from EU used car imports would amount to about 200,000 tons worth EUR 840 million per year (assuming a long-term price of EUR 4,000 per ton, with the current value being as much as EUR 7,000 per ton (Wilts *et al.*, 2011).

5.2 DEVELOPMENT OF RECYCLING CAPACITIES IN EMERGING COUNTRIES

The instrument of an international covenant provides a chance for promoting the decoupling of economic growth from resource use not only in Europe but also on a global level (Bleischwitz, 2010). By means of agreements regarding the targets, codes of practice and capacity building, the industrial sectors involved are provided incentives to intensify knowledge and technology transfer to the countries of export destination where in many cases, appropriate facilities and infrastructures for recycling are still completely missing. "In order to improve the technical and environmental standards in less developed countries, an increase

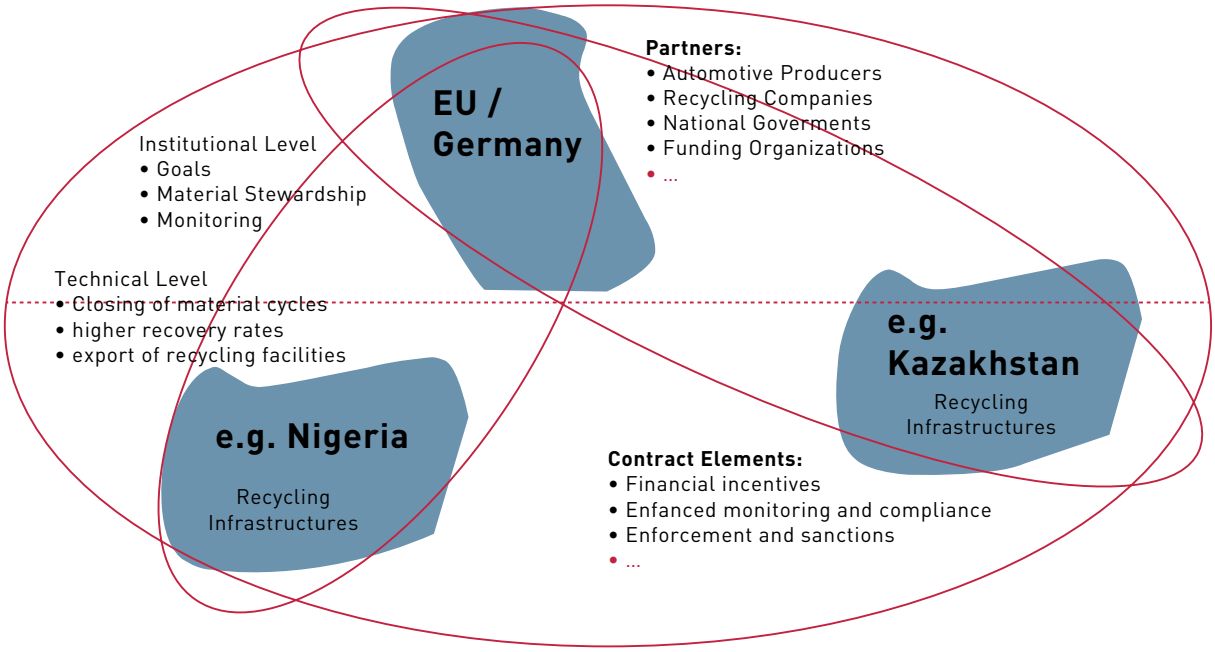

Figure 2. Scheme of an International Metal Covenant
Source: Wilts *et al.* 2010

of know-how in connection with technology transfer [...] is urgently needed". (UBA, 2009, p.5)

For the recycling industry to be involved in the covenant, the export of technologies constitutes an enormous market potential. Presumably, the market for environmental technologies for dismantling, shredding, or sorting will triple by the year 2020. Presently, the international market share of German enterprises in this field of business corresponds to about 25% (Federal Ministry for the Environment, 2009).

6. CONCLUSIONS

The decisive advantage of a private law contract on ELV recycling will lie in the opportunity to involve states and stakeholders outside the EU and thus, outside the regulatory area of the ELV Directive. The covenant will apply in an area which otherwise is not immediately accessible to legislation, either due to a lacking legal basis, to serious deficits in regulatory knowledge or for other reasons. Covenants may also work in anticipation of a possible passing of regulatory provisions (for a legal evaluation of binding self-commitments, see for example Töller, 2008, and Hagenah, 2002). Figure 2 depicts the scheme of our proposal.

We expect this sectoral approach to allow enterprises to coordinate their shares in the targets negotiated that can be assumed according to their individual adjustment costs. In analogy to the approach of an emissions trading scheme, equalization payments may be agreed upon on an intra-sectoral basis, to be paid by enterprises making only small contributions to reaching the set targets. Similar approaches could apply on the inter-sectoral level for negotiations between recyclers and car manufacturers as well as the resource-based industries. This also demonstrates that for sustainable materials management it is necessary to go beyond product governance and to also address horizontal integration.

Taking into account the entire value chain innovative approaches should result in shifting the resource efficiency frontier upwards. To achieve this aim, however, it is necessary to agree upon allocation rules for the equalization of costs incurred and benefits generated. Nevertheless, it has to be stated that it is impossible for a single policy instrument to appropriately cover the entire range of problem structures, objectives, types of stakeholders, resources, etc.. Instead, a balanced mixture of policies will be required to overcome the variety of obstacles, take into account innovation phases and cope with the future global challenges of sustainable resource management. Hence, in the short term, an international metal covenant could provide a means to benefit from a tense situation on raw material markets. In a medium-term perspective, it could constitute an expandable component of global resource management.

Future interdisciplinary research will be needed at the interface between legal institutions, economic incentives and different spatial conditions in order to assess the efficiency

of the instrument and its different components. In particular, the ongoing debate about transition management and strategic niche management could substantially enhance the understanding of the socio-technical dynamics and the interests involved of the ELV challenge (Geels *et al.*, 2010), while our approach may enrich the international dimension of such strands of research.

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