Work Package 4: Deliverable 4.2.1
Correlation between desired and achieved recovered paper quality and quantity

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1. Introduction

Collection rates and quality of recovered paper, now the CEPI term is paper for recycling (pfr), differ substantially in Central Europe. Both are influenced by a variety of aspects. Especially the collection from households has particular requirements as of the high number of sources, the mixture of paper grades and the socio-economic diversity of population.

One aim of the study was to identify correlations between different parameters (e.g. level of prosperity, population density, dwelling situation, collection systems) and the amount and quality of pfr collected from households described in deliverable 4.1.2 "The correlation between desired and achieved quality of the paper and board collected in a given area and the influential parameters governing the prevailing collection system will be studied and described."

With respect to the objective stated in work package 4 (WP4) it became obvious that the access to the data needed was anything but easy. Such data was at the best either only rudimentarily available at least in some of the countries, especially on local levels. The commitment to share information was limited which was reflected in the low response rate to the questionnaires from local authorities and waste management collectors.

On the other hand it became obvious that there existed quite a good basis from literature and online research to synthesise information about influencing factors and other studies and recommendations concerning waste management issues. Personal interviews also allowed to develop adequate ideas in terms of potential options for further improvements concerning collection strategies. Some of this information is included in this report which focuses on selected aspects representing the complexity of the subject.

If not otherwise stated in the data reported in what follows results from surveys carried out by project partners were used.

2. Correlation between level of prosperity and quantity of pfr

One of the most common indicators to specify the level of prosperity of a society is the gross domestic product (GDP). Although this seemingly started to change due to recent changes in consumer behaviour a strong correlation still exists between GDP and per capita consumption of paper in the Central European countries investigated in the study (fig. 1). Accordingly also the correlation between GDP and per capita collection of pfr is very strong as shown in figure 2. This fact allows to estimate the potential of pfr quantities available for a certain region or area depending on the GDP of this specific area/region.

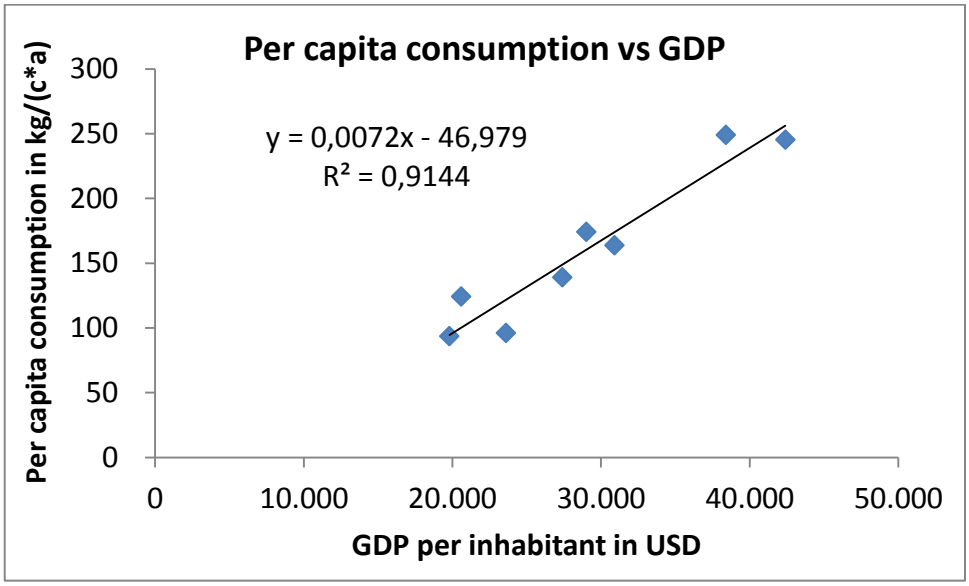

Fig. 1: Correlation between GDP and per capita consumption /1, 2/

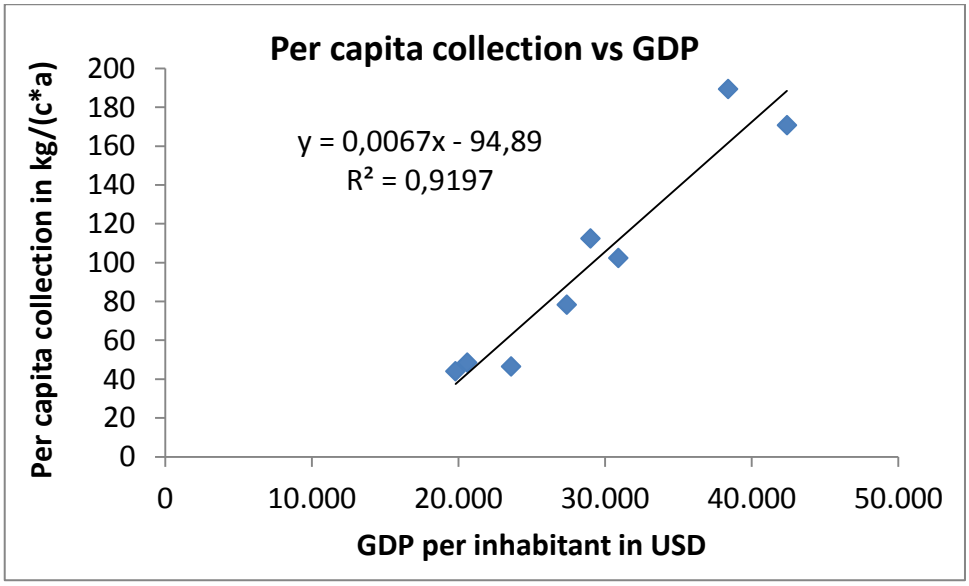

Fig. 2: Correlation between GDP and per capita collection of pfr from households and commercial sources/1, 2/

The comparison of GDP and recycling rates for the countries investigated still shows a strong, though slightly weaker correlation (fig. 3). The GDP is a leading indicator for the recycling rates achieved but there are obviously more and other influences than those regarded in the charts shown (GDP vs. capita consumption and GDP vs. capita collection).

A former study came to a similar result that in more prosperous cities not only the quantity of pfr from households is higher but also the share of separate collection tops cities with lower prosperity level /19/.

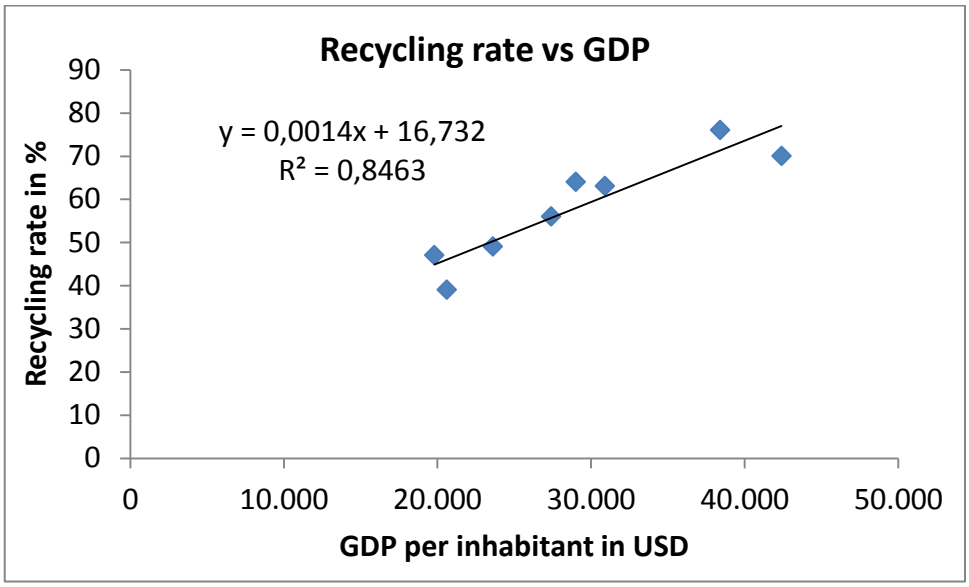

Fig. 3: Correlation between GDP and recycling rate /1, 2/
recycling rate = (pfr collection/paper&board consumption) * 100

3. Correlation between the type of a collection systems and its collection yield

The investigations clearly reveiled that in many cases pfr collection in a given region is performed simultaneously in different ways – with varying degree of success. The following tables show the combination of collection systems found in the areas for which the local authorities provided corresponding data compared to their collection yields in terms of the quantity of pfr collected per capita. Unfortunately more specific data suitable to quantify the contribution of the various collection systems was not available. To identify if there are differences concerning the degree of urbanisation the areas were categorised in rural, urban and metropolitan (definition see Deliverable 4.1.4 – Stakeholder collection in each country). In all cases the the reported collection quantities only contain pfr from municipal sources. They were either extracted from authorities' statistics or calculated on the basis of the data provided through the questionnaires /3/–/14/.

Unfortunately there was no data available for Poland.

As it turned out, in all countries investigated combinations of several collection systems having either very distinctive or one or more common elements can exist simultaneously in the same area or region. It could be assumed that this situation indicates the existence of different organisations active in pfr collection, but it could as well result from particular consideration being given to local differences in societal or infrastructural characteristics.

Data from Germany shows that specific collection quantities are lower in urban and metropolitan areas than in rural areas. Italy draws a largely different picture. In rural areas the collection quantity per capita is significantly lower than in urban regions. Unambiguous explantions for this phenomenon do not exist. Some possible reasons are discussed in chapter 4. The rather limited data obtained for urban and metropolitan areas in Austria did not allow a meaningful interpretation.

In Germany the range of collection quantities is particularly broad (34–110 kg/(c·a)) which possibly can be explained by pronounced local differences in prosperity (GDP) and/or the existence of private collection shops whose collection results do not appear in official statistics.

model areas	kerbside	onsite paper bin, mixed grades	onsite container, sep. grades	public container, mixed grades	public container, separate grades	recycling yards	collection shop	collection quantity in kg/(c·a)*
rural								not available
rural								80
rural								75
rural								86
rural								94
urban								89
metrop.								75

Fig. 4: Collection systems and quantities in different Austrian areas

model areas	kerbside	onsite paper bin, mixed grades	onsite container, sep. grades	public container, mixed grades	public container, separate grades	recycling yards	collection shop	collection quantity in kg/(c·a)*
rural								87
rural								56
rural								110
rural								88
rural								81
rural								56
rural								96

model areas	kerbside	onsite paper bin, mixed grades	onsite container, sep. grades	public container, mixed grades	public container, separate grades	recycling yards	collection shop	collection quantity in kg/(c·a)*
urban								92
urban								71
urban								52
urban								75
urban								34
metropol.								53
metropol.								71

Fig. 5: Collection systems in different German areas /3– 12/

model areas	kerbside	onsite paper bin, mixed grades	onsite container, sep. grades	public container, mixed grades	public container, separate grades	recycling yards	collection shop	collection quantity in kg/(c·a)*
rural								50
rural								38
rural								59
rural								38
rural								29
urban								71
urban								51
urban								64
urban								55
metrop.								61

Fig. 6: Collection systems and quantities in different Italian areas /13, 14/

model areas	kerbside	onsite paper bin, mixed grades	onsite container, sep. grades	public container, mixed grades	public container, separate grades	recycling yards	collection shop	collection quantity in kg/(c·a)*
rural	■			■				not available
rural	■							
rural				■		■	■	
urban	■			■			■	
urban	■	■		■				
urban	■			■			■	
urban			■	■			■	
metropol.	■	■	■	■	■	■	■	

Fig. 7: Collection systems in different Polish areas

Figure 8 compares collection quantities per capita achieved by different combinations of collection systems in Austria and Germany. These two countries where chosen because of their similar GDP.

The most prominent combination (4 mentions) offered are onsite paper bins/containers (pick up system) combined with recycling yards (drop off system). All stated combinations in Austria and Germany include the paper bin (blue/read bin, BB) as one available system.

There, however, is no clear indication that a certain combination guarantees above average collection quantities.

Fig. 8: Combination of collections systems in Austria and Germany vs. collected quantity per capita

To minimise the effects incurred by low GDP and private collection shops which are considered to reduce collection quantities, data from corresponding municipalities was removed from the diagram (fig. 9). Again, the chart does not indicate that any combination does outmatches others concerning collection quantities.

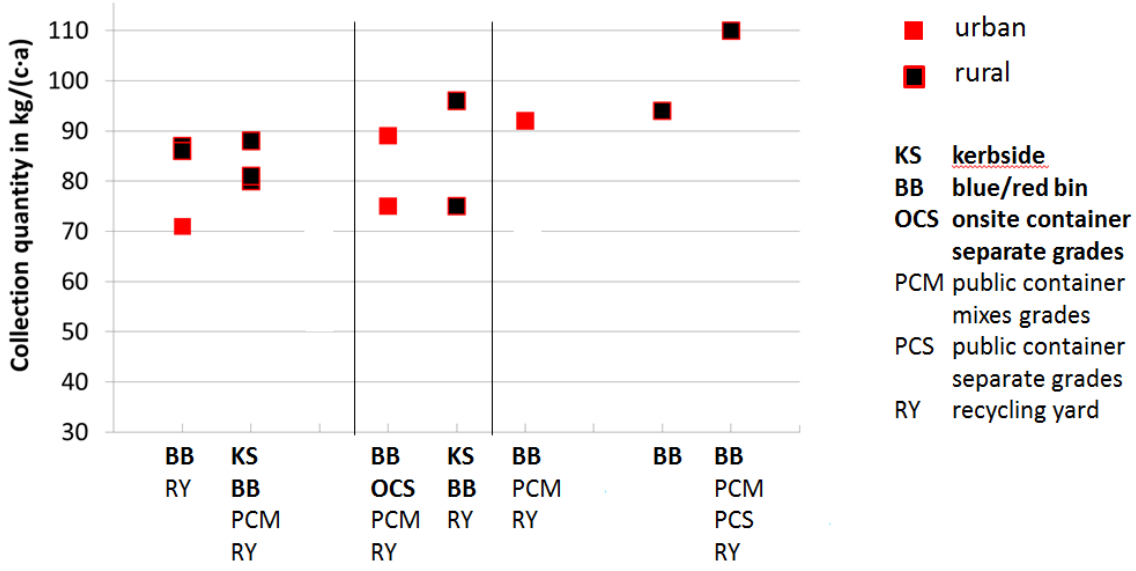

Fig. 9: Combination of collections systems in Austria and Germany disregarding areas with a particular low local GDP as well as those in which collection shops are installed

Although there is no sufficiently strong indication that the use of a certain combination of collection systems guarantees higher pfr quantities one study from 2002 investigating the potential of recyclable fractions in residual waste gave undisputable evidence that pick up systems are instrumental in reducing the amount of pfr in residual waste /15/. The study compared areas offering onsite paper bin/container and those with public containers installed for pfr. This finding is supported by the results of WP4 authorities' survey. 15 out of 39 interviewees answered to have introduced the onsite paper bin/container – the most dominant action by authorities, especially in Austria and Germany – to increase collection quantities in the last couple of years.

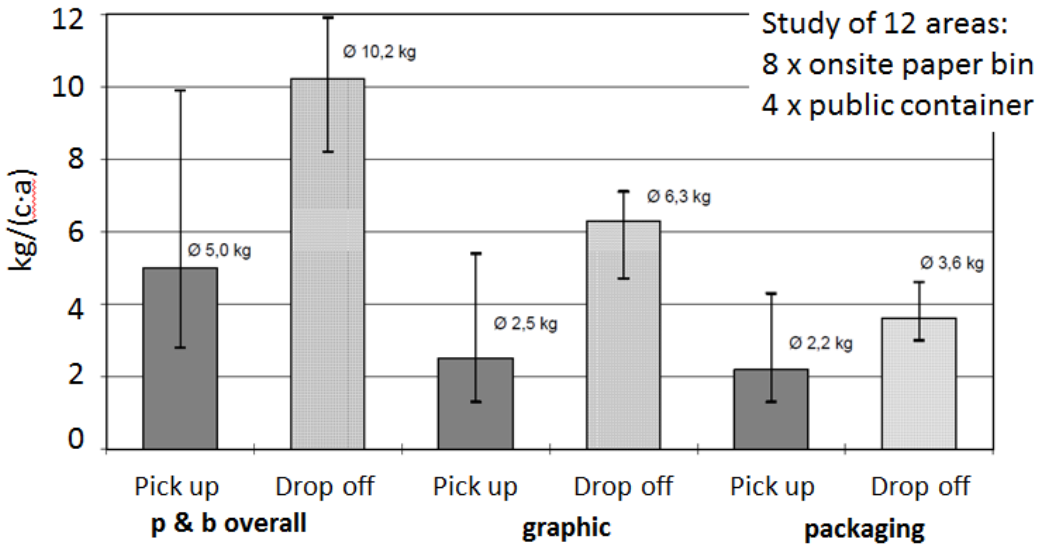

Fig. 10: Potential of paper and board in residual waste, comparison between pick up and drop of system /15/

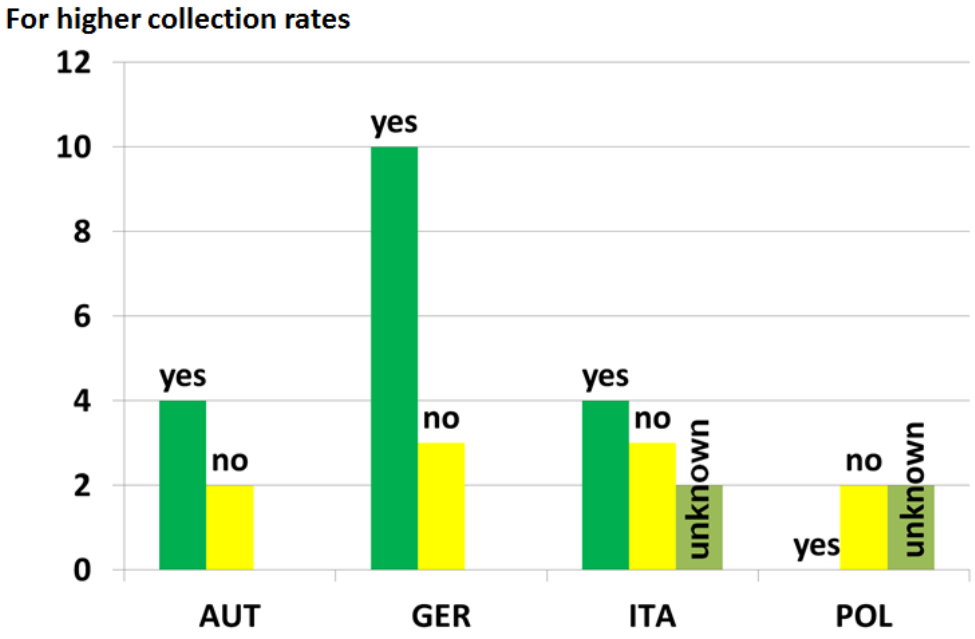

Fig. 11: WP4 survey on collection strategies for authorities and waste management associations – changes in recent years to improve collection rates

A comprehensive literature review neither gave any robust indication of a correlation between certain combination of collection systems and their respective collection rate /21/.

Furthermore it seems important to establish the right conditions for pfr collection. A Swiss analysis /22/ presented a strong correlation between fees charged for residual waste sacks and the amount of separately collected pfr. It also shows that the positive effect of the introduction of such fees is by far superior to the positive effect generated by increasing the collection frequency. Very good experience aiming at redirecting waste streams by installation of waste locks including a fee chip system for residual waste were also reported from a housing cooperation close to Dresden, Germany /23/ and from the Slovenian waste management company commissioned by the Ljubljana authority /24/.

4. Correlation between selected socio-economic factors and quantity of pfr

Urbanisation

As mentioned in chapter 3 Austria and Germany draw a different picture compared to Italy regarding collection quantities for different degrees of urbanisation. The reasons for this difference could be:

- Paper consumption in Italian rural areas is generally lower than in urban areas, possibly due to lower GDP or cultural attitude /20/.
- German urban and metropolitan areas with lower collection rates are in many cases located in regions with lower income and possibly lower environmental awareness.
- In rural Italian areas the use of used paper and board as a fuel replacing wood is far more common than in big cities – in particular as there are no pollution restrictions in rural areas /20/.
- In big Italian cities a significant amount of collected paper is allocated to the residents although it has been bought and used by e. g. commuters as well as tourists who eventually leave these products in public collection containers. Centralised public services typically located in bigger cities enhance this phenomenon. The same applies to newspapers distributed free of charge in public transport systems (e.g. at metro stations) /20/.
- If, like in Germany, in particular in times of supply shortages and thus rising prices for pfr private companies not commissioned by authorities start or at least intensify their efforts to collect pfr. The official statistics no longer reflect the true collection rate.

Type of dwelling

As far as Austria and Germany is concerned studies prove that in areas with a higher population density a higher portion of pfr does end up in residual waste. A recent study from the South of Lower Saxony in Germany demonstrates this (s. figure 12) and emphasises the importance of the dwelling situation as an influencing factor /16/. The diagram shows increasing rates of recyclable fractions for pfr in the residual waste for increasing population density. The highest share of misplaced pfr was found in urban areas using 1,100 litre containers to collect residual waste, most common in large housing estates.

The study from South of Lower Saxony is confirmed by an investigation about recyclable fractions found in residual waste from 2002 in Bavarian areas with different settlement structures /15/.

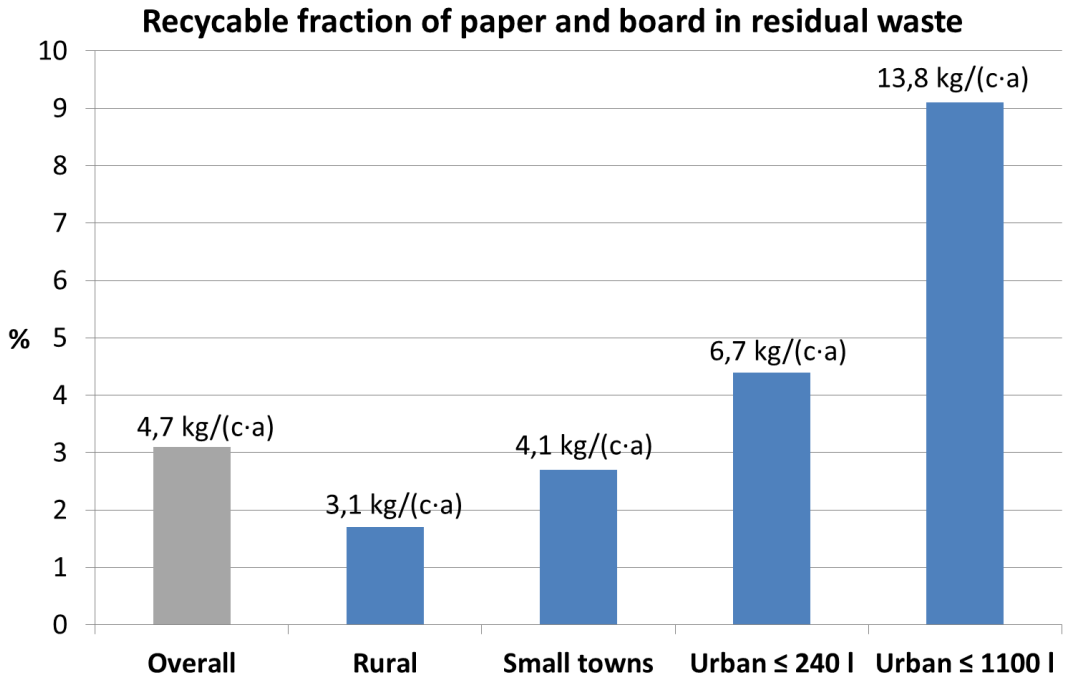

Fig. 12: Recyclable fraction of p & b in residual waste depending on urbanization /16/

Level of education

The above mentioned study from Switzerland also found a strong correlation between the proportion of working population with tertiary education and collection quantities of pfr /22/. The lower the education level was the lower was the quantity of pfr per inhabitant collected.

5. Correlation between collection system and quality/recycling rate

The following charts (fig. 13) present the correlation between the recycling rates and pfr quality as assessed by paper mills as a function of different collection systems in countries for which corresponding data was provided by local authorities. Unfortunately the low number of answers from Polish paper mills does not allow any statement for this country concerning paper mills' satisfaction with pfr.

These experiences suggest that the combination of onsite paper bins and recycling yards (Austria and Germany) typically improve the scores for both the quality of pfr and recycling rates. A few authorities even stated that the introduction of the onsite paper bin not only led to improved collection rates (see chapter 3.) but also to higher quality pfr (1 x Germany, 1 x Austria, 2 x Italy). Also all interviewed waste management companies reported more favourable results for pfr collected via onsite paper bins. This experience, however, is in sharp contrast to what Intecus /17/ reported during the Sopron workshop. According to their investigations the introduction of onsite paper bin might even worsen the quality of pfr due to miss-sorting of other waste fractions for the sake of convenience (short ways, easiness to drop other waste fractions). This statement is supported by manufacturers of recycled paper based graphic papers who report on higher sorting efforts and even quality problems of the re-sorted pfr /18/.

It should as well be added that the source of pfr, households or commercial, cannot be clearly allocated from the surveys and therefore an unambiguous correlation of results is not possible.

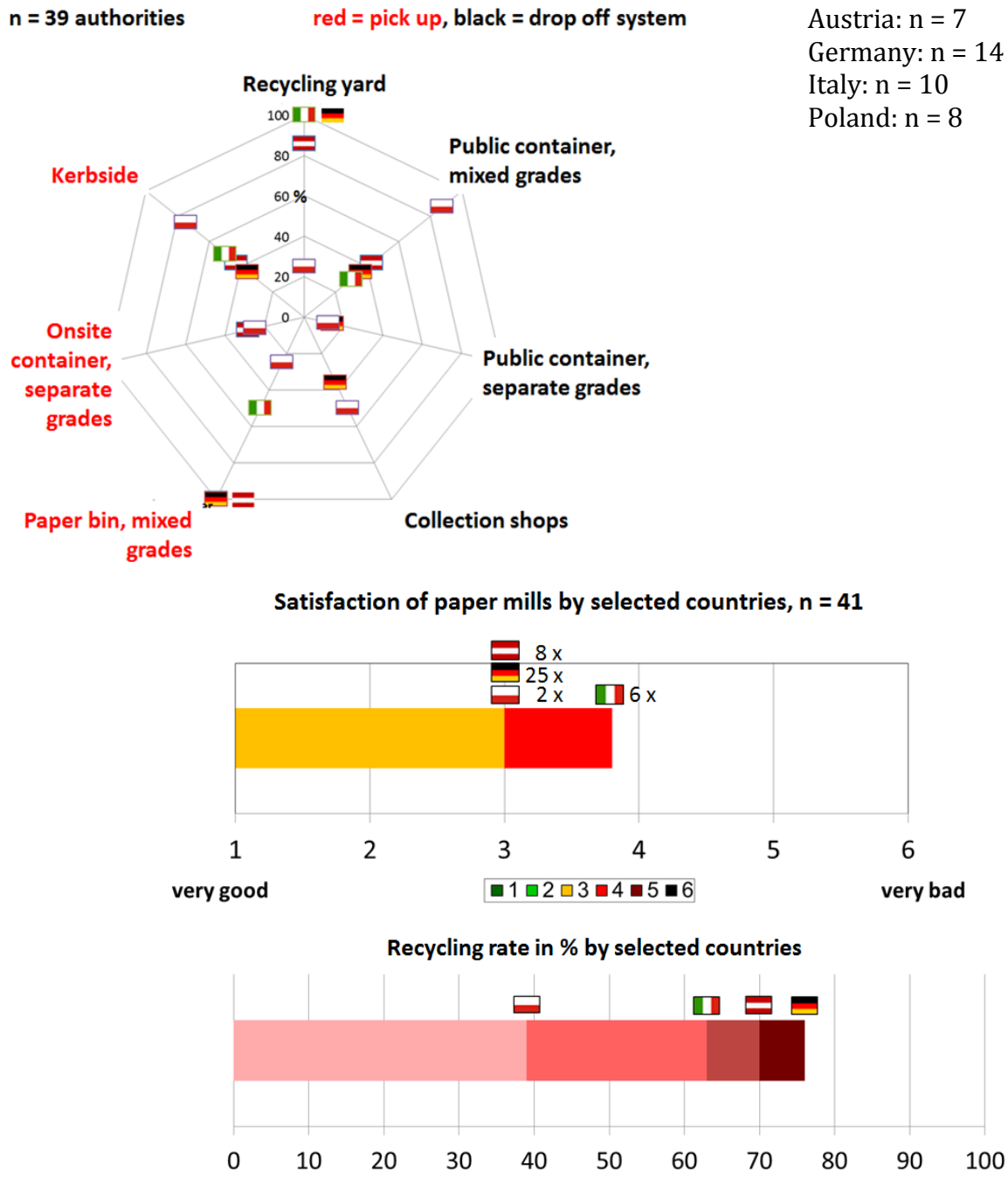

Fig. 13: Satisfaction of paper mills and recycling rates vs. utilisation of collection systems by selected countries (Austria, Germany, Italy, Poland) /1/

6. Conclusions

For those countries for which WP4 received valid data no clear correlation between general characteristics and collection quality/quantity could be detected for many of the specified criteria. In summary the investigatins carried out in the frame of WP4 allow the the following conclusions.

There exist a clear positive correlation between GDP and collection quantities and between GDP and recycling rates for data from official sources.

From the data of the survey it is not possible to draw conclusions about the influence of different collection systems on quantity and quality of pfr, except that the introduction of the paper bin usually results in higher amounts of pfr collected. The different ways in which pfr collection is organised in the investigated areas does not allow to compare data. Moreover assessment about pfr quality strongly depends on the particular stakeholder group the evaluator belongs to. It also turned out that the appropriateness of a certain collections system depends on local rather than on regional conditions. So even the small volume of existing data used to investigate the degree of urbanisation versus pfr collected gave contradictory results.

It seems that a mixture of socio-economic factors influences the acceptance and success of a collection system. While e. g. the importance of the dwelling situation and of economic incentives which belong to the hard influential facts is undoubtedly, though not in all cases equally given, the importance of environmental education and awareness, which can be regarded as difficult to measure and to quantify soft factors, turned out to be beyond dispute in particular when it comes to separate collection systems. Especially in cities with their particular broad spectrum of living conditions the way in which collection systems are organised needs to be adjusted to very local reqirements.

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