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Economic Assessment of informal collected waste compared to formal collected waste

6th period of the project TransWaste

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1. INTRODUCTION

Every year illegal collected items leave European borders, whereas the amounts are difficult to quantify. In general two different main transhipment routes can be found. Via the European harbours actors ship electric and electronic goods to countries in Africa, Asia and South America. Mostly shipments are declared as Second-Hand products or secondary raw materials, whereas they already come under the definition of waste according to article 3 of the Waste Framework Directive 2008/98/EC [Jaron, 2010].

The second main route of informal transports of wastes and second-hand items leads into Eastern European countries. It is mostly conducted through individuals. Nevertheless interviewed person from waste management organizations also mentioned organized groups. Thereby the informal sector collects goods in Western European countries and transfers them to Eastern European Countries [Lange, 2011a]. Mainly bulky waste and electric and electronic appliances fell under collected materials. In destination countries either a dismantling takes place to sell valuable materials or, regarding bulky waste and second-hand goods, the items are sold at flea markets for reuse.

The current contribution looks at economic characteristics of transhipments. Thereby individuals are considered that collect and sell reusable items at flea markets in Eastern European destinations. As introduction a short overview about economic aspects of waste, informal shipments and the informal sector is presented. Based on this, the methodology applied for the analysis will be documented. Afterwards a presentation of corresponding results and a conclusion will close this report.

1.1 Economic aspects of waste

Before the 1970s waste was an environmental burden. With growing economy and industrialization, primary resources were found to be limited and waste became more and more attractive as a source of secondary raw materials. The demand respectively the market values of several materials like metals or paper decreases and so does the value of waste. Especially for electric and electronic appliances a necessity of recovering processed materials like metals, semiconductor boards, aluminium or seldom-earth materials rise. Figure 1 exemplary shows the trend respectively demands regarding cupper in the last 5 years.

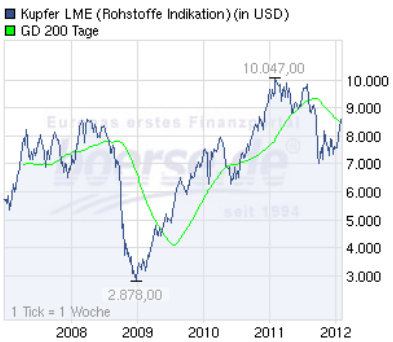

Figure 1: Price of cupper in the last 5 years (in USD/t) [www.boerse.de]

Taking into account the increasing global economy and corresponding demands, it is reasonable to circulate materials via recycling or even prolong the usage phase of products to

decelerate resource consumption. Thereby the transition point between usage phase and disposal phase is hardly definable. This leads to the discussion at which point an economic good is waste and vice versa. From an economic point of view a material without positive value is defined as macroeconomic waste [Weiland, 2000]. Nevertheless individuals have **different evaluation standards**. A disposing person connects a negative value with a good whereas a receiving individual positively evaluates the same good if reasonable usage is given. Hence, it has a value that can be expressed economically and therefore displays an economic good.

Processes like **recycling** can reproduce former waste into materials/products with a market value and introduce them again to the economic circle. Moreover time variances and different social levels change the definition from waste to economic good. This includes for example old appliances that have an antiquarian value or, based on the materialized economy, lose their value for one individual whereas it is still suitable for persons of lower social levels.

In the Eastern and Central European region different values of economic goods respectively waste are reasons for disharmonies between involved stakeholders. Considering the economic gap between Eastern and Western European states, social and economic disadvantages enforces transboundary shipments of materials.

1.2 Economic aspects of transboundary shipments

EEA conduct a study in 2008 and noticed a significant increase of transboundary shipments of wastes in the last decade. Thereof not all are assumed to be notified according to given regulations. In 2003 about 8.6 million tonnes of hazardous and problematic waste were shipped across European boundaries. Over 90% of this waste was shipped to other EU countries. About 80% were for recovery and 20% were for disposal. Regarding transhipments Fischer et. al. realized that the EU emerges to a single market regarding treatment of hazardous and problematic waste. The main driver behind transnational shipments of waste was found to be the economy. Thereby the following indicators play a decisive role, not only for formal but also for informal transhipments [Fischer, 2008]

- Differences in prices
- Different prices on secondary raw materials
- National waste taxes
- Transport costs
- Liberalisation

Next to the mentioned economic drivers differences can be found in incentives. Especially (organized) transhipments overseas but also organized transhipments to Eastern Europe result from cost differences between origin and destination country [Jaron 2009]. Mostly treatment and disposal costs of electric and electronic devices are higher in industrialized countries as in receiving countries respectively overmatch the transhipment costs [Fischer 2008]. Hence, the economic driver can be found in a cost saving respectively profit maximization of the involved actors.

Contrariwise individuals from Eastern European Countries and developing countries conduct informal collection to keep their livelihoods. Based on the social and economic situation of the

origin country it is often not ensured. Hence, the economic incentive can be found in the satisfaction of elementary needs (Figure 2).

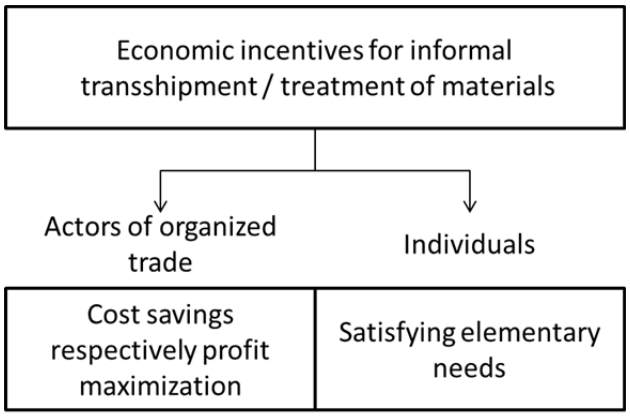

Figure 2: Economic drivers of not authorized collections

Those differences should be included within solution findings regarding the informal transhipment issue. In the following contribution the term ‘informal sector’ concentrates on operating individuals that conduct the collection for satisfying elementary needs.

1.3 Economic aspects of informal sector activities

In general the economic importance of a sector of an economy is measured by its contribution to gross domestic product [Hemmer, 1989]. Informal sector activities do not follow given regulation and standards. Hence, classification through current economic theories and policies is hardly reachable.

Regarding waste management informal activities occur all over the world [Lange, 2011b]. While using primarily muscle-powered equipment, it has an enormous influence on recycling quotas in developing countries [Scheinberg, 2010]. Moreover effects on the economy could be verified as recovered materials feed local, regional or even international industries. The German Agency for international cooperation (GIZ) conducted a study in 2010 and found out that informal sector activities contributes to volume reduction of disposed materials, avoid emissions from landfills and partially prolong the usage phase of products. Moreover economic effects of informal activities were conducted in 6 different cities: Cairo, Cluj, Lima, Lusaka, Pune and Quezon. Among others, the results of the economic analysis of informal sector activities could be found as follows:

- Informal activities cause environmental costs (e.g. burning of waste)
- Informal activities cause cost savings for municipalities (in total €39 million in the six cities) ,whereas cost savings mostly corresponds to collection costs
- Through informal valorisation, extraction, processing activities and sell of materials in all 6 cities a net profit of about 130 million Euros could be reached.
- informal sector causes social benefits and indirect economic benefits for the municipality

The influence of informal sector activities is enormous in the observed key areas. Nevertheless the waste management systems in the six cities lack regarding an efficient execution according to the state of the art. Therefore informal sector activities support collection, separation and treatment processes.

Other basic requirements predominate in Europe. Detailed guidelines regarding waste management exigencies result in a high standard treatment system. The effects of informal activities are hardly comparable to developing countries. So far no explicit economic evaluations took place in the Central and Eastern European region. Looking at different circumstances like the dependency of waste management systems on benefits regarding recovered materials but also on energy production of thermal treatment processes, it can be hypothesize that informal activities cause a negative economic influence.

A first investigation took place where different responsible persons of waste management associations were asked about the economic influence of informal sector activities. The following diagram shows the allocation of the categories ‘ Additional costs’, ‘Savings’, ‘Saving and costs’, ‘Neither costs nor savings’ and ‘Not known’. The sample size consists of 42 answers.

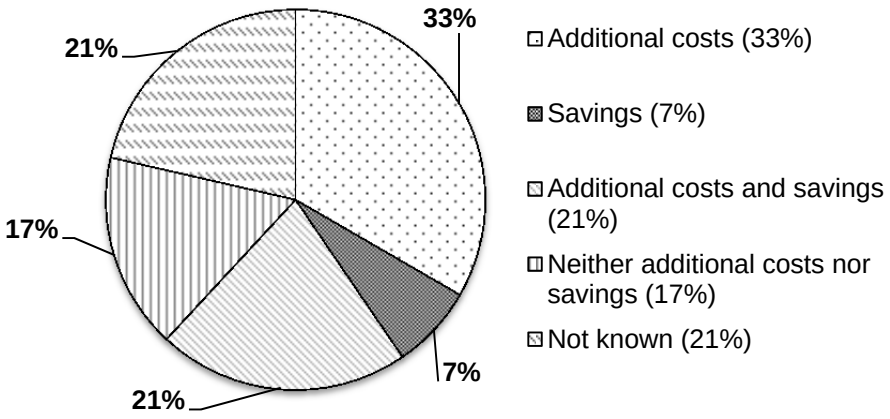

Figure 3: Costs and/or savings through waste picking

One third of the questioned interview partners reported about additional costs through waste picking. Littering as well as the robbery of valuable materials are mentioned reasons. In contrast seven per cent affirmed savings through informal activities. It is based on decreasing amounts of bulky waste for thermal treatment. Around 20 per cent of the answers were given in the categories ‘costs and savings’ and ‘neither costs nor savings’. As the economic revenue and/or loss through waste picking is dependent on, among other things, the waste picker behaviour, the treatment methods in the respective municipality, the market prices of materials, the financial situation of the disposal authorities, the collected respectively littered waste amount, an detailed evaluation of occurring costs or savings is necessary to show up effects of informal sector activities.

Within the project TransWaste an economic assessment of these proceedings take place while looking at existing material flows that cross considered borders.

2. METHODOLOGY

Within the project three different evaluations are conducted: an ecological, economic and social assessment. Based on already conducted analyses such as interviews with informal collectors and border countings of vehicles with an informal background, the basis parameters are defined and used for each evaluation. Table 1 gives an overview about the applied parameters.

Table 1: Basic parameters for evaluations

Collections per year	75	units
Transport distance in	300	km / trip
Loading capacity	69,50%	%
Payload of the van in kg	1.315,00	kg / van
Cargo bay in m3	9,85	m³ / van
Collected amount per year in kg	68.544,38	kg /a*Informal Coll.
in m3	513,43	m³/a*Informal Coll.
Transport costs for additional collection of littered goods	30	km
Transport by households to the WCC with passenger cars:	2	km
Transport by informal collectors from WCC to the markets to sell the products:	300	km with van (<3.5t).
Transport by recycling and disposal companies to recycling and disposal facilities:	200	km with 16 t lorry

Moreover, for all evaluations three different scenarios are established to compare the activities according to different requirements. The first scenario (**formal scenario**) analyses the official waste management in the Western and Eastern European countries. The second scenario (**informal scenario**) defines the current situation. It considers that the informal sector collects items directly after the end of the utilization phase of products. Afterwards, transhipment to Eastern European States and a reuse/resell of items takes place. The third scenario (**formalized scenario**) drafts a collection through the informal sector based on a structured and monitored accomplishment.

Basically the aim of the economic assessment is to identify the influence of missing informal transhipped amounts in Western European countries respectively additional informal transhipped amounts in Eastern European countries on the formal cost – benefit balance of waste management systems. Hence, informal transhipped amounts are connected to monetary streams for each scenario to compare the cost – benefit situation without informal activities, with informal activities and with formalized activities. The economic assessment is accomplished from the perspective of official waste management associations on the one hand and from informal collectors on the other hand.

The accomplishment of the economic assessment is based on the determination of the following variables:

- Considered regions
- Transhipped amounts
- Amount of littered goods
- Analysed fractions
- Treatment methods and
- Corresponding cost items

2.1 Considered regions, informal transhipped and littered amounts

Four regions were considered. This includes the countries Poland, Germany and Austria as well as Hungary. The countries were chosen as border countings between both regions took place and build the basis for defined transhipped amounts (Table 1). These add up to about 1300 kilogram per van and informal collector. Considering 75 collections per year and a loading volume of around 69 per cent in average, it complies with nearly 69.000 kilogram of informally transhipped amounts per year and informal collector.

Regarding littered amounts a definitive amount of illegal disposed waste through informal collectors could not be quantified. Nevertheless waste management authorities complained about the fact that littering causes additional costs for waste management operations and refer to arising ecological impacts. To evaluate the issue of leaving not usable items at collection points, a survey interviewed disposal authorities about their experiences. According to this, 60 per cent out of 47 usable answers reported about waste that is left by waste pickers whereas 40 per cent did not recognized littered waste in Germany. As an example the following picture shows a popular collection position in Dresden next to a recycling centre (Altonaer Straße 15) were informal collectors littered not usable items.

Figure 4: Littered waste at a collection position of informal collectors in Dresden

Due to these statements littered amounts were taken into account in the economic assessment. Unfavourable only waste statistics of the county Saxony in Germany gave information about

littered and afterwards formally collected amounts. This data basis was used to display the scenario of littered amounts in the economic assessment. The following assumptions based on the findings of the waste statistics of Saxony were made (L = Littering):

Table 2: Littered amounts

FORMAL SCENARIO			INFORMAL SCENARIO			FORMALIZED SCENARIO		
MIN	MED	MAX	MIN	MED	MAX	MIN	MED	MAX
no L	no L	no L	no L	L (0.5%)	L (1.0%)	no L	no L	no L

The scenario of formalization is defined through the assumption that no materials are littered as informal processes are structured and controlled. This presents the best case scenario, which apparently cannot be achieved in praxis.

2.2 Considered fractions

Through observations of informal activities, it was assessed that a not negligible amount of collected materials is presented through the fractions WEEE, metals and bulky waste. The allocation of transhipped amounts to each fraction was done through evaluations at the border crossings between Hungary and Austria. Moreover, interviews of German waste management associations were conducted. The results regarding the evaluation at border crossings between Hungary and Austria can be seen in figure 5, whereas results of the interviews are displayed in figure 6.

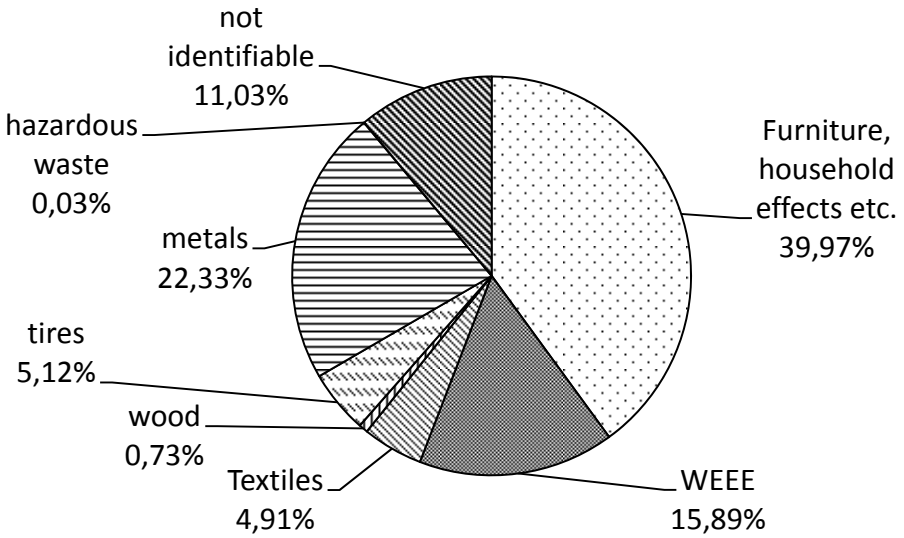

Figure 5: Fraction allocation in Austria from traffic counting results

As figure 5 shows, the highest percentage of transhipped goods are fractions furniture (40 %), WEEE (16 %) and metals (22 %). The results differ from German investigation, which results are shown in figure 6.

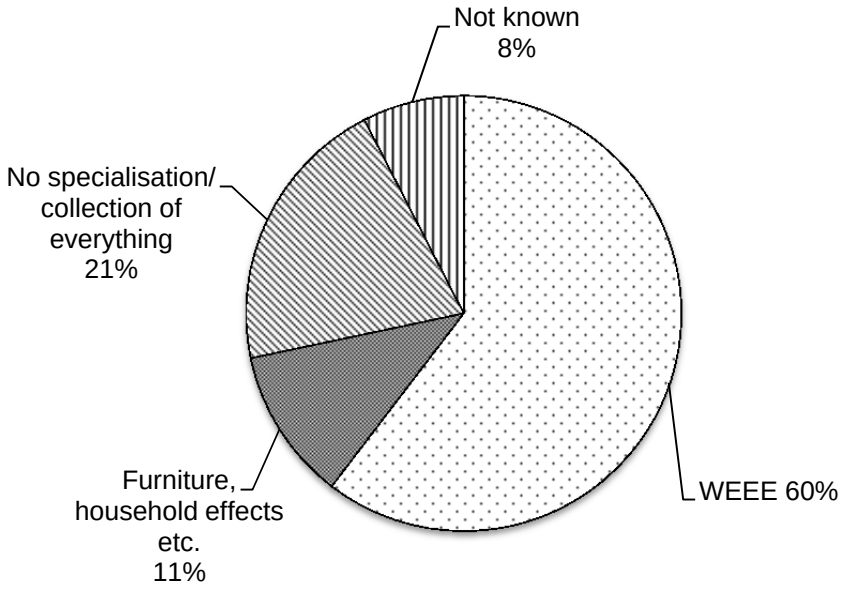

Figure 6: Fraction allocation in Germany from interviews

First of all a higher concentration of WEEE (60%) can be found in Germany. Nevertheless interviews with waste associations do not reflect objective situations due to missing practical experiences and partially prejudices against informal collection processes. Therefore the Austrian allocation was used for the economic assessment.

Hence, within the economic assessment 3 different fractions and corresponding appliances were selected:

- WEEE
    - CRT – Screen
    - Fridge
    - Washing machine
    - Small household appliances
- Metals
    - Scrap metal
- Bulky waste (without scrap wood).

Regarding the collection and treatment of WEEE the European Union (EU) released the directive 2002/96/EC, which was amended in July 2012 through the directive 2012/19/EU. Member states of the EU are obliged to transfer the directive into national law. One of the cornerstones of the WEEE directive is the extended producer responsibility. It implies that the responsibility for the treatment of WEEE has to be beard by the producer. Hence, an analysis of the national WEEE acts is accomplished to gather information about the implementation in the considered member states (Annex 1).

2.3 Considered material streams

For identifying and structure material flows of the formal, informal and intended formalized scenario, material / waste streams are included in the evaluation. The following treatment measurements in waste management of both, Western and Eastern European Countries, are considered:

- Recycling processes,
- Mechanical biological processes (MBT),
- Thermal treatment,
- Other thermal treatment,
- Mechanical treatment with affiliated landfilling
- and only landfilling

Later on these streams are connected to economic values, which are collected from each partner country. In general, the informal sector extracts items from the regular mass flow between citizen and waste management and transfers it to flea markets in Eastern European Countries. The offered items are either directly given to the waste management or bought by citizens of Eastern European Countries and end up at waste management after a prolonged usage phase.

2.4 Monetary streams and corresponding cost items

To display all occurring costs a cost – breakdown – structure is used for the formal, informal and the formalized scenario. The considered costs and revenues are shown according to streams of figure 7. The abbreviations of the scenarios formal (F), informal (I) and formalized (FZ) mark the corresponding scenario respectively the cost items that are used in the scenario.

Table 3: Cost – Breakdown – Structure of monetary streams of formal (F), informal (I) and formalized scenario (FZ)

Stream from Citizen/Waste Management to Informal Flea markets	
-Transportation costs(I,FZ) -fee for renting exhibition space (I,FZ) -fee for storage room (I,FZ) -membership fees for Organization (FZ) -Tax per month (FZ) -Fees for mobile usage (I,FZ)	
Stream from Informal Flea markets to EEC households	
-Income per month (I,FZ) -Set prices per item (I,FZ)	
Western European Countries	**Eastern European Countries**
Stream citizen to Waste Management	
- Costs for additional collection through littering (I)	- Costs for additional collection through littering (I) - Costs for additional collection of amounts of IS (I, FZ)
Stream from Waste Management to Reuse	
- Costs for transportation (F,I,FZ) - Costs for renting exhibition place (F,I,FZ) - Revenues from sell (F,I,Z)	- Costs for transportation(F,I,FZ) - Costs for renting exhibition place (F,I,FZ) - Revenues from sell (F,I,Z)
Stream from Waste Management to Treatment Option	
- Costs for transportation to treatment option (F,FZ) - Costs for treatment option (F,FZ) - Revenues through sell of valuable fractions (F,FZ)	- Costs for transportation to treatment option (I,FZ) - Costs for treatment option (I,FZ) - Revenues through sell of valuable fractions (I,FZ)

According to the cost – breakdown - structure the different cost and revenue items are quantified for one ton of the considered materials (chapter 2.2). For each partner country values for different cost and revenue items were gathered, whereas June 2012 was chosen as reference date to ensure an equal basis. Thereby it was defined that for treatment methods gate fees are used, as only limited data regarding specific treatment costs are available. Figure 8 illustrates the considered system borders.

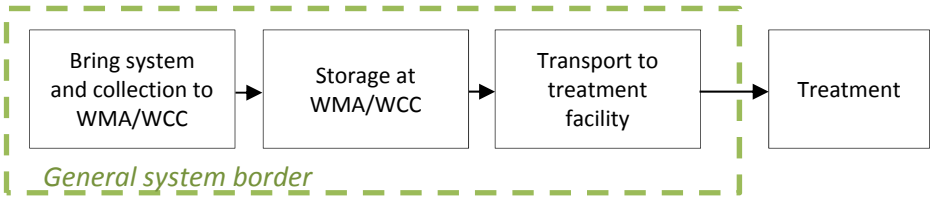

Figure 7: General system border

Based on the considered fraction, adaptions of the defined system borders due to a changing disposal way were made and explained for each country (Table 4, 8, 12, 16)

The stage Reuse is not considered continuative in the economic system. A lot of stakeholders are included in the second-hand-trade, whereas an allocation to e.g. flea markets operated by waste management associations, social-economic associations cooperating with waste management authorities or private second-hand-traders is hardly achievable. Each stakeholder has other possibilities of setting prices or offer services for free. Therefore the economic assessment is only focused on waste management treatment actions as mentioned in chapter 2.3.

3. Results WMA – perspective: Austria

Based on figure 8 the system borders for the Austrian formal scenario were adapted as presented in table 4. It is considered that citizens transport items (scrap metals, bulky waste, WEEE) to waste collection centres (WCCs). Delivered appliances are stored at WCCs and afterwards transported to treatment facilities.

Table 4: Considered system borders: Austria

Scrap metals	Bulky waste (without scrap wood)	WEEE
Citizen brings scrap metals to WCC	Citizen brings bulky waste to WCC	Citizen brings WEEE to WCC
WCC is storing the scrap metals	WCC is storing the Bulky waste	WCC is storing the WEEE
WCC transports scrap metals to recycling facility	WCC transports bulky waste to treatment facility	WCC receives infrastructural charges from Producer for WEEE / no transport, recycling responsibility
WCC receives revenues	WCC bears the costs for treatment	

Regarding the informal scenario items do not reach the WCC as they are earlier collected through the informal sector. In the formalized scenario only scrap metals are assumed to end up at the WCCs, as they are not collected due to defined guidelines of informal sector associations. Reusable bulky waste and EEE appliances are still collected within the formalized scenario according to rules of the mentioned guidelines of these associations.

3.1 Applied Treatment methods: Austria

In Austria the following treatment methods of the corresponding fractions are applied. As table 4 shows a high recycling rate for WEEE and metals is achieved while nearly 100 per cent of bulky waste is incinerated (Table 5).

Table 5: Allocation of treatment methods: Austria

Fraction	WEEE [%]	METALS [%]	BULKY WASTE (without scrap wood) [%]
Waste incineration	0,00%	0,00%	99,50%
Other thermal treatment	0,00%	0,00%	0,00%
Mechan. treatment and landfilling	0,00%	0,00%	0,00%
MBA	0,00%	0,00%	0,00%
Material recycling	99,50%	100,00%	0,00%
Only landfilling	0,00%	0,00%	0,00%
ReUse	0,50%	0,00%	0,50%

3.2 Costs and revenues: Austria

Considered cost and revenue items for Austria are displayed in table 6. Costs that arise for the collection of littered amounts are only present in the informal scenario. Nevertheless they only

have a minor influence as only 0.5 per cent to 0.1 per cent of one ton formally collected waste is littered according to the statistics of the Saxony waste collection.

The costs for the storage at WCCs is assumed to be 15 to 60 euro per ton, whereas the transport from the collection centre is about 20 euro per ton considering a 16 ton lorry and an average transportation way of 200 km to the treatment facility.

Regarding WEEE no differentiation of sub appliances took place for the Austrian assessment. This is based on the legally defined extended producers responsibility (Austrian WEEE Act §§ 13(3), 5, 6, 19). Hence, Austrian waste management association receive a so called infrastructural charge for the collection and reallocation of containers at WCCs. This infrastructural charge is transferred by the official implemented WEEE coordination body (Elektroaltgeräte Koordinierungsstelle Austria GmbH, EAK), which obtains fees from producers, that are legally responsible for the treatment and collection of WEEE. Hence, for WMAs no costs occur regarding the WEEE collection and treatment.

Bulky waste is incinerated in nearly 100 per cent of the cases. Hence for 99.50 per cent of one ton of bulky waste incineration gate fees are taken, while for scrap metals revenues through the sale at recycling facilities are included. The later ones are highly dependent on market conditions.

Table 6: Cost and revenue items: Austria

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Costs for collection of littered amounts	-	-	-	-	- 0,30	-0,60	-	-	-	€/t
Costs for storage at WCC	-15,00	-30,00	-60,00	-15,00	-30,00	-60,00	-15,00	-30,00	-60,00	
Costs for transportation to treatment plant	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	
Revenues from infrastructural charges (WEEE)	-	-	-	20,00	99,83	259,00	-	-	-	
Costs for treatment = incineration (bulky waste)	-	-	-	-	-	-	-130,00	-204,33	-299,00	
Revenues from sale of scrap metals	36,00	75,75	111,00	-	-	-	-	-	-	

3.3 Outcome: Austria

The results of the summary of the presented cost positions for each fraction are displayed in table 7. Regarding the formal scenario average costs of 176 euro per ton occur, as revenues from scrap metals and the infrastructural charges for WEEE does not balance the costs for the treatment of bulky waste. The difference is balanced through waste fees of citizens.

Considering the informal scenario only additional costs for the collection of littered amounts occur. The amount from 0.30 to 0.60 euro per ton only has a minor influence on the cost – benefit balance. This also implies that a positive influence of informal sector activities can be expected as higher amounts of bulky waste than WEEE and scrap metals are transhipped and, hence, treatment costs no longer exists. In this regard WMAs save around 176 €/t in comparison to the formal scenario. Moreover, considering a formalization of informal sector

activities higher outcomes can be expected as revenues from scrap metals are allocated to the WMA again. This is based on restrictions of informal collections, as collectors are not allowed to gather scrap metals due to guidelines of informal collector associations.

Table 7: Outcomes of the economic assessment: Austria

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Scrap metals	1,77	26,52	31,77	-	-	-	1,77	26,52	31,77	€/t
Bulky waste	-164,23	-253,56	-378,23	-	- 0,30	-0,60	-	-	-	
WEEE in general	-14,23	50,60	179,77	-	-0,30	-0,60	-	-	-	
TOTAL	-176,69	-176,44	-166,69	-	-0,60	-1,20	1,77	26,52	31,77	

In summary, informal sector activities in the considered system have an overall positive influence on the cost - benefit balance regarding the fractions scrap metals, bulky waste and WEEE. Nevertheless higher market prices for valuable materials can cause an alteration of the present result.

4. Results WMA – perspective: Germany

In Germany nearly the same procedure applies as in Austria (table 8). For scrap metals and bulky waste the same system borders are used. A different procedure is applied for WEEE as a different legal background exists. In Germany WMAs have the possibility to take an option on the collection and treatment of WEEE. This means a WMA can be responsible for the collection and treatment of WEEE for minimum of one year, if it is legally announced at the official implemented coordination body (stiftung elektro-altgeräte register, EAR). The economic assessment considers this procedure according to § 9(6) ElektroG, i.e. bears the costs respectively receives monetary means for the delivery at recycling facilities.

Table 8: Considered system borders: Germany

Scrap metal	Bulky waste	WEEE
Citizen brings scrap metals to WCC	Citizen brings bulky waste to WCC	Citizen brings WEEE to WCC
WCC stores the scrap metals	WCC is storing the Bulky waste	WCC stores WEEE using § 9(6) ElektroG
WCC transports scrap metals to recycling facility	WCC transports bulky waste to treatment facility	WCC transports WEEE to corresponding treatment facilities
WCC receives revenues	WCC bears the costs for treatment	WCC receives revenues

4.1 Applied treatment methods: Germany

In Germany a recycling rate of nearly 100 per cent of the fractions scrap metals and WEEE is achieved. Bulky waste on the other hand is mostly incinerated and recycled but also treated through other thermal treatment or in MBAs.

Table 9: Allocation of treatment methods: Germany

Fraction	WEEE [%]	METALS [%]	BULKY WASTE (without scrap wood) [%]
Waste incineration	0,00%	0,00%	36,21%
Other thermal treatment	0,00%	0,00%	2,58%
Mechan. treatment and landfilling	0,00%	0,00%	0,00%
MBA	0,00%	0,00%	8,00%
Material recycling	98,73%	98,50%	53,24%
Only landfilling	0,00%	0,00%	0,10%
ReUse	1,27%	1,50%	0,03%

4.2 Costs and revenues: Germany

For additional collection costs of littered amounts, costs for storage at WCC and the costs for transportation to treatment plants, same values are used as for Austria.

For WEEE a differentiation into different sub categories is conducted. Basically chapter 2.2 divided WEEE into CRT – monitor, fridge, washing machine and small household appliances. For Germany a minor adaption of the set categories was accomplished. In the national WEEE act (ElektroG) five collection groups are defined:

Collection group 1: Large household appliances, automatic dispensers
Collection group 2: Refrigerators and freezers
Collection group 3: IT and telecommunications equipment, consumer equipment
Collection group 4: Gas discharge lamps
Collection group 5: Small household appliances, lighting equipment, electric and electronic tools, toys, sports and leisure equipment, medical products, monitoring and control instruments

Except collection group 4, which is of less interest for the project, each collection group is typified through the defined sub categories in chapter 2.2. Monetary data is available for each collection group, whereas the values illustrate the gate fees WMAs have to pay (-) or receive (+) from the recycling facility. Next to market conditions, the gate fees are highly dependent on delivered items and corresponding treatment ways. Especially for displays/screen and cooling appliances higher treatment efforts arise and consequently higher treatment costs.

Costs for incineration, other thermal treatment, MBA, material recycling and landfilling display average gate fees of different treatment plants in Germany, whereas the values for scrap metals display current market prices (June 2012).

Table 10: Cost and revenue items: Germany

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Costs for collection of littered amounts	-	-	-	-	- 0,30	-0,60	-	-	-	
Costs for storage at WCC	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	
Costs for transportation to treatment plant	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	
Revenues from Collection group 1 (Washing machine)	-	-	-	180,00	200,00	220,00	-	-	-	
Revenues from Collection group 2 (Fridge)	-	-	-	-50,00	-10,00	30,00	-	-	-	
Revenues from Collection group 3 (CRT Screen)	-	-	-	-50,00	-7,50	35,00	-	-	-	€/t
Revenues from Collection group 5 (Small HH appl.)	-	-	-	20,51	77,57	124,23	-	-	-	
Costs for treatment bulky waste = incineration	-	-	-	-	-	-	-28,14	-73,47	-125,06	
Costs for treatment Bulky waste =other thermal treatment	-	-	-	-	-	-	-0,90	-65,00	-95,00	
Costs for treatment bulky waste =MBA	-	-	-	-	-	-	-6,40	-9,60	-12,80	
Revenues for Bulky waste =material recycling	-	-	-	-	-	-	5,32	15,97	26,62	
Costs for treatment bulky waste =landfilling	-	-	-	-	-	-	-0,07	-0,13	-0,20	
Revenues from sale of scrap metals	130,00	176,83	235,00	-	-	-	-	-	-	

4.3 Outcome: Germany

In Comparison to the Austrian results a different outcome results for German values (table 10). Only for minimum values in the formal scenario costs for bulky waste treatment are higher as revenues from WEEE and scrap metals. Hence, an informal scenario cause savings of about 47 euro per ton for WMAs as treatment costs no longer exists.

Regarding average and maximum values revenues from WEEE and scrap metals balance treatment costs of bulky waste and produce an overall benefit. Considering the informal scenario, it implies that for average and maximum values a loss of up to 35 euro per ton arises for WMAs. With regard to § 9(6) ElektroG, the German WMAs have a higher area of action related to the choice of the recycling facilities while considering market mechanisms (supply and demand). It explains the differences to Austrian results.

Taking into account the formalized scenario higher benefits can be achieved as in the formal scenario. Revenues out of the metal sale are allocated to WMAs, as for informal collectors of associations a metal collection is against agreed guidelines. Moreover, revenues out of WEEE delivery at recycling facilities do not balance bulky waste treatment costs, whereas for both parties, WMAs and informal collector, a formalized scenario would present a win-win situation.

Table 11: Outcomes of the economic assessment: Germany

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Scrap metals	80,51	119,40	159,23	-	-	-	80,51	119,40	159,23	
Bulky waste	-79,61	-205,50	-308,63	-	0,30	-0,60	-	-	-	
WEEE CG1	130,51	142,57	144,23	-	-0,30	-0,60	-	-	-	€/t
WEEE CG2	-99,49	-67,43	-45,77	-	-0,30	- 0,60	-	-	-	
WEEE CG3	- 99,49	-64,93	-40,77	-	-0,30	-0,60	-	-	-	
WEEE CG5	20,51	77,57	124,23	-	-0,30	-0,60	-	-	-	
TOTAL	-47,06	1,68	32,52	-	-1,50	-3,00	80,51	119,40	159,23	

5. Results WMA – perspective: Hungary

In Hungary different basic requirements regarding the procedures and, hence, system borders predominate. The fraction scrap metal is assumed to not reach the WMAs as informal collected metal amounts are directly sold at junk shops, intermediate dealers or at the industries. Hence, no influences through the informal metal business are assumed for WMAs in Hungary.

Bulky waste reaches the official waste management after a prolonged usage time (carpets, chairs etc.). In Hungary the bulky waste collection is accomplished through street collection and directly transferred to incineration and landfills, whereas the costs are beard by the WMAs.

In case of WEEE a street collection of reused appliances is conducted through WMAs as well. They are transported to a collection place (intermediate storage) and afterwards transferred to recycling facilities abroad. A dismantling partially takes place in Hungary, which is, based on lacking data, not included in the assessment. As WEEE is transported to recycling facilities abroad, German data on WEEE collection groups is applied in the assessment.

Table 12: Considered system borders: Hungary

Scrap metals	Bulky waste	WEEE
IS brings scrap metals to Junk shops or Industry	Streets collection of reused bulky waste through WMA	Street collection of reused WEEE through WMA
IS receives income for scrap metals	Direct transport to incineration, landfill, etc.	Transportation to collection place (intermediate storage)
	WMA bears the costs for treatment	Transportation to treatment / recycling company
		WMA receives revenues

5.1 Applied Treatment methods: Hungary

In Hungary metals are fully recycled, whereas WEEE is disposed at landfills in 15 per cent and is recycled in 85 per cent. A major part of bulky waste is landfilled and only nine per cent are incinerated.

Table 13: Allocation of treatment methods: Hungary

Fraction	WEEE [%]	METALS [%]	BULKY WASTE (without scrap wood) [%]
Waste incineration	0,00%	0,00%	8,90%
Other thermal Treatment	0,00%	0,00%	0,00%
Mechan. Treatment and landfilling	0,00%	0,00%	0,00%
MBA	0,00%	0,00%	0,00%
Material Recycling	84,10%	100,00%	0,00%
only Landfilling	15,50%	0,00%	90,60%
ReUse	0%	0%	0,0%

5.2 Costs and revenues: Hungary

For the Hungarian assessment additional collection costs for littered amounts are included as well (table 11). Additionally costs for the collection of amounts that are informally transhipped into the country are calculated for the informal and formalized scenario. Storage costs at collection places are included for the fraction WEEE and are assumed as high as in the other countries. Moreover costs for the transportation to treatment plants are calculated at the same level as already presented for the German and Austrian assessment.

As explained in chapter 5, the costs respectively revenues for WEEE are at the same level as German values, as WEEE is transhipped abroad for recycling. Costs for treatment of bulky waste such as incineration and other thermal treatment correspond to average gate fees in Hungary. For scrap metals neither revenues nor costs are included as it was defined that metals do not reach WMAs in any case.

Table 14: Cost and revenue items: Austria: Hungary

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Costs for collection of littered amounts	-	-	-	-	- 0,30	-0,60	-	-	-	
Costs for additional collection (transportation) of amounts of IS	-	-	-	-25,00	-60,00	-160,00	-25,00	- 60,00	-160,00	
Costs for storage at WCC	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	
Costs for transportation to treatment plant	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	€/t
Revenues from Collection group 1 (Washing machine)	-	-	-	180,00	200,00	220,00	180,00	200,00	220,00	
Revenues from Collection group 2 (Fridge)	-	-	-	-50,00	-10,00	30,00	-50,00	-10,00	30,00	
Revenues from Collection group 3 (CRT Screen)	-	-	-	-50,00	-7,50	35,00	-50,00	-7,50	35,00	
Revenues from Collection group 5 (Small HH appl.)	-	-	-	20,51	77,57	124,23	20,51	77,57	124,23	
Costs for treatment = incineration	-	-	-	-10,68	-23,14	-35,60	-10,68	-23,14	-35,60	
Costs for treatment =landfilling	-	-	-	-16,31	-28,09	-39,86	-16,31	-28,09	-39,86	
Revenues from sale of scrap metals	-	-	-	-	-	-	-	-	-	

5.3 Outcomes: Hungary

With regard to the formal scenario no changings occur for WMAs as no amounts are informally transhipped (table 15). Within the informal scenario additional costs for the bulky waste collection and treatment occur. Contrariwise revenues can be gathered for collection group one (washing machine) for minimum and average values. Nevertheless costs for the collection, transportation and treatment of the other fractions result in a negative outcome for the informal scenario. The worst case scenario means additional costs of around 750 euro per ton. Same applies for the formalized scenario. Only additional costs for the collection of littered items do not occur. Nevertheless it has only a minor effect on the overall result. With regard to changing market prices of valuable materials, the outcome can change in the future.

Table 15: Outcomes of the economic assessment: Hungary

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Scrap metals	-	-	-	-	-	-	-	-	-	
Bulky waste	-	-	-	-32,76	-92,30	-216,83	-32,76	-92,00	-216,23	
WEEE CG1	-	-	-	105,51	82,27	-16,37	105,51	82,57	-15,77	€/t
WEEE CG2	-	-	-	-44,49	-127,73	-286,37	-44,49	-127,43	-285,77	
WEEE CG3	-	-	-	-124,49	-125,23	-201,37	-124,49	-124,93	-200,77	
WEEE CG5	-	-	-	-4,49	17,27	-36,37	-4,49	17,57	-35,77	
TOTAL	-	-	-	-100,72	-245,72	-757,31	-100,72	-244,22	-754,31	

6. Results WMA – perspective: Poland

For Poland same procedures as in Hungary apply (table 16). One difference that is involved in the assessment displays the WEEE recycling. It is conducted within the country, hence no transhipment of WEEE takes place and market prices for WEEE correspond to polish values.

Table 16: Considered system borders: Poland

Scrap metals	Bulky waste	WEEE
IS brings scrap metals to Junk shops or Industry	Streets collection of reused bulky waste through WMA	Street collection of reused WEEE through WMA
IS receives income for scrap metals	Direct transport to incineration, landfill, etc.	Transportation to collection place (intermediate storage)
	WMA bears the costs for treatment	Transportation to treatment / recycling company
		WMA receives revenues

6.1 Applied Treatment methods: Poland

In Poland metals are recycled in 100 per cent (table 17). For WEEE a recycling rate of around 85 per cent can be reached. The remaining portion is landfilled, incinerated or mechanically

treated. Bulky waste is highly used in other thermal treatment but also recycled in 30 per cent of the cases. A minor portion of 5 per cent is landfilled.

Table 17: Allocation of treatment methods: Poland

Fraction	WEEE [%]	METALS [%]	BULKY WASTE (without scrap wood) [%]
Waste incineration	0,16%	0,00%	0,00%
Other thermal Treatment	0,29%	0,00%	64,60%
Mechan. Treatment and landfilling	1,73%	0,00%	0,00%
MBA	0,95%	0,00%	0,00%
Material Recycling	85,03%	100,00%	29,70%
only Landfilling	11,52%	0,00%	5,70%
ReUse	0%	0,00%	0,0%

6.2 Costs and revenues: Poland

The values for costs for collection of littered amounts, costs for additional collection of amounts of informal collectors, the costs for the storage at WCC or intermediate storage places and the transportation costs to treatment plants are at the same level as Hungarian data.

WEEE revenues are displayed, which show average gate fees from polish recycling companies. Also treatment costs for bulky waste such as incineration costs display average gate fees of corresponding plants in Poland.

Table 18: Cost and revenue items: Austria: Poland

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Costs for collection of littered amounts	-	-	-	-	- 0,30	-0,60	-	-	-	
Costs for additional collection (transportation) of amounts of IS	-	-	-	-25,00	-60,00	-160,00	-25,00	- 60,00	-160,00	
Costs for storage at WCC	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	-30,26	-38,20	-56,54	
Costs for transportation to treatment plant	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	-19,23	€/t
Revenues from Collection group 1 (Washing machine)	-	-	-	185,00	219,00	253,00	185,00	219,00	253,00	
Revenues from Collection group 2 (Fridge)	-	-	-	135,00	185,00	235,00	135,00	185,00	235,00	
Revenues from Collection group 3 (CRT Screen)	-	-	-	94,00	117,50	141,00	94,00	117,50	141,00	
Revenues from Collection group 5 (Small HH appl.)	-	-	-	106,00	158,50	211,00	106,00	158,50	211,00	
Costs for treatment = incineration	-	-	-	-97,66	-122,07	-146,48	-97,66	-122,07	-146,48	
Costs for treatment =Other thermal treatment	-	-	-	-23,47	-18,78	-14,08	-23,47	-18,78	-14,08	
Costs for treatment =Mechn Treat. + landfillin	-	-	-	-101,24	-69,32	-37,56	-101,24	-69,32	-37,56	
Costs for treatment =MBA	-	-	-	-51,34	-47,03	-43,03	-51,34	-47,03	-43,03	
Costs for treatment =Material recycling	-	-	-	-	3,33	10,00	-	3,33	10,00	
Costs for treatment =landfilling	-	-	-	-16,31	-28,09	-39,86	-16,31	-28,09	-39,86	
Revenues from sale of scrap metals	-	-	-	-	-	-	-	-	-	

6.3 Outcome: Poland

As already mentioned for Hungarian results, no effects of informal scrap metal transhipment are realized for the three scenarios as a direct transfer to intermediate dealers or the industry takes place. For bulky waste additional costs arise in comparison to the formal scenario as higher amounts have to be treated. For CRT-Screens and for fridges (average respectively maximum values) costs can occur as revenues cannot balance them.

Summing up the informal scenario for minimum values has a positive outcome. Additional benefits of around 140 euro per ton can be gathered. In comparison to the Hungarian assessment the benefits base on higher revenues from WEEE fractions. The formalized scenario only differs from the informal scenario through missing additional collection costs for littered amounts.

Table 19: Outcomes of the economic assessment: Poland

	Formal			Informal			Formalized			
	Min	Ø	Max	Min	Ø	Max	Min	Ø	Max	
Scrap metals	-	-	-	-	-	-	-	-	-	
Bulky waste	-	-	-	-56,01	-93,63	-195,39	-56,01	-93,45	-195,04	
Washing machine (WEEE)	-	-	-	110,51	101,27	-1,37	110,51	101,57	-0,77	€/t
Fridges (WEEE)	-	-	-	60,51	67,27	-1,37	60,51	67,57	-0,77	
CRT-Screens (WEEE)	-	-	-	-4,49	-18,06	-95,37	-4,49	-17,76	-94,77	
Small HH appl. (WEEE)	-	-	-	31,51	40,77	-25,37	31,51	41,07	-24,77	
TOTAL	0	0	0	142,03	97,62	-318,87	142,03	99,	-316,12	

Hence, summing up the informal sector has a positive influence on the waste balance if costs for the treatment of items are low, respectively if market prices for WEEE or for valuable materials rise in the future.

7. Informal collectors perspective

The informal collector's perspective shed a light on occurring costs and benefits of used item traders. Hungarian and Polish informal collectors are analyzed. Data used for the analysis are taken from Polish and Hungarian interviews at flea markets and display the informal scenario. Thereby the informal scenario implies a sold amount of 70 % of the total collected amount, whereas the formalized scenario includes a sold amount of 95 % based on better product quality and a accompanied sales success. The collected amount is equal in both scenarios. Regarding the income it is assumed that the formalization results in an increase of 10 %.

7.1 Hungary

The average income of Hungarian traders adds up to 2,170 € per trader and month within the informal and 2,635 € within the formalized scenario. It is assumed that the income raises about 15 % per cent from informal to formalized scenario based on higher quality goods.

An Hungarian informal trader collects about 4.4 tons per month in average, which compounds of 1.7 tons WEEE, 0.75 tons of metals and 1.9 tons of furniture. Accordingly, the total sold amount per month is 3.1 tons within the informal and 4.2 tons per month within the formalized scenario. It corresponds to an income of 0.49 € per kilogram collected amount for the informal and 0.58 € per kilogram collected amount for the formalized scenario. It complies with an increase of 15 % based on a higher income at same amounts of collected materials. Specific costs for sold amounts add up to 0.70 € per kilogram within the informal and 0.61 € per kilogram within the formalized scenario. The decrease of specific income of 13 % results from an increase of sold materials of 25 % and increase of income of 15 % (Table 20). These values can fluctuate based on collection and sales success of considered traders.

Table 20: Income, collected and sold amounts of Hungarian informal collectors

	WEEE	METALS	FURNITURE	**In GENERAL**	Unit
Income per month **INFORMAL SC**. [€/month*trader]	1100 €	170 €	900 €	**2170 €**	€ / month*trader
Income per month **+15% FORMALIZED SC.** [€/month*trader]	1294.12 €	200 €	1058.82 €	**2552.94 €**	€ / month*trader
collected amount per month [kg/month*trader]	1.74 t	0.75 t	1.93 t	**4.4** t	t / month*trader
sold amount per month **70% = INFORMAL SC.** [kg/month*trader]	1.218 t	0.525 t	1.351 t	**3.094 t**	t / month*trader
sold amount per month **95% = FORMALIZED SC.** [kg/month*trader]	1.653 t	0.7125 t	1.836 t	**4.199 t**	t / month*trader
Income per collected amount (**INFORMAL SC.)**	0.63 €	0.23 €	0.47 €	**0.49 €**	€ / kg*trader
Income per collected amount **(FORMALIZED SC.)**	0.74 €	0.27 €	0.55 €	**0.58 €**	€ / kg*trader
Income per sold amount (**INFORMAL SC.)**	0.90 €	0.32 €	0.67 €	**0.70 €**	€ / kg*trader
Income per sold amount (**FORMALIZED SC.)**	0.78 €	0.28 €	0.58 €	**0.61 €**	€ / kg*trader

Specific costs that occur should not overmatch given values for the specific income to ensure a profit margin. Moreover it indicates that an optimized collection of high-quality goods diminishes the span between income per sold and collected amounts. The difference between specific incomes of both is found to be 30 % within the informal scenario, whereas a difference within the formalized scenario only adds up to 5 %. It verifies a higher sales success (sales efficiency) at remaining collected amounts. While conducting a formalization process this value could serve as an indicator for the economic improvement of informal trader's situation.

Regarding costs, different values were considered. This includes transportation costs, fees for renting an exhibition space, fees for storage room and fees for mobile usage. For the informal scenario penalties through police actions and for the formalized scenario membership fees for the organization, taxes and waste fees are considered additionally. Each value is expressed through a minimum, average and maximum, only taxes and transportation costs are constant within the evaluation. Total costs per trader and month are displayed in table 21.

Table 21: Costs per Hungarian trader and month

	INFORMAL SCENARIO			FORMALIZED SCENARIO			
	Minimum	Average	Maximum	Minimum	Average	Maximum	Unit
Total costs	**604.13 €**	**952.63€**	**1301.13 €**	**1277.42 €**	**1388.92 €**	**1500.42 €**	**€/month *trader**
Costs per Sold am.	0.20 €	0.31 €	0.42 €	0.30 €	0.33 €	0.36 €	€/per kg*trader
Costs per collected am.	0.14 €	0.22 €	0.29 €	0.29 €	0.31 €	0.34 €	€/per kg*trader

Monthly costs for one informal collector add up from 604 € per month (minimum values) to 1,301 € per month (maximum values) considering the informal scenario. Key drivers are transportation costs (6.25 trips per month à 79 €) as well as penalties and fees for the storage room considering maximum values. Costs significantly increase within the formalized scenario. A range can be found between 1277 € per month (minimum values) to 1500 € per month (maximum values). It is explained through additional expenses for membership fees, waste fees and especially taxes of 27 %. The increase span between informal and formalized scenario lowers from minimum to maximum values as penalties are accounted with 500 € within the informal scenario and maximum values and can be nearly covered through additional taxes of 711 € within the formalized scenario.

Taken into account sold amounts, specific costs range between 0.20 € and 0.42 € per kilogram and trader within the informal scenario. A decrease of 36 % and 7 % for minimum and average values and an increase of 18 % for maximum values result in the formalized scenario. It is explained through a higher sales success of 25 % within the formalized scenario that faces highest increasing cost rates of 53 % at minimum values and lowest of 13 % at maximum values comparing informal and formalized scenario. It implies that, if the cost increase equals the increasing sales amount, specific costs are constant.

It is assumed that the amount of collected materials is not changing within the scenarios, whereas additional costs occur such as fees for membership and higher taxes based on a higher income (high quality goods). Hence, higher costs at same collection amounts increase specific costs per collected kilogram. Likewise the span between informal and formalized scenario lowers considering maximum values as dropping penalties can be nearly covered through additional taxes.

Figure 8 contrasts income and costs per collected amount regarding informal (pulled through curves) and formalized scenario (dotted curves). The cost curves are displayed while using maximum values. The figure includes a sensitivity analysis, whereas zero values at the x-axis correspond to presented values of table 20 and 21. An increase and decrease of specific income and costs of 20 % is considered.

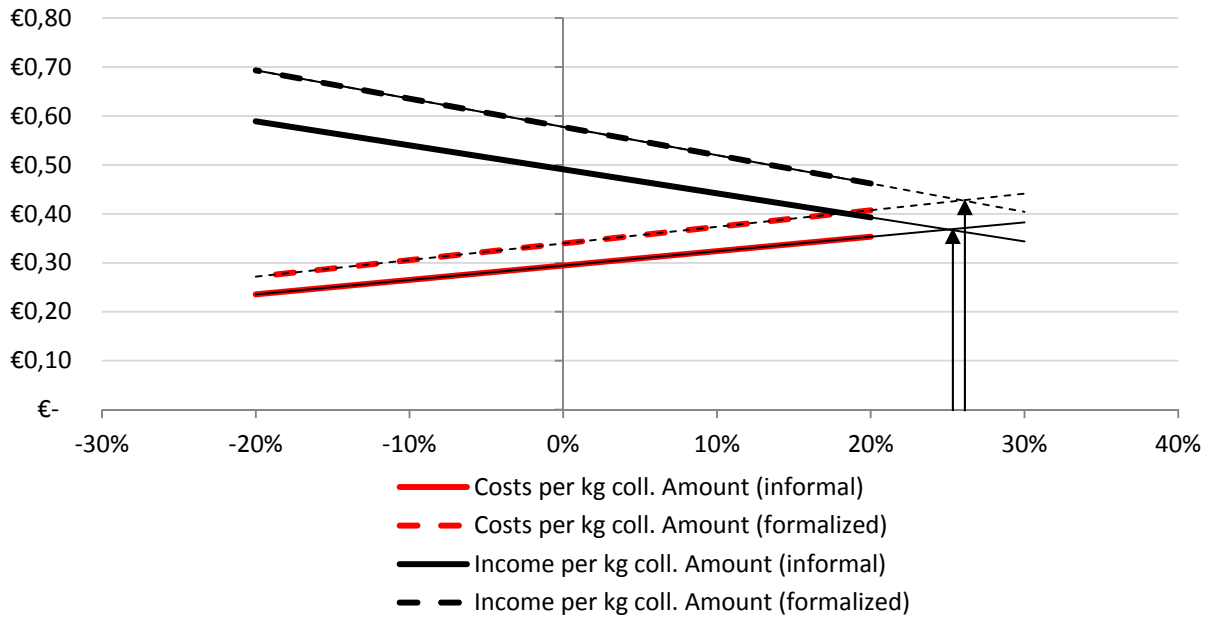

Figure 8: Income and costs per sold and collected amount in Hungary

Considering specific costs and income regarding presented data in table 20 and 21 (0 % at x-axis), informal collectors can reach a profit margin of 0.20 € per kilogram within the informal and0.24 € per kilogram within the formalized scenario. This corresponds to an available maintenance of 869 € per month (informal scenario) respectively 1,053 € per month (formalized scenario) considering maximum costs. Comparatively, the minimum wage as documented in January 2012 adds up to 295.63 €/month in Hungary according to EUROSTAT.

The specific profit margin raises about 17 % from informal to formalized scenario. It can be explained through constant collected amounts that face 15 % higher specific income and 13 % higher specific costs in the formalized scenario. Under the given system boundaries, it implies that the break – even point is faster reached within the informal scenario, which recommends the formalized scenario as the more economic efficient alternative. Contrariwise, if specific costs are higher than the specific income in the formalized scenario, the informal scenario displays the alternative for recommendation. This is true for minimum and average values as lower costs, especially the cost key driver 'penalties' of 20 € and 260 €, respectively, cannot be covered through additional costs for taxes (585.90 €).

The income is highly dependent on demands of flea market visitors. Hence, prices of items have to be set accordingly. Table 22 shows an assortment of goods considering defined fractions.

Table 22: Set prices for goods (Hungarian traders)

Set prices per Item	WEEE	METALS	FURNITURE
Example (fridge, Monitor, Bobby car…)	Fridge	Aluminium	Couch
Minimum [€/item]	17 €	1,1 €	30 €
Average [€/item]	76 €	1,2 €	115 €
Maximum [€/item]	135 €	1,3 €	200 €

Next to customer demands, price ranges depend on the quality of a good. Therefore spans of e.g. 17 €/item (minimum values) to 135 €/item (maximum values) for a fridge can be found.

7.2 Poland

Data about Polish traders could be gained through surveys as well. Thereby the average income adds up to 680 € per trader and month, which is about 70 % less than a Hungarian trader generates in average. One trader collects about 1.9 tons per month (Table 23). It corresponds to an income of 0.35 € per kilogram collected material and is 29 % lower than Hungarian income of 0.49 € per kilogram collected material within the informal scenario (Table 23).

Table 23: Income and collected amounts of Polish traders in average

	In GENERAL	Unit
Income per month **INFORMAL SC**.[€/month*trader]	680 €	€ per month*trader
Income per month **+15% FORMALIZED SC.** [€/month*trader]	800 €	
collected amount per month [kg/month*trader]	1.9	tons per month*trader
sold amount per month **70% = INFORMAL SC.** [kg/month*trader]	1.36	tons per month*trader
sold amount per month **95% = FORMALIZED SC.** [kg/month*trader]	1.84	tons per month*trader
Income per collected amount (**INFORMAL SC.)**	0.35 €	€ per kg*trader
Income per collected amount **(FORMALIZED SC.)**	0.41 €	€ per kg*trader
Income per sold amount (**INFORMAL SC.)**	0.50€	€ per kg*trader
Income per sold amount (**FORMALIZED SC.)**	0.43€	€ per kg*trader

Same relations as explained for the Hungarian case occur. Considering the specific income per collected amounts, the formalized scenario increases the income about 15 % as higher income at same collected amounts can be reached. Contrariwise the higher sales success within the formalized scenario results in a decrease of the specific income of 14 % as higher sold amounts of 25 % faces higher income of 15 %.

Regarding occurring costs per trader, fees for renting an exhibition place, transportation costs, fees for storage room, fees for mobile usage as well as taxes of 18 % are considered. The sum of the informal scenario amounts to monthly costs of 572.53 € (minimum values) to 958.84 € (maximum values). Main cost driver are transportation costs, which are quantified equally to the Hungarian case. Monthly costs for the formalized scenario range between 720.53 € and 1.112.84 € and are mainly influenced through taxes and transportation costs.

Table 24: Costs per Polish trader and month

	INFORMAL SCENARIO			FORMALIZED SCENARIO			
	Minimum	Average	Maximum	Minimum	Average	Maximum	Unit
Total costs	**572.53**	**674.67**	**958.84**	**720.53**	**825.67**	**1112.84**	**€/month *trader**
Costs per Sold am.	0.42 €	0.50 €	0.71 €	0.39 €	0.45 €	0.60 €	€/per kg*trader
Costs per collected am.	0.30 €	0.35 €	0.49 €	0.37 €	0.43 €	0.57 €	€/per kg*trader

It is recognizable that specific costs for sold amounts are lowered within the formalized scenario from 7 % (minimum values) to 14 % (maximum values). The relation displays a contrast to the Hungarian case. The reason can be found in a faster growth rate of sold amounts than costs. It means that a cost increase of 7 to 14 % faces an increase of sold amounts of 25 %. Contrariwise specific costs per collected amounts increase about 21 % (minimum values) to 14 % within the formalized scenario. It is explained through higher costs at remaining collected amounts.

Figure 9 contrasts income and costs per collected amount regarding informal (pulled through curves) and formalized scenario (dotted curves). The cost curves are displayed while using maximum values as accomplished for the Hungarian case. The figure includes a sensitivity analysis, whereas zero values at the x-axis correspond to presented values of table 23 and 24. An increase and decrease of specific income and costs of 20 % is considered.

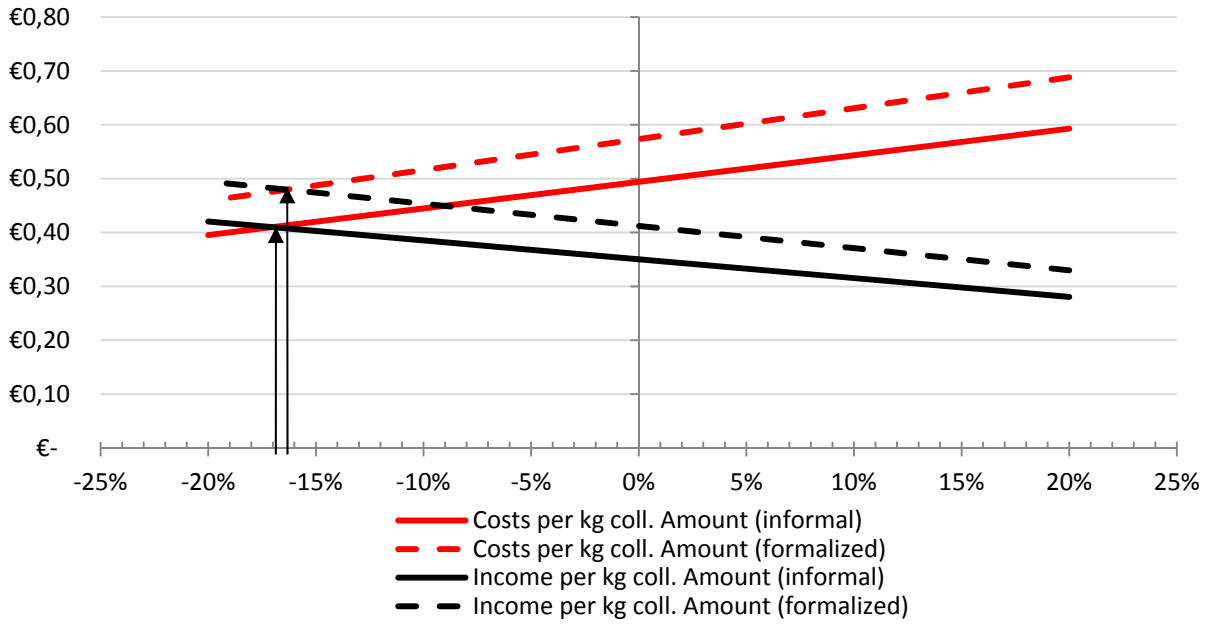

Figure 9: Income and costs per collected amount in Poland

Coverage of specific costs, respectively a break – even point, is only reached, if considered costs and incomes per kilogram collected material is reduced about 16.2 % and 17 % for the informal and formalized scenario, respectively. Thereby a formalization process results in specific losses of 0.14 € per kilogram within the informal scenario and 0.16 € per kilogram within the formalized scenario (0 %, x – axis), which implies a loss for informal traders for both scenarios. It amounts to 279 € within the informal and 313 within the formalized scenario. Only for average and minimum values benefits can be reached, which amounts to 108 € per month for the informal and 79 € per month for the formalized scenario. Based on taxes of 18 % of the generated income the formalized scenario causes higher cost growth in relation to an increasing income generation, whereas the formalized scenario displays the economic less efficient alternative.

These outcomes strongly depend on collected material and quality as well as set item prices for goods, which are dependent on customer demands in turn. Some examples for set prices are shown in table 25 according to the defined fractions.

Table 25: Set prices for goods (Polish traders)

set prices per Item	WEEE	METALS	FURNITURE
Example (fridge, Monitor, Bobby car…)	monitor	-	commode
Minimum [€/ item]	7,28 €	-	12,14 €
Average [€/item]	9,95 €	-	30,83 €
Maximum [€/item]	14,56 €	-	84,91 €

In summary polish traders can generate a profit margin of 108 € per month if low costs and an informal scenario is considered. Comparatively the polish minimum wage in January 2012 was 336.47 €/month according to EUROSTAT.

8. CONCLUSION

The contribution aimed to show up economic influences of informal sector activities on Eastern (Hungary, Poland) and Western European (Austria, Germany) waste management systems on the one hand. The economic situation of informal collectors was analysed in Poland and Hungary on the other hand.

The focus was put on three fractions: WEEE, metals and furniture, as they are mainly collected through informal collectors. The treatment methods for the materials were displayed and corresponding cost items for the waste management perspective and the informal collector's perspective were deduced and transferred into a cost-breakdown-structure. Finally the results were calculated for both perspectives.

Regarding the waste management perspective, the contribution showed an influence of informal activities on the cost – revenue - balance of all fractions and for Eastern as well as Western European countries. Key factors that significantly influence the results are the prevalent waste treatment method and the market prices of recyclables. Thereby the informal activities only have a positive influence on the cost – revenue – balance of Western European countries, if the loss of revenues through lower amounts of recyclables is not higher than the cost savings through missing amounts for transportation and treatment. Considering Eastern European countries the informal activities show a positive influence, if the waste treatment technology is focused on recycling. Nevertheless waste management systems in considered Eastern European countries still lack regarding an efficient accomplishment of state of the art waste treatment measures. Therefore mostly additional costs for imported informal material could be observed. Continuative an adaption process of waste treatment techniques and altering market prices of valuable materials will change the current situation.

Informal traders are found to generate higher income in Hungary. The monthly income add up to 2170 € per month for a Hungarian trader and 680 € per month for a Polish trader within the informal scenario. The assessment revealed that the formalization process causes higher profit margins for Hungarian traders, whereas Polish traders receive lower profit margins in comparison to the informal scenario. It is based on already low income level of Polish traders, whereas additional costs, such as taxes of 18 % lower the profit margin in the formalized scenario.

Nevertheless those data are subject to major fluctuations as income is strongly dependent on amount and quality of collected goods as well as costumer demands. Hence, an organization

and therefore an optimized and structured collection could lead into an improved income situation for informal collectors. An indicator for this hypothesis is found to be the collected and sold amount per kilogram. Through structured accomplishment of collection the span between collected and sold amount per kilogram might decrease.

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Annex 1: WEEE legislation in A, D, HU, P, SK

		Austria	Germany	Hungary	Poland	Slovakia
Collection from private households	Physical Responsibility	D, M, P	M	P	D	D,P
	Legal clause	3(13), 5, 6	9(4)	3	42(2)	54c (2), 54 b (1)(e)
	Financial Responsibility	D, P	M	P	D	D,P
	Legal Clause	19	9(4)	3	42(2)	54c (2), 54 b (1)(e)
In the countries listed below the legal text clearly distinguishes that producers are required to finance the waste from their own products placed on the market after 13 August 2005.						Finance waste from own products
We find other variations of Article 8(2), such as in the case of Germany and Austria, where producers are given the choice to decide of whether or not they are individually or collectively responsible financially for products placed on the market after 13 August 2006.		Choice of financing individual or collective	Choice of financing individual or collective	Defines new WEEE but no financial mechanism	Collection of own products mandated. No specific financing mechanisms. Responsibility could be delegated to collective systems	
	Legal Clause	7(3)	14(5) 1. or 2.	15 (1) a	27, 28(1)(1), 57	54e(1)
Allocation of Responsibility for Collection, Treatment, Recovery, Recycling and Disposal of WEEE from Private Households Deposited at Collection Points	Physical and financial responsibility	P	P	P	P	P
	Legal Clause	7	10(1)	3	27	54e
Requirements for a Financial Guarantee	Collective scheme membership is considered to be the financial guarantee	Producers in collective schemes are legally exempt from guarantee requirements 8(1)1. Producers with individual guarantees must sort products by brand during collection.		Producers in collective financing schemes are legally exempt from guarantee requirements	Guarantee is limited to costs of current year and not future waste costs	

	Financial guarantee required from all producers		As WEEE Directive, Guarantee in collective systems can be based on reciprocity			
	Product tax is de facto guarantee					Producers with individual system must provide guarantees for each product sold, whereas no requirements are set of guarantees from collective systems
	MS requirements for Financial guarantee	Collective scheme membership is considered to be the Financial Guarantee	Financial guarantee required from all compliers	Collective scheme membership is considered to be the Financial Guarantee	Collective scheme membership is considered to be the Financial Guarantee	Product Tax is considered to be the de facto guarantee if proof of compliance is not satisfied
	Legal clause	8	14 (5)	16 (7):	18(1). (1).	54h(1)
Approach to the Definition of Producer Taken by Member States	National Approach	x	x		x	x
	Ambiguous or Undefined Approach			x		
	Legal clause defining producer	13(1) of WM Act	3(11) of ElektroG	2(d-f)	3(13)	54a(10)
Variable fees paid to Municipal collection centres based on amount collected (contract) [€/t] (2006)		40 €/t Large App 55 €/t Refrig. 85 €/t TV, monito 52 €/t small app	-	-	-	-
Average costs of WEEE collection and Management at Municipal civic amenity sites (2006)		57,00 €	-	-	-	-
Variable fees paid to Municipal collection centres based on amount collected (without contract = lump sum) [€/WCC] (only 7.5% are without contract) (2006)		710 € Large App 710 € Refrig. 825 € TV, monito 420 € small app	-	-	-	-
Estimated annual operating costs for national systems	Annual Operating Costs [€]	670.000,00 €	9.600.000,00 €	10.131,00 €	33.733,00 €	16.500,00 €
	Number of registered Producers	1450	6100	704	2020	763
	Operating Ocsts per Producer [€]	462,07 €	1.573,77 €	14,39 €	16,70 €	21,63 €
Requirement to label	B2C	x	x	x	x	x

products with crossed-out wheeled bin in EU 27	B2B	-	-	x	x	x
Registration and Reporting Fees and Number of Registered Producers in EU 27		none	150 € basic registration (eplus costs for registration renewal)	300 € one time fee	Variable based on turnover 12 – 1875 €	None
Classification of Producer Registers and Clearinghouse by Responsible Actor		Register: Public Clearinghouse: Private	Register & Clearing house privately run	Register: Public	Register: Public	Register: Public
Countries with Competing Collectives or National and Pan-European Consortia		UFH Lamps (cat. 5) UFH (all but 5, B2C & B2B) ERA (all cat., B2C & B2B) EVA (all cat., B2C only) ERP (all but 5, B2C & B2B)	-	Electro-Coord (All cat.) Comp-Cord (2,3,4,5) E-Hulladeck (All cat.) Elektro-Waste Kht (3) Ökomat Kht. (All categories) Re-Elektro Kht. (All cat.)	Auraeko Biosystem Elektrorecykling EL-Centrum ElectroEko ERP	SEWA (All cat.) Ekolamp (cat. 5) ZEO (cat. 6) Etalux (cat 5)