ECO DESIGN FOR THE ENHANCEMENT OF CENTRAL EUROPE PAPER BASED PRODUCTS RECYCLING LOOP

ECOPAPERLOOP

Work Package 4

Improve collection strategies

(4.1.1 Definition of Main Characteristics describing local and regional structures)

Content

Figure list

Table list

1 Work package 4 – Improve collection strategies

1.1 Introduction

The European Paper and Board industry has a long term experience in the field of paper and board recycling /4-1/. With a recycling rate for CEPI countries[1] of 70.4% and a total collection of paper for recycling of 57.262 Mio. t in 2011, Europe is the world leader in pulp & board collection and recycling /4-1, 4-2/.

As already in /4-1/ described, the closer consideration of waste paper has the following backgrounds:

- Paper for recycling is an indispensable raw material for the European paper industry.
- Quality of paper for recycling determines its future utilisation options.
- The critical balance between prices, availability, demand and supply determines the future of paper for recycling.

In Central Europe (CE) regions paper for recycling is a major resource, but the amount of this resource is limited and the collection of paper for recycling is characterized by the following topics in CE:

- Paper recycling rates are still highly inhomogeneous.
- Collection systems are different.
- Recyclability oriented eco-design of paper products is addressed only in some countries.

The manufacturing of recycled products of a high quality requires high quality of collected paper for recycling. The paper for recycling is not only recycled in the country where it is produced. Some essential features such as ecodesign and ecocollection concepts must be developed at transnational level to increase the sustainability of the paper loop. Improper collection systems can drastically reduce the amount of paper being recovered for recycling; and improper design of a graphic or packaging product can make is useless or even harmful for the recycling process. /4-3/

The objectives of this work package are to:

- Develop a clear picture of each region's status.
- Develop common methodologies and practices.
- Develop a communication platform to enhance awareness of recycling oriented eco-design and eco-collections.
- Develop a sustainable strategy for Central Europe management of paper for recycling. /4-3/

The investigation of the amount, the paper grades and the used waste paper collective systems are a key for the reaching of these objectives.

[1] EU-27 countries plus Norway and Switzerland

1.2 Collection Strategies

As already mentioned the paper collective systems are different in CE. In general the way of collecting recovered paper depends on the collection region (rural, urban), its characteristics (population and housing structure, kind of industry) and customers of collected recovered paper. The efficiency of a collection system for used products is in general assessed with regard to /4-1, 4-3/:

- the quantity of the collected material,
- the quality of the collected material and
- the specific collection costs (€/t).

In general two main sources of paper for recycling can be distinguished /4-1/:

- Industrial collection and
- Private collection.

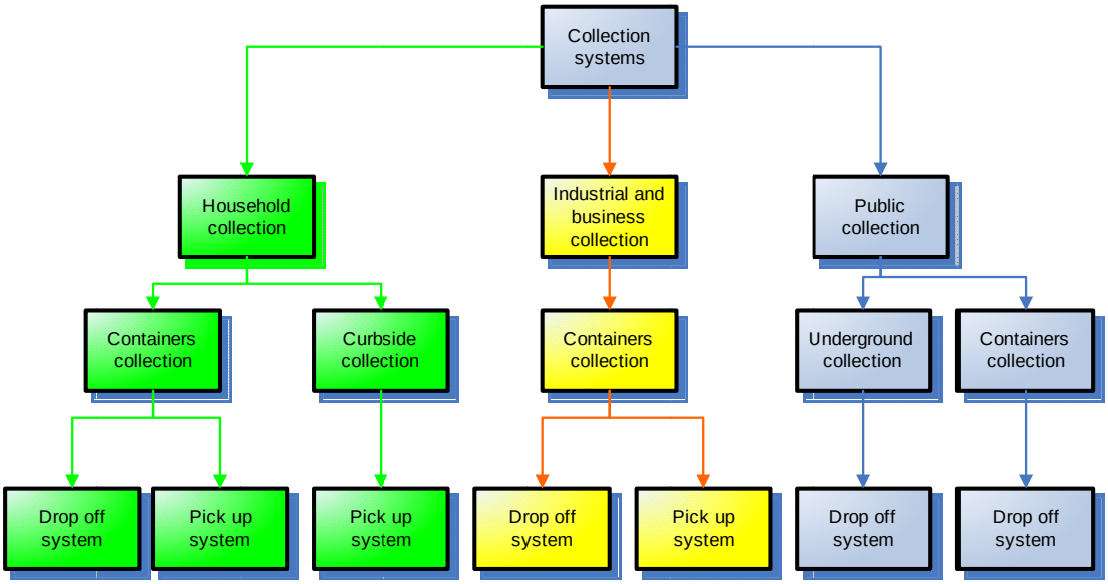

Figure 1: Basic collection systems /4-1, 4-4/

Private collection is also called household collection. Collection from industrial operations is a collection from business operations and sites where unwrapping is carried out (e.g., supermarkets), offices, authorities and administration, including returns of recovered paper from converting facilities (e.g., printing houses and corrugated board plants) as well as over–issues of news and magazines (10%). /4-1, 4-5/

In high developed countries with already high collection rate, the share ratio between those two sources in total collection is approximately equal. Situation changes in countries with low collection rate, where collection system is mainly focused on industrial sources. Practice shows that industrial and commercial paper and board collection is much easier to be carried out. Countries with high collection rate have capacity to collect even more than 90% of used paper by industrial collection, like for example The Netherlands, Spain, and Germany. /4-1/

In practise there different collection systems: kerbside, blue bins, public containers, recycling yards, collection shops, recycling centres and drop off recycling parks. /4-1/

All corresponding studies gave clear evidence that the success of such strategies is in the first place a function of

- the local /regional society's environmental awareness,
- the local/regional infrastructure
- the structure of the local/regional recycling industry and
- the way the collection strategy addresses the needs of this local/regional recycling industry.

The strategies by which used paper and board products are collected as well as the logistical environment have significant effects on the quality of the secondary materials, the economics and the environmental burdens caused by recycling.

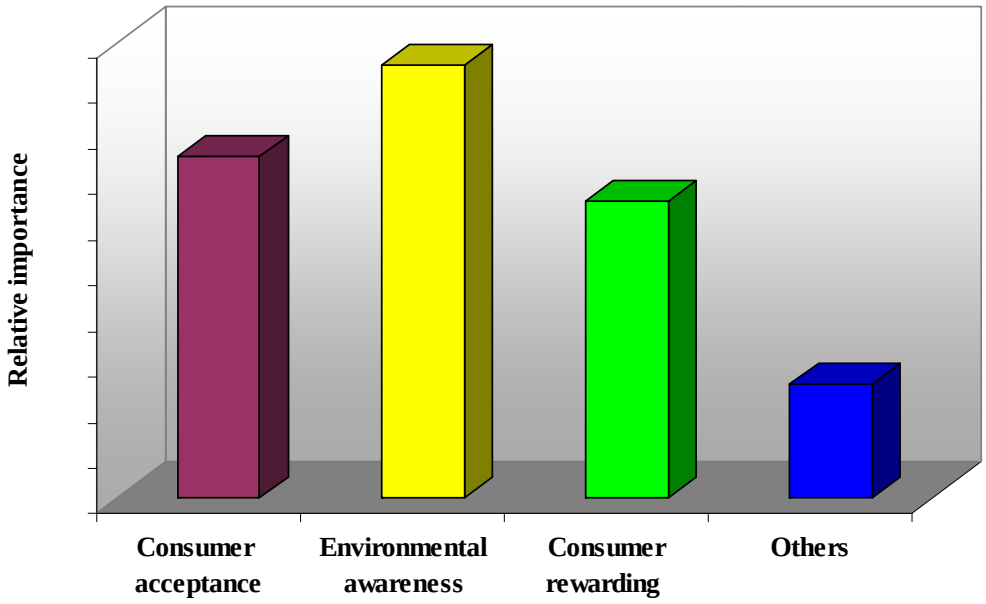

Figure 2: Relative importance of different means to improving collection of recovered paper and board /4-1/

Within COST E 48 a survey based on detailed questionnaires, which included all aspects that could influence the competitiveness of paper recycling, was performed. Since the answers to various questions were quantified by relative values, it was possible to evidence the relationships among factors that are impacting the competitiveness of paper recycling. Thus good correlations were found for the environmental awareness with the quality of recovered paper (Figure 3) and with households collection rate (Figure 4). The correlation factors (r) of 0.818 and 0.806 are quite relevantly and show that the environmental awareness is the main influence of the recovered paper quality /4-1/.

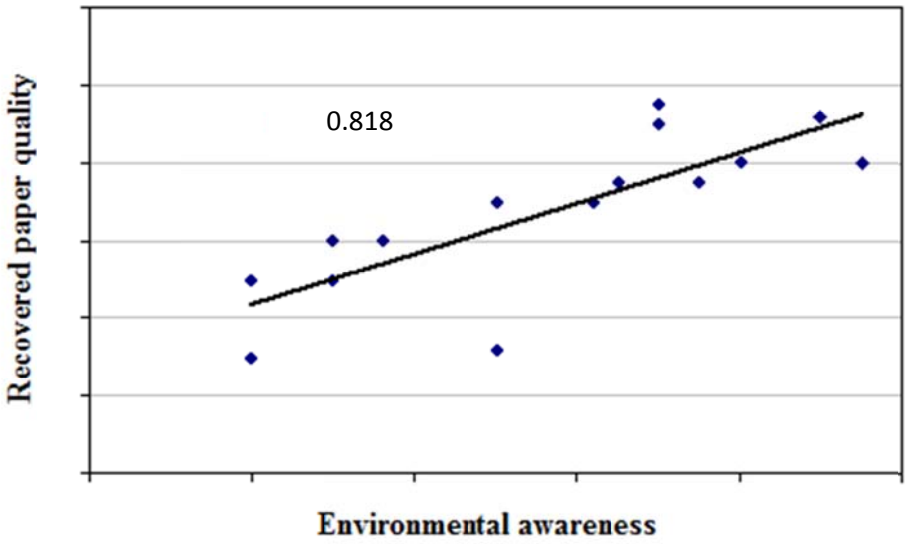

Figure 3: Relationship between recovered paper quality and environmental awareness of the consumers /4-1/

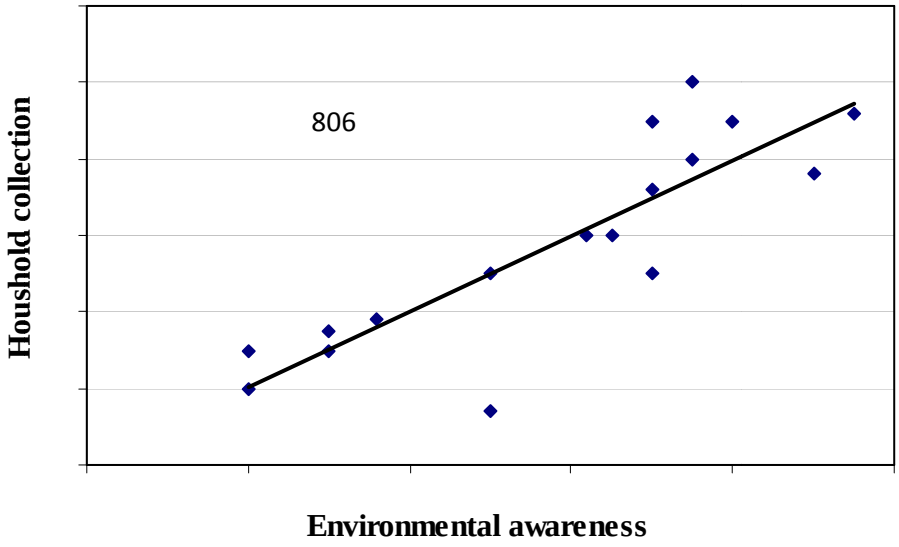

Figure 4: Relationship between the collection rate and environmental awareness /4-1/

The graph of Figure 4 shows clearly that the environmental awareness has a big influence on the household collection and those could be substantially improved by increasing the environmental awareness of the consumers. /4-1/

The influence of the living conditions is summarized in Figure 5. The collection quantity and the recovery rate increases from high rise apartment houses (31.36 kg/(c·a); 50.8%), through housing blocks (40.49 kg/(c·a); 66.3%) and semi-detached building structures (45.68 kg/(c·a); 82.2%) up to detached single family houses (60.22 kg/(c·a); 93.1%) /4-3/.

Structure characteristics	Collection quantity [kg/(c·a]	Recovery rate [%]
high rise appartment houses	31,36	50,8
housing blocks	40,49	66,3
semi-detached building structures	45,68	82,2
detached single family houses	60,22	93,1

Figure 5: Collection quantities and rates in a system for graphical paper collection in selected urban structures /4-3/

Paper and board are collected a. o. through household kerbside collections; commercial cardboard collections and a variety of paper/ board bring sites (Figure 6). While it seems that the collection system has only a minor influence on the amount of paper & board collected (provided enough capacity is offered) it obviously has a very pronounced influence on the quality of the paper for recycling. /4-3/

Bundle collection
(kerbside collection)

Paper bins
(kerbside collection)

Bring bank

Figure 6: Collection system samples /4-3/

The influence on the paper for recycling quality expresses itself in the composition of the paper collected with the different systems. The example of the graphic papers the following compositions arose in former investigations. /4-3/

Table 1: The influence of the collection system on paper for recycling quality on the example of graphic paper collection /4-d/

Recycling station:	99.5% graphical paper
	0.5% undesired (of which 0.1% non-paper materials)
Bundle collection:	97.5% graphical
	2.5 % undesired (of which 0.6% non-paper materials)
Bring bank:	96.6% graphical
	3.4 % undesired (of which 0.4% non-paper materials)
Paper bin pick-up:	82.3% graphical
	17.7% undesired (of which 1.9% non-paper materials)

1.3 Identification of the state-of-the-art of paper & board collection systems in CE

The identification of the state-of-the-art of paper & board collection systems in CE is mainly desk-top research and the realisation of surveys on the basis from questionnaires (Figure 7).

The assessment of the characteristics of effective collection systems is the basis for the identification of the pros and cons of existing strategies for used paper & board collection with respect to:

- quality
- yield
- logistic requirements
- acceptance
- costs

The characteristic of representative model regions in CE is carried out by characterizing typical regions in CE. The main focus will be on a definition of a limited number of archetypical regions within CE with respect to a. o.:

- population density
- local infrastructure
- structure of the regional paper & board industry
- level of prosperity
- per capita paper & board consumption

The assessment of the characteristics of typical recycling paper & board mills in CE will be performed by the description of the local recycling paper & board industry within CE with respect to a. o.:

- raw material basis
- products
- recovered paper procurement
- production capacity
- paper for recycling collection strategy

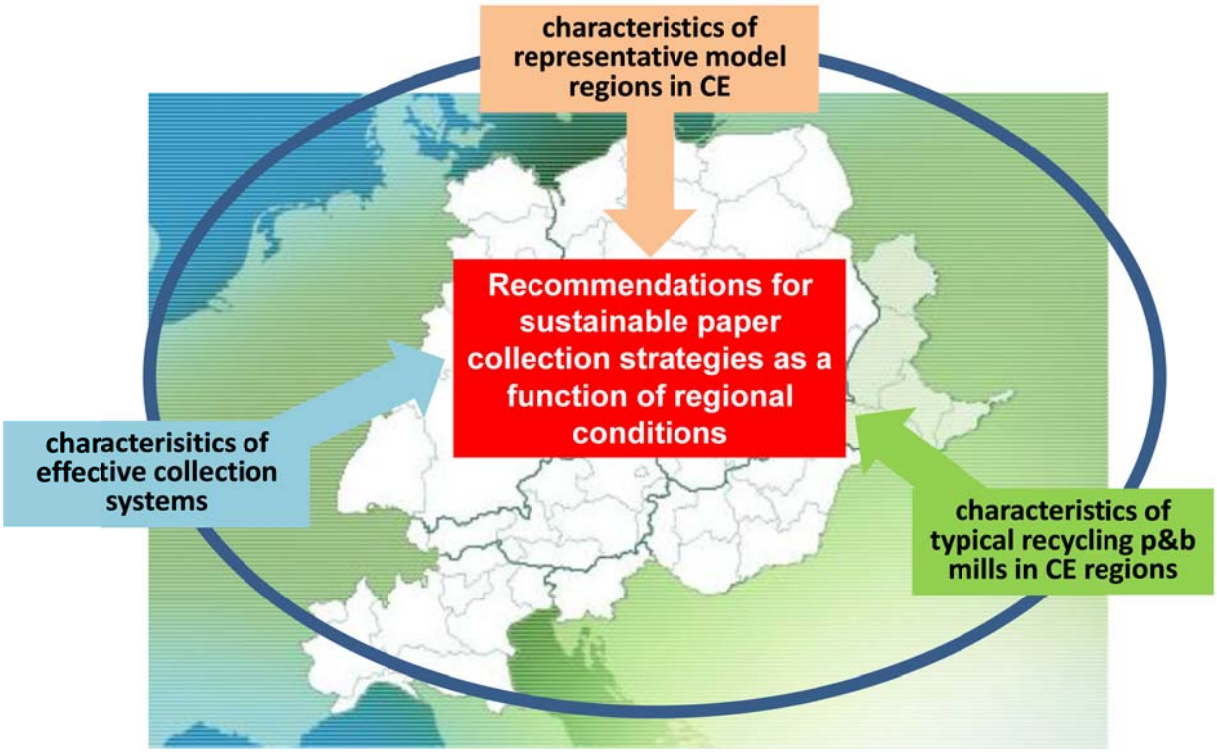

Figure 7: Charting of the work package 4 /4-3/

1.4 Statistical Data

The basic statistical data of the regions or the countries form the base for the assessment of the waste paper collective systems to him the regions belong. Outgoing from the level higher in each case (country) was begun, the statistical data on the in each case lying underneath levels (regions) to specified. They are in detail:

- Infrastructure characteristics
- Degree of Urbanization
- Dwelling situation
- Level of Education and Skills
- Paper Consumption
- Paper Recovery
- Location of the Paper Mills

The dates being at the moment will be further specified in the other course of the project. These statistical dates are already shown partially to the better comparison in colourfully emphasised maps of the regions of Central Europe.

On the basis of the upraised dates approx. 5 model regions which are typically for the seeming regional differences are selected in the other course of the project. These are examined closer with regard to the optimum recovered paper collection systems and form the basis for the proposals of the in each case optimum recovered paper collection systems.

1.5 Infrastructure characteristics

Infrastructure helps determine the success of manufacturing and agricultural activities in a region. Transport infrastructure is particularly important for a well-functioning regional paper industry and even more for an efficient regional paper recovery system. It is therefore most decisive when it comes to the selection of the best suited recovery system.

The two following figure draw a rather rough picture of the current situation of road infrastructure in the CENTRAL EUROPEAN countries in terms of the share between different types of TEN-T roads (Figure 8) in these countries.

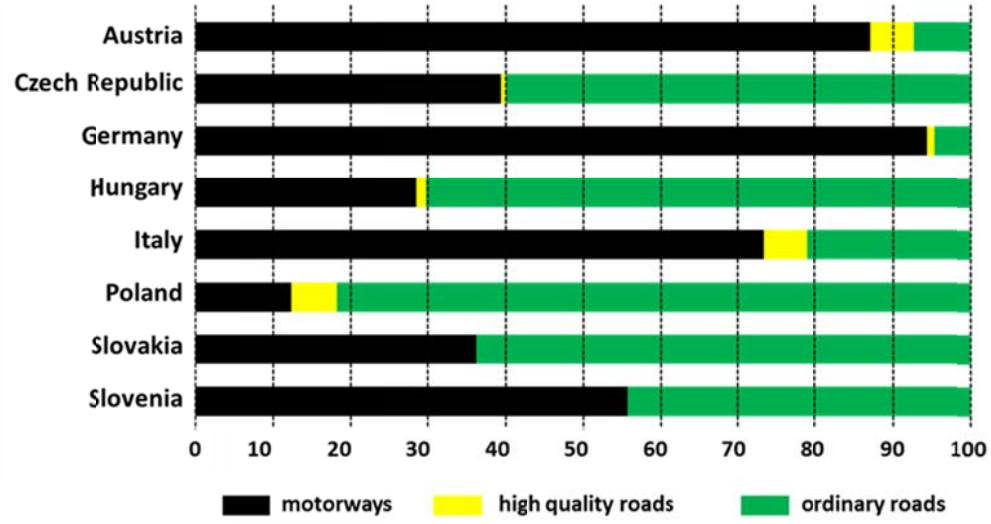

Figure 8: Type of the TEN-T roads (motorways, high quality roads and ordinary roads in %) per country in 2005 /4-6/

1.6 Degree of Urbanization

A proper system for paper recovery in a given region has to reflect the degree of urbanization as the requirements the recovery system has to meet differ largely between densely (urban) and sparsely (rural) populated areas. The degree of urbanization, i.e. the percentage of the total population living in urban areas, therefore, is a decisive criterion for the selection of the best system. This factor is frequently characterized on a scale from 0 to 100%, on which 0% means that virtually the whole population lives in a rural environment, while 100% characterizes a situation where virtually the total population lives in an urban environment.

The following table shows corresponding data for the CENTRAL EUROPEAN countries as published by the CIA /4-7/.

Table 2: Degree of Urbanization /4-7/

Austria	67,7		**Italy**	68,4		**Slovenia**	49,9
Czech Republic	73,4		**Hungary**	69,5		**Ukraine**	68,9
Germany	73,9		**Poland**	60,9		**Slovakia**	54,7

The population density of the single regions is connected with the urbanization degree. In towns and cities or in regions with a high number of cities the population density is higher than in rural areas. In the both next figures the middle population densities of the examined countries and regions are shown (Figure 9 and Figure 10) /4-8, 4-9/.

The highest population densities on country level are in Germany (DE) and Italy (IT) (Figure 9). Bigger differences are visible in the comparison of the single regions (Figure 10). The shortcuts on the figures based upon the ISO standard ISO 3166-1 /4-10/.

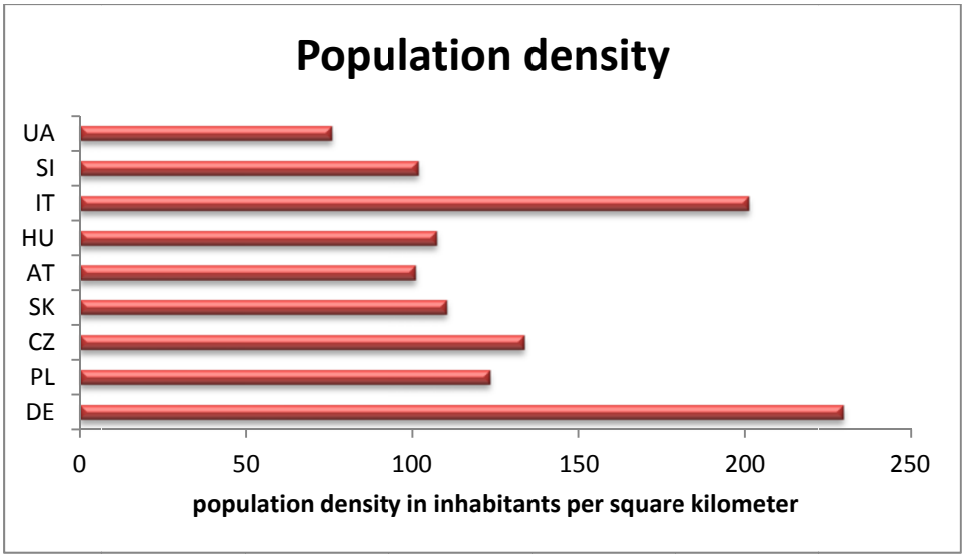

Figure 9: Population density of the different countries in Central Europe /4-8, 4-9/

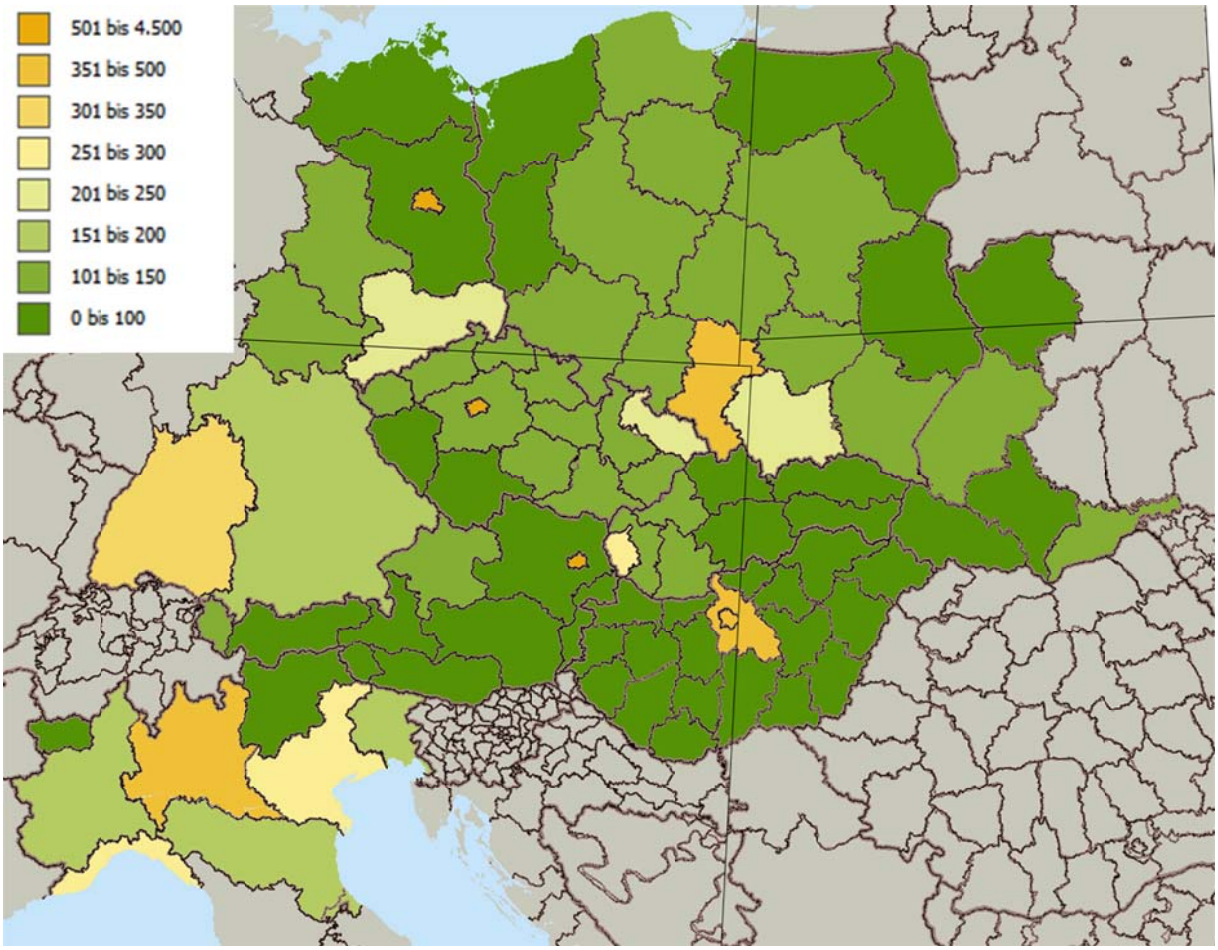

Figure 10: Population density of the different regions in Central Europe /4-11/

Another strong correlation exists between the gross domestic product (GDP) and the per capita consumption of paper as shown in the following figure shown (Figure 11).

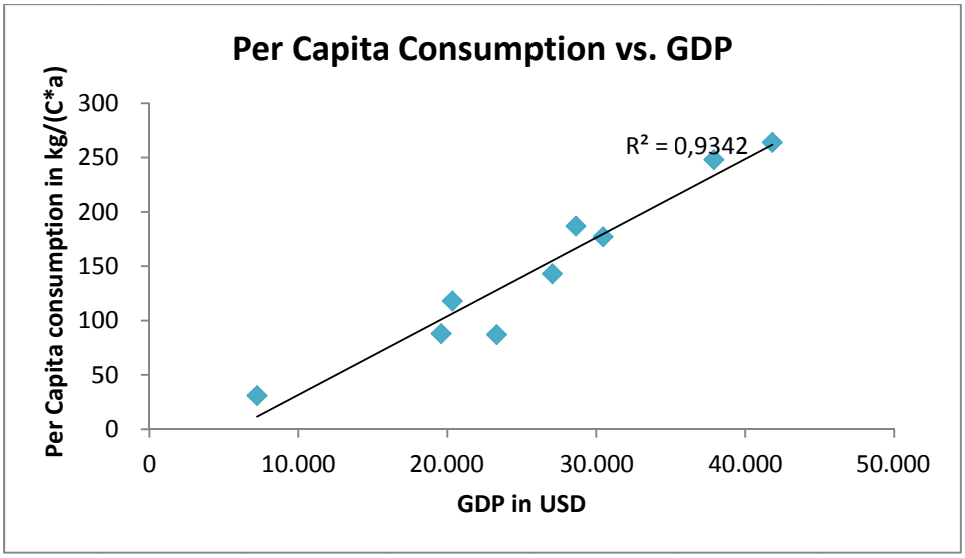

Figure 11: Per capita consumption vs. GDP in Central Europe /4-8, 4-9, 4-11/

The highest GDP in Central Europe is gained in Austria (AT) followed from Germany (DE). The following countries are Italy (IT), Slovenia (SLO), Czech Republic (CZ), Slovakia (SK), Poland (PL), Hungary (HU) and Ukraine (UA).

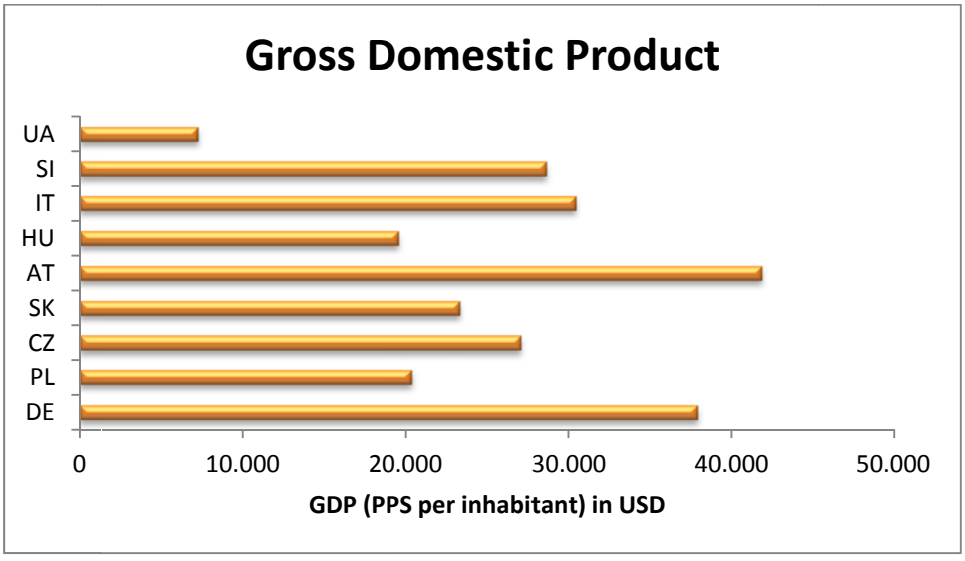

Figure 12: GDP of the different countries in Central Europe in USD /4-11/

If one looks at the GDP of the single regions so one recognises regions with strong GDP above all in the western and southwest regions as well as in big-city regions (Figure 13).

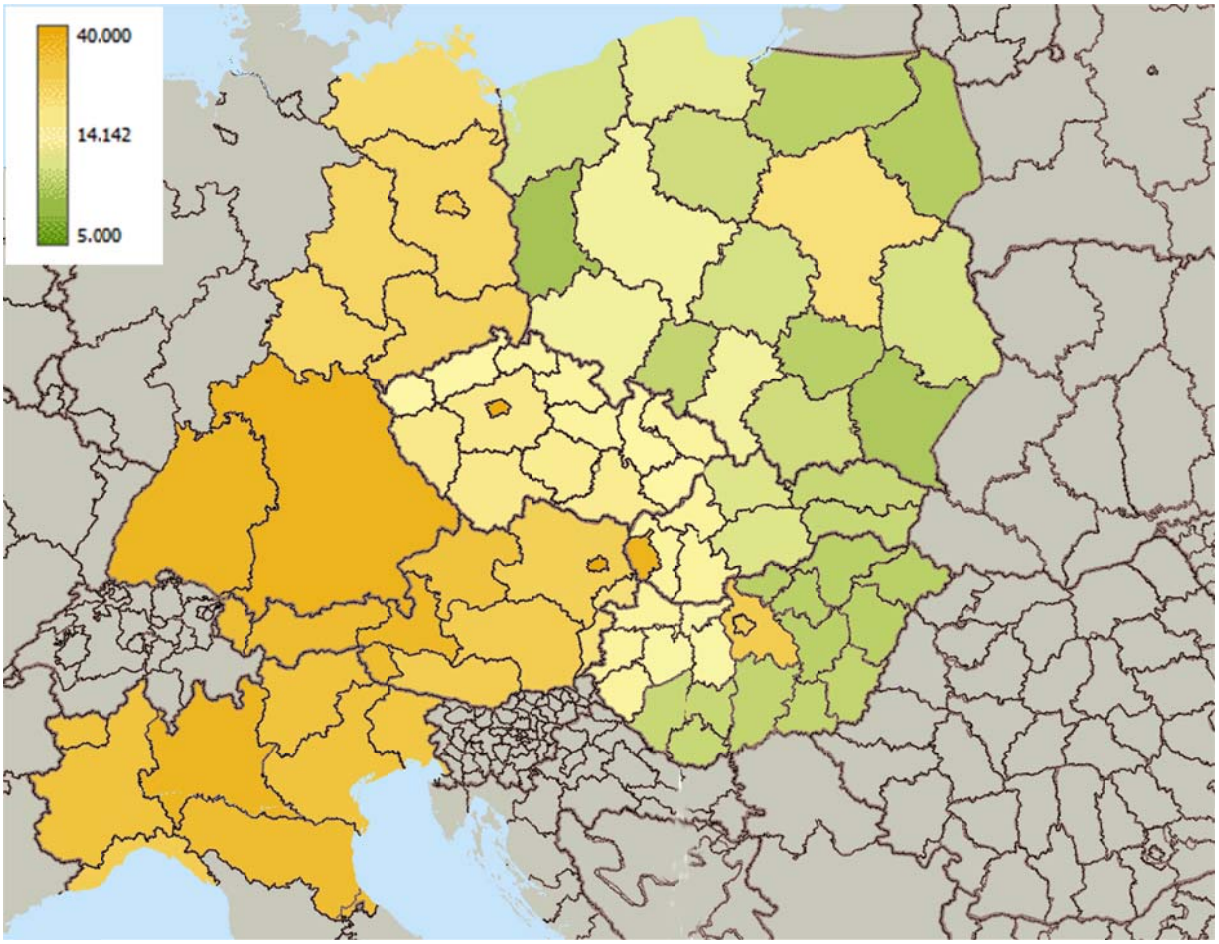

Figure 13: **GDP of the different regions in Central Europe in USD /4-11/**

1.7 Dwelling situation

Recent studies carried out in a number of European countries reviled that there is a significant correlation between the dwelling situation in a region and the amount of paper and board collected from households - no matter which collection system is installed. The following graph reflects - for the CENTRAL EUROPEA countries - the average values (in %) of inhabitants living under different dwelling (housing) situations (Figure 14).

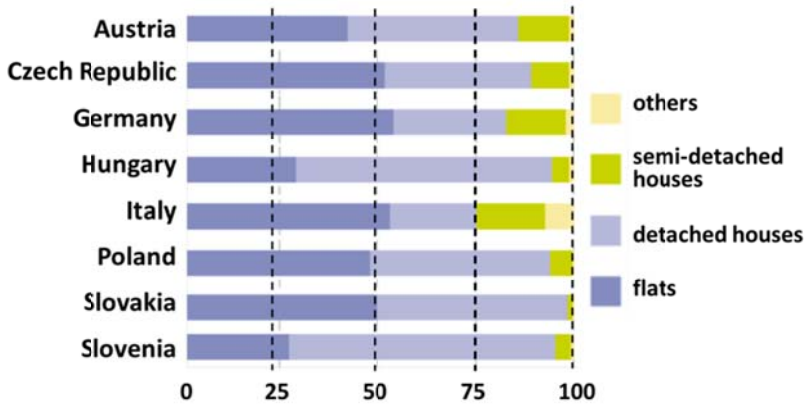

Figure 14: **Current dwelling situation in CENTRAL EUROPEAN countries (average) /4-12/**

1.8 Level of Education and Skills

The utilization of in particular graphic paper in a given region is a. o. a function of the educational level of the population. This criterion usually also correlates with the environmental awareness of a society. Both characteristics differ quite substantially between countries and even between regions in the same country – and they are as well a function of age. Due to their importance age structure and educational level of the population should be taken into account when decisions with respect to an efficient paper recovery strategy are to be made. The chart below (Figure 15) describes the current situation in the CENTRAL European countries as far as the share of population with tertiary education qualifications is concerned. Tertiary education generally is given in mainly in colleges, universities and polytechnics and culminates in the receipt of certificates, diplomas, or academic degrees. This might serve as measure – tough not as strong as desired – to characterize the level environmental awareness.

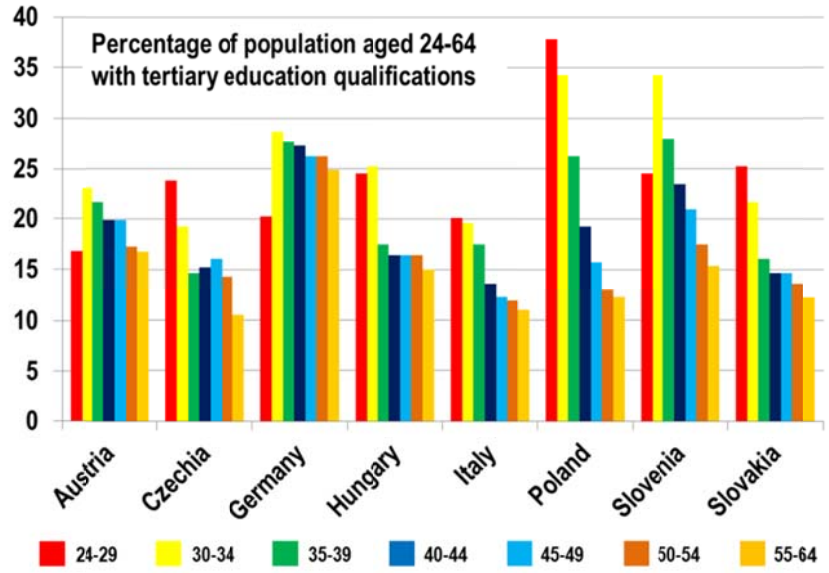

Figure 15: Percentage of the population with tertiary education qualifications /4-13 /.

1.9 Paper Consumption

The structure of system for recovering paper and board in a certain region and in particular its logistics and collection frequency have to reflect the amount which can be collected. One corresponding indicator is the per capita consumption in the region considered (Figure 16). But as the recovery systems for households and that for industrial or trade consumers are usually organized differently and as some grades cannot be recovered at all it is important to distinguish between the main paper grades. Corresponding mean figures are available now for the CENTRAL EUROPEAN countries but not for the regions (Figure 17 and Figure 18).

Per inhabitant paper was used in 2010 mostly in Central Europe in Austria (AT) and Germany (DE). Subsequently follow Slovenia (SI) and Italy (IT) as well as Czech Republic (CZ) and Poland (PL). Hungary (HU) and the Slovakia (SK) lie with regard to the pro-head consumption at the same level (Figure 16).

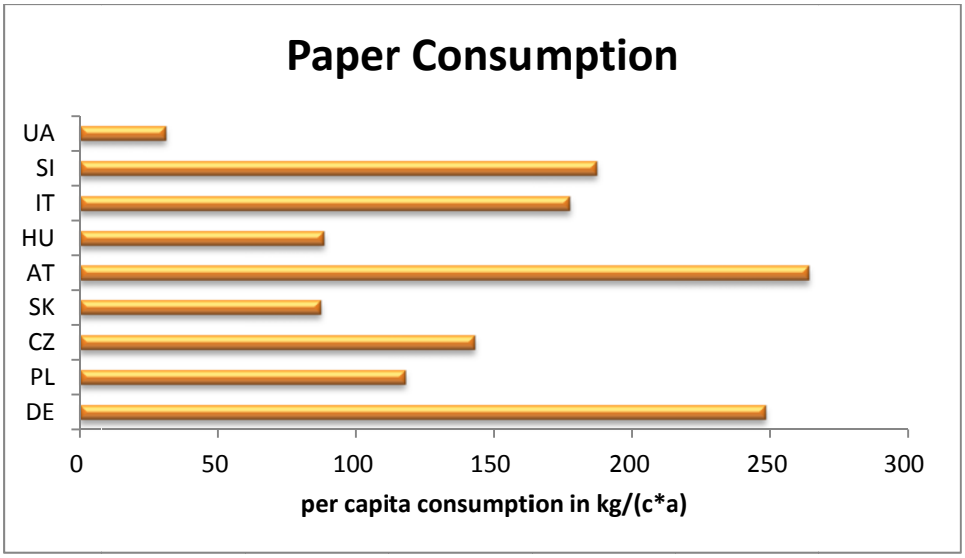

Figure 16: **Per capita consumption of paper in the different countries in Central Europe 2010 in kg/(c*a) /4-9/**

Concerning the absolute average figures of the paper consumption of the single main paper groups Germany (DE) and Italy (IT) are on account of the numbers of inhabitants at the head. To all looked countries is common in Central Europe that the main paper groups printing & writing papers as well as packaging papers are by far at the head (Figure 17).

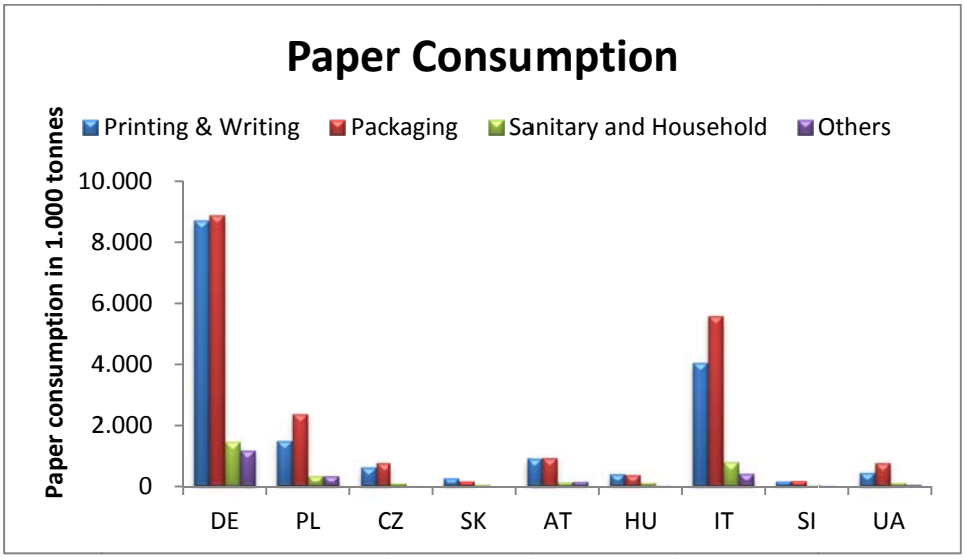

Figure 17: Paper consumption by paper grade in the different countries in Central Europe 2010 /4-9/

If one looks at the pro-head consumption so the distances shrink to themselves between the different countries (Figure 18).

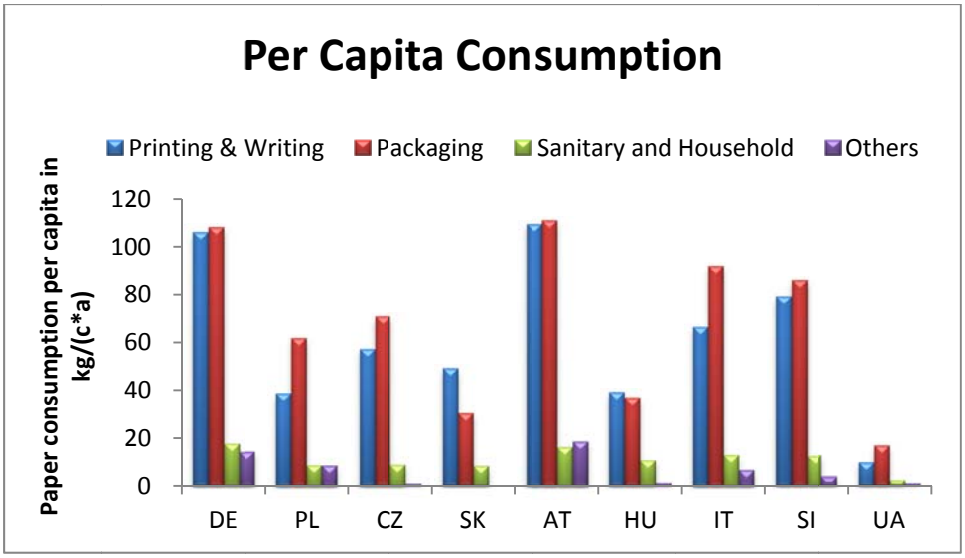

Figure 18: Per capita consumption by paper grade in the different countries in Central Europe 2010 /4-9/

1.10 Paper Recovery

With regard to the collection and the insertion of recovered paper Germany (D) lies again at the head followed from Italy (I). In comparison to Germany (D) and Italy (I) the differences are low in the other countries of Central Europe in 2010 (Figure 19).

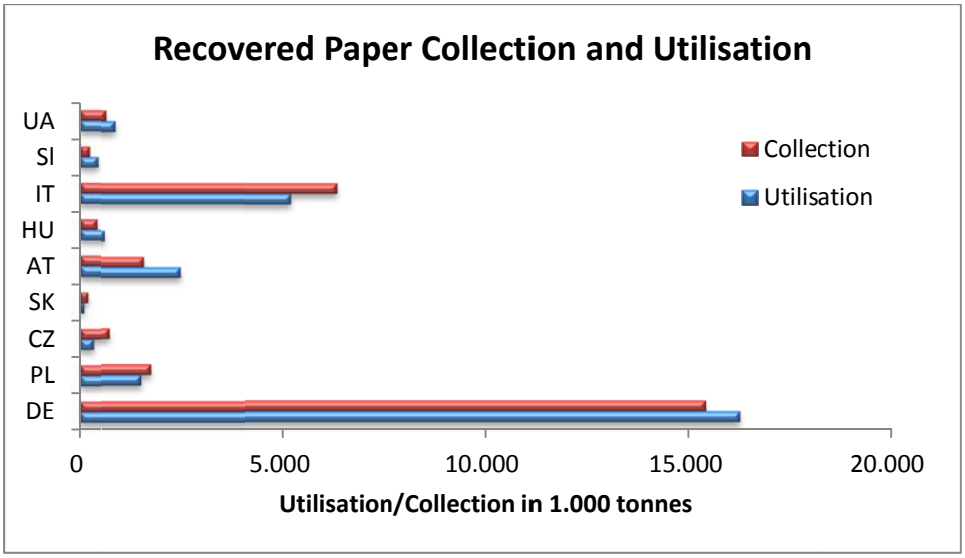

Figure 19: Recovered paper utilization in the different countries in Central Europe 2010 /4-9/

If one looks again the collection and the utilisation of recovered paper per inhabitant the distances shrink so again. With regard to the pro-head use Austria (AT) lies at the head followed con Italy and Germany (DE). With regard to the paper collection Germany and Austria lie together at the head followed from Slovenia (SI) and Italy (IT).

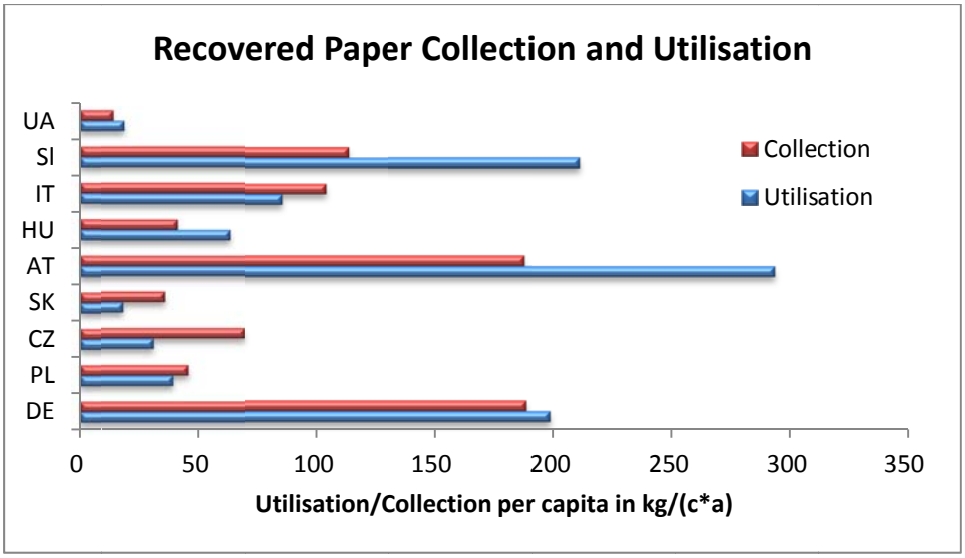

Figure 20: Recovered paper collection and utilization per capita in the different countries in Central Europe 2010 /4-9/

1.11 Location of the Paper Mills

For the assessment of the optimum collective systems not only the population structure and the urbanization as well as the respective GDP of the region are essential but also the nearness to the next paper mill which uses recovered paper. Furthermore it is important which raw materials are used in the local paper mill which paper / cardboard is produced there and whether the paper mills already have its own paper collection systems how it is partially the case. The overview about the paper factories is in the appendix.

1.12 Questionnaire

For further detailed assessment of the regions a questionnaire which will form the basis for the more detailed data acquisition has been sketched.

References

/4-1/ J.-E. Levlin, B. Read, H. Grossmann, A. Hooimeijer. et al.: COST Action E48 – The future of Paper Recycling in Europe: Opportunities and Limitations. The Paper Industry Association (PITA). Bury, Greater Manchester. COST Office 2010

/4-2/ N.N.: CEPI Annual Statistics 2011. European Pulp and Paper Industry. Confederation of European Paper Industries (CEPI) (Publ.), 2012

/4-3/ G. Elegir, H. Grossmann, R. Zelm.: Eco Design for the Enhancement of Central Europe's Paper Based Products Recycling Loop. Presented at VOP-meeting, 25. April 2013, Glashuette

/4-4/ A. Stawicka: Non-papwer fractions in recovred paper. Present and future methods of reduction. Master thesis, Poznan 2005

/4-5/ B. Bilitewski, A. Berger, J. Reichenbach: Collecting systems doe paper and cardboard packaging in Germany 2000, 2001

/4-6/ N.N.: http://ec.europa.eu/transport/themes/infrastructure/ten-t-policy/transport-mode/road_en.htm;

/4-7/ N.N.: https://www.cia.gov/library/publications/the-world-factbook/fields/2212.html

/4-8/ N-N.: http://en.wikipedia.org/wiki/List_of_sovereign_states_and_dependent_territories_by_population_density (Publ. United Nations, Department of Economic and Social Affairs)

/4-9/ N.N: Papier 2012 – Ein Leistungsbericht. Verband deutscher Papierfabriken (Publ.)

/4-10/ N.N.: ISO 3166-1: Codes for the representations of names of countries and their subdivisions – Part 1: Country codes, 2006.

/4-11/ N.N.: NUTS (fr. Nomenclature des unités territoriales statistiques. http://de.wikipedia.org/wiki/NUTS, March 2013

/4-12/ N.N: Europe in figures – Eurostat Yearbook 2011. (Ed. J. Piirto, A. Johansson, V. Lang) http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-11-001/EN/KS-CD-11-001-EN.PDF

/4-13 N.N.: Eurostat, Labour Force Survey (data extracted July 2011). http://epp.eurostat.ec.europa.eu/portal/page/portal/microdata/lfs

/4-14/ N.N.: EN 643 European List of Standard Grades of Recovered Paper and Board. Confederation of European Paper Industries (CEPI) (Publ.), 2002

/4-15/ N.N.: Birkner International Paperworld. Birkner GmbH & Co. KG (Publ.)